

User's Guide

# Keysight DAQ970A/DAQ973A Data Acquisition System



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# Notices

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## Software Revision

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements. To search for software updates and the latest documentation for your product, go to the product page at:

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

A portion of the software in this product is licensed under terms of the General Public License Version 2 (GPLv2). The text of the license and source code can be found at [www.keysight.com/find/GPLV2](http://www.keysight.com/find/GPLV2).

This product uses Microsoft Windows CE. Keysight highly recommends that all Windows-based computers connected to Windows CE instruments use current anti-virus software. For more information, go to the respective product page at:

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

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## Waste Electrical and Electronic Equipment (WEEE)

This product complies with the European WEEE directive marketing requirement. The affixed product label (see below) indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the European WEEE directive Annex 1, this product is classified as "Monitoring and Control instrumentation" product. Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office, or see <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> for more information.



## Declarations of Conformity

Declarations of Conformity for this product and for other Keysight products may be downloaded from the Web. Go to <https://regulations.about.keysight.com/DoC/default.htm>, you can then search by product model number to find the latest Declaration of Conformity.

# Safety and Regulatory Information

## Safety Considerations

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, intended use of the instrument, and could result in electrical shock or injury. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

### WARNING

#### BEFORE APPLYING POWER

Verify that all safety precautions are taken. Make all connections to the unit before applying power.

#### GROUND THE INSTRUMENT

This product is provided with protective earth terminals. To minimize shock hazard, the instrument must be connected to the ac power mains through a grounded power cable, with the ground wire family connected to an electrical ground (safety ground) at the protective (grounding) conductor. Disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

#### BEFORE POWER ON AND OFF

Before powering on the instrument, make sure all signal sources connected to modules are turned off. Turn on signal sources after the instrument is powered on. Turn off signal sources before the instrument is powered off.

#### DO NOT REMOVE THE INSTRUMENT COVER

Only qualified, service-trained personnel who are aware of the hazards involved should remove the instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

#### MODULE COVERS

Always replace module covers after terminal wiring and before inserting into mainframe.

#### DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

#### DO NOT MODIFY THE INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Keysight Sales and Service Office for service and repair to ensure that safety features are maintained.

#### DO NOT MEASURE MORE THAN THE RATED VOLTAGE

Maximum voltage as marked on each module is as below:

- a) DAQM900A: 120 Vrms
- b) DAQM901A, DAQM902A, DAQM903A, DAQM904A, DAQM908A: 300 Vrms
- c) DAQM905A, DAQM907A: 42 Vpk
- d) DAQM909A: +/-18Vpk (single ended) for both HI and LO pins.

#### DO NOT CONNECT ANY MODULE CHANNELS TO MAINS

Measurement category of the instrument is rated as CAT 'Others', terminals should not be directly connected to the mains.

**AC POWER CORD**

Removal of the AC power cord is the disconnect method to remove power from the instrument. Be sure to allow for adequate access to the power cord to permit disconnection from AC power. Use only the Keysight specified power cord for the country of use or one with equivalent ratings.

**SELF-TEST**

Before measuring any hazardous voltage or current, run the \*TST? query from the remote interface, and read the result to verify that the instrument is performing properly. The \*TST? query is a self-test that returns +0 if the instrument passes and +1 if the instrument fails. You can also perform this query from the front panel by pressing **[Utility] > Self Test > Quick Test**. If this self-test fails, make sure that the instrument is repaired and passes the self-test before continuing.

**CAUTION**

This is a sensitive measurement apparatus by design and may have some performance loss when exposed to ambient continuous electromagnetic phenomenon. Measurement Considerations – use shielded or twisted cable, use common mode choke, ferrite clamp and damping resistor before the input to DAQ970A/DAQ973A.

**CLEANING**

To prevent electrical shock, disconnect the instrument from AC mains power before cleaning. Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent, volatile liquids, or chemical solvents. Do not attempt to clean internally. If needed, contact a Keysight Technologies Sales and Service Office to arrange for proper cleaning to ensure that safety features and performance are maintained.

**NOTE**

Connect USB cable with ferrite core to the rear panel USB port of the instrument.

## Safety Symbol and Regulatory Markings

| Symbol                                                                              | Description                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Alternating current (AC).                                                                                                                                                                                                                                        |
|  | Protective earth (ground) terminal.                                                                                                                                                                                                                              |
|  | Earth (ground) terminal.                                                                                                                                                                                                                                         |
|  | Caution, risk of danger (refer to the manual for specific Warning or Caution information).                                                                                                                                                                       |
|  | Frame or chassis (ground) terminal.                                                                                                                                                                                                                              |
|  | Instrument cable lock.                                                                                                                                                                                                                                           |
|  | This product is marked with the ACMA RCM mark for compliance in Australia/New Zealand. A copy of the Manufacturer's Australia Declaration of Conformity for this instrument can be obtained by contacting your local Keysight Technologies Sales Representative. |



This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.



The CSA mark is a registered trademark of the Canadian Standards Association, with the 'C' and 'US' subscript indicates the instrument is certified to the applicable Canadian and United States of America standards respectively.



The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.

**ICES/NMB-001** - This ISM device complies with the Canadian ICES-001.

*Cet appareil ISM est conforme à la norme NMB-001 du Canada.*

**ISM GRP 1-A** - This is an Industrial Scientific and Medical (ISM) Group 1 Class A product.



This symbol is a South Korean Class A EMC Declaration, with the product identification code "R-REM-Kst-GM16412".

**R** - Identification of authorization prefix.

**REM** - Identification of basic certification information.

**Kst** - Identification of applicant's information

**GM16412** - Product identification.

This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.

#### WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

#### CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond CAUTION sign until the indicated conditions are fully understood and met.

#### NOTE

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight. Safety and Regulatory Information 12

## South Korean Class A EMC Declaration

Information to the user:

This instrument has been conformity assessed for used in business environments. In a residential environment this equipment may caused radio interference.

This EMC statement applies to the equipment only for use in business environment.

### 사용자안내문

이 기 기 는 업 무 용 환 경 에 서 사 용 할 목 적 으 로 적 합 성 평 가 를 받 은 기 기 로 서 가 정 용 환 경 에 서 사 용 하는 경 우 전 파 간 섭 의 우 려 가 있 습 니 다 .

사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

## Product Regulatory and Compliance

The DAQ970A/DAQ973A complies with safety and EMC requirements.

Refer to Declaration of Conformity at <http://www.keysight.com/go/conformity> for the latest revision.

### NOTE

Maximum transients on all inputs are limited to 1500 Vpk referenced to earth except for DAQM900A, DAQM905A, DAQM907A and DAQM909A which are 0 Vpk. Measurement is rated for CAT 'none', and terminals are not to be connected directly to mains. Do not use this equipment to measure circuits where transient over-voltages could exceed this level.

## Environmental Conditions and General Characteristics

Keysight DAQ970A/DAQ973A is designed for indoor use and in an area with low condensation. Tables below show the general environmental requirements and general characteristics for this instrument.

| Environmental condition | Requirement                                                                                                                                                                       |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature             | Operating condition: 0 °C to 55 °C<br>Storage condition: -40 °C to 70 °C                                                                                                          |
| Humidity                | Operating condition: Up to 80% RH at 40 °C (non-condensing), decreasing linearly to 50% RH at 55 °C (non-condensing)<br>Storage condition: Up to 50% RH at 55 °C (non-condensing) |
| Altitude                | Up to 3000m                                                                                                                                                                       |
| Pollution degree        | 2                                                                                                                                                                                 |

The electrical (power) requirements of the DAQ970A/DAQ973A are summarized as below.

| General characteristics | Requirement                                                                           |
|-------------------------|---------------------------------------------------------------------------------------|
| Power supply            | 100 – 240 VAC (Mains supply voltage fluctuation is not allowed to exceed $\pm 10\%$ ) |
| Power line frequency    | 50/60/400 Hz                                                                          |
| Power consumption       | 45 watts                                                                              |

### WARNING

**DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE OR WET ENVIRONMENTS**

Do not operate the instrument around flammable gases or fumes, vapor, or wet environments.



# 1 Introduction to the Instrument

Instrument at a Glance

Front Panel at a Glance

Instrument Annunciators

Rear Panel at a Glance

Plug-In Modules at a Glance

Dimension Diagram

Remote Interface Configuration

LAN Configuration Procedure

Firmware Update

Contacting Keysight Technologies

This chapter introduces the overview and basic functionality of the DAQ970A/DAQ973A.

## Instrument at a Glance

The DAQ970A/DAQ973A combines precision measurement capability with flexible signal connections for your production and development test systems. Three module slots are built into the rear of the instrument to accept any combination of data acquisition or switching modules. The combination of USB data logging and data acquisition features make this instrument a versatile solution for your testing requirements now and in the future.

### Easily display, save, and document your measurement results

- High usability with an intuitive, menu driven user interface.
- Histogram, trend chart, meter and numeric views on a high-resolution color display.
- Supported on both LAN and USB interfaces.
- Drag and drop, driverless USB connectivity.

### Convenient data logging features

- Direct measurement of temperature (thermocouples, RTDs, and thermistors), strain, DC voltage, AC voltage, 2-wire and 4-wire resistance, frequency, period, diode, capacitance, DC current, and AC current.
- Patented, metrology-level performance that serves as the foundation for all measurements.
- Interval scanning with storage of up to 1,000,000 time-stamped readings.
- Independent channel configuration with function, measurement scaling, and alarm limits available on a per-channel basis.
- Intuitive user interface with knob cursor navigation keypad, data entry from both softkeys (menu keys inside the screen view) and hardkeys (menu keys in front of the instrument).
- Portable, rugged case with non-skid feet.
- BenchVue Data Acquisition (DAQ) software for Microsoft® Windows® available for download from [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

### Flexible data acquisition/ switching features

- Up to 60 channels per instrument (120 single-ended channels).
- Reading rates are more than 5,000 readings per second on a single channel and scan rates up to 450 channels per second.
- Choice of multiplexing, matrix, general-purpose Form C switching, RF switching, digital I/O, totalize, DAC output, and DAC readback functions.
- Built-in Web Interface for monitoring and controlling the instrument via a Web browser.

### Programming language

- Compatible with SCPI (Standard Commands for Programmable Instruments) programming language.

## Front Panel at a Glance



| Label | Description                                                                |
|-------|----------------------------------------------------------------------------|
| 1     | USB Port                                                                   |
| 2     | On/Standby switch with LED indicator                                       |
| 3     | Display                                                                    |
| 4     | Softkeys                                                                   |
| 5     | Measurement operation menu (to control the initiation of the measurements) |
| 6     | Measurement configuration menu (to set parameters for measurements)        |
| 7     | Knob                                                                       |
| 8     | Cursor navigation keypad                                                   |

### Front panel key

#### NOTE

Press the **Save Recall Local** key to return the instrument into local control when the instrument is in remote (indicated by the **RMT** annunciator).

## Instrument Annunciators

The table below shows the various annunciators that are available on the DAQ970A/DAQ973A. The annunciators will be shown on the top of the display when the corresponding conditions are met.

| Annunciator                                                                       | Description                                                                                        |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
|  | Monitor mode enabled.                                                                              |
|  | Digitizing is in progress.                                                                         |
|  | Scanning/DMM digitizing is in progress.                                                            |
|  | A – Alarms are present in the alarm queue.<br>H1234L – A High or Low alarm condition has occurred. |
|  | Internal DMM is disabled. Instrument configured for an external scan interval when DMM is Off.     |
|  | Reading memory overflowed at 1,000,000 readings. New readings will overwrite the oldest readings.  |
|  | A USB drive is inserted in the front panel USB host port.                                          |
|  | Instrument is in remote (remote interface)                                                         |
|  | Errors are present in the error queue. Press [View] > Errors to view the list of errors.           |

## Rear Panel at a Glance



| Label | Description                                                                            |
|-------|----------------------------------------------------------------------------------------|
| 1     | Slot identifier (100, 200, 300)                                                        |
| 2     | GPIB interface ( <b>Available on the DAQ973A only</b> )                                |
| 3     | AC mains input                                                                         |
| 4     | LAN interface connector                                                                |
| 5     | USB interface connector                                                                |
| 6     | External trigger input, alarm outputs, channel advance input, and channel close output |
| 7     | Chassis ground screw                                                                   |

## Plug-In Modules at a Glance

The DAQ970A/DAQ973A offers a complete selection of plug-in modules to provide a high quality measurement, switching, and control capabilities. For more details, see [Module Overview](#).

Supported modules on the DAQ970A/DAQ973A:

- DAQM900A 20-Channel FET Multiplexer Module
- DAQM901A 20-Channel Armature Multiplexer Module
- DAQM902A 16-Channel Reed Multiplexer Module
- DAQM903A 20-Channel Actuator/General-Purpose Switch Module
- DAQM904A 4x8 Two-Wire Matrix Switch Module
- DAQM905A Dual 1:4 RF Multiplexer (50  $\Omega$ ) Module
- DAQM907A Multifunction Module
- DAQM908A 40-Channel Single-Ended Multiplexer Module
- DAQM909A 4-Channel 24-Bit Digitizer Module

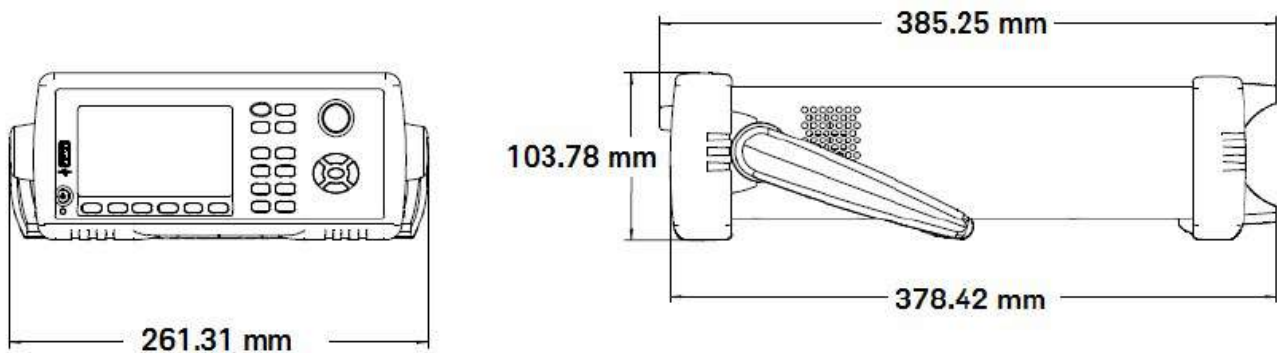
**NOTE**

Refer to the product data sheet at <http://literature.cdn.keysight.com/litweb/pdf/5992-3168EN.pdf> for a complete specifications on all the supported modules.

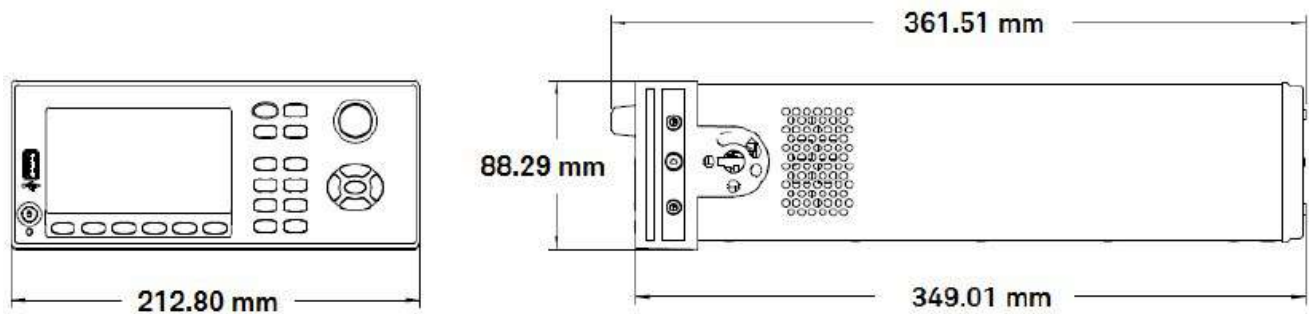
---

## Dimension Diagram

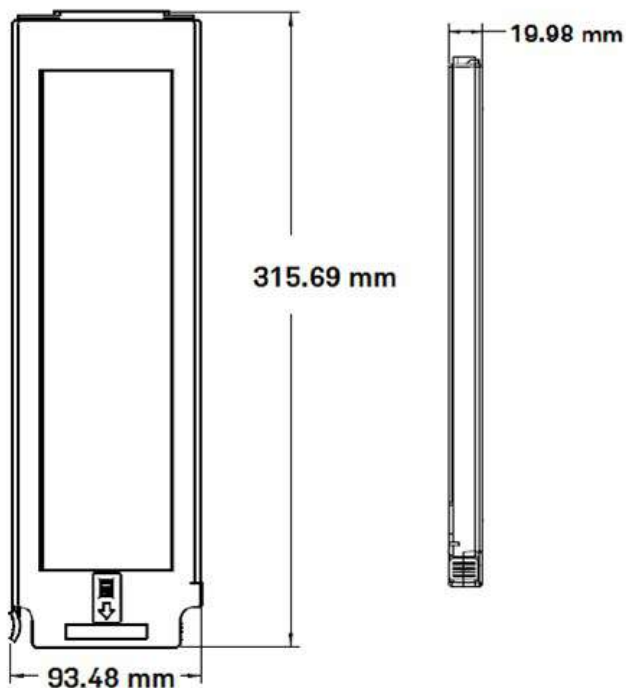
Bench dimension:



Rack dimension:



Module dimension:



## Remote Interface Configuration

### WARNING

#### REMOTE OPERATION

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

### NOTE

If Secure mode is enabled, the instrument must be unlocked with the correct security code to perform many of these actions. See **Security** for more information.

The DAQ970A supports remote interface communication over LAN and USB interfaces. The DAQ973A however supports an additional GPIB interface on top of LAN and USB interface. All the interfaces are "live" at power up when the instrument ships from the factory.

- **LAN Interface:** By default, the DHCP (Dynamic Host Configuration Protocol) is on, a protocol for assigning dynamic IP addresses to network devices, which may enable communication over LAN. With dynamic addressing, a device can have a different IP address every time it connects to the network. See **LAN Settings** for more information.
- **USB Interface:** Use the rear panel USB interface connector to communicate with the instrument using your PC. See **USB Settings** for more information.
- **GPIB Interface (DAQ973A only):** Set the instrument's GPIB address and connect to your PC using a GPIB cable.

## Keysight IO Libraries Suite

### NOTE

Ensure that the Keysight IO Libraries Suite is installed before you proceed for the remote interface configuration.

Keysight IO Libraries Suite is a collection of free instrument control software that automatically discovers instruments and allows you to control instruments over LAN and USB interfaces. For more information, or to download the IO Libraries, go to [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite).

### GPIB Settings (DAQ973A only)

Each device on the GPIB (IEEE-488) interface must have a unique whole number address between 0 and 30. The instrument ships with a default address of 9, and the GPIB address is displayed at power-on.

This setting is non-volatile; it will not be changed by power cycling or \*RST or SYSTem:PRESet. Your computer's GPIB interface card address must not conflict with any instrument on the interface bus.

| Front panel                                                                                                                                                       | Remote interface                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>GPIB</b> .                                                                                           | SYSTem:COMMunicate:GPIB:ADDRes <address>     |
| From this menu, you can set the GPIB address and turn GPIB on or off. After making changes, you must cycle power on the instrument for the change to take effect. | SYSTem:COMMunicate:ENABle {ON 1 OFF 0}, GPIB |



## LAN Settings

The following sections describe the primary front panel LAN configuration functions, including SCPI commands where applicable. In the *DAQ970A/DAQ973A Programming Guide*, see "SYSTEM Subsystem - Remote Interface Configuration Commands" for all LAN configuration commands.

### NOTE

Some LAN settings require you to cycle power to activate them. The instrument briefly displays a message when this is the case. Observe the display closely as you change the LAN settings.

### Enable or disable LAN interface

| Front panel                                                                                          | Remote interface                          |
|------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN</b><br>Set the softkey to On or Off | SYSTem:COMMunicate:ENABle {OFF   ON}, LAN |

### View the LAN status, MAC status, and current LAN configuration settings

Once the LAN interface is enabled, you can view the LAN status, MAC address, and current LAN configuration settings from the front panel. The LAN status may be different from the front panel configuration menu settings, which depends on the network configuration. If the settings are different, it is because the network has automatically assigned its own settings. If the instrument goes into remote, all LAN changes will be disabled and the display will go into a different screen. Re-selecting with LAN Settings page will display the new settings if a LAN restart took place.

| Front panel                                                                   | Remote interface |
|-------------------------------------------------------------------------------|------------------|
| Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> | (none)           |

### Modify Settings

As shipped from the factory, the instrument pre-configured settings (DHCP is on) should work in most LAN environments. However, if you wish to manually set an IP address, Subnet Mask, or Default Gateway, turn DHCP off, then change the IP setup as described below.

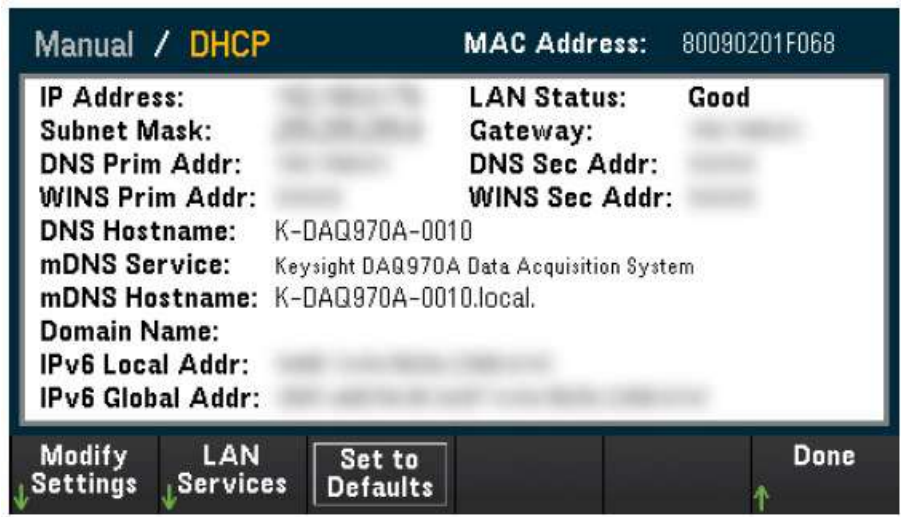
#### Manual/DHCP

The DHCP can automatically assign a dynamic IP address to a LAN device. This is typically the easiest way to configure the instrument for LAN. This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument preset (SYSTem:PRESet command).

Disabling DHCP will enable the Manual setting, and vice versa.

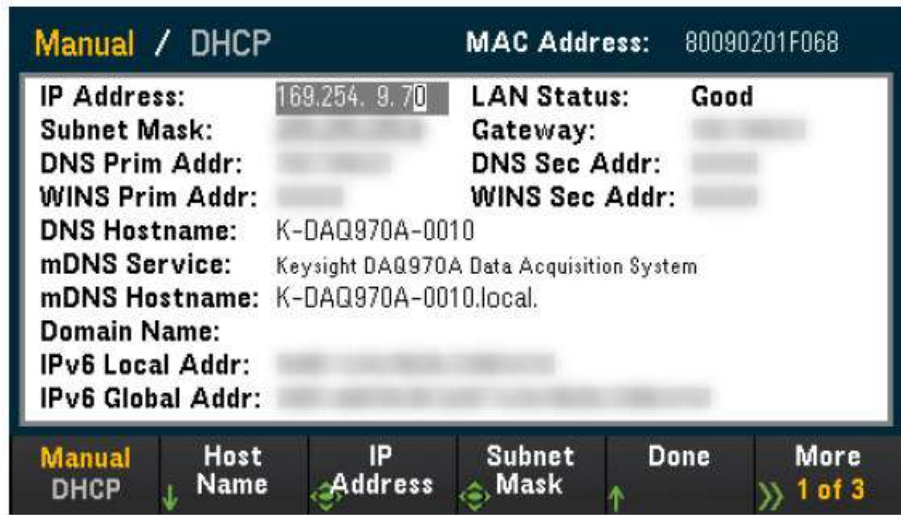
| Front panel                                                                                              | Remote interface                     |
|----------------------------------------------------------------------------------------------------------|--------------------------------------|
| Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . | SYSTem:COMMunicate:LAN:DHCP {OFF ON} |

To enable DHCP:



| Step | Front panel                                                                                            | Remote interface               |
|------|--------------------------------------------------------------------------------------------------------|--------------------------------|
| 1    | Press [Home] > User Settings > I/O > LAN Settings > Modify Settings.<br>Set the first softkey to DHCP. | SYSTem:COMMunicate:LAN:DHCP ON |
| 2    | If you change this parameter, you must press [Done] > [Apply Changes] for the change to take effect.   | SYSTem:COMMunicate:LAN:UPDate  |

To disable DHCP:



| Step | Front panel                                                                                              | Remote interface                |
|------|----------------------------------------------------------------------------------------------------------|---------------------------------|
| 1    | Press [Home] > User Settings > I/O > LAN Settings > Modify Settings.<br>Set the first softkey to Manual. | SYSTem:COMMunicate:LAN:DHCP OFF |
| 2    | If you change this parameter, you must press [Done] > [Apply Changes] for the change to take effect.     | SYSTem:COMMunicate:LAN:UPDate   |

Once DHCP is disabled, the following parameters will be available for manual setup:

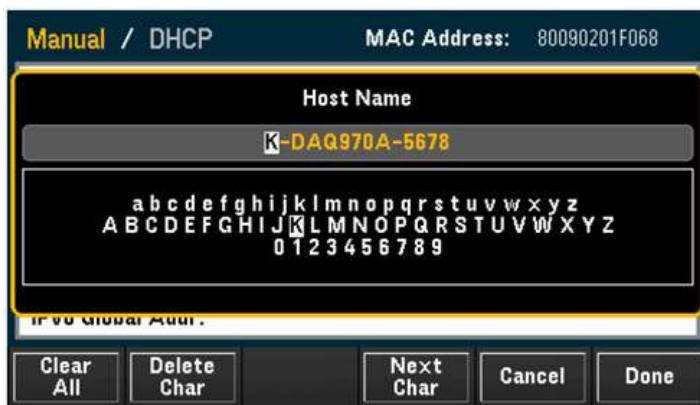
- Host Name
- IP Address
- Subnet Mask
- Gateway
- Primary and Secondary DNS
- Primary and Secondary WINS
- Service mDNS

## Host Name

A hostname is the host portion of the domain name, which is translated into an IP address.

| Step | Front panel                                                                                                                                                                                           | Remote interface                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>Host Name</b> to enter the host name. | SYSTem:COMMunicate:LAN:HOSTname |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                    | SYSTem:COMMunicate:LAN:UPDate   |

Each instrument is shipped with a default host name with the format: K-modelnumber-serialnumber, where modelnumber is the instrument's 7-character model number (e.g. DAQ970A), and serialnumber is the last five characters of the 10-character instrument serial number located on the label on the top of the unit (e.g. 45678 if the serial number is MY12345678).



- The instrument receives a unique hostname at the factory, but you may change it. The hostname must be unique on the LAN.
- The name must start with letter, other characters can be an upper or lower case letters, numeric digits, or dashes "-".
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## IP Address

You can enter a static IP address for the instrument as a four-byte integer expressed in dot notation. Each byte is a decimal value, with no leading zeros (for example, 169.254.2.20). Refer to [More about IP Addresses and Dot Notation](#) for further details.

| Step | Front panel                                                                                                                                                                                                   | Remote interface                 |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>IP Address</b> to set the desired IP address. | SYSTem:COMMunicate:LAN:IPAdDress |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                                            | SYSTem:COMMunicate:LAN:UPDate    |

- If DHCP is on, it attempts to assign an IP address to the instrument. If it fails, Auto-IP attempts to assign an IP address to the instrument.
- Contact your LAN administrator to obtain an IP address.
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## Subnet Mask

Subnetting allows the LAN administrator to subdivide a network to simplify administration and minimize network traffic. The subnet mask indicates the portion of the host address used to indicate the subnet.

| Step | Front panel                                                                                                                                                                                                             | Remote interface              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>Subnet Mask</b> to set the desired subnet mask address. | SYSTem:COMMunicate:LAN:SMASk  |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                                                      | SYSTem:COMMunicate:LAN:UPDate |

- Contact your LAN administrator to obtain an IP address.
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## Gateway

A gateway is a network device that connects networks. The default gateway setting is the IP address of the instrument.

| Step | Front panel                                                                                                                                                                                                     | Remote interface               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>Gateway</b> to set the desired gateway address. | SYSTem:COMMunicate:LAN:GATEway |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                                              | SYSTem:COMMunicate:LAN:UPDate  |

- Do not set a gateway address when DHCP is enabled (factory default).
- Contact your LAN administrator to obtain an IP address.
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## Primary and Secondary DNS

A DNS (Domain Name Service) is an Internet service that translates domain names into IP addresses. The DNS server address is the IP address of a server that performs this service.

| Step | Front panel                                                                                                                                                                                                                   | Remote interface                                                                                                                             |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>Primary DNS or Second DNS</b> to set the desired DNS address. | SYSTem:COMMunicate:LAN:DNS[{{1 2}}]<br><br>Note: The [{{1 2}}] syntax indicates the type of primary (1) or secondary (2) DNS server address. |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                                                            | SYSTem:COMMunicate:LAN:UPDate                                                                                                                |

- Normally, DHCP discovers the DNS address information; you only need to change this if DHCP is unused or non-functional.
- Contact your LAN administrator to obtain an IP address.
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## Primary and Secondary WINS

A WINS (Windows Internet Name System) is a system that enables Windows to identify NetBIOS systems on a TCP/IP network.

| Step | Front panel                                                                                                                                                                                                                             | Remote interface                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>Primary WINS</b> or <b>Second WINS</b> to set the desired WINS address. | SYSTem:COMMunicate:LAN:WINS[{1 2}]<br><br>Note: The [{1 2}] syntax indicates the type of primary (1) and secondary (2) WINS server address. |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                                                                      | SYSTem:COMMunicate:LAN:UPDate                                                                                                               |

- Normally, DHCP discovers the WINS address information; you only need to change this if DHCP is unused or nonfunctional.
- Contact your LAN administrator to obtain an IP address.
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## Service mDNS

A mDNS (multicast Domain Name Service) is an Internet service that is registered with the selected naming service.

| Step | Front panel                                                                                                                                                                                                                                          | Remote interface              |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Set the first softkey to <b>Manual</b> and press <b>Service mDNS</b> on the third page of the menu to set the desired mDNS service name. | LXI:MDNS:SNAME:DESired        |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                                                                                                                   | SYSTem:COMMunicate:LAN:UPDate |

Each instrument is shipped with a default service name with the format:

*Keysight Technologies\_<modelName>\_ - serial*

Number where modelName is the instrument 7-character model number (DAQ970A) and product name (Data Acquisition System), and serialNumber is the last five characters of the 10-character instrument serial number located on the label on top of the unit (e.g. 45678 if the serial number is MY12345678).

- The instrument receives a unique mDNS service name at the factory, but you may change it. The mDNS service name must be unique on the LAN.
- The name must start with letter, other characters can be an upper or lower case letters, numeric digits, or dashes "-".
- This setting is non-volatile, it will not be changed by cycling power, factory reset (\*RST command), or instrument present (SYSTem:PRESet command).

## LAN Restart

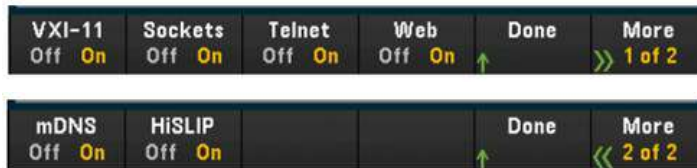
Any modification on the LAN settings described above will restart the LAN after pressing Apply Changes. This feature restarts the networking using ALL current LAN settings. LAN restart does not clear the Web Interface password.

### Remote interface

LXI:REStart

## LAN Services

Enables (On) or disables (Off) LAN services on the instrument.



| Step | Front panel                                                                                                                                               | Remote interface              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1    | Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>LAN Services</b><br>Press On to enable or Off to disable each setting. | (none)                        |
| 2    | If you change this parameter, you must press <b>[Done]</b> > <b>[Apply Changes]</b> for the change to take effect.                                        | SYSTem:COMMunicate:LAN:UPDate |

- Refer to the Keysight IO Libraries help for information on the VXI-11, Sockets, and HiSLIP protocols.
- Telnet – The instrument telnet port is 5024. Open SCPI sessions on the Telnet connection by entering: telnet IP address 5024
- Web – Enable or disable instrument programming from the instrument's Web Interface.
- mDNS – mDNS service is for use in networks where no conventional DNS server is installed. Cycling power or resetting the LAN always enables mDNS.

## Set to Defaults

This feature resets the LAN settings to the respective factory default values.

| Front panel                                                                                            | Remote interface |
|--------------------------------------------------------------------------------------------------------|------------------|
| Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Set to Defaults</b> | (None)           |

## LAN Reset

Resets the LAN using its current settings and enables DHCP mode and mDNS service. The LAN reset also clears any user-defined Web user interface (Web UI) password.

| Front panel                                                                | Remote interface |
|----------------------------------------------------------------------------|------------------|
| Press <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Reset</b> | LXI:RESet        |

## Web Interface

The DAQ970A/DAQ973A includes a built-in Web Interface for remote instrument access and control over LAN via a Web browser. Further details, refer to [Web Interface](#).

## More about IP Addresses and Dot Notation

Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value from 0 to 255) must be expressed with care, as most PC web software interprets byte values with leading zeros as octal (base 8) numbers. For example, "192.168.020.011" is actually equivalent to decimal "192.168.16.9" due to ".020" is interpreted as "16" expressed in octal, and ".011" as "9". To avoid confusion, use only decimal values from 0 to 255, with no leading zeros.



## USB Settings

USB Settings configures the front panel USB (storage) and rear panel USB (connectivity) connectors



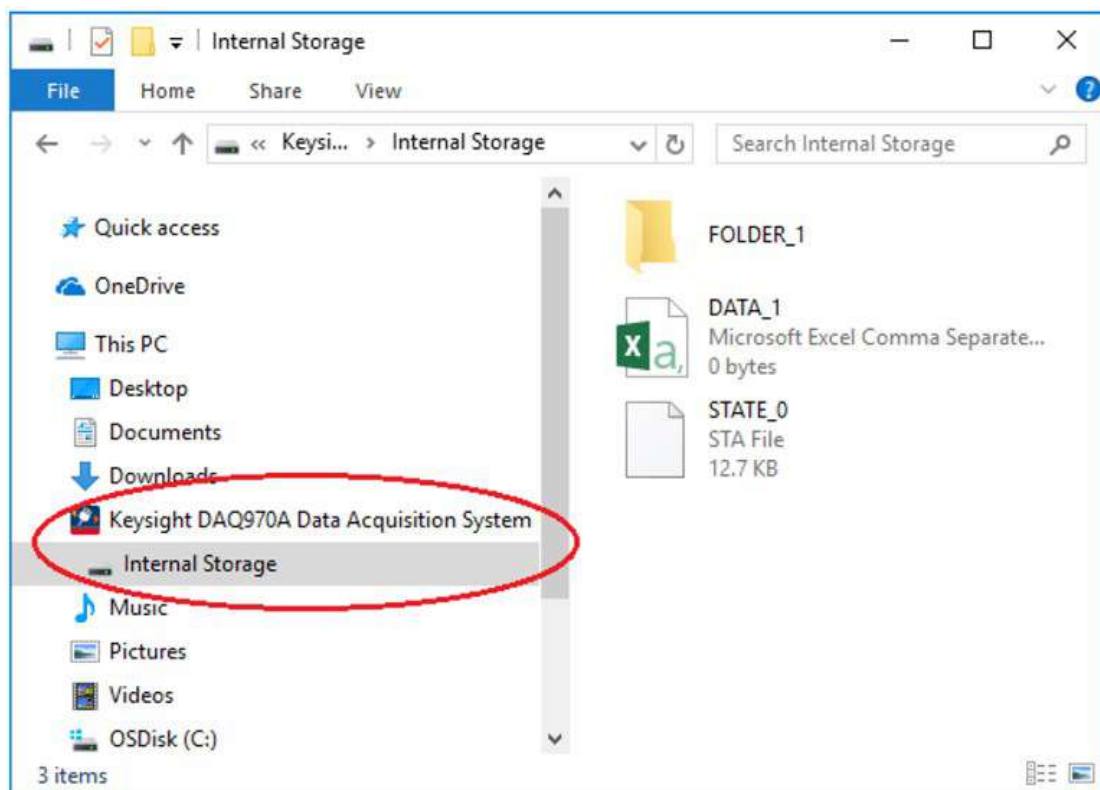
| Front panel                                       | Remote interface                          |
|---------------------------------------------------|-------------------------------------------|
| Press [Home] > User Settings > I/O > USB Settings | SYSTem:COMMunicate:ENABle {OFF   ON}, USB |

### USB SCPI

USB SCPI enables (On) or disables (Off) the instrument's USB control port on the rear panel. Once the interface state is changed, you must cycle the instrument power for the change to take effect. When disabled, the interface cannot be configured in the Keysight IO Libraries Connection Expert utility.

### Easy File Access (File Access Softkey)

Easy File Access allows you to easily transfer files between the instrument and your PC. Simply connect the rear panel USB control port on the instrument to a USB port on your PC and then use the window that appears on your PC to copy files from the instrument to your PC.



You can use your PC's standard file management features to copy files from the instrument to your PC.

**NOTE**

To use Easy File Access at the same time that you are remotely programming the instrument with SCPI over the USB interface (USB SCPI), you must have Keysight IO Libraries Suite 16.3 or later installed on your PC. You may download the latest version at [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite).

To use Easy File Access on a PC running the Windows XP operating system, make sure you have Microsoft Windows Media Player 11 for Windows XP SP1, or are using a Microsoft Windows XP SP2, SP3, or a newer version of Windows. You may download this software at [www.microsoft.com/en-us/-download/details.aspx?id=8163](http://www.microsoft.com/en-us/-download/details.aspx?id=8163).

**Show USB ID**

Displays the USB address string as used in VISA programming applications

**Technical Connection Details**

In most cases, you can easily connect to the instrument with the IO Libraries Suite or Web interface. In certain circumstances, it may be helpful to know the following information.

| Interface     | Details                                                                                                                                 |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| LAN           | VISA String: TCPIP0::<IP Address>::inst0::INSTR<br>Example: TCPIP0::192.168.10.2::inst0::INSTR                                          |
| Web Interface | Port number 80, URL <a href="http://&lt;IP address&gt;/">http://&lt;IP address&gt;/</a>                                                 |
| USB           | USB ID is in the form of USB0::<Vendor ID>::<Prod ID>::<Serial Number>::0::INSTR<br>Example: USB0::0x2A8D::0x0902::MY55160003::0::INSTR |

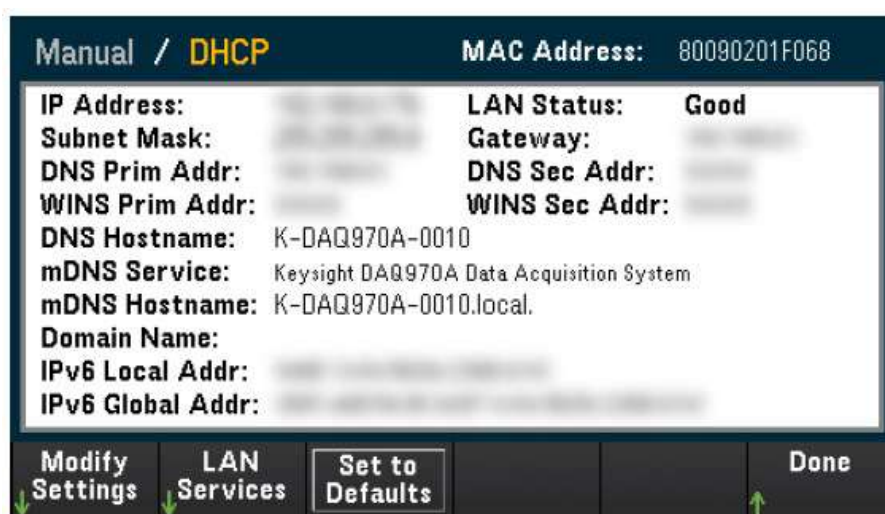
## LAN Configuration Procedure

There are several parameters that you might need to set to establish network communication using the LAN interface. Primarily, you will need to establish an IP address. You might need to contact your network administrator for help in establishing communication with the LAN interface.

### NOTE

If Secure mode is enabled, the instrument must be unlocked with the correct security code to perform many of these actions. See [Security](#) for more information.

1. Press [Home] > User Settings > I/O > LAN Settings.
2. You can select **Modify Settings** to change the LAN settings, select **LAN Services** to enable (On) or disable (Off) LAN services on the instrument, or select **Set to Defaults** to restore the LAN settings to its factory default settings.



3. To change settings, press **Modify Settings**. To access most items on this screen, use the first softkey to switch from **DHCP** to **Manual**. With DHCP on, an IP address will automatically be set by the DHCP (Dynamic Host Configuration Protocol) when you connect the instrument to the network; provided that the DHCP server is found and is able to do so. The DHCP also automatically deals with the subnet mask, gateway address, DNS, WINS, and domain name, if required. This is typically the easiest way to establish LAN communication for your instrument; all you need to do is leave the DHCP on. Contact your LAN administrator for details.
4. **Establish an "IP Setup"**  
If you are not using DHCP (the first softkey is set to Manual), you must establish an IP setup, including an IP address, and possibly a subnet mask and gateway address. The IP Address and Subnet Mask softkeys are on the main screen. Press More to configure other settings.

Contact your network administrator for the IP address, subnet mask, and gateway to use. All IP addresses take the dot-notation form "nnn.nnn.nnn.nnn" where "nnn" in each case is a byte value in the range 0 through 255. You can enter a new IP address using the knob or the front panel arrow keys. **Do not enter leading zeros.**

5. **Configure the "DNS Setup" (optional)**

The DNS (Domain Name Service) is an Internet service that translates domain names into IP addresses. Ask your network administrator whether the DNS is in use, and if it is, for the host name, domain name, and DNS server address to use.

- a. Set the "hostname". Press **Host Name** and enter the hostname. A hostname is the host portion of the domain name, which is translated into an IP address. The hostname is entered as a string using the front panel arrow keys to select and change characters. The hostname may include letters, numbers, and dashes ("-").
- b. Set the "DNS Server" addresses. From the LAN configuration screen, press **More** to go to the second of three sets of softkeys.

Enter the **Primary DNS** and **Second DNS**. See your network administrator for details.

## Firmware Update

**CAUTION**

Do not turn off the instrument during the update.

---

1. Press **[Home]** > **Help** > **About** to determine the firmware revision that is currently installed.
2. Go to [www.keysight.com/find/DAQ970Afirmware](http://www.keysight.com/find/DAQ970Afirmware) to find the latest firmware revision. If this matches the revision installed on your instrument, there is no need to continue with this procedure. Otherwise, download the firmware update utility and a ZIP file of the firmware. Detailed firmware instructions are in the Firmware Update Utility Instructions located on the download page.
3. Unzip the ZIP file and use the firmware update utility to prepare a USB drive with the updated firmware.
4. Attach the USB drive to the instrument front panel and press **[Utility]** > **Admin** > **Firmware Update** to update the firmware. If Secure mode is enabled, unlock the instrument with the security code before installing firmware.

**Important:** In order to update the instrument firmware from remote, the model number in the \*IDN? response must match the actual instrument model number. If you have changed the instrument's \*IDN? response to another instrument, when attempting to update the firmware from remote, you will see this error: "The instrument is not supported by this firmware file". To update the firmware, either update using the front panel procedure or, from remote, use SYSTem:PERSonA:MODEL to set the \*IDN? to match the actual model number, update the firmware, and then use SYSTem:PERSonA:MODEL again to set the \*IDN? response to the other model number.

## Contacting Keysight Technologies



You can contact Keysight Technologies for warranty, service, or technical support.

In the United States: (800) 829-4444

In Europe: 31 20 547 2111

In Japan: 0120-421-345

Use [www.keysight.com/find/assist](http://www.keysight.com/find/assist) to contact Keysight worldwide, or contact your Keysight Technologies representative.

## 2 Quick Start

Prepare Instrument for Use

Module Wiring Connection and Installation

Connect Power and I/O Cables

Use the Built-In Help System

Adjust the Carrying Handle

Rack Mounting the Instrument

Keysight BenchVue Data Acquisition (DAQ) Software

## Prepare Instrument for Use

Verify that you received the following items. If anything is missing, please contact your nearest Keysight sales office or Keysight authorized reseller.

- Power cord (for country of destination)
- Certificate of calibration (optional)
- Supplemental documentation packet
- USB 2.0 cable
- One J-type thermocouple and a flat blade screwdriver

The Keysight BenchVue Data Acquisition (DAQ) Software can be downloaded from [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

Any plug-in modules that you ordered are delivered in a separate shipping container.

An additional cable kit (50  $\Omega$ ) is also included when you order the DAQM905A Dual 1:4 RF Multiplexer (50  $\Omega$ ) Module.

The latest product documentation is available at:

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)



## Module Wiring Connection and Installation

### WARNING

To prevent electrical shock, use only wires that are rated for the maximum voltage applied to any channel.

Before removing a module cover, turn off all power to external devices that are connected to the module.

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous.

When any channel is connected to a hazardous voltage source, all channel wiring in the module should be rated for the maximum voltage applied.

When any channel is connected to a hazardous voltage source, thermocouples attached to any other channel on the module shall have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage, and will be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied.

Do not mount, move or remove any thermocouples when the device under test is connected to a signal source.

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

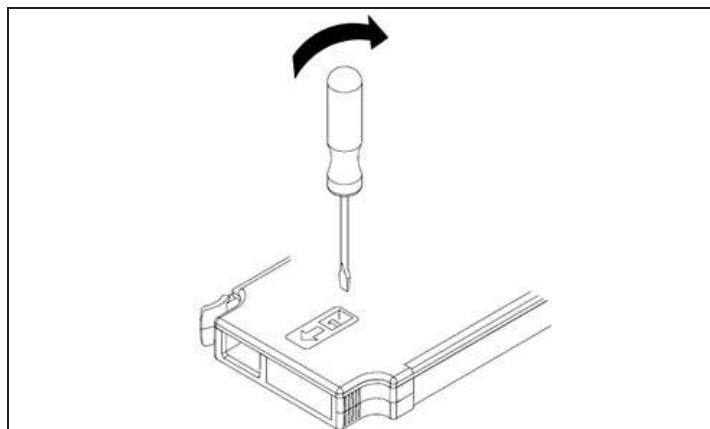
### CAUTION

During power on, any action to install or uninstall the modules from the rear panel will reboot the instrument.

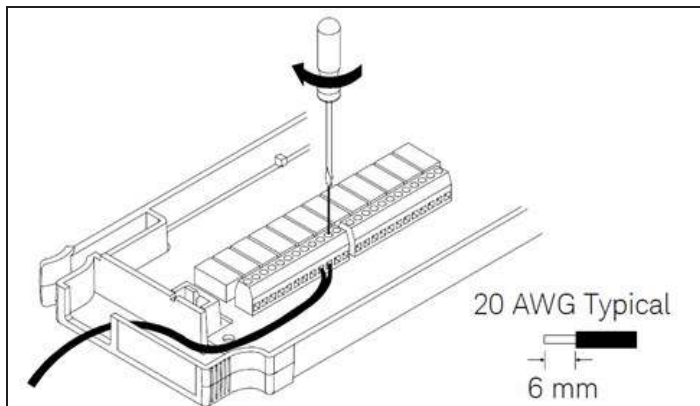
### Installing the Module

To connect wiring to a module and install to the rear panel of the instrument, follow the five steps shown below:

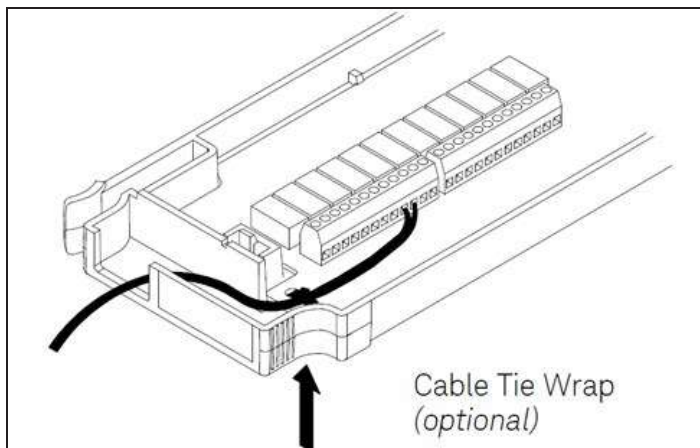
1. Using a flat head screwdriver, push the tab forward and lift up the cover to detach it from the module.



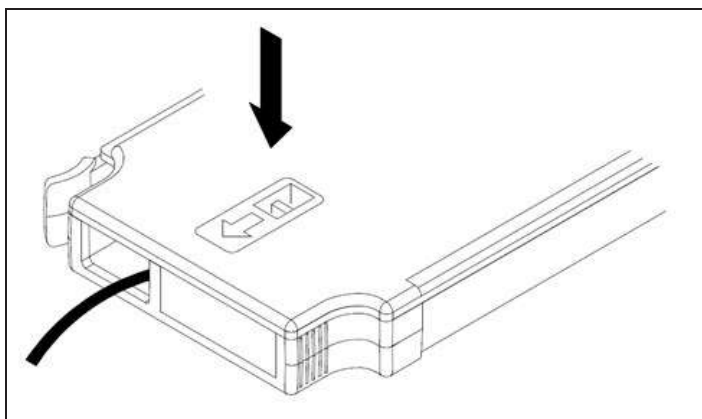
2. Connect the wiring to the screw terminals



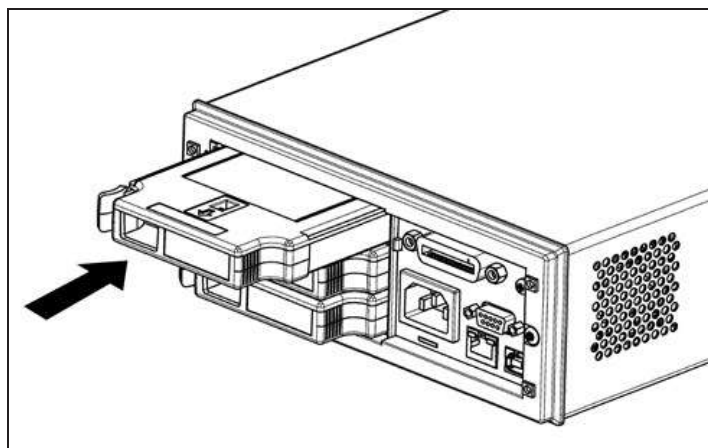
3. Route the wiring through the strain relief.



4. Replace the module cover.

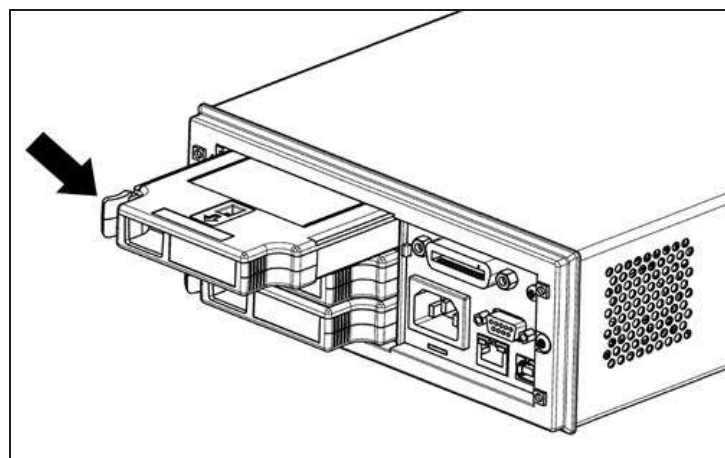


5. Install the module in to the instrument (at the rear panel)



## Uninstalling the Module

To unplug or replace any modules, push the clip located at the rear left side of the module inwards, and then pull it out from rear panel.



## Connect Power and I/O Cables

### To turn on the instrument

Before powering on the instrument, make sure all signal sources are turned off. Turn on signal sources after the instrument is powered on. Turn off signal sources before the instrument is powered off. Connect the power cord and LAN or USB cable as desired. Press the On/Standby switch on the front panel. Note that this switch is for standby purpose only. To disconnect the mains from the instrument, remove the power cord. If the instrument does not turn on, verify that the power cord is firmly connected.

The table below shows the statuses of the LED color displayed while the instrument is powered-on:

| LED color    | Instrument Status                                                 |
|--------------|-------------------------------------------------------------------|
| LED off      | No AC mains power connected.                                      |
| LED is amber | Instrument is in standby mode with AC mains power still connected |
| LED is green | Instrument is turned on.                                          |

### Power-on self test

After turning on, the instrument runs a power-on self test and displays a message on how to obtain help, along with the current IP address.

The front-panel display will light up briefly while the instrument perform its power-on self test, with all measurement channels turned off. If the power-on self test fails, the error annunciator, **ERR** is displayed on the screen. See "SCPI Error Messages" in the *DAQ970A/DAQ973A Programming Guide* for more information on SCPI error codes and error messages.

#### NOTE

A complete self-test performs a more extensive set of tests than those performed at power-on. See the *DAQ970A/DAQ973A Service Guide* for more information on the instrument complete self-test procedure.

The instrument's default measurement function is DC voltage (DCV), with autoranging enabled.

### To turn off the instrument

Press and hold the On/Standby switch for about half a second. This prevents you from accidentally turning off the instrument by brushing against the power switch.

#### NOTE

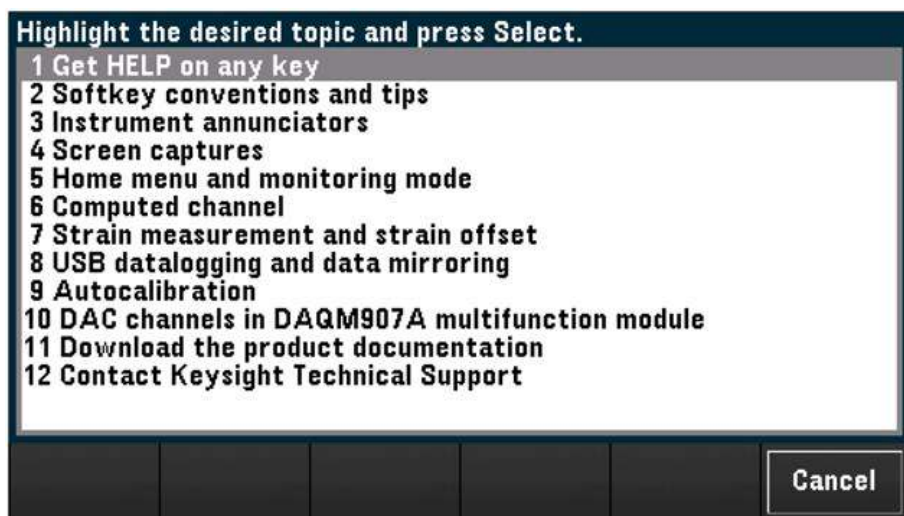
If you turn off the instrument by disconnecting the power source (this is not recommended), the instrument turns on as soon as the power is reconnected. You do need to press the **On/Standby** switch again.

## Use the Built-In Help System

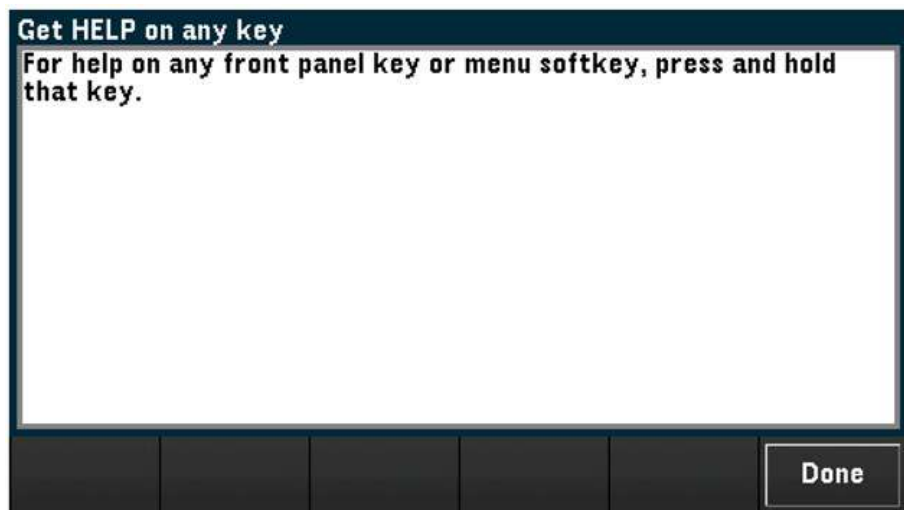
The built-in help system provides context-sensitive help on any front panel key or menu softkey. A list of help topics is also available to help you learn about the instrument. All messages, context-sensitive help, and help topics appear in the selected language. The menu softkey labels are not translated.

### View the list of help topics

Press **[Home]** > **Help** > **Help Topics** to view the list of help topics. Use the knob or the front panel arrow keys to highlight the desired topic, and press **[Select]** to view the help contents.



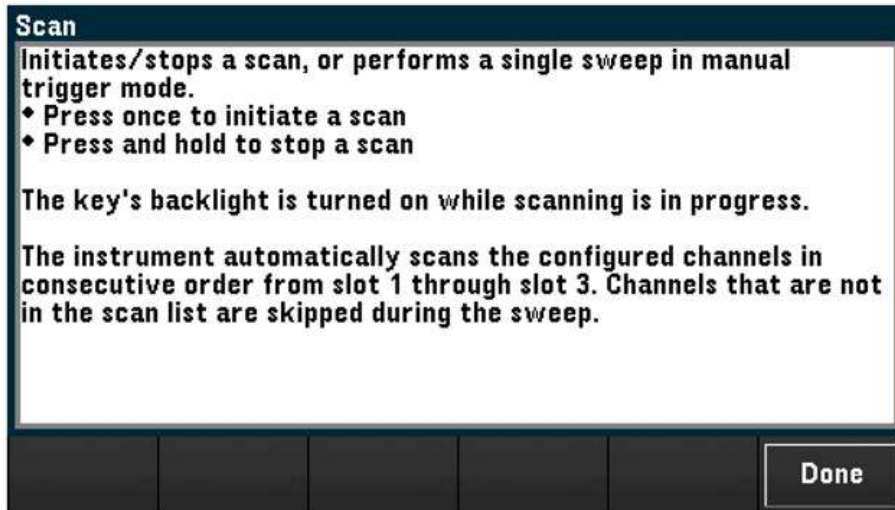
In this example, 1 Get HELP on any key was selected. The following help topic appears on the display:



Press **Done** to exit the help.

## View the help information for a front panel key

Press and hold any front panel key or softkey to get context-sensitive help, such as **[Scan]**. If the message contains more information than will fit on the display, use the knob or the front panel arrow keys to load in previous/next page.



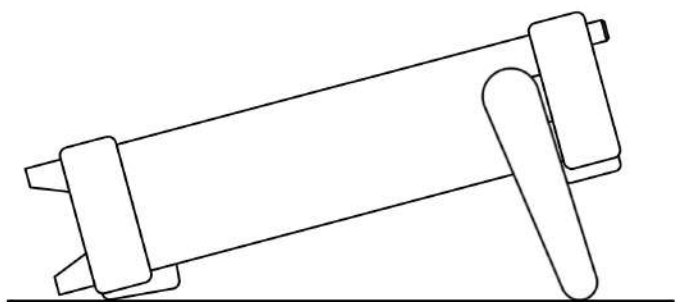
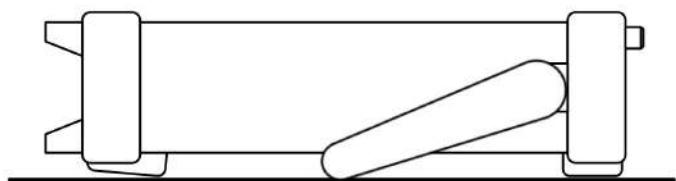
Press **Done** to exit the help.

## View the instrument information

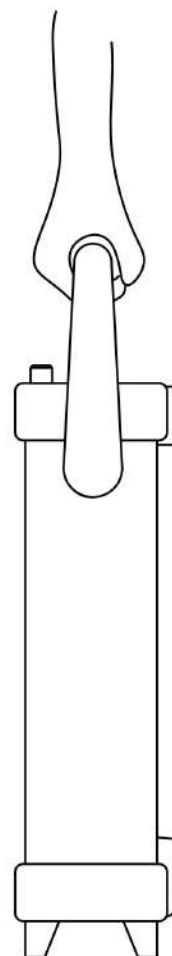
Press **[Home]** > **Help** > **About** to view the instrument information such as product serial number, IP address (when connected to LAN interface), and currently installed firmware revision. Press **Done** to exit.

## Adjust the Carrying Handle

The carrying handle has three positions (as shown below). To adjust the handle position, grasp the sides of the handle, pull outward, and rotate the handle.



Bench-top viewing positions



Carrying position

## Rack Mounting the Instrument

You can mount the instrument in a standard 19-inch rack cabinet by ordering the rack mount kit with the part number provided as below. Instructions and mounting hardware are included with each rack-mounting kit. Any Keysight System II instrument of the same size can be rack-mounted beside the DAQ970A/DAQ973A.

### CAUTION

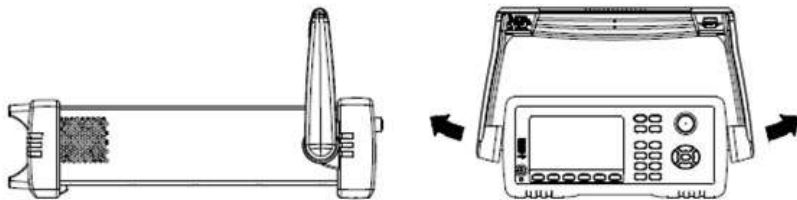
To prevent overheating, do not block air flow to or from the instrument.  
Allow enough clearance at the rear, sides, and bottom of the instrument to permit adequate internal air flow.

### NOTE

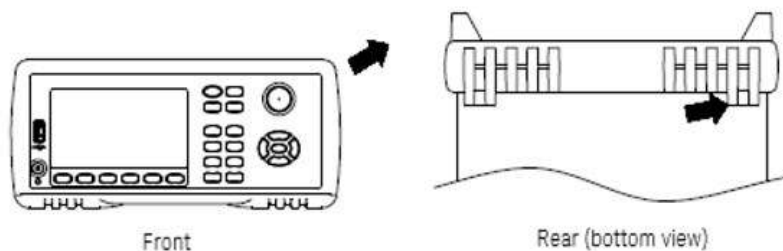
Remove the carrying handle, and the front and rear rubber bumpers, before rack-mounting the instrument.

### Removing the handle and bumpers

To remove the handle, rotate it to the vertical position and pull the ends outward.

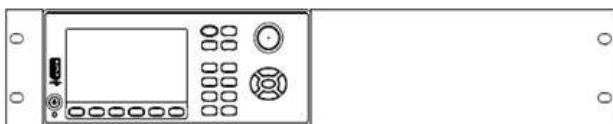


To remove the front and rear rubber bumpers, stretch a corner and then slide it off.



### Rack mounting a single instrument

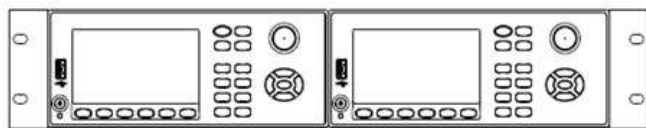
To rack mount a single instrument, order the adapter kit (part number: **DAQA190A** or 1CM124A).





## Rack mounting instruments side-by-side

To rack mount two instruments side-by-side, order the lock-link kit (part number: DAQA194A or 34194A) and flange kit (part number: DAQA191A or 1CM107A). Be sure to use the support rails inside the rack cabinet.

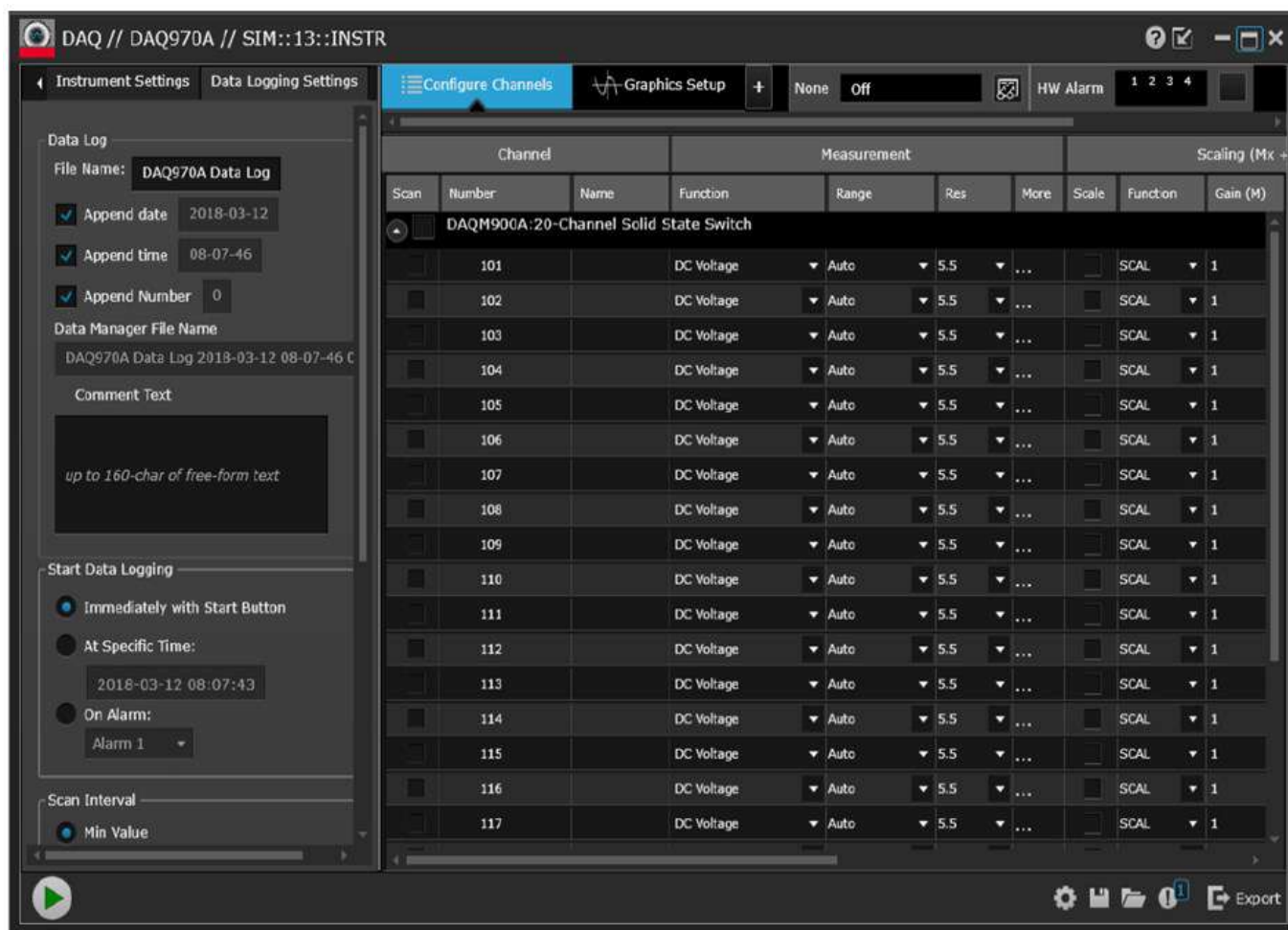


## Keysight BenchVue Data Acquisition (DAQ) Software

The Keysight BenchVue Data Acquisition (DAQ) Software is a Windows-based application that makes it easy to use the instrument with your PC for gathering and analyzing measurements. Use this software to set up your test, acquire and archive measurement data, and perform real-time display and analysis results of your measurements. The Keysight BenchVue Data Acquisition (DAQ) Software can be downloaded from

[www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

Application main screen:



## BenchVue Data Acquisition (DAQ) Software Licensing

To evaluate a BenchVue application for a free 30-day trial period, go to the BenchVue Application view, click once on the desired application, and then click on the "Start Trial" button – the trial period is based on the number of calendar days remaining. After the trial period expires, you will be required to purchase a software license for that application. Keysight's flexible licensing options allow you to select the license type and license terms that best fit your software needs. For more information on purchasing and installing a software license, see BenchVue Software Licensing Options in the Keysight BenchVue Data Acquisition (DAQ) Software Help .

# 3 Features and Functions

System Overview

Front Panel Menu References

[Scan/Start] Key

[Monitor] Menu

[Home] Menu

[View] Menu

[Channel] Menu

[Interval] Menu

[Math] Menu

[Copy] Menu

[Alarm] Menu

[Utility] Menu

[Module] Menu

[Save Recall] Menu

Web Interface

Module Overview

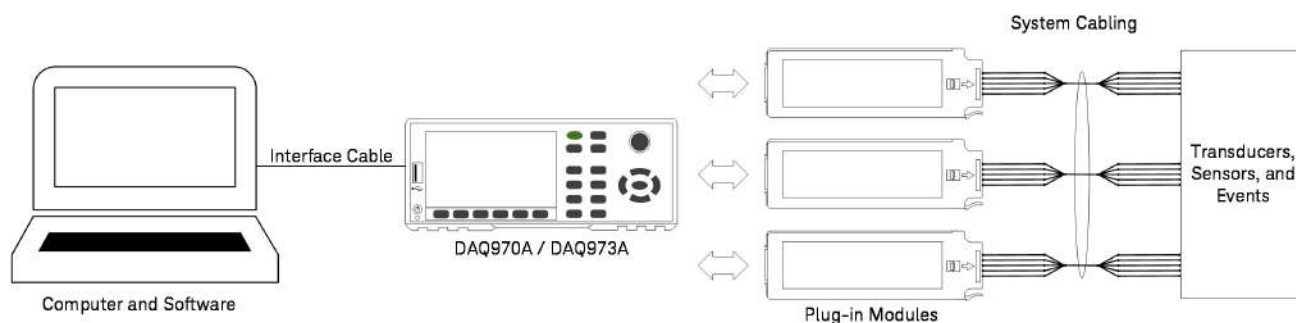
## System Overview

This section provides an overview of a computer-based system and describes the parts of a data acquisition system.

- [Data Acquisition System Overview](#)
- [Signal Routing and Switching](#)
- [Measurement Input](#)
- [Control Output](#)

## Data Acquisition System Overview

You can use the Keysight DAQ970A/DAQ973A as a stand-alone instrument, but there are many applications where you will want to take advantage of the built-in PC connectivity features. A typical data acquisition system is shown below:

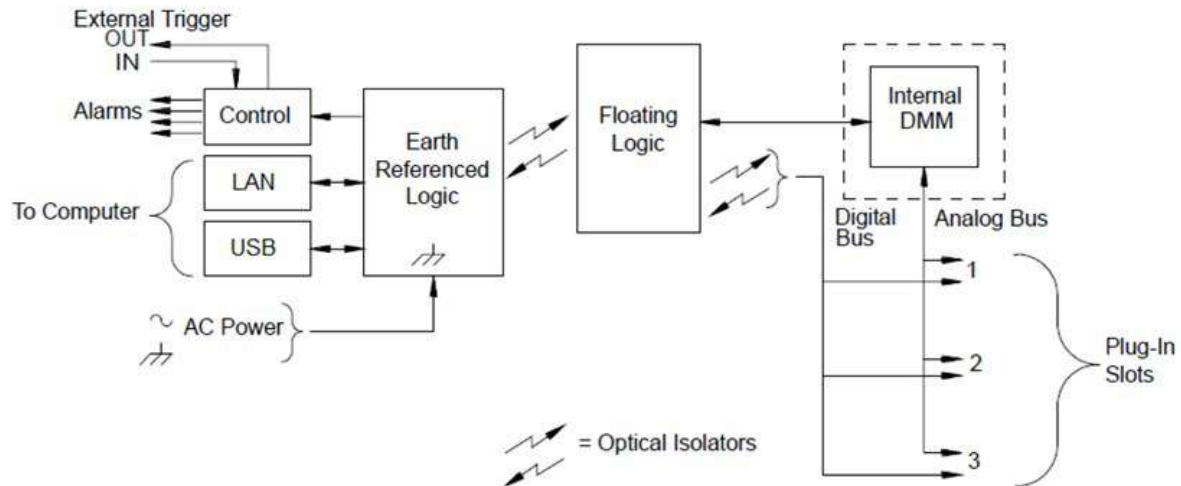


The configuration offers the following advantages:

- You can use the DAQ970A/DAQ973A to perform data storage, data reduction, mathematical calculations, and conversion to engineering units. You can use the PC to provide easy configuration and data presentation.
- You can remove the analog signals and measurement sensors from the noisy PC environment and electrically isolate them from both the PC and earth ground.
- You can get a single PC to monitor multiple instruments and measurement points while performing other PC-based tasks.

## DAQ970A/DAQ973A logic circuitry

As shown below the logic circuitry for the DAQ970A/DAQ973A is divided into two sections: earth-referenced and floating. These two sections are isolated from each other in order to maintain measurement accuracy and repeatability. See [Noise caused by ground loops](#) for further details on ground loops.



The earth-referenced and floating circuitry communicate with each other via an optically-isolated data link. The earth-referenced section communicates with the floating section to provide PC connectivity. The DAQ970A/DAQ973A is shipped with LAN and USB interfaces connectivity.

The earth-referenced section also provides four hardware alarm outputs and external trigger lines. You can use the alarm output lines to trigger external alarm lights, sirens, or send a TTL-compatible pulse to your control system.

The floating section contains the main system processor and controls all of the basic functionality of the instrument. This is where the instrument communicates with the plug-in modules, scans the keyboard, controls the front-panel display, and controls the internal DMM. The floating sections also performs measurement scaling, monitors alarm conditions, converts transducer measurements to engineering units, time stamps scanned measurements, and saves data in non-volatile memory.

## Plug-in modules

The DAQ970A/DAQ973A offers a complete selection of plug-in modules to give you high-quality measurement, switching, and control capabilities. The plug-in modules communicate with the floating logic via the internal isolated digital bus. The multiplexer modules also connect to the internal DMM via the internal analog bus. Each modules has its own microprocessor to offload the mainframe processor and minimize backplane communications for faster throughput. See [Module Overview](#) for more information.

| Module number            | Common uses                                                                                                                            |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measurement input</b> |                                                                                                                                        |
| DAQM900A                 | Scanning and direct measurement of temperature, voltage, resistance, frequency, and current (DAQM901A only) by using the internal DMM. |
| DAQM901A                 |                                                                                                                                        |
| DAQM902A                 |                                                                                                                                        |
| DAQM907A                 | Digital Input, Event Counting.                                                                                                         |
| DAQM908A                 | Scanning and direct measurement of temperature, voltage, and resistance by using the internal DMM.                                     |
| DAQM909A                 | Digitizing measurement of voltage and strain by using the on board digitizers.                                                         |
| <b>Signal routing</b>    |                                                                                                                                        |
| DAQM900A                 | N/A                                                                                                                                    |
| DAQM901A                 | Multiplexing of signals to or from external instruments.                                                                               |
| DAQM902A                 | N/A                                                                                                                                    |
| DAQM904A                 | 32 Crosspoint Matrix Switching.                                                                                                        |
| DAQM905A                 | 50 $\Omega$ high-frequency applications (<2 GHz).                                                                                      |
| DAQM908A                 | N/A                                                                                                                                    |
| <b>Control output</b>    |                                                                                                                                        |
| DAQM903A                 | General-purpose switching and control using Form C (SPDT) switches.                                                                    |
| DAQM907A                 | Digital Output, Voltage (DAC) Outputs.                                                                                                 |

## System cabling

The plug-in modules have screw-terminal connectors to make it easy to connect your system cabling. The type of cabling that you use to connect your signals, transducers, and sensors to the module is critical to measurement success. Some types of transducers, such as thermocouples, have very specific requirements for the type of cable that can be used to make connections. Be sure to consider the usage environment when choosing wire gauge and insulation qualities. Wire insulation typically consists of materials such as PVC or PTFE. Table below lists several common cable types and describes their typical uses.

### NOTE

Wiring insulation and usage is described in more detail in [System Cabling and Connections](#).

| Cable type                                   | Common uses                                               | Comments                                                                                                                                                                                                                                              |
|----------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Thermocouple Extension Wire                  | Thermocouple measurements.                                | Available in specific thermocouple types. Also available in shielded cable for added noise immunity.                                                                                                                                                  |
| Twisted Pair,<br>Shielded Twisted Pair       | Measurement inputs, voltage outputs, switching, counting. | Most common cable for low-frequency measurement inputs. Twisted pair reduces common mode noise. Shielded-twisted pair provides additional noise immunity.                                                                                             |
| Shielded Coaxial,<br>Double-Shielded Coaxial | VHF signal switching.                                     | Most common cable for high-frequency signal routing. Available in specific impedance values (50 $\Omega$ or 75 $\Omega$ ). Provides excellent noise immunity. Double-shielded cable improves isolation between channels. Requires special connectors. |
| Flat Ribbon,<br>Twisted pair Ribbon          | Digital Input/Output                                      | Often used with mass termination connectors. These cables provide little noise immunity.                                                                                                                                                              |

## Transducers and sensors

Transducers and sensors convert a physical quantity into an electrical quantity. The electrical quantity is measured and the result is then converted to engineering units. For example, when measuring a thermocouple, the instrument measures a DC voltage and mathematically converts it to a corresponding temperature in  $^{\circ}\text{C}$ ,  $^{\circ}\text{F}$ , or K.

| Measurement | Typical transducer types                             | Typical transducer output                                   |
|-------------|------------------------------------------------------|-------------------------------------------------------------|
| Temperature | Thermocouple                                         | 0 mV to 80 mV                                               |
|             | RTD                                                  | 2-wire or 4-wire resistance from 5 $\Omega$ to 500 $\Omega$ |
|             | Thermistor                                           | 2-wire resistance from 10 $\Omega$ to 1M $\Omega$           |
| Pressure    | Solid State                                          | $\pm 10$ DVC                                                |
| Flow        | Rotary Type<br>Thermal Type                          | 4 mA to 20 mA                                               |
| Strain      | Resistive Elements                                   | 4-wire resistance from 10 $\Omega$ to 10 k $\Omega$         |
| Events      | Limit Switches<br>Optical Counters<br>Rotary Encoder | 0 V or 5 V Pulse Train                                      |
| Digital     | System Status                                        | TTL-compatible Levels                                       |

## Alarm limits

The DAQ970A/DAQ973A has four alarm outputs which you can configure to alert you when a reading exceeds specified limits on a channel during a scan. You can assign a high limit, low limit, or both to any configured channel in the scan list. You can assign multiple channels to any of the four available alarms (numbered 1 through 4). For example, you can configure the instrument to generate an alarm on Alarm 1 when a limit is exceeded on any of the channels 103, 205, or 320.

You can also assign alarms to channels on the multifunction module. For example, generate an alarm when a specific bit pattern or bit pattern change is detected on a digital input channel or when a specific count is reached on a totalizer channel. With the multifunction module, the channels do not have to be part of the scan list to generate an alarm.

## Signal Routing and Switching

The switching capabilities of the plug-in modules available with the DAQ970A/DAQ973A provide test system flexibility and expandability. You can use the switching plug-in modules to route signals to and from your test system or multiplex signals to the internal DMM or external instruments.

Relays are electromechanical devices which are subject to wear-out failure modes. The life of a relay, or the number of actual operations before failure, is dependent upon how it is used – applied load, switching frequency, and environment. The DAQ970A/DAQ973A relay maintenance system automatically counts the cycles of each relay in the instrument and stores the total count in non-volatile memory on each switch module. Use this feature to track relay failures and to predict system maintenance requirements.

## Switching topologies

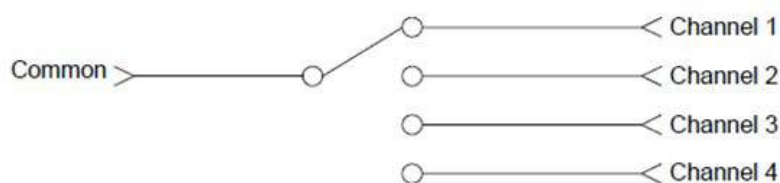
Several switching plug-in modules are available with different topologies for various applications:

| Switching topologies               | Plug-in modules                                  |
|------------------------------------|--------------------------------------------------|
| Multiplexer                        | DAQM900A, DAQM901A, DAQM902A, DAQM905A, DAQM908A |
| Matrix                             | DAQM904A                                         |
| Form C (single pole, double throw) | DAQM903A                                         |

The following sections describe each of these switching topologies.

### Multiplexer switching

Multiplexers allow you to connect one of multiple channels to a common channel, one at a time. A simple 4-to-1 multiplexer is shown below. When you combine a multiplexer with a measurement device, like the internal DMM, you create a scanner. For more information on scanning, see [Scanning](#).



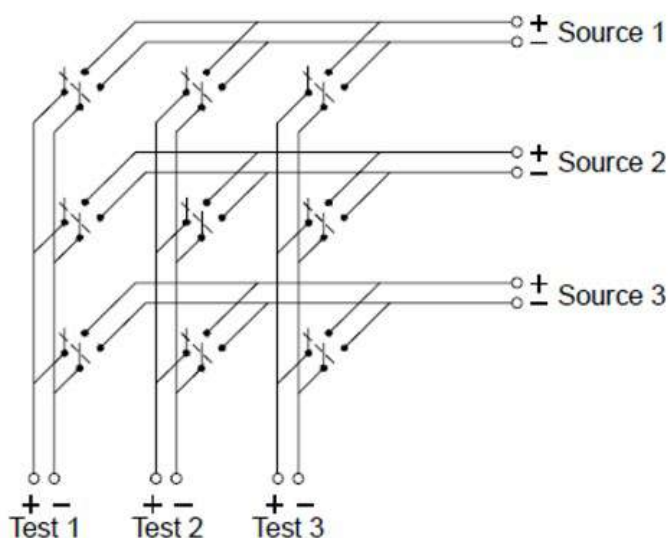


Multiplexers are available in several types:

| Multiplexer type        | Common use                                                                                                                               |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| One-wire (single-ended) | For common LO measurements. For more information, see <a href="#">One-wire (single-ended) multiplexers</a> .                             |
| Two-wire                | For floating measurements. For more information, see <a href="#">Two-wire multiplexers</a> .                                             |
| Four-wire               | For resistance and RTD measurements. For more information, see <a href="#">Four-wire multiplexers</a> .                                  |
| RF Signal               | Very High Frequency (VHF) for switching frequencies up to 2.8 GHz.<br>For more information, see <a href="#">RF Signal Multiplexing</a> . |

### Matrix switching

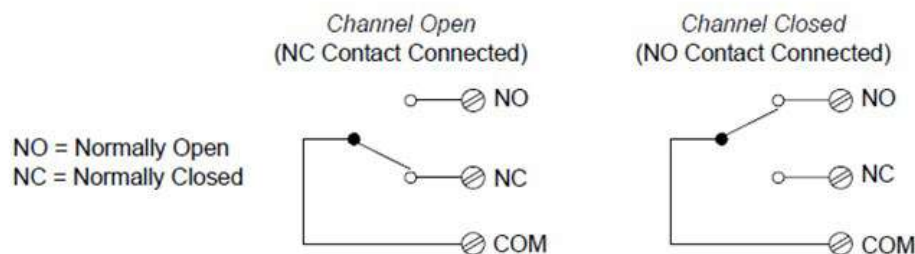
A matrix switch connects multiple inputs to multiple outputs and therefore offers more switching flexibility than a multiplexer. Use a matrix for switching low-frequency (less than 10 MHz) signals only. A matrix is arranged in rows and columns. For example, a simple 3×3 matrix could be used to connect three sources to three test points as shown below:



Any one of the signal sources can be connected to any one of the test inputs. Be aware that with a matrix, it is possible to make sure that dangerous or unwanted conditions are not created by these connections.

### Form C (SPDT) switching

The DAQM903A contains 20 Form C switches (also called single-pole, double-throw). You can use Form C switches to route signals but they are typically used to control external devices.



## Measurement Input

The DAQ970A/DAQ973A allows you to combine a DMM (either internal or external) with multiplexer channels to create a scan. During a scan, the instrument connects the DMM to the configured multiplexer channels one at a time and makes a measurement on each channel.

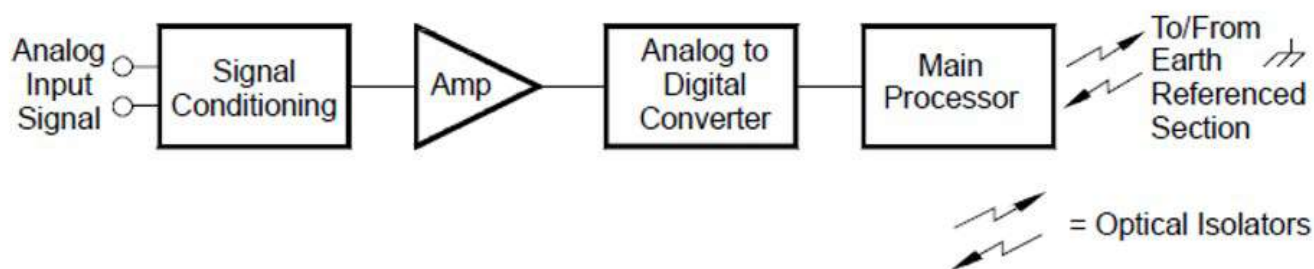
Any channel that can be "read" by the instrument can also be included in a scan. This includes any combination of temperature, voltage, resistance, current, frequency, or period measurements on multiplexer channels. A scan can also include a read of a digital port, a read via the sense channel, or a read of the totalizer count on the multifunction module.

### The internal DMM

A transducer or sensor converts a physical quantity being measured into an electrical signal which can be measured by the internal DMM. To make these measurements, the internal DMM incorporates the following functions:

- Temperature (thermocouple, RTD, and thermistor)
- Voltage (DC and AC up to 300 V)
- Resistance (2-wire and 4-wire up to  $1\text{G}\Omega$ )
- Current (DC and AC up to 1 A)
- Frequency and Period (up to 300 kHz)

The internal DMM provides a universal input front-end for measuring a variety of transducer types without the need for additional external signal conditioning. The internal DMM includes signal conditioning, amplification (or attenuation), and a high resolution (up to 22 bits) analog-to-digital converter. A simplified diagram of the internal DMM is shown below:



### Signal conditioning, ranging, and amplification

Analog input signals are multiplexed into the internal DMM's signal-conditioning section – typically comprising switching, ranging, and amplification circuitry. If the input signal is a DC voltage, the signal conditioner is composed of an attenuator for the higher input voltages and a DC amplifier for the lower input voltages. If the input signal is an AC voltage, a converter is used to convert the AC signal to its equivalent DC value (true RMS value). Resistance measurements are performed by supplying a known DC current to an unknown resistance and measuring the DC voltage drop across the resistor. The input signal switching and ranging circuitry, together with the amplifier circuitry, convert the input to a DC voltage which is within the measuring range of the internal DMM's analog-to-digital converter (ADC).

You can allow the instrument to automatically select the measurement range using autoranging or you can select a fixed measurement range using manual ranging. Autoranging is convenient because the instrument automatically selects the range to use for each measurement based on the input signal. For fastest scanning operation, use manual ranging for each measurement (some additional time is required for autoranging since the instrument has to make a range selection).

### Analog-to-digital conversion (ADC)

The ADC takes a prescaled DC voltage from the signal-conditioning circuitry and converts it to digital data for output and display on the front panel. The ADC governs some of the most basic measurement characteristics.

These include measurement resolution, reading speed, and the ability to reject spurious noise. There are several analog-to-digital conversion techniques but they can be divided into two types: integrating and non-integrating. The integrating techniques measure the average input value over a defined time interval, thus rejecting many noise sources. The non-integrating techniques sample the instantaneous value of the input, plus noise, during a very short interval. The internal DMM uses an integrating ADC technique.

### Main processor

The main processor, located in the floating logic section, controls the input signal conditioning, ranging, and the ADC. The main processor accepts commands from, and sends measurement results to, the earth referenced logic section. The main processor synchronizes measurements during scanning and control operations. The main processor uses a multi-tasking operation system to manage the various system resources and demands.

The main processor also calibrates measurement results, performs  $Mx+B$  scaling, monitors alarm conditions, converts transducer measurements to engineering units, time stamps scanned measurements, and stores data in non-volatile memory.

## Scanning

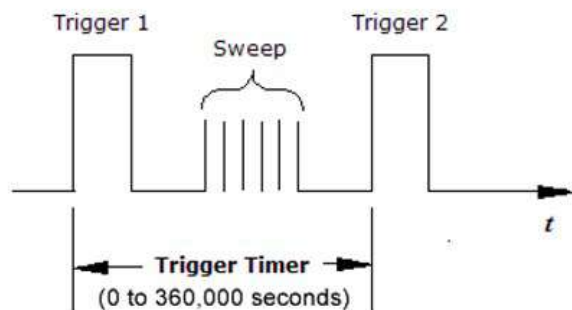
The instrument allows you to combine a DMM (either internal or external) with multiplexer channels to create a scan. During a scan, the instrument connects the DMM to the configured multiplexer channels one at a time and makes a measurement on each channel.

Before you can initiate a scan, you must set up a scan list to include all desired multiplexer or digital channels. Channels which are not in the scan list are skipped from the scan. The instrument automatically scans the list of channels in ascending order from slot 1 through slot 3. Measurements are taken only during a scan and only on those channels which are included in the scan list.

You can store up to 1,000,000 readings in non-volatile memory during a scan. Readings are stored only during a scan and all readings are automatically time stamped. Each time you start a new scan, the instrument clears all readings stored in memory from the previous scan. Therefore, all readings currently stored in memory are from the most recent scan.

You can configure the event or action that controls the onset of each sweep through the scan list (a sweep is one pass through the scan list):

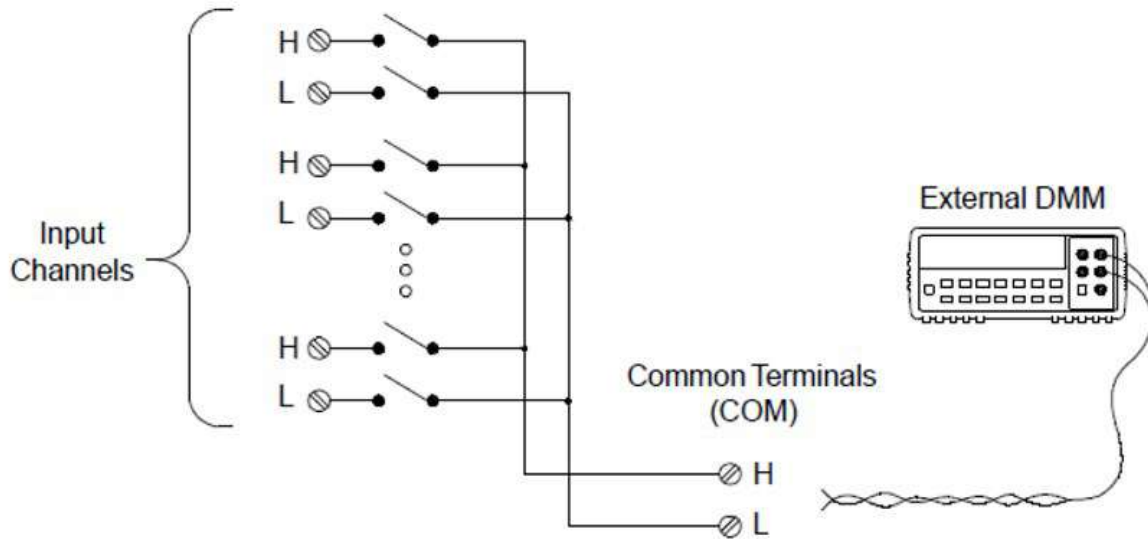
- You can set the instrument's internal timer to automatically scan at a specific interval as shown below. You can also program a time delay between channels in the scan list.



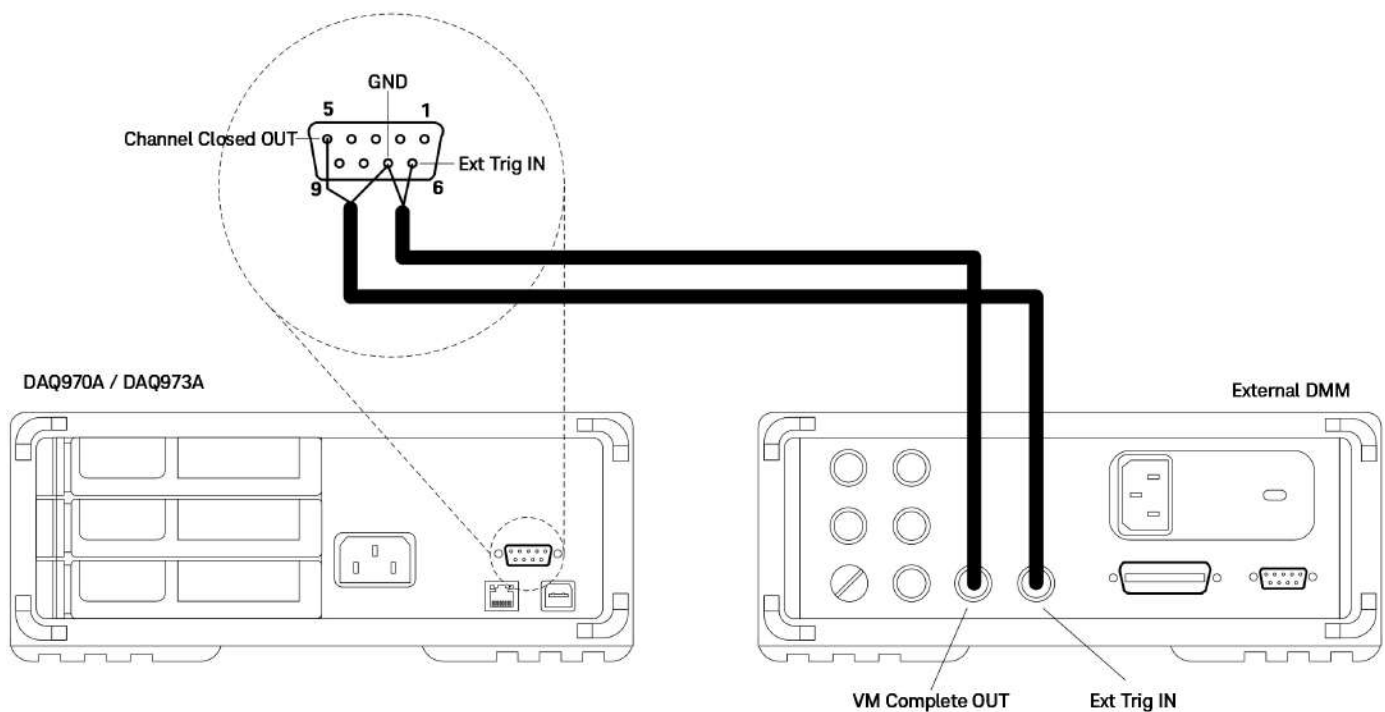
- You can manually control a scan by repeatedly pressing **[Scan/Start]** key from the front panel.
- You can start a scan by sending a software command from the remote interface.
- You can start a scan when an external TTL-compatible trigger pulse is received.
- You can start a scan when an alarm condition is logged on the channel being monitored.

## Scanning with External Instruments

You can use the DAQ970A/DAQ973A for signal routing or control applications. If you install a multiplexer plug-in module, you can use the DAQ970A/DAQ973A for scanning with an external instrument. You can connect an external instrument (such as a DMM) to the multiplexer COM terminal.



To control scanning with an external instrument, two control lines are provided. When the DAQ970A/DAQ973A and the external instrument are properly configured, you can synchronize a scan sequence between the two.



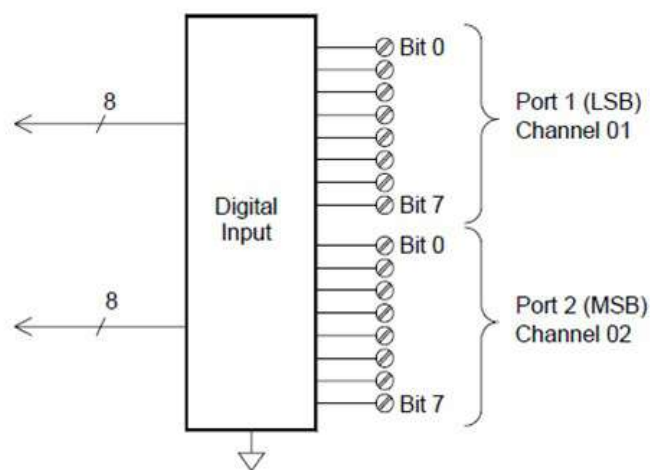
## The Multifunction Module

The multifunction module (DAQM907A) adds two additional measurement input capabilities to the system: digital input and event totalize.

The multifunction module also contains a dual voltage output (DAC). For more details, see [Transducers and sensors](#).

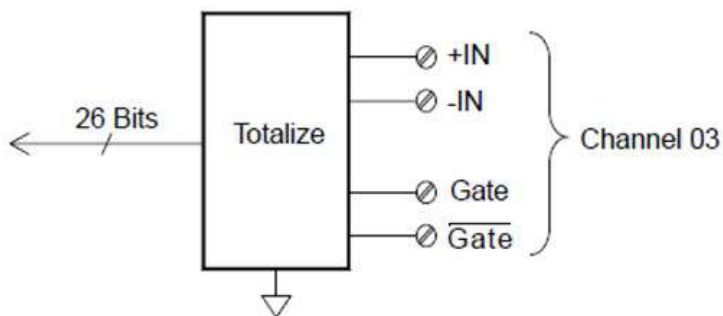
### Digital input

The multifunction module has two non-isolated 8-bit input/output ports which you can use for reading digital patterns. You can read the live status of the bits on the port or you can configure a scan to include a digital read. Each port has a separate channel number on the module and contains 8-bits. You can combine the two ports to read a 16-bit word.



### Totalizer

The multifunction module has a 26-bit totalizer which can count pulses at a 100 kHz rate. You can manually read the totalizer count or you can configure a scan to read the count.



You can configure the totalizer to count on the rising edge or falling edge of the input signal. The maximum count is 67,108,863 ( $2^{26}-1$ ). The count rolls over to "0" after reaching the maximum allowed value. You can configure the totalizer to read without affecting the count or reset the count to zero without losing any counts.

## Control Output

In addition to signal routing and measurement, you can also use the DAQ970A/DAQ973A to provide simple control outputs. For example, you can control external high-power relays using the actuator module or a digital output channel.

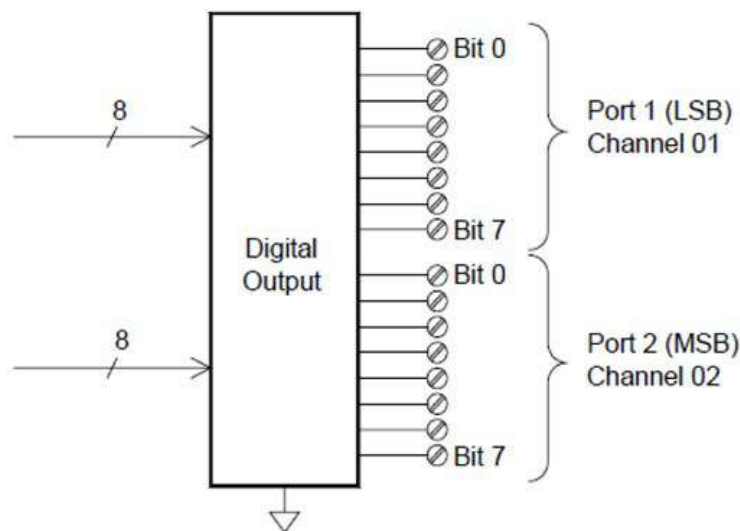
### The multifunction module

The multifunction module (DAQM907A) adds two additional control output capabilities to the system: digital output and voltage (DAC) output.

The multifunction module also contains digital input and event totalizer capabilities. For more details, see [The Multifunction Module](#).

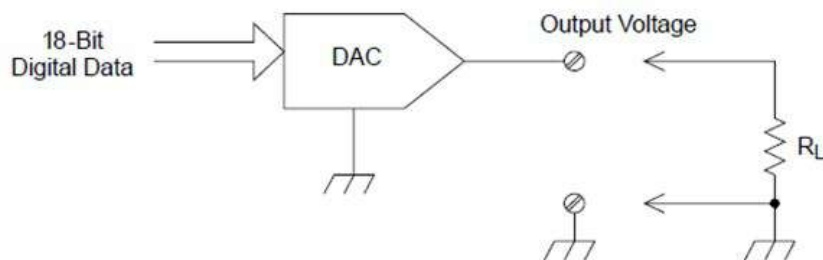
#### Digital output

The multifunction module has two non-isolated 8-bit input / output ports which you can use to output digital patterns. Each port has a separate channel number on the module and contains 8-bits. You can combine the two ports to output a 16-bit word.



#### Voltage (DAC) output

The multifunction module has two analog outputs capable of outputting calibrated voltages between  $\pm 12$  V with 18 bits of resolution. Each DAC (Digital-to-Analog Converter) channel can be used as a programmable voltage source for analog input control of other devices. A simplified diagram is shown below:



You can set the output voltage to any value between  $\pm 12$  VDC, in  $100\ \mu\text{V}$  steps. Each DAC is earth referenced, it cannot float. Each DAC channel is capable of supplying 15 mA maximum current during output voltage mode. Or you can set the DAC to constant current mode, to output any current between  $\pm 24$  mA, in  $0.2\ \mu\text{A}$  steps.

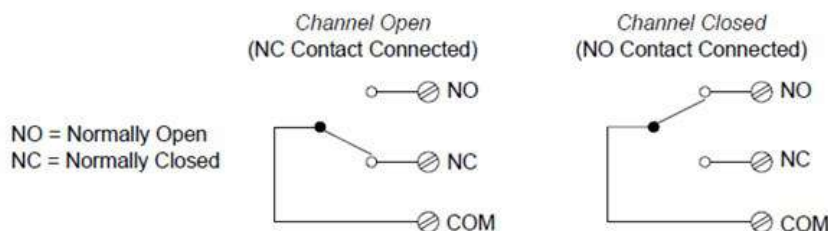
Each DAC channel is capable of supplying 24 mA maximum current.

#### NOTE

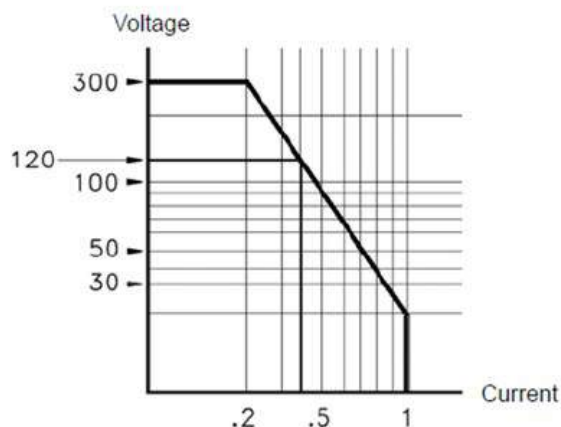
You must limit the output current to 40 mA for each slot (two DAC channels).

### The actuator/general purpose switch

You can think of the DAQM903A Actuator as a control output because it is often used to control external power devices. The actuator provides 20 independent, isolated Form C (SPDT) switches.



Each channel can switch up to 300 V DC or AC rms. Each switch can also switch up to 1 A DC or AC rms up to maximum 50 W. For example, the maximum current that you can switch at 120 V is 0.45 A as shown below:





For control applications, the actuator has the following advantages:

Higher voltage and power rating than the digital output channels. The actuator switches can also be used to control power devices.

When used with high-power devices, however, it is critical that you provide protection to the switch from capacitive and inductive loads to ensure maximum relay life.

For more information on attenuators, see [Using Attenuators](#).

## Front Panel Menu References

Table below summarizes the front panel keys and the menu structure.

| Key                                                                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <ul style="list-style-type: none"> <li>– Initiates/stops a scan/digitize process, or performs a single sweep in manual trigger mode.</li> <li>– Press once to initiate a scan/digitize; press and hold to stop the operation.</li> <li>– The key's backlight is turned on while scanning/digitizing is in progress.</li> <li>– In DMM Digitize, and Digitizer data acquisition mode, the key's backlight is also turned on while auto save is in progress</li> <li>– In Scan data acquisition mode, the instrument automatically scans the configured channels in consecutive order from slot 1 through slot 3. Channels that are not configured are skipped.</li> <li>– In DMM Digitize data acquisition mode, the instrument automatically starts the DMM digitizing operation on a single configured channel.</li> <li>– In Digitizer data acquisition mode (only supported on the DAQM909A plug-in module), the instrument automatically starts the digitizing operation for all the configured channels simultaneously.</li> </ul> |
|  | <ul style="list-style-type: none"> <li>– Monitors a channel's measurement data that is useful for troubleshooting the instrument and observing an important signal.</li> <li>– You can select to view the monitor measurements in number, bar meter, trend chart, and histogram format.</li> <li>– The key's backlight is turned on while monitoring is enabled. The monitor annunciator will also be displayed, and the sample annunciator will flash when monitoring is made. In the event the Digitizer data acquisition mode is enabled, the key's backlight will be turned off but the annunciator will continue to be displayed on screen indicating that the monitor operation is still running in the background.</li> <li>– To stop the monitoring mode and return to Home menu page, press this key again on the Monitor menu page.</li> </ul>                                                                                                                                                                                |
|  | <ul style="list-style-type: none"> <li>– Brings up the Home page that displays the instrument information and a list of help topics the in selected local language.</li> <li>– Selects the data acquisition mode to be used (Scan, DMM Digitize, or Digitizer).</li> <li>– Measures the offset on strain channels.</li> <li>– Configures the four alarm output hardware lines.</li> <li>– Configures various user preferences.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|  | <ul style="list-style-type: none"> <li>– Views scanned memory readings.</li> <li>– View digitized readings.</li> <li>– Views alarm queue.</li> <li>– Views error queue.</li> <li>– Performs and views power analysis.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                     | <ul style="list-style-type: none"> <li>– Channel labeling.</li> <li>– Closes or opens switches on switching channels.</li> <li>– Selects measurement function.</li> <li>– Selects measurement range or autorange.</li> <li>– Selects the integration time.</li> <li>– Configures advanced measurement features.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <ul style="list-style-type: none"> <li>– Configures what starts each sweep, or the interval between sweeps, and the number of sweeps during the scan.</li> <li>– Configures the sample timer, sample count and trigger settings for the digitizer.</li> </ul>                                                                                                                                                                                                                                                                                                                 |
| <b>Math</b>    | <ul style="list-style-type: none"> <li>– Configures the measurement scaling (mX+b, %, dBm, or dB) on the current channel.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Copy</b>    | <ul style="list-style-type: none"> <li>– Copies the measurement configuration from the selected channel(s) to other channel(s).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Alarm</b>   | <ul style="list-style-type: none"> <li>– Configures alarm on the selected channel. There are four configurable alarms in this instrument.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Utility</b> | <ul style="list-style-type: none"> <li>– Self-test.</li> <li>– Calibration.</li> <li>– Autocalibration. Instrument security (NISPOM).</li> <li>– Firmware update.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                  |
|                | <ul style="list-style-type: none"> <li>– Overview of the scan list for the module.</li> <li>– Performs a module reset.</li> <li>– Module labeling.</li> <li>– Views information on the internal DMM.</li> <li>– Views information on modules' relay cycle.</li> </ul>                                                                                                                                                                                                                                                                                                         |
|                | <ul style="list-style-type: none"> <li>– Saves and recalls instrument state files (.sta extension) and preference files (.prf extension).</li> <li>– File management.</li> <li>– Saves the readings from trend chart or histogram.</li> <li>– Captures and saves the screen image.</li> <li>– Instrument factory reset and system preset.</li> <li>– Data logging to a USB drive on the front panel.</li> <li>– Auto save digitizer data to a USB drive on the front panel.</li> <li>– Returns the instrument into local control when the instrument is in remote.</li> </ul> |

## [Scan/Start] Key

Press the **[Scan/Start]** key on the front panel to initiate any scanning or digitizing operations, or to perform a single sweep/record when operating in manual trigger mode. See the **[Interval] Menu** for more information on how the **[Scan/Start]** key is used when the manual trigger mode is selected.

The **[Scan/Start]** key's backlight is turned on while scanning/digitizing is in progress. To stop the scan or digitizer operation, press and hold the **[Scan/Start]** key for more than 2 seconds. In Scan data acquisition mode, "Scan stopped" is shown when the operation is terminated. Likewise, in DMM Digitize and Digitizer data acquisition mode, "DMM Digitize stopped" and "Digitizer stopped" will be shown respectively when the operation is terminated.

### NOTE

When the Auto Save feature in the **[Save Recall]** menu is turned on for DMM Digitize/Digitizer data acquisition mode, the digitizing operation will not begin unless the instrument detects a USB drive connected to the USB port at the front panel.

---

## [Monitor] Menu

### NOTE

The [Monitor] menu features are not available for **Digitizer** data acquisition mode.

In **Scan/DMM Digitize** mode, you can monitor the measurement data on a selected channel by pressing the **[Monitor]** key. The key's backlight is turned on while monitoring is enabled. The monitor annunciator will also be displayed, and the sample annunciator will flash when monitor measurements are made.

In **Scan** mode, you can view the monitor data for all channels, except for computed channels (channels 401 through 420). Monitoring of computed channels is only available while scanning and will only display the reading from the most recent sweep. You can also view monitor data on the DAQM907A digital I/O and totalizer channels even if they are not in the scan list.

Monitor measurements are made repetitively when scanning is idle or between sweeps of a scan. To stop the monitoring mode and return to the Home menu page, press the **[Monitor]** key again on the Monitor menu page.

In **DMM Digitize** mode, you can only view the monitoring data of the single channel that is configured for **DMM Digitize**. The data will only be displayed as a number and its related Minimum, Maximum, and Peak to Peak data if the **Peak On/Off** softkey is toggled to **On**.

However in **Scan** mode, you may choose to display the monitoring data in the following formats: **Number**, **Bar Meter**, **Trend Chart**, or **Histogram**. To configure, press **Display** softkey to select your desired display mode. The example of the softkeys is shown below.



Number

Displays readings as a number

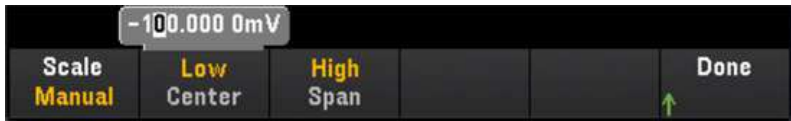


| Softkey                                                                                                      | Description                                                                                                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Peak On/Off                                                                                                  | Press the <b>Peak</b> softkey to toggle between enabling ( <b>On</b> ) or disabling ( <b>Off</b> ) the measurement of the Minimum, Maximum, and Peak to Peak values acquired within the measurement aperture.                                                                                         |
| Clear Peaks                                                                                                  | Press the <b>Clear Peaks</b> softkey to reset the reading of peak values. This is done by clearing the accumulated history of peak-to-peak function.                                                                                                                                                  |
| <div>NOTE</div> <div>The Clear Peaks softkey will only be displayed when Peak is set to On.</div>            |                                                                                                                                                                                                                                                                                                       |
| Clear Mon Data                                                                                               | Press the <b>Clear Mon Data</b> softkey to clear the statistics, trend chart, and histogram on the monitor channel.                                                                                                                                                                                   |
| <div>NOTE</div> <div>The Clear Mon Data softkey will only be displayed when Statistics is set to Show.</div> |                                                                                                                                                                                                                                                                                                       |
| Statistics Hide/Show                                                                                         | Press the <b>Statistics</b> softkey to toggle between <b>Hide</b> or <b>Show</b> the measurement statistics for the monitor channel. Monitor channel statistics are cleared when monitor mode is turned on, when the monitor channel changes, or when the monitor channel's configuration is changed. |

## Bar Meter

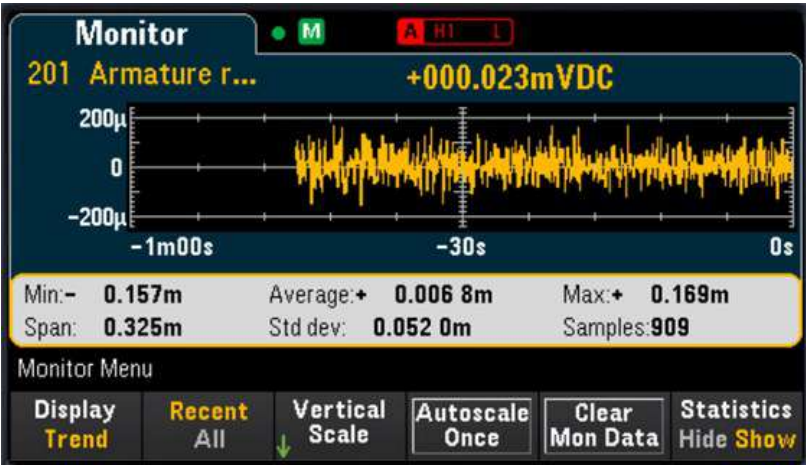
The bar meter adds a moving bar below the standard Number display.

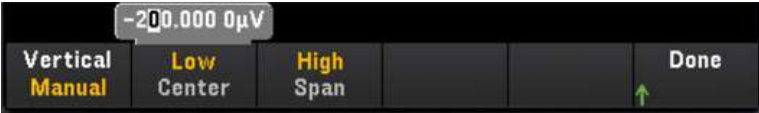


| Softkey              | Description                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scale                | Default                                                                                                                                                                                                                                                                                               | <b>Default</b> sets the scale to the measurement range.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                      | Manual                                                                                                                                                                                                                                                                                                |  <p><b>Manual</b> allows you to configure the scale either as <b>High</b> and <b>Low</b> values or as a <b>Span</b> around a <b>Center</b> value. For example, a scale that goes from a <b>Low</b> of -500 <math>\Omega</math> to a <b>High</b> of 1000 <math>\Omega</math> could also be specified as a <b>Center</b> of 250 <math>\Omega</math> with a <b>Span</b> of 1500 <math>\Omega</math>.</p> |
|                      | Limits                                                                                                                                                                                                                                                                                                | <p><b>Limits</b> set the scale to the alarm limits.</p> <div> <div>NOTE</div> <div>This softkey is only available when you configure alarm on the selected channel by pressing the [Alarm] key on the front panel.</div> </div>                                                                                                                                                                                                                                                         |
| Peak On/Off          | Press the <b>Peak</b> softkey to toggle between enabling ( <b>On</b> ) or disabling ( <b>Off</b> ) the measurement of the Minimum, Maximum, and Peak to Peak values acquired within the measurement aperture.                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Clear Peaks          | Press the <b>Clear Peaks</b> softkey to reset the reading of peak values. This is done by clearing the accumulated history of peak-to-peak function.                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                      | <div> <div>NOTE</div> <div>The Clear Peaks softkey will only be displayed when Peak is set to On.</div> </div>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Clear Mon Data       | Press the <b>Clear Mon Data</b> softkey to clear the statistics, trend chart, and histogram on the monitor channel.                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                      | <div> <div>NOTE</div> <div>The Clear Mon Data softkey will only be displayed when Statistics is set to Show.</div> </div>                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Statistics Hide/Show | Press the <b>Statistics</b> softkey to toggle between <b>Hide</b> or <b>Show</b> the measurement statistics for the monitor channel. Monitor channel statistics are cleared when monitor mode is turned on, when the monitor channel changes, or when the monitor channel's configuration is changed. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

Trend Chart

In the Continuous measurement mode, the trend chart shows data trends over time. Data is collected and displayed in pixel columns as described below:

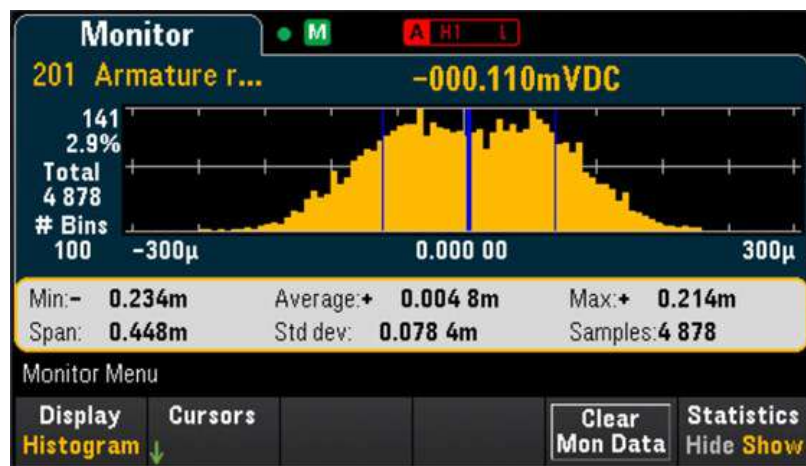


| Softkey              |                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Recent/All           | Recent/All           | The <b>Recent/All</b> softkey specifies whether all measurements ( <b>All</b> ) or only the most recent measurements ( <b>Recent</b> ) are shown on the trend chart. Neither selection clears reading memory. In <b>All</b> mode, the trend chart displays all readings being taken and builds from left to right. After the display is filled, the data becomes compressed on the left side of the display as new data is added on the right side of the display. In <b>Recent</b> mode, the trend chart displays data taken during a specified amount of time. |
|                      | Vertical Scale       | Default sets the scale to the measurement range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                      | Auto                 | Auto automatically adjusts the scale to appropriately fit the line currently shown on the screen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                      | Manual               | <div></div> <p>Manual allows you to configure the scale either as High and Low values or as a Span around a Center value. For example, a scale from a Low of 0 V to a High of 5 V is equivalent to a Center of 2.5 V and a Span of 5 V.</p>                                                                                                                                                                                                                                  |
| Limits               | Limits               | Limits set the scale to the alarm limits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                      |                      | <div><div>NOTE</div><p>This softkey is only available when you configure alarm on the selected channel by pressing the <b>[Alarm]</b> key on the front panel.</p></div>                                                                                                                                                                                                                                                                                                                                                                                          |
| Autoscale Once       | Autoscale Once       | Press <b>Autoscale Once</b> softkey to automatically scale the trend chart's vertical axis one time based on the scanned memory readings shown on the screen. This also sets the <b>Vertical Scale</b> mode to <b>Manual</b> .                                                                                                                                                                                                                                                                                                                                   |
| Clear Mon Data       | Clear Mon Data       | Press the <b>Clear Mon Data</b> softkey to clear the statistics, trend chart, and histogram on the monitor channel.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                      |                      | <div><div>NOTE</div><p>The <b>Clear Mon Data</b> softkey will only be displayed when <b>Statistics</b> is set to <b>Show</b>.</p></div>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Statistics Hide/Show | Statistics Hide/Show | Press the <b>Statistics</b> softkey to toggle between <b>Hide</b> or <b>Show</b> the measurement statistics for the monitor channel. Monitor channel statistics are cleared when monitor mode is turned on, when the monitor channel changes, or when the monitor channel's configuration is changed.                                                                                                                                                                                                                                                            |



## Histogram

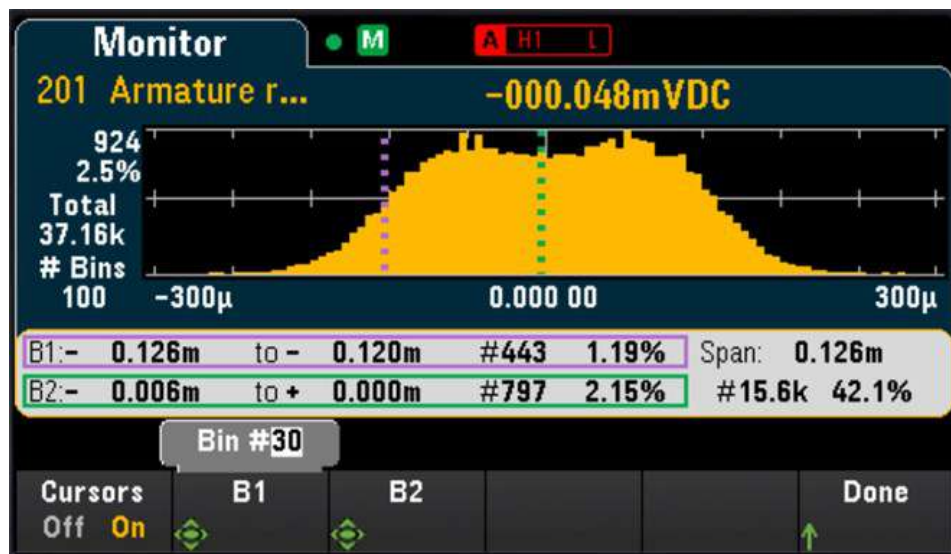
The histogram shows measurement data as a graphical representation of the distribution of measurement data. Data is grouped in bins represented by vertical bars in the histogram display.



| Softkey              |                 | Description                                                                                                                                                                                                                                                                                           |
|----------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors              | Cursors Off/ On | Press the <b>Cursors</b> softkey to toggle between enabling (On) or disabling (Off) the histogram's cursors                                                                                                                                                                                           |
|                      | B1              | Use the knob or arrow keys to adjust the position of cursor B1 (Violet dotted vertical line).                                                                                                                                                                                                         |
|                      | B2              | Use the knob or arrow keys to adjust the position of cursor B2 (Green dotted vertical line).                                                                                                                                                                                                          |
| Clear Mon Data       |                 | Press the <b>Clear Mon Data</b> softkey to clear the statistics, trend chart, and histogram on the monitor channel.                                                                                                                                                                                   |
|                      |                 | <div style="display: flex; align-items: center;"> <div style="background-color: #cccccc; padding: 5px; margin-right: 10px;"><b>NOTE</b></div> <div>The Clear Mon Data softkey will only be displayed when Statistics is set to Show.</div> </div>                                                     |
| Statistics Hide/Show |                 | Press the <b>Statistics</b> softkey to toggle between <b>Hide</b> or <b>Show</b> the measurement statistics for the monitor channel. Monitor channel statistics are cleared when monitor mode is turned on, when the monitor channel changes, or when the monitor channel's configuration is changed. |

Cursors in the histogram are specified as bin numbers and display the range of values covered by those bins, the count and the percentage of the total. The total count and percentage of total, as well as the measurement range covered, between the cursor bins, are also displayed.

In the example below, cursor B1 (violet vertical lines) is positioned on bin number 30 and cursor B2 (green vertical lines) is positioned on bin number 50 (bin number shown above the B2 softkey). The bin information for cursor B1 is shown in the violet box and the bin information for cursor B2 is shown in the green box.



Based on the example above, the information for cursor B1 can be interpreted as follows:

- 0.126m to 0.120m - Range of DCV measurement values for this bin.
- #443 - Number of samples in this bin.
- 1.19% - Percentage of the total number of samples in this bin.

The data between the B1 and B2 cursors, including the data in the B1 and B2 bins, is shown to the right of the violet and green boxes. In the graphic above:

- Span: 0.126m - The measurement range covered from B1 to B2.
- #15.6k - The number of samples from B1 to B2.
- 42.1% - The percentage of the total number of samples from B1 to B2.

## [Home] Menu

Press the **[Home]** key to access the instrument's **Home** page. On the **Home** page, an overview of the instrument's current status and operation will be displayed on the main screen. In the **Home** menu, you will also be able to access the instrument's help topics here and configure various settings such the instrument's acquire mode, strain offset, alarm output hardware lines, and user's preferences.

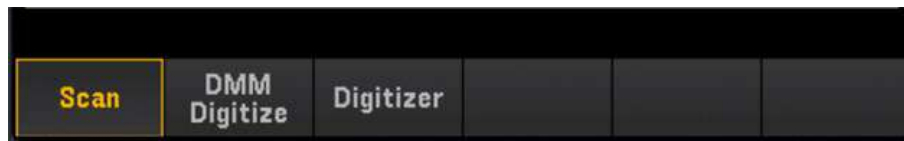
### NOTE

The instrument will return to the Home menu page when monitoring mode is stopped.



## Data acquisition mode

Press the **Acquire** softkey to select a data acquisition mode.



| Softkey | Description  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acquire | Scan         | The instrument continuously scans through all configured channels and performs measurements.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|         | DMM Digitize | The instrument digitizes the signals of a single configured channel using the internal DMM.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|         | Digitizer    | The instrument digitizes up to 4 configured digitizer channels simultaneously for each DAQM909A plug-in module inserted in the instrument using the DAQM909A's onboard digitizers. In other words, a maximum of 12 configured channels can be digitize simultaneously when the DAQ970A/DAQ973A is installed with 3 DAQM909A plug-in modules. It can also operate in parallel to a <b>Scan</b> or <b>DMM Digitize</b> data acquisition operation as it utilizes the DAQM909A's onboard digitizers instead of the instrument's internal DMM. |

### NOTE

The **Digitizer** softkey will only be available when the DAQM909A module is inserted into the mainframe.

## Strain offset

### NOTE

This softkey is only available after you configured the channel for strain measurements by pressing **[Channel]** > **Measure**, and select **STRAIN** with DAQM900A, DAQM901A, DAQM902A, DAQM908A, and DAQM909A modules. See **Strain** for details.



Strain offset is also known as the unstrained value. You can select one or more channels on which you want to measure the offset value. The strain formula will automatically use this offset value when calculating the measurement result.



To configure the strain offset:

1. Use the knob or the front panel arrow keys to navigate across the list and press the **Select** softkey to enable the strain offset measurement on the highlighted channel. The selected channel is marked with an "X". Press the **Select** softkey again to disable the offset measurement on the highlighted channel. Note that upon pressing this softkey will also enable the **Measure Now** and **Clear Offsets** softkeys.

| Unstrained |                                |         |       |
|------------|--------------------------------|---------|-------|
| Check      | Channel                        | Offset  | Units |
| [x]        | 101 Armature relay MUX Channel | +0.0000 | mVDC  |
|            | 102 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +0.0000 | mVDC  |
|            | 104 Armature relay MUX Channel | +0.0000 | mVDC  |

2. Press **Select All** to enable the offset measurement on all listed channels. Press this softkey again to disable the offset measurement on all listed channels.

| Unstrained |                                |         |       |
|------------|--------------------------------|---------|-------|
| Check      | Channel                        | Offset  | Units |
| [x]        | 101 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 102 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 104 Armature relay MUX Channel | +0.0000 | mVDC  |

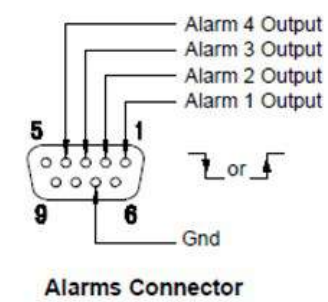
3. Press **Measure Now** to immediately measures the offset value on the selected channel(s). Offset readings will display on the screen as shown below:

| Unstrained |                                |           |       |
|------------|--------------------------------|-----------|-------|
| Check      | Channel                        | Offset    | Units |
| [x]        | 101 Armature relay MUX Channel | +827.0444 | mVDC  |
| [x]        | 102 Armature relay MUX Channel | +826.7458 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +825.8469 | mVDC  |
| [x]        | 104 Armature relay MUX Channel | +822.6777 | mVDC  |

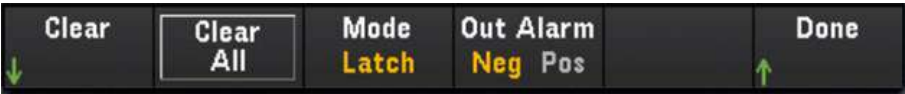
4. Press **Clear Offsets** softkey if you would like to immediately clear the strain offset value to 0 on the selected channel(s).

Alarm output

Configures the four alarm output hardware lines. Four TTL-compatible alarm outputs are available on the rear panel Ext Trig/Alarms connector. You can use these hardware outputs to trigger external alarm lights, sirens, or send a TTL-compatible pulse to your control system. You can assign an alarm to any configured channel and multiple channels can be assigned to the same alarm number. Each alarm output line represents the logical "OR" of all channels assigned to that alarm number (an alarm on any of the associated channels will pulse the line).



Press the **Alarm Out** softkey to configure the output alarm.



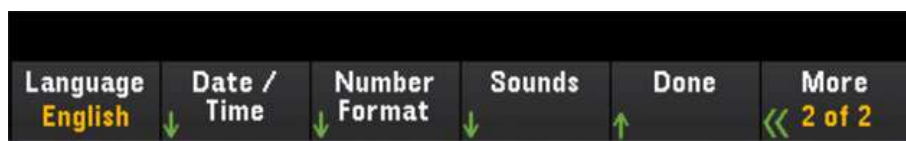
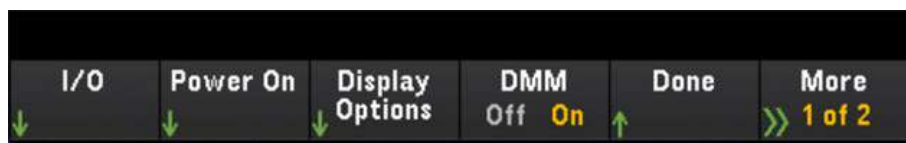
| Softkey   |         | Description                                                                                                                                                                                                                         |
|-----------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clear     | Alarm 1 | Clears the state of a specified alarm output line (Alarms 1 through 4).                                                                                                                                                             |
|           | Alarm 2 |                                                                                                                                                                                                                                     |
|           | Alarm 3 |                                                                                                                                                                                                                                     |
|           | Alarm 4 |                                                                                                                                                                                                                                     |
| Clear All |         | Clears the state of all four alarm output lines.                                                                                                                                                                                    |
| Mode      | Latch   | The alarm output is asserted when a channel's reading crosses a limit, and remains asserted until you clear it manually, start a new scan, or cycle power.                                                                          |
|           | Track   | The alarm output is asserted when a channel's reading crosses a limit, and remains asserted only while subsequent readings remain outside the limit. When a reading returns within the limits, the output is automatically cleared. |
| Out Alarm | Neg     | Configures the level for all four alarm output lines to indicate an alarm at 0 V (TTL-compatible low).                                                                                                                              |
|           | Pos     | Configures the level for all four alarm output lines to indicate an alarm at 3.3 V (TTL-compatible high).                                                                                                                           |

Help topics

Displays the instrument information and a list of help topics in the selected local language. See [Use the Built-In Help System](#) for details.

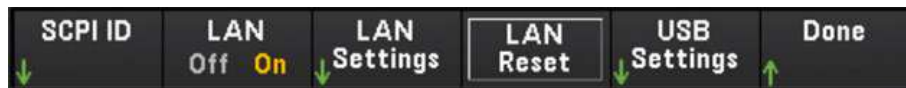
## User settings

Configures user preferences that control how the user interacts with the instrument. These settings are saved in non-volatile memory and can be saved in a preferences (.prf) file.



### I/O

Configures the I/O parameters for remote operations over the LAN and USB interfaces.



| Softkey     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCPI ID     | <p>SCPI ID determines the manufacturer and model number returned by identification query (*IDN? command). The serial number and version information are unaffected. Use this setting to avoid changing existing test system code where the manufacturer or model number are verified and to maximize backwards compatibility with the Keysight 34970A and 34972A. The default settings return "Keysight Technologies" followed by the model number "DAQ970A". For more information, see the *IDN? and SYSTem:PERSonA Subsystem commands in the <i>Keysight DAQ970A/DAQ973A Programming Guide</i>.</p> <p><b>Important:</b> In order to update the instrument firmware from remote, the model number in the *IDN? response must match the actual instrument model number. If you have changed the instrument's *IDN? response to another instrument, when attempting to update the firmware from remote, you will see this error: The instrument is not supported by this firmware file. To update the firmware, either update using the front panel procedure or, from remote, use SYSTem:PERSonA:MODEL to set the *IDN? to match the actual model number, update the firmware, and then use SYSTem:PERSonA:MODEL again to set the *IDN? response to the other model number.</p> |
| LAN On/Off  | Refer to <a href="#">Enable or disable LAN interface</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| LAN Setting | Refer to <a href="#">LAN Settings</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| LAN Reset   | Refer to <a href="#">LAN Reset</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| USB Setting | Refer to <a href="#">USB Settings</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



Power On

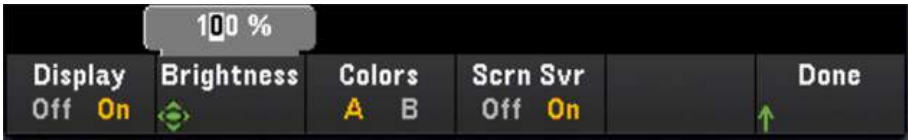
Configures the instrument's power-on state and power-on message.



| Softkey          | Description                                                                                                                                                                                                                                                                                                                                                                     |                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Power On         | Last                                                                                                                                                                                                                                                                                                                                                                            | At power up, the instrument loads the previous state it was in during power down. |
|                  | User Defined                                                                                                                                                                                                                                                                                                                                                                    | At power up, the instrument loads up a user-selected state file.                  |
|                  | Factory Defaults                                                                                                                                                                                                                                                                                                                                                                | At power up, the instrument loads up the factory default state.                   |
| Power On Message | <b>Power On Message</b> sets a message that is displayed when the instrument powers up and when you press [Home] > Help > About. Use the knob or the front panel arrow keys and [Select] key to select the letters. Then press <b>Done</b> to exit and save the message. The message will appear as shown below when you turn the instrument on or press [Home] > Help > About. |                                                                                   |

Display Options

Configures the instrument's display.



You can enable or disable the display, adjust the brightness (10 to 100%), pick a color scheme, and enable or disable the screen saver. If you turn off the display, press any front panel key to turn it on again. By default, the screen saver increases display life by dimming the display during long periods of inactivity. You may disable this screen saver from the front panel only. The display is enabled when power is cycled, after an instrument reset (\*RST), or when you return to local (front panel) operation. Press the [Local] key ([Save Recall] key) to return to the local state.

DMM On/Off

Enables or disables the internal DMM. The  annunciator will display when internal DMM is disabled. Once disabled, the DMM Digitize option will not be available when selecting the data acquisition mode.

Language

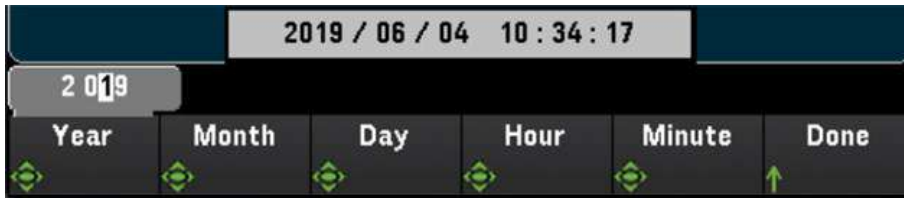
Selects the local language for front panel use.

All messages, context-sensitive help, and help topics appear in the selected language. The menu softkey labels are not translated.



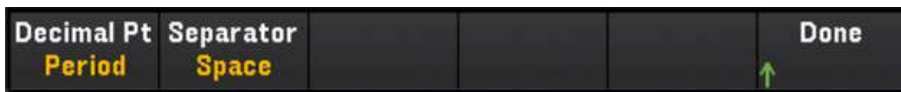
## Date/Time

Sets the date and time of the real-time clock in 24-hour format. The real-time clock does not automatically adjust for time zone changes or daylight savings time. Be sure to set the date and time when you first receive your instrument. Use the knob or the front panel arrow keys to set the year, month, day, hour, and minute.



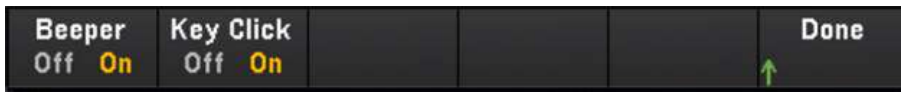
## Number Format

Number Format specifies how numbers are displayed on the front panel: 12,345.6 or 12.345,6. Other possibilities also exist. For example, you can use the space as a separator.



## Sounds

Enables or disables the tone heard associated when an error is generated from the front panel or remote interface (Beeper), or the click heard when keys are pressed (Key Click).



## [View] Menu

Press **[View]** on the front panel to view the scanned memory readings, digitized readings, alarm queue, or error queue. In the View menu, you can also perform various post processing measurements as well as power analysis on the digitized readings.

### NOTE

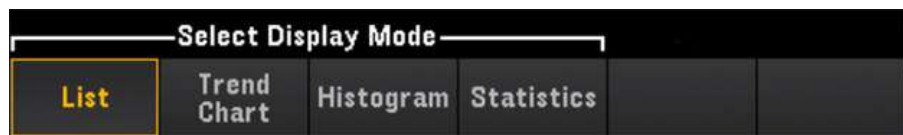
The options within the **[View]** menu will vary depending on the selected data acquisition mode in the **[Home]** menu (**[Home]** > **Acquire** > **Scan**, **DMM Digitize**, or **Digitizer**).

### [View] Menu in Scan mode



### Selecting the display mode

Press the **Display** softkey to select a display mode.



### List

Displays the scanned memory readings in list format. Use the knob and arrow keys to scroll across the readings in different pages.

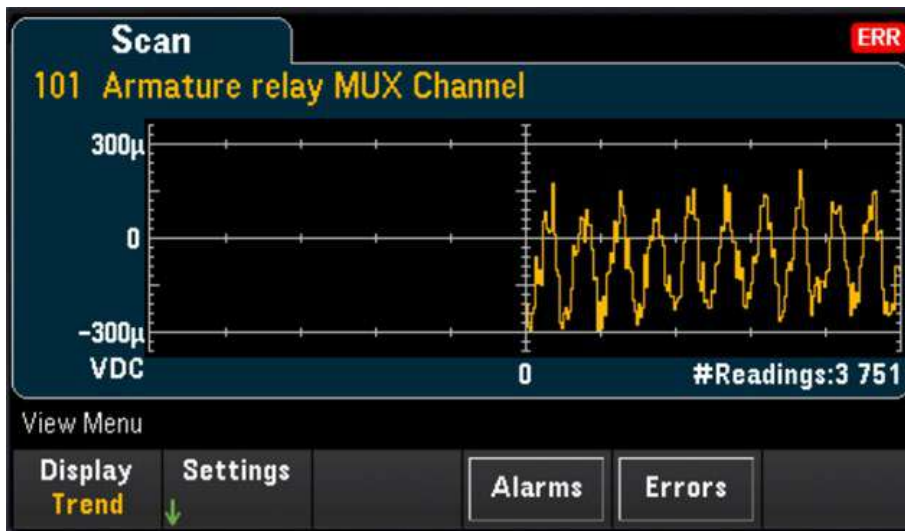
The image shows a screenshot of the 'Scan Memory' list display. The title 'Scan Memory' is at the top left. Below it is a table with four columns: 'Date', 'Time', 'Channel', and 'Reading'. The table contains eight rows of data. At the bottom of the screen, there is a 'View Menu' bar with buttons 'Display List' (highlighted with a green arrow), 'Browse', 'Alarms', and 'Errors'. To the right of the 'View Menu' bar, it says 'Current Page: 1/292'.

| Date      | Time         | Channel                  | Reading        |
|-----------|--------------|--------------------------|----------------|
| 6/10/2019 | 16:07:11.557 | 101 Armature relay MU... | -9.409 mVDC    |
| 6/10/2019 | 16:07:11.598 | 101 Armature relay MU... | -180 $\mu$ VDC |
| 6/10/2019 | 16:07:11.639 | 101 Armature relay MU... | -102 $\mu$ VDC |
| 6/10/2019 | 16:07:11.680 | 101 Armature relay MU... | -109 $\mu$ VDC |
| 6/10/2019 | 16:07:11.721 | 101 Armature relay MU... | -160 $\mu$ VDC |
| 6/10/2019 | 16:07:11.762 | 101 Armature relay MU... | -294 $\mu$ VDC |
| 6/10/2019 | 16:07:11.803 | 101 Armature relay MU... | -234 $\mu$ VDC |
| 6/10/2019 | 16:07:11.844 | 101 Armature relay MU... | -249 $\mu$ VDC |

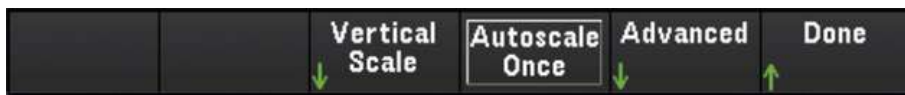
| Softkey | Description |                                                                                               |
|---------|-------------|-----------------------------------------------------------------------------------------------|
| Browse  | First Page  | Press the <b>First Page</b> softkey and the display will return the scan list back to Page 1. |
|         | Last Sweep  | Press the <b>Last Sweep</b> softkey and the readings from the most recent sweep.              |

### Trend Chart

Displays the scanned memory readings in trend chart format. Use the knob and arrow keys to scroll across the readings



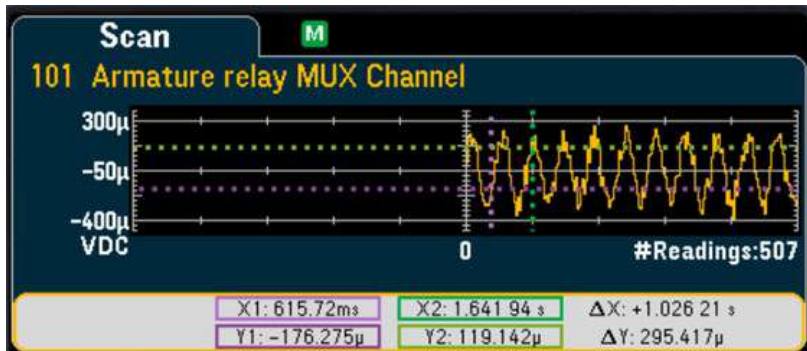
To configure the trend chart, press the **Settings** softkey to bring up the trend chart settings menu.



| Softkey        | Description                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vertical Scale | Default                                                                                                                                                                                                                        | Default sets the scale to the measurement range.                                                                                                                                                                                                                                               |
|                | Auto                                                                                                                                                                                                                           | Auto automatically adjusts the scale to appropriately fit the line currently shown on the screen.                                                                                                                                                                                              |
|                | Manual                                                                                                                                                                                                                         | <div> </div> <p>Manual allows you to configure the scale either as High and Low values or as a Span around a Center value. For example, a scale from a Low of 0 V to a High of 5 V is equivalent to a Center of 2.5 V and a Span of 5 V.</p> |
| Autoscale Once | Press <b>Autoscale Once</b> softkey to automatically scale the trend chart's vertical axis one time based on the scanned memory readings shown on the screen. This also sets the <b>Vertical Scale</b> mode to <b>Manual</b> . |                                                                                                                                                                                                                                                                                                |

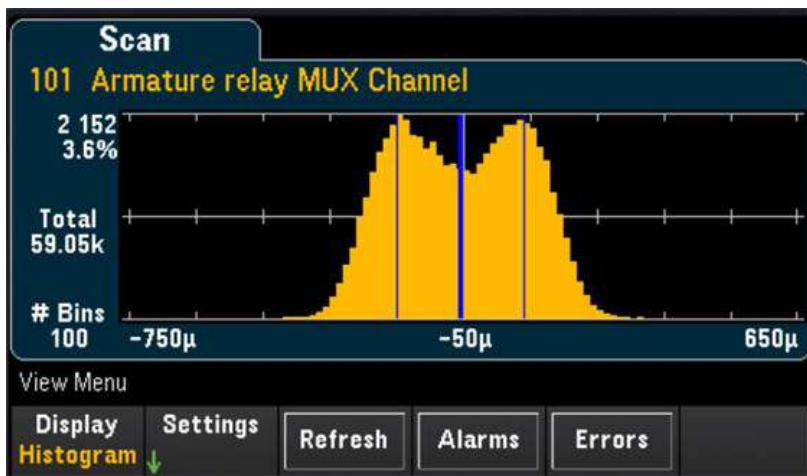
|          |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advanced | Pan       | <p>Press the <b>Pan</b> softkey to pan and select which reading in memory is displayed at the center of the screen. Press and release an arrow key to move the cursor by one display pixel. Hold down an arrow key to move the cursor in 20-display pixel increments.</p> <div> <div>NOTE</div> <p>The number of data displayed pixel will vary depending on the zoom level.</p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|          | Zoom      | <p>Press the <b>Zoom</b> softkey and use the knob or the up/down arrow keys to select the amount of zoom, in percent. You can configure the zoom percentage of the trend chart at 0.02%, 0.05%, 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 50%, 100%, 200%, 500%, or 1000%.</p> <div> <div>NOTE</div> <p>To pan one reading at a time, set the zoom level to 1000%. After selecting a reading of your interest, you can then decrease the zoom level, if necessary, to view the surrounding signal.</p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|          | Cursors   | <p>Display and control X1, X2, Y1, Y2, and tracking cursors (shown as lines) on the trend chart. X cursors are vertical lines along the sample or time axis and Y cursors are horizontal lines along the measurement (magnitude) axis in units of the selected measurement.</p> <div>  </div> <ul style="list-style-type: none"> <li>– Press the <b>Off</b> softkey to disable the cursors displayed.</li> <li>– Press the <b>X Only</b> softkey to display the X1 and X2 cursors. Press the <b>X1</b>, or <b>X2</b> softkeys and use the knob or arrow keys to adjust the cursor position along the X axis (time). To keep X1 and X2 cursors at a fixed distance from each other, press the <b>ΔX Lock</b> softkey to toggle it to On. The values of each point and the delta between the two points are displayed below the trend chart.</li> <li>– Press the <b>Y Only</b> softkey to display the Y1 and Y2 cursors. Press the <b>Y1</b>, or <b>Y2</b> softkeys and use the knob or arrow keys to adjust the cursor position along the Y axis (magnitude). To keep Y1 and Y2 cursors at a fixed distance from each other, press the <b>ΔY Lock</b> softkey to toggle it to On. To set the Y1 or Y2 cursor to a value that puts it into view on the trend chart, press the <b>Y1</b>, or <b>Y2</b> softkey followed by the <b>Place Yn on Screen</b> softkey. The values of each point and the delta between the two points are displayed below the trend chart.</li> <li>– Press the <b>X and Y</b> softkey to display all the X and Y cursors on the trend chart. Press the <b>X1</b>, <b>X2</b>, <b>Y1</b>, or <b>Y2</b> softkeys and use the knob or arrow keys to adjust the cursor position along their respective axis. The values of each point and the delta between the two points are displayed below the trend chart.</li> <li>– Press the <b>Track Rdn at X</b> to view the time and magnitude values of any two points in the trend chart. First, select two readings using the <b>X1</b> and <b>X2</b> softkeys to position cursors X1 and X2 on the point of interest along the time axis. The Y1 and Y2 cursors will automatically track the position of X1 and X2 cursors respectively and display the respective magnitude axis values of the X1 and X2 cursors. The values of each point and the delta between the two points are displayed below the trend chart. You may also fixed the distance of X1 and X2 cursors by toggling the <b>ΔX Lock</b> softkey.</li> <li>– To record the X and Y data and the delta X and Y data as a screen shot, take a screen shot of the Web UI, not the front panel screen shot utility.</li> </ul> |
|          | Reset Pan | <p>Press the <b>Reset Pan</b> softkey to set the center reading to "0".</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

Below is an example of a trend chart with **Track Rdnng at X** function. The violet colored dotted lines are cursors X1,Y1 while the green colored dotted lines are cursors X2,Y2. The values of each point and the delta between the two points are displayed below the trend chart.

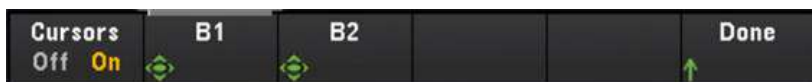


### Histogram

Displays the scanned memory readings in histogram format.



Press the **Settings** softkey to access the cursors menu.



| Softkey | Description     |                                                                                                             |
|---------|-----------------|-------------------------------------------------------------------------------------------------------------|
| Cursors | Cursors Off/ On | Press the <b>Cursors</b> softkey to toggle between enabling (On) or disabling (Off) the histogram's cursors |
|         | B1              | Use the knob or arrow keys to adjust the position of cursor B1 (Violet dotted vertical line).               |
|         | B2              | Use the knob or arrow keys to adjust the position of cursor B2 (Green dotted vertical line).                |

Press the **Refresh** softkey to recalculate the histogram which will include new readings.

## Statistics

Displays the scanned memory readings of a selected channel in statistics format (Maximum, Minimum, Peak to Peak, Average, and Standard Deviation). Toggle between **Statistics** to display the per-channel statistics and **Pk Times** to display the time of occurrence of the per-channel minimum and maximum peak readings.



The screenshot shows the 'Scan Stats' screen with a table of statistics for channel 101. The table has six columns: Ch, Max, Min, Pk-Pk, Average, and StdDev. Below the table are buttons for 'View Menu', 'Display Statistics', 'Statistics Pk Times', 'Alarms', and 'Errors'. The 'Current Page' is 1/1.

| Ch  | Max  | Min   | Pk-Pk | Average | StdDev |
|-----|------|-------|-------|---------|--------|
| 101 | 315μ | -419μ | 734μ  | -54.9μ  | 134.7μ |
|     |      |       |       |         |        |
|     |      |       |       |         |        |
|     |      |       |       |         |        |
|     |      |       |       |         |        |
|     |      |       |       |         |        |

View Menu Current Page: 1/1

Display Statistics **Statistics** Pk Times Alarms Errors

### View the alarm queue

In **View** menu page, press the **Alarms** softkey to display the first 20 alarms, including the reading and time stamp, in the alarm queue. You are only able to view this alarm queue when the alarm limit is configured on the selected channel by pressing **[Alarm]** key on the front panel. See **[Alarm] Menu** for more details.



The screenshot shows the 'Alarms' screen with a table of alarm data. The table has seven columns: Channel, Alarm, Limit, Reading, Unit, Date, and Time. Above the table are status indicators 'S' and 'A HI'. Below the table is the 'Current Page: 1/1' indicator.

| Channel | Alarm | Limit | Reading | Unit | Date      | Time         |
|---------|-------|-------|---------|------|-----------|--------------|
| 101     | 1     | High  | 30.63   | °C   | 8/14/2019 | 14:47:06.137 |
| 101     | 1     | High  | 25.55   | °C   | 8/14/2019 | 14:47:06.383 |
| 101     | 1     | High  | 25.86   | °C   | 8/14/2019 | 14:47:06.465 |
| 101     | 1     | High  | 26.56   | °C   | 8/14/2019 | 14:47:06.547 |
| 101     | 1     | High  | 27.04   | °C   | 8/14/2019 | 14:47:07.368 |
| 101     | 1     | High  | 25.16   | °C   | 8/14/2019 | 14:47:08.107 |
| 101     | 1     | High  | 25.82   | °C   | 8/14/2019 | 14:47:08.928 |
| 101     | 1     | High  | 28.94   | °C   | 8/14/2019 | 14:47:09.010 |

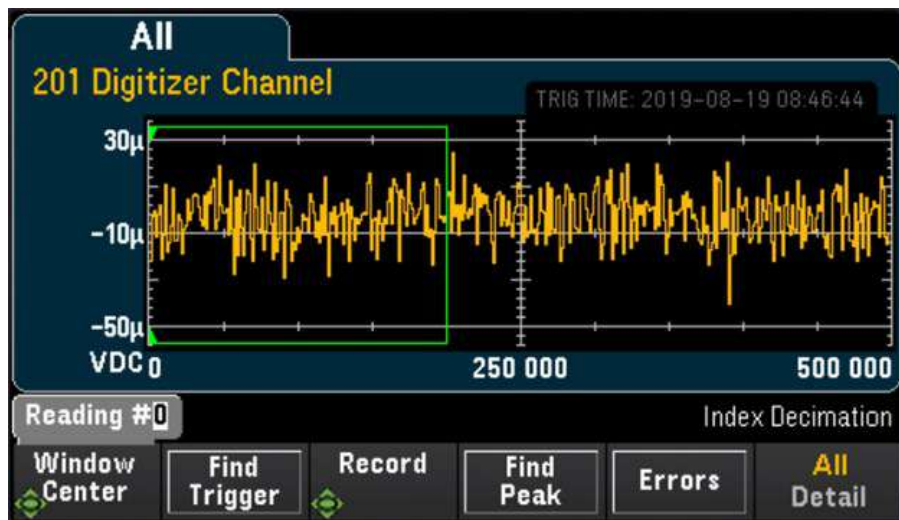
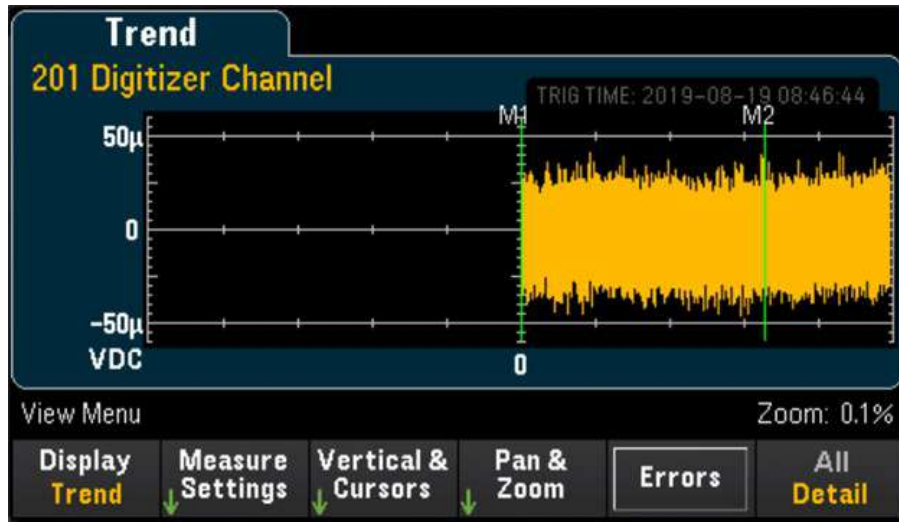
Current Page: 1/1

### View the error queue

In **View** menu page, press **Errors** to display up to the 20 errors in the error queue. Error annunciator, **ERR**, is cleared as you read them. When the front panel Error annunciator (ERR) turns on, one or more command syntax, execution, or hardware errors have been detected. A record of up to 20 errors is saved in the instrument's error queue. Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was saved. Errors are cleared as you read them. When you have read all errors from the queue, the ERR annunciator turns off and the errors are cleared. The instrument beeps once each time an error is generated. If more than 20 errors have occurred, the last error saved in the queue (the most recent error) is replaced with "Error queue overflow". No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the instrument responds with "No error".



## [View] Menu in DMM Digitize or Digitizer mode



## Selecting the display mode

Press the **Display** softkey to select either **Trend** or **Power** as the display mode.

**NOTE**

By default, only the **Trend** option will be shown. The **Power** option will only be available in the Display menu when the instrument's acquisition mode is set to **Digitizer** at the Home menu and the **Pwr. Alys** (Power Analysis) option is turned on in the Channel menu. See **Power Analysis** for more information.

## All/Detail softkey

Press the **All/Detail** softkey to toggle between how the trend graph is shown on the display.

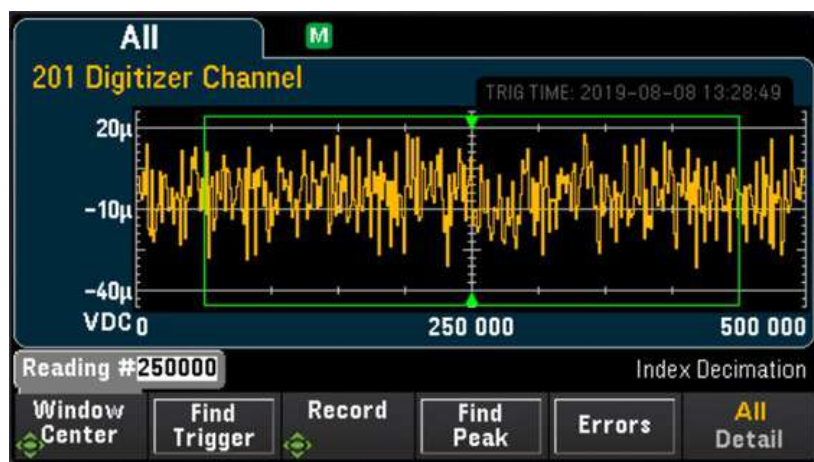
### NOTE

In **DMM Digitize** data acquisition mode, the **All/Detail** softkey will only be available when there is a minimum of 401 digitized samples.

### All view

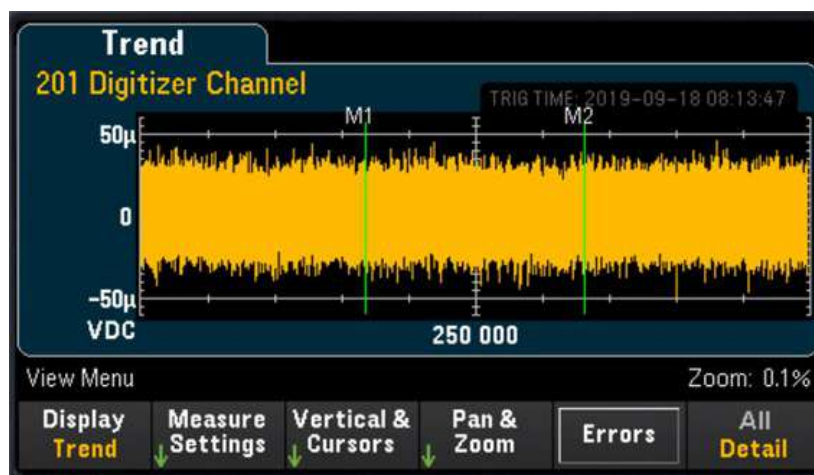
When **All** is selected, the instrument will display all the digitized samples on the screen. This allows you to have an overview of the all the digitized samples. In the **All** view, there will also be a window which you can pan across the digitized samples to select a portion of the digitized samples, up to 400,000 samples (maximum window size), to be displayed on the screen in the **Detail** view.

In the image shown below is an example where 500,000 samples were digitized and in the **All** view, all 500,000 samples are shown on the screen. The window encloses 400,000 samples (Readings #50,000 to #450,000) where the center is at reading #250,000. When you switch to **Detail** view, only readings #50,000 to #450,000 will be shown on the screen.



### Detail view

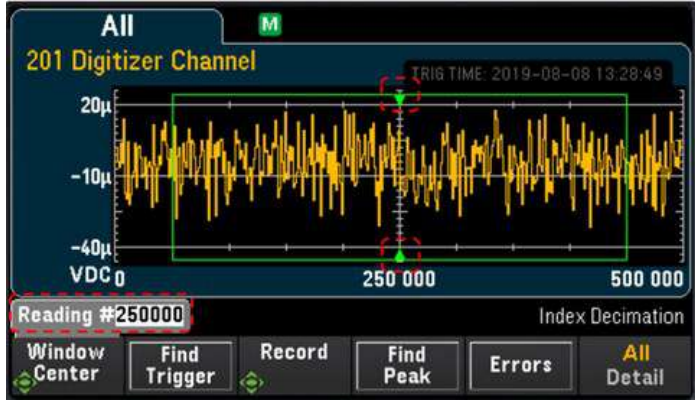
The **Detail** view helps to isolate points of interest from the entire set of digitized samples to ease the post processing of the points of interest. When **Detail** view is selected, the instrument will display up to 400,000 samples on the screen based on the samples which are within the window in the **All** view.



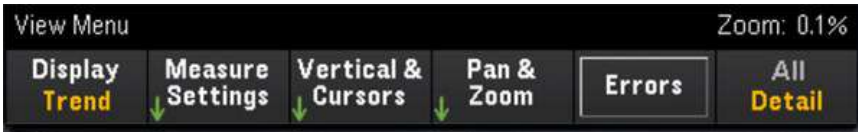


## Settings in All view



| Softkey       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Window Center | <p>Press the <b>Window Center</b> softkey and use the knob or arrow keys to shift the position of the window along the screen. The reading at the center of the window is indicated by the pointers at the top and bottom of the window and the number will be displayed above the softkey.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Find Trigger  | Press the <b>Find Trigger</b> softkey and the instrument will locate the trigger points and position the window center on the point where the trigger occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Record        | <p>Press the <b>Record</b> softkey and use the knob or arrow keys to scroll through the list of Arm events to view the set of data samples acquired from each respective Arm event number.</p> <p><b>Important:</b> If a certain Record's data is incomplete, the data of the Record will not be retrievable.</p> <ul style="list-style-type: none"> <li>– <b>Example #1:</b> The digitizer channel is configured as such - <i>Arm Count = 1, Sample Count = 1,000,000</i> and the digitizing operation is initiated. If you abort the operation before 1,000,000 samples have been acquired, all acquired data in the 1<sup>st</sup> Record prior to the abort cannot be retrieved.</li> <li>– <b>Example #2:</b> The digitizer channel is configured as such - <i>Arm Count = 3, Sample Count = 1,000,000</i> and the digitizing operation is initiated. If you abort the operation during the 3<sup>rd</sup> Record before 1,000,000 samples have been acquired, all acquired data in the 3<sup>rd</sup> Record prior to the abort cannot be retrieved. However the acquired data in the 1<sup>st</sup> and 2<sup>nd</sup> Record is still retrievable.</li> </ul> <p><b>NOTE</b> The <b>Record</b> softkey will only be available when Digitizer is selected as the data acquisition mode ([Home] &gt; Acquire &gt; Digitizer)</p> |
| Find Peak     | <p>Press the <b>Find Peak</b> softkey to perform decimation on a large set of digitized data. You may pause the decimation process by pressing the <b>Cancel</b> softkey and resume the decimation process by pressing the <b>Resume Find Pk.</b> softkey. Do note that data points that has been decimated cannot be reverted back to its original value.</p> <p>The decimation feature is useful in improving the speed of data throughput. You may digitize a large amount of data per record at a high sampling rate to ensure thorough data capture, but do not need to return all the stored values. Therefore by applying decimation, the instrument returns only the minimum and maximum of actual digitized samples from each group of samples.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Errors        | Press the <b>Errors</b> softkey to display up to the 20 errors in the error queue. The error annunciator is cleared as you read them.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

Settings in Detail view

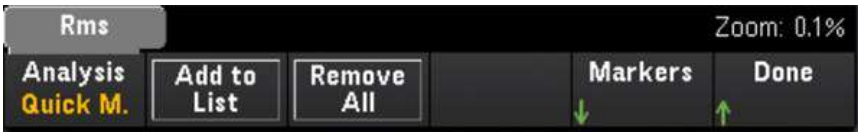


Measure Settings

Press the **Measure Settings** softkey to configure the position of markers and set the mode of data analysis.

NOTE

The **Measure Settings** softkey will only be available once a minimum of 256 samples have been digitized.



| Softkey     |            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis    | Quick M.   | <p>The Quick M. (Quick Measurement) option allows you to add up to four quick measurement modes to be displayed on the screen.</p> <p>To select quick measurement modes for analysis, press <b>Analysis &gt; Quick M.</b> Next, use the knob or the arrow keys to browse through the different options. Once you have selected your desired quick measurement option, press the <b>Add to List</b> softkey to add it into the list of quick measurement that will be displayed.</p> <p>The quick measurement options available are:</p> <ul style="list-style-type: none"><li>– Rms: Root mean square</li><li>– DCycle: Duty cycle</li><li>– PWidth: Positive width</li><li>– NWidth: Negative width</li><li>– RTime: Rising time</li><li>– FTime: Falling time</li><li>– Period</li><li>– Freq: Frequency</li></ul> |
|             | Statistics | <p>Press <b>Analysis &gt; Statistics</b> to display statistics data such as Minimum, Maximum, Average and Standard Deviation) on the screen.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Add to List |            | <p>Press the <b>Add to List</b> softkey to add the selected quick measurement mode to be displayed on the screen. You may add up to four quick measurement modes to be displayed. Do note that when you add more than four measurement modes, the most recent measurement mode will replace the first measurement mode which was added (First-in, first-out behavior).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Remove All  |            | <p>Press the <b>Remove All</b> softkey to remove all the quick measurement modes displayed on the screen.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                                                                                                                                                             |                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Display Off/On                                                                                                                                                              | Toggle the <b>Display Off/On</b> softkey to enable ( <b>On</b> ) or disable ( <b>Off</b> ) the display of the quick measurements data or statistics data. This setting will be reflected on all the other channels. |
| <div><div>NOTE</div><div>The <b>Display Off/On</b> softkey will only appear when an analysis mode (<b>Statistics</b> or a <b>Quick M.</b> option) is selected .</div></div> |                                                                                                                                                                                                                     |
| Markers                                                                                                                                                                     | Please refer to <b>Markers softkey</b> in following section for more information.                                                                                                                                   |

Markers softkey

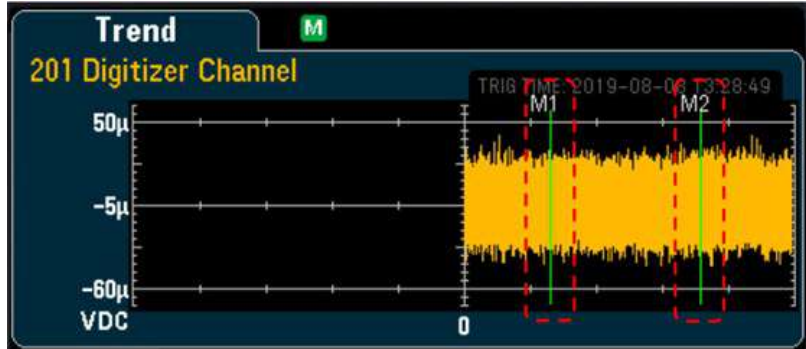
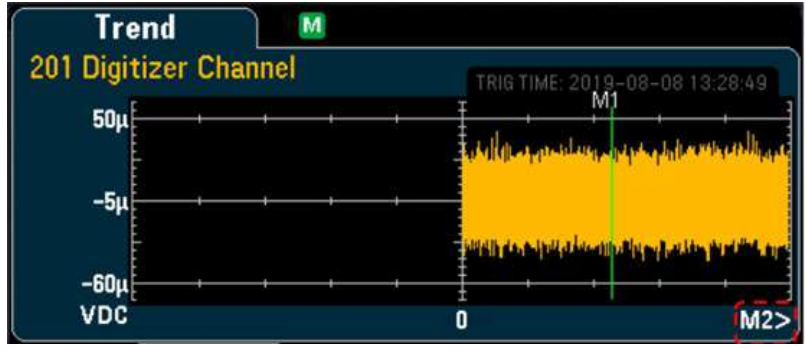
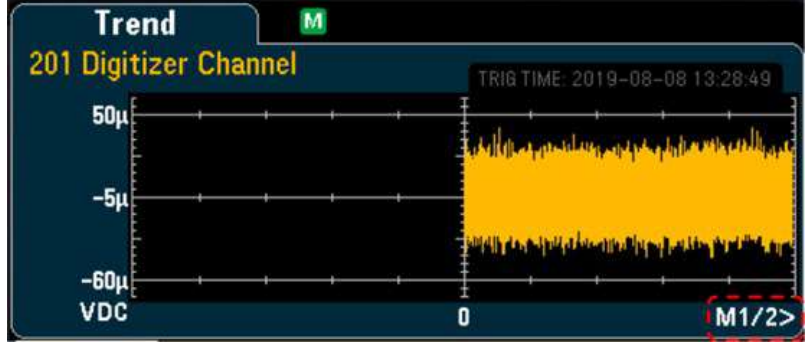
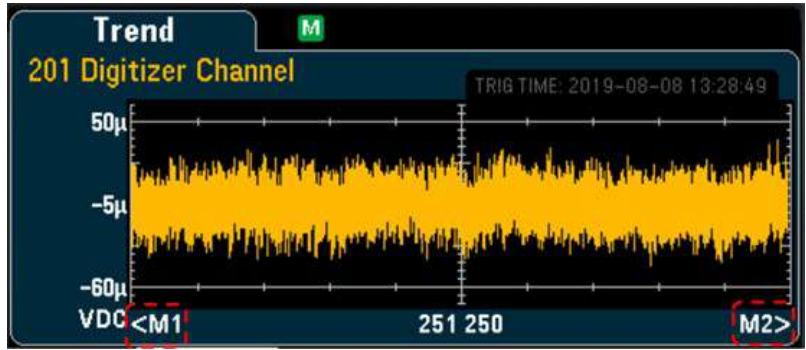


Markers determine a range of data points which are used to compute the quick measurements and statistics. In the image above, the two markers which are represented by green vertical lines and labeled M1 and M2 respectively.

|      |                                                                            |
|------|----------------------------------------------------------------------------|
| NOTE | Between Marker 1 and Marker 2, there will be a minimum of 256 data points. |
|------|----------------------------------------------------------------------------|

| Softkey | Description      |                                                                                                                                                                                                                           |
|---------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Markers | Marker 1         | Press the <b>Marker 1</b> softkey and use the knob or arrow keys to adjust the position of Marker 1 (M1).                                                                                                                 |
|         | Marker 2         | Press the <b>Marker 2</b> softkey and use the knob or arrow keys to adjust the position of Marker 2 (M2).                                                                                                                 |
|         | LockMrkrs On/Off | Press the <b>LockMrkrs</b> softkey to toggle between locking the positions of M1 and M2 in a fixed distance ( <b>On</b> ) or allowing the position of M1 or M2 to be adjusted independently of each other ( <b>Off</b> ). |

Below are some examples of what you may observe on the screen when you adjust the position of the markers:

| Example                                                                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>In the image, Markers 1 and 2 are positioned on data points that are viewable on the screen.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    | <p>In this image, Marker 1 is positioned on a data point that is viewable on the screen while Marker 2 is positioned on a data point that is not viewable on the screen.</p> <p>In such cases, an indicator, <b>M2&gt;</b>, will appear at the bottom right of the screen to indicate that Marker 2 is located at a data point towards the right.</p>                                                                                                                                                                                                                                                                                                            |
|   | <p>In both images shown, both markers are positioned on data points that are not viewable on the screen.</p> <p>In the first image, an indicator, <b>M1/2&gt;</b>, appears at the bottom right of the screen to indicate that both markers are located towards the right.</p> <p>To bring the markers back into view; First, press the M1 softkey and turn the knob counter-clockwise. This will bring marker M1 back into the edge of the screen. Next, press the M2 softkey and turn the knob counter-clockwise again and this will bring marker M2 to the edge of the screen. Do note that the distance between markers M1 and M2 is now 256 data points.</p> |
|  | <p>In the second image, both markers are on opposite sides. In such cases, indicators <b>&lt;M1</b> and <b>M2&gt;</b> will appear at the bottom of the screen indicating the direction of markers.</p> <p>To bring the markers back into view; First, press the M1 softkey and turn the knob clockwise. This will bring marker M1 back into the edge of the screen on the left. Next, press the M2 softkey and turn the knob counter-clockwise and this will bring marker M2 to the edge of the screen on the right.</p>                                                                                                                                         |

## Vertical & Cursors

Press the **Vertical** softkey to configure the vertical scaling of the trend chart and also to access the cursors menu.



| Softkey        | Description                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                    |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vertical       | Default                                                                                                                                                                                                                      | Default sets the scale to the measurement range.                                                                                                                                                                                                                                                                   |
|                | Auto                                                                                                                                                                                                                         | Auto automatically adjusts the scale to appropriately fit the line currently shown on the screen.                                                                                                                                                                                                                  |
|                | Manual                                                                                                                                                                                                                       |  <p>Manual allows you to configure the scale either as High and Low values or as a Span around a Center value. For example, a scale from a Low of 0 V to a High of 5 V is equivalent to a Center of 2.5 V and a Span of 5 V.</p> |
| Autoscale Once | Press <b>Autoscale Once</b> softkey to automatically scale the trend chart's vertical axis one time based on the digitized data points shown on the screen. This also sets the <b>Vertical Scale</b> mode to <b>Manual</b> . |                                                                                                                                                                                                                                                                                                                    |

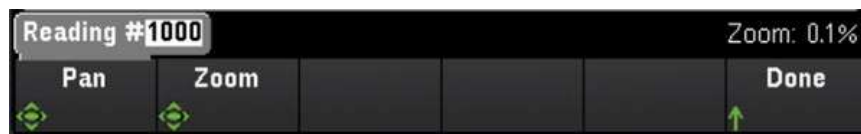
Press the **Cursors** softkey to access the Cursors menu.



| Softkey                                                                                                                                            | Description      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors                                                                                                                                            | Off              | Press the <b>Off</b> softkey to disable the cursors displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                    | X only           | Press the <b>X Only</b> softkey to display the X1 and X2 cursors. Press the <b>X1</b> , or <b>X2</b> softkeys and use the knob or arrow keys to adjust the cursor position along the X axis (time). To keep X1 and X2 cursors at a fixed distance from each other, press the <b>ΔX Lock</b> softkey to toggle it to On. The values of each point and the delta between the two points are displayed below the trend chart.                                                                                                                                                                                                                                                           |
|                                                                                                                                                    | Y only           | Press the <b>Y Only</b> softkey to display the Y1 and Y2 cursors. Press the <b>Y1</b> , or <b>Y2</b> softkeys and use the knob or arrow keys to adjust the cursor position along the Y axis (magnitude). To keep Y1 and Y2 cursors at a fixed distance from each other, press the <b>ΔY Lock</b> softkey to toggle it to On. To set the Y1 or Y2 cursor to a value that puts it into view on the trend chart, press the <b>Y1</b> , or <b>Y2</b> softkey followed by the <b>Place Yn on Screen</b> softkey. The values of each point and the delta between the two points are displayed below the trend chart.                                                                       |
|                                                                                                                                                    | X and Y          | Press the <b>X and Y</b> softkey to display all the X and Y cursors on the trend chart. Press the <b>X1</b> , <b>X2</b> , <b>Y1</b> , or <b>Y2</b> softkeys and use the knob or arrow keys to adjust the cursor position along their respective axis. The values of each point and the delta between the two points are displayed below the trend chart.                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                    | Track Rdnng at X | Press the <b>Track Rdnng at X</b> view the time and magnitude values of any two points in the trend chart. First, select two readings using the <b>X1</b> and <b>X2</b> softkeys to position cursors X1 and X2 on the point of interest along the time axis. The Y1 and Y2 cursors will automatically track the position of X1 and X2 cursors respectively and display the respective magnitude axis values of the X1 and X2 cursors. The values of each point and the delta between the two points are displayed below the trend chart. You may also fixed the distance of X1 and X2 cursors by toggling the <b>ΔX Lock</b> softkey. See the <b>example</b> shown for more details. |
| To record the X and Y data and the delta X and Y data as a screen shot, take a screen shot of the Web UI, not the front panel screen shot utility. |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## Pan & Zoom

Press the **Pan & Zoom** softkey to pan across the trend graph and also configure the zoom level.



| Softkey | Description                                                                                                                                                                                                                                                          |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pan     | Press the <b>Pan</b> softkey to pan and select which reading in memory is displayed at the center of the screen. Press and release the arrow key to move the cursor by one display pixel. Hold down the arrow key to move the cursor in 20-display pixel increments. |
| Zoom    | Press the <b>Zoom</b> softkey and use the knob or the up/down arrow keys to select the amount of zoom, in percent. You can configure the zoom percentage of the trend chart at 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 50%, 100%, 200%, 500%, or 1000%.              |

The table below shows the list of zoom percentages with its corresponding number of data points per display pixel.

| Zoom (%) | Number of data points per display pixel |
|----------|-----------------------------------------|
| 0.1 %    | 1000                                    |
| 0.2 %    | 500                                     |
| 0.5 %    | 200                                     |
| 1 %      | 100                                     |
| 2 %      | 50                                      |
| 5 %      | 20                                      |
| 10 %     | 10                                      |
| 20 %     | 5                                       |
| 50 %     | 2                                       |
| 100 %    | 1                                       |
| 200%     | 0.5                                     |
| 500%     | 0.2                                     |
| 1000%    | 0.1                                     |

## View the error queue

Press the **Errors** softkey to display up to the 20 errors in the error queue. Error annunciator, **ERR**, is cleared as you read them. When the front panel Error annunciator (ERR) turns on, one or more command syntax, execution, or hardware errors have been detected. A record of up to 20 errors is saved in the instrument's error queue.

Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was saved. Errors are cleared as you read them. When you have read all errors from the queue, the ERR annunciator turns off and the errors are cleared. The instrument beeps once each time an error is generated. If more than 20 errors have occurred, the last error saved in the queue (the most recent error) is replaced with "Error queue overflow". No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the instrument responds with "No error".



## Power Analysis

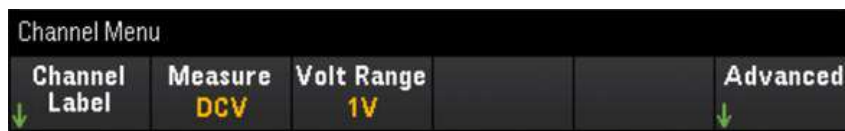
This section describes how to configure the DAQM909A digitizer channels to perform power analysis in View mode.

### Enabling the Power Analysis function in the [Channel] menu

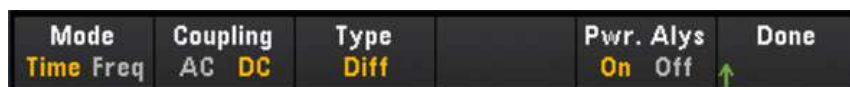
1. In the **[Channel]** menu, use the knob or arrow keys to select either **Channel 01** or **Channel 03**. DAQM909A's Channel 02 and Channel 04 are always assigned as Power Coupling channels which are coupled to Channel 01 and Channel 03 respectively when the power analysis function is enabled. Therefore, any settings on Channel 02 and Channel 04 will be omitted when power analysis is enabled.

| Main Channel | Power Coupling Channel |
|--------------|------------------------|
| Channel 01   | Channel 02             |
| Channel 03   | Channel 04             |

2. Next, press the **Measure** softkey and select **DCV** and configure the voltage range and sampling rate parameters.



3. Press the **Advanced** softkey followed by the **Pwr. Alys** softkey to toggle between enabling (**On**) or disabling (**Off**) the power analysis function of the selected channel.



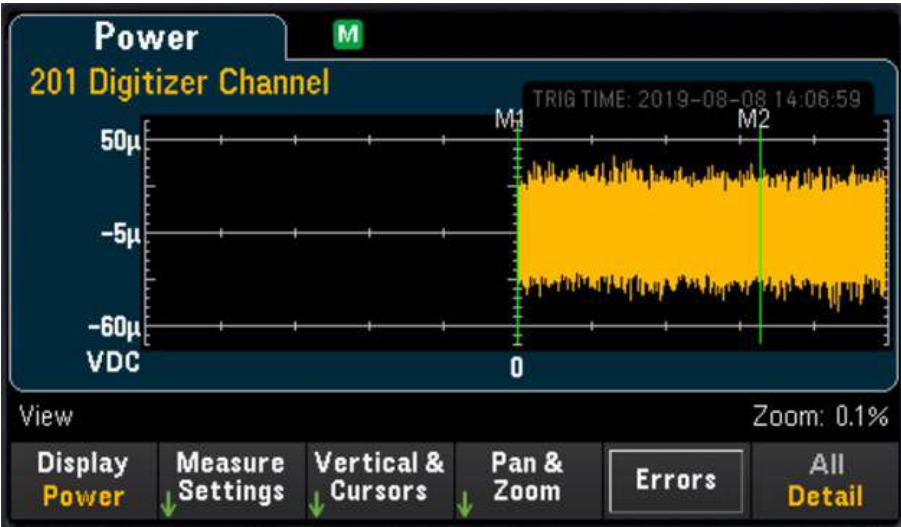
When you enable the power analysis function for the selected channel, the adjacent channel linked to it will be automatically configured as the **Power Coupling** channel. In the example below, **Pwr. Alys** is turned **On** for Channel 01, and Channel 02 is automatically configured as the **Power Coupling** channel.



4. Press the **[Scan/Start]** key to begin digitizing. Once complete, press the **[View]** key enter the View menu.

Viewing the Power Analysis results

Press the [View] key to access the View menu.



Display softkey

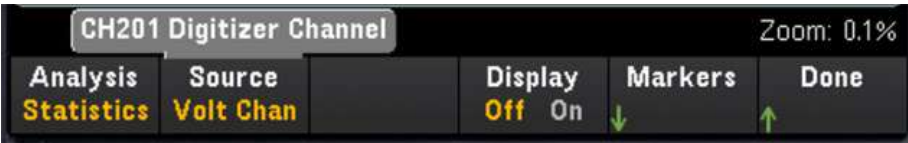
Press the Display softkey followed by the Power softkey in order to view the results of the power analysis.

NOTE

You may continue to view each channel's current power analysis data that stored in memory, as long as the specified channel did not begin a new digitizing operation as this will overwrite the old data.

Measure Settings softkey

Press the Measure Settings softkey to configure the power analysis parameters.



| Softkey         |            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis        | Statistics | This softkey is static as this is the only analysis option for Power Analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Source          | Volt Chan  | The selected source will determine the graph that is displayed on the screen. <b>Volt Chan</b> will display the data of the channel assigned to it as a function of voltage, <b>Curr Chan</b> will compute the data of the channel assigned to it and display as a function of current, and <b>V*I</b> computes the data of both Volt Chan and Curr Chan and display the data as a function of power. Press the <b>Source</b> softkey to toggle between voltage channel ( <b>Volt Chan</b> ), current channel ( <b>Curr Chan</b> ), or power channel ( <b>V * I</b> ). For <b>Volt Chan</b> and <b>Curr Chan</b> , use the knob or arrow keys to assign the channels. |
|                 | Curr Chan  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                 | V * I      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Gain            |            | Press the <b>Gain</b> softkey and use the knob or arrow keys to specify the gain value for current value computation for Curr Chan.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Display Off/ On |            | Toggle the <b>Display Off/On</b> softkey to enable (On) or disable (Off) the display of data statistics on the screen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Markers         |            | Please refer to <b>Markers softkey</b> for more information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



### Vertical & Cursors softkey

Please refer to **Vertical & Cursors** for more information.

### Pan & Zoom softkey

Please refer to **Pan & Zoom** for more information.

### View the error queue

Press the **Errors** softkey to display up to the 20 errors in the error queue. Error annunciator, **ERR** is cleared as you read them. When the front panel Error annunciator (ERR) turns on, one or more command syntax, execution, or hardware errors have been detected. A record of up to 20 errors is saved in the instrument's error queue.

Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was saved. Errors are cleared as you read them. When you have read all errors from the queue, the ERR annunciator turns off and the errors are cleared. The instrument beeps once each time an error is generated.

If more than 20 errors have occurred, the last error saved in the queue (the most recent error) is replaced with "Error queue overflow". No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the instrument responds with "No error".

## [View] Menu Status

In the event where there is no data available to be displayed, the [View] menu will display a status text on the bottom of the display. Below is a list of the status text and its respective description.

| Status                                                                                              | Description                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| "The readings in memory were made with a different set of modules installed, and cannot be graphed" | The instrument is unable to plot the data of the last completed Scan data acquisition operation because the module card has been switched out. |
| "Pre-Storing"                                                                                       | The instrument is currently collecting PreTrigger samples before entering into Wait for Trigger state.                                         |
| "No scan data in memory"                                                                            | No data acquired in Scan mode.                                                                                                                 |
| "No digitize data in memory"                                                                        | No data acquired in DMM Digitize and Digitizer mode.                                                                                           |
| "Scan in progress"                                                                                  | Scan data acquisition mode is in progress.                                                                                                     |
| "Digitize in progress"                                                                              | DMM Digitize/ Digitizer data acquisition mode is in progress.                                                                                  |
| "Wait for arm event"                                                                                | The digitizer is waiting for arm event before initiating the digitizing process.                                                               |
| "Wait for external event"                                                                           | The instrument is waiting for an external trigger before initiating data acquisition.                                                          |
| "Wait for internal event"                                                                           | The instrument is waiting for an internal trigger before initiating data acquisition.                                                          |
| "Wait for alarm event"                                                                              | The instrument is waiting for an alarm trigger before initiating data acquisition.                                                             |
| "Wait for manual event"                                                                             | The instrument is waiting for a manual trigger before initiating data acquisition.                                                             |
| "Wait for channel event"                                                                            | The instrument is waiting for a channel trigger before initiating data acquisition.                                                            |

## [Channel] Menu

### Multiplexer modules: Measurements

The Keysight DAQ970A/DAQ973A supports many common measurement functions with the multiplexer module. You can configure the measurement function on the selected channel by pressing **[Channel] > Measure**.

In **Scan** data acquisition mode, selecting **Off** will disable the measurement function in current selected channel. No measurement function will be displayed in the scan list on the selected channel. The default measurement function will set to DCV (DC Voltage).

In **DMM Digitize** data acquisition mode, by default the first suitable channel will automatically configured for **DMM Digitize** and it will be assigned a measurement function (DCV by default). You may switch to another available channel on the plug-in module and configure it for DMM Digitize operation instead. In contrast to **Scan** mode, there is no Off function available because DMM Digitize can only utilize a single configured channel for its digitizing operation. Therefore, the selected channel's measurement function must always be enabled.

Table below shows the overview of each supported multiplexer module on the measurement function. Click on each link to see the details of each configuration step.

| Measurement function       | Multiplexer modules |                  |          |                  |
|----------------------------|---------------------|------------------|----------|------------------|
|                            | DAQM900A            | DAQM901A         | DAQM902A | DAQM908A         |
| Temperature - Thermocouple | √                   | √                | √        |                  |
| Temperature - RTD          |                     | √                | √        | √ <sup>[2]</sup> |
| Temperature - Thermistor   |                     | √                | √        | √ <sup>[2]</sup> |
| Strain - Bridge            | √                   | √                | √        | √                |
| Strain - Direct            |                     | √                | √        | √ <sup>[2]</sup> |
| DC Voltage                 | √                   | √                | √        | √                |
| AC Voltage                 | √                   | √                | √        | √                |
| DC Current                 |                     | √ <sup>[1]</sup> |          |                  |
| AC Current                 |                     | √ <sup>[1]</sup> |          |                  |
| Resistance                 | √                   | √                | √        | √ <sup>[2]</sup> |
| Frequency                  | √                   | √                | √        | √                |
| Period                     | √                   | √                | √        | √                |
| Diode                      |                     | √                | √        | √                |
| Capacitance                |                     | √                | √        | √                |

Notes:

[1] Channel 21 and 22 only.

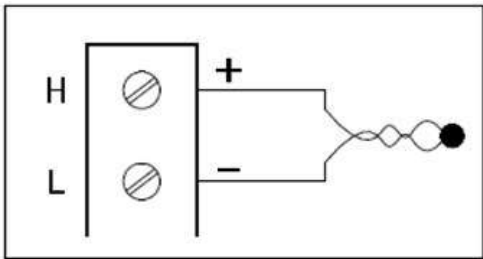
[2] 2-wire measurements only. 4-wire measurements are not supported on DAQM908A multiplexer module.

Temperature

This section describes how to configure the selected channel for temperature measurements from the front panel. Temperature measurements require a temperature transducer probe and the supported probes are thermocouple, thermistor and resistance thermometer (RTD).

Thermocouple

- 1. Connect a thermocouple to the module's screw terminals.



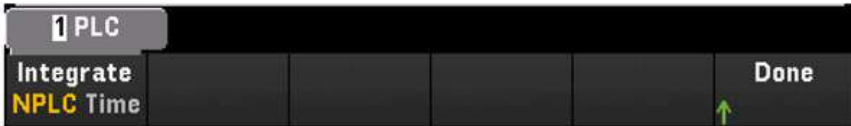
- 2. Press [Channel] > Measure, and select TEMP from the selection menu.



- 3. Press the Units softkey to specify the temperature measurement units as °C (Celsius), °F (Fahrenheit), or K (Kelvin). You can mix temperature units on different channels within the instrument and on the same module.
- 4. Press Sensor Settings > Sensor, specify the type of transducer probe used as TCouple, and press Type softkey to select the type of thermocouple. Supported types are J (default), K, E, T, N, R, B, and S.



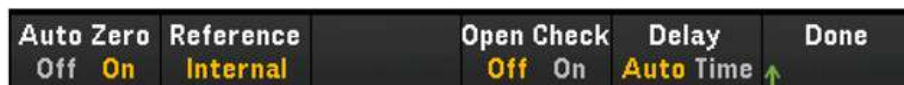
- 5. Press Integrated Settings softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (NPLC) or directly in seconds (Time). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.



| Softkey   |      | Description                                                                                                                                                                                                                                                                         |
|-----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

## Advance Settings

Press **Advanced** softkey to configure the advanced settings for the measurement.



| Softkey               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On  | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Reference             | Internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Thermocouple measurements require a reference junction temperature. You can input a known fixed reference junction temperature (typically used for external reference junctions), use the internally measured temperature on the module as the reference junction temperature, or use the external thermistor or RTD measurement. Selects the reference junction source as <b>Internal</b> , <b>External</b> , or <b>Fixed</b> . |
|                       | External                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                       | Fixed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <div><b>NOTE</b></div> The <b>External</b> softkey option is not available when <b>DMM Digitize</b> is selected as the acquisition mode.                                                                                                                                                                                                                                                                                         |
| Open Check<br>Off/ On | Enables (On) or disables (Off) the thermocouple check feature to verify that the thermocouples are properly connected for measurements. When enabled, the instrument performs a resistance measurement with each temperature to check for an open circuit. If one is detected, the result will be shown as +Overload. If this check is not performed, measurement of an open circuit can produce a voltage reading near zero resulting in an invalid temperature reading.                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <div><b>NOTE</b></div> This setting is only available when <b>Scan</b> is selected as the acquisition mode.                                                                                                                                                                                                                                                                                                                      |
| Delay<br>Auto/ Time   | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <div><b>NOTE</b></div> This setting is only available when <b>Scan</b> is selected as the acquisition mode.                                                                                                                                                                                                                                                                                                                      |

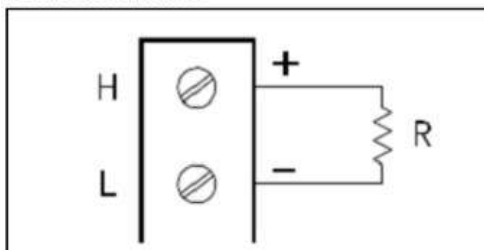
## 2-wire and 4-wire Thermistor

**NOTE**

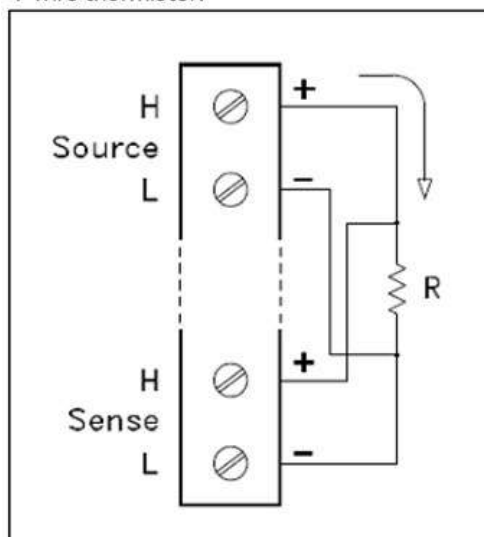
This feature is only available when **Scan** is selected as the acquisition mode.

1. Connect a thermistor to the module's screw terminals.

2-wire thermistor:



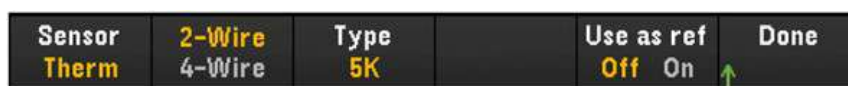
4-wire thermistor:



2. Press [Channel] > Measure, and select TEMP from the selection menu.



3. Press the Units softkey to specify the temperature measurement units as °C (Celsius), °F (Fahrenheit), or K (Kelvin). You can mix temperature units on different channels within the instrument and on the same module.
4. Press **Sensor Settings** > **Sensor** and select **Thermistor**. Next, toggle the **2-Wire/4-Wire** softkey to specify the type of transducer probe used as **2-wire** or **4-wire Therm**. After that press the **Type** softkey to select the type of thermistor. Supported types are 2.2K, 5K (default), and 10K.



5. Toggle **Use as ref** to enable (**On**) or disable (**Off**) the currently selected channel to be used as the reference channel for subsequent thermocouple measurements that specify an external reference source.

6. Press Integrate Settings softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (NPLC) or directly in seconds (Time). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

| Softkey   | Description                                                                                                                                                                                                                                                                                 |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC<br>Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time<br>Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

### Advanced Settings

Press **Advanced** softkey to configure the advanced settings for the measurement.

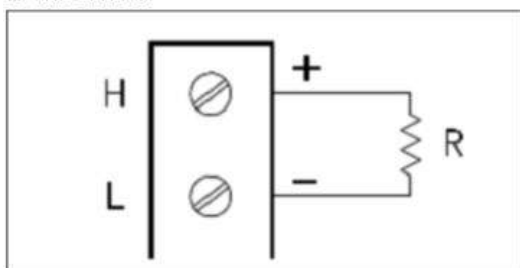


| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| Low Power<br>Off/ On | Selects the low-power resistance measurement. This sources less current resulting in lower power dissipation, and less self-heating, in the resistance under test. Typically, this is about 1/10th the current sourced for the standard resistance measurements. The approximate current sourced for each measurement range is shown at the bottom of the resistance range softkeys, for example: (~ 1 mA).                                                                                                                                                                                                                                                                                                                                 |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

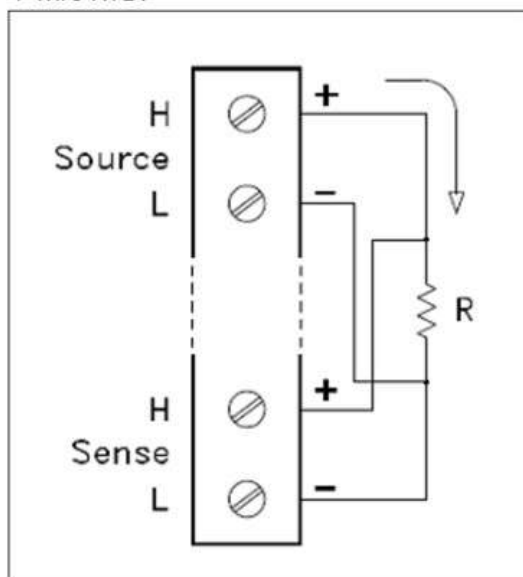
## 2-wire and 4-wire RTD

1. Connect an RTD to the module's screw terminals.

2-wire RTD:



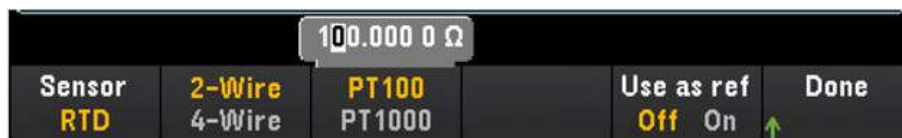
4-wire RTD:



2. Press [Channel] > Measure, and select TEMP from the selection menu.



3. Press the Units softkey to specify the temperature measurement units as °C (Celsius), °F (Fahrenheit), or K (Kelvin). You can mix temperature units on different channels within the instrument and on the same module.
4. Press **Sensor Settings** > **Sensor** and select **RTD**. Next, toggle the **2-Wire/4-Wire** softkey to specify the type of transducer probe used as **2-wire** or **4-wire** RTD. Then, toggle the **PT100/PT1000** softkey to select the nominal resistance,  $R_0$ , as **PT100** (100  $\Omega$ ) or **PT1000** (1000  $\Omega$ ).  $R_0$  is the nominal resistance of a RTD at 0 °C.





- Press **Use as ref** to enable (**On**) or disable (**Off**) the currently selected channel to be used as the reference channel for subsequent thermocouple measurements that specify an external reference source. This option is not available in **DDMM Digitize** mode.
- Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

| Softkey             | Description                                                                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
| Time                | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

### Advanced settings

#### NOTE

In **DDMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** softkey to configure the advanced settings for the measurement.

|                            |                            |                            |                             |             |
|----------------------------|----------------------------|----------------------------|-----------------------------|-------------|
| <b>Auto Zero</b><br>Off On | <b>OffstComp</b><br>Off On | <b>Low Power</b><br>Off On | <b>Delay</b><br>Auto Time ↑ | <b>Done</b> |
|----------------------------|----------------------------|----------------------------|-----------------------------|-------------|

| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| OffstComp            | Offset compensation removes the effects of small DC voltages in the circuit being measured. The technique involves taking the difference between two resistance measurements, one with the current source set to the normal value, and one with the current source set to a lower value.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Low Power<br>Off/ On | Selects the low-power resistance measurement. This sources less current resulting in lower power dissipation, and less self-heating, in the resistance under test. Typically, this is about 1/10th the current sourced for the standard resistance measurements. The approximate current sourced for each measurement range is shown at the bottom of the resistance range softkeys, for example: (~ 1 mA).                                                                                                                                                                                                                                                                                                                                 |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

## Strain

This section describes how to configure the selected channel for strain measurements from the front panel. When a force is applied to a body, the body deforms. The deformation per unit length is called strain ( $\epsilon$ ). Strain may be either tensile (+) or compressive (-). The DAQ970A/DAQ973A supports two types of strain measurements which are Bridge configuration and direct resistive method.

Once you have configured strain measurement function in all strain channels, press **[Home]** > **Strain Offset** to measure or specify the unstrained offset that will be subtracted from strain measurements before the strain conversion is performed.

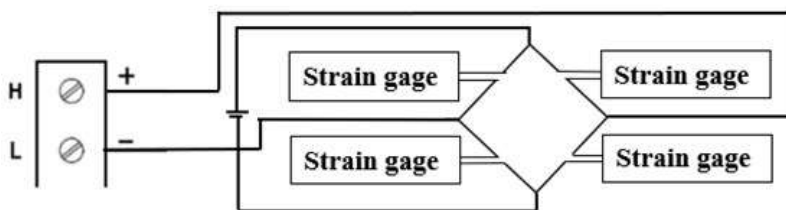
### Bridge configuration

#### Full and half bridge in bending arrangement

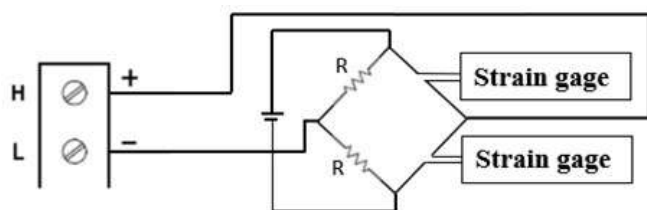
This section describes how to configure the selected channel for full and half bending bridge strain gage measurements from the front panel.

1. Connect bridge configuration source to the module's screw terminals.

Full bending bridge:



Half bending bridge:



2. Press **[Channel]** > **Measure**, and select **STRAIN** from the selection menu.



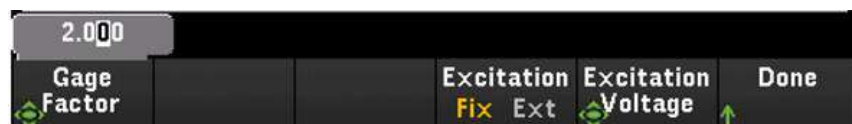
- Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range. The **Auto** option is not available in **DMM Digitize** data acquisition mode.



- Press **Sense Settings** > **Sense**, specify the strain measurement method as full and half bridge in bending arrangements.



- Press **Gage Settings**, and use the knob or the front panel arrow keys to specify various strain gage settings.



| Softkey                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Gage factor is the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the gage. The larger the value, the more sensitive strain gage. Gage factor is a dimensionless quantity. The typical value is approximately 2.                                                                                                                                                                                                                                                                                                                                                                      |
| Excitation<br>Fix/ Ext | Strain bridge conversions require the voltage of the external bridge excitation. For this voltage, you can dedicate a multiplexer channel to measure the excitation voltage, or can specify a known fixed voltage value. Fixed ( <b>Fix</b> ) - The fixed value specified by the Excitation Voltage softkey will be used for the strain conversion. External ( <b>Ext</b> ) - DCV measurements on the enabled reference channel will be used for subsequent strain bridge measurements that specify an external excitation voltage source. Note that the external DCV reference channel must be a lower-numbered channel than the strain channel. |
| Excitation<br>Voltage  | Use the knob or the front panel arrow keys to specify the fixed excitation voltage applied to the bridge by an external voltage source. This value will be used to convert strain bridge measurements on the selected channel.                                                                                                                                                                                                                                                                                                                                                                                                                    |

6. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

| Softkey   | Description |                                                                                                                                                                                                                                                                                     |
|-----------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC        | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time        | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

### Advanced settings

#### NOTE

In **DMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** to configure the advanced settings for the measurement.



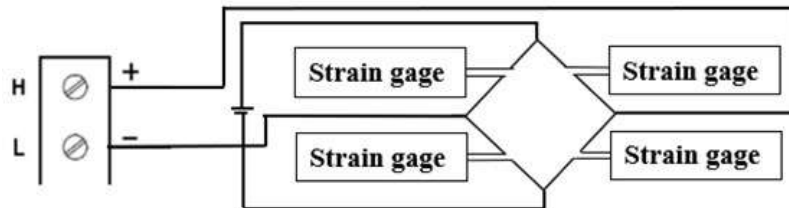
| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

### Full and half bridge in Poisson arrangement

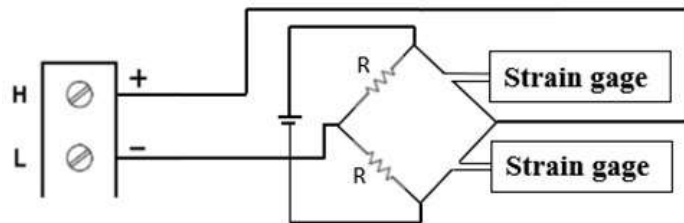
This section describes how to configure the selected channel for full and half Poisson bridge strain gage measurements from the front panel.

1. Connect bridge configuration source to the module's screw terminals.

Full bending bridge:



Half bending bridge:



2. Press [Channel] > Measure, and select STRAIN from the selection menu.



3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.



4. Press **Sense Settings** > **Sense**, specify the strain measurement method as full and half bridge in Poisson arrangements.



5. Press **Gage Settings**, and use the knob or the front panel arrow keys to specify various strain gage settings.



| Softkey                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Gage factor is the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the gage. The larger the value, the more sensitive strain gage. Gage factor is a dimensionless quantity. The typical value is approximately 2.                                                                                                                                                                                                                                                                                                                                                                      |
| Poisson Ratio          | Specifies the Poisson ratio of the strain gage. Poisson ratio is defined as the negative ratio of the strain in the transverse direction to the strain in the longitudinal direction.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Excitation<br>Fix/ Ext | Strain bridge conversions require the voltage of the external bridge excitation. For this voltage, you can dedicate a multiplexer channel to measure the excitation voltage, or can specify a known fixed voltage value. Fixed ( <b>Fix</b> ) - The fixed value specified by the Excitation Voltage softkey will be used for the strain conversion. External ( <b>Ext</b> ) - DCV measurements on the enabled reference channel will be used for subsequent strain bridge measurements that specify an external excitation voltage source. Note that the external DCV reference channel must be a lower-numbered channel than the strain channel. |
| Excitation<br>Voltage  | Use the knob or the front panel arrow keys to specify the fixed excitation voltage applied to the bridge by an external voltage source. This value will be used to convert strain bridge measurements on the selected channel.                                                                                                                                                                                                                                                                                                                                                                                                                    |

6. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

| Softkey   | Description                                                                                                                                                                                                                                                                         |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC                                                                                                                                                                                                                                                                                |
|           | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time                                                                                                                                                                                                                                                                                |
|           | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

## Advanced settings

### NOTE

In **DMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** to configure the advanced settings for the measurement.



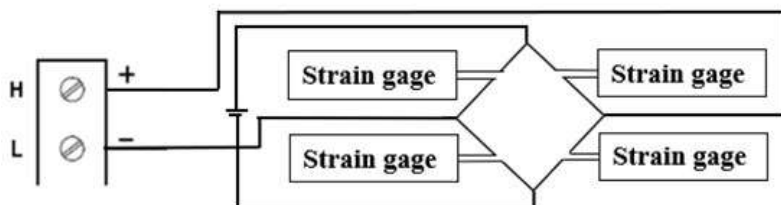
| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

### Full bridge in bending Poisson arrangement

This section describes how to configure the selected channel for full bending Poisson bridge strain gage measurements from the front panel.

1. Connect bridge configuration source to the module's screw terminals.

Full bending bridge:



2. Press [Channel] > Measure, and select STRAIN from the selection menu.



3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.

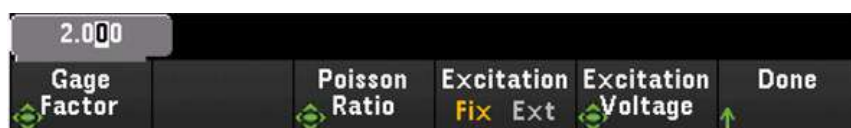


4. Press **Sense Settings** > **Sense**, specify the strain measurement method as full bridge in bending Poisson arrangement.





5. Press **Gage Settings**, and use the knob or the front panel arrow keys to specify various strain gage settings.



| Softkey                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Gage factor is the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the gage. The larger the value, the more sensitive strain gage. Gage factor is a dimensionless quantity. The typical value is approximately 2.                                                                                                                                                                                                                                                                                                                                                                      |
| Poisson Ratio          | Specifies the Poisson ratio of the strain gage. Poisson ratio is defined as the negative ratio of the strain in the transverse direction to the strain in the longitudinal direction.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Excitation<br>Fix/ Ext | Strain bridge conversions require the voltage of the external bridge excitation. For this voltage, you can dedicate a multiplexer channel to measure the excitation voltage, or can specify a known fixed voltage value. Fixed ( <b>Fix</b> ) - The fixed value specified by the Excitation Voltage softkey will be used for the strain conversion. External ( <b>Ext</b> ) - DCV measurements on the enabled reference channel will be used for subsequent strain bridge measurements that specify an external excitation voltage source. Note that the external DCV reference channel must be a lower-numbered channel than the strain channel. |
| Excitation<br>Voltage  | Use the knob or the front panel arrow keys to specify the fixed excitation voltage applied to the bridge by an external voltage source. This value will be used to convert strain bridge measurements on the selected channel.                                                                                                                                                                                                                                                                                                                                                                                                                    |

6. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

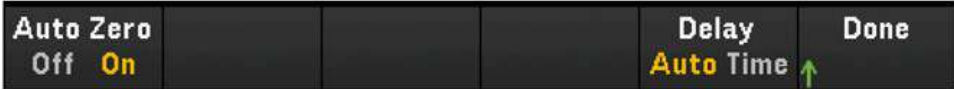
| Softkey             | Description                                                                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
| Time                | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

Advanced settings

NOTE

In **DMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** to configure the advanced settings for the measurement.

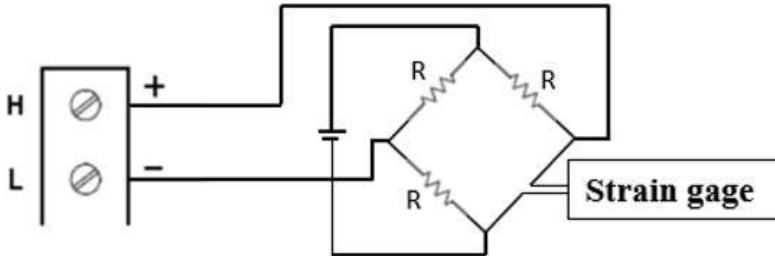


| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

### Quarter bridge arrangement

This section describes how to configure the selected channel for quarter bridge strain gage measurements from the front panel.

1. Connect bridge configuration source to module's screw terminals



2. Press [Channel] > Measure, and select **STRAIN** from the selection menu.



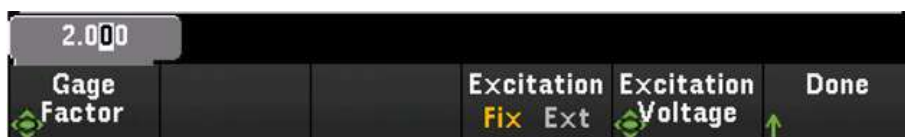
3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.



4. Press **Sense Settings** > **Sense**, specify the strain measurement method as quarter bridge arrangement.



5. Press **Gage Settings**, and use the knob or the front panel arrow keys to specify various strain gage settings.



| Softkey                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Gage factor is the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the gage. The larger the value, the more sensitive strain gage. Gage factor is a dimensionless quantity. The typical value is approximately 2.                                                                                                                                                                                                                                                                                                                                                                      |
| Excitation<br>Fix/ Ext | Strain bridge conversions require the voltage of the external bridge excitation. For this voltage, you can dedicate a multiplexer channel to measure the excitation voltage, or can specify a known fixed voltage value. Fixed ( <b>Fix</b> ) - The fixed value specified by the Excitation Voltage softkey will be used for the strain conversion. External ( <b>Ext</b> ) - DCV measurements on the enabled reference channel will be used for subsequent strain bridge measurements that specify an external excitation voltage source. Note that the external DCV reference channel must be a lower-numbered channel than the strain channel. |
| Excitation<br>Voltage  | Use the knob or the front panel arrow keys to specify the fixed excitation voltage applied to the bridge by an external voltage source. This value will be used to convert strain bridge measurements on the selected channel.                                                                                                                                                                                                                                                                                                                                                                                                                    |

6. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

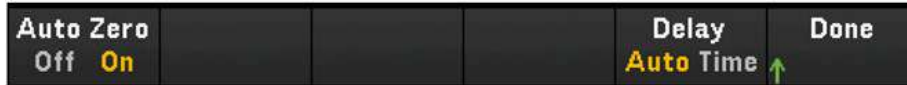
| Softkey             | Description                                                                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
| Time                | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

## Advanced settings

### NOTE

In **DMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** to configure the advanced settings for the measurement.



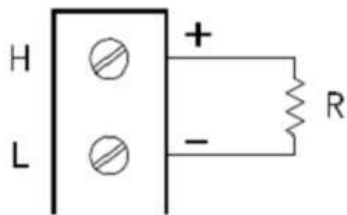
| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

### Direct resistive method

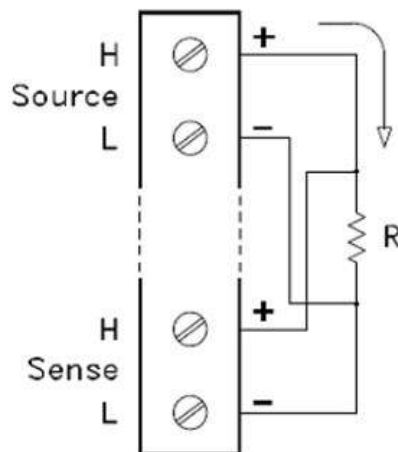
This section describes how to configure the selected channel for direct 2-wire and 4-wire strain gage measurements from the front panel. The measurement configurations for 2-wire and 4-wire direct resistive are same, below descriptions explained by using 2-wire resistance measurements.

1. Connect direct resistive source to the module's screw terminals.

2-wire direct strain:



4-wire direct strain:



2. Press [Channel] > Measure, and select STRAIN from the selection menu.



3. Press **Sense Settings** > **Sense**, specify the strain measurement method as direct 2-wire or 4-wire. Do note that the **Range** softkey (as seen in step 2) will no longer be available for configuration once direct 2-wire or 4-wire method is selected.



4. Press **Gage Settings**, and use the knob or the front panel arrow keys to specify various strain gage settings.



| Softkey     | Description                                                                                                                                                                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor | Gage factor is the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the gage. The larger the value, the more sensitive strain gage. Gage factor is a dimensionless quantity. The typical value is approximately 2. |
| Gage Ohms   | Gage resistance to be used to convert direct strain measurements on the selected channel.                                                                                                                                                                                    |

5. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

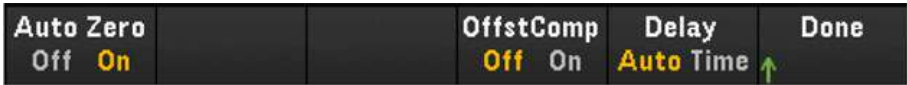
| Softkey             | Description                                                                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
| Time                | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

Advanced settings

NOTE

In DMM Digitize data acquisition mode, only the Auto Zero setting will be available in the Advanced settings.

Press **Advanced** to configure the advanced settings for the measurement.



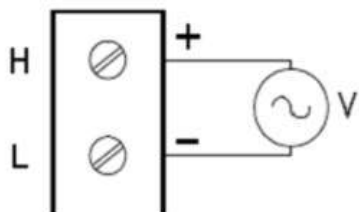
| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| OffstComp<br>Off/ On | Offset compensation removes the effects of small DC voltages in the circuit being measured. The technique involves taking the difference between two resistance measurements, one with the current source set to the normal value, and one with the current source set to a lower value.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Delay<br>Auto/Time   | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |



## DC Voltage

This section describes how to configure the selected channel for DC voltage measurements from the front panel.

1. Connect the voltage source to the module's screw terminals.



2. Press [Channel] > Measure, and select DCV from the selection menu.

| Channel Label | Measure | Range |  | Integrate Settings | Advanced |
|---------------|---------|-------|--|--------------------|----------|
| ↓             | DCV     | Auto  |  | ↓                  | ↓        |

3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.

### NOTE

Autorange is not supported on the DMM Digitize data acquisition mode.

| Select DC Voltage Range |       |    |     |      |      |
|-------------------------|-------|----|-----|------|------|
| Auto                    | 100mV | 1V | 10V | 100V | 300V |

4. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

| Softkey   | Description |                                                                                                                                                                                                                                                                                     |
|-----------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC        | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time        | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

## Advanced settings

Press **Advanced** to configure the advanced settings for the measurement.

|                            |                            |  |  |                             |      |
|----------------------------|----------------------------|--|--|-----------------------------|------|
| Auto Zero<br>Off <b>On</b> | Input Z<br><b>10M</b> Auto |  |  | Delay<br><b>Auto</b> Time ↑ | Done |
|----------------------------|----------------------------|--|--|-----------------------------|------|

| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | <p>Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled (<b>On</b>), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled (<b>Off</b>), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements).</p> <div> <div>NOTE</div> <div>This setting is available when <b>Scan</b> or <b>DMM Digitize</b> is selected as the acquisition mode.</div> </div> |
| Input Z<br>10M/ Auto | <p>Specifies the measurement terminal input impedance, which is either 10 M<math>\Omega</math> (<b>10M</b>) or high impedance (<b>Auto</b>). The Auto mode selects high impedance (&gt; 10 G<math>\Omega</math>) for the 100 mV, 1 V, and 10 V ranges, and 10 M<math>\Omega</math> for the 100 V and 300 V ranges. In most situations, 10 M<math>\Omega</math> is high enough to not load most circuits, but low enough to make readings suitable for high impedance circuits. It also leads to readings with less noise than the high impedance option, which is included for situations where the 10 M<math>\Omega</math> load is significant.</p> <div> <div>NOTE</div> <div>This setting is available when <b>Scan</b> or <b>DMM Digitize</b> is selected as the acquisition mode.</div> </div>                                                                                           |
| Delay<br>Auto/ Time  | <p>Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b>, instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b>, the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.</p> <div> <div>NOTE</div> <div>This setting is only available when <b>Scan</b> is selected as the acquisition mode.</div> </div>                                                                                                                                                                                                                                              |

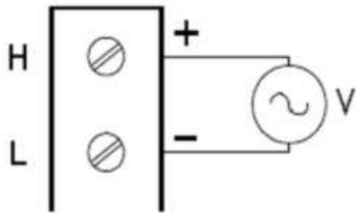
## AC Voltage

### NOTE

The AC Voltage measurement option will only be available when **Scan** is selected as the acquisition mode.

This section describes how to configure the selected channel for AC voltage measurements from the front panel.

1. Connect the AC voltage source to the module's screw terminals.



2. Press [Channel] > Measure, and select **ACV** from the selection menu.

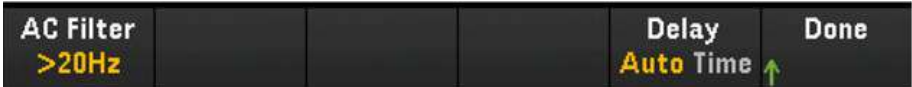


3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.



Advanced settings

Press **Advanced** to configure the advanced settings for the measurement.



| Softkey             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter           | Specifies which AC filter to use. The instrument uses three different AC filters that enable you either to optimize low frequency accuracy or achieve faster AC settling following a change in input signal amplitude. The three filters are <b>3 Hz</b> , <b>20 Hz</b> , and <b>200 Hz</b> , and you should generally select the highest frequency filter whose frequency is less than that of the signal you are measuring, because higher frequency filters result in faster measurements. For example, when you are measuring a signal between 20 and 200 Hz, you should use the 20 Hz filter. If measurement speed is not an issue, choosing a lower frequency filter may result in quieter measurements, depending on the signal that you are measuring. |
| Delay<br>Auto/ Time | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                                                 |

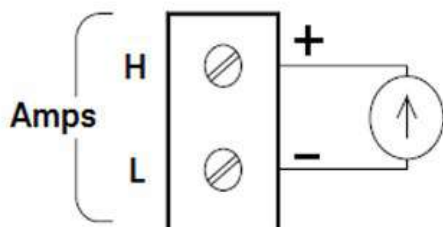
## DC Current

### NOTE

DC Current measurement is supported only on DAQM901A's channels 21 and 22.

This section describes how to configure the selected channel for DC current measurements from the front panel.

1. Connect DC current source to the module's screw terminals.



2. Press [Channel] > Measure, and select DCI from the selection menu.



3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range. The **Auto** option is not available in **DMM Digitize** data acquisition mode.



4. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

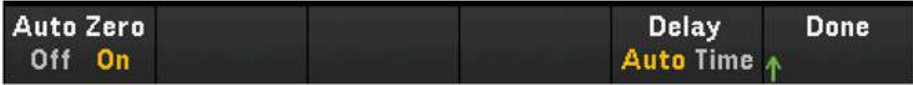
| Softkey   | Description |                                                                                                                                                                                                                                                                                     |
|-----------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC        | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time        | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

Advanced settings

NOTE

In **DMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** to configure the advanced settings for the measurement.



| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

## AC Current

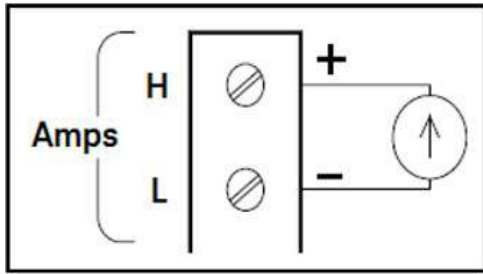
**NOTE**

The AC Current measurement option will only be available when **Scan** is selected as the acquisition mode.

AC Current measurement is supported only on DAQM901A's channels 21 and 22.

This section describes how to configure the selected channel for AC current measurements from the front panel.

1. Connect a current source to the module's screw terminals.



2. Press [Channel] > Measure, and select ACI from the selection menu.



3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.



Advanced settings

Press **Advanced** to configure the advanced settings for the measurement.



| Softkey             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter           | Specifies which AC filter to use. The instrument uses three different AC filters that enable you either to optimize low frequency accuracy or achieve faster AC settling following a change in input signal amplitude. The three filters are <b>3 Hz</b> , <b>20 Hz</b> , and <b>200 Hz</b> , and you should generally select the highest frequency filter whose frequency is less than that of the signal you are measuring, because higher frequency filters result in faster measurements. For example, when you are measuring a signal between 20 and 200 Hz, you should use the 20 Hz filter. If measurement speed is not an issue, choosing a lower frequency filter may result in quieter measurements, depending on the signal that you are measuring. |
| Delay<br>Auto/ Time | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                                                 |

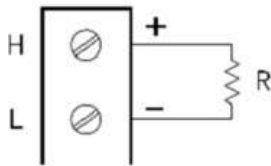


## Resistance

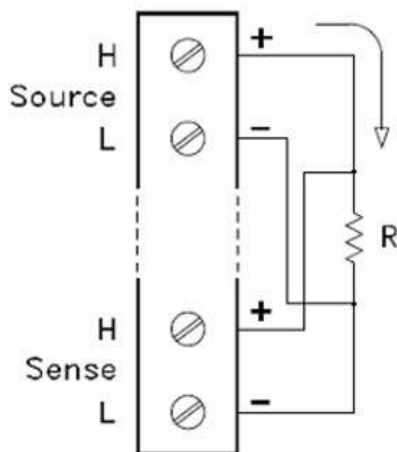
This section describes how to configure the selected channel for 2-wire and 4-wire measurements from the front panel. The measurement configurations for 2-wire and 4-wire resistance are same, below descriptions explained by using 2-wire resistance measurements.

1. Connect resistance source to the module's screw terminals.

2-wire ohms:



4-wire ohms:



2. Press [Channel] > Measure, and select OHMS or OHMS 4W from the selection menu.



3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (only available when **Scan** is selected as the data acquisition mode) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range. The **Auto** option is not available in **DMM Digitize** data acquisition mode.



4. Press **Integrate Settings** softkey to select whether the measurement integration time will be specified in terms of Number of Power Line Cycles (**NPLC**) or directly in seconds (**Time**). Only 1, 2, 10, 20, 100, and 200 PLC provide normal mode (line frequency noise) rejection. Selecting 200 PLC provides the best noise rejection and resolution, but the slowest measurements.

| Softkey   | Description |                                                                                                                                                                                                                                                                                     |
|-----------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate | NPLC        | Sets the integration time as 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100, and 200 Power Line Cycles (PLC). Only 1 PLC and longer times provide normal mode (line frequency noise) rejection. Selecting 100 or 200 PLC provides the best noise rejection and resolution. |
|           | Time        | Directly sets the integration time in seconds.                                                                                                                                                                                                                                      |

### Advanced settings

#### NOTE

In **DMM Digitize** data acquisition mode, only the **Auto Zero** setting will be available in the **Advanced** settings.

Press **Advanced** to configure the advanced settings for the measurement.

|                            |  |                            |                            |                             |             |
|----------------------------|--|----------------------------|----------------------------|-----------------------------|-------------|
| <b>Auto Zero</b><br>Off On |  | <b>OffstComp</b><br>Off On | <b>Low Power</b><br>Off On | <b>Delay</b><br>Auto Time ↑ | <b>Done</b> |
|----------------------------|--|----------------------------|----------------------------|-----------------------------|-------------|

| Softkey              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero provides the most accurate measurements, but requires additional measurement time to perform the zero measurement. With auto zero enabled ( <b>On</b> ), the instrument internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset voltages present on the instrument's input circuitry from affecting measurement accuracy. With auto zero disabled ( <b>Off</b> ), the instrument measures the offset once and subtracts the offset from all subsequent measurements. The instrument takes a new offset measurement each time you change the function, range, or integration time. (There is no auto zero setting for 4-wire measurements). |
| OffstCmp<br>Off/ On  | Offset compensation removes the effects of small DC voltages in the circuit being measured. The technique involves taking the difference between two resistance measurements, one with the current source set to the normal value, and one with the current source set to a lower value.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Low Power<br>Off/ On | Selects the low-power resistance measurement. This sources less current resulting in lower power dissipation, and less self-heating, in the resistance under test. Typically, this is about 1/10th the current sourced for the standard resistance measurements. The approximate current sourced for each measurement range is shown at the bottom of the resistance range softkeys, for example: (~ 1 mA).                                                                                                                                                                                                                                                                                                                                 |
| Delay<br>Auto/ Time  | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                              |

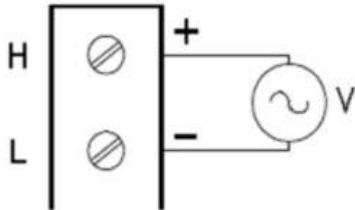
## Frequency and Period

### NOTE

The Frequency and Period measurement option will only be available when **Scan** is selected as the acquisition mode.

This section describes how to configure the selected channel for frequency and period measurements from the front panel.

1. Connect an AC source to the module's screw terminals.



2. Press [Channel] > **Measure**, and select **FREQ** or **PERIOD** from the selection menu.

| Channel<br>Label | Measure<br><b>FREQ</b> | Range<br><b>Auto</b> |  | Gate Time<br><b>100ms</b> | Advanced |
|------------------|------------------------|----------------------|--|---------------------------|----------|
| ↓                |                        |                      |  |                           | ↓        |

3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. **Auto** (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.

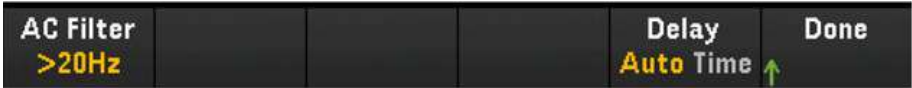
| Select Frequency Voltage Range |       |    |     |      |      |
|--------------------------------|-------|----|-----|------|------|
| <b>Auto</b>                    | 100mV | 1V | 10V | 100V | 300V |

4. Press **Gate Time** to specify the measurement's aperture (integration time) as 1 ms, 10 ms, 100 ms, or 1 s.

| Select Gate Time |      |              |    |  |  |
|------------------|------|--------------|----|--|--|
| 1ms              | 10ms | <b>100ms</b> | 1s |  |  |

Advanced settings

Press **Advanced** to configure the advanced settings for the measurement.



| Softkey             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter           | Specifies which AC filter to use. The instrument uses three different AC filters that enable you either to optimize low frequency accuracy or achieve faster AC settling following a change in input signal amplitude. The three filters are <b>3 Hz</b> , <b>20 Hz</b> , and <b>200 Hz</b> , and you should generally select the highest frequency filter whose frequency is less than that of the signal you are measuring, because higher frequency filters result in faster measurements. For example, when you are measuring a signal between 20 and 200 Hz, you should use the 20 Hz filter. If measurement speed is not an issue, choosing a lower frequency filter may result in quieter measurements, depending on the signal that you are measuring. |
| Delay<br>Auto/ Time | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time.                                                                                                                                                                                                                                                 |

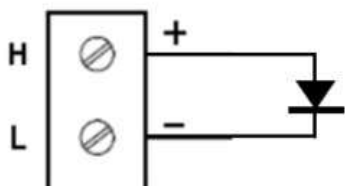
## Diode

### NOTE

The Diode measurement option will only be available when **Scan** is selected as the acquisition mode.

This section describes how to configure the selected channel for diode test from the front panel.

1. Connect diode source to the module's screw terminals.



2. Press [Channel] > Measure, and select DIODE from the selection menu.



### Advanced settings

Press **Advanced** to configure the advanced settings for the measurement.



| Softkey             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delay<br>Auto/ Time | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time. |

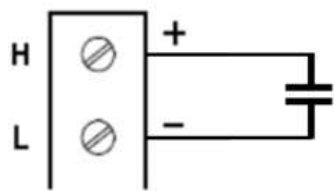
Capacitance

NOTE

The Capacitance measurement option will only be available when **Scan** is selected as the acquisition mode.

This section describes how to configure the selected channel for capacitance measurements from the front panel.

- 1. Connect capacitance source to the module's screw terminals.



- 2. Press [Channel] > **Measure**, and select **CAP** from the selection menu.



- 3. Press **Range** and use the knob or the front panel arrow keys to specify the measurement range. Auto (autorange) automatically selects the range for the measurement based on the input. Autoranging is convenient, but it results in slower measurements than using a manual range. Autoranging goes up a range at 120% of the present range, and down a range below 10% of the present range.



Advanced settings

Press **Advanced** to configure the advanced settings for the measurement.

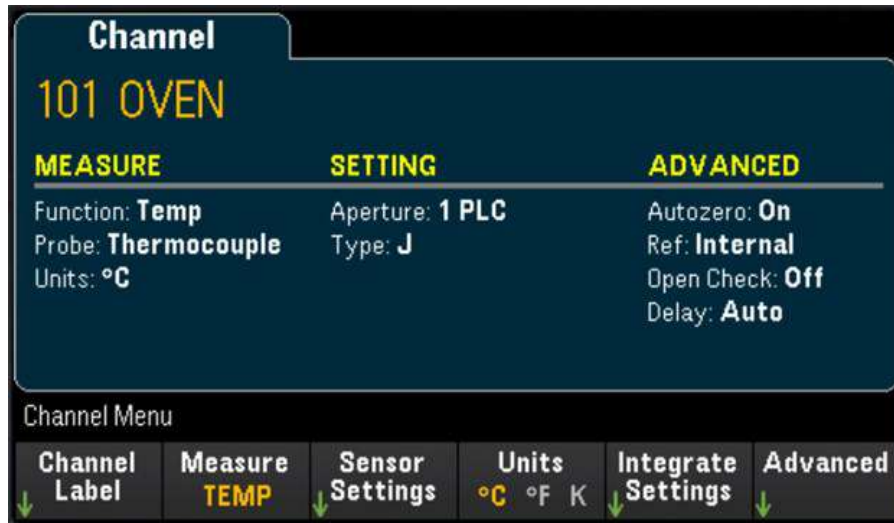


| Softkey             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delay<br>Auto/ Time | Selects whether the delay between channels in the scan list will be automatically or manually selected. By selecting <b>Auto</b> , instrument will automatically determine the channel delay based on measurement function, range, integration time, and AC filter setting. By selecting <b>Time</b> , the specified delay (time in seconds) is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time. |

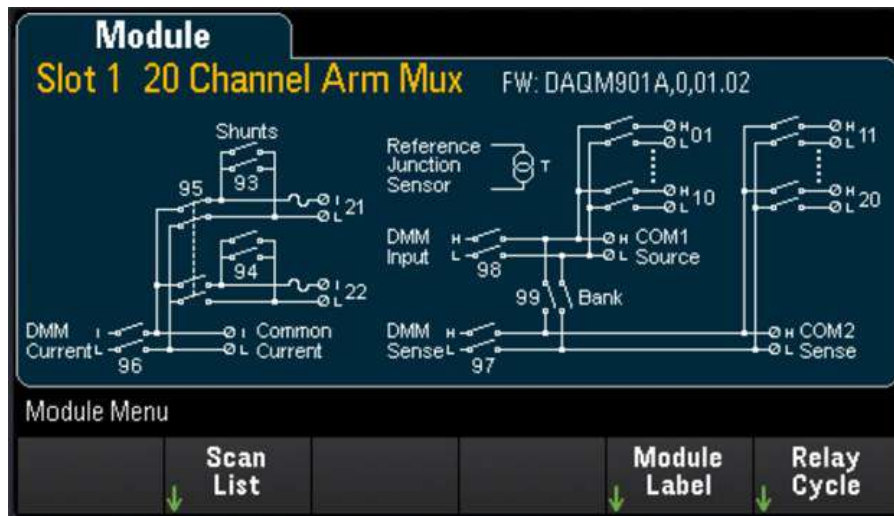
## Multiplexer modules: Switch mode

The multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) are also able to operate in switch mode which enables you to open and close channels independently. The section below will describe the steps to enable and configure the switch mode.

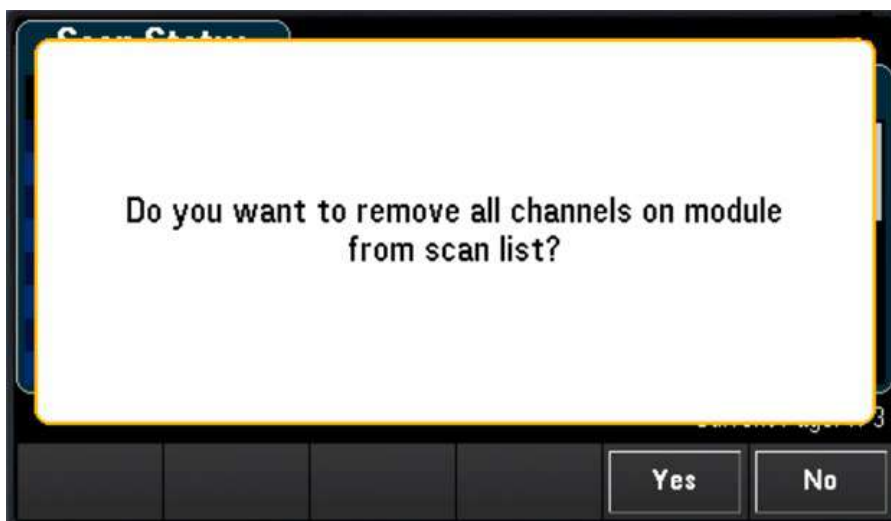
1. Press the **[Channel]** key to access the Channel menu. In the example below, Channel 101 of a DAQM901A module in slot 1, labeled as OVEN is set up to measure temperature in degrees °C using a type J thermocouple.



2. Press the **[Module]** key to go to the Module menu. Next, press the **Scan List** softkey.



3. You would notice that Channel 101 label is OVEN and the Scan Status is ON. Press the **Remove from Scan** softkey and you will be prompted to confirm your action. Press the **Yes** softkey to confirm removing all channels on the module from the scan list. This action turns off the measurements for the channels on the module and places the module in switch mode.

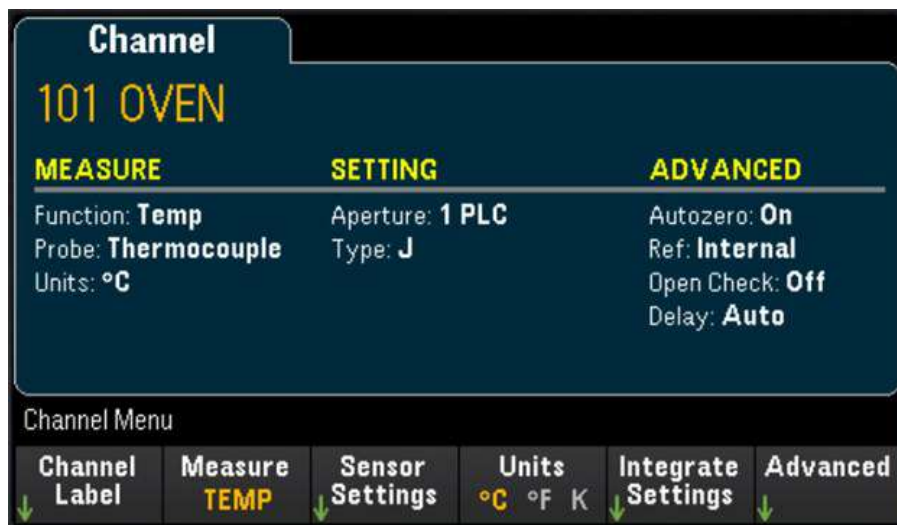




4. Press the **[Channel]** key to return to the Channel menu. Notice the **Open** and **Close** softkeys are now available since the module is now in switch mode. The channel label is maintained. You can press the **Close** softkey to change the channel state.



5. To return to scan mode, press the **Measure** softkey and select a measurement mode. In the example below, TEMP is selected and the module is now back in scan mode. The temperature measurement is restored and the **Open** and **Close** softkey are no longer available.



## DAQM907A - Multifunction Module

The following section describes how you may configure each of the channels on the DAQM907A. There are total 7 channels available in the DAQM907A multifunction module as shown in the table below:

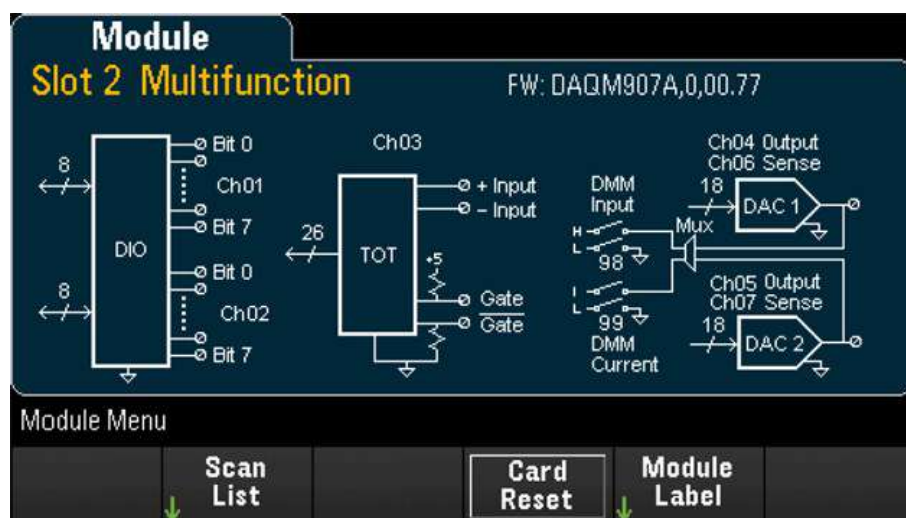
| Channel number | Channel label             |
|----------------|---------------------------|
| 01             | 8-bit Digital I/O Channel |
| 02             | 8-bit Digital I/O Channel |
| 03             | Totalizer Channel         |
| 04             | DAC Output Channel        |
| 05             | DAC Output Channel        |
| 06             | DAC Output Sense Channel  |
| 07             | DAC Output Sense Channel  |

### Digital I/O (DIO) Channels (Channel 01 and 02)

The DAQM907A multifunction module has two non-isolated 8-bit input/output ports which you can use for reading digital patterns. You can read the live status of the bits on the port or you can configure a scan to include a digital read.

#### Configure the DIO channel

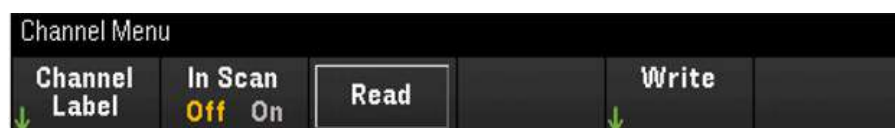
1. Press **[Module]** and use the knob or the front panel arrow keys to select the slot containing the multifunction module.



- Press **[Channel]** and use the knob or the front panel arrow keys to select the DIO channels (channel 01 and 02).



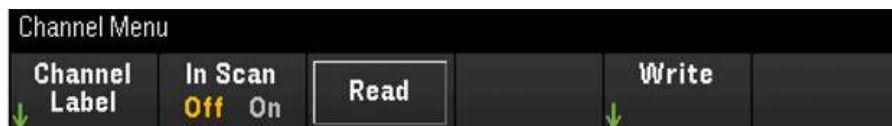
- Press **In Scan** to specify whether to include (**On**) or exclude (**Off**) the DIO channel from the scan list.



| Softkey | Description                                                                          |
|---------|--------------------------------------------------------------------------------------|
| Read    | Press the Read softkey to read the bit patterns directly from a digital input port.  |
| Write   | Press the Write softkey to specify and output the bit pattern to the specified port. |

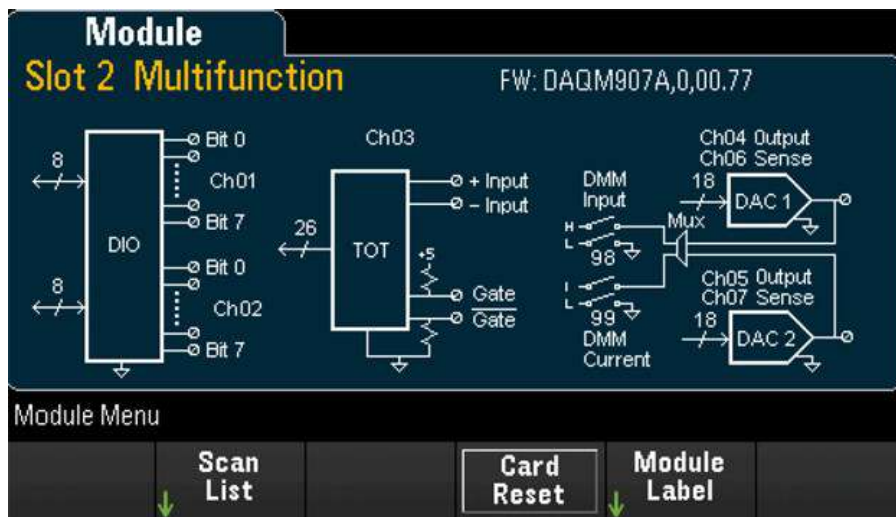
### Read a digital input port

Press the **Read** softkey to define the DIO direction as Input.



**Write to a digital input**

1. Press **[Module]** and use the knob or the front panel arrow keys to select the slot containing the multifunction module.



2. Press **[Channel]** and use the knob or the front panel arrow keys to select the DIO channels (channel 01 and 02).



3. Press **Write** > **Base** and use the knob or the front panel arrow keys to select the number base used (**Hex**, **Binary**, or **Decimal**), and then press **Pattern** to define each output pattern from the selected base.



4. Press **Write Pattern** to output the bit pattern on the selected digital output port. The DIO direction will be set to Output.



5. Press **Clear** to set the output pattern to "0".



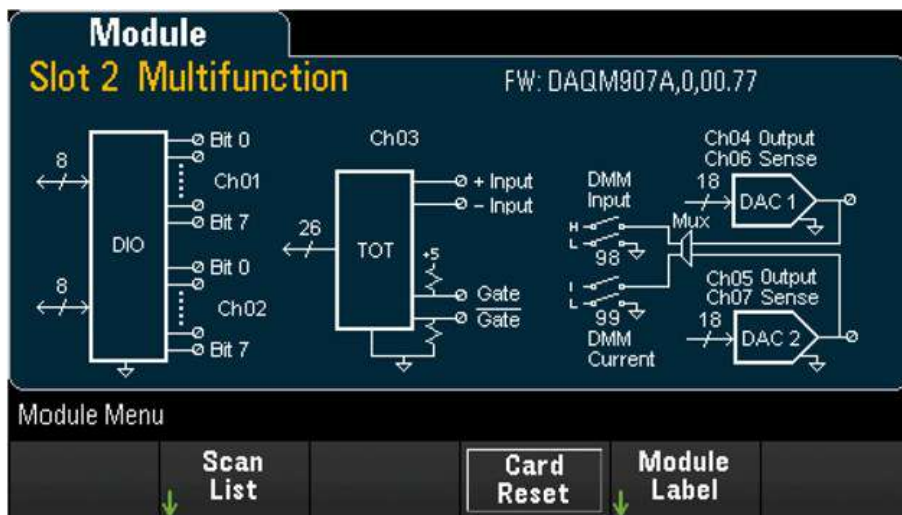
## Totalizer Channel

The DAQM907A multifunction module has a 26-bit totalizer which can count TTL-compatible pulses at a 100 kHz rate. The totalizer channel is numbered "s03", where "s" represents the slot number. The totalizer channel is labeled as channel 03.

You can manually read the totalizer count or you can configure a scan to read the count.

To configure the totalizer channel with the multifunction module:

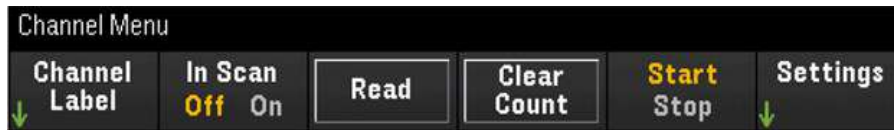
1. Press **[Module]** and use the knob or the front panel arrow keys to select the slot which containing the DAQM907A multifunction module.



2. Press **[Channel]** and use the knob or the front panel arrow keys to select the totalizer channel (channel 03).



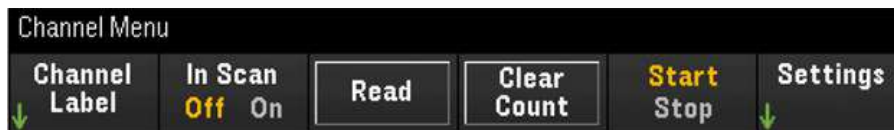
- Press **In Scan** to specify whether to include (**On**) or exclude (**Off**) the totalizer channel from the scan list.



- Press **Settings** > **Edge** to specify if the totalizer channel should count on the rising edge (**Pos**) or falling edge (**Neg**) if the input signal, and then press **ReadReset** to specify if the totalizer count should be automatically reset (**On**) or not (**Off**) when read.



- Press **Read** to read the totalizer count. The count is read once each time you press Read; the count does not update automatically on the display.



- Press **Clear Count** to reset the totalizer count to "0".
- Press the Start/Stop softkey to toggle between **Start** to start the counting on the current totalizer channel, or **Stop** to stop the counting on the current totalizer channel.



### DAC output and sense channels (Channels 04 through 07)

The DAQM907A multifunction module has two DAC output channels (channel 04 and 05), and two DAC output sense channels (channel 06 and 07). Any of these channels may be scanned.

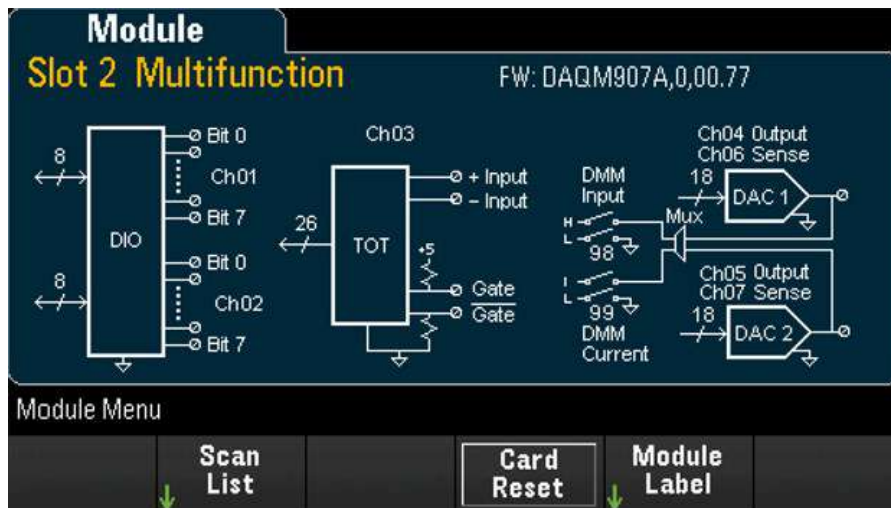
For the DAC output channels, no actual output measurement is made; the scanned value will be the programmed output value (voltage or current).

The DAC output sense channels will make a complementary (voltage or current) measurement based on the output mode of the corresponding DAC output channel:

- Channel 06 will make the measurement based on the output mode set in channel 04.
- Channel 07 will make the measurement based on the output mode set in channel 05.

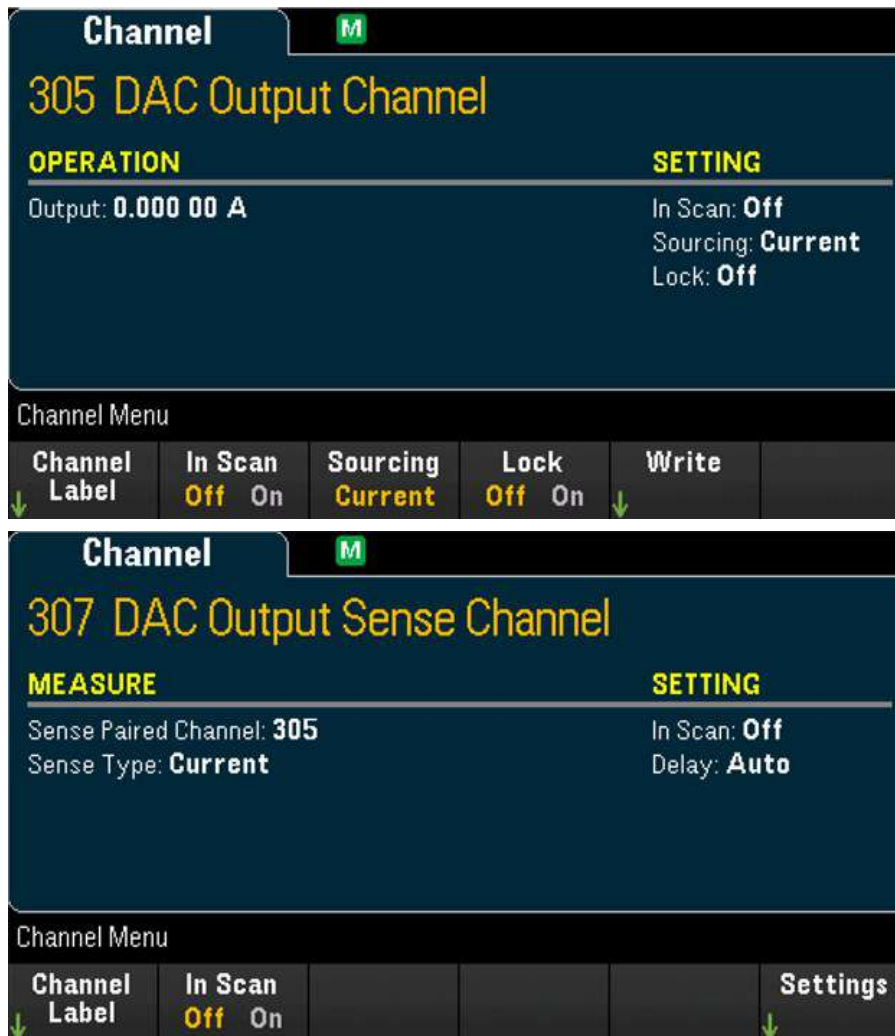
If DAC output channel 04 is set to voltage mode, then the corresponding DAC sense channel 06 will measure current. If the output channel is set to current mode, the sense channel will measure voltage.

1. Press **[Module]** and use the knob or the front panel arrow keys to select the slot containing the multifunction module.





- Press **[Channel]** and use the knob or the front panel arrow keys to select the DAC output channels (channel 04 and 05) or the DAC sense channels (channel 06 and 07).



- Press **In Scan** to specify whether to include (On) or exclude (Off) the DAC channel from the scan list.
- Press **Sourcing** to set the output mode in the DAC output channel to **Voltage** or **Current**.
- Toggle **Lock (On)** to lock the DAC output channel mode or toggle **Lock (Off)** to disable the lock on the DAC output channel mode.
- Press **Write** > **Output** to set the output voltage/current level, and then press **Write Output** to output the voltage/-current from the selected DAC output channel.

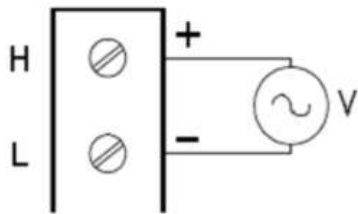
## DAQM909A - 4 Channel 24-Bit Digitizer Module

The DAQM909A can be configured to digitize DC Voltage (DCV) and Strain. The following section describes how you may configure the channels on the DAQM909A.

### DC Voltage (DCV)

This section describes how to configure the channels on DAQM909A for DC voltage measurement from the front panel.

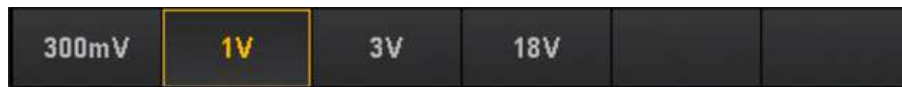
1. Connect the voltage source to the module's screw terminals.



2. Press [Channel] > Measure, and select DCV from the selection menu

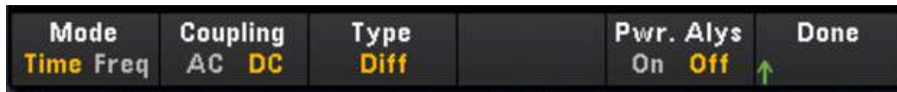


3. Press the **Volt Range** softkey to specify the DC voltage measurement range. You may choose between 300mV, 1 V (default value), 3 V, or 18V.



## Advance Settings

Press Advanced to configure the advanced settings for the digitizer.



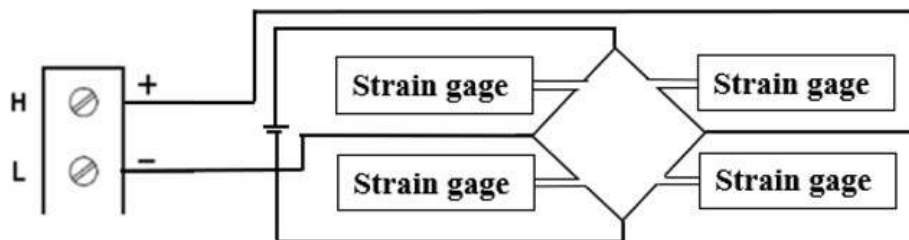
| Softkey              |      | Description                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>Time/ Freq   |      | Determines the ADC filter mode. Press the <b>Mode</b> softkey to toggle between setting the input in time domain mode ( <b>Time</b> ) or setting the input in frequency domain mode ( <b>Freq</b> ). When <b>Time</b> mode is selected, the on board ADC is configured to use the Sinc5 filter. When <b>Freq</b> mode is selected, the onboard ADC is configured to use the Wideband filter. |
| Coupling<br>AC/ DC   |      | Press the <b>Coupling</b> softkey to toggle between how the graph is displayed, in AC or DC mode. In <b>AC</b> mode, the AC coupling will display the DC signal that is normalized to a mean of zero. In <b>DC</b> mode, the DC coupling will display the original signal on the screen.                                                                                                     |
| Type                 | Diff | Differential ( <b>Diff</b> ) input measures the input signals from high and low input terminals.                                                                                                                                                                                                                                                                                             |
|                      | Send | Single Ended ( <b>Send</b> ) input measures the input signals from high input terminal and grounded low input terminal.                                                                                                                                                                                                                                                                      |
|                      | Iepe | Integrated Electronics Piezo Electric ( <b>Iepe</b> ) transducer (2-wire IEPE with 100 Ohm LO Ground) measures the input signals with direct current supplied to the high and low input terminals.                                                                                                                                                                                           |
| Pwr. Alys<br>On/ Off |      | Press the <b>Pwr. Alys</b> softkey to toggle between enabling ( <b>On</b> ) or disabling ( <b>Off</b> ) the power analysis feature on the specified channel during data post processing in the View menu.                                                                                                                                                                                    |
|                      |      | <div>NOTE</div> See <b>Power Analysis</b> for further details                                                                                                                                                                                                                                                                                                                                |

## Strain

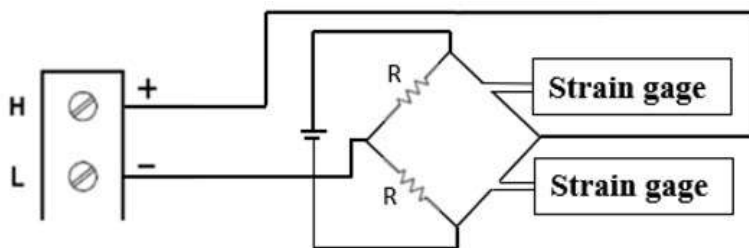
This section describes how to configure the channels on DAQM909A for strain measurement from the front panel.

1. Connect your desired bridge configuration source to the module's screw terminals.

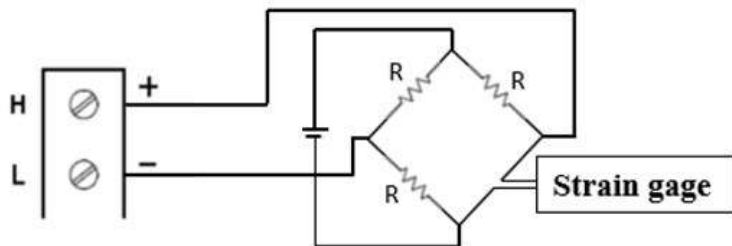
Full bending bridge:



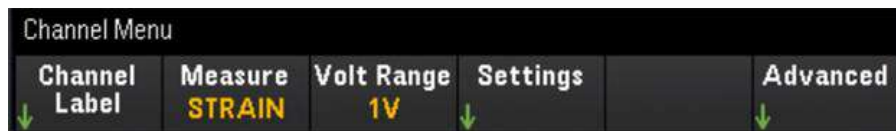
Half bending bridge:



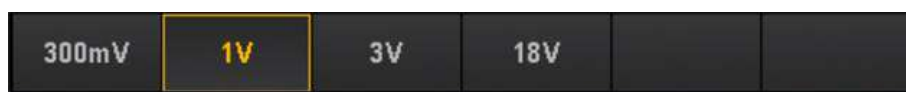
Quarter bridge:



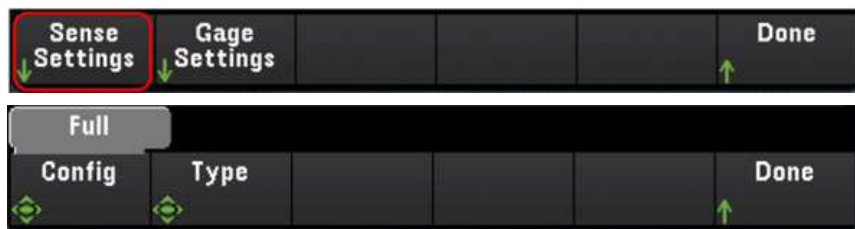
2. Press [Channel] > Measure, and select STRAIN from the selection menu.



3. Press the Volt Range softkey to specify the DC voltage measurement range. You may choose between 300mV, 1 V (default value), 3 V, or 18V.



4. Press **Settings** > **Sense Settings** softkey to specify the strain measurement method based on the bridge configuration which was setup in step 1.



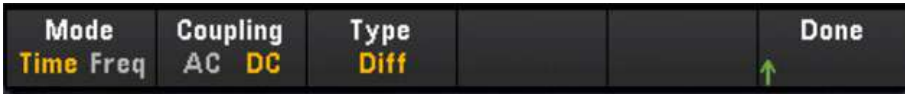
5. Press the **Gage Settings** softkey to specify the various strain gage settings.



| Softkey                                                                                                                                                                                                                                                                          | Description                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor                                                                                                                                                                                                                                                                      | Gage factor is the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the gage. The larger the value, the more sensitive strain gage. Gage factor is a dimensionless quantity. The typical value is approximately 2. |
| Poisson Ratio                                                                                                                                                                                                                                                                    | Specifies the Poisson ratio of the strain gage. Poisson ratio is defined as the negative ratio of the strain in the transverse direction to the strain in the longitudinal direction.                                                                                        |
| <div style="display: flex; align-items: center;"> <div style="background-color: #cccccc; padding: 5px; margin-right: 10px;"><b>NOTE</b></div> <div>The Poisson Ratio softkey will only be available when Poisson is specified as the type in the <b>Sense</b> menu.</div> </div> |                                                                                                                                                                                                                                                                              |
| Excitation Voltage                                                                                                                                                                                                                                                               | Use the knob or the front panel arrow keys to specify the fixed excitation voltage applied to the bridge by an external voltage source. This value will be used to convert strain bridge measurements on the selected channel.                                               |

Advance Settings

Press Advanced to configure the advanced settings for the digitizer.



| Softkey            |      | Description                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>Time/ Freq |      | Determines the ADC filter mode. Press the <b>Mode</b> softkey to toggle between setting the input in time domain mode ( <b>Time</b> ) or setting the input in frequency domain mode ( <b>Freq</b> ). When <b>Time</b> mode is selected, the on board ADC is configured to use the Sinc5 filter. When <b>Freq</b> mode is selected, the onboard ADC is configured to use the Wideband filter. |
| Coupling<br>AC/ DC |      | Press the <b>Coupling</b> softkey to toggle between how the graph is displayed, in AC or DC mode. In <b>AC</b> mode, the AC coupling will display the DC signal that is normalized to a mean of zero. In <b>DC</b> mode, the DC coupling will display the original signal on the screen.                                                                                                     |
| Type               | Diff | Differential ( <b>Diff</b> ) input measures the input signals from high and low input terminals.                                                                                                                                                                                                                                                                                             |
|                    | Send | Single Ended ( <b>Send</b> ) input measures the input signals from high input terminal and grounded low input terminal.                                                                                                                                                                                                                                                                      |
|                    | Iepe | Integrated Electronics Piezo Electric ( <b>Iepe</b> ) transducer (2-wire IEPE with 100 Ohm LO Ground) measures the input signals with direct current supplied to the high and low input terminals                                                                                                                                                                                            |

## Computed Channel

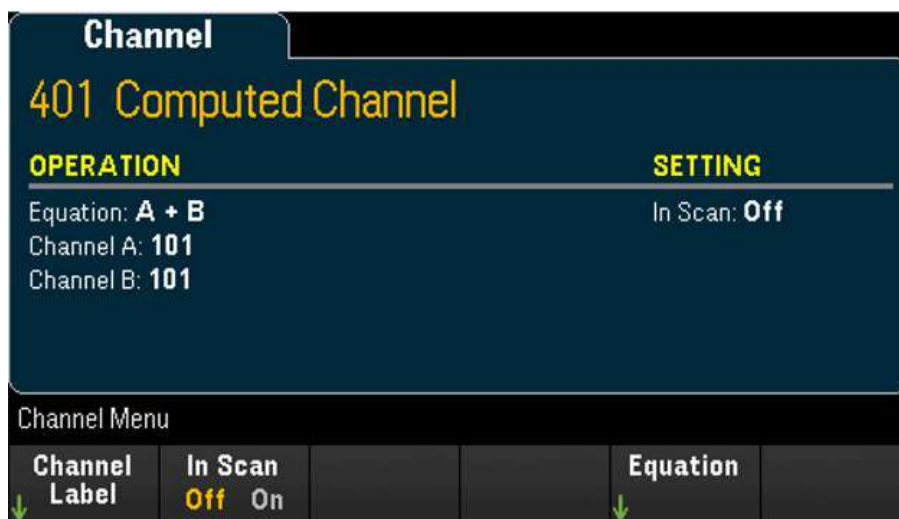
A computed channel performs mathematical operations on the readings from measurement channels, or other computed channels. To configure, press **Channel** and use the knob or right arrow key to select one of the computed channels (channels 401 through 420).

### NOTE

You must configure the measurement channel(s) before performing the mathematical operations in the computed channel.

Monitoring of computed channels is only available during scanning and will only display the reading from the most recent sweep.

The computed channel is not available when DMM Digitize, or Digitizer is selected as the data acquisition mode.



Press **In Scan** to specify whether the computed channel is included in (**On**) or excluded from (**Off**) the scan list. Press **Equation** to specify the equation to be used for the computed channel. The equations choices can be categorized in three main groups: Basic math, polynomial fifth order, and statistics.

## Basic math

Table below shows the supported basic mathematical operations with the respective softkey label.

| Operation      | Equation softkey label |
|----------------|------------------------|
| Addition       | A + B                  |
| Subtraction    | A - B                  |
| Multiplication | A * B                  |
| Division       | A / B                  |
| Reciprocal     | 1 / A                  |
| Power          | A <sup>2</sup>         |
| Square root    | Sqrt(A)                |

For example, to perform the Addition operation from measurement channels (channel 101 and 102) to the computed channel (channel 401):

1. Press **Equation** > **A+B**, use the knob or the front panel arrow keys to specify the **Channel A** softkey to channel 101 and **Channel B** softkey to channel 102.



2. Press once on the **[Scan/Start]** key to initiate a scan. You can view the scanned memory readings by pressing **[View]** key. The result of the addition operation from channel 101 and 102 to channel 401 will be displayed as below:

*Channel 401 = Channel 101 + Channel 102*

| Date      | Time         | Channel               | Reading           |
|-----------|--------------|-----------------------|-------------------|
| 17/4/2018 | 11:36:51.664 | 101 Armature relay... | -148.32 $\mu$ VDC |
| 17/4/2018 | 11:36:51.816 | 102 Armature relay... | -159.01 $\mu$ VDC |
| 17/4/2018 | 11:36:51.822 | 401 Computed Cha...   | -307.33 $\mu$     |

3. Repeat the above steps for the rest of basic math operations (subtract, multiply, etc). If you would like to compute from a single operand channel, set both Channel A and Channel B softkeys to the same channel. The computed readings will be the result of addition readings from the selected channel itself. For example:

*Channel 401 = Channel 101 + Channel 101*

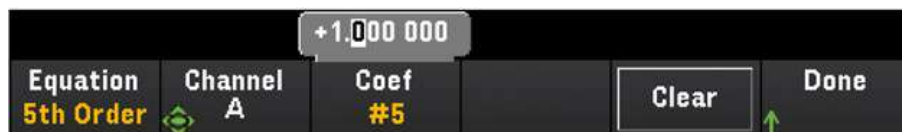
| Date      | Time         | Channel               | Reading           |
|-----------|--------------|-----------------------|-------------------|
| 17/4/2018 | 18:21:48.186 | 101 Armature relay... | -50.556 $\mu$ VDC |
| 17/4/2018 | 18:21:48.186 | 401 Computed Cha...   | -101.11 $\mu$     |



## Polynomial fifth order

To perform this operation from operand channel (channel 101) to the computed channel (channel 401):

1. Press **Equation** > **5th Order**, use the knob or the front panel arrow keys to specify the **Channel A** softkey to channel 101.



2. Press **Coef** to cycle through the coefficient order (**Coef #5**, **Coef #4**, **Coef #3**, **Coef #2**, **Coef #1**, and **Coef #0**). Specify the coefficient parameters for each coefficient order.
3. Press once on the **[Scan/Start]** key to initiate a scan. You can view the scanned memory readings by pressing **[View]** key. The result of polynomial 5th order will display as below:

| Scan Memory |              |                          |              |
|-------------|--------------|--------------------------|--------------|
| Date        | Time         | Channel                  | Reading      |
| 6/19/2019   | 10:37:22.226 | 101 Armature relay MU... | 19 $\mu$ VDC |
| 6/19/2019   | 10:37:22.310 | 401 Computed Channel     | 1.000 02     |

## Statistics

Table below shows the supported statistics operations with the respective softkey label. For statistics, (list) means a set of operand channels that in the computation.

| Operation          | Statistics softkey label | Description                                                                                                                                             |
|--------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average            | Avg(list)                | Returns the average readings from a list of operand channels, where Average reading = Total sum of all the readings/number of operand channels selected |
| Maximum            | Max(list)                | Returns the maximum reading from a list of operand channels                                                                                             |
| Minimum            | Min(list)                | Returns the minimum reading from a list of operand channels                                                                                             |
| Standard deviation | SDev(list)               | Returns the standard deviation readings from a list of operand channels                                                                                 |
| Sum                | Sum(list)                | Returns the total sum of all readings from a list of operand channels                                                                                   |

For example, to perform the Average operation from measurement channels (channels 101 through 103) to the computed channel (channel 401):

1. Press **Equation** > **Avg(list)**, use the knob or the front panel arrow keys to select the operand channels in the **Select** softkey, then press **Add to List** to add the selected operand channel to the operand channel list. Press this softkey repeatedly to add the subsequent operand channel to the operand channel list.



- When the number of operand channel added is reached, the **Remove from List** softkey will appear. Press this key to remove the previous selected operand channel from the operand channel list.



- Press **View List** to display a list of available measurement channels. Currently selected operand channels are marked with an "X". Press **Clear** to remove all selected operand channel from the operand channel list.

| Check | Channel                        | In Scan |
|-------|--------------------------------|---------|
| [x]   | 101 Armature relay MUX Channel | Yes     |
| [x]   | 102 Armature relay MUX Channel | Yes     |
| [x]   | 103 Armature relay MUX Channel | Yes     |

- Press once on the **[Scan/Start]** key to initiate a scan. You can view the scanned memory readings by pressing **[View]** key. The result of Average operation will display as below:

*Channel 401 = (Channel 101+102+103)/3*

| Date      | Time         | Channel               | Reading       |
|-----------|--------------|-----------------------|---------------|
| 17/4/2018 | 12:25:47.944 | 101 Armature relay... | -941,53 μVDC  |
| 17/4/2018 | 12:25:47.996 | 102 Armature relay... | -1,214.8 mVDC |
| 17/4/2018 | 12:25:48.048 | 103 Armature relay... | -1,391.3 mVDC |
| 17/4/2018 | 12:25:48.049 | 401 Computed Cha...   | -1,182.5 m    |

#### NOTE

The format for numbers displayed here are Comma as decimal point separator, and thousand separator set to On where period is inserted between every three digits. See [Number Format](#) for details.

You can also include the computed channel as a operand channel in the computed channel list. For example, to include the computed channel 401 from above example to other computed channel (channel 402):

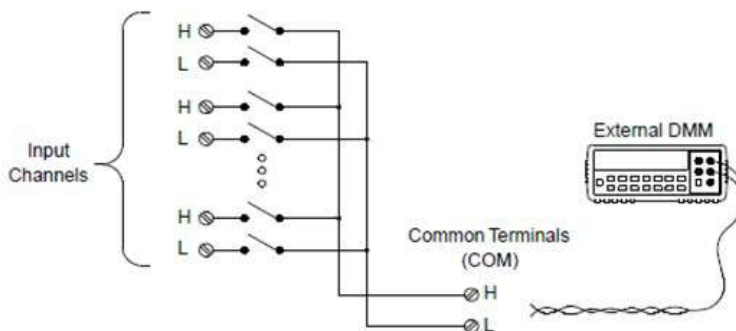
1. Repeat step 1-4 as mentioned above.
2. Press **[Channel]** and use the knob or the front panel arrow keys to set the channel into Channel 402. Press **In Scan** and enables the softkey to include channel 402 in the scan list. Then press **Equation > Avg(list)**, use the knob or the front panel arrow keys to specify the **Channel A** softkey to channel 101 and **Channel B** softkey to 401 computed channel.
3. Press the **[Scan/Start]** key once to initiate a scan. You can view the scanned memory readings by pressing **[View]** key. The result of Average operation will display as below:

*Channel 402 = (Channel 101+102+103+401)/4*

| Date      | Time         | Channel               | Reading  |      |
|-----------|--------------|-----------------------|----------|------|
| 17/4/2018 | 12:43:47.090 | 101 Armature relay... | -1,303.0 | mVDC |
| 17/4/2018 | 12:43:47.142 | 102 Armature relay... | -1,221.3 | mVDC |
| 17/4/2018 | 12:43:47.195 | 103 Armature relay... | -1,146.8 | mVDC |
| 17/4/2018 | 12:43:47.195 | 401 Computed Cha...   | -1,223.7 | m    |
| 17/4/2018 | 12:43:47.195 | 402 Computed Cha...   | -1,223.7 | m    |

## Scanning with External Instruments

In this configuration, you can use the DAQ970A/DAQ973A for signal routing or control applications. If you install a multiplexer plug-in module, you can use the DAQ970A/DAQ973A for scanning with an external instrument. You can connect an external instrument (such as a DMM) to the multiplexer COM terminal.



To control scanning with an external instrument, two control lines are provided. When the DAQ970A/DAQ973A and the external instrument are properly configured, you can synchronize a scan sequence between the two.

In this configuration, you must set up a scan list to include all desired multiplexer or multifunction channels. Channels which are not in the scan list are skipped during the scan. The instrument automatically scans the list of channels in ascending order from slot 100 through slot 300.

For an externally-controlled scan, you must disable the internal DMM by pressing **[Home]** > **User Settings** > **DMM Off**. Since the internal DMM is disabled, readings from multiplexer channels are not stored in internal reading memory.

External connections are required to synchronize the scan sequence between the DAQ970A/DAQ973A and the external instrument. The DAQ970A/DAQ973A must notify the external instrument when a relay is closed and settled (including channel delay). The DAQ970A/DAQ973A outputs a Channel Closed pulse from pin 5 on the rear-panel connector. In response, the external instrument must notify the DAQ970A/DAQ973A when it has finished its measurement and ready to advance to the next channel in the scan list. The DAQ970A/DAQ973A accepts a Channel Advance signal on the External Trigger input line (pin 6).

You can configure the event or action that controls the onset of each sweep through the scan list (a sweep is one pass through the scan list). When the DMM is disabled, the default scan interval source is "Auto" (Immediate). For more information, refer to Scan Interval. You can configure the event or action that notifies the DAQ970A/DAQ973A to advance to the next channel in the scan list. Note that the Channel Advance source shares the same sources as the scan interval. However, an error is generated if you attempt to set the channel advance source to the same source used for the scan interval.

You can specify the number of times the instrument will sweep through the scan list. When the specified number of sweeps have occurred, the scan stops.

An externally-controlled scan can also include a read of a digital port or a read of the totalizer count on the multifunction module. When the channel advance reaches the first digit channel, the instrument scans through all the digital channels in that slot and stores the readings in reading memory (only one channel advance signal is required).

You can configure the list of channels for 4-wire external scanning. When enabled, the instrument automatically pairs channel  $n$  with channel  $n+10$ .

## Channel Labeling

Press the **Channel Label** softkey to specify a label for current selected channel. Use the knob or the front panel arrow keys to enter the characters into the display. Note that you are only allowed to enter maximum of 10 characters for the module label, including letters, numbers, and special characters. To return into the default channel label, press **Channel Label > Clear All > Done**. This setting is applicable to all modules installed, as well as the computed channels.



# [Interval] Menu

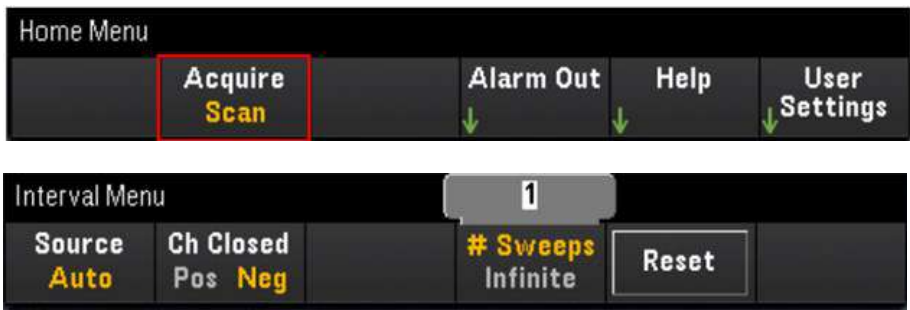
Press the [Interval] key on the front panel to configure what starts each sweep and the number of sweeps in the scan.

NOTE

The options within the [Interval] menu will vary depending on the selected data acquisition mode in the [Home] menu ([Home] > **Acquire** > **Scan**, **DMM Digitize**, or **Digitizer**).

When you press [Home] > **Acquire** > **DMM Digitize**, or **Digitizer**, the [Interval] menu will only be available once you have configured the channel(s).

## [Interval] menu in Scan mode



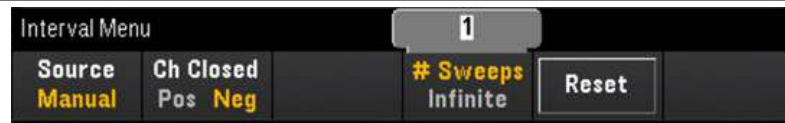
## Selecting the trigger source

Press the **Source** softkey to select the trigger source to start a sweep. A sweep is one pass through the scan list.



| Softkey |      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source  | Auto | <div><div>Interval Menu</div><div><div>1</div></div><div><div>Source Auto</div><div>Ch Closed Pos Neg</div><div># Sweeps Infinite</div><div>Reset</div></div></div> <div>Selects an immediate trigger. When the scan is started, each sweep will start automatically.</div>                                                                                                                                                                                              |
|         | Time | <div><div>Interval Menu</div><div><div>00.000 s</div></div><div><div>Source Time</div><div>Ch Closed Pos Neg</div><div>Time</div><div># Sweeps Infinite</div><div>Reset</div></div></div> <div>Sets the instrument's internal timer to automatically start sweeps at a specific interval. Once you have selected this as the trigger source, press the <b>Time</b> softkey to configure the time interval between 0 seconds and 360,000 seconds (100:00:00 hours).</div> |

Manual



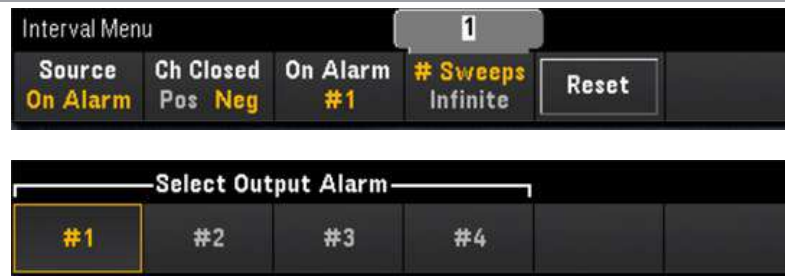
Selects manual trigger. A sweep is started manually by pressing the **[Scan/Start]** key once on the front panel.

External



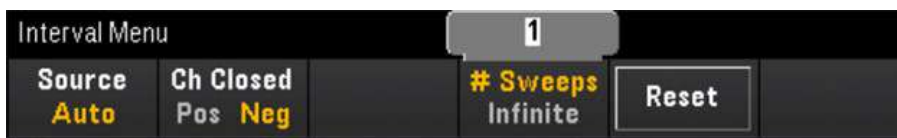
Starts a sweep when an external TTL-compatible trigger pulse is received from the Ext Trig/Alarms connector on the rear panel. Once you have selected this as the trigger source, press the **Ext Trig** softkey to specify the polarity of the Ext Trig signal as rising edge (**Pos**) or falling edge (**Neg**).

On Alarm



Starts a sweep when an alarm condition is detected during a scan, on the monitor channel, or on a DIO or Totalizer channel. Once you have selected this as the trigger source, press the **On Alarm** softkey to specify which of the four alarms will be used to report alarm conditions on the selected channel.

### Selecting the output trigger polarity



Press **Ch Closed** softkey to select the rising edge (**Pos**) or falling edge (**Neg**) as the Chan Closed signal on the rear panel Ext Trig/Alarm connector.

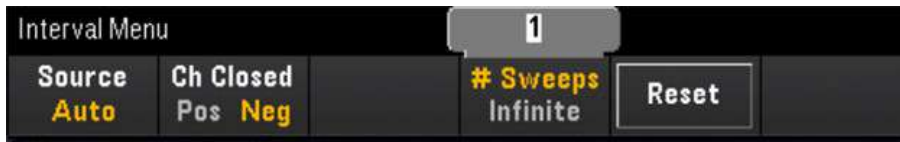
#### NOTE

The output trigger (channel closed signal) operates differently during internal or external scan.

- For internal scans (internal DMM enabled), it is generated at the **END** of a sweep, not the beginning of a sweep.
- For external scans (internal DMM disabled), it is generated when each channel is closed, and can be used to trigger the measurement on the external DMM.



## Specifying number of sweeps in the scan



Specifies the number of times that the instrument will sweep through the scan list (**# Sweeps**) or continuous sweeps (**Infinite**).

- **# Sweeps** – Specifies the number of times (between 1 to 1,000,000 sweeps) that the instrument will sweep through the scan list after the scan is started. Press **Reset** to reset the sweep count to 1.
- **Infinite** – Sets a scan to continue indefinitely until manually stopped using the front panel **[Scan/Start]** key, or the SCPI "ABORT" command is sent, or a "Device Clear" message is sent from the remote interface.

The instrument can hold up to 1,000,000 readings in reading memory, after which the **MEM** annunciator will be displayed indicating reading memory overflow. Any new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved.



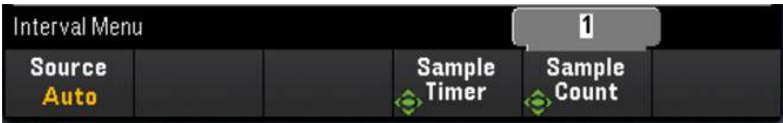
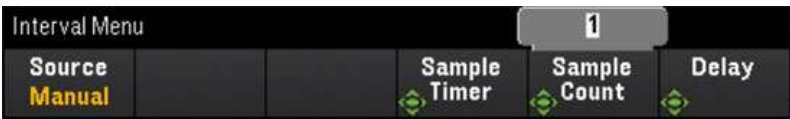
## [Interval] menu in DMM Digitize mode



### Selecting the trigger source

Press the **Source** softkey to select the trigger source.



| Softkey  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source   | <div>Auto</div>  <p>Selects an immediate trigger. The instrument will automatically trigger immediately when the <b>[Scan/Start]</b> key is pressed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Manual   | <div>Manual</div>  <p>The specified channel is triggered by pressing the <b>[Scan/Start]</b> key twice on the front panel. The first time the <b>[Scan/Start]</b> key is pressed, the channel is initialized. The second time the <b>[Scan/Start]</b> key is pressed, the channel is manually triggered and will begin the digitizing operation.</p>                                                                                                                                                                                                                       |
| External | <div>External</div>  <p>Selects external trigger. The instrument is triggered when an external TTL-compatible trigger pulse is received from the Ext Trig connector on the rear panel. Once you have selected this as the trigger source:</p> <ul style="list-style-type: none"> <li>– You may press the <b>Ext Trig</b> softkey to specify the polarity of the Ext Trig signal as rising edge (<b>Pos</b>) or falling edge (<b>Neg</b>).</li> <li>– You may also press the <b>PreTrigger Count</b> softkey to specify a pretrigger count between 0 to 999,999.</li> </ul> |



Selects level trigger. The instrument is triggered when the specified measurement threshold condition is met.

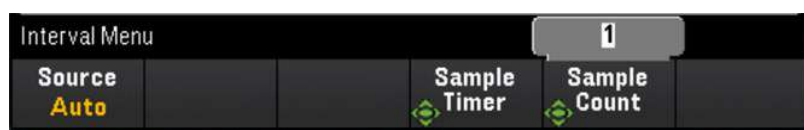
- You may press the **Ext Trig** softkey to specify the polarity of the Ext Trig signal as rising edge (**Pos**) or falling edge (**Neg**).
- You may also press the **PreTrigger Count** softkey to specify a pretrigger count between 0 to 999,999.

#### NOTE

After specifying a pretrigger count, readings are taken and held in a buffer while waiting for the trigger event to occur. When the trigger event occurs, the buffered readings are transferred to reading memory and the remaining readings are recorded as usual. If the trigger event occurs before Pretrigger Count readings have been taken, the trigger event will still take effect and digitizing will complete without having taken all of the pretrigger readings.

The Pretrigger Count is limited to one less than the total number of readings specified to be taken by the Sample Count setting. If Sample Count = 1, the **Pretrigger** softkey will be hidden.

## Specifying the Sample Timer

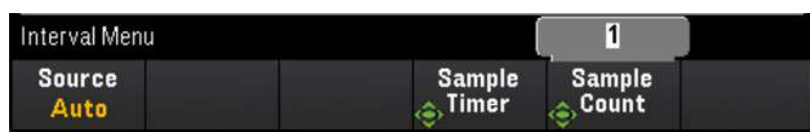


| Softkey      | Description                                                                                                |
|--------------|------------------------------------------------------------------------------------------------------------|
| Sample Timer | Use the knob or arrow key to specify the sample timer (time between samples) between 20 $\mu$ s to 3600 s. |

#### NOTE

This configured value for Sample Timer will remain even though you have changed the channel's measurement function in the **[Channel]** menu.

## Specifying the Sample Count



| Softkey      | Description                                                                                                                          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Sample Count | Use the knob or arrow key to specify the total number of samples to digitize between 1 sample up to a maximum of 50,331,648 samples. |

#### NOTE

This configured value for Sample Count will remain even though you have changed the channel's measurement function in the **[Channel]** menu.

When Pretrigger Count  $\neq$  0, the instrument will limit the Sample Count to 1,000,000.

## Specifying the delay time

Press the **Delay** softkey and use the knob or arrow keys to set a time delay prior to digitizing.

### NOTE

The **Delay** option will not be available in these configurations:

- When **Source > Auto** is selected.
  - When a **PreTrigger Count** value is set.
-

[Interval] menu in Digitizer mode.

NOTE

This menu is only available when the DAQM909A module is plugged in.

The interval configurations will be reset to the default values when **Pwr. Alys** (Power Analysis) is enabled in [Channel] menu.

Specifying the Trigger Settings

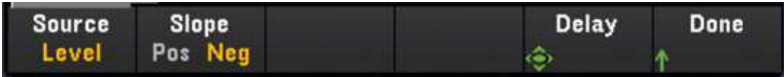
Press **Trigger Settings** > **Source** softkey to select the trigger source.

| Softkey |          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source  | Auto     | <div><div>Source Auto</div><div>Done</div></div> <p>The specified digitizer channel will automatically trigger immediately when the [Scan/Start] key is pressed.</p>                                                                                                                                                                                                                                                                                                                                                                                                   |
|         | Manual   | <div><div>Source Manual</div><div>Delay Done</div></div> <p>The specified digitizer channel is triggered by pressing the [Scan/Start] key twice on the front panel. The first time the [Scan/Start] key is pressed, the digitizer channel is initialized. The second time the [Scan/Start] key is pressed, the digitizer channel is manually triggered and will begin the digitizing operation. You may press the <b>Delay</b> softkey and use the knob or arrow keys to specify a delay time prior to digitizing.</p>                                                 |
|         | External | <div><div>Source Ext Trig Pos Neg</div><div>Delay Done</div></div> <p>The specified digitizer channel is triggered when an external TTL-compatible trigger pulse is received from the Ext Trig connector on each DAQM909A plug-in module. Once you have selected this as the trigger source, you may press the <b>Ext Trig</b> softkey to specify the polarity of the Ext Trig signal as rising edge (<b>Pos</b>) or falling edge (<b>Neg</b>). You may press the <b>Delay</b> softkey and use the knob or arrow keys to specify a delay time prior to digitizing.</p> |

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Keysight DAQ970A/DAQ973A User's Guide

| Softkey | Description |
|---------|-------------|
| Source  | Level       |

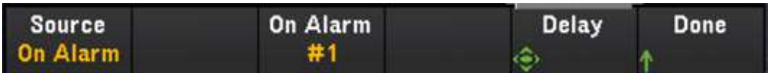


The specified digitizer channel is triggered when the input signal crosses the specified trigger level at the specified slope. Once you have selected this as the trigger source, you may press the **Slope** softkey to specify the polarity of the internal trigger signal as rising edge (**Pos**) or falling edge (**Neg**). You may press the **Delay** softkey and use the knob or arrow keys to specify a delay time prior to digitizing.

**NOTE**

Please refer to Level triggering for more information.

|          |          |          |       |      |
|----------|----------|----------|-------|------|
| On Alarm | Source   | On Alarm | Delay | Done |
|          | On Alarm | #1       |       |      |



The specified digitizer channel is triggered when an alarm condition is detected. Press the **On Alarm** softkey to specify which of the four alarms will be used to trigger the channel when the alarm conditions are met. You may press the **Delay** softkey and use the knob or arrow keys to specify a delay time prior to digitizing.

|         |         |       |      |
|---------|---------|-------|------|
| Channel | Source  | Delay | Done |
|         | Channel |       |      |



The specified digitizer channel is triggered when its master channel is triggered. Any digitizer channels can be configured and selected as the master channel even the channel is from different module. You may press the **Delay** softkey and use the knob or arrow keys to specify a delay time prior to digitizing.

**NOTE**

The Channel option will only be available once the conditions below are met:

- One of the digitizer channels must first be configured as the trigger channel before the option of selecting Channel as a source is made available to the rest of the digitizer channels.
- The trigger source of the trigger channel is not set to Auto.

Rules for configuring a trigger channel:

- The trigger source of the trigger channel cannot be set to Auto.
- A digitizer channel cannot select itself as trigger channel.
- A channel can be the trigger master of multiple channels, but a channel cannot have multiple trigger channels.
- When dealing with a chain of trigger channels, a trigger channel cannot be a child channel of another trigger channel in the chain.
- Trigger channel configurations will return to default upon disabling the digitizer channel.

Specifying the Arm Settings

Press the Arm Settings softkey to specify the digitizer's arm settings.



NOTE

The **Source** softkey will not be available for configuration when **DMM Digitize** data acquisition mode is enabled on another plug-in module's channel.

| Softkey                                                                                                                                                                                               |       | Description                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------|
| Source                                                                                                                                                                                                | Auto  | The digitizer is armed upon entering the Wait for Arm state (Immediate arming).                           |
|                                                                                                                                                                                                       | Sweep | The digitizer channel is armed at the start of each sweep during the scanning on the multiplexer modules. |
| <div>NOTE</div> <div>The <b>Sweep</b> option will only be available when these plug-in modules are inserted and configured on the instrument: DAQM900A, DAQM901A, DAQM902A, DAQM907A, DAQM908A.</div> |       |                                                                                                           |
| Arm Count                                                                                                                                                                                             |       | Press the <b>Arm Count</b> softkey and use the knob or arrow keys to specify the number of Arm Count.     |

Specifying the Sample Settings

Press the Sample Settings softkey to specify the digitizer's trigger settings.



| Softkey          |                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trigger Settings | Samp Rate        | <div><div>800K</div><div>400K</div><div>200K</div><div>100K</div><div>50K</div><div>More 1 of 2</div></div> <div>Press the <b>Samp Rate</b> softkey to set your desired sampling rate (in Hz). You may choose a sampling rate from the options provided, ranging between 1.5625 KHz to 800 KHz.</div> <div>NOTE</div> <div>The same configured sampling rate value will be reflected across all channels in the DAQM909A module with the same ADC filter.</div> |
|                  | Sample Count     | Press the <b>Sample Count</b> softkey and use the knob or arrow keys to specify the number of sample counts.                                                                                                                                                                                                                                                                                                                                                    |
| PreTrigger Count | PreTrigger Count | Press the <b>PreTrigger Count</b> softkey and use the knob or arrow keys to specify the number of pretrigger count.                                                                                                                                                                                                                                                                                                                                             |
|                  |                  | <div>NOTE</div> <div>The number of <b>Pretrigger Count</b> is limited to one less than the specified number of <b>Sample Count</b>.</div> <div>The <b>PreTrigger Count</b> setting will not be available when <b>Source</b> &gt; <b>Auto</b> is selected.</div>                                                                                                                                                                                                 |

**NOTE**

The instrument allocates a fixed amount of memory for DAQM909A plug-in modules. This memory is equally divided by the total number of digitizer channels available, which is based on the number of DAQM909A module inserted into the instrument.

Since each digitizer channel is allocated with a fixed amount of memory, in your application, you may choose to use up the entire memory for a single record with a maximum sample count, or you may choose to have multiple records with less sample count.

The number of record for a digitizer channel is determined by the specified number of Arm Count. So, in order to get the maximum number of record, set the sample count to minimum.

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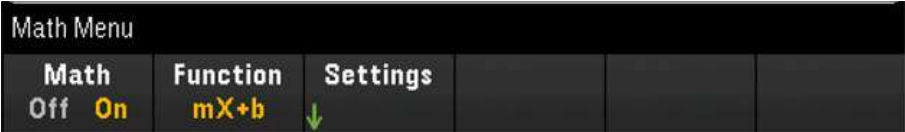
# [Math] Menu

NOTE

The [Math] menu features will not be available when **DMM Digitize**, or **Digitizer** is selected as the data acquisition mode.

You must configure the channel before applying any scaling values.

In the Math menu page, press the **Math** softkey to enable (**On**) or disable (**Off**) measurement scaling.



NOTE

Math is set to Off when you change measurement functions (for example, changing from DCV to ACV). You must re-enable math after changing measurement functions.

Press the **Function** softkey to select a scaling function on the selected channel. The **dBm** and **dB** functions are only available on channels configured to measure DC or AC voltage.



Selects a scaling function and press **Settings** softkey to perform various scaling settings. Scaling values are saved in non-volatile memory for the selected channel.

## mX+b Scaling

mX+b scaling function allows you to perform a linear scaling with offset operation, by applying a gain (m) and offset (b) values to all readings on a selected channel during a scan. To configure, select scaling function as **mX+b** and press **Settings** to open the configuration menu.



| Softkey        | Description                                                                                                                          |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Gain (m)       | Use the knob or front panel arrow keys to set the Gain value.                                                                        |
| Offset (b)     | Use the knob or front panel arrow keys to set the Offset value.                                                                      |
| Measure Offset | Press <b>Measure Offset</b> softkey to perform an immediate offset measurement and save the offset value for subsequent measurement. |
| Clear Offset   | Press <b>Clear Offset</b> to clear the offset values to 0.                                                                           |



|            |                    |                                                                                                                                                                                                                                                                                   |
|------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| User Units | User Units On/ Off | Press <b>User Units</b> > <b>User Units Off/On</b> to display ( <b>On</b> ) or turns off ( <b>Off</b> ) user-defined measurement units. Selecting <b>On</b> will display unit as defined by the <b>Edit Units</b> softkey; selecting <b>Off</b> will display default units (VDC). |
|            | Edit Units         | Press <b>User Units</b> > <b>Edit Units</b> to specify a string containing up to three characters that will be shown in place of the standard measurement units. These units are subsequently used for the entry of various instrument settings such as limits and graph scaling. |
|            | Default Units      | Press <b>Default Units</b> to return the unit to the default units for the selected measurement type. For example, if you configure the selected channel as temperature measurement, pressing this softkey will return the default unit into °C.                                  |

## % Scaling

% performs a percent change operation. The result is the difference between the reading and the reference value, expressed in percentage:

To configure, select scaling function as % and press Settings to open the configuration menu.

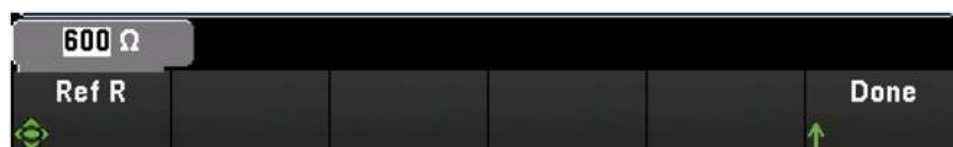


| Softkey           | Description                                                                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ref Value         | Use the knob or front panel arrow keys to set the Reference value.                                                                                                                                                |
| Measure Reference | Press <b>Measure Reference</b> softkey to perform an immediate reference measurement and saves the reference value for subsequent measurements, or press <b>Ref Value</b> softkey to specify the reference value. |
| Default Reference | Press <b>Default Reference</b> softkey to set the reference value to its factory default settings.                                                                                                                |

## dBm Scaling

Selects dBm scaling for the present measurement function. The result is a calculation of power delivered to a reference resistance (specified using the Ref R softkey), relative to 1 milliwatt.

To configure, select scaling function as **dBm** and press **Settings** to open the configuration menu.



The reference resistance value (Ref R) may be 50, 75, 93, 110, 124, 125, 135, 150, 250, 300, 500, 600 (default), 800, 900, 1000, 1200, or 8000 Ω. Press **Ref R** to specify the reference resistance value for converting voltage measurements to dBm.

## dB Scaling

Selects dB scaling for the present measurement function. The result is the difference between the input signal and a stored dB relative reference value, with both values converted to dBm:

To configure, select scaling function as **dB** and press **Settings** to open the configuration menu.



The reference value can be a measurement converted to dBm (**Measure Ref Value** softkey), or you can specify a reference value (**dB Ref Value** softkey). Press **Clear dB Ref** to clear the reference value for dB measurements.

## [Copy] Menu

### NOTE

Source channel (channel to copy the configuration from) must be included in the scan list before performing this feature.

Copy/paste operation only available for channels with the similar measurement function (for example, from DCV to DCV); where the start channel and end channel are from the similar module slot.

The [Copy] menu features will not be available when **DMM Digitize** is selected as the data acquisition mode.

Press **[Copy]** key on the front panel to copy the measurement configuration from the selected channel(s) to other channel(s). This feature makes it easy to configure several channels for the same measurement. When you copy the configuration from one channel to another, other configuration information such as measurement function, scaling function, alarm configuration, and advanced measurement configurations are automatically copied to other channel(s).

Three options are available:

### Copy/paste from a single channel to a single channel (one-to-one)

For example, to copy/paste the measurement configuration from channel 01 to channel 02:

1. Press **[Channel]** and use the knob or the front panel arrow keys to configure channel 01 as DCV (Autorange).



2. Press **[Copy]** > **Source Chan(s)**. Both **Start Channel** and **End Channel** will be displayed with the selected channel 01 as there is no any other configured source channel except this channel. Press **Done** to exit this menu.



3. Press **Dest. Chan(s)** to select the destination channel for the paste operation. The instrument will automatically select the subsequent channel as default choice of destination channel. In this example, use the knob or the front panel arrow keys to determine both **Start Channel** and **End Channel** as channel 02. Press **Done** to proceed.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 102        |
| CH 101 Armature relay MUX Channel | CH 102        |
| 1 CH SELECTED                     | 1 CH SELECTED |

- Press **Copy Now**. The measurement configuration from channel 01 will copy to channel 02. "COMPLETE" message will prompt out at the bottom of the screen when the operation is completed. Press **Copy Now** again to repeatedly copy the same configuration to the new selected channels (channel 03, channel 04, and so on).



### Copy/paste from a single channel to multiple channels (one-to-many)

For example, to copy/paste the measurement configuration from channel 01 to channel 02 and 03:

- Press **[Channel]** and use the knob or the front panel arrow keys to configure channel 01 as DCV (Autorange).
- Press **[Copy]** > **Source Chan(s)**. Both **Start Channel** and **End Channel** will be displayed with the selected channel 01 as there is no any other configured source channel except this channel. Press **Done** to exit this menu.
- Press **Dest. Chan(s)** to select the destination channel for the paste operation. The instrument will automatically select the subsequent channel as default choice of destination channels. In this example, use the knob or the front panel arrow keys to determine both Start Channel as channel 02 and End Channel as channel 03. Press **Done** to proceed.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 102        |
| CH 101 Armature relay MUX Channel | CH 103        |
| 1 CH SELECTED                     | 2 CH SELECTED |

- Press **Copy Now**. The measurement configuration from channel 01 will copy to both channel 02 and 03. "COMPLETE" message will prompt out when the operation is completed. Press **Copy Now** again to repeatedly copy the same configuration to the new selected channels (channel 04, channel 05, and so on).



## Copy/paste from multiple channels to multiple channels (many-to-many)

For example, to copy/paste the measurement configuration from channels 01 through 04 to channels 05 through 08:

1. Press **[Channel]** and use the knob or the front panel arrow keys to configure the source channels as below:
  - Channel 01 and 02 (DCV with Autorange)
  - Channel 03 and 04 (2-wire resistance with the range of 100  $\Omega$ )
2. Press **[Copy]** > **Source Chan(s)**. Use the knob or the front panel arrow keys to determine the **Start Channel** as channel 01 while **End Channel** as channel 04. Press **Done** to exit this menu.
3. Press **Dest. Chan(s)** to select the destination channel for the paste operation. The instrument will automatically select the subsequent channel as default choice of destination channels. In this example, use the knob or the front panel arrow keys to determine both **Start Channel** as channel 05.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 105        |
| CH 104 Armature relay MUX Channel | CH 108        |
| 4 CH SELECTED                     | 4 CH SELECTED |

End Channel softkey is unavailable in this option, instrument will automatically perform the copy/paste operation into the next N subsequent destination channels based on the N selected of source channels. For example, if you set the Start Channel as channel 06, destination channels selected will be channels 06 through 09. Press Done to proceed.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 106        |
| CH 104 Armature relay MUX Channel | CH 109        |
| 4 CH SELECTED                     | 4 CH SELECTED |

4. Press **Copy Now**. The measurement configuration from channels 01 through 04 will copy to channels 06 through 09. "COMPLETED" message will prompt out when the operation is completed. Press **Copy Now** again to repeatedly copy the same configuration to the new selected channels (channels 09 through 11, and so on).

| Copy <span>M</span>               |               |
|-----------------------------------|---------------|
| Configuration Summary             |               |
| SOURCE CHAN(S)                    | DEST. CHAN(S) |
| CH 101 Armature relay MUX Channel | CH 110        |
| CH 104 Armature relay MUX Channel | CH 113        |
| 4 CH SELECTED                     | 4 CH SELECTED |
| COMPLETED                         |               |

# [Alarm] Menu

Press **[Alarm]** key on the front panel to configure alarm on the selected channel. There are four configurable alarms in this instrument. You must configure the channel before setting any alarm limits. If you change the measurement configuration, alarms are turned off and the limit values are cleared. If you plan to use **scaling function** on a channel which will also use alarms, be sure to configure the scaling values first.

NOTE

The [Alarm] menu features will not be available when **DMM Digitize**, or **Digitizer** is selected as the data acquisition mode.

## Configuring alarms limits on multiplexer modules

1. In Alarm menu page, press **Output** softkey to select which of the four alarms will be used to report alarm conditions on the selected channel. You can assign multiple channels to any of the four available alarms (numbered 1 through 4).



2. Press Alarm to disable (Off) or specify an alarm limit (high, low, or both), and then press **Set Limits** to determine the limit value. The instrument will generate an alarm when a scanned or monitor reading exceeds the specified limit.

| Alarm softkey | Set Limits softkey                                                                                                                                                                                       |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Off           | N/A - Alarm is disabled                                                                                                                                                                                  |
| High + Low    | Specify the limits as high and low values, or as a center value with a span around the center value. Pressing either the 1 <sup>st</sup> or 2 <sup>nd</sup> softkey will toggle between the two options. |
|               |                                                                                                                                                                                                          |
| High          | Specify the upper limit value using the knob or front panel arrow keys. The upper limit value must always be greater than or equal to the lower limit.                                                   |
|               |                                                                                                                                                                                                          |
| Low           | Specify the lower limit value using the knob or front panel arrow keys. The lower limit value must always be less than or equal to the upper limit.                                                      |
|               |                                                                                                                                                                                                          |

3. Press **Clear** to return the limit value to the default value, 0.
4. Press **[Scan/Start]** to initiate the scan and save the readings in reading memory. If an alarm occurs on a channel as it is being scanned, then that channel's alarm status is saved in reading memory as the readings are taken. Each time you start a new scan, the instrument clears all readings (including alarm data) stored in reading memory from the previous scan.
5. As alarms are generated, they are also logged in an alarm queue, which is separated from reading memory. Press **[View] > Alarms** to display the alarm queue.

## Configuring alarm limits with the multifunction module

You can configure the DAQM907A multifunction module to generate an alarm when a specific bit pattern or bit pattern change is detected on a digital I/O channels (channel 01 and 02) or when a specific count is reached on a totalizer channel (channel 03).

### To configure an alarm on a digital I/O channel

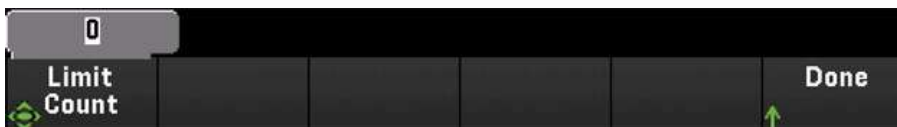
1. On a multifunction module slot, press **[Alarm]** and select the digital I/O channel.
2. Press **Set Pattern > Pattern**, and use the knob or the front panel arrow keys to set the digital mask data for 8-bit digital pattern comparison.



3. Sets each bit to "0", "1", or "X" by pressing the **Set to all 0's**, **Set to all 1's**, or **Set to all X's** softkeys. Bits set to "X" are excluded from the digital pattern comparison.
4. Press **Fail On** to configure the selected channel to generate an alarm when a specific 8-bit pattern read is equal or not equal to the digital data read.

### To configure an alarm on a totalizer channel

1. On a multifunction module slot, press **[Alarm]** and select the totalizer channel.
2. Press **Set Limits > Limit Count** to specify the limit count. An alarm will be generated when a specific count is reached during scanning.





## Alarm limit indications

The display uses colors to indicate limits and limit violations.

### Number

The bright red color (shown below) indicates that the displayed measurement exceeds the limits.



### Bar Meter

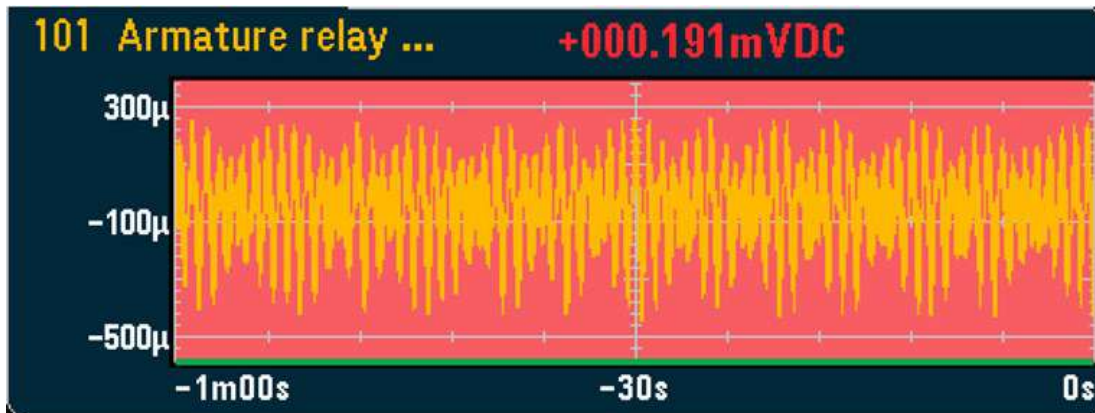
The bar meter (below) uses the same color scheme. The following example shows a limit violation. The word **FAIL** indicates that a limit has been exceeded.





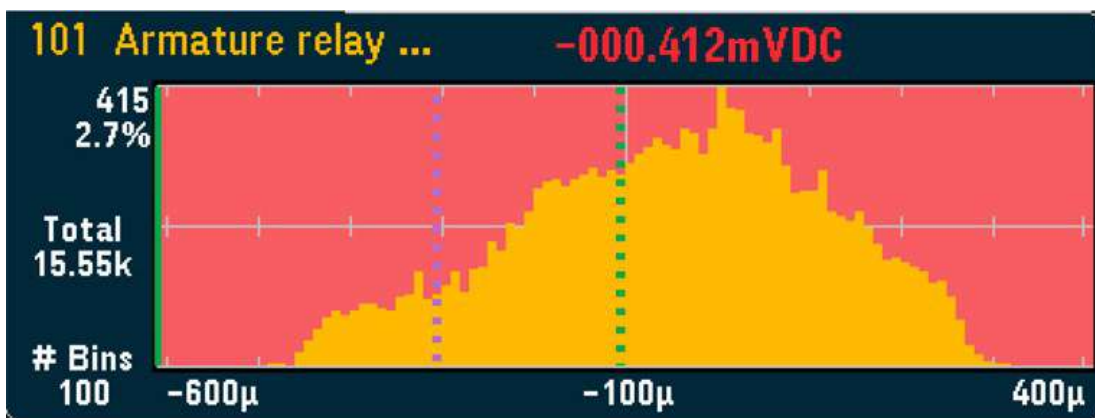
## Trend Chart

The trend chart (below) uses the same color scheme. The following example shows a limit violation.



## Histogram

The histogram (below) uses the same color scheme. The following example shows a limit violation.



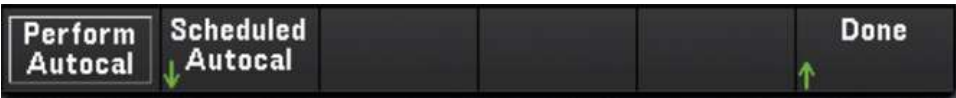
[Utility] Menu



Self Test

Self-test verifies proper instrument operation. See *Keysight DAQ970A/DAQ973A Service Guide* for details about the self-test procedures.

Autocal

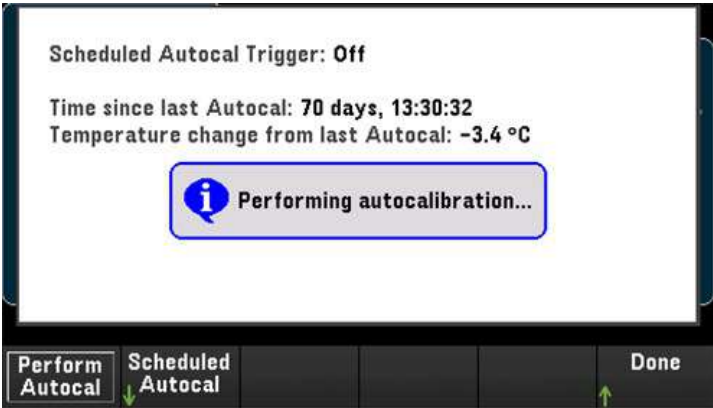


Autocalibration

Autocalibration compensates for internal drifts in the internal DMM or on DAQ970A/DAQ973A modules caused by time and temperature change. This can help to eliminate the errors to achieve a better performance. For DAQ970A/DAQ973A, autocalibration is performed on the internal DMM, on the DAC output and sense channels (channels 04 through 07) on the DAQM907A multifunction module, and the DAQM909A Digitizer module.

| Softkey | Description |
|---------|-------------|
|---------|-------------|

Perform Autocal      To perform autocalibration, press **Perform Autocal** softkey and the screen below will be displayed.

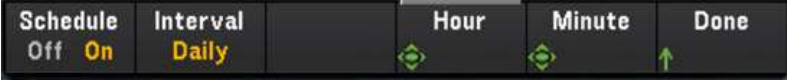
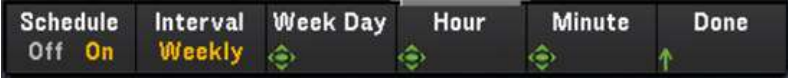


The estimated duration of autocalibration process with the relevant individual module is as below:

| Area         | Estimated Time (s) | Example of Total Duration Calculation                                                                                    |
|--------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|
| Internal DMM | ~15 seconds        | Full autocalibration with 3 x DAQM909A in one mainframe:<br>Internal DMM + (3 x DAQM909A) = ~15 s + (3 x ~20 s) = ~ 75 s |
| DAQM907A     | ~ 6 seconds        |                                                                                                                          |
| DAQM909A     | ~20 seconds        |                                                                                                                          |

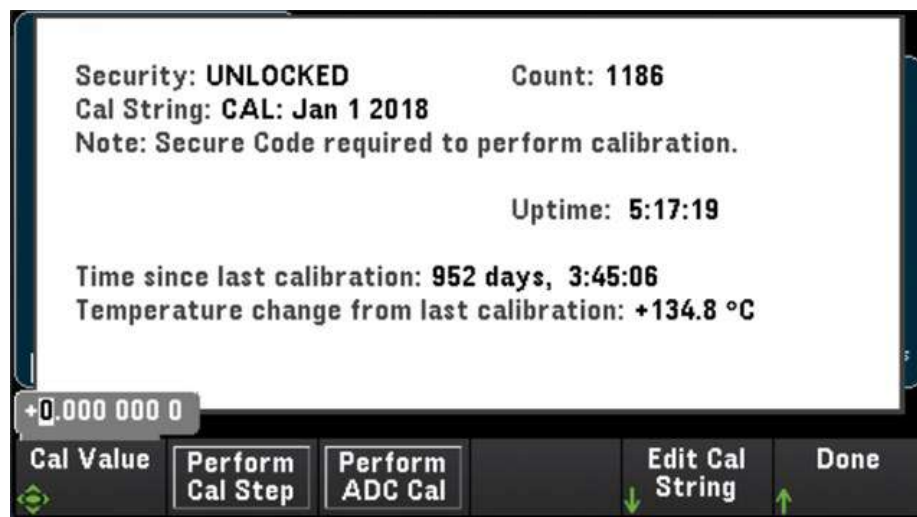
## Scheduled Autocalibration

You can also schedule the instrument to perform autocalibration based on a scheduled time. To use this feature, press **Scheduled Autocal** > **Schedule** > **On**. To specify the frequency, press **Interval** > **Daily**/ **Weekly**/ **Monthly**.

| Softkey  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interval | Daily                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|          |  <ol style="list-style-type: none"> <li>To schedule the instrument to perform daily autocalibration, press <b>Interval</b> &gt; <b>Daily</b></li> <li>To set the time for daily autocalibration, press the <b>Hour</b>, or the <b>Minute</b> softkeys respectively and use the knob or front panel arrow keys to set your desired time of the day. Once complete, press <b>Done</b>.</li> </ol>                                                     |
|          | Weekly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|          |  <ol style="list-style-type: none"> <li>To schedule the instrument to perform weekly autocalibration, press <b>Interval</b> &gt; <b>Weekly</b></li> <li>To set the day and time for weekly autocalibration, press the <b>Week Day</b>, the <b>Hour</b>, or the <b>Minute</b> softkeys respectively and use the knob or front panel arrow keys to set your desired day of the week and time of the day. Once complete, press <b>Done</b>.</li> </ol> |
|          | Monthly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|          |  <ol style="list-style-type: none"> <li>To schedule the instrument to perform weekly autocalibration, press <b>Interval</b> &gt; <b>Monthly</b></li> <li>To set the day and time for monthly autocalibration, press the <b>Day</b>, the <b>Hour</b>, or the <b>Minute</b> softkeys respectively and use the knob or front panel arrow keys to set your desired day of the month and time of the day. Once complete, press <b>Done</b>.</li> </ol>   |

## Calibrate

Calibrate accesses the instrument calibration procedure. See *Keysight DAQ970A/DAQ973A Service Guide* for further details.



Security

**Security** shows current instrument security status and enables you to lock or unlock the instrument or enter a new secure code. The instrument must be unlocked to perform calibration, update firmware, or change the secure code.

If Secure Mode is enabled, this shows an overview of instrument I/O settings and provides access to the NISPOM Sanitize function and I/O configuration. The instrument must be unlocked to perform NISPOM Sanitize or to enable or disable I/Os. The Secure Count increments whenever any operation requiring the secure code is performed.



| Softkey                                                                              | Description                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| New Code                                                                             | Press the <b>New Code</b> softkey to enter and set a new secure code for unlocking the instrument security. The code must start with a letter and may have up to 12 letters, digits, or the underscore character.                                                                                                  |
| LOCK                                                                                 | Locks instrument security using the current secure code. Secure code is set to "DAQ970A" for both DAQ970A, and DAQ973A models at the factory.                                                                                                                                                                      |
| Secure                                                                               | Toggling the <b>Secure</b> softkey will enable ( <b>On</b> ) or disable ( <b>Off</b> ) the instrument security. When <b>On</b> , <b>NISPOM Sanitize</b> softkey will appear and security must be unlocked to make changes to I/O enables and configuration.                                                        |
| NISPOM Sanitize                                                                      | Press the <b>NISPOM Sanitize</b> softkey to sanitize all user-accessible instrument memory except for the calibration constants. This complies with requirements in chapter 8 of the National Industrial Security Program Operating Manual (NISPOM). When Off, I/O changes can be made without unlocking security. |
| <div>NOTE</div> The instrument will reboot itself once the sanitization is complete. |                                                                                                                                                                                                                                                                                                                    |

CAUTION

The NISPOM Sanitize softkey and the SYSTem:SECurity:IMMEdiate command are equivalent. They are for customers, such as military contractors, who must comply with NISPOM.

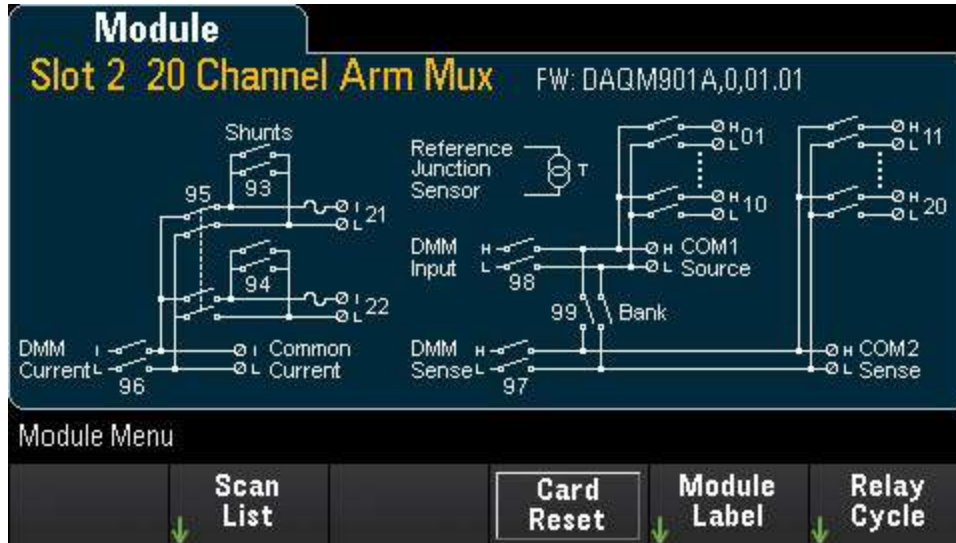
This feature destroys all user-defined state information, measurement data, and user-defined I/O settings such as the IP address. This feature is not recommended for use in routine applications because of the possibility of unintended data loss.

Admin

Press **Admin** > **Firmware Update** to update the instrument firmware to a new version. See **Firmware Update** for more details.

## [Module] Menu

Press the **[Module]** key to access the Module menu. In the Module page, you can view the instrument's scan list, reset the modules, rename the label of a module, and check the relay cycles of the internal DMM and the plug-in modules.



## Scan List

### NOTE

The options is only available when **Scan** is selected as the data acquisition mode.

Press the **Scan List** softkey to view the available channels on the module that are included in the scan list (Scan Status = ON). Press **Remove From Scan** softkey to turn off measurements on all channels on the module, and remove the channels from the scan list. If the channel list is longer than one page, press the up/down arrow keys on the front panel to scroll through the other pages.

| Scan Status                    |             |
|--------------------------------|-------------|
| Channel                        | Scan Status |
| 201 Armature relay MUX Channel | OFF         |
| 202 Armature relay MUX Channel | OFF         |
| 203 Armature relay MUX Channel | OFF         |
| 204 Armature relay MUX Channel | OFF         |
| 205 Armature relay MUX Channel | OFF         |
| 206 Armature relay MUX Channel | OFF         |
| 207 Armature relay MUX Channel | OFF         |
| 208 Armature relay MUX Channel | OFF         |
| Current Page: 1/3              |             |
| <b>Remove From Scan</b>        | <b>Done</b> |

## Card Reset

### NOTE

The options is only available when **Scan** is selected as the data acquisition mode.

Press the **Card Reset** softkey to reset the module. This opens all the channels on the module. On the multifunction module, this also configures the digital I/O ports as inputs and sets the DAC outputs to voltage mode (if not locked) and the output level to 0.

## Module Label

Press Module Label softkey to specify a label for current selected module. Use the knob or the front panel arrow keys to enter the characters into the display. Note that you are only allowed to enter maximum of 10 characters for the module label, including letters, numbers, and special characters. To reset it to the default module label, press **Module Label > Clear All > Done**.





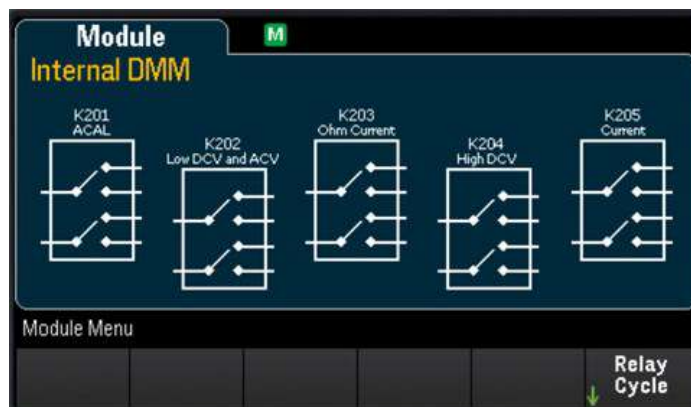
## Relay Cycle

Press the **Relay Cycle** softkey to view the number of cycles on each relay in the internal DMM and plug-in modules. Use this feature to track relay failures and predict system maintenance requirements. For more details, see [Relay Life and Preventive Maintenance](#).

| Relay Cycles                   |             |
|--------------------------------|-------------|
| Channel                        | User Cycles |
| 201 Armature relay MUX Channel | 6497        |
| 202 Armature relay MUX Channel | 5609        |
| 203 Armature relay MUX Channel | 1489        |
| 204 Armature relay MUX Channel | 1427        |
| 205 Armature relay MUX Channel | 1079        |
| 206 Armature relay MUX Channel | 1050        |
| 207 Armature relay MUX Channel | 797         |
| 208 Armature relay MUX Channel | 229         |
| Current Page: 1/4              |             |
| Done                           |             |

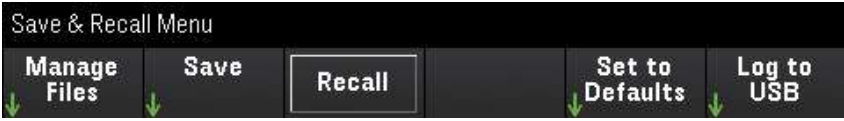
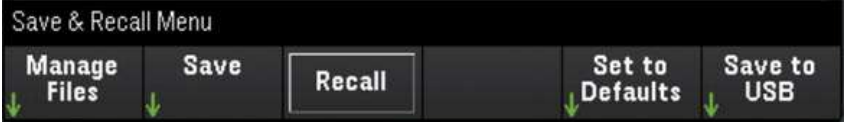
### NOTE

To access the Internal DMM page in the **Module** menu, turn the knob counter-clockwise, or press the left arrow key until you see the Internal DMM module page appear. After that, press the Relay Cycle softkey to view the relay cycle of the internal DMM.



| Relay Cycles                         |             |
|--------------------------------------|-------------|
| Channel                              | User Cycles |
| 001 Non-controllable Internal Switch | 499         |
| 002 Non-controllable Internal Switch | 423         |
| 003 Non-controllable Internal Switch | 487         |
| 004 Non-controllable Internal Switch | 335         |
| 005 Non-controllable Internal Switch | 497         |
| Current Page: 1/1                    |             |

## [Save Recall] Menu

| Data Acquisition Mode   | [Save Recall] menu softkeys                                                        |
|-------------------------|------------------------------------------------------------------------------------|
| Scan                    |  |
| DMM Digitize, Digitizer |  |

## Manage Files

The **Manage Files** softkey allows you to create, copy, delete, and rename files and folders in the instrument's internal flash memory or on a USB drive attached to the front panel. Upon pressing the **Manage Files** softkey, the following options will appear:



| Softkey      | Description                                                                                                                                                                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action:      | <div>Delete</div> <ol style="list-style-type: none"> <li>To delete a file or folder, press <b>Delete</b> &gt; <b>Browse</b> to navigate the file directory to locate the desired file or folder in the directory.</li> <li>Once the desired file or folder is highlighted, press <b>Select</b> &gt; <b>Perform Delete</b> &gt; <b>Done</b>.</li> </ol>      |
|              | <div>Folder</div> <ol style="list-style-type: none"> <li>To create a new folder, press <b>Folder</b> &gt; <b>Browse</b> to navigate the file directory to the location you wish to create the new folder in.</li> <li>Press <b>File Name</b>, enter your desired folder name and press <b>Done</b>. Press <b>Create Folder</b> &gt; <b>Done</b></li> </ol>  |
|              | <div>Copy</div> <ol style="list-style-type: none"> <li>To copy a file or folder, press <b>Copy</b> &gt; <b>Browse</b> to navigate the directory to the file or folder you wish to copy and press <b>Select</b>.</li> <li>Press <b>Copy Path</b> and select an internal or external path for copying. Press <b>Perform Copy</b> &gt; <b>Done</b>.</li> </ol> |
|              | <div>Rename</div> <ol style="list-style-type: none"> <li>To rename a file or folder, press <b>Rename</b> &gt; <b>Browse</b> to navigate the directory to the file or folder you wish to rename and press <b>Select</b>.</li> <li>Press <b>New Name</b>, enter a new name and press <b>Done</b>. Press <b>Perform Rename</b> &gt; <b>Done</b>.</li> </ol>    |
| Browse       | The <b>Browse</b> softkey opens up the file directory where you can select the file or folder upon which the action will be performed. Use the knob, front panel arrow keys, and <b>[Select]</b> to navigate through the file directory. The left and right arrow keys collapses or expands a folder.                                                       |
| Copy Path    | The <b>Copy Path</b> softkey selects an internal or external folder path for copying. Use the knob, front panel arrow keys, and <b>[Select]</b> to navigate through the file directory. The left and right arrow keys collapses or expands a folder.                                                                                                        |
| Perform Copy | The <b>Perform Copy</b> softkey copies the selected file or folder to its new location.                                                                                                                                                                                                                                                                     |

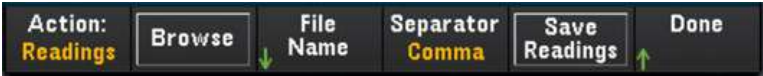


## Save

The **Save** softkey allows you to save the instrument's state, user's preferences, and screenshots of the display.

### NOTE

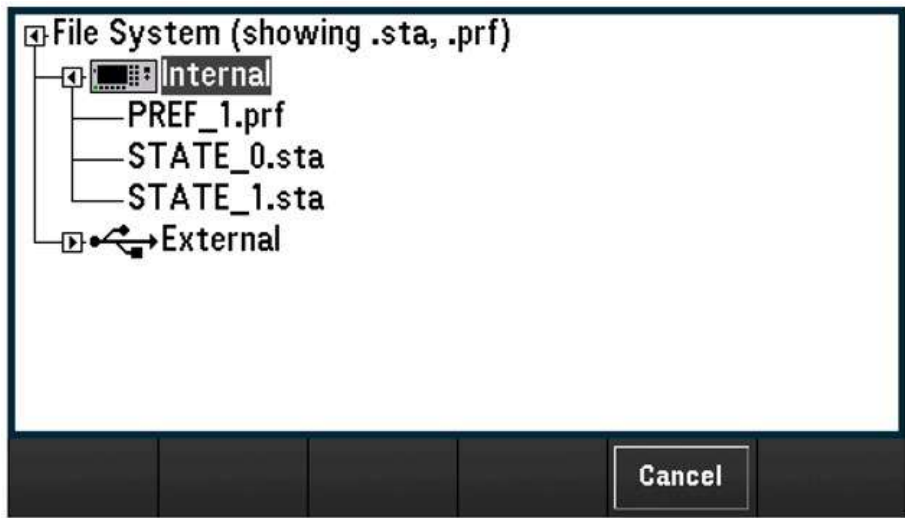
The options on 4<sup>th</sup> softkey will change in accordance to the option chosen on the [Action:] softkey

| Softkey  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action:  | State                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|          |  <p>Saves the current instrument's state or user's preference. The files may have any name, but ends with the (.sta) extension for State files and (.prf) extensions for Preference files respectively. Instrument states saved by the SCPI (*SAV command) are saved in file names STATE_0.sta through STATE_4.sta.</p> <ol style="list-style-type: none"> <li>To save the instrument's state or user's preference, press <b>State</b> &gt; <b>Browse</b> to navigate the file directory to the location you wish to save the file in and press <b>Select</b>.</li> <li>Press <b>File Name</b>, enter a file name and press <b>Done</b>.</li> <li>Press the <b>State/Preference</b> softkey to toggle between saving the current instrument's state (State) or user's preference (Preference).</li> <li>Press the <b>Save State/ Save Preference</b> softkey to save the current instrument's state or user's preference in designated location in the file directory.</li> </ol> |
|          | <div> <div>NOTE</div> <div> <p><b>State:</b> Saves the measurement configuration including channel configurations and scan settings.</p> <p><b>Preference:</b> Saves non-volatile settings associated with instrument, including user's preferences and I/O settings.</p> </div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Readings |  <ol style="list-style-type: none"> <li>To save the measurement readings, press <b>Readings</b> &gt; <b>Browse</b> to navigate the file directory to the location you wish to save the file in and press <b>Select</b>.</li> <li>Press <b>File Name</b>, enter a file name and press <b>Done</b>.</li> <li>Press the <b>Separator</b> softkey to specify the character (<b>Comma</b>, <b>Tab</b>, or <b>Semicolon</b>) which will be used to separate information on each row.</li> <li>Press the <b>Save Readings</b> softkey to save the file in the designated location in the file directory.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                    |
| Capture  |  <ol style="list-style-type: none"> <li>To save a screenshot of the display, press <b>Capture</b> &gt; <b>Browse</b> to navigate the file directory to the location you wish to save the file in and press <b>Select</b>.</li> <li>Press <b>File Name</b>, enter a file name and press <b>Done</b>.</li> <li>Press the <b>Format</b> softkey to specify the image file format (<b>.bmp</b> or <b>.png</b>) to be saved.</li> <li>Press the <b>Save Screen</b> softkey to save the screenshot in the designated location in the file directory.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                       |

|           |                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Browse    | The <b>Browse</b> softkey opens up the file directory where you can select the file or folder upon which the action will be performed. Use the knob, front panel arrow keys, and <b>[Select]</b> to navigate through the file directory. The left and right arrow keys collapses or expands a folder.                                                                                |
| File Name | The <b>File Name</b> softkey enables you to set the folder or file name for the selected action. To specify a folder or file name, use the knob or the front panel arrow keys to select the desired characters and press <b>[Select]</b> to enter the selected character and move to the next character. When you have finished entering your desired file name, press <b>Done</b> . |

Recall

The **Recall** softkey allows you to recall a previously saved state file (.sta extension) or preference file (.prf extension). Use the knob or the front panel arrow keys to browse to a file on internal flash memory (Internal) or the USB drive (External). Use the right arrow key to expand a folder. Press **Select** to recall the selected file.



Set to Defaults

The **Set to Defaults** softkey allows you to return the selected settings to their Factory Reset and Preset values. Upon pressing the **Set to Defaults** softkey, the following options will appear:



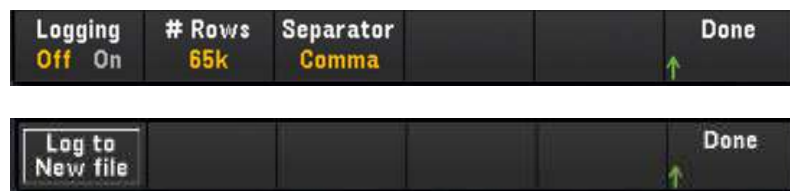
| Softkey       | Description                                                                                                                                                  |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Factory Reset | Resets the instrument to the factory configuration. This softkey will not affect any previously-saved instrument states or I/O settings, such as IP address. |
| Default Pref  | Returns all preferences to default value which includes user preferences and I/O setting which are stored in non-volatile memory                             |
| Preset State  | Presets the instrument. All readings are cleared and all channels will be open. Channel configurations are unchanged except on multifunction module.         |

## Log to USB

### NOTE

The option is only available when **Scan** is selected as the data acquisition mode.

The **Log to USB** softkey allows you to log scanned memory readings to a USB drive connected to the front panel USB host port. The USB annunciator is displayed whenever a USB drive is connected. Upon pressing the **Log to USB** softkey, the following options will appear:



| Softkey         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Logging         | Toggling the <b>Logging</b> softkey will enable ( <b>On</b> ) or disable ( <b>Off</b> ) logging of the scanned memory readings to a USB drive connected to the front panel USB host port. When USB data logging is enabled, readings are saved to files in the USB drive. However, the readings will not be restored to reading memory after power is cycled.                                                                                                                             |
| # Rows          | Pressing the <b># Rows</b> softkey will allow you to specify the row limit (maximum number of rows for sweep data) that will be written to each data logging file. You may choose from three options: <b>65k</b> (the limit of each data logging file is 65,536 rows per file), <b>1M</b> (the limit of each data logging file is 1,048,576 rows per file), or <b>Infinite</b> (the limit is the number of bytes allowed by the file system - up to 4 GBytes or available storage space.) |
| Separator       | Pressing the <b>Separator</b> softkey will allow you to specify the character ( <b>Comma</b> , <b>Tab</b> , or <b>Semicolon</b> ) to be used for separating the information on each row.                                                                                                                                                                                                                                                                                                  |
| Log to New file | The Log to New file softkey will appear when data logging is in progress. Each time the <b>Log to New file</b> softkey is pressed, it will log the data to a new file.                                                                                                                                                                                                                                                                                                                    |

## Folder and file structure

### Folder description

Each saved scan will be stored in a top-level folder named:

`/DAQ97xA/[instrument_SN]/[yyyymmdd_hhmmssmmm]`

- The square brackets ( [ ] ) are not part of the directory name.
- instrument\_SN is the instrument's serial number.
- yyyymmdd\_hhmmssmmm is a timestamp indicating the approximate start of the scan. The format is year (yyyy), month (mm), day (dd), underscore ( \_ ), hours (hh), minutes (mm), seconds (ss), and milliseconds (mmm).

For example, the folder named: `/DAQ970A/MY00012345/20191127_134523123` would indicate a scan on instrument number MY00012345 started approximately 23.123 seconds after 1:45 pm (13:45) on November 27, 2019.

### File description

The top level folder described above will contain two types of files.

#### 1. config.csv

This is a text file that documents the instrument configuration for this scan. The timestamp is as described above. This file lists the configuration of the instrument in a human readable form.

#### 2. dat#####.csv

If you use the command `MMEMory:FORMat:READing:RLIMit OFF`, all of the data will be stored in one file, named `dat00001.csv`.

You can issue the command `MMEMory:FORMat:READing:RLIMit ON` to limit the data to 64K – 1 (65,535) sweeps per file, in which case the sweeps are stored in multiple files, named `dat00001.csv`, `dat00002.csv`, `dat00003.csv`, and so on. This is helpful for importing data into spreadsheet or other data analysis software. Note that some spreadsheet or data analysis software may import the data more easily if you change the extension from `csv` to `txt`. If your software does not import the file correctly, try changing the extension on the data file.

## Contents of data files

Logging into data files is only supported for channels that are in the scan list. The possible channels are shown in the table below; note that s stands for the slot number, which is 1, 2, or 3.

For example, the DAQM901A module supports could have channels 101-120, 201-220, or 301-320.

| Module   | Description                             | Channels       |
|----------|-----------------------------------------|----------------|
| DAQM900A | 20-channel FET multiplexer              | s01 - s20      |
| DAQM901A | 20-channel, 2-wire armature multiplexer | s01 - s20      |
| DAQM902A | 16-channel, 2-wire reed multiplexer     | s01 - s16      |
| DAQM907A | 2-channel DIO input                     | s01 - s02      |
| DAQM907A | 1-channel totalizer, 4-channel DAC      | s03, s04 - s27 |
| DAQM908A | 40-channel, 1-wire armature multiplexer | s01 - s40      |

The format for all USB data files is similar to what Keysight BenchLink Data Logger produces by default. The default field separator is a comma, but you can use the **Separator** softkey to specify a different separator.

A sample file is shown below:

| Sweep # | Time                    | Chan 201 (VDC) | Chan 202 (VDC) |
|---------|-------------------------|----------------|----------------|
| 1       | 11/27/2019 08:07:12:237 | 0.36823663     | 1.23895216     |
| 2       | 11/27/2019 08:07:13:237 | 0.62819233     | 0.98372939     |
| 3       | 11/27/2019 08:07:13:237 | 0.38238212     | 0.39382906     |
| 4       | 11/27/2019 08:07:13:237 | 0.46773299     | 0.55543345     |
| 6       | 11/27/2019 08:07:13:237 | 1.32323567     | 0.21213335     |

- The channel numbers and the associated units are shown in the header row.
- If the row limit feature is ON and the data spills over into multiple files, scan numbering continues where it left off in the previous file. Thus, the first scan in the second data file would be number 65,536, the first scan in the third data file would be number 131,071, and so on.

Save to USB

**NOTE**

This option is only available when **DMM Digitize**, or **Digitizer** is selected as the data acquisition mode.

The **Save to USB** softkey similarly allows you to save digitized data to a USB drive connected to the front panel USB host port. The USB annunciator is displayed whenever a USB drive is connected. Upon pressing the **Save to USB** softkey, the following options will appear:



| Softkey             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Save<br>On/Off | <div>Toggling the <b>Auto Save</b> softkey will enable (<b>On</b>) or disable (<b>Off</b>) the instrument from saving the digitized data to a USB drive connected to the front panel USB host port. If <b>Auto Save</b> is enabled, the instrument will begin saving the data file into the USB drive when the digitizer operation is complete.</div> <div><div><b>NOTE</b></div><div>If the instrument does not detect a USB drive, it will prevent the instrument from initiating a digitizing process until a USB drive is detected or the Auto Save function is disabled.</div></div> <div>You may start viewing the results in the <b>[View]</b> menu while the Auto Save operation is running in the background.</div> |
| Separator           | <div>Pressing the <b>Separator</b> softkey will allow you to specify the character (<b>Comma</b>, <b>Tab</b>, or <b>Semicolon</b>) to be used for separating the information on each row in the data file.</div> <div><div><b>NOTE</b></div><div>This setting is only available when <b>DMM Digitize</b> is selected as the data acquisition mode.</div></div>                                                                                                                                                                                                                                                                                                                                                               |

---

Path Name

Selects a location or folder within the USB drive to save the digitized data.

Press the **Browse** softkey and use the knob or arrow keys to select your desired save location. After that, press the **File Name** softkey to specify your desired file name. Press **Done** to complete the process.

**NOTE**

After every digitizer operation, the new set of data will be written into the same file specified in the Path Name setting; overwriting the old data. Therefore, if you would like to save different sets of data from different digitizing operations, you would need to select a different file in the save path each time before you initiate the digitizer.

---

## Save to USB file format

In **Digitizer** mode, all data files are saved in **.dat** file format when saved into the USB drive. The **.dat** file extension suffix is fixed and cannot be changed.

In **DMM Digitize** mode, by default, all data files are saved in **.csv** file format. However, you may choose to save the data file with a **.dat** filename extension. You may do so by including **.dat** at the end of the file name when you are naming the file.

## Save to USB front panel display

The front panel display will have indicators on the screen to inform you that the auto saving operation is in progress. These indicators (highlighted in red) are shown in the images below:

### DMM Digitize data acquisition mode:



### Digitizer data acquisition mode:





## Web Interface

The Keysight DAQ970A/DAQ973A Data Acquisition System include a built-in Web Interface for monitoring and controlling the instrument via a Web browser.

Two available options to access the Web Interface:

- **LAN Interface:** Connect your instrument to the LAN interface and enter the instrument's IP address into the address bar at the top of your PC's Web browser.
- **Keysight IO Libraries Suite:** Select the instrument in Connection Expert and click the Web UI button. Ensure that the Keysight IO Libraries Suite is installed before you proceed for the remote interface configuration.

### NOTE

The following is a high-level overview of the Web Interface tabs shown on top of the Web Interface window. When using the Web Interface, open a particular tab, and then click the help button (?) to view help contents for that tab.

## Home page

The Home Page displays basic instrument information. Click More Information or Less Information to toggle display of LAN details and LXI compliance information. To change any of the information displayed on this page, use the Control Instrument Page .

**KEYSIGHT** DAQ970A Data Acquisition System  
Serial number: PROTO00010

Home Control Instrument Configure LAN ?

Connected to DAQ970A Data Acquisition System  
at IP address 10.116.33.101

☐ Enable front panel identification indicator

**Description**

|                   |                                                       |
|-------------------|-------------------------------------------------------|
| Model number      | DAQ970A Data Acquisition System                       |
| Manufacturer      | Keysight Technologies                                 |
| Serial number     | PROTO00010                                            |
| Firmware revision | A.00.2172-01.00-01.73-00.02-01.02-02-01               |
| Description       | Keysight DAQ970A Data Acquisition System - PROTO00010 |

**VISA instrument addresses**

|                       |                                                           |
|-----------------------|-----------------------------------------------------------|
| HISLIP LAN protocol   | TCPIP::K-DAQ970A-0010.png.is.keysight.com::hislip0::INSTR |
| VXI-11 LAN protocol   | TCPIP::K-DAQ970A-0010.png.is.keysight.com::inst0::INSTR   |
| TCPIP SOCKET protocol | TCPIP::K-DAQ970A-0010.png.is.keysight.com::5025::SOCKET   |
| USB (USB7MC/488)      | USB::10893::9223::PROTO00010::0::INSTR                    |

▼ More Information

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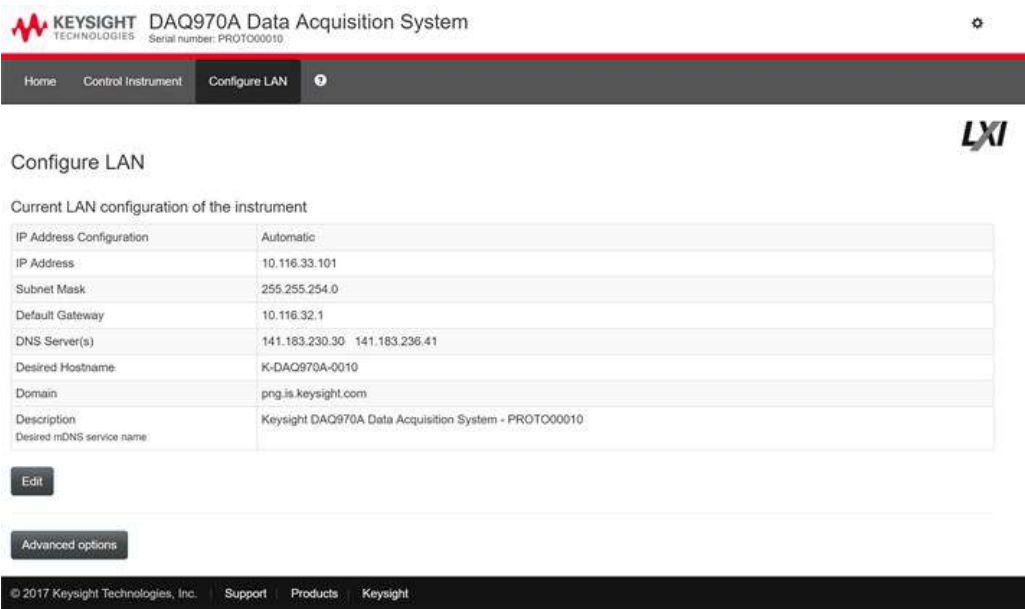
Check the "Enable front panel identification indicator" checkbox to enable a visual indicator that identifies the DAQ970A/DAQ973A. This can help you physically locate the instrument in a rack, for example.

The indicator position and type can vary. Common indicators are LEDs, an onscreen message, or a message displayed in a dialog box. Uncheck the checkbox to turn off the indicator.

Control Instrument page



Configure LAN page



Click **Edit** button to edit network configuration page.

When done, click **Apply Changes** to accept new settings or click **Cancel** to ignore changes.

Click **Advanced options** button to reset network configuration options.

## Help page

Help is available for each of the tabs described above. For example:



**KEYSIGHT**  
TECHNOLOGIES

DAQ970A Data Acquisition System  
Help

---

### Home Page Help

The *Keysight Technologies* web pages for the DAQ970A Data Acquisition System will help you get your system up and running as quickly as possible. If you have trouble with the instrument, contact Keysight by clicking on the **Support** link that appears in the footer of the page.

The **Home Page** displays detailed configuration information about the DAQ970A Data Acquisition System.

- The information presented is specified by the LXI Consortium and is consistent across instruments.
- You can use this information to form addresses needed to run SIDL or VISA programs (for example).
- Actions, the navigation bar, and information fields are described below.

---

### Actions

- Click **More Information/Less Information** to toggle display of LAN details and LXI compliance information.
- Enable front panel indicator** checkbox:
  - Select (check) the **Enable front panel indicator** checkbox to enable a visual indicator that identifies the DAQ970A Data Acquisition System. This can help you physically locate the instrument in a rack, for example.
  - The indicator position and type can vary. Common indicators are LEDs, an onscreen message, or a message displayed in a dialog box.
  - Clear (uncheck) the checkbox to turn off the indicator.

---

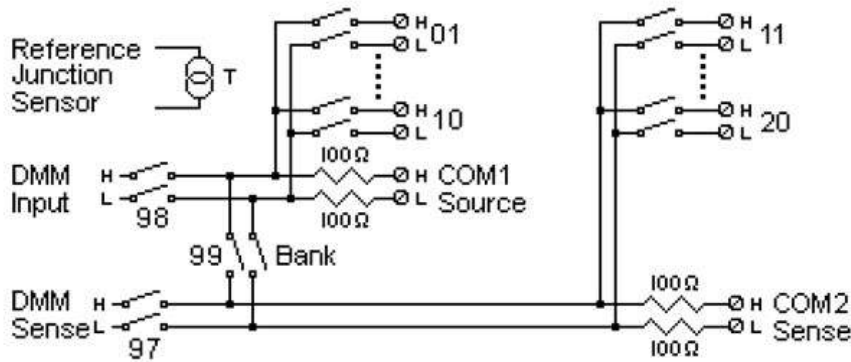
## Module Overview

This section gives a description of each plug-in module, including simplified schematics and block diagrams. A wiring log is also included to make it easy to document your wiring configuration for each module.

- DAQM900A 20-Channel FET Multiplexer Module
- DAQM901A 20-Channel Armature Multiplexer Module
- DAQM902A 16-Channel Reed Multiplexer Module
- DAQM903A 20-Channel Actuator/General-Purpose Switch Module
- DAQM904A 4x8 Two-Wire Matrix Switch
- DAQM905A Dual 1:4 RF Multiplexer (50  $\Omega$ ) Module
- DAQM907A Multifunction Module
- DAQM908A 40-channel Single-ended Multiplexer
- DAQM909A 4-Channel 24-Bit Digitizer Module

## DAQM900A 20-Channel FET Multiplexer Module

This module is divided into two banks of 10 two-wire channels each. All 20 channels switch both HI and LO inputs, thus providing fully isolated inputs to the internal DMM or an external instrument. During 4-wire resistance measurements, channels from Bank A (channel  $n$ ) are automatically paired with channels from Bank B (channel  $n+10$ ) to provide the source and sense connections. The module has a built-in thermocouple reference junction to minimize errors due to thermal gradients when measuring thermocouples.



### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

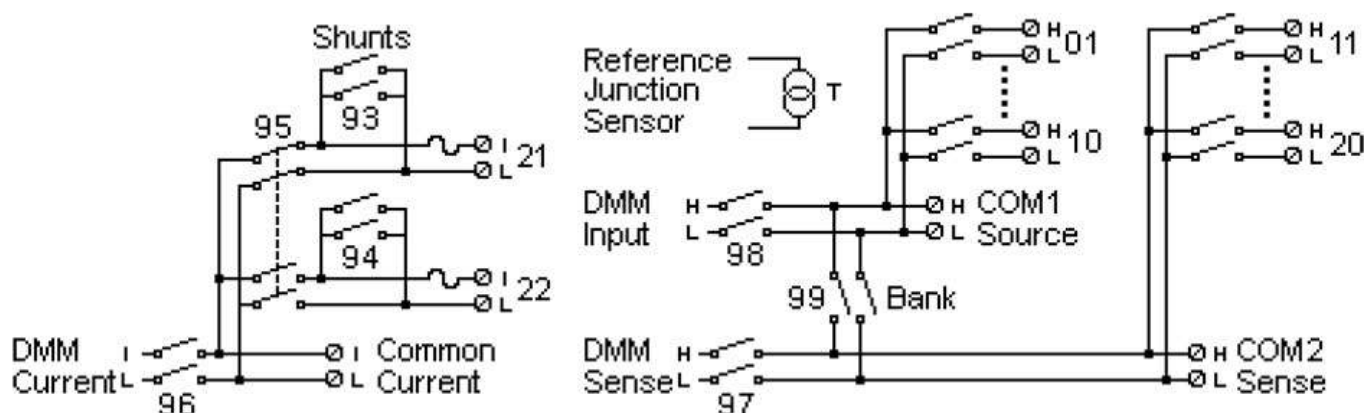
When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

#### ENVIRONMENTAL HEALTH AND SAFETY

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

## DAQM901A 20-Channel Armature Multiplexer Module

This module is divided into two banks of 10 two-wire channels each. Two additional fused channels are available on the module (total in 22 channels) for making direct, calibrated DC or AC current measurements with the internal DMM (external shunts resistors are not required). All 22 channels switch both HI and LO inputs, thus providing fully isolated inputs to the internal DMM or an external instrument. During 4-wire resistance measurements, channels from Bank A (channel  $n$ ) are automatically paired with channels from Bank B (channel  $n+10$ ) to provide the source and sense connections. The module has a built-in thermocouple reference junction to minimize errors due to thermal gradients when measuring thermocouples.



### NOTE

Only one of channels 21 and 22 can be connected to the internal DMM and/or COM at a time; connecting one channel will close the other (thus shorting the input "I" to "LO").

### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

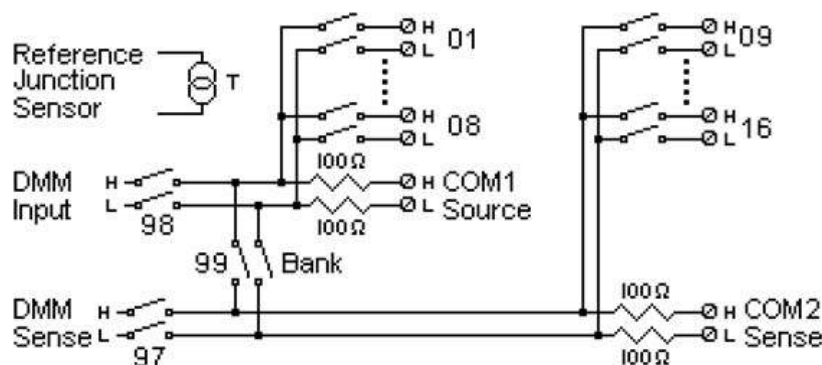
When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

#### ENVIRONMENTAL HEALTH AND SAFETY

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

## DAQM902A 16-Channel Reed Multiplexer Module

This module is divided into two banks of 8 two-wire channels each. Use this module for those applications that require high-speed scanning and high-throughput in automated test. All 16 channels switch both HI and LO inputs, thus providing fully isolated inputs to the internal DMM or an external instrument. During 4-wire resistance measurements, channels from Bank A (channel  $n$ ) are automatically paired with channels from Bank B (channel  $n+8$ ) to provide the source and sense connections. The module has a built-in thermocouple reference junction to minimize errors due to thermal gradients when measuring thermocouples.



### NOTE

Current measurements on this module will require external shunt resistors.

### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

#### ENVIRONMENTAL HEALTH AND SAFETY

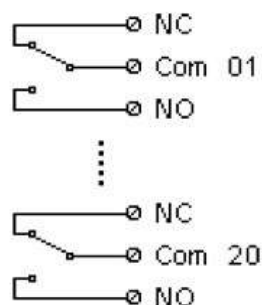
When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.



## DAQM903A 20-Channel Actuator/General-Purpose Switch Module

This module contains 20 independent, and SPDT (Form C) latching relays. This module can switch 300 V, 1 A (50 W maximum switch power) to your device under test or to actuate external devices. Screw terminals on the module provide access to the Normally-Open, Normally-Closed, and Common contacts for each of the 20 switches. This module does not connect to the internal DMM. Use this module for those applications that require high-integrity contacts or quality connections of non-multiplexed signals.

A breadboard area is provided near the screw terminals to implement custom circuitry, such as simple filters, snubbers, and voltage dividers. The breadboard area provides the space necessary to insert your own components but there are no circuit board traces here. You must add your own circuitry and signal routing.



### NOTE

You can close multiple channels at the same time on this module.

The channel CLOSE and OPEN commands control the state of the Normally Open (NO) to COM connection on each channel. For example, CLOSE 201 connects the Normally Open contact to COM on channel 01.

### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

#### ENVIRONMENTAL HEALTH AND SAFETY

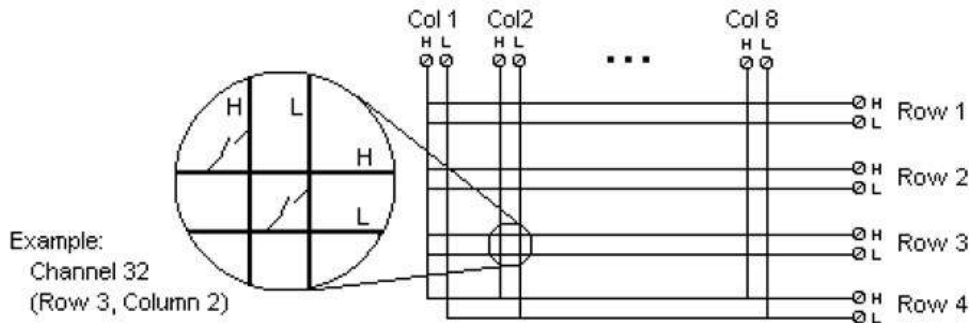
When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.



## DAQM904A 4x8 Two-Wire Matrix Switch

This module contains 32 two-wire crosspoints organized in a 4-row by 8-column configuration. You can connect rows and columns between multiple modules to build larger matrices such as 8x8 and 4x16, with up to 96 crosspoints in a single mainframe. Use this module to connect multiple instruments to multiple points, or any combination of inputs and outputs on your device under test at the same time.

This module does not connect to the internal DMM. Each crosspoint relay has its own unique channel label representing the row and column. For example, channel 32 represents the crosspoint connection between row 3 and column 2 as shown below:



### NOTE

You can close multiple channels at the same time on this module.

### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

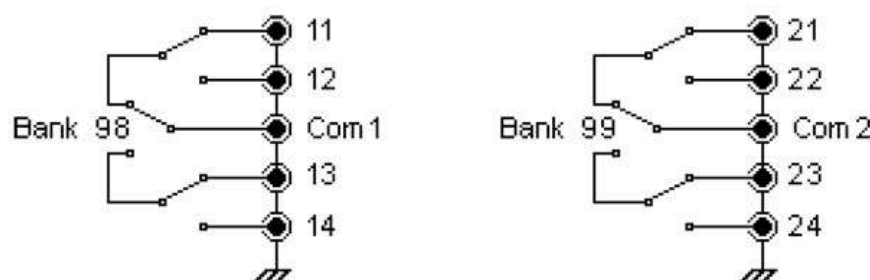
#### ENVIRONMENTAL HEALTH AND SAFETY

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

## DAQM905A Dual 1:4 RF Multiplexer (50 $\Omega$ ) Module

These modules consist of two independent banks of 4-to-1 multiplexers, which offer wideband switching capabilities for high frequency and pulsed signals. The channels in each bank are organized in a “tree” structure to provide high isolation and low VSWR. Both modules have a common earth ground, offer low crosstalk and excellent insertion loss performance. To create larger RF multiplexers, you can cascade multiple banks together.

This module does not connect to the internal DMM. You can connect your signals directly to the on-board SMB connectors or to the SMB-to-BNC cables provided with the module.



### NOTE

You can close only one channel per bank at a time on these modules; closing one channel in a bank will open the previously closed channel. One channel in each bank is always connected to COM.

This module responds only to the CLOSE command (OPEN does not apply). To OPEN a channel, send the CLOSE command to another channel in the same bank.

### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

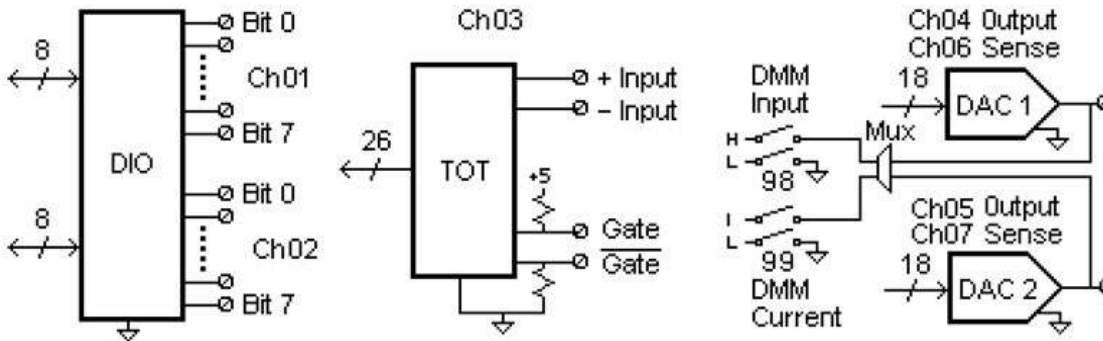
#### ENVIRONMENTAL HEALTH AND SAFETY

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

## DAQM907A Multifunction Module

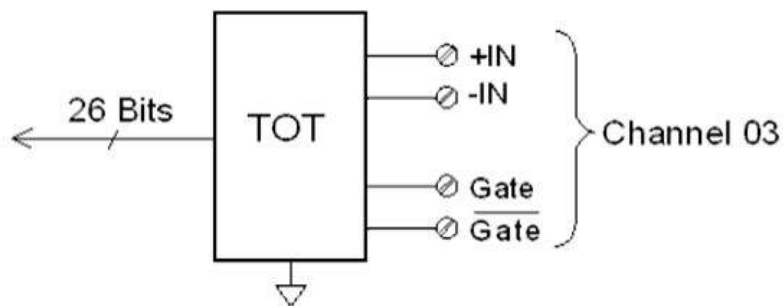
This module combines two 8-bit ports of digital input/output, a 100 kHz totalizer, and two  $\pm 12$  V analog outputs (DAC). For greater flexibility, you can read digital inputs and the totalizer count during a scan. Use this module to sense status and control external devices such as solenoids, power relays, and microwave switches.

### Digital Input/Output (DIO)



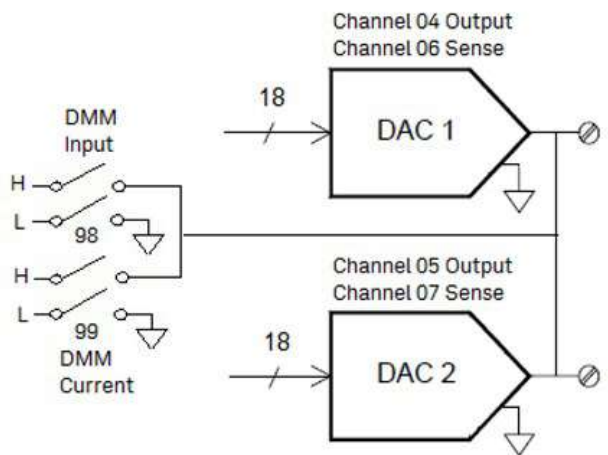
The DIO consists of two 8-bit ports with TTL-compatible inputs and output. The open-drain outputs can sink up to 400 mA. From the front panel, you can read data from only one 8-bit input port at a time. From the remote interface, you can read both ports simultaneously as a 16-bit word only if neither port is in the scan list.

### Totalizer input



The 26-bit totalizer can count pulses at a 100 kHz rate. You can configure the totalizer to count on the rising edge or falling edge of the input signal. A TTL high signal applied to the "+" terminal enables counting and a low signal disables counting. A TTL-compatible low signal applied to the "-" terminal enables counting and a high signal disables counting. The totalizer only counts when both terminals are enabled. Move the Totalize Threshold jumper to the "AC" position to detect changes through 0 V. Move the jumper to the "TTL" position (factory setting) to detect changes through TTL threshold levels.

## Analog Output (DAC) Output and Sense



The two analog outputs (channel 04 and 05) and senses (channel 06 and 07) are capable of outputting calibrated voltages or currents with 18 bits of resolution. You must limit the DAC output current to 40 mA total for each slot (two DAC channels). Table below shows the output values of DAC in current mode and voltage mode:

| Mode         | Current     | Voltage    |
|--------------|-------------|------------|
| Current Mode | $\pm 24$ mA | $\pm 12$ V |
| Voltage Mode | $\pm 15$ mA | $\pm 12$ V |

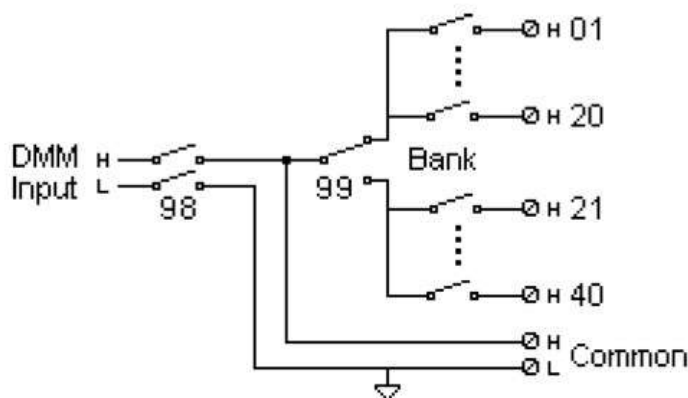
### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

## DAQM908A 40-channel Single-ended Multiplexer

The module is divided into two banks of 20 channels each. All of the 40 channels switch HI only, with a common LO for the module. Use this module for high-density switching applications which require single-wire inputs with a common LO.



### NOTE

Only one channel can be closed at a time, closing one channel will open the previously closed channel.

This module cannot be used to directly measure current or any 4-wire measurements.

### WARNING

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

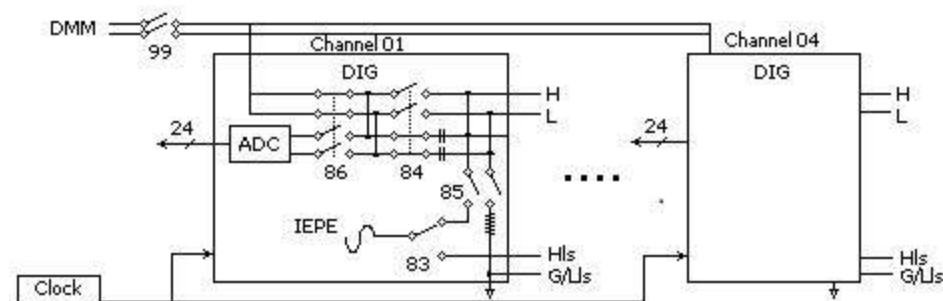
#### CAUTION WITH HAZARDOUS VOLTAGES

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

#### ENVIRONMENTAL HEALTH AND SAFETY

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

## DAQM909A 4-Channel 24-Bit Digitizer Module



The DAQM909A is a four-channel digitizer module capable of providing four simultaneously-sampled channels with sampling rate as high as 800,000 samples per second with a maximum resolution of 24 bits. The input channels of the DAQM909A can be configured as a differential input or a single-ended input and each of the channels can provide up to 4mA of constant current to power up an external IEPE transducer. When three DAQM909A modules are inserted within the same instrument, all 12 channels can be synchronized to provide simultaneous sampling.

### WARNING

#### DO NOT MEASURE MORE THAN THE RATED VOLTAGE

The maximum input voltage for measurement is  $\pm 18\text{Vpk}$  (single ended) for both HI and LO pins.

#### TO PREVENT ELECTRICAL SHOCK

To prevent electrical shock, use only wire that is rated for the highest voltage to any channel. Before removing a module cover, turn off all power to external devices connected to the module.

#### CAUTION WITH MULTIPLE SIGNALS

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

#### CAUTION WITH HAZARDOUS VOLTAGES

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous and all channel wiring in the module should be rated for the maximum voltage applied. Thermocouples attached to any other channel on the module should have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and should be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied. Do not mount, move, or remove any thermocouples when the device under test is connected to a supply source.

#### ENVIRONMENTAL HEALTH AND SAFETY

When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.

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# 4 Measurement Tutorials

System Cabling and Connections

Measurement Fundamentals

Digitizing measurements

Actuators and General-Purpose Switching

Matrix Switching

RF Signal Multiplexing

Multifunction Module

Relay Life and Preventive Maintenance

This chapter describes methods that you can use to reduce errors that can affect your measurements. You will also find information to help you better understand how the DAQ970A/DAQ973A makes measurements and what you can do to get the best results.



## System Cabling and Connections

This section describes methods to reduce measurement errors that can be introduced by your system cabling. Many system cabling errors can be reduced or eliminated by selecting the proper cable and grounding scheme for your system.

- Cable specifications
- Grounding techniques
- Shielding techniques
- Separation of high-level and low-level signals
- Source of system cabling errors

### Cable specifications

A wide variety of general-purpose and custom cables are available. The following factors influence the type of cable that you choose.

- Signal requirement – such as voltage, frequency, accuracy, and measurement speed.
- Interconnection requirements – such as wire sizes, cable lengths, and cable routing.
- Maintenance requirements – such as intermediate connectors, cable terminations, strain reliefs, cable lengths, and cable routing.

Cables are specified in a variety of ways. Be sure to check the following specifications for the cable type you intend to use:

- Nominal impedance (insulation resistance) – Varies with the frequency of the input signal. Check for HI-to-LO, channel-to-channel, and HI-or LO-to-shield. High frequency RF applications have exact requirements for cable impedance.
- Dielectric withstand voltage – Must be high enough for your application.

**WARNING**

To prevent electrical shock or equipment damage, insulate all channels to the highest potential in the system. It is recommended that you use a wire with at least 600 V rated insulation.

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- Cable resistance – Varies with wire gauge size and cable length. Use the largest gauge wire possible and try to keep the cable lengths as short as possible to minimize the cable resistance. The following table lists typical cable resistance for copper wire of several gauge sizes (the temperature coefficient for copper wire is 0.35% per °C).

| AWG               | $\Omega$ / ft (2 conductors) at 25 °C |
|-------------------|---------------------------------------|
| 14                | 5 m $\Omega$                          |
| 16                | 10 m $\Omega$                         |
| 18                | 15 m $\Omega$                         |
| 20 <sup>[1]</sup> | 20 m $\Omega$                         |
| 22                | 30 m $\Omega$                         |
| 24                | 50 m $\Omega$                         |

- Cable capacitance – Varies with insulation type, cable length, and cable shielding. Cable should be kept as short as possible to minimize cable capacitance. In some cases, low-capacitance cable can be used.

The table below lists the typical cable specifications.

| Cable Type            | Nominal impedance                     | Capacitance    | Attenuation                  |
|-----------------------|---------------------------------------|----------------|------------------------------|
| Twisted pair          | 100 $\Omega$ at 1 MHz                 | 10 to 20 pF/ft | Up to 1 dB/100 ft at 1 MHz   |
| Shielded twisted pair | 100 $\Omega$ at 1 MHz                 | 10 to 20 pF/ft | Up to 1 dB/100 ft at 1 MHz   |
| Coaxial               | 50 $\Omega$ or 75 $\Omega$ at 100 MHz | 15 to 25 pF/ft | Up to 6 dB/100 ft at 100 MHz |
| Twisted pair ribbon   | 100 $\Omega$ at 1 MHz                 | 15 to 20 pF/ft | Up to 1 dB/100 ft at 1 MHz   |

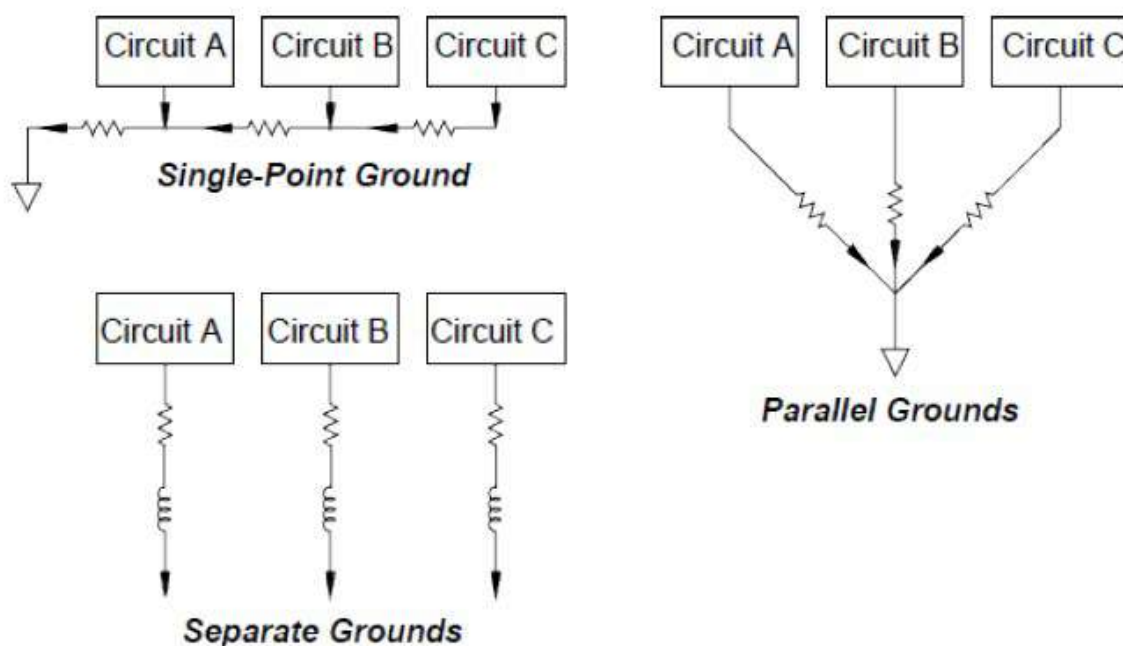
<sup>[1]</sup>Recommended wire size for the screw terminals on the DAQ970A/DAQ973A plug-in modules.

## Grounding techniques

The purpose of grounding is to avoid ground loops and minimize noise. Most systems should have at least three separate ground returns.

1. One ground for signals. You may also want to provide separate signal grounds between high-level signals, low-level signals, and digital signals.
2. A second ground is used for noisy hardware such as relays, motors, and high-power equipment.
3. A third ground is used for chassis, racks, and cabinets. The AC power ground should generally be connected to this third ground.

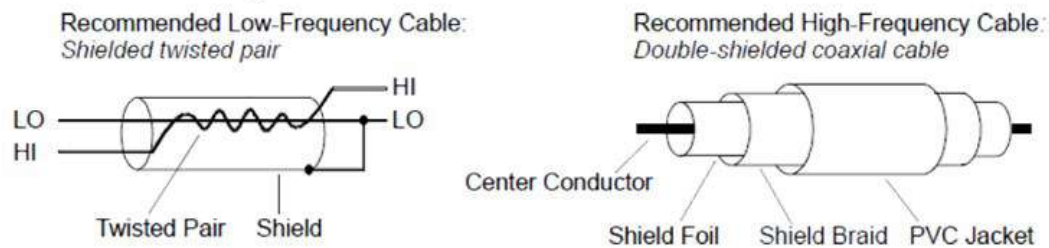
In general, for frequencies below 1 MHz or for low-level signals, use single-point grounding (see image below). Parallel grounding is superior but it is also more expensive and more difficult to wire. If single point grounding is adequate, the most critical points (those with the lowest levels and/ or the most precise measurement requirements) should be positioned near the primary ground point. For frequencies above 10 MHz, use the separate grounding system. For signals between 1 MHz and 10 MHz, you can use a single-point system if the longest ground return path is kept to less than 1/20 of a wavelength. In all cases, return-path resistance and inductance should be minimized.



## Shielding techniques

Shielding against noise must address both capacitive (electrical) and inductive (magnetic) coupling. The addition of a grounded shield around the conductor is highly effective against capacitive coupling. In switching networks, this shielding often takes the form of coaxial cables and connectors. For frequencies above 100 MHz, double-shielded coaxial cable is recommended to maximum shielding effectiveness.

Reducing loop area is the most effective method to shield against magnetic coupling. Below a few hundred kilohertz, twisted pairs may be used against magnetic coupling. Use shielded twisted pair for immunity from magnetic and capacitive pickup. For maximum protection below 1 MHz, make sure that the shield is not one of the signal conductors.



## Separation of high-level and low-level signals

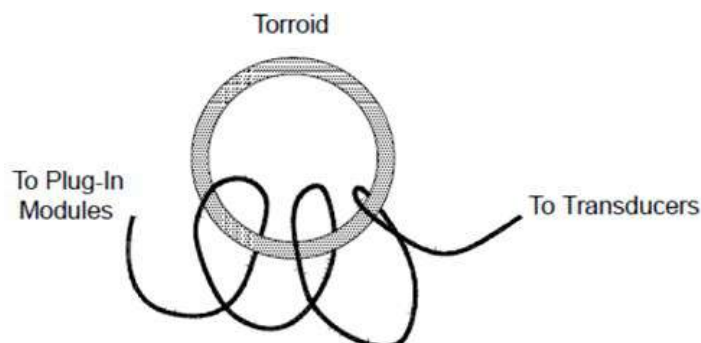
Signals whose levels exceed a 20-to-1 ratio should be physically separated as much as possible. The entire signal path should be examined including cabling and adjacent connections. All unused lines should be grounded (or tied to LO) and places between sensitive signal paths. When making your wiring connections to the screw terminals on the module, be sure to wire like functions on adjacent channels.

## Source of system cabling errors

### Radio frequency interference

Most voltage-measuring instruments can generate false readings in the presence of large, high-frequency signals. Possible sources of high-frequency signals include nearby radio and television transmitters, computer monitors, and cellular telephones. High-frequency energy can also be coupled to the internal DMM on the system cabling. To reduce the interference, try to minimize the exposure of the system cabling to high-frequency RF sources.

If your application is extremely sensitive to RF1 radiated from the instrument, use a common mode choke in the system cabling as shown below to attenuate instrument emissions.



## Thermal EMF errors

Thermoelectric voltages are the most common source of error in low-level DC voltage measurements. Thermoelectric voltages are generated when you make circuit connections using dissimilar metals at different temperatures. Each metal-to-metal junction forms a thermocouple, which generates a voltage proportional to the junction temperature difference. You should take the necessary precautions to minimize thermocouple voltages and temperature variations in low-level voltage measurements. The best connections are formed using copper-to-copper crimped connections. The table below shows common thermoelectric voltages for connections between dissimilar metals.

| Copper-to-         | Approx. $\mu\text{V}/^\circ\text{C}$ |
|--------------------|--------------------------------------|
| Copper             | < 0.3                                |
| Gold               | 0.5                                  |
| Silver             | 0.5                                  |
| Brass              | 3                                    |
| Beryllium Copper   | 5                                    |
| Aluminium          | 5                                    |
| Kovar or Alloy 42  | 40                                   |
| Silicon            | 500                                  |
| Copper-Oxide       | 1000                                 |
| Cadmium-Tin Solder | 0.2                                  |
| Tin-Lead Solder    | 5                                    |

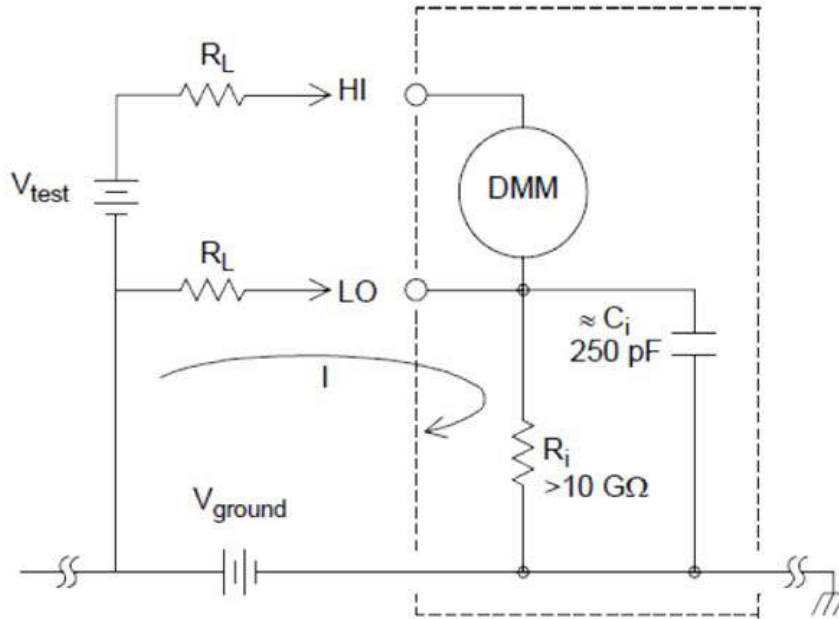
## Noise caused by magnetic fields

If you are making measurements near magnetic fields, you should take precautions to avoid inducing voltages in the measurement connections. Voltage can be induced by either movement of the input connection wiring in a fixed magnetic field or by a varying magnetic field. An unshielded, poorly dressed input wire moving in the earth's magnetic field can generate several millivolts. The varying magnetic field around the AC power line can also induce voltages up to several hundred millivolts. You should be especially careful when working near conductors carrying large currents.

Where possible, you should route cabling away from magnetic fields. Magnetic fields are commonly present around electric motors, generators, televisions, and computer monitors. Also make sure that your input wiring has proper strain relief and is tied down securely when operating near magnetic fields. Use twisted-pair connections to the instrument to reduce the noise pickup loop area, or dress the wires as close together as possible.

## Noise caused by ground loops

When measuring voltages in circuits where the internal DMM and the device-under-test are both referenced to a common earth ground, a ground loop is formed. As shown below, any voltage difference between the two ground reference points ( $V_{\text{ground}}$ ) causes a current to flow through the LO measurement lead. This causes an error voltage ( $V_L$ ) which is added to the measured voltage.



Where:

$R_L$  = Lead resistance

$R_i$  = DMM isolation resistance

$C_i$  = DMM isolation capacitance

$V_{\text{ground}}$  = Ground noise voltage

To minimize ground loop errors:

- If  $V_{\text{ground}}$  is a DC voltage, keep  $R_L$  small compared to  $R_i$ .
- If  $V_{\text{ground}}$  is an AC voltage, keep  $R_L$  small compared to  $Z$ , and set the DMM's integration time to 1 PLC or greater.

## Low-level AC measurement errors

When measuring AC voltages less than 100 mV, be aware that these measurements are especially susceptible to errors introduced by extraneous noise sources. An exposed test lead will act as an antenna and the internal DMM will measure the signals received. The entire measurement path, including the power line, act as a loop antenna. Circulating currents in the loop will create error voltages across any impedances in series with the instrument's input. For this reason, you should apply low-level AC voltages to the instrument through shielded cables. You should also connect the shield to the input LO terminal.

Be sure to minimize the area of any ground loops that cannot be avoided. A high-impedance source is more susceptible to noise pickup than a low-impedance source. You can reduce the high-frequency impedance of a source by placing a capacitor in parallel with the instrument's input terminals. You may have to experiment to determine the correct capacitance value for your application.

Most extraneous noise is not correlated with the input signal. You can determine the error as shown below:

Correlated noise, while rare, is especially detrimental. Correlated noise will always add directly to the input signal. Measuring a low-level signal with the same frequency as the local power line is a common situation that is prone to this error.

You should use caution when switching high-level and low-level signals on the same module. It is possible that high-level charged voltages may be discharged onto a low-level channel. It is recommended that you either use two different modules or separate the high-level signals from the low-level signals with an unused channel connected to ground.

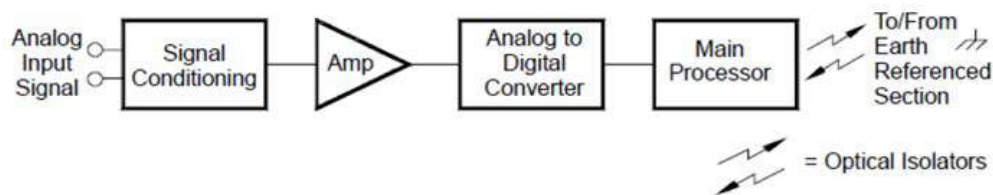
# Measurement Fundamentals

This section explains how the DAQ970A/DAQ973A makes measurements and discusses the most common sources of error related to these measurements.

- The internal DMM
- Temperature measurements
- DC voltage measurements
- AC voltage measurements
- Current measurements
- Resistance measurement
- Strain gage measurements
- Frequency and period measurements
- Capacitance measurements
- Digitizing measurements
- Level triggering

## The internal DMM

The internal DMM provides a universal input front-end for measuring a variety of transducer types without the need for additional external signal conditioning. The internal DMM includes signal conditioning, amplification (or attenuation), and a high resolution (up to 22 bits) analog-to-digital converter. A simplified diagram of the internal DMM is shown below.



The internal DMM can directly make the following types of measurements. Each of these measurements is described in the following sections of this chapter:

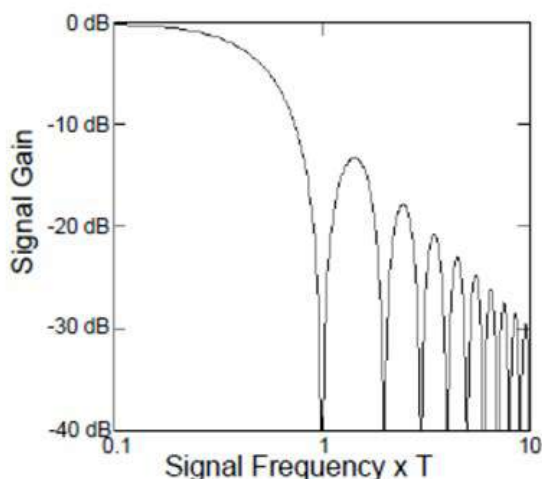
- Temperature (thermocouple, 2-wire and 4-wire RTD, 2-wire and 4-wire thermistor)
- Voltage (DC and AC up to 300 V)
- Resistance (2-wire and 4-wire up to 1 G $\Omega$ )
- Current (DC and AC up to 1 A)
- Frequency and Period (up to 300 kHz)
- Strain (bridge and direct methods)



## Rejecting Power-Line Noise Voltages

A desirable characteristic of an integrating analog-to-digital (A/D) converter is its ability to reject spurious signals. Integrating techniques reject power-line related noise present with DC signals on the input. This is called normal mode rejection or NMR. Normal mode noise rejection is achieved when the internal DMM measures the average of the input by “integrating” it over a fixed period. If you set the integration time to a whole number of power line cycles (PLCs) of the spurious input, these errors (and their harmonics) will average out to approximately zero.

When you apply power to the internal DMM, it measures the power-line frequency (50 Hz or 60 Hz), and uses this measurement to determine the integration time. The following graph shows the attenuation of AC signals measured in the DC voltage function for various A/D integration time settings. Note that signal frequencies at multiples of  $1/T$  exhibit high attenuation.



## Temperature measurements

A temperature transducer measurement is typically either a resistance or voltage measurement converted to an equivalent temperature by software conversion routines inside the instrument. The mathematical conversion is based on specific properties of the various transducers. The mathematical conversion accuracy (not including the transducer accuracy) for each transducer type is shown below:

| Transducer   | Conversion Accuracy |
|--------------|---------------------|
| Thermocouple | 0.05 °C             |
| RTD          | 0.02 °C             |
| Thermistor   | 0.05 °C             |

Errors associated with temperature measurements include all of those listed for DC voltage and resistance measurements elsewhere in this chapter. The largest source of error in temperature measurements is generally the transducer itself.

Your measurement requirements will help you to determine which temperature transducer type to use. Each transducer type has a particular temperature range, accuracy, and cost. The table below summarizes some typical specifications for each transducer type. Use this information to help select the transducer for your application. The transducer manufacturers can provide you with exact specifications for a particular transducer.

| Parameter              | Thermocouple                                                      | RTD                                        | Thermistor                           |
|------------------------|-------------------------------------------------------------------|--------------------------------------------|--------------------------------------|
| Temperature Range      | -210 °C to 1820 °C                                                | -200 °C to 850 °C                          | -80 °C to 150 °C                     |
| Measurement Type       | Voltage                                                           | 2- or 4- Wire Ohms                         | 2- or 4- Wire Ohms                   |
| Transducer Sensitivity | 6 $\mu\text{V}/^\circ\text{C}$ to 60 $\mu\text{V}/^\circ\text{C}$ | $\approx R_0 \times 0.004\ ^\circ\text{C}$ | $\approx 400\ \Omega/^\circ\text{C}$ |
| Probe Accuracy         | 0.5 °C to 5 °C                                                    | 0.01 °C to 0.1 °C                          | 0.1 °C to 1 °C                       |
| Cost (U.S. Dollars)    | \$1/foot                                                          | \$20 to \$100 each                         | \$10 to \$100 each                   |
| Durability             | Rugged                                                            | Fragile                                    | Fragile                              |

## RTD measurements

An RTD is constructed of a metal (typically platinum) that changes resistance with a change in temperature in a precisely known way. The internal DMM measures the resistance of the RTD and then calculates the equivalent temperature.

An RTD has the highest stability of the temperature transducers. The output from an RTD is also very linear. This makes an RTD a good choice for high-accuracy and long-term measurements. The DAQ970A/DAQ973A supports RTDs with  $\alpha = 0.00385$  (DIN / IEC 751) using ITS-90 software conversions. “PT100” is a special label that is sometimes used to refer to an RTD with  $\alpha = 0.00385$  and  $R_0 = 100\ \Omega$ .

The resistance of an RTD is nominal at 0 °C and is referred to as  $R_0$ . The DAQ970A/DAQ973A can measure RTDs with  $R_0$  values from  $100\ \Omega \pm 1\%$  or  $1000\ \Omega \pm 1\%$ .

You can measure RTDs using a 2-wire or 4-wire measurement method. The 4-wire method provides the most accurate way to measure small resistances. Connection lead resistance is automatically removed using the 4-wire method.

## Thermistor measurements

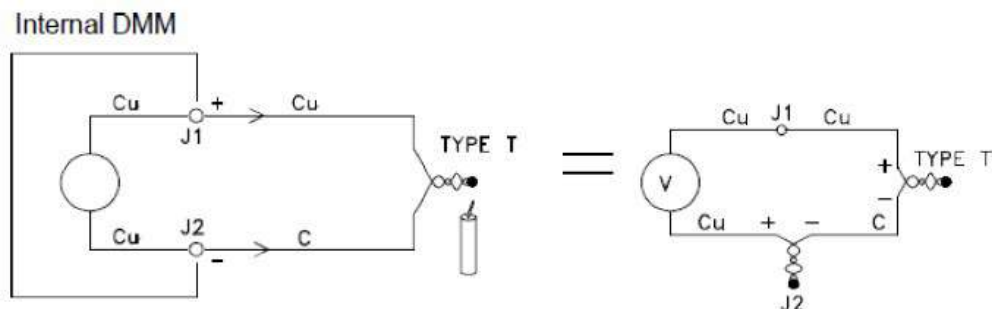
A thermistor is constructed of materials that non-linearly changes resistance with changes in temperature. The internal DMM measures the resistance of the thermistor and then calculates the equivalent temperature.

Thermistors have a higher sensitivity than thermocouples or RTDs. This makes a thermistor a good choice when measuring very small changes in temperature. Thermistors are, however, very non-linear, especially at high temperatures and function best below 100 °C.

Because of their high resistance, thermistors can be measured using a 2-wire measurement method. The internal DMM supports 2.2 k $\Omega$  (44004), 5 k $\Omega$  (44007), and 10 k $\Omega$  (44006) thermistors. The thermistor conversion routines used by the DAQ970A/DAQ973A are compatible with the International Temperature Scale of 1990 (ITS-90).

## Thermocouple Measurements

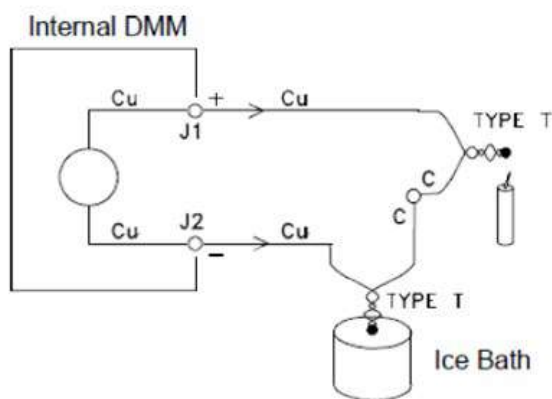
A thermocouple converts temperature to voltage. When two wires composed of dissimilar metals are joined, a voltage is generated. The voltage is a function of the junction temperature and the types of metals in the thermocouple wire. Since the temperature characteristics of many dissimilar metals are well known, a conversion from the voltage generated to the temperature of the junction can be made. For example, a voltage measurement of a T-type thermocouple (made of copper and constantan wire) might look like this.



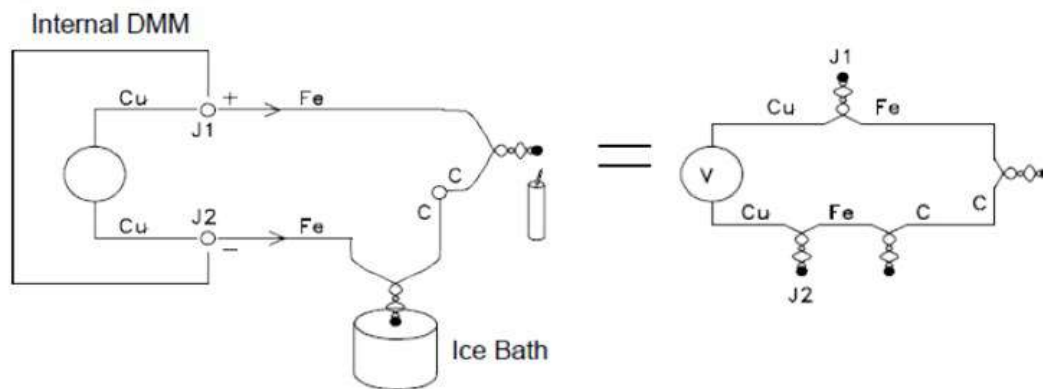
Notice, however, that the connections made between the thermocouple wire and the internal DMM make a second, unwanted thermocouple where the constantan (C) lead connects to the internal DMM's copper (Cu) input terminal. The voltage generated by this second thermocouple affects the voltage measurement of the T-type thermocouple.

If the temperature of the thermocouple created at J2 (the LO input terminal) is known, the temperature of the T-type thermocouple can be calculated. One way to do this is to connect two T-type thermocouples together to create only copper-to-copper connections at the internal DMM's input terminals, and to hold the second thermocouple at a known temperature.

An *ice bath* is used to create a known reference temperature (0 °C). Once the reference temperature and thermocouple type are known, the temperature of the measurement thermocouple can be calculated.

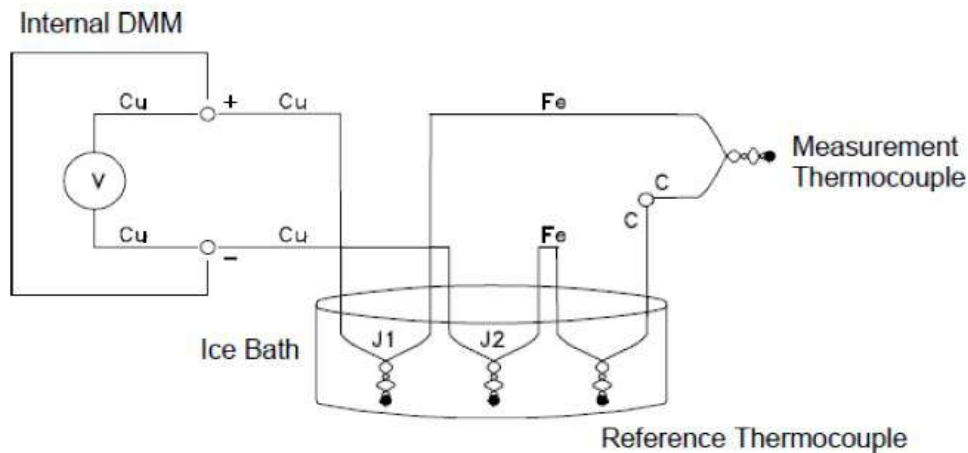


The T-type thermocouple is a unique case since one of the conductors (copper) is the same metal as the internal DMM's input terminals. If another type of thermocouple is used, two additional thermocouples are created. For example, take a look at the connections with a J-type thermocouple (iron and constantan):

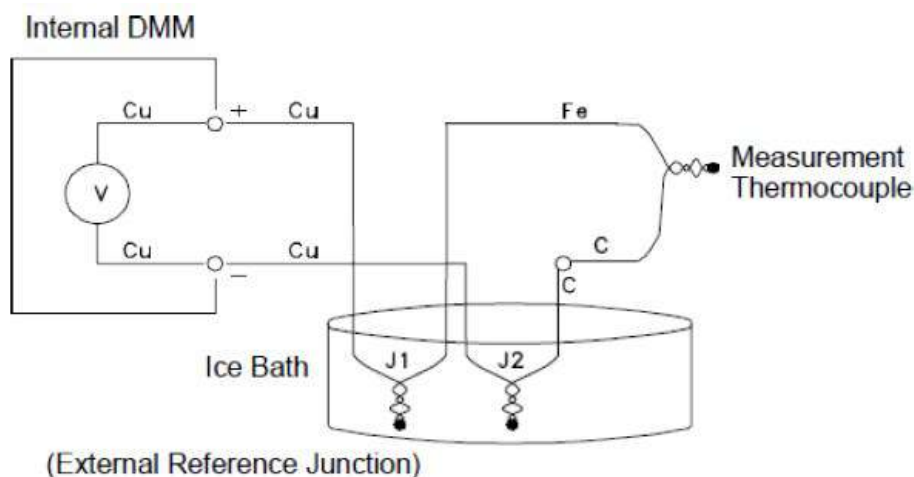


Two additional thermocouples have been created where the iron (Fe) lead connects to the internal DMM's copper (Cu) input terminals. Since these two junctions will generate opposing voltages, their effect will be to cancel each other. However, if the input terminals are not at the same temperature, an error will be created in the measurement.

To make a more accurate measurement, you should extend the copper test leads of the internal DMM closer to the measurement and hold the connections to the thermocouple at the same temperature.



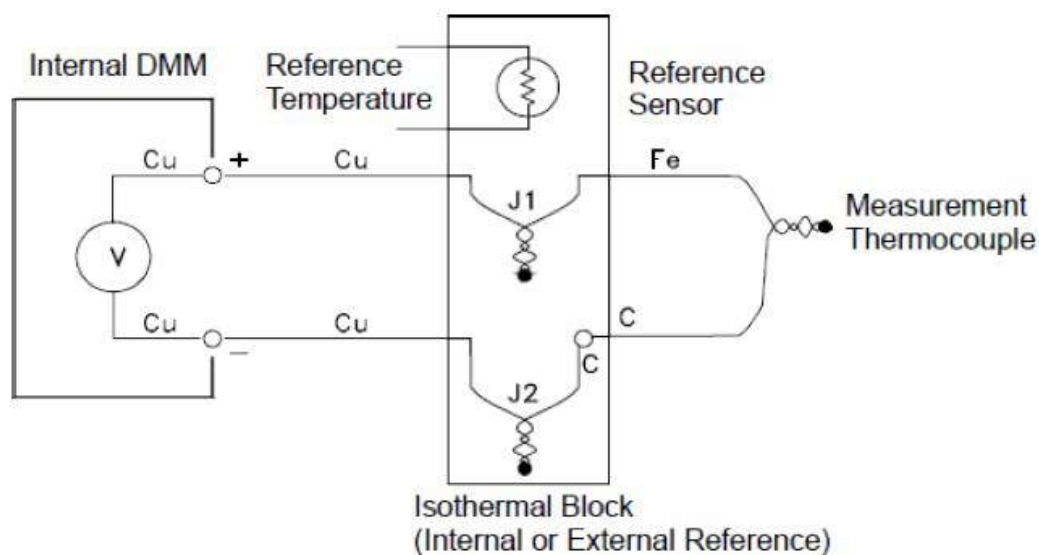
This circuit will give accurate temperature measurements. However, it is not very convenient to make two thermocouple connections and keep all connections at a known temperature. The Law of Intermediate Metals eliminates the need for the extra connection. This empirical law states that a third metal (iron (Fe) in this example) inserted between two dissimilar metals will have no effect upon the output voltage, provided the junctions formed are at the same temperature. Removing the reference thermocouple makes the connections much easier.



*This circuit is the best solution for accurate thermocouple connections.*

In some measurement situations, however, it would be nice to remove the need for an ice bath (or any other fixed external reference). To do this, an isothermal block is used to make the connections. An isothermal block is an electrical insulator, but a good heat conductor. The additional thermocouples created at J1 and J2 are now held at the same temperature by the isothermal block.

Once the temperature of the isothermal block is known, accurate temperature measurements can be made. A temperature sensor is mounted to the isothermal block to measure its temperature.



Thermocouples are available in a variety of types. The type is specified by a single letter. The table below shows the most commonly used thermocouple types and some key characteristics of each.

#### NOTE

The thermocouple conversion routines used by the DAQ970A/DAQ973A are compatible with the International Temperature Scale of 1990 (ITS-90).

## Thermocouple types:

| T/C Type                                          | Post (+) Lead                                                   | Neg (-) Lead                                                | Temperature Range | Probe Accuracy   | Comments                                                                                                             |
|---------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------|-------------------|------------------|----------------------------------------------------------------------------------------------------------------------|
| B<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Platinum-30% Rhodium<br>Gray<br>N/A<br>Red<br>Red<br>N/A        | Platinum-60% Rhodium<br>Red<br>N/A<br>Gray<br>Gray<br>N/A   | 250 °C - 1820 °C  | ±0.5 °C          | High temperature.<br>Beware of<br>contamination.<br>Do not insert in metal<br>tubes.                                 |
| E<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Nickel-Chromium<br>Purple<br>Brown<br>Red<br>Red<br>Yellow      | Constantan<br>Red<br>Blue<br>Black<br>White<br>Blue         | -200 °C - 1000 °C | ±1 °C - 1.7 °C   | Highest output<br>voltage.<br>Highest resolution.                                                                    |
| J<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Iron<br>White<br>Yellow<br>Red<br>Red<br>Yellow                 | Constantan<br>Red<br>Blue<br>Blue<br>White<br>Black         | -210 °C - 1200 °C | ±1.1 °C - 2.2 °C | For vacuum, inert<br>environments.<br>Least expensive.<br>Not recommended for<br>low temperature.                    |
| K<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Nickel-Chromium<br>Yellow<br>Brown<br>Red<br>Red<br>Yellow      | Nickel-Aluminium<br>Red<br>Blue<br>Green<br>White<br>Purple | -200 °C - 1370 °C | ±1.1 °C - 2.2 °C | For oxidizing<br>environments.<br>Good linearity above 8<br>°C.                                                      |
| N<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Nicrosil<br>Orange<br>N/A<br>N/A<br>N/A<br>N/A                  | Nisil<br>Red<br>N/A<br>N/A<br>N/A<br>N/A                    | -200 °C - 1300 °C | ±1.1 °C - 2.2 °C | Superior stability to K<br>type at higher tem-<br>peratures.                                                         |
| R<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Platinum -13% Rhodium<br>Black<br>White<br>Red<br>Red<br>Yellow | Rhodium<br>Red<br>Blue<br>White<br>White<br>Green           | -50 °C - 1760 °C  | ±0.6 °C - 1.5 °C | Higher temperature.<br>Beware of<br>contamination.<br>Do not insert in metal<br>tubes.                               |
| S<br>U.S.<br>British<br>DIN<br>Japanese<br>French | Platinum -10% Rhodium<br>Black<br>White<br>Red<br>Red<br>Yellow | Platinum<br>Red<br>Blue<br>White<br>White<br>Green          | -50 °C - 1760 °C  | ±0.6 °C - 1.5 °C | Low error, good<br>stability.<br>High temperature.<br>Beware of<br>contamination.<br>Do not insert in metal<br>tubes |

| T/C Type | Post (+) Lead | Neg (-) Lead | Temperature Range | Probe Accuracy | Comments                      |
|----------|---------------|--------------|-------------------|----------------|-------------------------------|
| T        | Copper        | Constantan   | -200 °C - 400 °C  | ±0.5 °C - 1 °C | Withstands moisture.          |
| U.S.     | Blue          | Red          |                   |                | Has a copper lead.            |
| British  | White         | Blue         |                   |                | Low temperature applications. |
| DIN      | Red           | Brown        |                   |                |                               |
| Japanese | Red           | White        |                   |                |                               |
| French   | Yellow        | Blue         |                   |                |                               |

**NOTE**

Constantan = Copper-Nickel; Nicrosil = Nickel-Chromium-Silicon; Nisil = Nickel-Silicone-Magnesium;  
N/A = Not Available

## Sources of error in thermocouple measurements

### Reference junction error

A thermocouple is typically formed by welding or soldering two wires together to make the junction. Soldering introduces a third metal into the junction. Provided that both sides of the thermocouple are at the same temperature, the third metal has little effect.

Commercial thermocouples are welded using a capacitive-discharge technique. This technique is used to prevent overheating of the thermocouple wire near the junction and to prevent the diffusion of the welding gas and atmosphere into the thermocouple wire.

A poor weld or bad solder connection can also cause errors in a thermocouple measurement. Open thermocouple junctions can be detected by checking the resistance of the thermocouple. A resistance measurement of more than 5 k $\Omega$  typically indicates a defective thermocouple. The DAQ970A/DAQ973A contains a built-in, automatic thermocouple check feature. If you enable this feature, the instrument measures the channel resistance after each thermocouple measurement to ensure a proper connection.

### Diffusion error

Diffusion in a thermocouple wire is the process of changing the alloy type along the wire itself. Atmospheric particles can actually diffuse into the metal. These changes in the wire alloy introduce small voltage changes in the measurement. Diffusion is caused by exposure to high temperatures along the wire or by physical stress to the wire such as stretching or vibration.

Temperature errors due to diffusion are hard to detect since the thermocouple will still respond to temperature changes and give nearly correct results. The diffusion effects are usually detected as a drift in the temperature measurements.

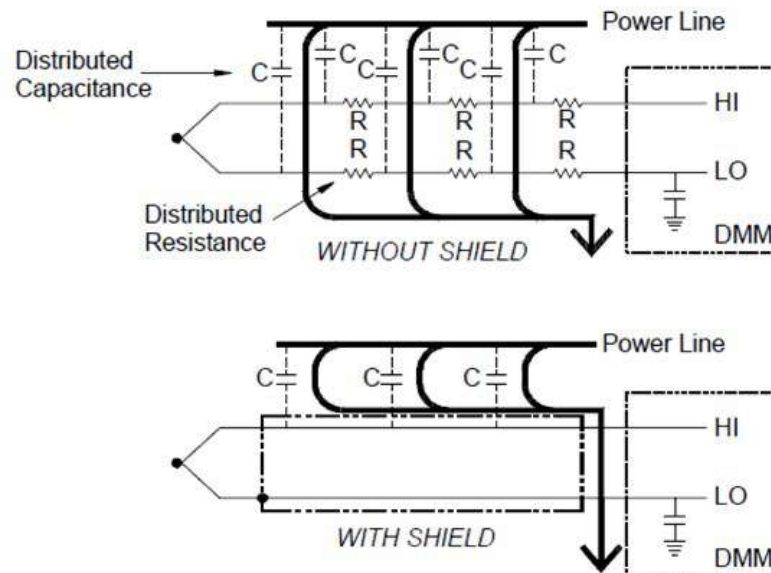
Replacing a thermocouple which exhibits a diffusion error may not correct the problem. The extension wire and connections are all subject to diffusion. Examine the entire measurement path for signs of temperature extremes or physical stress. If possible, keep the temperature gradient across the extension wire to a minimum.

### Shunt Impedance

The insulation used for thermocouple wire and extension wire can be degraded by high temperatures or corrosive atmospheres. These breakdowns appear as a resistance in parallel with the thermocouple junction. This is especially apparent in systems using a small gauge wire where the series resistance of the wire is high.

## Shielding

Shielding reduces the effect of common mode noise on a thermocouple measurement. Common mode noise is generated by sources such as power lines and electrical motors. The noise is coupled to the unshielded thermocouple wires through distributed capacitance. As the induced current flows to ground through the internal DMM, voltage errors are generated along the distributed resistance of the thermocouple wire. Adding a shield to the thermocouple wire will shunt the common mode noise to earth ground and preserve the measurement.



Common mode noise can dramatically affect the internal DMM. A typical thermocouple output is a few millivolts and a few millivolts of common mode noise can overload the input to the internal DMM.

## Calculation Error

An error is inherent in the way a thermocouple voltage is converted to a temperature. These calculation errors are typically very small compared to the errors of the thermocouple, wiring connections, and reference junction.

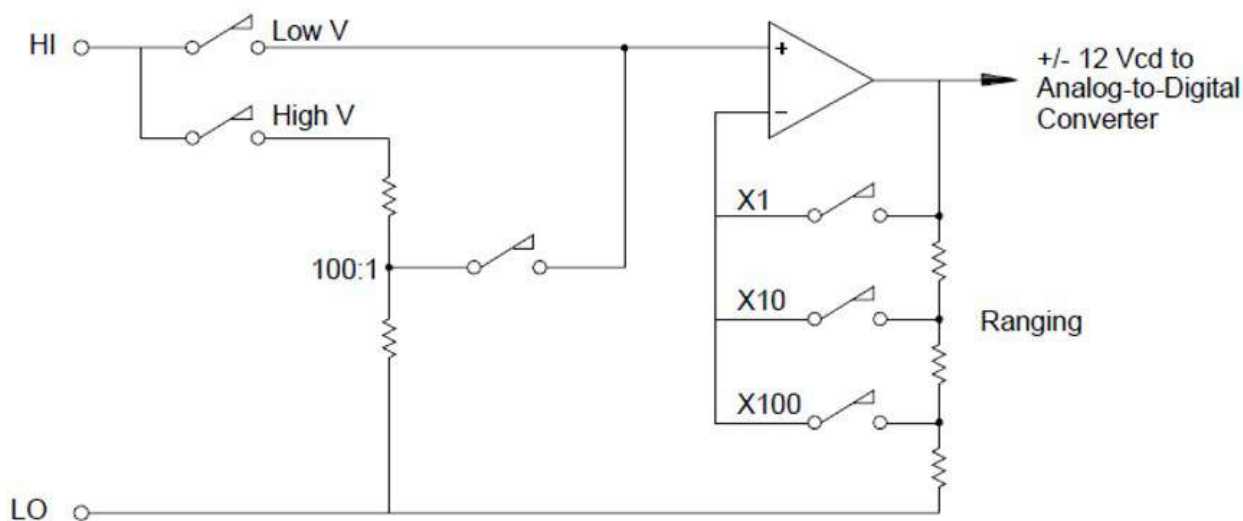


## DC voltage measurements

To make a useful DC meter, a “front-end” is required to condition the input before the analog-to-digital conversion. Signal conditioning increases the input resistance, amplifies small signals, and attenuates large signals to produce a selection of measuring ranges.

### Signal Conditioning for DC Measurements

Input signal conditioning for DC voltage measurements includes both amplification and attenuation. A simplified input to the internal DMM is shown below:



For input voltages less than 12 VDC, the Low V switch is closed and applies the input signal directly to the input amplifier. For higher voltages, the High V switch is closed and the signal is attenuated 100:1 before being applied to the input amplifier. The input amplifier gain is set to one of three values (x1, x10, or x100) to yield a signal in the range of  $\pm 12$  VDC for the analog-to-digital converter.

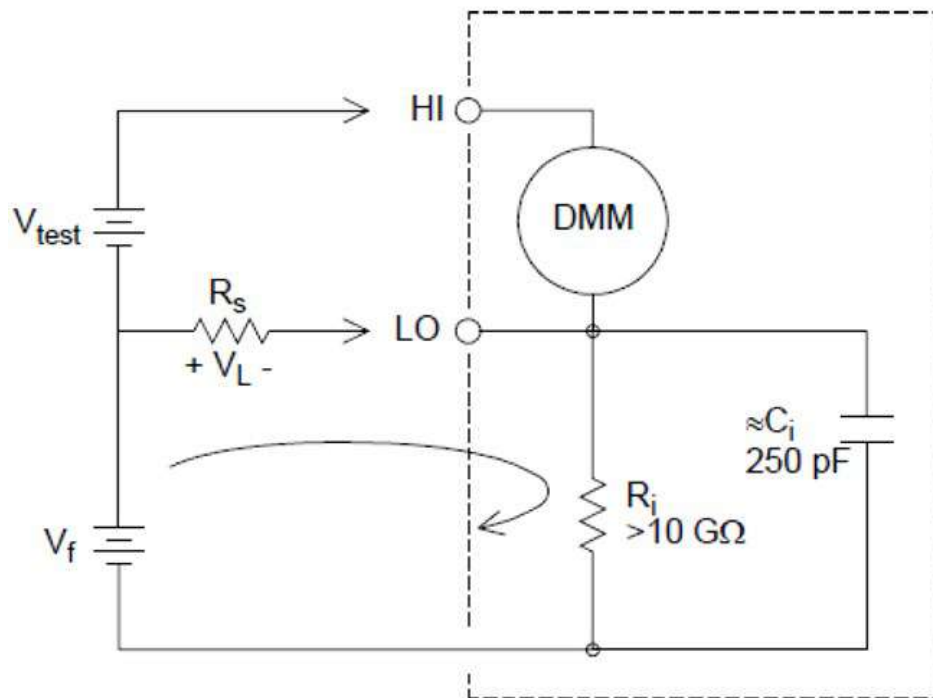
For the lower voltage ranges, the internal DMM's input resistance is essentially that of the input amplifier. The input amplifier uses a low bias current (less than 50 pA) FET input stage yielding an input resistance greater than 10 G $\Omega$ . On the 100V and 300V input ranges, the input resistance is determined by the total resistance of the 100:1 divider. You can also set the input resistance to 10 M $\Omega$  by continuously closing the High V switch.

## Sources of error in DC voltage measurements

### Common Mode rejection

Ideally, the internal DMM is completely isolated from earth-referenced circuits. However, there is finite resistance and capacitance between the input LO terminal and earth ground. If the input terminals are both driven by an earth-referenced signal ( $V_f$ ) then a current will flow through  $R_s$  and create a voltage drop  $V_L$  as shown below:

Any resulting voltage ( $V_L$ ) will appear as an input to the internal DMM. As the value of  $R_s$  approaches zero, so does the error. Additionally, if  $V_f$  is at the power line frequency (50 Hz or 60 Hz), the noise can be greatly reduced by setting the internal DMM's integration time to 1 PLC or greater.



Where:

$V_f$  = Common mode float voltage

$R_s$  = LO lead resistance

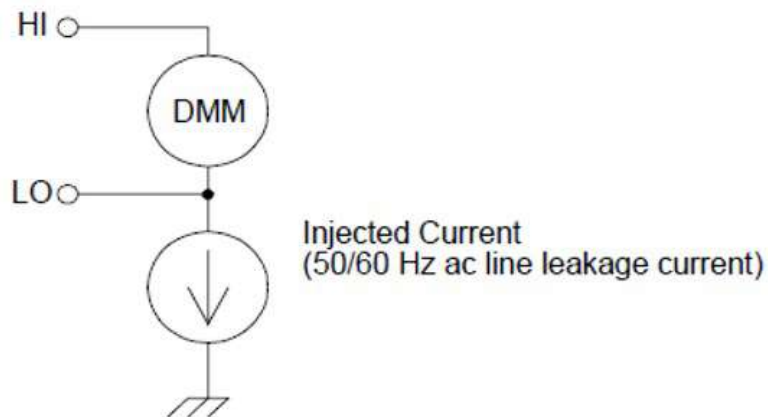
$R_i$  = Isolation resistance

$C_i$  = Isolation capacitance

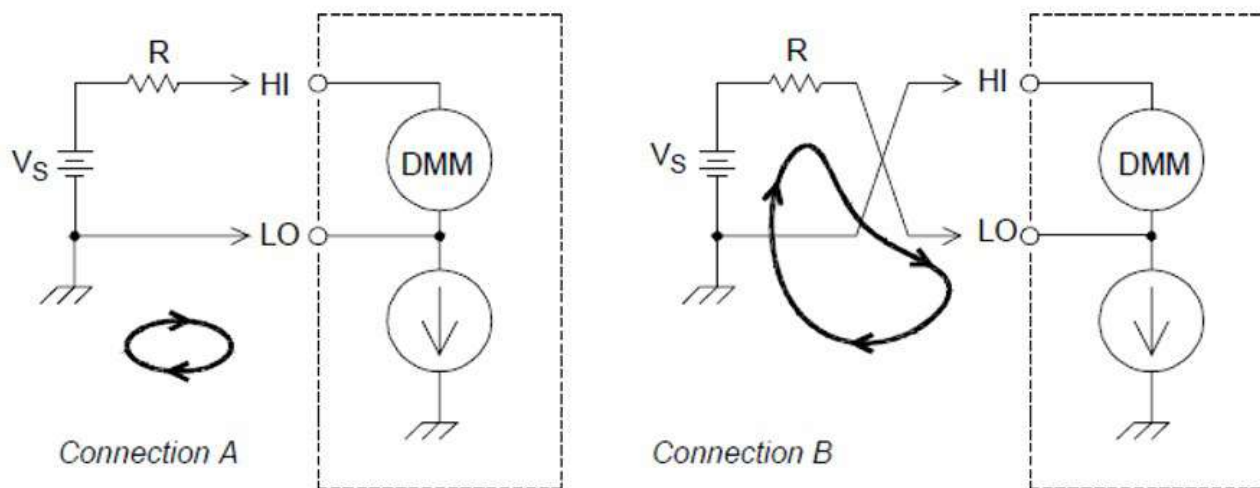
$Z_i$  = Parallel impedance of  $R_i + C_i$

### Noise caused by injected current

Residual capacitance in the instrument's power transformer cause small currents to flow from the LO terminal of the internal DMM to earth ground. The frequency of the "injected current" is the power line frequency or possibly harmonics of the power line frequency. The injected current is dependent upon the power line configuration and frequency. A simplified circuit is shown below:



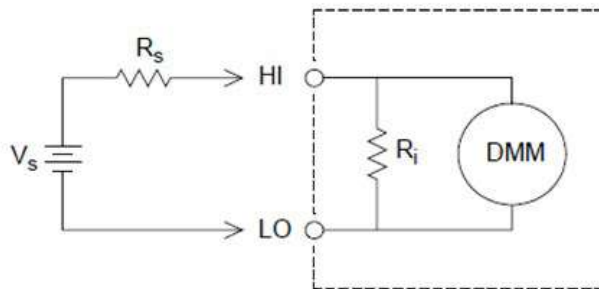
With Connection A (see below), the injected current flows from the earth connection provided by the circuit to the LO terminal of the internal DMM. This configuration adds no noise to the measurement. However, with Connection B, the injected current flows through the resistor  $R$  thus adding noise to the measurement. With Connection B, larger values of  $R$  will make the problem worse.



The measurement noise caused by injected current can be significantly reduced by setting the integration time of the internal DMM to 1 PLC or greater.

### Loading Errors Due to Input Resistance

Measurement loading errors occur when the resistance of the device-under-test (DUT) is an appreciable percentage of the instrument's own input resistance. The diagram below shows this error source:



Where:

$V_s$  = Ideal DUT voltage

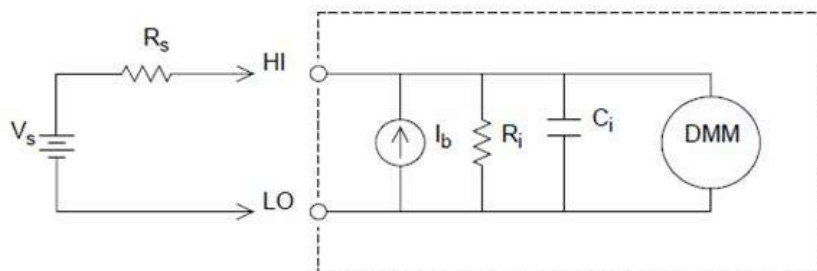
$R_s$  = DUT source resistance

$R_i$  = Input resistance ( $10\text{ M}\Omega$  or  $>10\text{ G}\Omega$ )

To minimize loading errors, set the DMM's DC input resistance to greater than  $10\text{ G}\Omega$  when needed.

### Loading Errors Due to Input Bias Current

The semiconductor devices used in the input circuits of the internal DMM have slight leakage currents called bias currents. The effect of the input bias current is a loading error at the internal DMM's input terminals. The leakage current will approximately double for every  $10^\circ\text{C}$  temperature rise, thus making the problem much more apparent at higher temperatures.



Where:

$I_b$  = DMM bias current

$R_s$  = DUT source resistance

$R_i$  = Input resistance ( $10\text{ M}\Omega$  or  $>10\text{ G}\Omega$ )

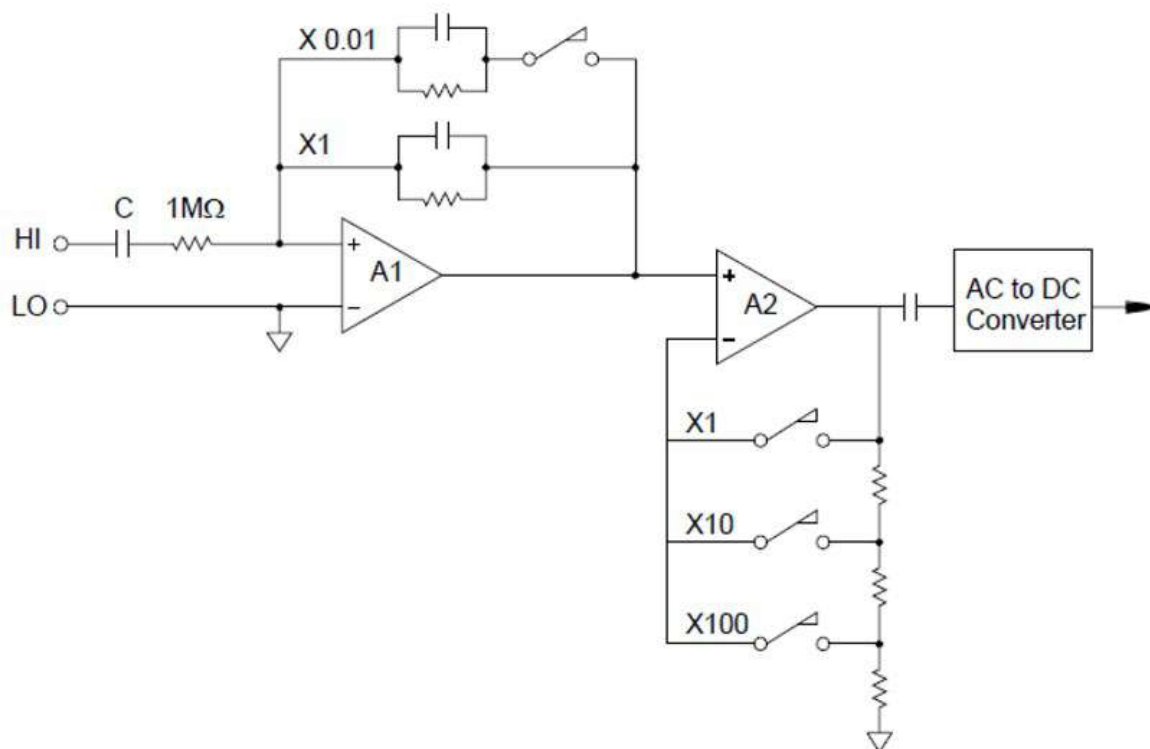
$C_i$  = DMM input capacitance

## AC voltage measurements

The main purpose of an AC “front end” is to change an AC voltage input into a DC voltage which can be measured by the ADC.

### Signal conditioning for AC measurements

Input signal conditioning for AC voltage measurements includes both attenuation and amplification. An input coupling capacitor (C) blocks the DC portion of the input signal so that only the AC component is measured. Ranging is accomplished by combining signal attenuation from the first-stage amplifier and gain from the second-stage amplifier.

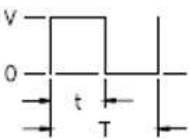


The first stage implements a high input impedance ( $1\text{ M}\Omega$ ) switchable compensated attenuator. The second stage provides variable-gain signal amplification to scale the input to the AC converter to the fullscale level. Any residual DC offset from the attenuator and amplifier stages is blocked by a capacitor.

An AC voltage front end similar to the one discussed above is also used to measure AC current. Shunt resistors convert the AC current into an AC voltage which can then be measured. Current shunts are switched to provide selectable AC current ranges.

## True RMS AC measurements

True RMS responding multimeters measure the “heating” potential of an applied voltage. Unlike an “average responding” measurement, a true RMS measurement is used to determine the power dissipated in a resistor. The power is proportional to the square of the measured true RMS voltage, independent of waveshape. An average responding AC multimeter is calibrated to read the same as a true RMS meter for sinewave inputs only. For other waveform shapes, an average responding meter will exhibit substantial errors as shown below:

| Waveform Shape                                                                    | Crest Factor (C.F.)  | AC RMS                                                           | AC+DC RMS         | Average Responding Error |
|-----------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------|-------------------|--------------------------|
|  | 1.414                | $\frac{V}{1.414}$                                                | $\frac{V}{1.414}$ | Calibrated for 0 error   |
|  | 1.732                | $\frac{V}{1.732}$                                                | $\frac{V}{1.732}$ | -3.9%                    |
|  | $\sqrt{\frac{T}{t}}$ | $\frac{V}{C.F.} \times \sqrt{1 - \left(\frac{1}{C.F.}\right)^2}$ | $\frac{V}{C.F.}$  | -46% for C.F. = 4        |

The internal DMM's AC voltage and AC current functions measure the ac-coupled true RMS value. This is in contrast to the ac+dc true RMS value shown above. Only the “heating value” of the AC component of the input waveform is measured (dc is rejected). For sinewaves, triangle waves, and square waves, the AC and AC+DC values are equal since these waveforms do not contain a DC offset. Non-symmetrical waveforms, such as pulse trains, contain DC voltages which are rejected by ac-coupled true RMS measurements.

An ac-coupled true RMS measurement is desirable in situations where you are measuring small AC signals in the presence of large DC offsets. For example, this situation is common when measuring AC ripple present on DC power supplies. There are situations, however, where you might want to know the ac+dc true RMS value. You can determine this value by combining results from DC and AC measurements as shown below. You should perform the DC measurement using at least 10 power line cycles of integration for best AC rejection.

## Making high-speed AC measurements

The internal DMM's AC voltage and AC current functions implement three low-frequency filters. These filters allow you to trade-off low frequency accuracy for faster scanning speed. The fast filter settles in 0.12 seconds and is useful for measurements above 200 Hz. The medium filter settles in 1 second and is useful for measurements above 20 Hz. The slow filter settles in 7 seconds and is useful for measurements above 3 Hz.

With a few precautions, you can perform AC measurements at speeds up to 100 readings per second (use manual ranging to eliminate autoranging delays). By setting the preprogrammed channel settling delays to zero, each filter will allow up to 100 channels per second. However, the measurement might not be very accurate since the filter is not fully settled. In scanning applications where sample-to-sample levels vary widely, the medium filter (20 Hz) will settle at 1 reading per second, and the fast filter (200 Hz) will settle at 10 readings per second.

If the sample-to-sample levels are similar, little settling time is required for each new reading. Under this specialized condition, the medium filter (20 Hz) will provide reduced accuracy results at 5 readings per second, and the fast filter (200 Hz) will provide reduced accuracy results at 50 readings per second. Additional settling time may be required when the DC level varies from sample to sample.

The internal DMM's DC blocking circuitry has a settling time constant of 0.2 seconds. This settling time only affects measurement accuracy when DC offset levels vary from sample to sample. If maximum measurement speed is desired in a scanning system, you may want to add an external DC blocking circuit to those channels with significant DC voltages present. This circuit can be as simple as a resistor and a capacitor.

| AC filter      | Channel delay | Setting time |
|----------------|---------------|--------------|
| 200 Hz (Fast)  | AUTO          | 0.12 seconds |
| 20 Hz (Medium) | AUTO          | 1 second     |
| 3 Hz (Slow)    | AUTO          | 7 seconds    |
| 200 Hz (Fast)  | 0             | 0.02 seconds |
| 20 Hz (Medium) | 0             | 0.2 seconds  |
| 3 Hz (Slow)    | 0             | 1.5 seconds  |

*DC blocking settling time (1 time constant) = 0.2 seconds.*

## Sources of error in AC voltage measurements

Many of the errors associated with DC voltage measurements also apply to AC voltage measurements. Additional errors unique to AC voltage measurements are described in this section.

### Crest Factor Errors (non-sinusoidal inputs)

A common misconception is that “since the internal DMM is true RMS, its sinewave accuracy specifications apply to all waveforms.” Actually, the shape of the input signal can dramatically affect measurement accuracy. A common way to describe signal waveshapes is crest factor. Crest factor is the ratio of the peak value to the RMS value of a waveform.

In general, the greater the crest factor the greater the energy contained in higher frequency harmonics. All multimeters exhibit measurement errors that are crest factor dependent. Note that the crest factor errors do not apply for input signals below 100 Hz when using the slow AC filter.

You can estimate the measurement error due to signal crest factor as shown below:

Where:

$\text{Error}_{\text{sine}} = \text{DMM's sinewave accuracy}$

$\text{Error}_{\text{crest factor}} = \text{DMM's crest factor}$

$\text{Error}_{\text{bandwidth}} =$

Where:

C.F = Signal crest factor

F = Fundamental input signal frequency

BW = DMM's -3dB bandwidth (1 MHz for the DAQ970A/DAQ973A)

### Example: Calculating measurement error

Calculate the approximate measurement error for a pulse train input with a crest factor of 3 and a fundamental frequency of 20 kHz. The internal DMM is set to the 1 V range. For this example, use the 90-day accuracy specifications of  $\pm (0.05\% \text{ of reading} + 0.04\% \text{ of range})$ .

$\text{Error}_{\text{sine}} = \pm(0.05\% + 0.04\%) = \pm 0.09\%$

$\text{Error}_{\text{crest factor}} = 0.15\%$

$\text{Error}_{\text{bandwidth}} =$

Total Error =  $0.09\% + 0.15\% + 1.4\% = 1.6\%$



## AC Loading Errors

In the AC voltage function, the input of the internal DMM appears as a 1 M $\Omega$  resistance in parallel with 150 pF of capacitance. The cabling that you use to connect signals to the instrument will also add additional capacitance and loading. The table below shows the approximate input resistance at various frequencies.

| Input frequency | Input resistance |
|-----------------|------------------|
| 100 Hz          | 700 k $\Omega$   |
| 1 kHz           | 600 k $\Omega$   |
| 10 kHz          | 100 k $\Omega$   |
| 100 kHz         | 10 k $\Omega$    |

For low frequencies:

Additional error for high frequencies:

Where:

F = Input Frequency

R<sub>S</sub> = Source resistance

C<sub>in</sub> = Input capacitance (150 pF) + Cable capacitance

Use low-capacitance cable when measuring high frequency AC signals.

### Low-level AC measurement errors

When measuring AC voltages less than 100 mV, be aware that these measurements are especially susceptible to errors introduced by extraneous noise sources. An exposed test lead will act as an antenna and the internal DMM will measure the signals received. The entire measurement path, including the power line, act as a loop antenna. Circulating currents in the loop will create error voltages across any impedances in series with the instrument's input. For this reason, you should apply low-level AC voltages to the instrument through shielded cables. You should also connect the shield to the input LO terminal.

Be sure to minimize the area of any ground loops that cannot be avoided. A high-impedance source is more susceptible to noise pickup than a low-impedance source. You can reduce the high-frequency impedance of a source by placing a capacitor in parallel with the instrument's input terminals. You may have to experiment to determine the correct capacitance value for your application.

Most extraneous noise is not correlated with the input signal. You can determine the error as shown below:

Correlated noise, while rare, is especially detrimental. Correlated noise will always add directly to the input signal. Measuring a low-level signal with the same frequency as the local power line is a common situation that is prone to this error. You should use caution when switching high-level and low-level signals on the same module. It is possible that high-level charged voltages may be discharged onto a low-level channel. It is recommended that you either use two different modules or separate the high-level signals from the low-level signals with an unused channel connected to ground.

### Measurements below full scale

You can make the most accurate AC measurements when the internal DMM is at full scale of the selected range. Autoranging occurs at 10 % and 120 % of full scale. This enables you to measure some inputs at full scale on one range and 10% of full scale on the next higher range. Note that the measurement accuracy will be significantly different for the two cases. For highest accuracy, you should use manual ranging to select the lowest range possible for the measurement.

### Temperature coefficient and overload errors

The internal DMM uses an AC measurement technique that periodically measures and removes internal offset voltages when you select a different function or range. When manual ranging to a new range in an overload condition, the internal offset measurement may be degraded for the selected range. Typically, an additional 0.01% of range error may be introduced. This additional error will remain until the next periodic removal (typically 15 minutes).

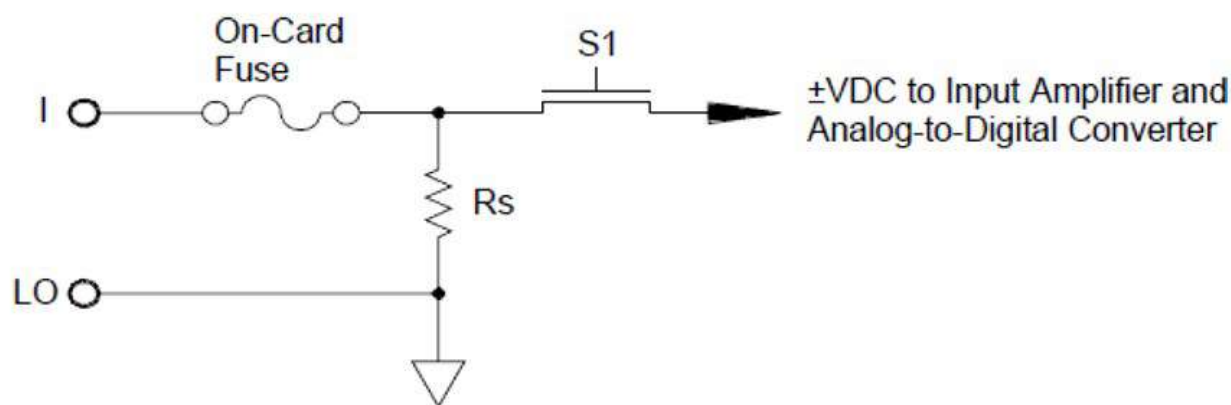
## Current measurements

**NOTE**

Only supported on the DAQM901A multiplexer module

An ammeter senses the current flowing through its input connections – approximating a short circuit between its input terminals. An ammeter must be connected in series with the circuit or device being measured such that current flows through both the meter and the test circuit.

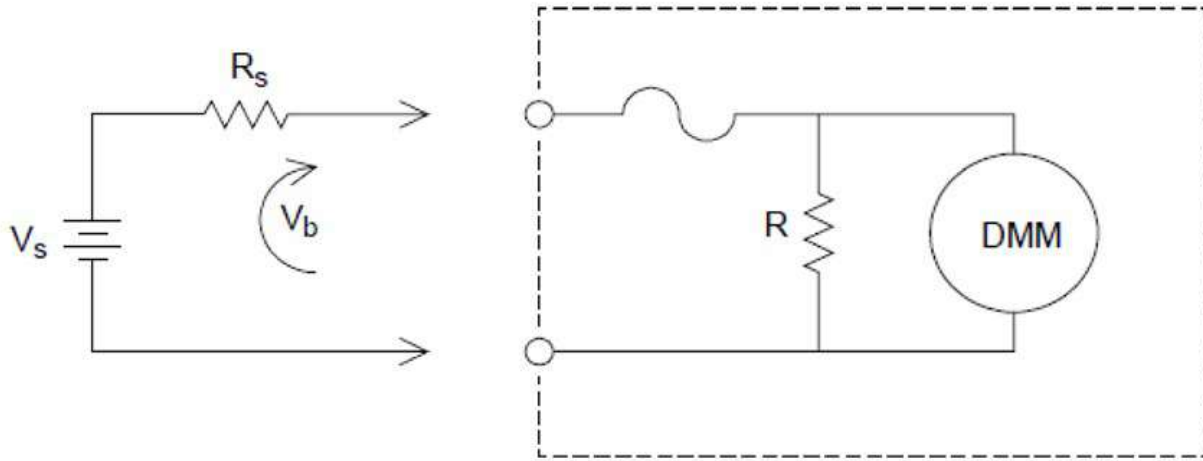
A resistor,  $R_s$  in the diagram below, is connected across the input terminals such that a voltage drop proportional to the input current is generated. The value of  $R_s$  is selected as low as possible to minimize the instrument's burden voltage, or  $IR$  drop. This voltage drop is sensed by the internal DMM and scaled to the proper current value to complete the measurement (see the discussion on the following page).



AC current measurements are very similar to DC current measurements. The output of the current-to-voltage sensor is measured by an AC voltmeter. The input terminals are direct coupled (ac+dc coupled) to the shunt so that the internal DMM maintains DC continuity in the test circuit. Performing AC current measurements demands additional care. The burden voltage (loading) varies with frequency and input inductance, often causing unexpected behavior in the test circuit.

### Sources of error in DC current measurements

When you connect the internal DMM in series with a test circuit to measure current, a measurement error is introduced. The error is caused by the DMM's series burden voltage. A voltage is developed across the wiring resistance and current shunt resistance of the internal DMM as shown below:



Where:

$V_s$  = Source voltage

$R_s$  = Source resistance

$V_b$  = Current shunt resistance

### Sources of error in AC current measurements

Burden voltage errors, which apply to DC current, also apply to AC current measurements. However, the burden voltage for AC current is larger due to the internal DMM's series inductance and the measurement connections. The burden voltage increases as the input frequency increases. Some circuits may oscillate when performing current measurements due to the internal DMM's series inductance and the measurement connections.

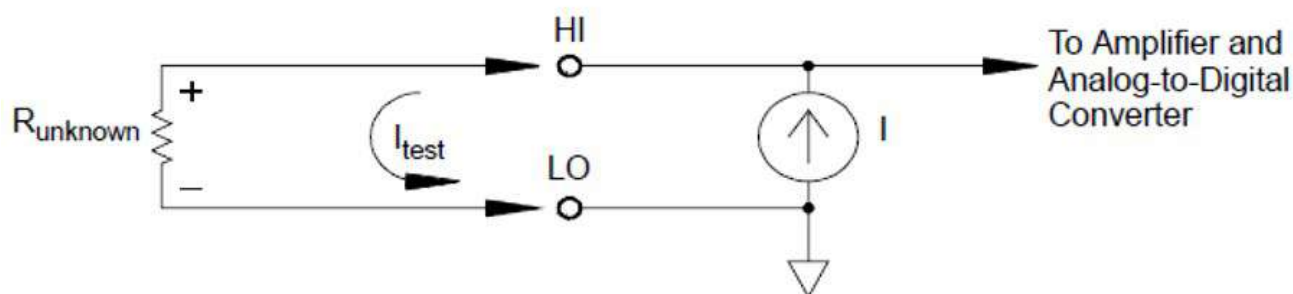
## Resistance measurement

### NOTE

2-wire resistance measurements only supported on the DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

4-wire resistance measurements only supported on the DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

An ohmmeter measures the DC resistance of a device or circuit connected to its input. Resistance measurements are performed by supplying a known DC current to an unknown resistance and measuring the DC voltage drop.



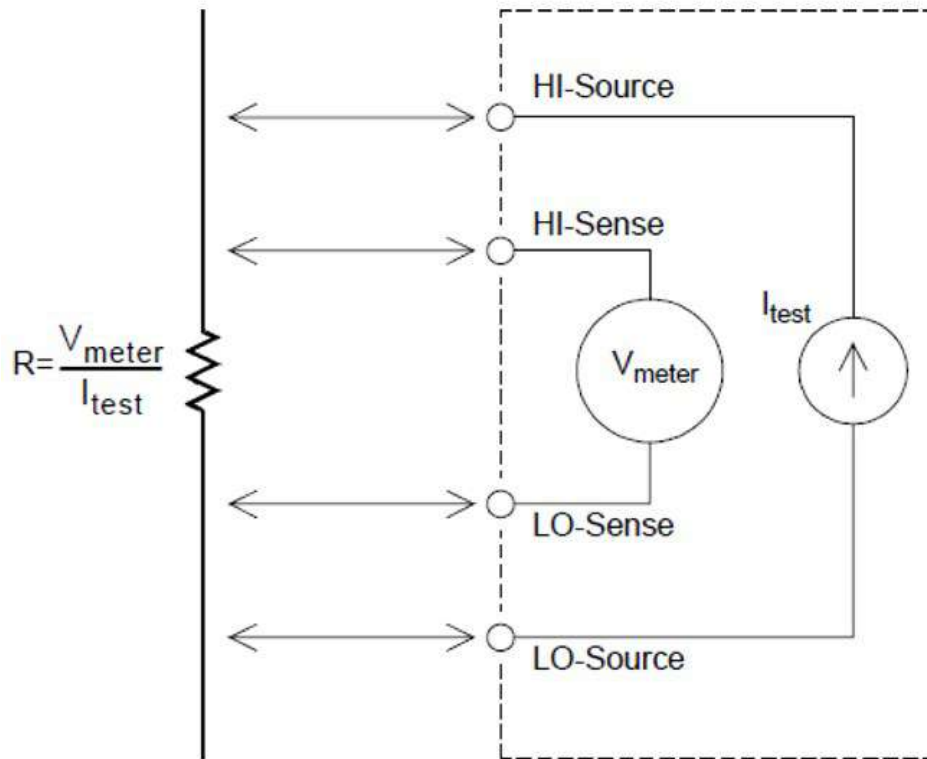
The internal DMM offers two methods for measuring resistance: 2-wire and 4-wire ohms. For both methods, the test current flows from the input HI terminal through the resistor being measured. For 2-wire ohms, the voltage drop across the resistor being measured is sensed internal to the DMM. Therefore, test lead resistance is also measured. For 4-wire ohms, separate “sense” connections are required. Since no current flows in the sense leads, the resistance in these leads does not give a measurement error.

### 4-Wire Ohms measurements

The 4-wire ohms method provides the most accurate way to measure small resistances. Test lead, multiplexer, and contact resistances are automatically reduced using this method. The 4-wire ohms method is often used in automated test applications where long cable lengths, input connections, and a multiplexer exist between the internal DMM and the device-under-test.

The recommended connections for 4-wire ohms measurements are shown in the diagram on the following page. A constant current source, forcing current  $I$  through unknown resistance  $R$ , develops a voltage measured by a DC voltage front end. The unknown resistance is then calculated using Ohm's Law.

The 4-wire ohms method is used in systems where lead resistances can become quite large and variable and in automated test applications where cable lengths can be quite long. The 4-wire ohms method has the obvious disadvantage of requiring twice as many switches and twice as many wires as the 2-wire method. The 4-wire ohms method is used almost exclusively for measuring lower resistance values in any application, especially for values less than  $10\ \Omega$  and for high-accuracy requirements such as RTD temperature transducers.



## Offset compensation

Most connections in a system use materials that produce small DC voltages due to dissimilar metal-to-metal contact (thermocouple effect) or electrochemical batteries. These DC voltages also add errors to resistance measurements. The offset-compensated measurement is designed to allow resistance measurements in the presence of small DC voltages.

Offset compensation makes two measurements on the circuit connected to the input channel. The first measurement is a conventional resistance measurement. The second is the same except the internal DMM's test current source is turned off (essentially a normal DC voltage measurement). The second measurement is subtracted from the first prior to scaling the result, thus giving a more accurate resistance measurement.

Offset compensation can be used for 2-wire or 4-wire ohms measurements (but not for RTD or thermistor measurements). The DAQ970A/DAQ973A disables offset compensation when the measurement function is changed or after a Factory Reset (\*RST command). An Instrument Preset (SYSTem:PRESet command) or Card Reset (SYSTem:CPON command) does not change the setting.

If the resistor being measured does not respond quickly to changes in current, offset compensation will not produce an accurate measurement. Resistors with very large inductances or resistors with large parallel capacitance would fall into this category. In these cases, the channel delay parameter can be increased to allow more settling time after the current source is switched on or off, or offset compensation can be turned off.

## Sources of error in resistance measurements

### External voltages

Any voltages present in the system cabling or connections will affect a resistance measurement. The effects of some of these voltages can be overcome by using offset compensation (as described in the above section).

### Settling time effects

The internal DMM has the ability to insert automatic measurement settling delays. These delays are adequate for resistance measurements with less than 200 pF of combined cable and device capacitance. This is particularly important if you are measuring resistances above 100 k $\Omega$ . Settling due to RC time constant effects can be quite long. Some precision resistors and multifunction calibrators use large parallel capacitances (1000 pF to 0.1  $\mu$ F) with high resistance values to filter out noise currents injected by their internal circuitry. Non-ideal capacitances due to dielectric absorption (soak) effects in cables and other devices may have much longer settling times than expected just by RC time constants. Errors will be measured when settling after the initial connection, after a range change, or when using offset compensation. You may need to increase the channel delay time before a measurement in these situations.

### High-resistance measurement errors

When you are measuring large resistances, significant errors can occur due to insulation resistance and surface cleanliness. You should take the necessary precautions to maintain a “clean” high-resistance system. Test leads and fixtures are susceptible to leakage due to moisture absorption in insulating materials and “dirty” surface films. Nylon and PVC are relatively poor insulators ( $10^9$  ohms) when compared to PTFE insulators ( $10^{13}$  ohms). Leakage from nylon or PVC insulators can easily contribute a 0.1% error when measuring a 1 M $\Omega$  resistance in humid conditions. The table below shows several common insulating materials and their typical resistances.

| Insulating material      | Resistance range               | Moisture absorbing |
|--------------------------|--------------------------------|--------------------|
| PTFE                     | 1 T $\Omega$ to 1 P $\Omega$   | No                 |
| Nylon                    | 1 G $\Omega$ to 10 T $\Omega$  | Yes                |
| PVC                      | 10 G $\Omega$ to 10 T $\Omega$ | Yes                |
| Polystyrene              | 100 G $\Omega$ to 1 P $\Omega$ | No                 |
| Ceramic                  | 1 G $\Omega$ to 1 P $\Omega$   | No                 |
| Glass Epoxy (FR-4, G-10) | 1 G $\Omega$ to 10 T $\Omega$  | Yes                |
| Phenolic, Paper          | 10 M $\Omega$ to 10 G $\Omega$ | Yes                |

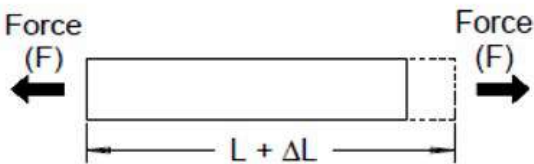
## Strain gage measurements

You can measure a strain gage using a 4-wire resistance measurement with scaling.

When a force is applied to a body, the body deforms. The deformation per unit length is called strain ( $\epsilon$ ). Strain may be either tensile (+) or compressive (-). Practical strain values are usually quite small (typically less than 0.005 inch/inch for most metals) and are often expressed in micro-strains ( $\mu\epsilon$ ). There are three common types of strain measurements as shown below:

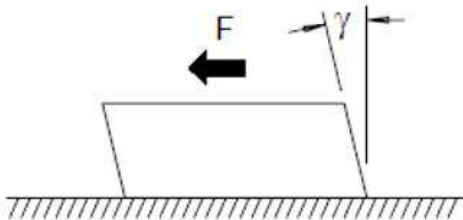
### 1. Normal strain ( $\epsilon$ )

It is a measure of the deformation along the axis of the applied force, where  $\epsilon = \Delta L / L$



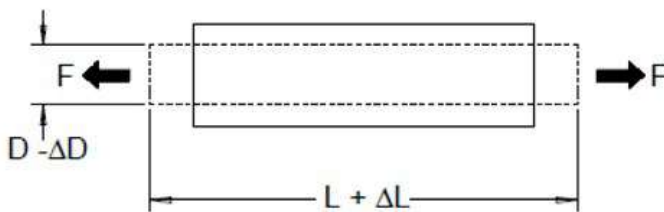
### 2. Shearing strain ( $\gamma$ )

It is a measure of the angular distortion of a body. It is approximated by the tangent of the angle formed by the angular change between two line segments that were parallel in the undeformed state.



### 3. Poisson Strain ( $\nu$ )

It measures a property of materials known as the Poisson Ratio. It is the negative ratio of transverse and longitudinal normal strain when a body has a longitudinal tensile force applied, where  $\nu = -\epsilon_t / \epsilon$ , where  $\epsilon_t = \Delta D / D$  and  $\epsilon = \Delta L / L$





## Stress

Stress is a term used to compare the loading applied to a material with its ability to carry the load. Stress ( $\sigma$ ) in a material can not be measured directly; it must be computed from material properties and measurable quantities such as strain and force.

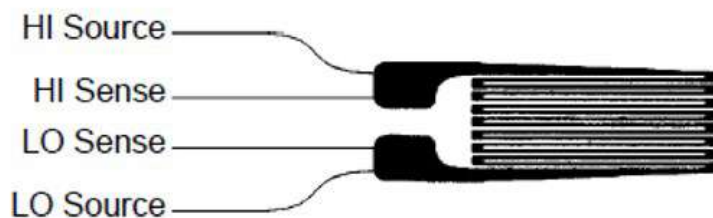
## Strain sensors

The metal foil resistance strain gage is by far the most widely used strain measurement sensor. It consists of a thin metallic foil grid bonded to a thin insulating, adhesive backing. The resistance of the foil varies linearly with strain. Strain in the test body is simply the ratio of the foil's strained to unstrained resistance:  $\epsilon = \Delta R / R$ .

## Gage Factor (GF)

The Gage Factor (GF) indicates the sensitivity of a strain gage and is a measure of the fractional resistance change per strain:  $GF = (\Delta R / R) / \epsilon$ . Devices with a higher gage factor will exhibit a greater resistance change per strain applied.

Strain gages are available in various numbers and configurations of elements. The most common element is the single gage form shown below. Multi-element strain gages, also called rosettes, are used to measure components of strain in different directions. Two-element (90°) and three-element (45° or 60°) configurations are the most common.



## Common uses for strain gages

Strain gages are used to sense many types of physical parameters. Strain gages are primarily a force-sensing device. Force is measured indirectly by measuring the deformation of a test body to a known applied force thus producing a resistance change proportional to the applied force. Many other physical quantities can be measured through force measurements. Common applications of strain gages include weight, pressure, flow, and level measurements.

## Making strain gage measurements

A Wheatstone bridge is commonly used to enable instruments with low-sensitivity measuring capabilities to measure small resistance changes common in strain measurements. Instruments with high-resolution resistance measuring capabilities, like the DAQ970A/DAQ973A internal DMM, can directly measure small resistance changes with high precision and linearity. You should also use the 4-wire resistance method when measuring strain gages to eliminate system cabling errors.

An initial, unstrained, gage resistance measurement is used as the reference ( $R_0$ ) measurement from which strain ( $\Delta R / R_0$ ) is measured. For best results, you should perform this reference measurement after the strain gage has been mounted to the test body. The table below shows the resistance changes corresponding to 1  $\mu\epsilon$  strain for common gage factor and unstrained gage resistance values.

| Strain          | GF  | $R_0$         | $\Delta R$      | DMM Sensitivity                     |
|-----------------|-----|---------------|-----------------|-------------------------------------|
| 1 $\mu\epsilon$ | 2.0 | 120 $\Omega$  | 0.24 m $\Omega$ | 0.1 m $\Omega$ (0.4 $\mu\epsilon$ ) |
| 1 $\mu\epsilon$ | 2.0 | 350 $\Omega$  | 0.70 m $\Omega$ | 1.0 m $\Omega$ (1.4 $\mu\epsilon$ ) |
| 1 $\mu\epsilon$ | 2.0 | 1000 $\Omega$ | 2.0 m $\Omega$  | 1.0 m $\Omega$ (0.5 $\mu\epsilon$ ) |

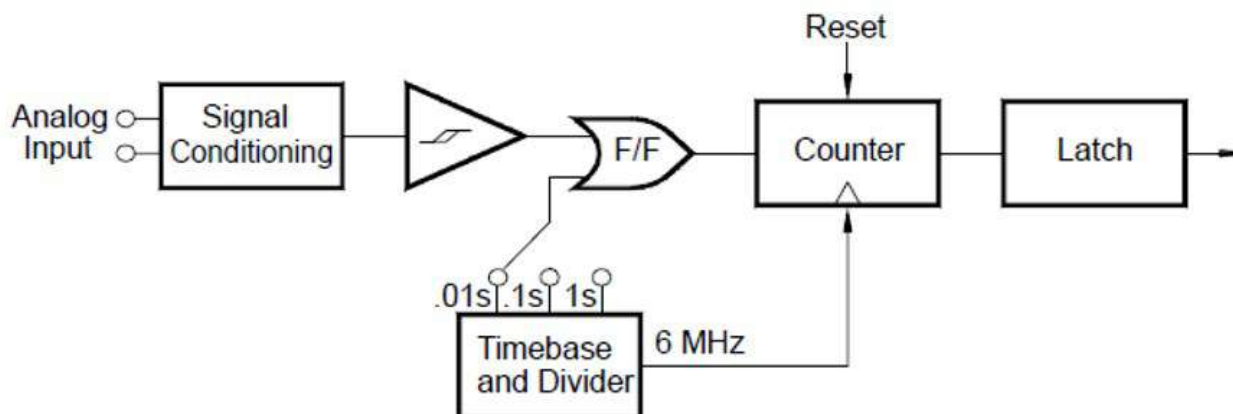
Using the measurement scaling function ( $mX+b$ ) with the equations shown below will allow you to display results directly in strain on the DAQ970A/DAQ973A front-panel display. You can use a custom measurement unit to display readings in “ $\mu\epsilon$ ” (micro-strain) directly. The instrument will automatically add the micro (“ $\mu$ ”) prefix based upon actual calculated values.

## Temperature effects

The resistive element of a strain gage will produce a resistance change  $\Delta R$  due to measured strain as well as changes in gage temperature. This will create an “apparent” strain change which is undesirable. A second gage of similar type can be used to detect temperature changes and thus remove this error source. You should mount the second gage in close proximity and at 90° to the first gage, thus responding to local temperature changes but rejecting strain changes. Subtracting measurements from the second gage will remove any undesirable strain errors.

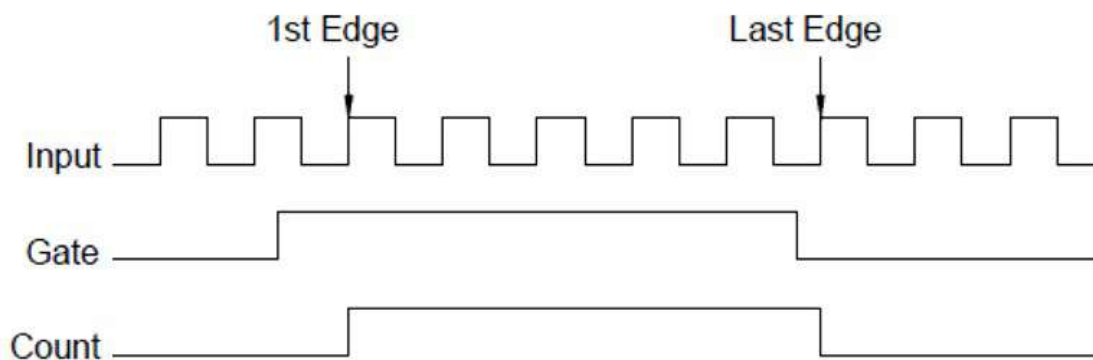
## Frequency and period measurements

The internal DMM uses a reciprocal counting technique to measure frequency and period. This method generates constant measurement resolution for any input frequency. The internal DMM's AC voltage measurement section performs input signal conditioning for frequency and period measurements.



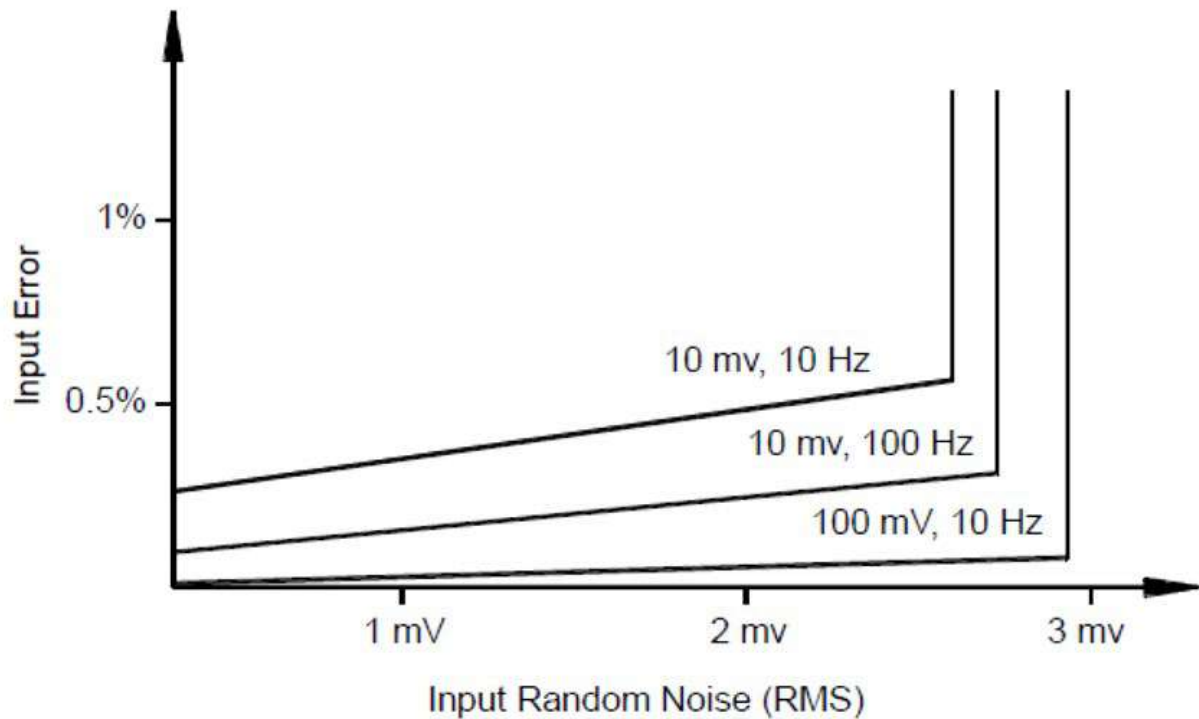
The timebase is divided to provide a gate signal. The gate signal and input signal are combined to enable the counter. During the “on” time, the counter counts the 6 MHz timebase signal. At the end of each gate period, the total count is latched and the result is divided by the known timebase frequency to determine the input frequency. The counter is then reset before the next gate period. The resolution of the measurement is tied to the timebase, and not the input frequency. This increases measurement speed especially at low frequencies.

The reciprocal counter has the advantage of a constant number of digits of display, no matter what the input frequency is. With a reciprocal counter, the number of digits of resolution scales with the gate time. If a 1-second gate gives six digits of resolution, a 0.1-second gate gives five digits, and so forth.



## Sources of error in frequency and period measurements

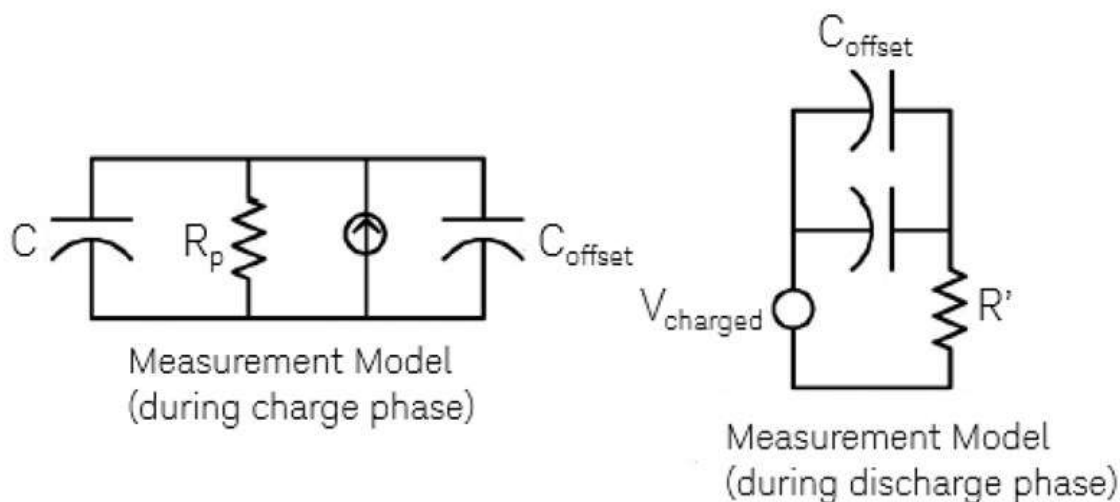
The internal DMM's AC voltage measurement section performs input signal conditioning. All frequency counters are susceptible to errors when measuring low-voltage, low-frequency signals. The effects of both internal noise and external noise pickup are critical when measuring “slow” signals. The error is inversely proportional to frequency. Measurement errors will also occur if you attempt to measure the frequency (or period) of an input following a DC offset voltage change. You must allow the internal DMM's input DC blocking capacitor to fully settle before making frequency measurements.



If the external noise pickup becomes large enough to exceed the hysteresis of the measuring circuitry, the frequency function may actually become unusable. External shielding and low-pass filtering may help.

## Capacitance measurements

The DAQ970A/DAQ973A makes capacitance measurements by applying a known current to charge the capacitance and then a resistance to discharge as shown below:



Capacitance is calculated by measuring the change in voltage ( $DV$ ) that occurs over a “short aperture” time, ( $Dt$ ). This measurement is repeated at two different times during the exponential rise that occurs. An algorithm takes the data from these four points, and by linearizing that exponential rise over these “short apertures”, accurately calculates the capacitance value.

The measurement cycle consists of two parts: a charge phase (shown in the graph) and a discharge phase. The time-constant during the discharge phase is longer, due to a 100 k $\Omega$  protective resistor in the measurement path. This time-constant plays an important role in the resultant reading rate (measurement time). The incremental times (or “sample times”) as well as the width of the “short apertures”, vary by range, in order to minimize noise and increase reading accuracy. For the best accuracy, take a zero null measurement with open probes, to null out the test lead capacitance, before connecting the probes across the capacitor to be measured.

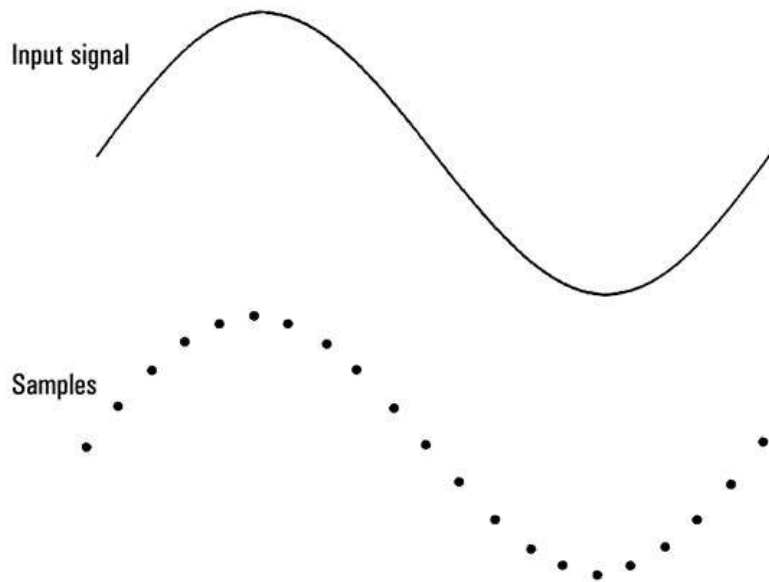
## Capacitance measurement considerations

Capacitors that have a high dissipation factor or other non-ideal characteristics will affect capacitance measurements. Capacitors with high dissipation factors may exhibit a variance between the measured value using the multimeter versus the single frequency method of some other LCR meters. The single frequency method will also see more variation at different frequencies. For example, some inexpensive capacitance substitution boxes, when measured with the multimeter, are almost 5% different compared to the same capacitance measured with the single frequency method of an LCR meter. The LCR meter will also show different values at different frequencies.

Capacitors with long time constants (dielectric absorption) will result in slow measurement settling time, and will take a number of seconds to stabilize. You may see this when first connecting a capacitor or when the delay time to make a measurement is varied. A high quality film capacitor typically shows the least of this and an electrolytic capacitor the most, with ceramic capacitors typically in between.

## Digitizing measurements

The digitize mode is available on both DAQ970A/DAQ973A with the **DMM Digitize** data acquisition mode. Digitizing is the process of converting a continuous analog signal, such as a sine wave, into a series of discrete samples (readings). The figure below shows the result of digitizing a sine wave. This chapter discusses the various ways to digitize signals. The importance of the sampling rate, and how to use level triggering.

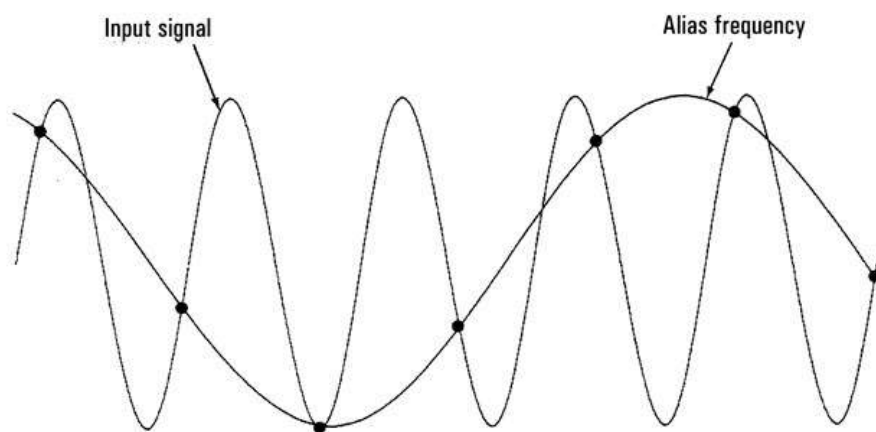


## Sampling rate

The Nyquist or Sampling Theorem states: If a continuous, bandwidth-limited signal contains no frequency components higher than  $F$ , then the original signal can be recovered without distortion (aliasing) if it is sampled at a rate that is greater than  $2F$  samples per second.

In practice, the multimeter's sampling rate must be greater than twice the highest frequency component of the signal being measured. From the front panel you can select a sample rate in samples per second, or select a sample interval (time between samples) by toggling the **Sample** softkey.

The figure below shows a sine wave sampled at a rate slightly less than  $2F$ . As shown by the dashed line, the result is an alias frequency which is much different than the frequency of the signal being measured. Some digitizers have a built-in anti-aliasing low-pass filter with a sharp cutoff at a frequency equal to  $1/2$  the digitizer's sampling rate. This limits the bandwidth of the input signal so that aliasing cannot occur. Since the multimeter has a variable sample rate for DCV digitizing, and to preserve the upper bandwidth for high-frequency measurements, no anti-aliasing filter is provided in the multimeter. If you are concerned about aliasing, you should add an external anti-aliasing filter.



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## Level triggering

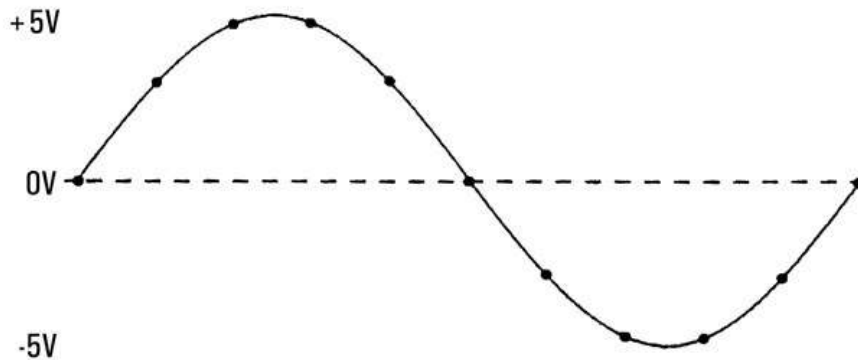
When digitizing, it is important to begin sampling at some defined point on the input signal such as when the signal crosses zero volts or when it reaches the midpoint of its positive or negative peak amplitude. Level triggering allows you to specify when (with respect to voltage and slope) to begin sampling. Refer to [Level triggering](#) for more information.

## About DMM Digitize mode

- DMM Digitize mode is available for both DAQ970A/DAQ973A.
- DMM Digitize allows you to take samples of the input signal, at a specified **Sample Rate** (for example, 50 kHz) or **Sample Interval** (for example, 20  $\mu$ S). You can specify the Duration as either an amount of Time or a number of Readings (samples). You can use either auto, external, or level triggering. After pressing **[Home]**, press **Acquire > DMM Digitize**. You can then select the digitizing/triggering parameters. After configuring the digitizing parameters, press **[Scan/Start]**. Digitizing will begin when the specified trigger event occurs.
- The DMM Digitize option enables pretriggering, level triggering, and trigger delay capability.
- For pretrigger, if a trigger comes before all pretriggers are received, trigger is executed to begin readings.
- All samples taken during digitizing are saved in volatile memory. After completing a digitize operation, press **[Save Recall] > Save > Readings** softkey and specify a file to save the digitized readings to a file.
- The maximum number of readings that can be captured is based on volatile memory space available.
- Reading stored is cleared at the start of a new acquisition.

## Level triggering

Level triggering allows you to trigger measurements at some defined point on the input signal, such as when the signal crosses zero volts or when it reaches the midpoint of its positive or negative peak amplitude. For example, this graphic shows sampling beginning as the input signal crosses 0V with a positive slope:



### About level trigger

Level triggering is available for these measurement functions:

- DC voltage and DC current
- Strain
- 2-wire and 4-wire resistance with offset compensation off, and low power off
- Temperature (RTD sensor only)

The level trigger is edge-sensitive. That is, the instrument must detect a change in the quantity being measured from one side of the level setting to the other side (direction controlled by Slope setting). For example, if the Slope is positive, then the quantity being measured must first reach a value below the set level before a trigger event can be detected. Level trigger performance is not uniform. Its accuracy, latency, and sensitivity are dependent on other DMM features.



## Low-Level Signal Multiplexing and Switching

Low-level multiplexers are available in the following types: one-wire, 2-wire, and 4-wire. The following sections in this chapter describe each type of multiplexer. The following low-level multiplexer modules are available with the DAQ970A/DAQ973A.

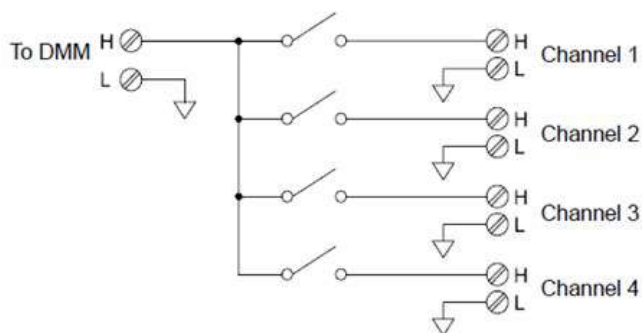
- DAQM900A 20-Channel FET Multiplexer
- DAQM901A 20-Channel Armature Multiplexer
- DAQM902A 16-Channel Reed Multiplexer
- DAQM908A 40-Channel Single-Ended Multiplexer

An important feature of a multiplexer used as a DMM input channel is that only one channel is connected at a time. For example, using a multiplexer module and the internal DMM, you can configure a voltage measurement on channel 1 and a temperature measurement on channel 2. The instrument first closes the channel 1 relay, makes the voltage measurement, and then opens the relay before moving on to channel 2 (called break-before-make switching).

- DAQM903A 20-Channel Actuator
- DAQM904A 4×8 Two-Wire Matrix

### One-wire (single-ended) multiplexers

On the DAQM908A multiplexer, all of the 40 channels switch the HI input only, with a common LO for the module.

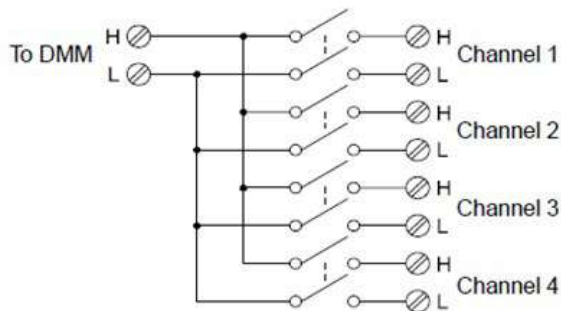


#### NOTE

Only one channel can be closed at a time; closing one channel will open the previously closed channel.

## Two-wire multiplexers

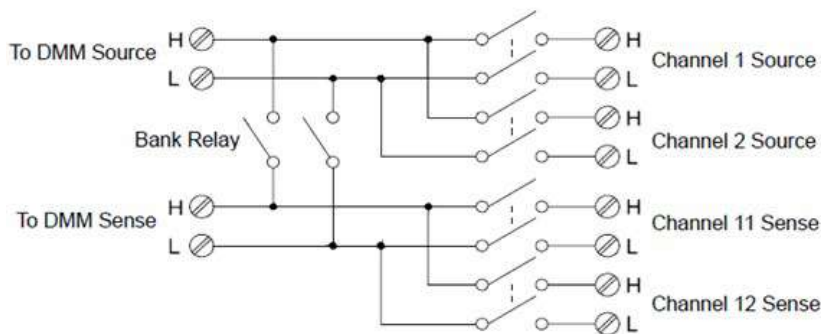
The DAQM900A, DAQM901A, and DAQM902A multiplexers switch both HI and LO inputs, thus providing fully isolated inputs to the internal DMM or an external instrument. These modules also provide a thermocouple reference junction for making thermocouple measurements.



## Four-wire multiplexers

You can make 4-wire ohms measurements using the DAQM900A, DAQM901A, and DAQM902A multiplexers. For a 4-wire ohms measurement, the channels are divided into two independent banks by opening the bank relay.

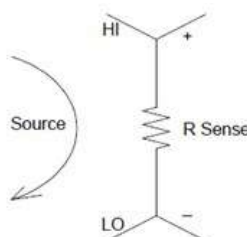
For 4-wire measurements, the instrument automatically pairs channel  $n$  with channel  $n+10$  (DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 2 and the sense connections to the HI and LO terminals on channel 12.



### NOTE

If any channels are configured to be part of the scan list, you cannot close multiple channels; closing one channel will open the previously closed channel.

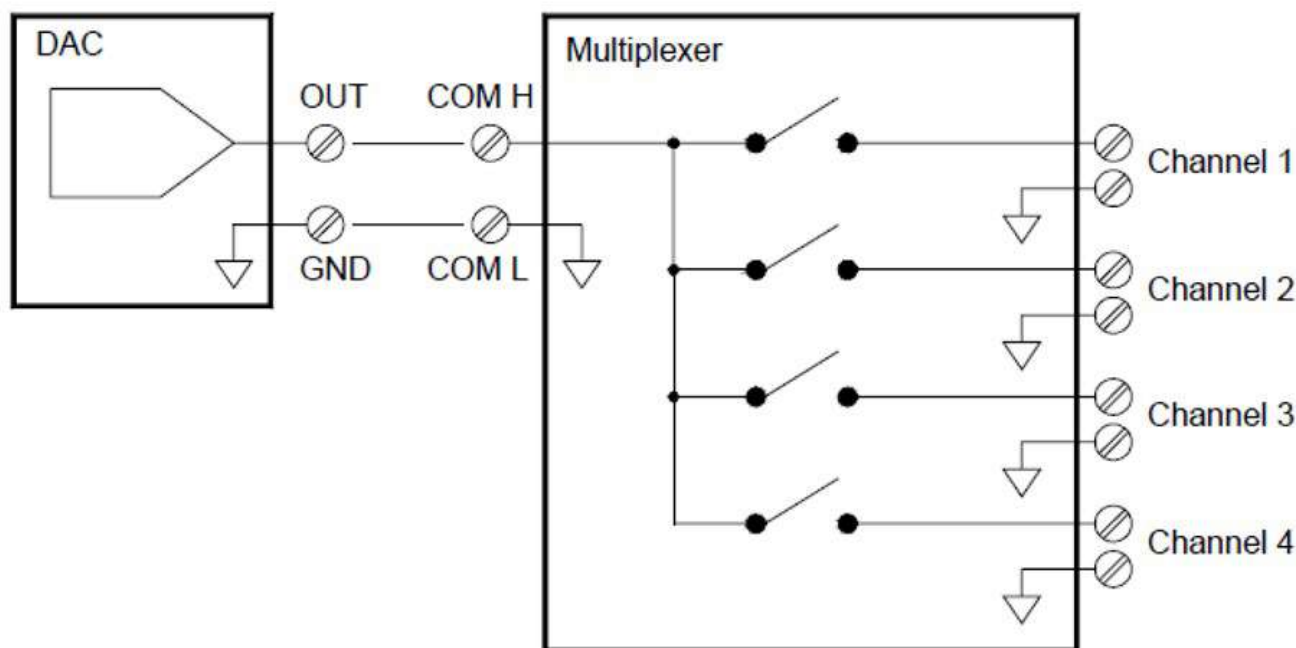
When making a 4-wire measurement, the test current flows through the source connections from the HI terminal through the resistor being measured. To eliminate the test lead resistance, a separate set of sense connections are used as shown below:



## Signal routing and multiplexing

When used stand-alone for signal routing (not scanning or connected to the internal DMM), multiple channels on the DAQM901A and DAQM902A multiplexers can be closed at the same time. You must be careful that this does not create a hazardous condition (for example, connecting two power sources together).

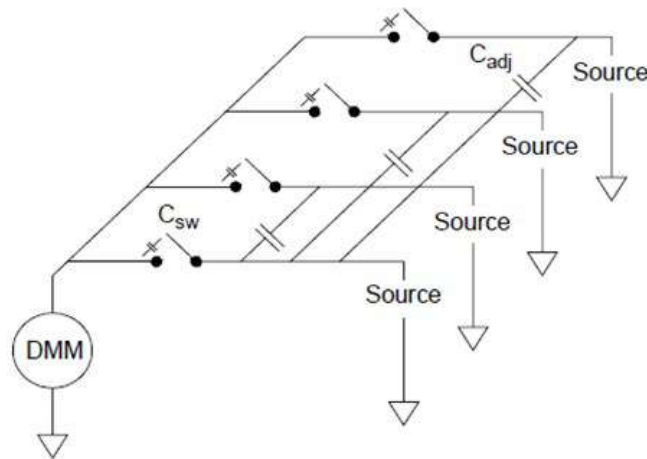
Note that a multiplexer is not directional. For example, you can use a multiplexer with a source (such as a DAC) to connect a single source to multiple test points as shown below:



## Sources of error in multiplexing and switching

Noise can be coupled inside a switch by the drive circuitry, by switch thermal EMFs, or by coupling among signal paths. Noise can also be generated outside the network and conducted or coupled into the switch. Although noise problems apply to the entire system, they can become especially acute for switching. Switch networks contain a high concentration of signals, which magnify the errors. Most problems with electric noise can be traced to improper grounding and shielding.

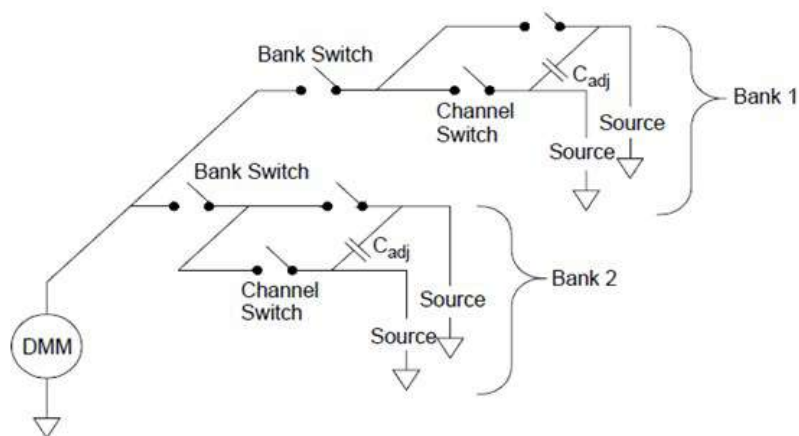
Noise can be capacitively coupled between physically adjacent channels in a switching system. Noise can be coupled between the switch contacts themselves ( $C_{sw}$ ) or between adjacent cabling ( $C_{adj}$ ).



Capacitive noise coupling is a function of area and proximity. A simple method to reduce the noise coupling is to physically separate the switches and cables from each other. However, this may not be practical for all applications.

Another solution is to keep large amplitude signals and small amplitude signals away from each other. Group similar signals together (high voltages, low voltages, analog, and digital). If possible, use two separate switch modules; one for high-level signals and one for low-level signals. If you are using a single module for mixed-signal switching, leave one unused, grounded channel between the groups. Also, ground any unused channels on the module.

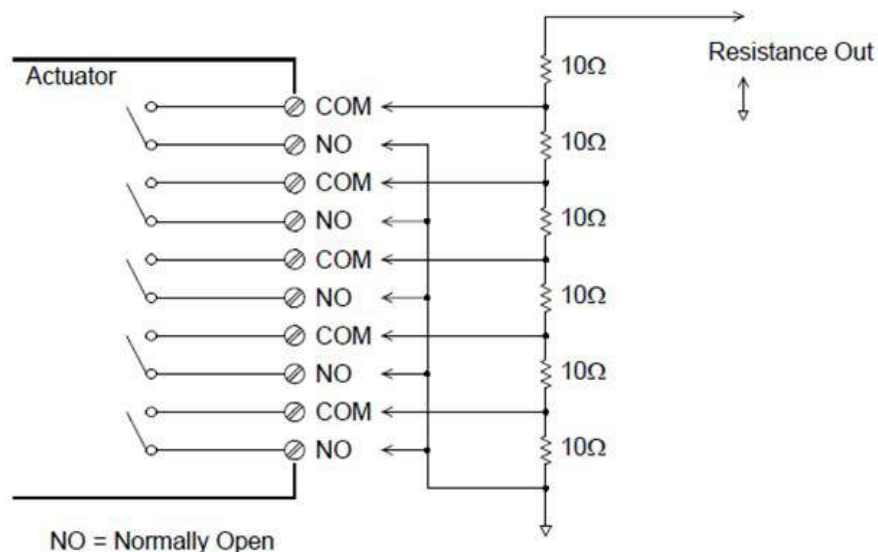
The DAQM901A and DAQM902A multiplexers have an additional relay, called a bank switch or tree switch, which helps reduce channel-to-channel noise ( $C_{adj}$ ). The multiplexer channels are divided into two banks. The bank switch isolates one bank of channels from the other, effectively removing any parallel adjacent capacitance from the isolated bank. During a scan, the instrument automatically controls the bank switches.



| Module   | Bank 1                | Banks 2                |
|----------|-----------------------|------------------------|
| DAQM900A | Channels 1 through 10 | Channels 11 through 20 |
| DAQM901A | Channels 1 through 10 | Channels 11 through 20 |
| DAQM902A | Channels 1 through 8  | Channels 9 through 16  |
| DAQM908A | Channels 1 through 20 | Channels 21 through 40 |

## Actuators and General-Purpose Switching

The DAQM903A Actuator provides 20 independent, isolated SPDT (single-pole, double-throw) or Form C switches. This module offers simple on-off switching which you can use to control power devices or for custom switching applications. For example, you can use an actuator to build a simple resistance ladder as shown below:

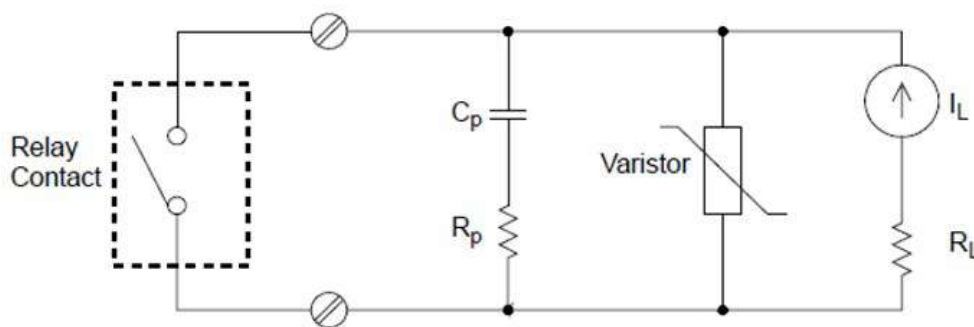


In the above diagram, the resistance is  $60\Omega$  when all of the actuator channels are open (not connected to COM). Note that when the actuator channels are open, as shown above, the normally-closed contacts (not shown above) are connected to COM. Values from  $10\Omega$  to  $50\Omega$  are selected by closing the appropriate channel(s) on the module.

### Snubber circuits

Whenever a relay contact opens or closes, electrical breakdown or arcing can occur between the contacts. This can cause high-frequency noise radiation, voltage and current surges, and physical damage to the relay contacts.

A breadboard area is provided on the DAQM903A to implement custom circuitry such as simple filters, snubbers, and voltage dividers. The breadboard area provides the space necessary to insert your own components but there are no circuit board traces here. You can build these networks to provide contact protection when actuating AC power line for reactive loads. Although many types of contact protection networks can be used, only RC networks and varistors are described in this section.



## RC protection network

When designing RC protection networks, the protection resistor  $R_p$  is selected as a compromise between two resistance values. The minimum value of  $R_p$  is determined by the maximum acceptable relay contact current ( $I_{max}$ ). For the DAQM903A, the maximum allowable relay current ( $I_{max}$ ) is 1 ADC or AC rms. Thus, the minimum value for  $R_p$  is  $V/I_o$ , where  $V$  is the peak value of the supply voltage.

The maximum value for  $R_p$  is usually made equal to the load resistance  $R_L$ . Therefore, the limits on  $R_p$  can be stated as:

Note that the actual value of the current ( $I_o$ ) in a circuit is determined by the equation:

where  $V$  is the peak value of the source voltage and  $R_L$  is the resistance of the load. The value for  $I_o$  will be used to determine the value of the protection capacitor ( $C_p$ ).

In determining the value of the protection network capacitor ( $C_p$ ), there are several things that you will need to consider. First, the total circuit capacitance ( $C_{tot}$ ) must be such that the peak voltage across the open relay contacts does not exceed 300 Vrms. The equation for determining the minimum allowable circuit capacitance is:

where  $L$  is the inductance of the load and  $I_o$  is the current value calculated earlier.

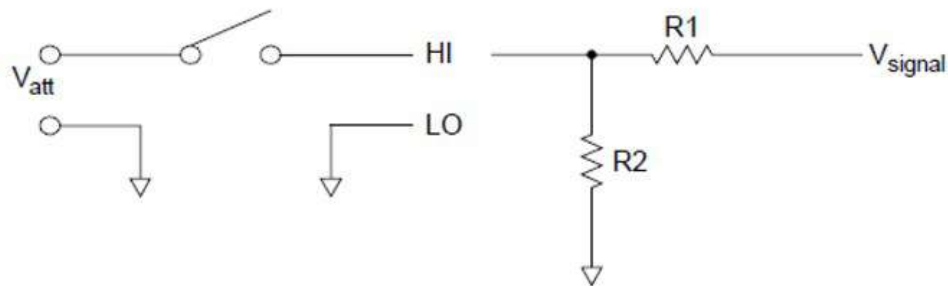
The total circuit capacitance ( $C$ ) is actually made up of the wiring capacitance plus the value of the protection network capacitor ( $C_p$ ). Therefore, the minimum value for  $C_p$  should be the value obtained for the total circuit capacitance ( $C$ ). Note that the actual value used for  $C_p$  should be substantially greater than the value calculated for  $C$ .

## Using Varistors

Use a varistor to add an absolute voltage limit across the relay contacts. Varistors are available for a wide range of voltage and clamp energy ratings. Once the circuit reaches the voltage rating of the varistor, the varistor's resistance declines rapidly. A varistor can supplement an RC network and is especially useful when the required capacitance ( $C_p$ ) is too large.

## Using Attenuators

Provisions have been made on the DAQM903A circuit board for installing simple attenuators or filter networks. An attenuator is composed of two resistors that act as a voltage divider. A typical attenuator circuit is shown below:

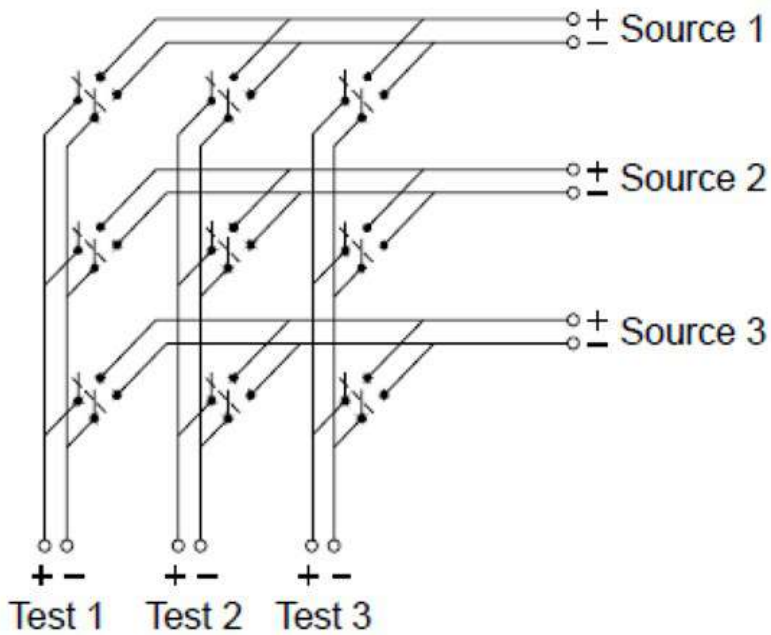


To select the attenuator components, use the following equation:

One typical use for the shunt component is with 4 to 20 mA transducers. A  $50\ \Omega$ ,  $\pm 1\%$ , 0.5 watt resistor can be installed in the  $R2$  location. The resultant voltage drop (transducer current through the resistor) can be measured by the internal DMM. Thus, the  $50\ \Omega$  resistor converts the 4 to 20 mA current to a 0.2 to 1 volt signal.

## Matrix Switching

A matrix switch connects multiple inputs to multiple outputs and therefore offers more switching flexibility than a multiplexer. Use a matrix for switching low-frequency (less than 10 MHz) signals only. A matrix is arranged in rows and columns. For example, a simple 3x3 matrix could be used to connect three sources to three test points as shown below:

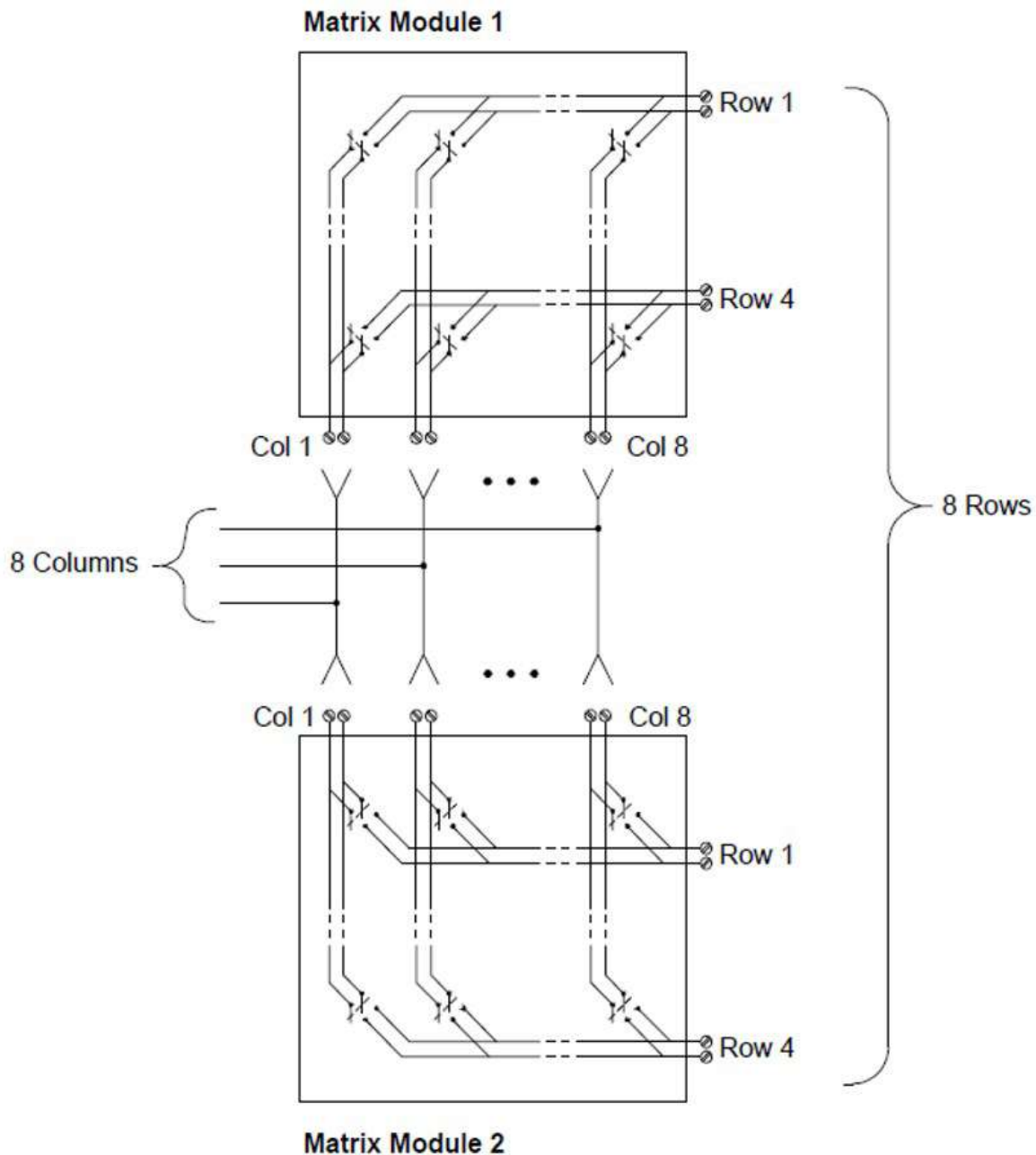


Any one of the signal sources can be connected to any one of the test inputs. Be aware that with a matrix, it is possible to connect more than one source at the same time. It is important to make sure that dangerous or unwanted conditions are not created by these connections.



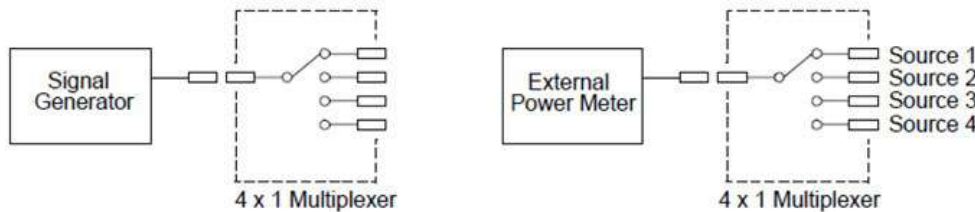
## Combining Matrices

You can combine two or more matrix switches to provide more complex switching. For example, the DAQM904A provides a 4-row by 8-column matrix. You can combine two of these modules as either a 4-row by 16-column matrix or an 8-row by 8-column matrix. An 8x8 matrix is shown below:

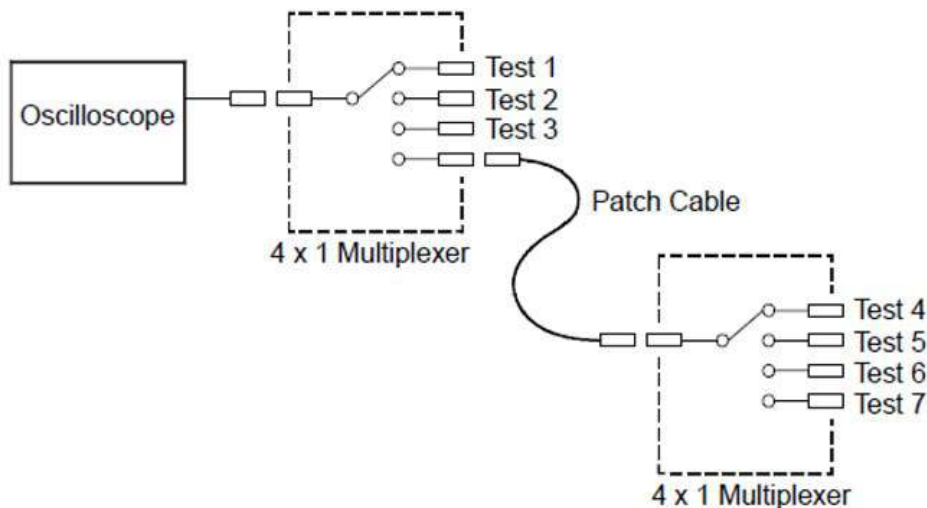


## RF Signal Multiplexing

A special type of multiplexer is the RF multiplexer. This type of multiplexer uses special components to maintain a 50  $\Omega$  impedance in the signal line being switched. In a test system, these switches are often used to route a test signal from a signal source to the device-under-test. The switches are bi-directional. The diagram below shows two examples of a 4-to-1 channel RF multiplexer in a test system.



By using patch cables, you can expand RF multiplexers to provide additional test inputs or outputs. For example, you can combine two 4-to-1 multiplexers to create a 7-to-1 multiplexer as shown below:



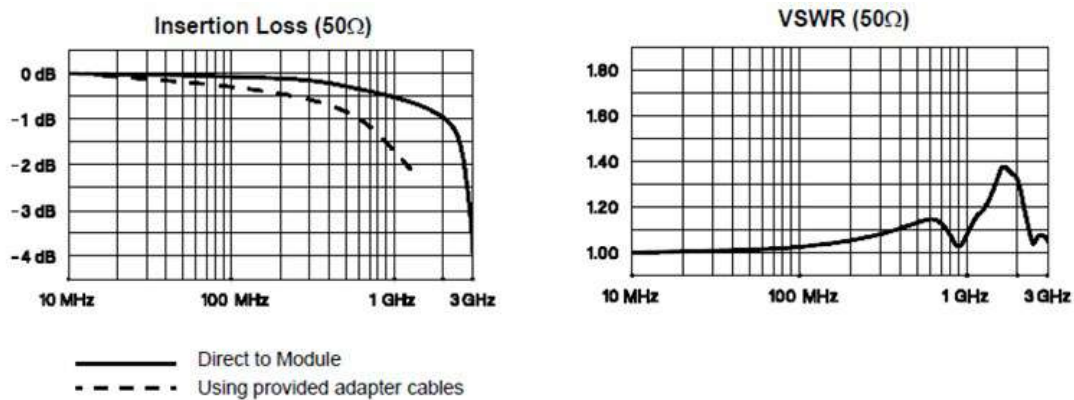
On the DAQM905A (50  $\Omega$ ) RF multiplexers, you can close only one channel per bank at a time; closing one channel in a bank will open the previously closed channel. These modules respond only to the CLOSE command (OPEN does not apply). To open a channel, send the CLOSE command to another channel in the same bank. Note that DAQM905A module do not automatically terminate open channel.

## Sources of error in RF switching

Impedance mismatching can cause a variety of errors in an RF multiplexing system. These errors can cause distorted waveforms, overvoltage, or undervoltage conditions.

To minimize RF impedance mismatching:

- Use the correct cable and connector for the circuit impedance ( $50\ \Omega$ ).
- Be sure that all leads and signal paths are properly terminated. Unterminated sections of line can appear as near shorts at RF frequencies.

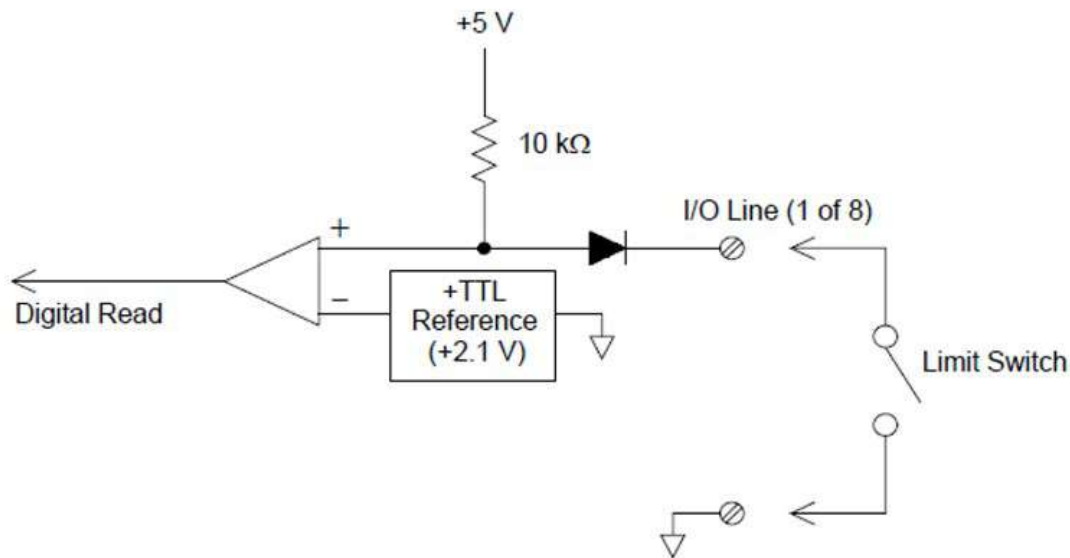


# Multifunction Module

## Digital Input

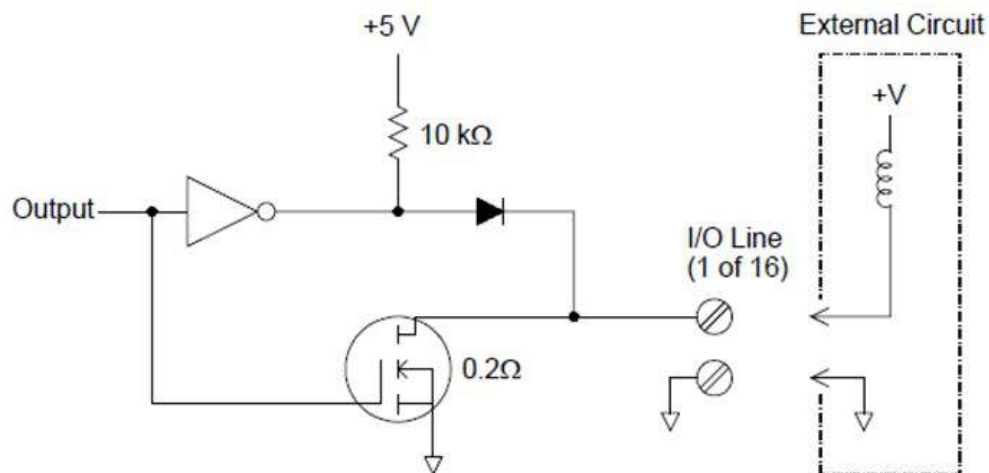
The DAQM907A module has two non-isolated 8-bit input/output ports which you can use for reading digital patterns.

- You can read the live status of the bits on the port or you can configure a scan to include a digital read.
- You can generate an alarm when a specific bit pattern or bit pattern change is detected on an input channel. The channels do not have to be part of the scan list to generate an alarm.
- The internal +5 V pull-up circuitry allows you to use the digital input to detect contacts closures like micro-switches or limit switches. An open input floats to +5 V and is read as a "1". An input shorted to ground is read as a "0". An example of a contact close detection channel is shown below:



## Digital Output

The DAQM907A module has two non-isolated 8-bit input/output ports, which you can use for outputting digital patterns. You can combine the two ports to output a 16-bit word. A simplified diagram of a single output bit is shown below:



- Each output bit is capable of directly driving up to 10 TTL loads (less than 1 mA). The buffer for each port is used to drive a high output from the internal +5 V supply through the diode. The drive is rated at +2.4 V minimum at 1 mA.
- Each output bit is also can active sink, capable of sinking up to 400 mA from the external power supply. The FET is used to sink currents and has a nominal "on" resistance of 0.2  $\Omega$ .
- For non-TTL logic you must provide an external pull-up. A description of the pull-up calculation is given on the following section.
- If used with an external power supply and pull-up, the external supply must be greater than +5 VDC and less than +42 VDC.

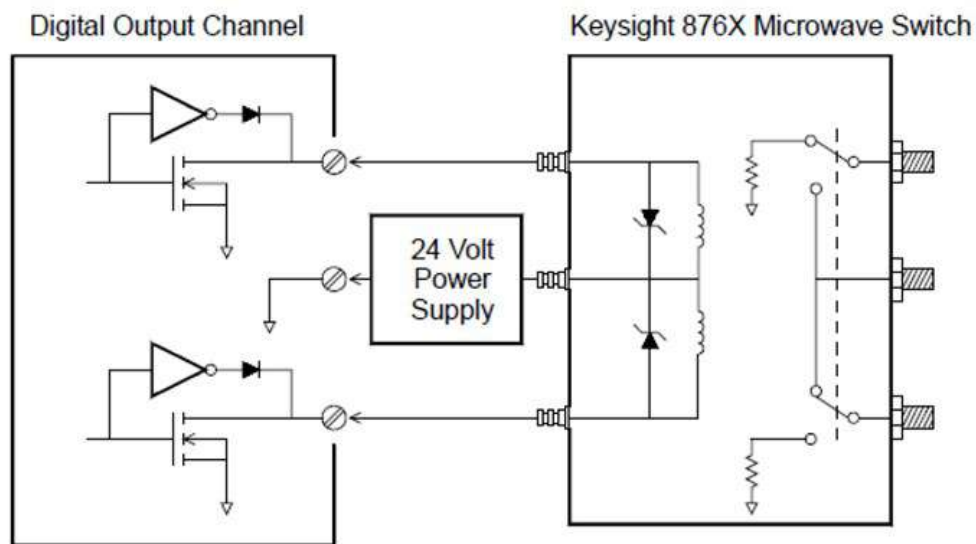
## Using external pull-up

In general, an external pull-up is required only when you want to set the output “high” value greater than TTL levels. For example, to use a +12V external power supply, the value of the external pull-up resistor is calculated as follows:

The value of the logic "high" level with the external 24 k $\Omega$  pull-up resistor is calculated as follows:

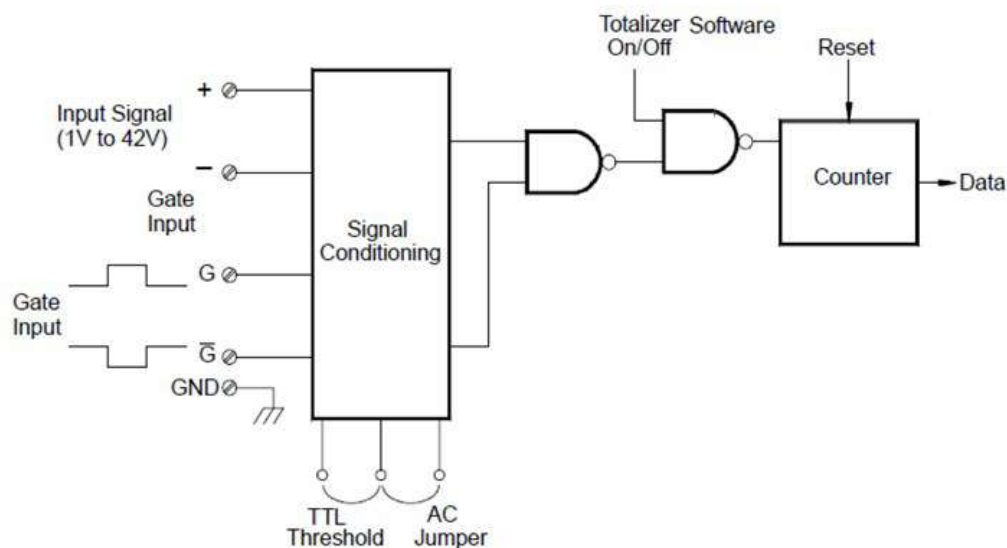
## Driving external switches

You can use two digital output channels to control an external switch. For example, you can drive the Keysight 876X series of microwave switches using an external power supply and two digital output channels. The state of the 2-to-1 multiplexer is changed by setting the appropriate output bit low (0).



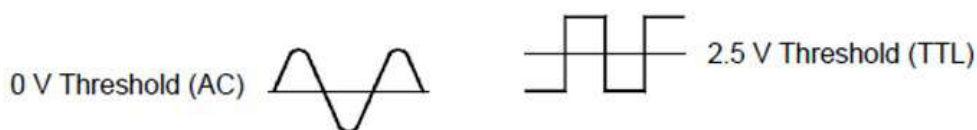
## Totalizer

The DAQM907A module has a 26-bit totalizer which can count pulses at a 100 kHz rate. You can manually read the totalizer count or you can configure a scan to read the count.



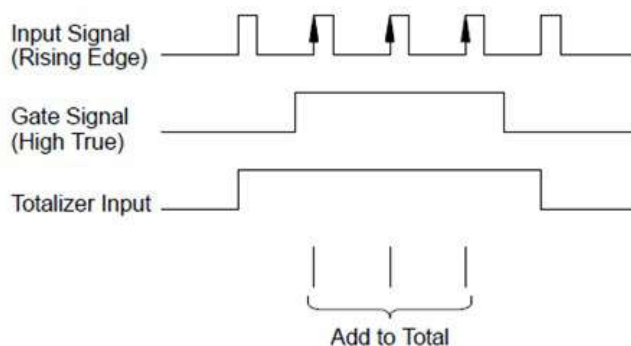
You can configure the totalizer to count on the rising edge or falling edge of the input signal.

Using the hardware jumper labeled "Totalize Threshold" on the module, you can control the threshold at which an edge is detected. Move the jumper to the "AC" position to detect changes through 0 volts. Move the jumper to the "TTL" position (factory setting) to detect changes through TTL threshold levels.



The maximum count is 67,108,863 (2<sup>26</sup>-1). The count rolls over to "0" after reaching the maximum allowed value.

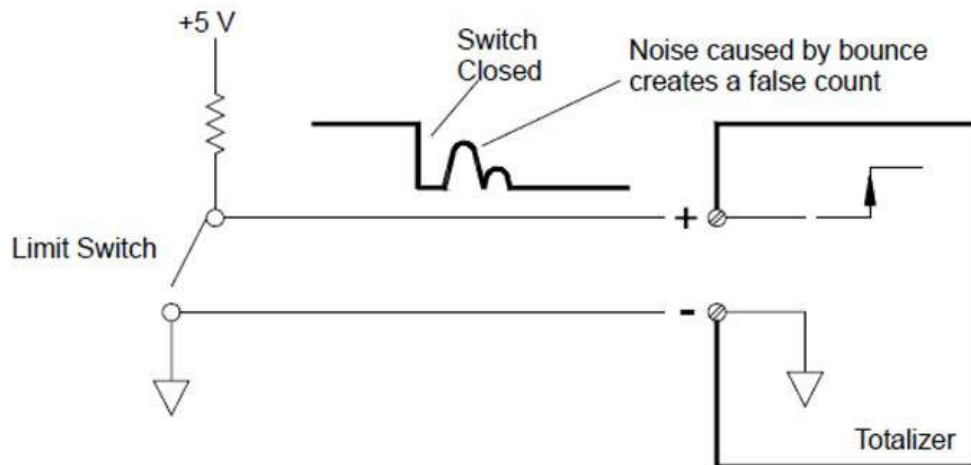
You can control when the totalizer actually records counts by providing a gate signal ( and terminals on the module). A TTL high signal applied to the "G" terminal enables counting and a low signal disables counting. A TTL low signal applied to the terminal enables counting and a high signal disables counting. The totalizer only counts when both terminals are enabled. You can use the either G terminal, the terminal, or both. When a gate is not connected, the gate terminal floats to the enabled state, effectively creating a "gate always" condition.



## Totalizer errors

Noise on the totalizer input can be a problem, especially on signals with a slow rise time. This noise can create a false indication of a threshold crossing. See [System Cabling and Connections](#) for more information.

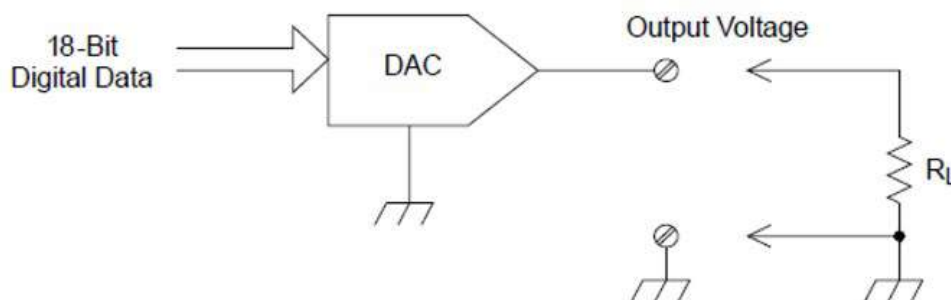
Contact bounce on external switches can create false counts. All mechanical switches bounce when they open and close. Use an external capacitor to filter the contact bounce.



## Analog Output (DAC)

The DAQM907A module has two analog outputs and senses capable of outputting calibrated voltages or currents with 18 bits of resolution.

Each DAC (Digital-to-Analog Converter) channel can be used as a programmable voltage or current source for analog input to other devices.



You can set the output voltage to any value between +12 VDC and -12 VDC, in 0.1 mV steps. Each DAC is earth referenced; it cannot float.

Each DAC channel is capable of supplying 15 mA maximum current.

### NOTE

You must limit the DAC output current to 40 mA total for each slot (two DAC channels).

To maintain the rated output accuracy, the load ( $R_L$  in the diagram shown above) must be greater than 1 k $\Omega$ .

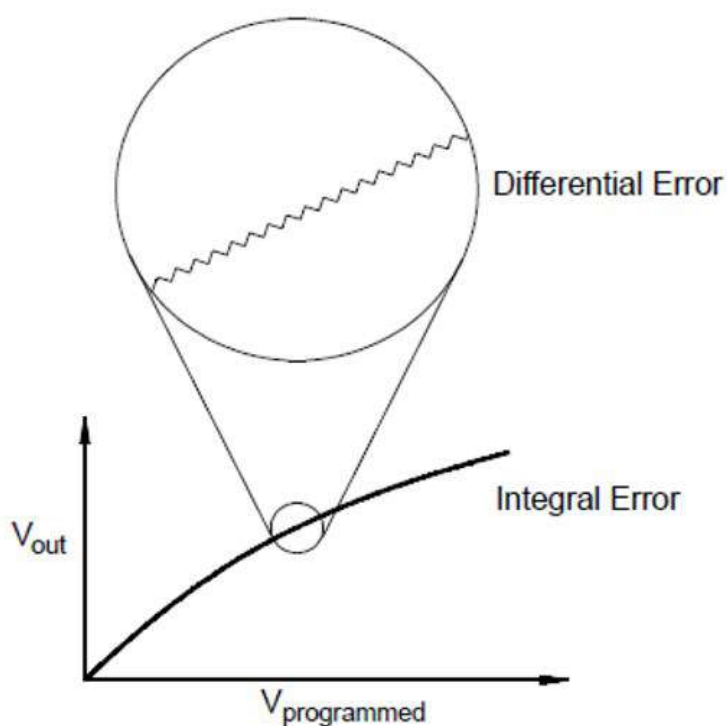


## DAC errors

The output of a DAC varies with temperature. If possible, you should operate the instrument at a stable temperature and as close as possible to the calibration temperature of the DAC for greater accuracy, or perform autocalibration to recalibrate the DAC if the temperature has changed much from calibration temperature.

The output of a DAC also exhibits two other types of errors: differential error and integral error.

| Types of errors    | Description                                                                                                                                                                                          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Differential error | Refers to the smallest possible change in voltage.<br>The DAC output is not linear, but is stepped as progressively larger (or smaller) voltages are programmed. The step is in $100\ \mu\text{V}$ . |
| Integral error     | Refers to the difference between the programmed voltage and the actual output voltage from the DAC.                                                                                                  |



## Relay Life and Preventive Maintenance

The DAQ970A/DAQ973A Relay Maintenance System automatically counts the cycles on each relay in the instrument and stores the total count in nonvolatile memory on each switch module. Use this feature to track relay failures and predict system maintenance requirements.

Relays are electromechanical devices which are subject to wear-out failure modes. The life of a relay, or the number of actual operations before failure, is dependent upon how it is used – applied load, switching frequency, and environment.

You can use the graphs shown in this section to estimate relay lifetimes for your application. Additional background information is also provided to give you a better understanding of relay wear-out mechanisms. In general, relay lifetimes depend heavily upon the signals that are being switched and the types of measurements being performed.

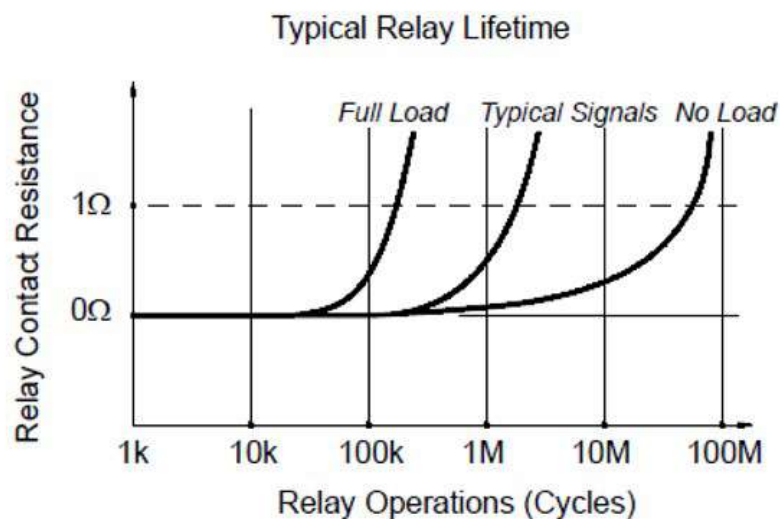
- Switching typical signal levels will result in relay lifetimes from 1,000,000 to 10,000,000 operations.
- High-power switching (>25% rating) or high-voltage switching (>100 V) applications will yield relay lifetimes from 100,000 to 1,000,000 operations.
- Low-voltage switching (<25% rating) and low-current switching (<10 mA) applications will yield relay lifetimes to 10,000,000 operations.
- RF switching applications seldom exhibit relay lifetimes exceeding 1,000,000 operations due to more stringent constant resistance requirements (typically less than 0.2  $\Omega$ ).

The following table shows the time required to reach the specified number of switch operations for several switching speeds.

| Continuous switching speed | Switching operations |           |            |
|----------------------------|----------------------|-----------|------------|
|                            | 100,000              | 1,000,000 | 10,000,000 |
| 1 / hour                   | 12 years             | N/A       | N/A        |
| 1 / minute                 | 10 weeks             | 2 years   | N/A        |
| 1 / second                 | 1 day                | 12 days   | 4 months   |
| 10 / second                | 3 hours              | 1 day     | 12 days    |

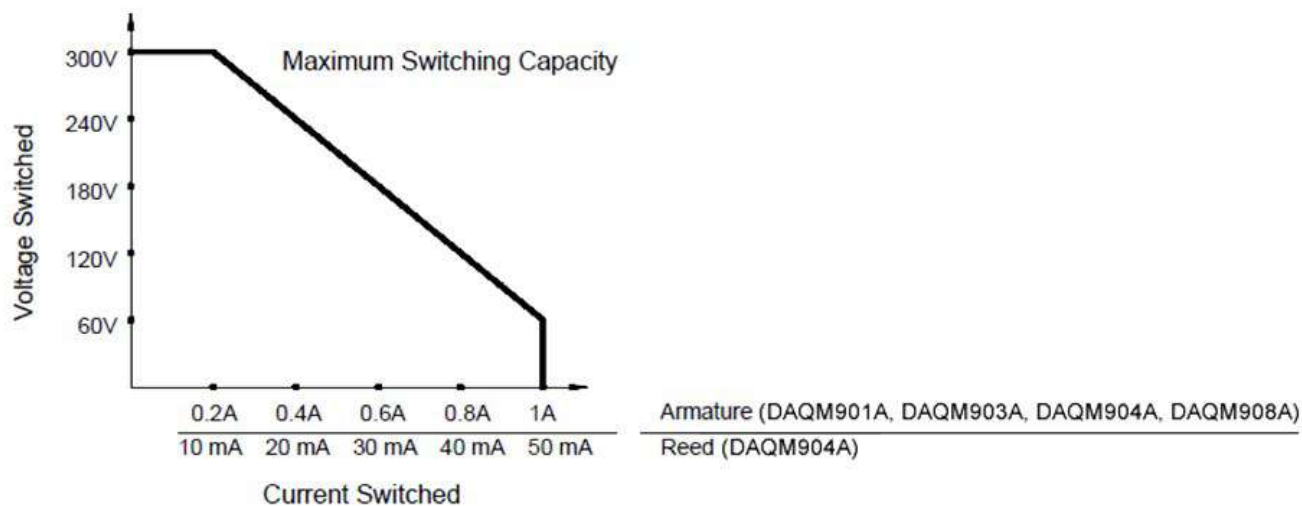
## Relay life

As a relay is used, the contacts begin to wear and the resistance of the closed contacts increases. The initial contact resistance of a relay is typically  $50\text{ m}\Omega$  (plus lead resistance). When the contact resistance exceeds 20 to 50 times its initial value, the contact resistance becomes very erratic and the relay should probably be replaced. For most applications, a relay with contact resistance greater than  $1\text{ }\Omega$  should be replaced. The graph below shows the typical contact resistance characteristics of the relays used on the DAQ970A/DAQ973A switching modules.



## Relay load

For most applications, the load switched by the relay is the most important factor affecting relay life. As shown in the graph below, relay life is maximized by switching low power. As the power switched increases, relay life deteriorates.



## Switching frequency

Relay contacts heat up as they switch significant power. The heat is dissipated through the leads and the body of the relay. As you increase the switching frequency to near its maximum, heat cannot dissipate before the next cycle. The contact temperature rises and the life of the relay is reduced.

## Replacement strategy

There are essentially two strategies that you can use for preventive maintenance of the relays on the switching modules. The strategy that you choose depends upon your application, the consequences of a relay failure in your system, and the number of relay cycles during a measurement session.

The first strategy is to replace each relay as needed after it fails or becomes erratic. This is suitable if you are switching higher loads on only a few relays on the module. The disadvantage of this strategy is the inconvenience of continually replacing relays as they near the end of their life at different times.

The second strategy is to replace all relays on the module or simply purchase a new module as the relays near the end of their life. This strategy is best suited for those applications where all relays on the module are switching similar loads. The failure of several relays over a relatively short period of time may indicate impending failures on other relays switching similar loads. This strategy decreases the risk of failure during actual use at the expense of replacing some relays that may have useful life remaining.

### NOTE

For switching frequency and replacement strategy as described above, you can use the DAQ970A/DAQ973A Relay Maintenance System to track and even predict relay failures.

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Guide d'utilisation

# Keysight DAQ970A/DAQ973A Système d'acquisition de données



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## Version du logiciel

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- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

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- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

## Garantie

LES INFORMATIONS CONTENUES DANS CE DOCUMENT SONT FOURNIES « EN L'ÉTAT » ET POURRONT FAIRE L'OBJET DE MODIFICATIONS SANS PRÉAVIS DANS LES ÉDITIONS ULTÉRIEURES. DANS LES LIMITES DE LA LÉGISLATION EN VIGUEUR, KEYSIGHT EXCLUT EN OUTRE TOUTE GARANTIE, EXPRESSE OU IMPLICITE, CONCERNANT CE MANUEL ET LES INFORMATIONS QU'IL CONTIENT, Y COMPRIS, MAIS NON EXCLUSIVEMENT, LES GARANTIES IMPLICITES DE QUALITÉ MARCHANDE ET D'ADÉQUATION À UN USAGE PARTICULIER. KEYSIGHT NE SAURAIT EN AUCUN CAS ÊTRE TENUE RESPONSABLE DES ERREURS OU DES DOMMAGES ACCESSOIRES OU INDIRECTS LIÉS À LA FOURNITURE, À L'UTILISATION OU À L'EXACTITUDE DES INFORMATIONS CONTENUES DANS CE DOCUMENT OU AUX PERFORMANCES DE TOUT PRODUIT AUQUEL IL SE RAPPORTE. SI KEYSIGHT ET L'UTILISATEUR SONT LIÉS PAR UN CONTRAT ÉCRIT SÉPARÉ DONT LES CONDITIONS DE GARANTIE CONCERNANT CE DOCUMENT SONT EN CONFLIT AVEC LES PRÉSENTES CONDITIONS, LES CONDITIONS DE LA GARANTIE DU CONTRAT SÉPARÉ PRÉVALENT.

## Licences technologiques

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## Déchets d'équipements électriques et électroniques (DEEE)

Ce produit est conforme aux exigences d'étiquetage de la directive européenne DEEE en matière de mise au rebut des équipements électriques et électroniques. L'étiquette collée sur le produit (voir ci-dessous) indique que vous ne devez pas jeter cet appareil électrique/électronique avec les ordures ménagères.

Catégorie du produit : par référence aux types d'équipements décrits dans l'annexe 1 de la directive européenne DEEE, ce produit est classé comme un produit « d'instrumentation de surveillance et de contrôle ». Ne le jetez pas avec les ordures ménagères.

Pour se débarrasser des produits usagés, contacter l'agence Keysight la plus proche ou se connecter sur <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> pour plus de détails.



## Certificats de conformité

Il est possible de télécharger la Déclaration de conformité pour ces produits et d'autres produits Keysight sur le Web. Accédez à <https://regulations.about.keysight.com/DoC/default.htm>, vous pourrez alors exécuter une recherche par numéro de produit pour trouver la dernière Déclaration de conformité.

# Informations relatives à la sécurité et à la réglementation

## Consignes de sécurité

Les consignes de sécurité présentées dans cette section doivent être appliquées dans toutes les phases de l'utilisation, de l'entretien et de la réparation de cet équipement. Le non-respect de ces précautions ou des avertissements spécifiques mentionnés dans ce guide constitue une violation des normes de sécurité établies lors de la conception, de la fabrication et de l'usage normal de l'équipement et pourrait provoquer un choc électrique ou des blessures. Keysight Technologies ne saurait être tenu responsable du non-respect de ces consignes.

### AVERTISSEMENT

#### AVANT LA MISE SOUS TENSION

Vérifiez que vous avez bien respecté toutes les consignes de sécurité. Effectuez tous les branchements à l'appareil avant de le mettre sous tension.

#### MISE À LA TERRE DE L'INSTRUMENT

Ce produit comporte des bornes de terre de protection. Afin de réduire les risques d'accidents électriques, l'instrument doit être relié à une source de courant alternatif par l'intermédiaire d'un cordon d'alimentation secteur pourvu d'un fil de terre connecté fermement à une terre électrique (terre de sécurité) au niveau de la prise de courant. Le débranchement de la borne de terre entraîne un risque d'électrocution vous exposant à de graves blessures.

#### AVANT LA MISE SOUS TENSION OU HORS TENSION

Avant la mise sous tension de l'instrument, assurez-vous que toutes les sources de signal connectées aux modules sont désactivées. Mettez les sources de signal sous tension après avoir mis l'instrument sous tension. Mettez les sources de signal hors tension avant de mettre l'instrument hors tension.

#### NE PAS DÉMONTER LE CAPOT DE L'INSTRUMENT

Seul du personnel qualifié, formé à la maintenance et conscient des risques encourus, est autorisé à démonter les capots de l'instrument. Débranchez toujours le cordon d'alimentation et tous les circuits externes avant de démonter le capot de l'instrument.

#### CAPOTS DES MODULES

Toujours replacer les capots des modules après le câblage du terminal et avant de les insérer dans l'unité centrale.

#### NE PAS UTILISER EN ATMOSPHÈRE EXPLOSIVE

N'utilisez pas l'instrument en présence de gaz ou de vapeurs inflammables.

#### NE PAS MODIFIER L'INSTRUMENT

Ne pas installer de composants de rechange et ne pas apporter de modifications non autorisées à l'appareil. Pour toute opération de maintenance ou de réparation, renvoyez l'appareil à une agence commerciale et de service après-vente Keysight afin d'être certain que les fonctions de sécurité seront conservées.

#### NE PAS MESURER PLUS QUE LA TENSION NOMINALE

Les tensions maximales telles qu'indiquées sur chaque module sont les suivantes :

- a) DAQM900A : 120 Vrms
- b) DAQM901A, DAQM902A, DAQM903A, DAQM904A, DAQM908A : 300 Vrms
- c) DAQM905A, DAQM907A : 42 Vpk
- d) DAQM909A : +/-18 Vpk (unipolaire) pour les broches hautes et basses.

---

#### NE CONNECTER AUCUNE VOIE DE MODULE À L'ALIMENTATION SECTEUR

La catégorie de mesure de l'instrument est classée comme CAT « Autres », les bornes ne doivent pas être directement raccordées à l'alimentation secteur.

---

#### CÂBLE D'ALIMENTATION CA

La dépose du câble d'alimentation est la méthode de déconnexion utilisée pour couper l'alimentation de l'instrument. Assurez-vous que l'accès au câble d'alimentation est adéquat afin de permettre la déconnexion de l'alimentation secteur. Utilisez uniquement le câble d'alimentation défini par Keysight pour le pays d'utilisation ou un câble de performances équivalentes.

---

#### AUTOTEST

Avant de mesurer toute tension ou courant dangereux, exécutez une requête \*TST? depuis l'interface distante, et vérifiez d'après les résultats que l'instrument fonctionne correctement. La requête \*TST? est un autotest qui renvoie la valeur +0 si l'instrument passe le test et +1 s'il échoue. Vous pouvez également effectuer cette requête depuis le panneau avant en appuyant sur **[Utility] > Self Test > Quick Test** ([Utilitaire] > Auto-test > Test rapide). En cas d'échec, assurez-vous que l'instrument est réparé et passe l'auto-test avant de continuer.

#### ATTENTION

Cet appareil de mesure est sensible de par sa conception et une exposition à des phénomènes électromagnétiques ambiants continus peut engendrer des pertes de performances. Considérations relatives aux mesures - utilisez des câbles blindés ou torsadés, utilisez une inductance d'arrêt de mode commun, une pince en ferrite et une résistance d'amortissement avant l'entrée vers le DAQ970A/DAQ973A.

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#### NETTOYAGE

Pour prévenir toute électrocution, déconnectez l'instrument de l'alimentation secteur avant de commencer le nettoyage. Nettoyez les parties externes de l'instrument à l'aide d'un chiffon doux non pelucheux légèrement humidifié. N'utilisez pas de détergent, de liquides volatiles ou de solvants chimiques. Ne tentez aucun nettoyage interne. Si nécessaire, contactez un bureau de ventes et de service après-vente Keysight Technologies pour organiser un nettoyage approprié afin de garantir la préservation des caractéristiques de sécurité et de performance.

#### REMARQUE

Connectez le câble USB avec noyau de ferrite au port USB du panneau arrière de l'instrument.

## Symboles de sécurité et marquages réglementaires

| Symbole                                                                             | Description              |
|-------------------------------------------------------------------------------------|--------------------------|
|  | Courant alternatif (CA). |

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Borne de terre (masse) de protection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|    | Borne de prise de terre.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    | Attention, risque de danger (reportez-vous au manuel pour des informations détaillées sur les avertissements et les mises en garde).                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|    | Raccordement du cadre ou du châssis à la terre (masse).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|    | Blocage du câble de l'instrument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|    | Ce produit dispose du marquage ACMA RCM pour la conformité en Australie/Nouvelle-Zélande. Pour obtenir une copie de la Déclaration de conformité pour l'Australie du fabricant de cet instrument, contactez votre représentant commercial local Keysight Technologies.                                                                                                                                                                                                                                                                                                |
|    | Ce symbole indique la période pendant laquelle aucune détérioration ou fuite de substances toxiques ou dangereuses n'est à attendre dans le cadre d'une utilisation normale. La durée de vie prévue du produit est de quarante ans.                                                                                                                                                                                                                                                                                                                                   |
|    | La marque CSA est une marque déposée de la Canadian Standards Association, les indices 'C' et 'US' indiquant que l'instrument est certifié conforme aux normes américaines et canadiennes applicables, respectivement.                                                                                                                                                                                                                                                                                                                                                |
|   | <p>ICES/NMB-001 ISM GRP 1-A</p> <p>Le marquage CE est une marque déposée de la Communauté Européenne. Cette marque CE montre que le produit est conforme à toutes les Directives juridiques européennes pertinentes.</p> <p><b>ICES/NMB-001</b> - Cet appareil ISM est conforme à la norme canadienne ICES-001.</p> <p><i>Cet appareil ISM est conforme à la norme NMB-001 du Canada.</i></p> <p><b>ISM GRP 1-A</b> - Il s'agit d'un produit industriel scientifique et médical (ISM) de groupe 1 classe A.</p>                                                       |
|  | <p>Ce symbole est une déclaration EMC de classe A de Corée du Sud, avec le code d'identification du produit "R-REM-Kst-GM16412".</p> <p><b>R</b> - Identification du préfixe d'autorisation.</p> <p><b>REM</b> - Identification des informations de base relatives à la certification.</p> <p><b>Kst</b> - Identification des renseignements relative au demandeur</p> <p><b>GM16412</b> - Identification du produit.</p> <p>Il s'agit d'un instrument de classe A adapté à un usage professionnel dans un environnement électromagnétique en dehors du domicile.</p> |
|  | La mention AVERTISSEMENT signale un danger. Si la manœuvre ou la procédure correspondante n'est pas respectée ou correctement réalisée, il peut y avoir un risque de blessures. En présence de la mention AVERTISSEMENT, il convient de ne pas poursuivre tant que les conditions indiquées n'ont pas été parfaitement comprises et respectées.                                                                                                                                                                                                                       |
|  | La mention ATTENTION signale un danger. Si la procédure correspondante n'est pas exécutée correctement ou respectée, il peut y avoir un risque d'endommagement ou de destruction d'une partie ou de l'ensemble de l'appareil. En présence de la mention ATTENTION, il convient de ne pas poursuivre tant que les conditions indiquées n'ont pas été parfaitement comprises et remplies.                                                                                                                                                                               |
|  | La mention REMARQUE signale des informations importantes. Il attire l'attention sur une procédure, une pratique, une condition ou autre, qu'il est important de noter. Informations relatives à la sécurité et à la réglementation 12                                                                                                                                                                                                                                                                                                                                 |



## Déclaration sud-coréenne de CEM de classe A

Information à l'utilisateur :

La conformité de cet instrument pour une utilisation dans des environnements professionnels a été évaluée. Dans un environnement résidentiel, cet équipement peut causer des interférences radio.

Cette déclaration EMC ne s'applique que pour les équipements utilisés uniquement dans un environnement professionnel.

### 사 용 자 안 내 문

이 기 기 는 업 무 용 환 경 에 서 사 용 할 목 적 으 로 적 합 성 평 가 를 받 은 기 기 로 서 가 정 용 환 경 에 서 사 용 하 는 경 우 전 파 간 섭 의 우 려 가 있 습 니 다 .

사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

## Conformité et réglementation des produits

Le DAQ970A/DAQ973A est conforme aux exigences de sécurité et de CEM.

Reportez-vous à la Déclaration de conformité <http://www.keysight.com/go/conformity> pour connaître la dernière révision.

### REMARQUE

Les transitoires maximaux sur toutes les entrées sont limités à 1500 Vpk référencés à la terre, à l'exception des DAQM900A, DAQM905A, DAQM907A et DAQM909A qui sont de 0 Vpk. La mesure est évaluée pour CAT « aucune » et les bornes ne doivent pas être connectées directement au secteur. N'utilisez pas ce équipement pour mesurer des circuits sur lesquels les tensions transitoires pourraient dépasser cette valeur.

## Conditions d'environnement

Le Keysight DAQ970A est conçu pour être utilisé dans des locaux fermés où la condensation est faible. Les tableaux ci-dessous indiquent les conditions d'environnement générales requises et les caractéristiques générales pour cet instrument.

| Conditions d'environnement | Exigences                                                                                                                                                                                                                                                                     |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Température                | Conditions de fonctionnement : de 0 à 55 °C<br>Conditions de stockage : -40 °C à 70 °C                                                                                                                                                                                        |
| Humidité                   | Conditions de fonctionnement : Jusqu'à 80 % d'humidité relative à 40 °C (sans condensation), diminuant de façon linéaire jusqu'à 50 % d'humidité relative à 55 °C (sans condensation)<br>Conditions de stockage : Jusqu'à 50% d'humidité relative à 55 °C (sans condensation) |
| Altitude                   | jusqu'à 3000m                                                                                                                                                                                                                                                                 |
| Degré de pollution         | 2                                                                                                                                                                                                                                                                             |

Les conditions d'alimentation requises du compteur DAQ970A/DAQ973A sont résumées ci-dessous.

| Caractéristiques générales | Exigences                                                                                    |
|----------------------------|----------------------------------------------------------------------------------------------|
| Alimentation               | 100 - 240 VAC (la fluctuation de la tension d'alimentation ne doit pas dépasser $\pm 10\%$ ) |
| Fréquence d'alimentation   | 50/60/400 Hz                                                                                 |
| Consommation d'énergie     | 45 watts                                                                                     |

### AVERTISSEMENT

**NE L'UTILISEZ PAS DANS UNE ATMOSPHÈRE EXPLOSIVE OU DES ENVIRONNEMENTS HUMIDES**  
N'utilisez pas l' instrument dans des environnements avec des gaz ou des fumées inflammables, de la vapeur ou des environnements humides.



# 1 Présentation de l'instrument

Présentation succincte de l'instrument

Présentation succincte du panneau avant

Témoins de l'instrument

Présentation succincte du panneau arrière

Présentation succincte des modules enfichables

Schéma de dimensions

Configuration de l'interface distante

Configuration du réseau local

Mise à jour du micrologiciel

Pour contacter Keysight Technologies

Ce chapitre présente un aperçu et les fonctionnalités essentielles du DAQ970A/DAQ973A.

## Présentation succincte de l'instrument

Le modèle DAQ970A/DAQ973A associe des possibilités de mesure de précision à un vaste choix de connexions de signaux pour vos systèmes de test de production et de développement. Trois logements sont intégrés à l'arrière de l'instrument afin d'accepter toute combinaison de modules d'acquisition de données ou de commutation. L'association des fonctionnalités d'enregistrement de données USB et d'acquisition de données font de cet instrument une solution polyvalente pour vos besoins de test d'aujourd'hui et de demain.

### Afficher, enregistrer et documenter facilement vos résultats de mesure

- Excellente ergonomie avec une interface utilisateur intuitive basée sur des menus.
- Histogramme, graphique des tendances, compteur et vues numériques sur un écran couleur haute résolution.
- Pris en charge sur les deux interfaces LAN et USB.
- Connectivité USB sans pilote en glisser-déposer.

### Fonctionnalités d'enregistrement de données pratiques

- Mesures directes de la température (thermocouples, RTD, et thermistances), contrainte, tension continue, tension alternative, résistances en 2 et 4 fils, fréquence, période, diode, capacité, courant continu et courant alternatif.
- Performance de niveau métrologie brevetée qui sert de base à toutes les mesures.
- Scrutation par intervalle avec mémorisation de 1 000 000 lectures horodatées (maximum).
- Configuration indépendante des voies avec fonction, mise à l'échelle des mesures et limites d'alarme disponibles voie par voie.
- Interface utilisateur intuitive avec bouton curseur du clavier de navigation, saisie de données pour chacune des touches logicielles (touches menu sur l'écran) et des touches matérielles (touches menu sur l'avant de l'instrument).
- Boîtier robuste et portatif avec patins anti-dérapants.
- Logiciel BenchVue Data Acquisition (DAQ) pour Microsoft® Windows® disponible pour téléchargement sur [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

### Fonctions d'acquisition de données/commutation d'une grande souplesse d'utilisation

- 60 voies au maximum par instrument (120 voies asymétriques).
- Plus de 5 000 lectures par seconde sur une seule voie et rythme de scrutation jusqu'à 450 voies par seconde.
- Choix de fonctions de multiplexage, matrice, commutation universelle forme C, commutation RF, entrées/sorties numériques, totalisation, sortie CAN et fonctions de relectures CAN.
- Interface Web intégrée pour la surveillance et le contrôle de l'instrument via un navigateur Web.

### Langage de programmation

- Compatible avec le langage de programmation SCPI (Standard Commands for Programmable Instruments).

## Présentation succincte du panneau avant



| Libellé | Description                                                                  |
|---------|------------------------------------------------------------------------------|
| 1       | Port USB                                                                     |
| 2       | Commande On/Standby avec indicateur LED                                      |
| 3       | Écran                                                                        |
| 4       | Touches de fonction                                                          |
| 5       | Menu d'utilisation des mesures (pour contrôler le lancement des mesures)     |
| 6       | Menu de configuration des mesures (afin de régler les paramètres de mesures) |
| 7       | Bouton                                                                       |
| 8       | Curseur du clavier de navigation                                             |

### Touches du panneau avant

#### REMARQUE

Appuyez sur la touche **Save Recall Local** pour rétablir le contrôle local lorsque l'instrument est en mode distant (indiqué par le témoin **RMT**).

## Témoins de l'instrument

Le tableau ci-dessous montre les différents témoins disponibles sur le DAQ970A/DAQ973A. Les témoins sont affichés en haut de l'écran lorsque les conditions correspondantes sont réunies.

| Témoin                                                                             | Description                                                                                                                                                         |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Le mode de surveillance est activé.                                                                                                                                 |
|   | La numérisation est en cours.                                                                                                                                       |
|   | La scrutation/numérisation du multimètre numérique est en cours.                                                                                                    |
|   | A – Des alarmes sont présentes dans la file d'attente d'alarmes.<br>H1234L – Une condition d'alarme haute ou basse s'est produite.                                  |
|   | Le multimètre numérique (DMM) interne est désactivé. L'instrument configuré pour un intervalle de scrutation externe lorsque le multimètre numérique est désactivé. |
|   | La mémoire de mesures est surchargée à 1 000 000 mesures. Les nouvelles mesures écraseront les plus anciennes.                                                      |
|   | Une clé USB est insérée dans le port USB hôte du panneau avant.                                                                                                     |
|   | L'instrument est en commande à distance (par l'interface à distance)                                                                                                |
|  | Des erreurs sont présentes dans la file d'erreurs. Appuyez sur [View] > Errors ([Voir] > Erreurs) pour afficher la liste d'erreurs.                                 |

## Présentation succincte du panneau arrière



| Libellé | Description                                                                                                 |
|---------|-------------------------------------------------------------------------------------------------------------|
| 1       | Identificateur de logement (100, 200, 300)                                                                  |
| 2       | Interface GPIB ( <b>disponible sur le DAQ973A uniquement</b> )                                              |
| 3       | Entrée alimentation CA principale                                                                           |
| 4       | Connecteur d'interface LAN                                                                                  |
| 5       | Connecteur d'interface USB                                                                                  |
| 6       | Entrée de déclenchement externe, sorties d'alarme, entrée d'incrémentation de voie et sortie de voie fermée |
| 7       | Borne à vis de mise à la terre du châssis                                                                   |



## Présentation succincte des modules enfichables

Le DAQ970A/DAQ973A propose un choix complet de modules enfichables afin de vous offrir des possibilités de mesure, de multiplexage et de contrôle de haute qualité. Pour plus d'informations, consultez [Présentation des modules](#).

Modules pris en charge sur le DAQ970A/DAQ973A :

- Module multiplexeur à transistor à effet de champ 20 voies DAQM900A
- Module multiplexeur à relais électromagnétiques 20 voies DAQM901A
- Module multiplexeur à relais à lame souple 16 voies DAQM902A
- Module Actionneur/commutateur à usage général 20 voies DAQM903A
- Module de commutation à matrice 4x8 à 2 fils DAQM904A
- Module multiplexeur RF (50  $\Omega$ ) double 4 voies vers 1 DAQM905A
- Module multifonction DAQM907A
- Module multiplexeur asymétrique 40 voies DAQM908A
- Module numériseur 4 voies 24 bits DAQM909A

### REMARQUE

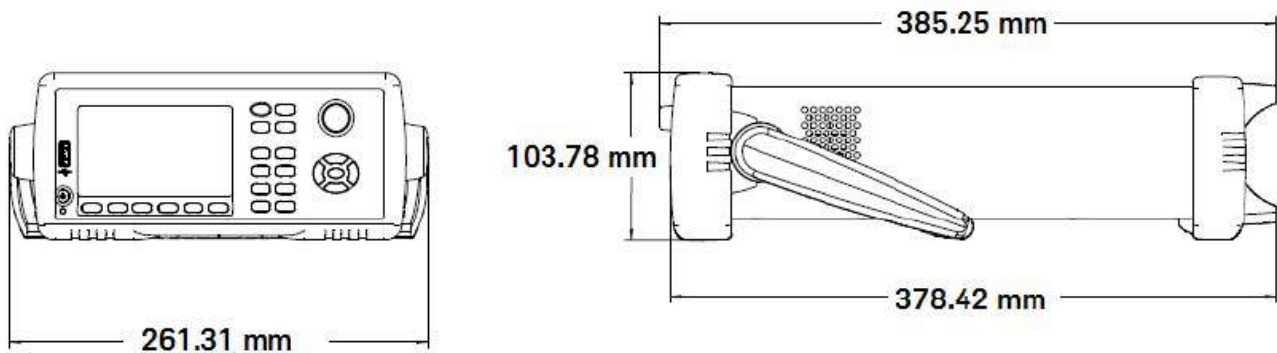
Reportez-vous à la fiche technique du produit à l'adresse

<http://literature.cdn.keysight.com/litweb/pdf/5992-3168EN.pdf> pour des spécifications complètes sur tous les modules pris en charge.

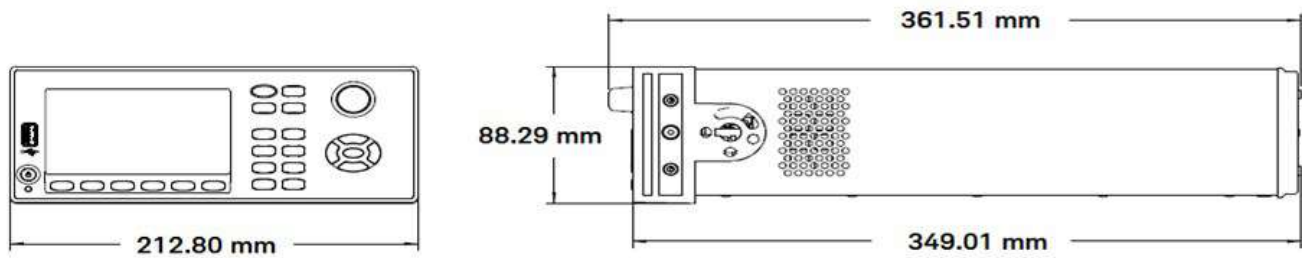
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## Schéma de dimensions

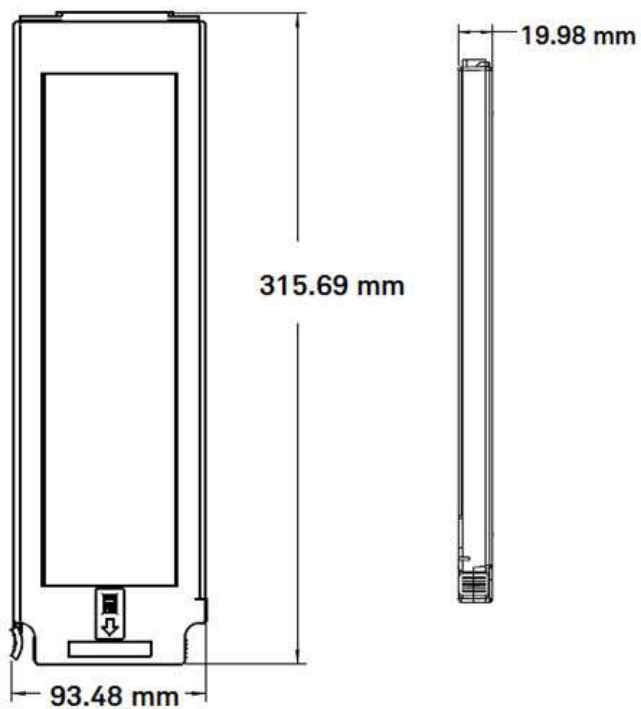
Dimension de la paillasse :



Dimension de l'armoire :



Dimension du module :



## Configuration de l'interface distante

### AVERTISSEMENT

#### FONCTIONNEMENT À DISTANCE

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

### REMARQUE

Si le mode Sécurisé est activé, l'instrument doit être déverrouillé avec le code de sécurité correct pour que la plupart de ces actions puissent être effectuées. Voir **Sécurité** pour plus d'informations.

Le modèle DAQ970A prend en charge les communications avec l'interface distante sur LAN et USB interfaces. Le DAQ973A prend toutefois en charge une interface GPIB supplémentaire au-dessus des interfaces LAN et USB. Les deux interfaces sont « actives » à la mise sous tension lorsque l'instrument est livré de l'usine.

- **Interface au réseau local (LAN)** : Par défaut, the DHCP (Dynamic Host Configuration Protocol) est actif, un protocole d'attribution d'adresse IP dynamique aux périphériques réseau, qui peut permettre de communiquer sur le LAN. Avec l'adressage dynamique, un périphérique peut avoir une adresse IP différente chaque fois qu'il se connecte au réseau. Voir **Paramètres LAN** pour plus d'informations.
- **Interface USB** : Utilisez le connecteur de l'interface USB du panneau arrière pour communiquer avec l'instrument via votre PC. Voir **Paramètres USB** pour plus d'informations.
- **Interface GPIB (DAQ973A uniquement)** : Configurez l'adresse GPIB de l'instrument et connectez l'instrument à votre PC avec un câble GPIB.

## Keysight IO Libraries Suite

### REMARQUE

Assurez-vous que la suite Keysight IO Libraries est installée avant de procéder à la configuration de l'interface distante.

La suite Keysight IO Libraries est une série de logiciels de commande d'instruments gratuits qui découvre automatiquement des instruments et vous permet de commander des instruments sur les interfaces LAN et USB. Pour plus d'informations ou pour télécharger les IO Libraries, rendez-vous à l'adresse [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite).

### Paramètres GPIB (DAQ973A uniquement)

Chaque périphérique connecté à l'interface GPIB (IEEE-488) doit avoir une adresse entière unique comprise entre 0 et 30. L'instrument est livré avec une adresse par défaut de 9 et l'adresse GPIB est affichée à la mise sous tension.

Ce paramètre est non volatile ; il n'est pas modifié par une remise sous tension ou la commande \*RST ou SYSTem:PRESet. L'interface GPIB de votre ordinateur ne doit pas être en conflit avec un instrument sur le bus de l'interface.

| Panneau avant                                                                                                                                                                                                                                                                          | Interface à distance                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Appuyez sur <b>[Home]&gt;User Settings&gt;I/O&gt;GPIB</b> .<br>Vous pouvez configurer dans ce menu l'adresse GPIB et activer/désactiver l'interface GPIB. Une fois les modifications apportées, vous devez allumer et éteindre l'instrument pour que les modifications prennent effet. | SYSTem:COMMunicate:GPIB:ADDRes <address><br>SYSTem:COMMunicate:ENABLE {ON 1 OFF 0},GPIB |

## Paramètres LAN

Les paragraphes suivants décrivent les fonctions de base de configuration du réseau local sur le panneau avant, y compris les commandes SCPI le cas échéant. Dans le *DAQ970A/DAQ973A Guide de programmation*, voir « Sous-système SYSTem – Commandes de configuration des interfaces distantes » pour toutes les commandes de configuration LAN.

### REMARQUE

Certains paramètres LAN nécessitent un redémarrage pour les activer. L'instrument affiche brièvement un message lorsque c'est le cas. Observez attentivement l'écran lorsque vous modifiez les paramètres LAN.

### Activez ou désactivez l'interface LAN

| Panneau avant                                                                                                                                                                | Interface à distance                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN</b><br>([Accueil] > Paramètres de l'utilisateur > E/S > LAN)<br>Régler la touche droite sur On ou Off | SYSTem:COMMunicate:ENABle {OFF   ON}, LAN |

### Afficher l'état du LAN, l'état du MAC et les paramètres de configuration du LAN actuel

Une fois l'interface LAN activée, vous pouvez afficher l'état du LAN, l'adresse MAC et les paramètres de configuration du LAN actuel depuis le panneau avant. L'état du LAN peut être différent des paramètres du menu de configuration du panneau avant, en fonction de la configuration du réseau. Les paramètres sont différents lorsque le réseau a affecté les siens automatiquement. Si l'instrument passe en mode distant, toutes les modifications du réseau local sont désactivées et l'écran change. Si vous sélectionnez à nouveau la page LAN Settings, les nouveaux paramètres sont affichés si un redémarrage du réseau a lieu.

| Panneau avant                                                                                                                                           | Interface à distance |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b><br>([Accueil] > Paramètres de l'utilisateur > E/S > Paramètres LAN) | (aucun)              |

### Modifier les paramètres

À la sortie d'usine, les paramètres préconfigurés de l'instrument (DHCP est activé) devraient fonctionner dans la plupart des environnements de réseau local. Toutefois, si vous souhaitez définir manuellement une adresse IP, un masque de sous-réseau et une passerelle par défaut, désactivez DHCP, puis modifiez la configuration IP comme décrit ci-dessous.

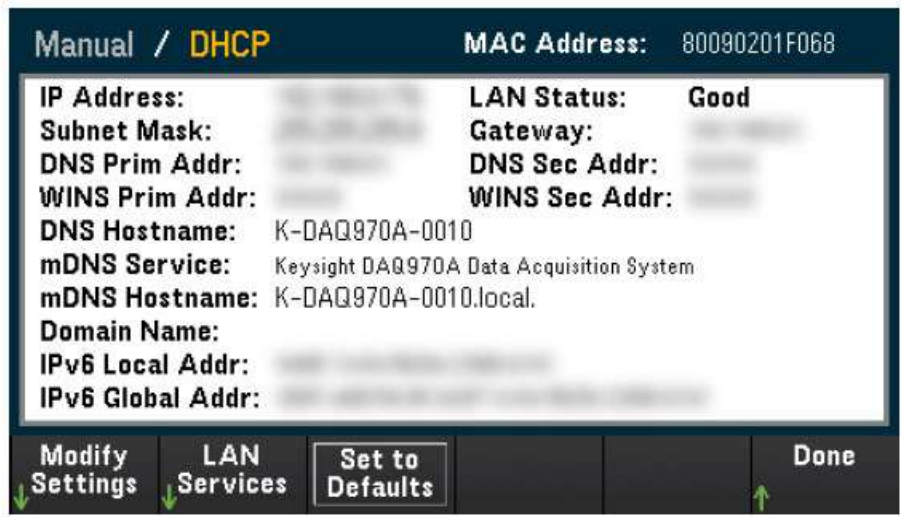
#### Manuel/DHCP

Le DHCP peut attribuer automatiquement une adresse IP dynamique à un périphérique sur le réseau local. C'est généralement le moyen le plus simple de configurer l'instrument pour le réseau LAN. Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

La désactivation de DHCP activera le réglage manuel, et inversement.

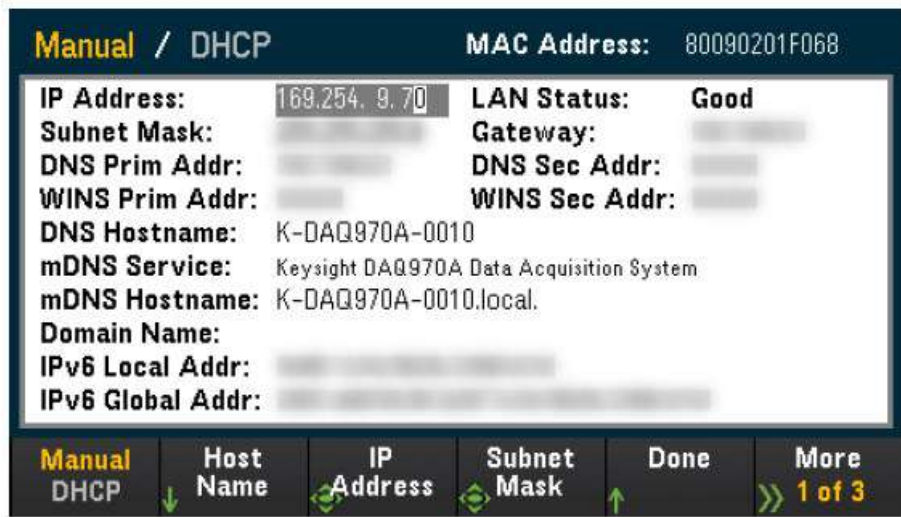
| Panneau avant                                                                                                          | Interface à distance                 |
|------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modifier les paramètres</b> . | SYSTem:COMMunicate:LAN:DHCP {OFF ON} |

Pour activer le DHCP :



| Étape | Panneau avant                                                                                                                                | Interface à distance           |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 1     | Appuyez sur [Home] > User Settings > I/O > LAN Settings > Modify Settings. Réglez la première touche sur DHCP.                               | SYSTem:COMMunicate:LAN:DHCP ON |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur [Done] > [Apply Changes] pour que les modifications apportées soient prises en compte. | SYSTem:COMMunicate:LAN:UPDate  |

Pour désactiver le mode DHCP :



| Étape | Panneau avant                                                                                                                                | Interface à distance            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1     | Appuyez sur [Home] > User Settings > I/O > LAN Settings > Modify Settings. Réglez la première touche sur Manual (Manuel).                    | SYSTem:COMMunicate:LAN:DHCP OFF |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur [Done] > [Apply Changes] pour que les modifications apportées soient prises en compte. | SYSTem:COMMunicate:LAN:UPDate   |

Une fois que DHCP est désactivé, les paramètres suivants seront disponibles pour la configuration manuelle :

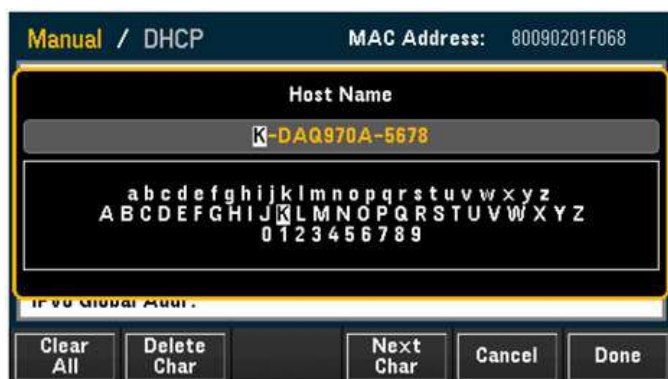
- Présentation succincte de l'instrument
- Adresse IP
- Masque de sous-réseau
- Passerelle
- DNS primaire et secondaire
- WINS primaire et secondaire
- Service mDNS

## Nom d'hôte

Un nom d'hôte est la partie hôte du nom du domaine qui est convertie en adresse IP.

| Étape | Panneau avant                                                                                                                                                                                                                                      | Interface à distance            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> (Manuel) et appuyez sur <b>Host name</b> (Nom d'hôte) pour saisir le Nom de l'hôte. | SYSTem:COMMunicate:LAN:HOSTname |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Done]</b> > <b>[Apply Changes]</b> pour que le changement prenne effet.                                                                                                  | SYSTem:COMMunicate:LAN:UPDate   |

Chaque instrument est livré avec un nom d'hôte par défaut au format suivant : K-numérodemodelle-numérodésérie, où numérodemodelle représente le numéro de modèle de l'instrument à 7 caractères (par exemple DAQ970A), et numérodésérie correspond aux cinq derniers caractères du numéro de série de l'instrument à 10 caractères situé sur l'étiquette placée au-dessus de l'unité (par exemple 5678 si le numéro de série est MY12345678).



- L'instrument reçoit en usine un nom d'hôte unique que vous pouvez changer. Ce nom doit être unique sur le réseau LAN.
- Le nom doit commencer par une lettre ; les autres caractères peuvent être des majuscules ou des minuscules, des chiffres ou des tirets « - ».

- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

## Adresse IP

Vous pouvez entrer une adresse IP statique pour l'instrument sous la forme de 4 octets avec la notation par points. Chaque octet est une valeur décimale sans zéro initial (ex. 169.254.2.20). Reportez-vous à la section **En savoir plus sur les adresses IP et leur notation** pour plus d'informations.

| Étape | Panneau avant                                                                                                                                                                                                                                              | Interface à distance             |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> (Manuel) et appuyez sur <b>IP Address</b> (Adresse IP) pour entrer une nouvelle adresse IP. | SYSTem:COMMunicate:LAN:IPADdress |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                                                                                                 | SYSTem:COMMunicate:LAN:UPDate    |

- Si le protocole DHCP est activé, il essaie d'affecter une adresse IP à l'instrument. Si le protocole DHCP échoue, Auto-IP essaie d'affecter une adresse IP à l'instrument.
- Contactez votre administrateur réseau pour obtenir une adresse IP.
- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

## Masque de sous-réseau

Le masque de sous-réseau permet à l'administrateur réseau de sous-diviser un réseau pour simplifier sa gestion et minimiser le trafic sur le réseau. Le masque de sous-réseau indique la partie de l'adresse de l'hôte utilisée pour désigner le sous-réseau.

| Étape | Panneau avant                                                                                                                                                                                                                                                                        | Interface à distance          |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> (Manuel) et appuyez sur <b>Subnet Mask</b> (Masque de sous-réseau) pour définir le masque de sous-réseau, par défaut. | SYSTem:COMMunicate:LAN:SMASk  |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                                                                                                                           | SYSTem:COMMunicate:LAN:UPDate |

- Contactez votre administrateur réseau pour obtenir une adresse IP.
- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).



## Passerelle

Une passerelle est un périphérique de connexion au réseau. La passerelle par défaut est l'adresse IP de l'instrument.

| Étape | Panneau avant                                                                                                                                                                                                                                                         | Interface à distance           |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> (Manuel) et appuyez sur <b>Gateway</b> (Passerelle) pour entrer une nouvelle adresse de la passerelle. | SYSTem:COMMunicate:LAN:GATeWay |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                                                                                                            | SYSTem:COMMunicate:LAN:UPDate  |

- Ne définissez pas d'adresse de la passerelle lorsque le DHCP est activé (valeur par défaut).
- Contactez votre administrateur réseau pour obtenir une adresse IP.
- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

## DNS primaire et secondaire

Un DNS (Domain Name Service) est un service Internet qui traduit les noms de domaine en adresses IP. L'adresse du serveur DNS est l'adresse IP d'un serveur qui fournit ce service.

| Étape | Panneau avant                                                                                                                                                                                                                                                      | Interface à distance                                                                                                                            |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> (Manuel) et appuyez sur <b>Primary DNS</b> ou <b>Second DNS</b> pour fixer l'adresse DNS souhaitée. | SYSTem:COMMunicate:LAN:DNS[{1 2}]<br><br>Remarque : La syntaxe [{1 2}] indique le type d'adresse de serveur DNS primaire (1) ou secondaire (2). |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                                                                                                         | SYSTem:COMMunicate:LAN:UPDate                                                                                                                   |

- Normalement, DHCP recherche l'adresse DNS ; il vous suffit d'indiquer si le protocole DHCP est inutilisé ou non fonctionnel.
- Contactez votre administrateur réseau pour obtenir une adresse IP.
- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

## WINS primaire et secondaire

Un WINS (Windows Internet Name System) est un système qui permet à Windows d'identifier les systèmes NetBIOS sur un réseau TCP/IP.

| Étape | Panneau avant                                                                                                                                                                                                                                                                 | Interface à distance                                                                                                                              |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> (Manuel) et appuyez sur <b>Pri-<br/>mary WINS</b> ou <b>Second WINS</b> pour définir l'adresse WINS souhaitée. | SYSTem:COMMunicate:LAN:WINS[{1 2}]<br><br>Remarque : La syntaxe [{1 2}] indique le type d'adresse de serveur WINS primaire (1) et secondaire (2). |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                                                                                                                    | SYSTem:COMMunicate:LAN:UPDate                                                                                                                     |

- Normalement, DHCP recherche l'adresse WINS ; il vous suffit d'indiquer si le protocole DHCP est inutilisé ou non fonctionnel.
- Contactez votre administrateur réseau pour obtenir une adresse IP.
- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

## Service mDNS

Un mDNS (multicast Domain Name Service) est un service Internet qui est enregistré avec le service de désignation sélectionné.

| Étape | Panneau avant                                                                                                                                                                                                                                                                    | Interface à distance          |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Définissez la première touche sur <b>Manual</b> et appuyez sur <b>Service mDNS</b> sur la troisième page du menu pour configurer le nom du service mDNS souhaité. | LXI:MDNS:SNAME:DESired        |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                                                                                                                       | SYSTem:COMMunicate:LAN:UPDate |

Chaque instrument est livré avec un nom de service par défaut au format suivant :

*Keysight Technologies\_<modelNumber>\_ - serial*

Nombre Où numéroModèle représente le numéro de modèle de l'instrument principal à 7 caractères (DAQ970A) et nom de produit (Système d'acquisition de données) et numéroSérie correspond aux cinq derniers caractères du numéro de série à 10 caractères situé sur l'étiquette placée au-dessus de l'instrument (par exemple, 45678 si le numéro de série est MY12345678).

- L'instrument reçoit en usine un nom de service nDNS unique que vous pouvez changer. Le nom de service nDNS doit être unique sur le LAN.
- Le nom doit commencer par une lettre ; les autres caractères peuvent être des majuscules ou des minuscules, des chiffres ou des tirets « - ».
- Ce paramètre est non volatil ; il n'est pas modifié par une remise sous tension, une réinitialisation usine (commande \*RST) ou le pré-réglage de l'instrument (commande SYSTem:PRESet).

## Redémarrage du LAN

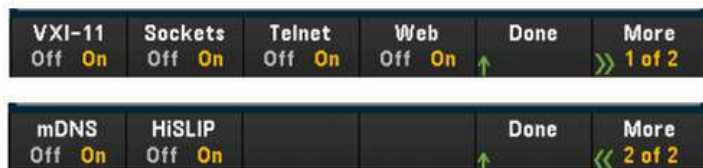
Si les paramètres LAN décrits ci-dessus ont été modifiés, le LAN redémarre après avoir appuyé sur Apply Changes (Appliquer les modifications). Cette caractéristique redémarre le réseau en utilisant TOUS les paramètres LAN actuels. Le redémarrage du LAN n'efface pas le mot de passe de l'interface Web.

### Interface à distance

LXI:REStart

## Services LAN

Active (Activé) ou désactive (Désactivé) les services LAN de l'instrument.



| Étape | Panneau avant                                                                                                                                                                     | Interface à distance          |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1     | Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>LAN Services</b><br>Appuyez sur On pour activer ou Off pour désactiver chaque paramètre. | (aucun)                       |
| 2     | Si vous modifiez ce paramètre, vous devez appuyer sur <b>[Done]</b> > <b>[Apply Changes]</b> pour que les modifications apportées soient prises en compte.                        | SYSTem:COMMunicate:LAN:UPDate |

- Reportez-vous aux Bibliothèques d'E/S Keysight pour plus d'informations sur le VXI-11, Sockets, et protocoles HiSLIP.
- Telnet- Le port Telnet de l'instrument est 5024. Ouvrez les sessions SCPI sur la connexion Telnet en saisissant : telnet adresse IP 5024
- Web - active ou désactive la programmation de l'instrument à partir de son interface Web.
- mDNS - le service mDNS s'utilise dans les réseaux où aucun serveur DNS conventionnel n'est installé. La mise hors puis sous tension ou la réinitialisation du LAN active toujours le mDNS.

## Rétablir les valeurs par défaut

Cette fonction rétablit les valeurs d'usine par défaut des paramètres LAN.

### Panneau avant

Appuyez sur **[Home]** > **User Settings** > **I/O** > **LAN Settings** > **Set to Defaults**

### Interface à distance

(aucun)

## Réinitialisation du LAN

Réinitialise le LAN avec ses paramètres actifs et active le mode DHCP et le service mDNS. La réinitialisation du LAN efface également tout mot de passe personnalisé d'interface utilisateur Web (IU Web).

| Panneau avant                                                                                                                                              | Interface à distance |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Reset</b><br>([Accueil] > Paramètres de l'utilisateur > E/S > Réinitialiser le LAN) | LXI:RESet            |

## Interface Web

Le modèle DAQ970A/DAQ973A inclut une interface Web intégrée pour l'accès et le contrôle à distance de l'instrument sur le LAN via un navigateur Web. Pour plus de détails, reportez-vous à [Interface Web](#).

## En savoir plus sur les adresses IP et leur notation

Les adresses notées par points (« nnn.nnn.nnn.nnn » où « nnn » est la valeur d'un octet comprise entre 0 et 255) doivent être soigneusement exprimées du fait que la plupart des logiciels des PC interprètent les octets avec des zéros initiaux comme des nombres en base 8. Par exemple, « 192.168.020.011 » est équivalent à la notation décimale « 192.168.16.9 » parce que « .020 » est interprété comme « 16 » en base 8 et « .011 » comme « 9 ». Pour éviter toute confusion, utilisez uniquement des valeurs décimales comprises entre 0 et 255 sans zéro d'en-tête.

## Paramètres USB

USB Settings (Paramètres USB) configure les connecteurs USB du panneau avant (stockage) et arrière (connectivité).



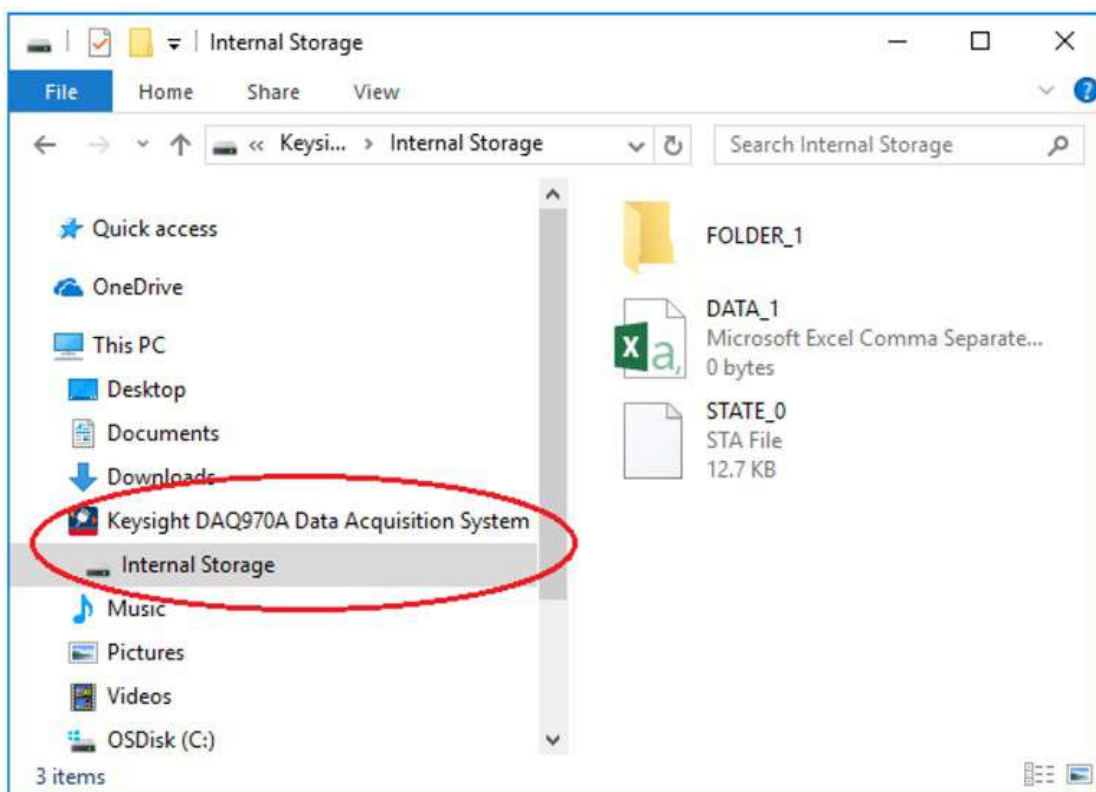
| Panneau avant                                                                       | Interface à distance                      |
|-------------------------------------------------------------------------------------|-------------------------------------------|
| Appuyez sur <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>USB Settings</b> | SYSTem:COMMunicate:ENABLE {OFF   ON}, USB |

## USB SCPI

USB SCPI active (On) ou désactive (Off) le port USB de l'instrument sur le panneau arrière. Une fois que l'état de l'interface a été modifié, vous devez éteindre l'instrument et le remettre sous tension pour que la modification soit prise en compte. Lorsqu'elle est désactivée, l'interface ne peut pas être configurée par l'utilitaire Keysight IO Libraries Connection Expert.

## Accès facile aux fichiers (Touche d'accès au fichier)

Easy File Access vous permet de transférer facilement des fichiers entre l'instrument et votre ordinateur. Connectez simplement le port USB du panneau arrière de l'instrument à un port USB de votre ordinateur. Utilisez ensuite la fenêtre qui apparaît sur votre ordinateur pour copier les fichiers en provenance de l'instrument.



Vous pouvez utiliser les fonctionnalités standard de gestion des fichiers de votre PC pour copier les fichiers de l'instrument sur votre PC.

**REMARQUE**

Pour utiliser l'Accès facile aux fichiers en même temps que vous programmez à distance l'instrument avec SCPI sur l'interface USB (USB SCPI), Keysight IO Libraries Suite version 16.3 ou une version supérieure doit être installé sur votre ordinateur. Vous pouvez télécharger la dernière version à l'adresse [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite).

Pour utiliser l'Accès facile aux fichiers sur un PC exécutant le système d'exploitation Windows XP, assurez-vous que votre ordinateur dispose de Microsoft Windows Media Player 11 pour Windows XP SP1, ou que vous utilisez Microsoft Windows XP SP2, SP3, ou une version plus récente de Windows. Vous pouvez télécharger ce logiciel à l'adresse [www.microsoft.com/en-us/-download/details.aspx?id=8163](http://www.microsoft.com/en-us/-download/details.aspx?id=8163).

## Afficher l'identifiant USB

Affiche la chaîne d'adresse USB utilisée dans les applications de programmation VISA

## Détails techniques de la connexion

Dans la plupart des cas, vous pouvez vous connecter facilement à l'instrument avec la suite IO Libraries ou l'interface Web. Dans certaines circonstances, il peut être utile de connaître les informations suivantes.

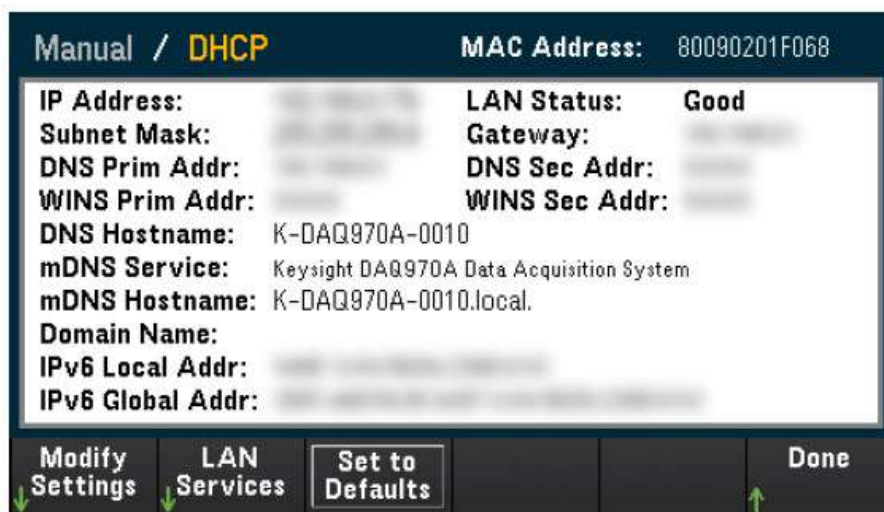
| Interface     | Détails                                                                                                                                  |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------|
| LAN           | Chaîne VISA : TCPIP0::<Adresse IP>::inst0::INSTR<br>Exemple : TCPIP0::192.168.10.2::inst0::INSTR                                         |
| Interface Web | Numéro de port 80, URL <a href="http://&lt;Adresse IP &gt;/">http://&lt;Adresse IP &gt;/</a>                                             |
| USB           | USB ID is in the form of USB0::<Vendor ID>::<Prod ID>::<Serial Number>::0::INSTR<br>Exemple : USB0::0x2A8D::0x0902::MY55160003::0::INSTR |

## Configuration du réseau local

Plusieurs paramètres peuvent être nécessaires pour établir les communications au moyen de l'interface de réseau local. Vous devez d'abord configurer une adresse IP. Vous devrez peut-être contacter votre administrateur réseau qui vous aidera à établir les communications avec l'interface du réseau local.

**REMARQUE** Si le mode Sécurisé est activé, l'instrument doit être déverrouillé avec le code de sécurité correct pour que la plupart de ces actions puissent être effectuées. Voir **Sécurité** pour plus d'informations.

1. Appuyez sur [Home] > User Settings > I/O > LAN Settings.
2. Vous pouvez sélectionner **Modify Settings** (Modifier les paramètres) pour modifier les paramètres LAN, sélectionner **LAN Services** (Services LAN) pour activer (On) ou désactiver (Off) des services LAN sur l'instrument, ou sélectionner **Set to Defaults** (Rétablir les valeurs par défaut) pour rétablir les valeurs d'usine des paramètres LAN.



3. Pour modifier les paramètres, Appuyez sur **Modify Settings** (Modifier les paramètres). Pour accéder à la plupart des paramètres de cet écran, utilisez la première touche de fonction pour basculer de **DHCP** à **Manual** (Manuel). Si l'option DHCP est activée, une adresse IP est automatiquement configurée par le DHCP (Dynamic Host Configuration Protocol) lorsque vous connectez l'instrument au réseau, si le serveur DHCP existe et peut effectuer cette opération. Le DHCP traite également automatiquement le masque de sous-réseau, l'adresse passerelle, le DNS, le WINS et le nom de domaine, si besoin. Il s'agit de la manière la plus facile d'établir les communications avec le réseau local pour votre instrument ; il vous suffit de maintenir le DHCP actif. Contactez votre administrateur réseau pour plus d'informations

#### 4. Spécifier une « Configuration IP »

Si vous n'utilisez pas l'option DHCP (première touche de fonction sur Manual (Manuel)), vous devez spécifier une configuration IP, y compris une adresse IP, et éventuellement un masque de sous-réseau et l'adresse d'une passerelle. Les touches IP Address (Adresse IP) et Subnet Mask (Masque de sous-réseau) sont disponibles sur l'écran principal. Appuyez sur More (Plus) pour configurer les autres paramètres.

Contactez votre administrateur réseau pour connaître l'adresse IP, le masque de sous-réseau et la passerelle à utiliser. Tous les adresses IP sont exprimées sous la forme de notation par points "nnn.nnn.nnn.nnn" où "nnn" est la valeur d'un octet de 0 à 255. Vous pouvez entrer une nouvelle adresse IP à l'aide du bouton ou des touches fléchées sur le panneau avant. **Ne saisissez pas de zéro au début des nombres.**

#### 5. Configurer le « Paramétrage DNS » (facultatif)

Le DNS (Domain Name Service) est un service Internet qui traduit les noms de domaine en adresses IP. Demandez à votre administrateur réseau si ce service est utilisé ; si c'est le cas, demandez le nom de l'hôte, le nom du domaine et l'adresse du serveur DNS à utiliser.

- a. Configurez le « nom de l'hôte » (hostname). Appuyez sur **Host Name** et entrez ce nom. Un nom d'hôte est la partie hôte du nom du domaine qui est convertie en adresse IP. Vous entrez le nom de l'hôte sous forme d'une chaîne de caractères au moyen des touches fléchées sur le panneau avant pour sélectionner et modifier les caractères. Le nom de l'hôte peut contenir des lettres, des chiffres et des tirets ("-").
- b. Configurez les adresses "Serveur DNS". Sur l'écran de configuration LAN, appuyez sur **More** (Plus) pour passer au deuxième des trois jeux de touches.

Saisissez le **Primary DNS** (DNS primaire) et le **Second DNS** (DNS secondaire). Consultez votre administrateur réseau pour de plus amples informations.



## Mise à jour du micrologiciel

### ATTENTION

Ne désactivez pas l'instrument pendant la mise à jour.

---

1. Appuyez sur **[Home]** > **Help** > **About** ([Accueil] > Aide > À propos) pour déterminer la version du micrologiciel installée.
2. Accédez à la page [www.keysight.com/find/DAQ970Afirmware](http://www.keysight.com/find/DAQ970Afirmware) pour trouver la dernière version du micrologiciel. S'il correspond à la version installée sur votre instrument, il n'est pas nécessaire de poursuivre cette procédure. Sinon, téléchargez l'utilitaire de mise à jour du micrologiciel et un fichier ZIP du micrologiciel. Des instructions détaillées concernant le micrologiciel sont disponibles dans le document Instructions relatives à l'utilitaire de mise à jour du micrologiciel, situé sur la page de téléchargement.
3. Décompressez le fichier ZIP et utilisez l'utilitaire de mise à jour pour préparer une clé USB avec le micrologiciel mis à jour.
4. Fixez la clé USB sur le panneau avant de l'instrument et appuyez sur **[Utility]** > **Admin** > **Firmware Update** ([Outils] > Admin > Mise à jour du micrologiciel pour mettre à jour le micrologiciel. Si le mode Sécurisé est activé, déverrouillez l'instrument avec le code de sécurité avant d'installer le firmware.

**Important :** Pour mettre à jour le micrologiciel de l'instrument à distance, le numéro de modèle de la réponse \*IDN? doit correspondre au numéro de modèle réel de l'instrument. Si vous avez remplacé la réponse \*IDN? de l'instrument par celle d'un autre instrument, vous verrez l'erreur suivante lorsque vous tenterez de mettre à jour le micrologiciel à distance : « L'instrument n'est pas pris en charge par ce fichier de micrologiciel. » Pour mettre à jour le micrologiciel, effectuez la mise à jour par la procédure en panneau avant ou, à distance, utilisez SYSTem:PERSonA:MODEl pour définir l'\*IDN? de façon à ce qu'il corresponde au numéro de modèle réel, effectuez la mise à jour, puis utilisez SYSTem:PERSonA:MODEl à nouveau pour régler la réponse \*IDN? sur un autre numéro de modèle.

## Pour contacter Keysight Technologies



Vous pouvez contacter Keysight Technologies pour les questions de garantie, de maintenance ou d'assistance technique.

Aux États-Unis : (800) 829-4444

En Europe : 31 20 547 2111

Au Japon : 0120-421-345

Rendez-vous à l'adresse [www.keysight.com/find/assist](http://www.keysight.com/find/assist) pour des informations sur les coordonnées internationales de Keysight ou contactez votre représentant Keysight Technologies.

## 2 Mise en route rapide

Préparation de l'instrument

Connexion et installation du câblage du module

Connecter les câbles d'alimentation et d'E/S

Utilisez le système d'aide intégré

Réglage de la poignée de transport

Montage de l'instrument dans une armoire

Logiciel Keysight BenchVue Data Acquisition (DAQ)

## Préparation de l'instrument

Vérifiez que vous avez reçu les éléments suivants. S'il manque quelque chose, contactez votre agence commerciale Keysight ou votre distributeur agréé Keysight le plus proche.

- Cordon d'alimentation (adapté au pays)
- Certificat d'étalonnage (facultatif)
- Paquet de documentation supplémentaire
- Câble USB 2.0
- Un thermocouple de type J et un tournevis à lame plate

Le logiciel Keysight BenchVue Data Acquisition (DAQ) est disponible en téléchargement à l'adresse [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

Tous les modules enfichables que vous avez commandés sont livrés dans un emballage séparé. Un kit de câbles supplémentaires (50  $\Omega$ ) est également inclus avec le module multiplexeur RF (50  $\Omega$ ) double 4 voies vers 1 DAQM905A.

La dernière documentation produit est disponible sur :

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

## Connexion et installation du câblage du module

### AVERTISSEMENT

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension maximale appliquée sur une voie quelconque.

Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être considérées comme dangereuses.

Lorsqu'une voie est connectée à une source de tension dangereuse, tous les câbles de voie du module doivent être adaptés à la tension maximale.

Lorsqu'une voie est connectée à une source de tension dangereuse, les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée.

Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source de signal.

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

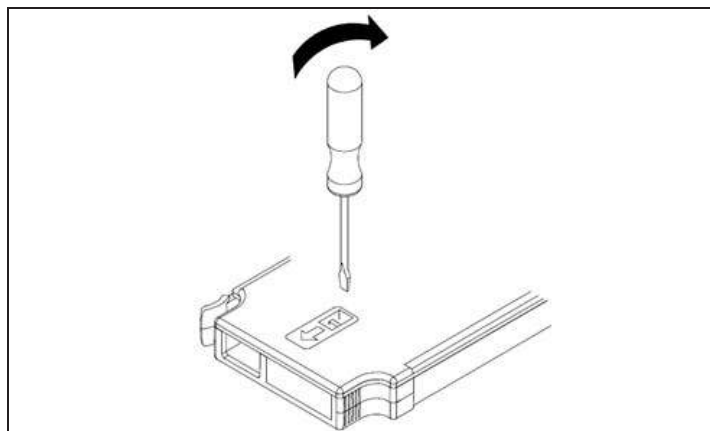
### ATTENTION

Lors de la mise sous tension, toute action d'installer ou de désinstaller des modules du panneau arrière va redémarrer l'instrument.

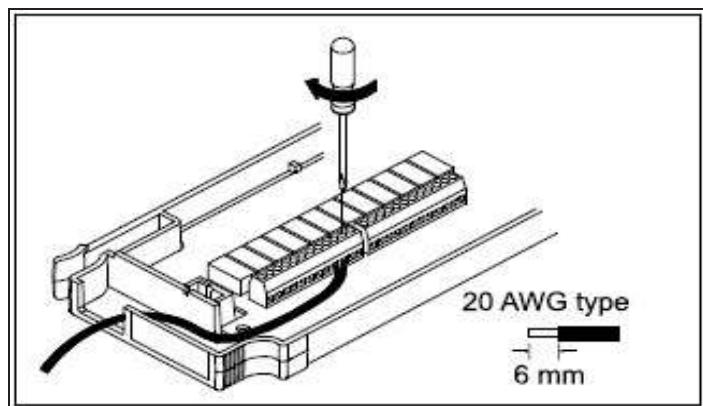
### Installation du module

Pour brancher les câbles à un module et l'installer sur le panneau arrière de l'instrument, procédez en 5 étapes comme suit :

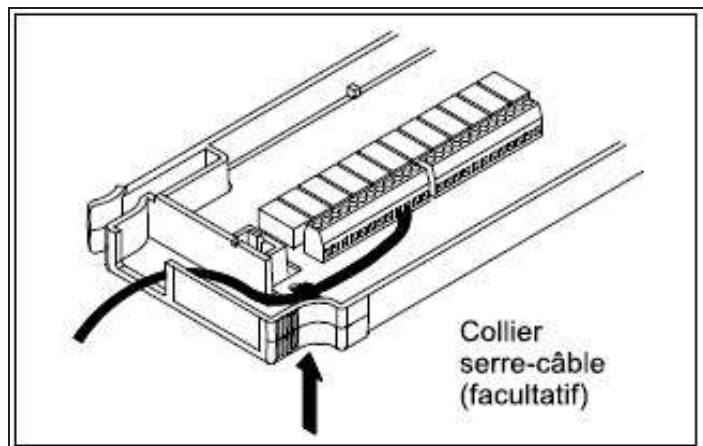
1. À l'aide d'un tournevis à tête plate, poussez la languette vers l'avant et soulevez le capot pour le détacher du module.



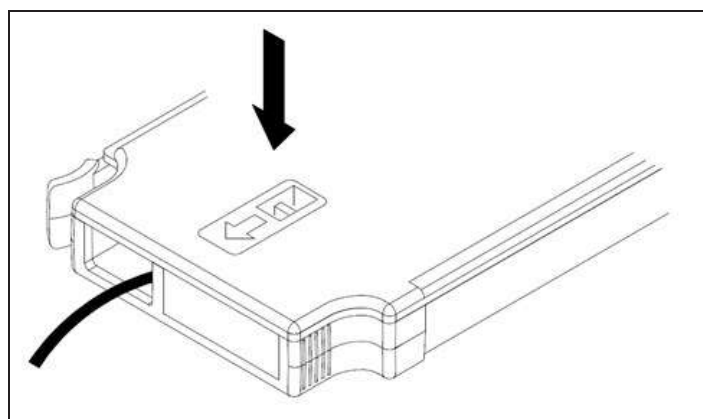
2. Connectez le câblage aux bornes à vis



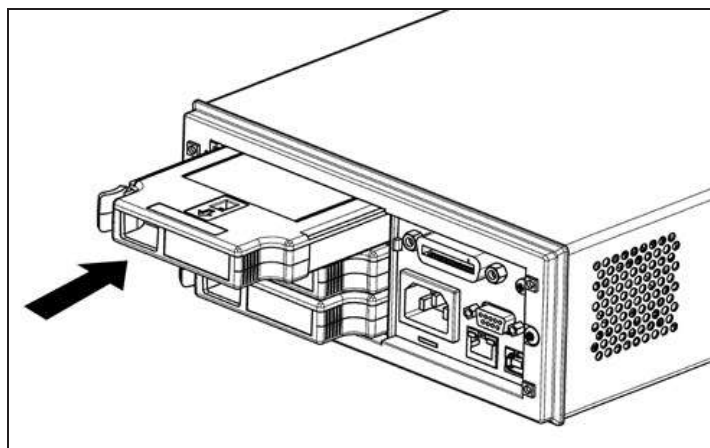
3. Passez les câbles à travers le serre-câble.



4. Remettez en place le couvercle du module.

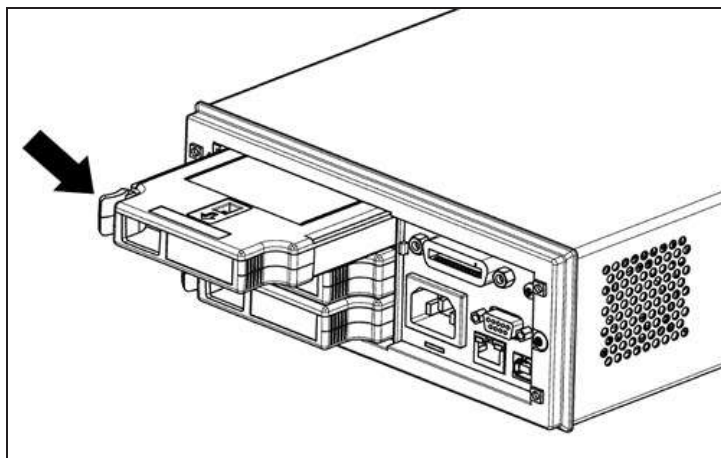


5. Installez le module dans l'instrument (sur le panneau arrière)



## Désinstallation du module

Pour débrancher ou remplacer les modules, poussez vers l'intérieur la pince située à l'arrière sur la gauche du module et sortez-le depuis le panneau arrière.



## Connecter les câbles d'alimentation et d'E/S

### Pour mettre sous tension l'instrument

Avant la mise sous tension de l'instrument, assurez-vous que toutes les sources de signal sont désactivées. Mettez les sources de signal sous tension après avoir mis l'instrument sous tension. Mettez les sources de signal hors tension avant de mettre l'instrument hors tension. Branchez le cordon d'alimentation et le câble de réseau local (LAN) ou USB selon les besoins. Appuyez sur l'interrupteur On/Standby (Marche/Veille) du panneau avant. Notez que cet interrupteur met seulement l'instrument en veille (Standby). Pour isoler complètement l'instrument de son alimentation secteur, débrancher le cordon d'alimentation. Si l'instrument ne s'allume pas, vérifiez que le cordon d'alimentation est solidement branché.

Le tableau ci-dessous indique les différents états de la couleur de LED lors de la mise sous tension de l'instrument :

| Couleur de la LED | État de l'appareil                                                   |
|-------------------|----------------------------------------------------------------------|
| LED off           | Pas d'alimentation secteur connectée.                                |
| La LED est ambré  | L'instrument est en mode veille et connecté à l'alimentation secteur |
| La LED est verte  | L'instrument est mis sous tension.                                   |

### Auto-test de mise en route

Après la mise sous tension, l'instrument exécute un auto-test et affiche un message qui explique comment obtenir de l'aide et indique l'adresse IP actuelle.

L'écran du panneau avant s'illumine brièvement pendant que l'instrument effectue son auto-test de mise sous tension, avec toutes les voies de mesure hors tension. Si l'auto-test de mise sous tension échoue, le témoin d'erreur, **ERR** s'affiche à l'écran. Voir « Messages d'erreur SCPI » dans le *DAQ970A/DAQ973A Guide de programmation* pour plus d'informations sur les codes et messages d'erreur SCPI.

#### REMARQUE

Un auto-test complet effectue un ensemble de tests plus étendus que ceux effectués à la mise sous tension. Voir le *DAQ970A/DAQ973A Guide de maintenance* pour plus d'informations sur la procédure d'auto-test complète de l'instrument.

La fonction de mesure par défaut de l'instrument est la tension CC (V CC), avec la sélection automatique de plage activée.

### Mettre l'instrument hors tension

Maintenez l'interrupteur On/Standby (Marche/Veille) appuyé pendant quelques secondes. Cela évite d'éteindre l'instrument par accident en effleurant l'interrupteur d'alimentation.

#### REMARQUE

Si vous mettez l'instrument hors tension en débranchant la source d'alimentation électrique (cela n'est pas recommandé), l'instrument sera mis sous tension dès que l'alimentation sera rétablie. Vous devez appuyez à nouveau sur l'interrupteur **On/Standby** (Marche/Veille).

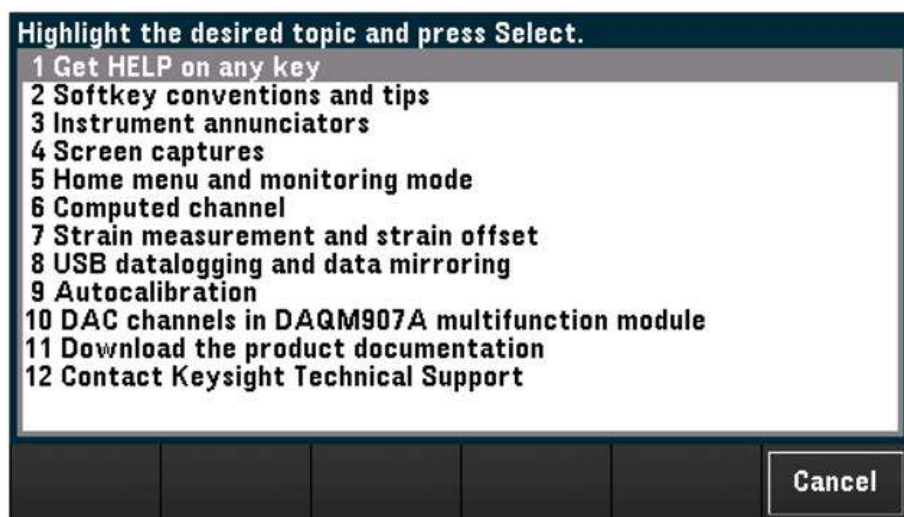


## Utilisez le système d'aide intégré

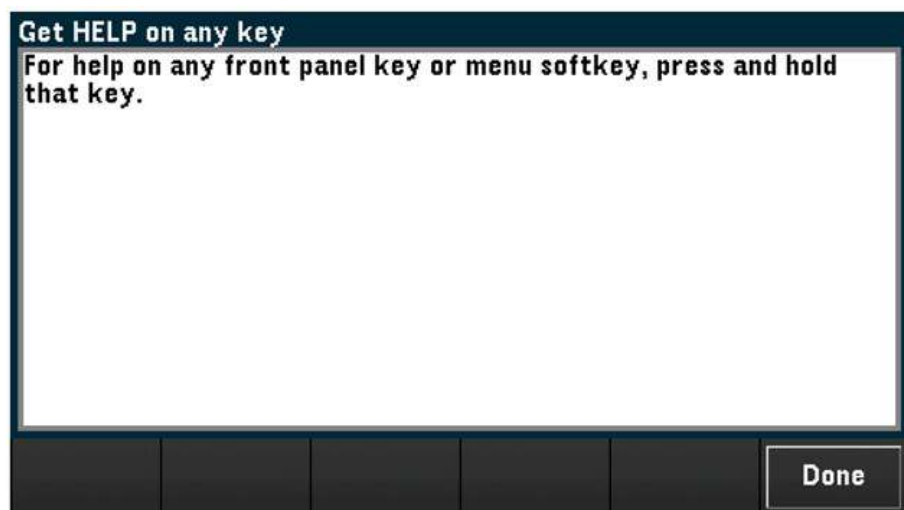
Le système d'aide intégré fournit une aide contextuelle sur toutes les touches de la face avant et les touches de fonction des menus. Une liste des rubriques d'aide est également disponible pour vous aider à en apprendre davantage sur l'instrument. Tous les messages, les aides contextuelles et les rubriques d'aide s'affichent dans la langue sélectionnée. Les libellés des touches de fonction ne sont pas traduits.

### Afficher la liste des rubriques d'aide

Appuyez sur **[Home]** > **Help** > **Help Topics** ([Accueil] > Aide > Rubriques d'aide) pour afficher la liste des rubriques d'aide. Utilisez le bouton rotatif ou les touches fléchées du panneau avant pour mettre en surbrillance le sujet souhaité, puis appuyez sur **[Select]** pour afficher le contenu de l'aide.



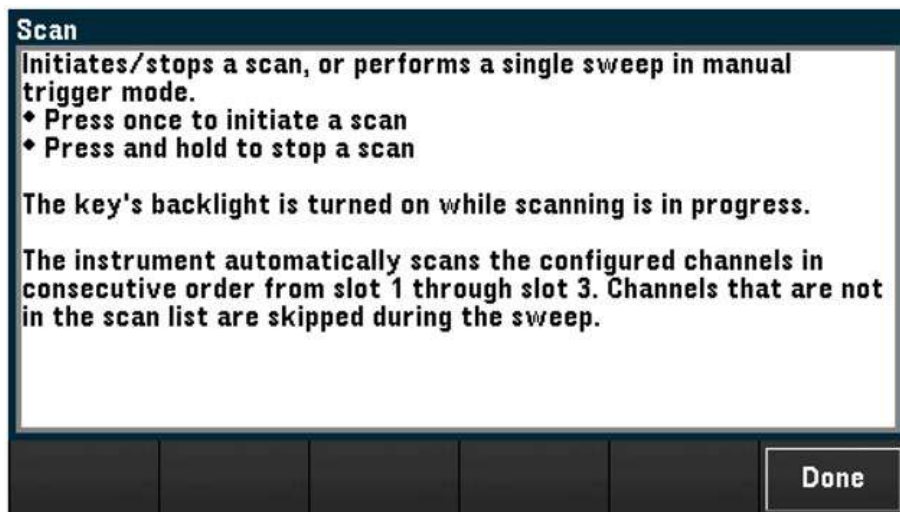
Dans cet exemple, nous avons sélectionné 1 Get HELP on any key. La rubrique d'aide suivante s'affiche à l'écran :



Appuyez sur **Done** (Terminé) pour quitter l'aide.

## Afficher les informations d'aide pour une touche du panneau avant

Maintenez enfoncée n'importe quelle touche du panneau avant pour obtenir de l'aide contextuelle, comme **[Scan]** ([Balayage]). Si le message contient d'autres informations que l'affichage ne peut contenir, utilisez le bouton ou les touches fléchées du panneau avant pour charger la page précédente/suivante.



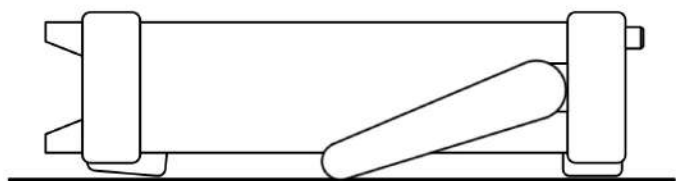
Appuyez sur **Done** (Terminé) pour quitter l'aide.

## Afficher les informations relatives à l'instrument

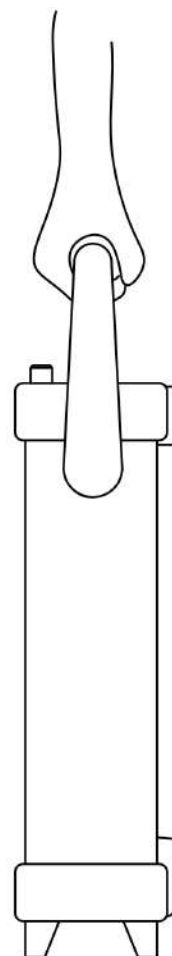
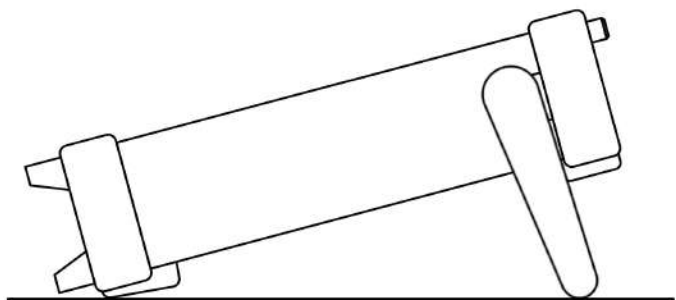
Appuyez sur **[Home]** > **Help** > **About** ([Accueil] > Aide > À propos) pour afficher les informations relatives à l'instrument comme le numéro de série du produit, l'adresse IP (lorsqu'il est connecté à l'interface LAN), la version du micrologiciel actuellement installé. Appuyez sur **Done** (Terminé) pour sortir.

## Réglage de la poignée de transport

La poignée de transport a trois positions (comme illustré ci-dessous). Pour régler la position de la poignée, saisissez les bords de la poignée, tirez vers l'extérieur et faites tourner la poignée.



Positions à plat



Position de transport

## Montage de l'instrument dans une armoire

Vous pouvez installer l'instrument dans une armoire de baie standard 19 pouces en commandant le kit de montage en armoire dont le numéro de référence est indiqué ci-dessous. Les instructions et le matériel de montage sont inclus avec chaque kit de montage en baie. Tout instrument Keysight System II de mêmes dimensions peut s'installer dans une baie à côté du DAQ970A/DAQ973A.

### ATTENTION

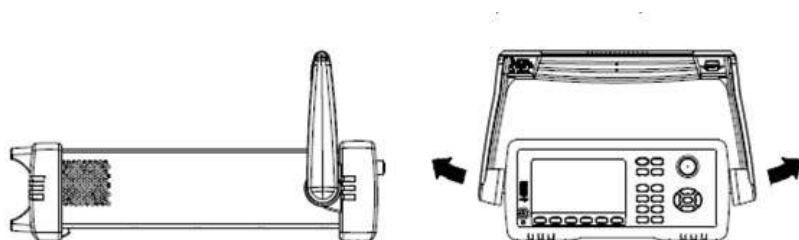
Pour éviter la surchauffe de l'instrument, ne bouchez pas l'écoulement d'air sur l'instrument (entrée et sortie). Laissez un espace suffisant à l'arrière, sur les côtés et sous l'instrument afin de permettre une circulation d'air interne suffisante.

### REMARQUE

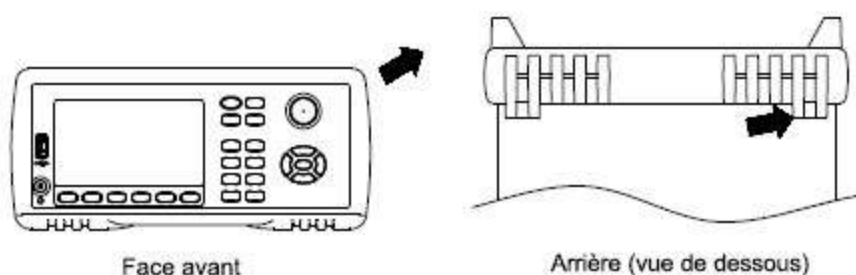
Avant de monter l'instrument dans une baie, démontez la poignée de transport et les plots en caoutchouc à l'avant et à l'arrière.

### Retirer la poignée et les plots

Pour démonter la poignée, placez-la en position verticale et tirez les extrémités vers l'extérieur.

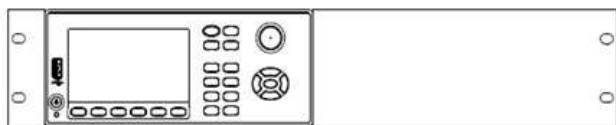


Pour retirer les plots caoutchouc à l'avant et à l'arrière, étirez un coin et faites glisser.



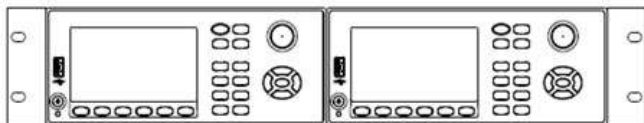
### Montage d'un seul instrument dans une baie

Pour monter un seul instrument dans une baie, commandez le kit de montage (référence : DAQA190A ou 1CM124A).



### Montage des instruments côte à côte dans une baie

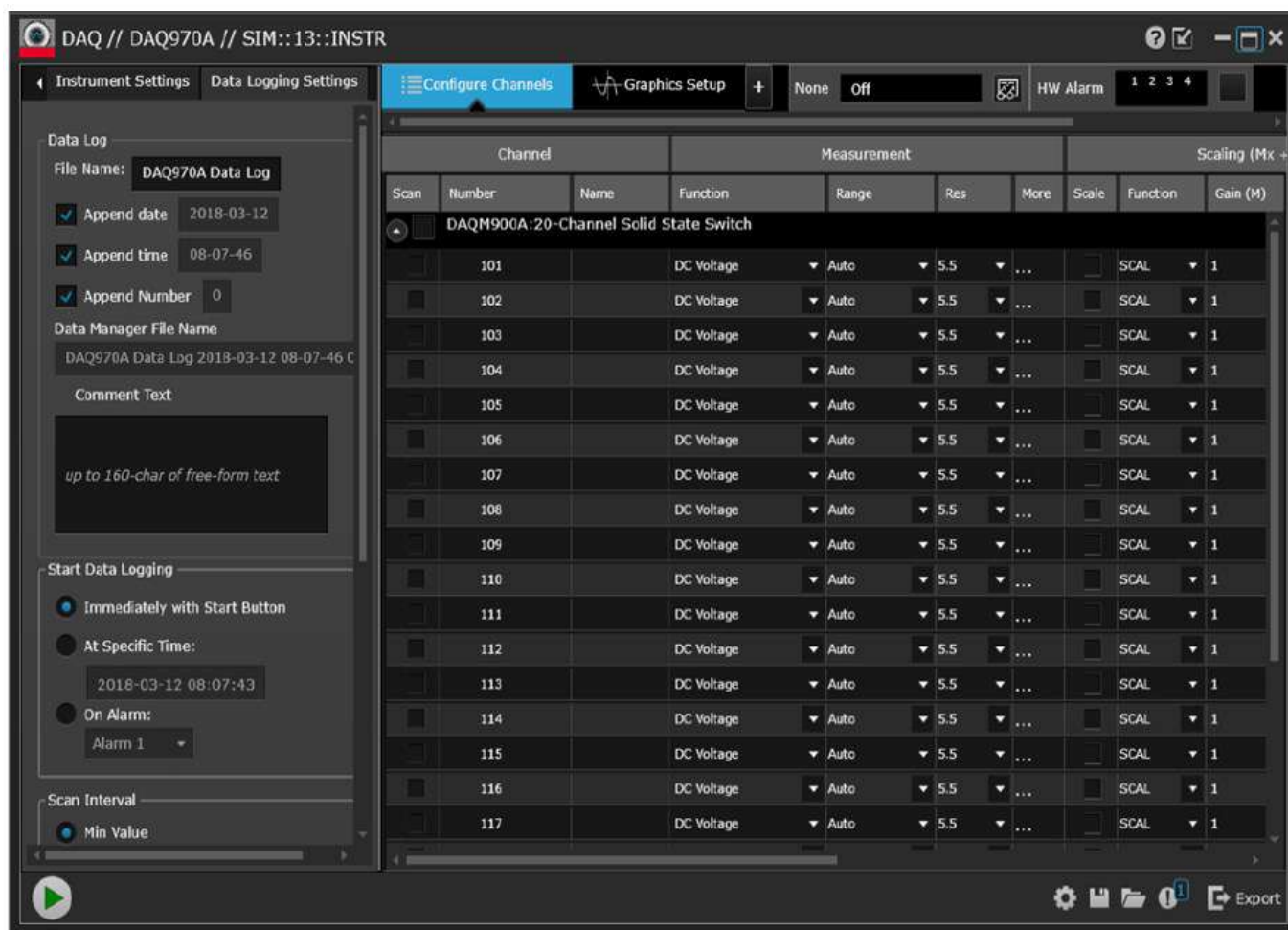
Pour installer deux instruments côte à côte dans une baie, commandez le kit de liaison (référence : DAQA194A ou 34194A) et le kit de cornières (référence : DAQA191A ou 1CM107A). Utilisez les rails de guidage à l'intérieur de l'armoire.



## Logiciel Keysight BenchVue Data Acquisition (DAQ)

Le logiciel Keysight BenchVue Data Acquisition (DAQ) est une application sous Windows® qui simplifie l'utilisation de l'instrument avec votre ordinateur pour la collecte et l'analyse de mesures. Vous utiliserez ce logiciel pour préparer votre test, recueillir et archiver les résultats des mesures et effectuer un affichage et une analyse en temps réel des résultats de vos mesures. Le logiciel Keysight BenchVue Data Acquisition (DAQ) est disponible en téléchargement à l'adresse [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

Écran principal de l'application :



## Licence logicielle BenchVue Data Acquisition (DAQ)

Pour évaluer une application BenchVue pour une période d'essai gratuite de 30 jours, accédez à la vue Application BenchVue, cliquez une fois sur l'application souhaitée, puis cliquez sur le bouton "Démarrer la version d'évaluation" - la période d'évaluation est basée sur le nombre de jours calendaires restants. À l'expiration de la période d'essai, vous devrez acheter une licence de logiciel pour cette application. Les options de licence flexibles de Keysight vous permettent de sélectionner le type de licence et les conditions qui correspondent le mieux à vos besoins logiciels. Pour plus d'informations sur l'achat et l'installation d'une licence de logiciel, voir la rubrique Options de licence logicielle BenchVue dans l'aide du logiciel Keysight BenchVue Data Acquisition (DAQ).

# 3 Fonctions et caractéristiques

Présentation succincte du système

Aide-mémoire des menus du panneau avant

Touche [Scan/ Début]

Menu [Monitor] ([Surveillance])

Menu [Home] ([Accueil])

Menu [View] ([Affichage])

Menu [Channel] ([Voie])

Menu [Interval] ([Intervalle])

Menu [Math] ([Math])

Menu [Copy] ([Copier])

Menu [Alarm] ([Alarme])

Menu [Utility] ([Utilitaire])

Menu [Module] ([Module])

Menu [Save Recall] ([Enreg./Rappel])

Interface Web

Présentation des modules

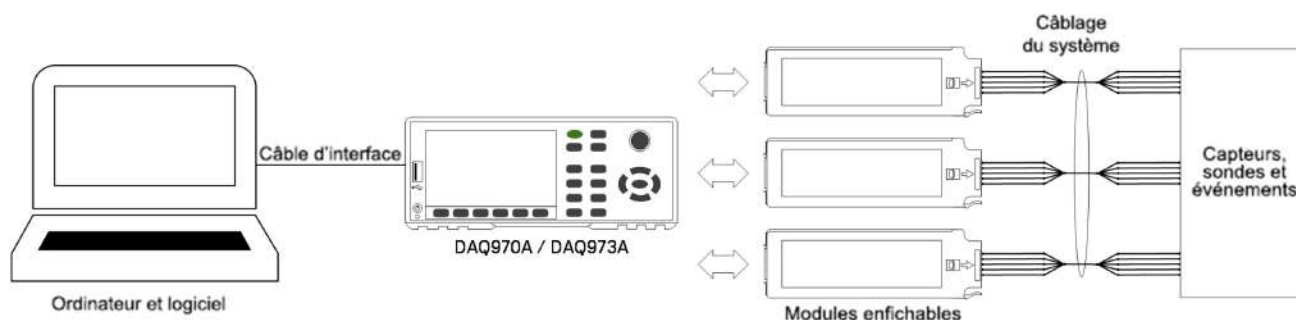
## Présentation succincte du système

Cette section présente succinctement un système informatique et décrit les composants d'un système d'acquisition de données.

- Présentation succincte d'un système d'acquisition de données
- Présentation succincte du système
- Entrée de mesure
- Sortie de commande

## Présentation succincte d'un système d'acquisition de données

Vous pouvez utiliser le DAQ970A/DAQ973A Keysight comme un instrument autonome, mais il existe de nombreuses applications pour lesquelles vous souhaitez profiter des fonctions intégrées de connexion à un ordinateur. Un système d'acquisition typique est représenté ci-dessous :



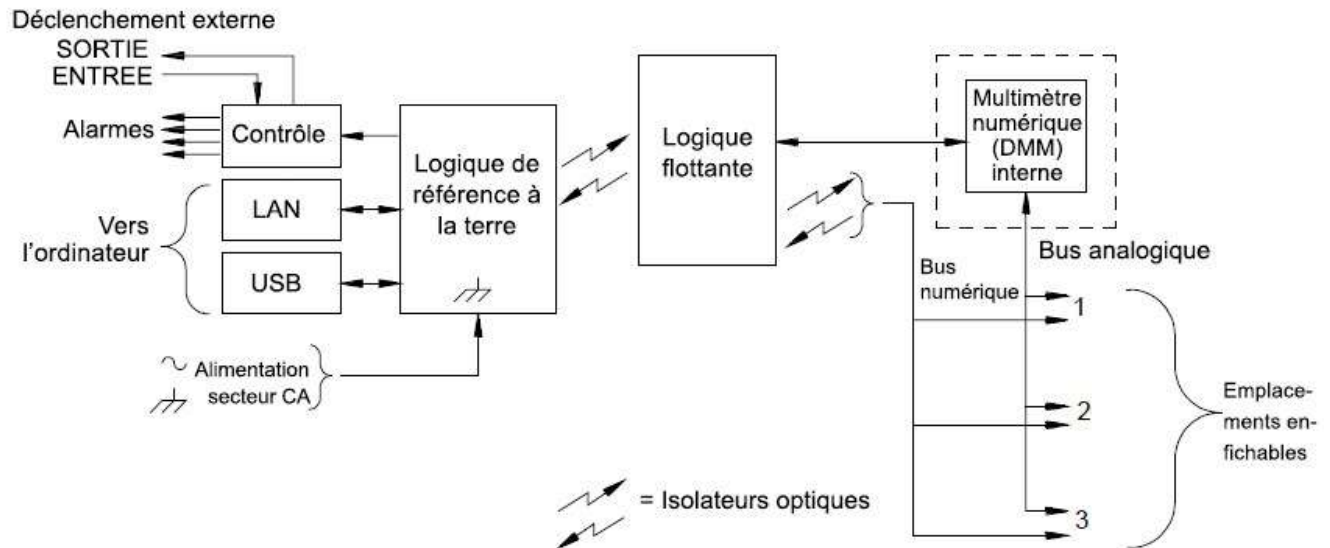
La configuration offre les avantages suivants :

- Vous pouvez utiliser le DAQ970A/DAQ973A pour réaliser un stockage et une réduction de données, des calculs mathématiques et une conversion en unités techniques. Vous pouvez utiliser le PC pour réaliser une configuration simple et une présentation des données.
- Vous pouvez supprimer les signaux analogiques et les capteurs de mesure de l'environnement PC bruyant et isolez-les électriquement du PC et de la terre.
- Vous pouvez utiliser un seul ordinateur pour surveiller plusieurs instruments et points de mesure tout en effectuant d'autres tâches informatiques.



## DAQ970A/DAQ973A circuit logique

Comme le montre le schéma de principe ci-dessous, les circuits logiques du DAQ970A/DAQ973A sont répartis en deux sections : logique référencée à la terre et logique flottante. Ces deux sections sont isolées l'une de l'autre afin de maintenir la précision et la répétabilité des mesures. Voir **Bruit causé par des boucles de terre** pour plus de détails sur les boucles de masse.



Les circuits référencés à la terre et les circuits flottants communiquent entre eux par une liaison de données opto-isolée. La section référencée à la terre communique avec la section flottante afin de permettre la connexion avec un ordinateur. Le DAQ970A/DAQ973A est livré avec des interfaces LAN et USB.

La section référencée à la terre comporte également quatre sorties d'alarmes matérielles et des lignes de déclenchement externe. Ces lignes de sorties d'alarmes permettent de déclencher des voyants ou des sirènes d'alarme externes ; il est également possible de les utiliser pour envoyer une impulsion compatible TTL au système de commande.

La section flottante contient le processeur système principal et contrôle toutes les fonctionnalités de base de l'instrument. C'est l'endroit où l'instrument communique avec les modules enfichables, explore le clavier, contrôle l'écran du panneau avant et le multimètre numérique (DMM) interne. La section flottante effectue également le réglage d'échelle Mesure, surveille les conditions d'alarme, convertit les mesures de capteurs en unités techniques, horodate les mesures de scrutation et enregistre les données en mémoire non volatile.

## Modules enfichables

Le DAQ970A/DAQ973A propose un choix complet de modules enfichables afin de vous offrir des possibilités de mesure, de multiplexage et de contrôle de haute qualité. Les modules enfichables communiquent avec la logique flottante via le bus numérique interne isolé. Les modules multiplexeurs se connectent également au multimètre numérique (DMM) interne via le bus analogique interne. Chaque module comporte son propre microprocesseur destiné à décharger le processeur de l'unité principale et à réduire le nombre de communications à travers le fond de panier pour augmenter la vitesse. Voir [Présentation des modules](#) pour plus d'informations.

| Numéro de module                | Utilisations courantes                                                                                                                                      |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Entrée de mesure</b>         |                                                                                                                                                             |
| DAQM900A                        | Scrutation et mesure directe de température, tension, résistance, fréquence et courant (DAQM901A seulement) à l'aide du multimètre numérique (DMM) interne. |
| DAQM901A                        |                                                                                                                                                             |
| DAQM902A                        |                                                                                                                                                             |
| DAQM907A                        | Entrée numérique, comptage d'événements.                                                                                                                    |
| DAQM908A                        | Scrutation et mesure directe de température, tension, résistance à l'aide du multimètre numérique (DMM) interne.                                            |
| DAQM909A                        | Mesures de numérisation de la tension et de la contrainte à l'aide des numériseurs intégrés.                                                                |
| <b>Acheminement des signaux</b> |                                                                                                                                                             |
| DAQM900A                        | S/O                                                                                                                                                         |
| DAQM901A                        | Multiplexage de signaux vers ou en provenance d'instruments externes.                                                                                       |
| DAQM902A                        | S/O                                                                                                                                                         |
| DAQM904A                        | Commutation par matrice à 32 points de croisement                                                                                                           |
| DAQM905A                        | Applications haute fréquence 50 $\Omega$ (< 2 GHz).                                                                                                         |
| DAQM908A                        | S/O                                                                                                                                                         |
| <b>Sortie de commande</b>       |                                                                                                                                                             |
| DAQM903A                        | Commutation générale et contrôle à l'aide de commutateurs forme C (unipolaires deux positions).                                                             |
| DAQM907A                        | Sortie numérique, sorties de tension (convertisseur numérique-analogique).                                                                                  |

## Câblage du système

Les modules enfichables comportent des borniers à vis destinés à simplifier la réalisation du câblage de votre système. Le type de câblage que vous pouvez utiliser pour connecter vos signaux, vos capteurs et vos sondes aux modules est important pour le succès de vos mesures. Certains types de capteurs, comme les thermocouples, ont des exigences très spécifiques en ce qui concerne le type de câble pouvant être utilisé pour réaliser les connexions. Veillez à prendre en compte l'environnement d'utilisation lors du choix de la section des fils et des qualités d'isolement. L'isolement des fils se compose essentiellement de matériaux comme le PVC ou le PTFE. Le tableau ci-dessous dresse la liste de plusieurs types de câbles et décrit leurs utilisations typiques.

### REMARQUE

L'isolement et l'usage des fils sont décrits plus en détails à la section **Câblage et connexions du système**.

| Type de câble                                        | Utilisations courantes                                          | Commentaires                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Câble d'extension pour thermocouple                  | Mesures de thermocouples.                                       | Disponibles selon les types spécifiques de thermocouples. Disponibles également sous forme de câbles blindés pour une meilleure immunité au bruit.                                                                                                                                                                |
| Paire torsadée,<br>Paire torsadée blindée            | Entrées de mesures, sorties de tensions, commutation, comptage. | Câble le plus courant pour les entrées de mesures en basse fréquence. Une paire torsadée réduit le bruit de mode commun. Une paire torsadée blindée apporte une immunité au bruit supplémentaire.                                                                                                                 |
| Coaxial blindé,<br>coaxial à double blindage         | Commutation de signaux VHF.                                     | Câbles les plus courants pour l'acheminement de signaux haute fréquence. Disponibles avec plusieurs impédances caractéristiques (50 $\Omega$ ou 75 $\Omega$ ). Apportent une excellente immunité au bruit. Les câbles à double blindage améliorent l'isolement entre les voies. Exigent des connecteurs spéciaux. |
| Câbles en nappe,<br>câbles en nappe à paire torsadée | Entrées/sorties numériques                                      | Souvent utilisés avec des connecteurs à nombreux contacts. Ces câbles n'offrent qu'une faible immunité au bruit.                                                                                                                                                                                                  |

## Capteurs et sondes

Les capteurs et les sondes convertissent une grandeur physique en une grandeur électrique. La grandeur électrique est mesurée et le résultat est ensuite converti en unités techniques. Par exemple, lors de la mesure d'un thermocouple, l'instrument mesure une tension continue et la convertit mathématiquement en une température correspondante en °C, °F ou K.

| Mesure      | Types typiques de capteur      | Sortie typique du capteur                                                |
|-------------|--------------------------------|--------------------------------------------------------------------------|
| Température | Thermocouple                   | 0 à 80 mV                                                                |
|             | RTD                            | Résistance en 2 fils ou 4 fils comprise entre 5 $\Omega$ et 500 $\Omega$ |
|             | Thermorésistance               | Résistance en 2 fils comprise entre 10 $\Omega$ et 1 M $\Omega$          |
| Pression    | Semi-conducteur                | $\pm 10$ Vcc                                                             |
| Débit       | Type rotatif                   | 4 mA to 20 mA                                                            |
|             | Type thermique                 |                                                                          |
| Contrainte  | Éléments résistifs             | Résistance en 4 fils comprise entre 10 $\Omega$ et 10 k $\Omega$         |
| Événements  | Interrupteurs de fin de course | Trains d'impulsions comprises entre 0 et 5 V                             |
|             | Compteurs optiques             |                                                                          |
|             | Codeur rotatif                 |                                                                          |
| Numérique   | État de système                | Niveaux compatibles TTL                                                  |

## Limites d'alarme

Le DAQ970A/DAQ973A possède quatre sorties d'alarmes que vous pouvez configurer afin de vous prévenir lorsqu'une lecture dépasse des limites prédéfinies sur une voie lors d'une scrutation. Vous pouvez affecter une limite haute, une limite basse ou les deux à toute voie configurée dans la liste de scrutation. Vous pouvez affecter plusieurs voies à l'une quelconque des quatre alarmes disponibles (numérotées de 1 à 4). Par exemple, vous pouvez configurer l'instrument afin qu'il produise une alarme sur la sortie d'alarme 1 lorsqu'une limite est dépassée sur l'une quelconque des voies 103, 205 ou 320.

Vous pouvez également attribuer des alarmes à des voies du module multifonction. Par exemple, programmez une alarme se déclenchant lorsque l'instrument détecte une séquence de bits (configuration binaire) donnée, ou un changement de séquence de bits, sur une voie d'entrée numérique, ou encore lorsqu'une voie de totalisateur atteint une valeur donnée. Avec le module multifonction, il n'est pas nécessaire que les voies figurent dans la liste de scrutation pour générer une alarme.

## Acheminement et commutation de signaux

Les possibilités de commutation des modules enfichables disponibles avec le DAQ970A/DAQ973A apportent la souplesse et les possibilités d'extension au système de test. Vous pouvez utiliser les modules multiplexeurs enfichables pour acheminer les signaux vers et depuis votre système de test ou pour les multiplexer vers le multimètre numérique (DMM) interne ou d'autres instruments externes.

Les relais sont des composants électromécaniques sujets à usure. La durée de vie d'un relais, ou le nombre de commutations réelles avant panne, dépend de la manière avec laquelle le relais est utilisé (charge appliquée, fréquence de commutation et environnement). Le système de maintenance des relais du DAQ970A/DAQ973A compte automatiquement le nombre de commutations de chaque relais et stocke ce nombre en mémoire non volatile pour chaque module multiplexeur. Utilisez cette fonctionnalité pour assurer le suivi des pannes de relais et pour prévoir le moment où une opération de maintenance sera nécessaire.

### Topologies de multiplexage

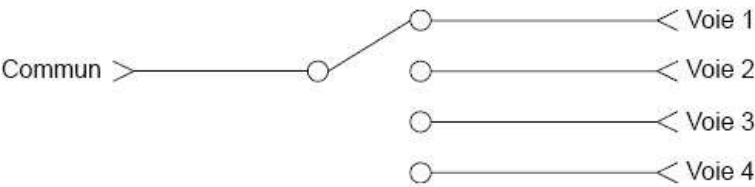
Plusieurs modules multiplexeurs enfichables sont disponibles avec des topologies différentes pour diverses applications :

| Topologies de multiplexage            | Modules enfichables                              |
|---------------------------------------|--------------------------------------------------|
| Multiplexeur                          | DAQM900A, DAQM901A, DAQM902A, DAQM905A, DAQM908A |
| Matrice                               | DAQM904A                                         |
| Forme C ( Unipolaire, deux positions) | DAQM903A                                         |

Les sections suivantes décrivent chacune de ces topologies de multiplexage.

#### Commutation par multiplexeur

Les multiplexeurs vous permettent de connecter une ou plusieurs voies à une voie commune, une voie à la fois. Un multiplexeur simple 4 vers 1 est illustré ci-dessous. Lorsque vous associez un multiplexeur à un appareil de mesure, comme le multimètre numérique (DMM) interne, vous créez un dispositif de scrutation. Pour en savoir plus sur la scrutation, voir [Analyse](#).

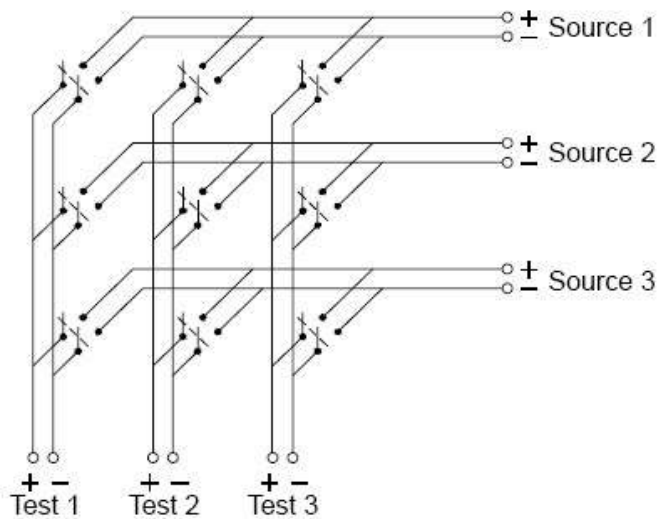


Les multiplexeurs sont disponibles selon plusieurs types :

| Types de multiplexeurs | Utilisations courantes                                                                                                                                            |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Un fil (asymétrique)   | Pour les mesures communes de niveau bas. Pour plus d'informations, reportez-vous à <a href="#">Multiplexeurs un fil (asymétriques)</a> .                          |
| Deux fils              | Pour les mesures flottantes. Pour plus d'informations, voir <a href="#">Multiplexeurs deux fils</a> .                                                             |
| Quatre fils            | Pour les mesures de résistance et de RTD. Pour plus d'informations, reportez-vous à <a href="#">Multiplexeurs quatre fils</a> .                                   |
| Signal RF              | Très haute fréquence (VHF) pour la commutation de signaux jusqu'à 2,8 GHz. Pour plus d'informations, reportez-vous à <a href="#">Multiplexage de signaux RF</a> . |

Matrice de commutation

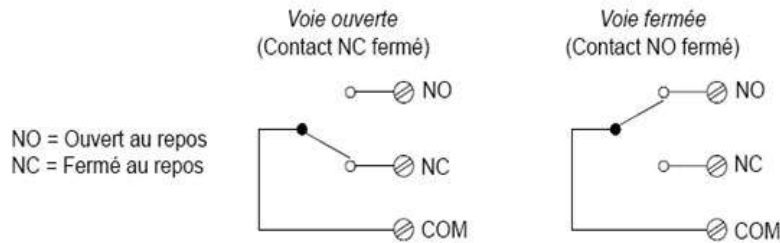
Une matrice de commutation connecte plusieurs entrées à plusieurs sorties, et offre par conséquent plus de souplesse de commutation qu'un multiplexeur. Utilisez une matrice pour commuter des signaux à basse fréquence (inférieure à 10 MHz) seulement. Une matrice se compose de lignes et de colonnes. Par exemple, une matrice simple 3× 3 peut être utilisée pour connecter trois sources à trois points de test comme l'illustre la figure ci-dessous :



N'importe laquelle des sources de signaux peut être connectée à n'importe laquelle des entrées de test. Il est important de vérifier que des conditions dangereuses ou indésirables ne sont pas créées par ces connexions.

Commutation forme C (unipolaire deux positions)

Le DAQM903A contient 20 inverseurs forme C (appelés aussi unipolaires, deux positions). Vous pouvez utiliser des inverseurs forme C pour acheminer des signaux, mais ils sont utilisés habituellement pour contrôler des dispositifs externes.



## Entrée de mesure

Le DAQ970A/DAQ973A vous permet d'associer un multimètre numérique (DMM) interne ou externe avec des voies de multiplexeur pour créer une scrutation. Pendant la scrutation, l'instrument connecte le multimètre numérique (DMM) successivement à chaque voie configurée du multiplexeur et réalise une mesure.

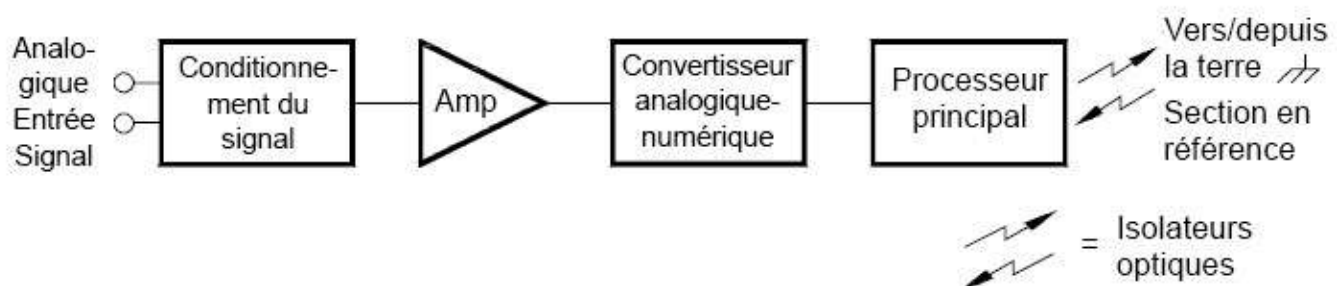
Toute voie pouvant être « lue » par l'instrument peut aussi être incluse dans une scrutation. Cela inclut toute combinaison de mesures de température, tension, résistance, courant, fréquence ou période sur les voies du multiplexeur. Une scrutation peut aussi inclure une lecture d'un port numérique, une lecture par le biais de la voie de mesure ou une lecture du comptage d'un totaliseur sur le module multifonction.

## Le multimètre numérique (DMM) interne

Un capteur ou une sonde convertit la grandeur physique en un signal électrique pouvant être mesuré par le multimètre numérique (DMM) interne. Pour réaliser ces mesures, le multimètre numérique (DMM) comprend les fonctions suivantes :

- Température (thermocouple, RTD et thermistance)
- Tension (continue et alternative jusqu'à 300 V)
- Résistance (2 et 4 fils jusqu'à 1 GΩ)
- Courant (continu et alternatif jusqu'à 1 A)
- Fréquence et période (jusqu'à 300 kHz)

Le multimètre numérique (DMM) interne comporte une entrée universelle frontale pour mesurer une grande diversité de types de capteurs sans qu'il soit nécessaire d'ajouter de circuit de conditionnement (mise en forme) de signal externe. Il comprend des circuits de conditionnement, d'amplification (ou d'atténuation) de signaux et un convertisseur analogique-numérique à haute résolution (jusqu'à 22 bits). Un schéma simplifié du multimètre numérique (DMM) interne est illustré ci-dessous :







## Conditionnement du signal, commutation de plage et amplification

Les signaux d'entrée analogiques sont multiplexés dans la section de conditionnement de signal du multimètre numérique (DMM) interne – comprenant normalement les circuits de commutation, de commutation de plage et d'amplification. Si le signal d'entrée est une tension continue, le circuit de conditionnement de signal se résume à un atténuateur pour les tensions d'entrée les plus élevées et un amplificateur de tension continue pour les tensions d'entrées les plus basses. Si le signal d'entrée est une tension alternative, un convertisseur transforme le signal alternatif en sa valeur équivalente de tension continue (valeur efficace vraie). Les mesures de résistance sont effectuées en injectant un courant continu connu dans la résistance inconnue et en mesurant la chute de tension aux bornes de cette résistance. Les circuits de commutation et de plage, conjointement au circuit amplificateur, convertissent l'entrée en une tension continue qui est comprise dans la plage de mesure du convertisseur analogique-numérique (CAN) du multimètre numérique (DMM) interne.

Vous pouvez laisser l'instrument sélectionner automatiquement la plage à l'aide de la commutation automatique ou sélectionner une plage fixe à l'aide de la sélection manuelle. La commutation automatique est pratique parce que l'instrument sélectionne automatiquement la plage à utiliser pour chaque mesure en fonction du signal d'entrée. Pour une scrutation plus rapide, utilisez la sélection manuelle pour chaque mesure (un certain temps supplémentaire est nécessaire pour la commutation de plage automatique puisque l'instrument doit faire cette sélection).

## Conversion analogique-numérique (CAN)

Le CAN prend la tension continue à échelle prééglée du circuit de conditionnement de signaux et la convertit en données numériques pour sortie et affichage sur le panneau avant. Le CAN régit certaines des caractéristiques de base de mesure. Cela comprend la résolution de mesure, la vitesse de lecture et la possibilité de rejeter le bruit parasite. Il existe plusieurs méthodes de conversion analogique-numérique, mais elles peuvent se répartir en deux types : intégration et non intégration. Les méthodes d'intégration mesurent la valeur moyenne d'entrée sur un intervalle de temps défini, rejetant de cette façon de nombreuses sources de bruit. Les méthodes de non intégration échantillonnent la valeur instantanée de l'entrée, plus le bruit, pendant un très court intervalle. Le multimètre numérique (DMM) interne utilise une méthode de conversion analogique-numérique à intégration.

## Processeur principal

Le processeur principal, situé dans la section à logique flottante, contrôle le conditionnement des signaux, la commutation de plage et le convertisseur analogique-numérique. Il accepte des commandes en provenance de la section à logique référencée à la terre et y renvoie les résultats de mesure. Le processeur principal synchronise les mesures pendant les opérations de scrutation et de contrôle. Le processeur principal utilise un système d'exploitation multitâches pour gérer les diverses ressources et demandes du système.

Le processeur principal étalonne également les résultats de mesure, effectue le réglage d'échelle  $Mx+B$ , surveille les conditions d'alarme, convertit les mesures de capteurs en unités techniques, horodate les mesures de scrutation et enregistre les données en mémoire non volatile.

## Analyse

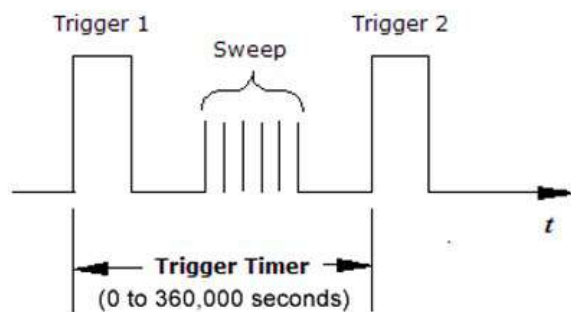
L'instrument vous permet d'associer un multimètre numérique (DMM) interne ou externe avec des voies de multiplexeur pour créer une scrutation. Pendant la scrutation, l'instrument connecte le multimètre numérique (DMM) successivement à chaque voie configurée du multiplexeur et réalise une mesure.

Avant de lancer une scrutation, vous devez créer une liste de scrutation comprenant toutes les voies de multiplexeur ou numériques souhaitées. Les voies absentes de la liste sont ignorées pendant la scrutation. L'instrument effectue automatiquement la scrutation des voies de la liste par ordre croissant depuis le logement 1 jusqu'au logement 3. Les mesures ne sont prises que pendant une scrutation et uniquement sur les voies incluses dans la liste de scrutation.

Vous pouvez enregistrer jusqu'à 1 000 000 lectures en mémoire non volatile à chaque scrutation. Les lectures sont enregistrées seulement pendant une scrutation et elles sont toutes horodatées automatiquement. À chaque nouvelle scrutation, l'instrument efface de la mémoire toutes les lectures de la précédente scrutation. Par conséquent, toutes les lectures enregistrées en mémoire sont celles de la scrutation la plus récente.

Vous pouvez configurer l'événement ou l'action qui commande le déclenchement de chaque cycle de balayage de la liste (un cycle de balayage correspond à une mesure de toutes les voies de la liste) :

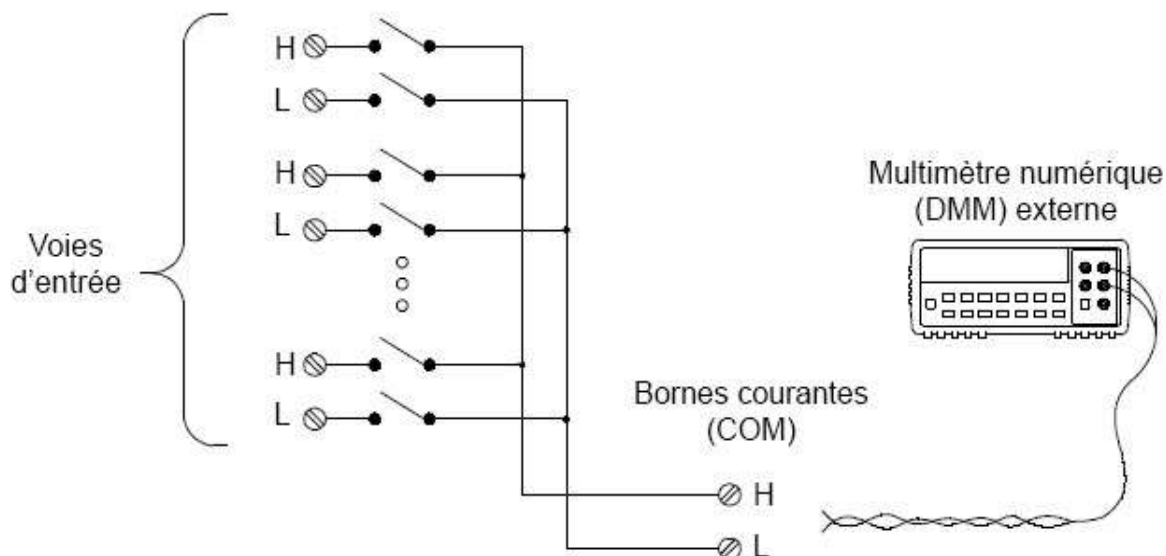
- Vous pouvez régler le temporisateur interne de l'instrument pour qu'il déclenche automatiquement le balayage à intervalles spécifiques comme le montre la figure ci-dessous. Vous pouvez également programmer un intervalle de temps entre les voies de la liste de scrutation.



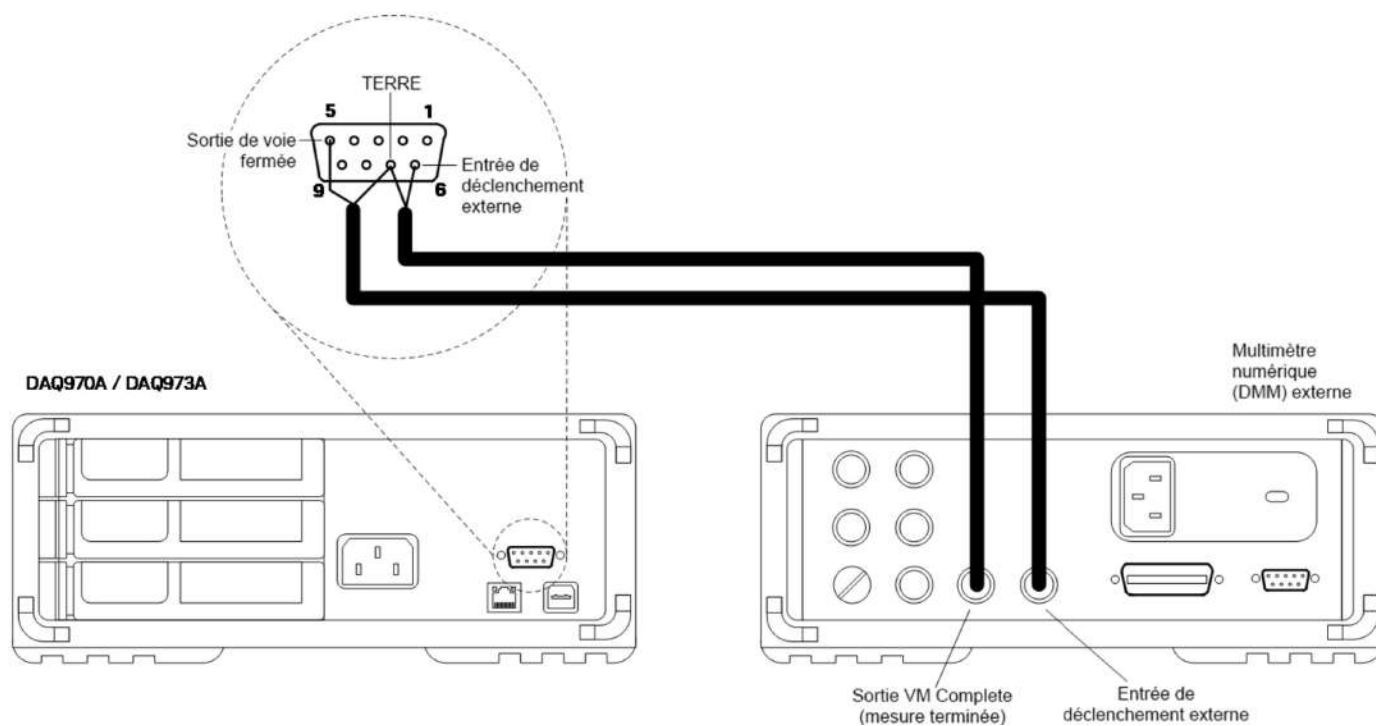
- Vous pouvez déclencher une scrutation manuellement en appuyant plusieurs fois sur la touche **[Scan/Start]** du panneau avant.
- Vous pouvez déclencher une scrutation en envoyant une commande logicielle depuis l'interface de commande à distance.
- Vous pouvez déclencher une scrutation à la réception d'une impulsion de déclenchement compatible TTL externe.
- Vous pouvez déclencher une scrutation lorsqu'une condition d'alarme est consignée sur la voie surveillée.

## Scrutation avec des instruments externes

Vous pouvez utiliser le DAQ970A/DAQ973A pour acheminer des signaux ou contrôler des applications. Si vous installez un module multiplexeur enfichable, vous pouvez utiliser le modèle DAQ970A/DAQ973A pour des scrutations avec un instrument externe. Vous pouvez connecter un instrument externe, comme un multimètre numérique (DMM), aux bornes COM du multiplexeur.



Pour contrôler la scrutation avec un instrument externe, il existe deux lignes de contrôle. Lorsque le DAQ970A/DAQ973A et l'instrument externe sont configurés correctement, vous pouvez synchroniser une séquence de scrutation entre les deux.



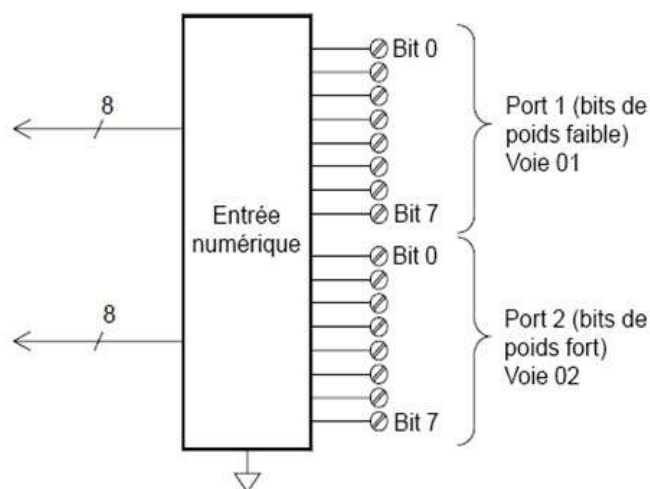
## Le module multifonction

Le module multifonction (DAQM907A) ajoute deux possibilités d'entrée de mesure supplémentaires au système : entrée numérique et totalisation d'événements.

Le module multifonction contient également une double tension de sortie (CAN). Pour plus d'informations, consultez [Capteurs et sondes](#).

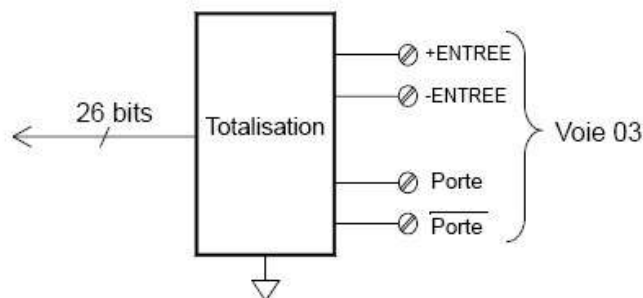
### Entrée numérique

Le module multifonction comporte deux ports non isolés d'entrées/sorties sur 8 bits que vous pouvez utiliser pour lire des séquences numériques. Vous pouvez lire l'état actif des bits sur le port ou vous pouvez configurer une scrutation afin qu'elle comprenne une lecture numérique. Chaque port a un numéro de voie distinct sur le module et comporte 8 bits. Vous pouvez associer les deux ports afin de lire des mots de 16 bits.



### Totalisateur

Le module multifonction comporte un totaliseur 26 bits pouvant compter des impulsions à la fréquence de 100 kHz. Vous pouvez lire manuellement le comptage du totaliseur ou vous pouvez configurer une scrutation pour lire ce comptage.



Vous pouvez configurer le totalisateur afin qu'il compte les fronts montants ou les fronts descendants du signal d'entrée. Le comptage maximum est de 67 108 863 ( $2^{26}-1$ ). Le comptage retourne à « 0 » après avoir atteint la valeur maximale autorisée. Vous pouvez configurer le totalisateur afin de lire sans perturber le comptage ou remettre le comptage à zéro sans perdre aucun compte.

## Sortie de commande

En plus de l'acheminement de signaux et des mesures, vous pouvez également utiliser le DAQ970A/DAQ973A pour disposer de sorties de commande simples. Par exemple, vous pouvez commander des relais externes à haute puissance à l'aide du module actionneur ou d'une voie de sortie numérique.

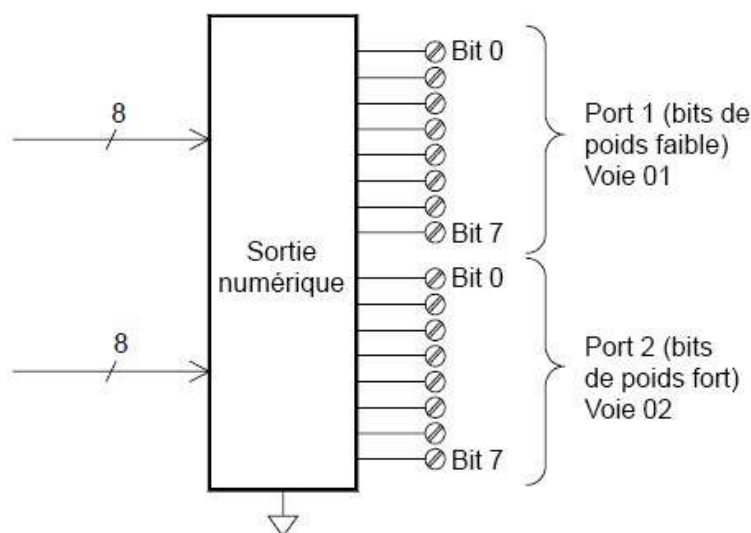
## Module multifonction

Le module multifonction module (DAQM907A) ajoute deux possibilités de sorties de commande supplémentaires au système : sortie numérique et sortie de tension (convertisseur numérique-analogique).

Le module multifonction comporte également une entrée numérique et un totalisateur d'événements. Pour plus d'informations, consultez [Le module multifonction](#).

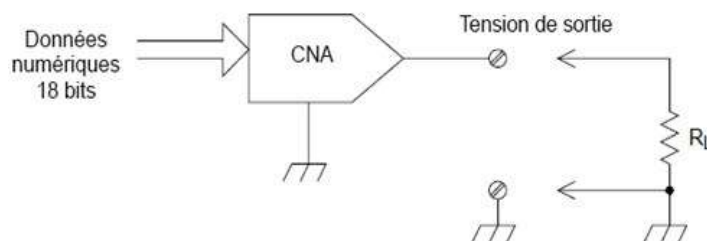
### Sortie numérique

Le module multifonction comporte deux ports non isolés d'entrées/sorties sur 8 bits que vous pouvez utiliser pour produire des séquences numériques. Chaque port a un numéro de voie distinct sur le module et comporte 8 bits. Vous pouvez associer les deux ports afin de délivrer des mots de 16 bits.



### Sortie de tension (CNA)

Le module multifonction comporte deux sorties analogiques pouvant délivrer des tensions étalonnées comprises entre  $\pm 12$  V avec une résolution de 18 bits. Chaque voie de CNA (Convertisseur numérique-analogique) peut servir de source de tension programmable pour commander l'entrée analogique d'autres dispositifs. Un schéma simplifié est illustré ci-dessous :



Vous pouvez régler la tension de sortie à toute valeur comprise entre  $\pm 12 V_{cc}$ , par paliers de  $100 \mu V$ . Chaque convertisseur numérique-analogique est référencé à la terre, il ne peut être flottant. Chaque voie de convertisseur numérique-analogique peut délivrer un courant maximal de  $15 mA$ , en mode tension de sortie. Ou vous pouvez régler le CNA sur le mode courant constant, pour produire tout courant compris entre  $\pm 24 mA$ , par paliers de  $0,2 \mu A$ .

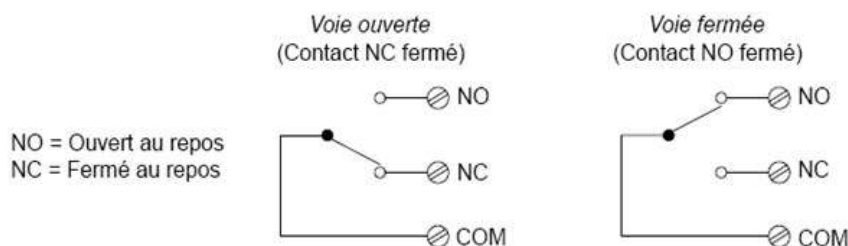
Chaque voie de convertisseur numérique-analogique peut délivrer un courant maximal de  $24 mA$ .

#### REMARQUE

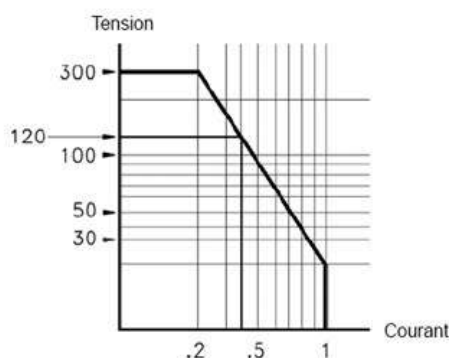
Vous devez limiter le courant de sortie à  $40 mA$  pour chaque logement (deux voies de CNA).

### L'actionneur / Commutateur à usage général

Vous pouvez penser à l'actionneur DAQM903A pour une sortie de commande parce qu'il est souvent utilisé pour commander des dispositifs de puissance externes. L'actionneur comporte 20 inverseurs indépendants isolés forme C (unipolaires à deux positions).



Chaque voie peut commuter jusqu'à  $300 V$  en courant continu ou alternatif. Chaque interrupteur peut également commuter jusqu'à  $1 A$  en courant continu ou alternatif avec un maximum de  $50 W$ . Par exemple, le courant maximal que vous pouvez commuter à  $120 V$  est de  $0,45 A$  comme indiqué ci-dessous :



Pour des applications de commande, l'actionneur présente les avantages suivants :

Tension et puissance plus élevée que pour les voies de sortie numériques. Les inverseurs de l'actionneur peuvent également servir à commander des dispositifs de puissance.

En revanche, lorsqu'ils sont utilisés avec des dispositifs de forte puissance, il est important que vous assuriez la protection contre les charges capacitatives et inductives afin de préserver la durée de vie maximale des relais.

Pour en savoir plus sur les actionneurs, voir [Utilisation d'atténuateurs](#).

## Aide-mémoire des menus du panneau avant

Le tableau ci-dessous résume les touches du panneau avant et la structure du menu.

| Touche                                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <ul style="list-style-type: none"> <li>– Lance/arrête un processus de scrutation/numérisation ou effectue un balayage unique en mode de déclenchement manuel.</li> <li>– Appuyez une fois pour lancer une scrutation/numérisation ; maintenez appuyé pour arrêter l'opération.</li> <li>– Le rétro-éclairage de la touche est allumé lorsque la scrutation/numérisation est en cours.</li> <li>– Dans les modes Numériser DMM et acquisition de données du numériseur, le rétro-éclairage de la touche est également activé lors de la sauvegarde automatique.</li> <li>– Dans le mode d'acquisition de données de scrutation, l'instrument effectue automatiquement la scrutation des voies configurées par ordre croissant depuis le logement 1 jusqu'au logement 3. Les voies non configurées sont ignorées.</li> <li>– Dans le mode d'acquisition de données Numériser DMM, l'instrument démarre automatiquement l'opération de numérisation du DMM sur une seule voie configurée.</li> <li>– En mode d'acquisition de données du numériseur (uniquement pris en charge sur le module enfichable DAQM909A), l'instrument commence automatiquement l'opération de numérisation sur toutes les voies configurées simultanément.</li> </ul> |
|    | <ul style="list-style-type: none"> <li>– Surveille les données de mesure d'une voie utiles pour le dépannage de l'instrument et l'observation d'un signal important.</li> <li>– Vous pouvez choisir d'afficher les mesures de surveillance sous forme de nombre, de graphique à barres, de graphique des tendances et d'histogramme.</li> <li>– La touche est rétro-éclairée lorsque la surveillance est activée. Le témoin de surveillance est également affiché et le témoin échantillon clignote lors de la prise de mesures de surveillance. Dans le cas où le mode d'acquisition de données du numériseur est activé, le rétro-éclairage de la touche est désactivé, mais le voyant reste affiché à l'écran indiquant que l'opération de surveillance est toujours en cours d'exécution en arrière-plan.</li> <li>– Pour désactiver le mode de surveillance et revenir au menu d'accueil, appuyez à nouveau sur la page du menu Surveiller.</li> </ul>                                                                                                                                                                                                                                                                                  |
|  | <ul style="list-style-type: none"> <li>– Dirige vers la page d'accueil où sont affichées les informations relatives à l'instrument et une liste de rubriques d'aide dans la langue sélectionnée.</li> <li>– Sélectionne le mode d'acquisition de données à utiliser (Scrutation, Numériser DMM ou Numériseur).</li> <li>– Mesure le décalage sur les voies de contrainte.</li> <li>– Configure les quatre lignes matérielles de sortie d'alarme.</li> <li>– Définit diverses préférences utilisateur.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|  | <ul style="list-style-type: none"> <li>– Affiche des mesures de mémoire en cours de scrutation.</li> <li>– Voir les mesures numérisées.</li> <li>– Affiche la file d'alarmes.</li> <li>– Affiche la file d'erreurs.</li> <li>– Effectue et affiche l'analyse de puissance.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Channel</b>                   | <ul style="list-style-type: none"> <li>– Étiquetage des voies.</li> <li>– Ferme ou ouvre des commutateurs sur les voies de commutation.</li> <li>– Sélectionne une fonction de mesure.</li> <li>– Sélectionne la plage de mesure ou la sélection de plage automatique.</li> <li>– Sélectionne le temps d'intégration.</li> <li>– Configure les fonctionnalités de mesure avancées.</li> </ul>                                                                                                                                                                                                                                                                                                                                             |
| <b>Interval</b>                  | <ul style="list-style-type: none"> <li>– Configure ce qui lance chaque balayage, ou l'intervalle entre les balayages et le nombre de balayages dans la scrutation.</li> <li>– Configure le minuteur d'échantillonnage, nombre d'échantillons et les paramètres de déclenchement pour le numériseur.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Math</b>                      | <ul style="list-style-type: none"> <li>– Configure la mise à l'échelle de la mesure (mX+b, %, dBm, ou dB) sur la voie actuelle.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Copy</b>                      | <ul style="list-style-type: none"> <li>– Copie la configuration de mesure de la (les) voie(s) sélectionné(s) sur une autre (d'autres) voie(s).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Alarm</b>                     | <ul style="list-style-type: none"> <li>– Configure des alarmes pour la voie sélectionnée. Il y a quatre alarmes configurables dans cet instrument.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Utility</b>                   | <ul style="list-style-type: none"> <li>– Autotest.</li> <li>– Étalonnage.</li> <li>– Auto-étalonnage. Sécurité de l'instrument (NISPOM).</li> <li>– Mise à jour du micrologiciel.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Module</b>                    | <ul style="list-style-type: none"> <li>– Présentation de la liste de scrutation pour le module.</li> <li>– Effectue une réinitialisation du module.</li> <li>– Étiquetage du module.</li> <li>– Affiche les informations relatives au multimètre numérique (DMM) interne.</li> <li>– Affiche les informations relatives du cycle du relais du module.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Save<br/>Recall<br/>Local</b> | <ul style="list-style-type: none"> <li>– Enregistre et rappelle les fichiers de configuration de l'instrument (extension .sta) et les fichiers de préférences (extension .prf).</li> <li>– Gestion des fichiers.</li> <li>– Enregistre les lectures du graphique de tendances ou de l'histogramme.</li> <li>– Capture et enregistre l'image de l'écran.</li> <li>– Réinitialisation de la configuration d'usine et du pré-réglage du système.</li> <li>– Enregistrement des données sur un lecteur USB sur le panneau avant.</li> <li>– Enregistrez automatiquement les données du numériseur sur un lecteur USB sur le panneau avant.</li> <li>– Rétablit la commande locale lorsque l'instrument est en contrôle à distance.</li> </ul> |

## Touche [Scan/ Début]

Appuyez sur la touche **[Scan/Start]** ([Scrutation/Démarrer]) du panneau avant pour lancer ou arrêter une opération de scrutation ou de numérisation, ou effectuer un balayage/enregistrement unique lorsque le mode de déclenchement manuel est activé. Voir le **Menu [Interval] ([Intervalle])** pour plus d'informations sur la façon dont la touche **[Scan/Start]** ([Scrutation/Démarrer]) est utilisée lorsque le mode de déclenchement manuel est sélectionné.

La touche **[Scan/Start]** ([Scrutation/Démarrer]) est rétro-éclairée lorsque la scrutation/numérisation est en cours. Pour arrêter la scrutation ou la numérisation, appuyez et maintenez la touche **[Scan/Start]** ([Scrutation/Démarrer]) enfoncée pendant plus de 2 secondes. Dans le mode d'acquisition de données de scrutation, le message « Scrutation arrêtée » s'affiche lorsque l'opération est terminée. De la même manière, dans les modes Numériser DMM et d'acquisition de données du numériseur, les messages « Numériser DMM arrêté » et « Numériseur arrêté » respectivement s'affichent lorsque l'opération est terminée.

### REMARQUE

Lorsque la fonction Auto Save (sauvegarde automatique) dans le menu **[Save Recall]** (Enreg./Rappel) est activée pour le mode Numériser DMM/acquisition de données du numériseur, l'opération de numérisation ne commencera que si l'instrument détecte un lecteur USB connecté au port USB du panneau avant.

---

## Menu [Monitor] ([Surveillance])

### REMARQUE

Les fonctionnalités du menu [Monitor] ([Surveillance]) ne sont pas disponibles pour le mode d'acquisition de données du **Numériseur**.

Dans le mode **Scan/DMM Digitize**, appuyez sur la touche **[Monitor]** ([Surveillance]) pour surveiller les données de mesure sur une voie sélectionnée. La touche est rétro-éclairée lorsque la surveillance est activée. Le témoin de surveillance est également affiché et le témoin échantillon clignote lors de la prise de mesures de surveillance.

En mode **Scan**, vous pouvez afficher les données de contrôle pour tous les canaux, à l'exception des canaux calculés (canaux 401 à 420). La surveillance des voies calculées n'est disponible que pendant la scrutation et n'affiche que la mesure faite lors du balayage le plus récent. Vous pouvez également afficher les données de surveillance sur les voies d'E/S numériques et du totaliseur, même si elles ne sont pas dans la liste de scrutation.

Les mesures de surveillance sont effectuées de façon répétitive lorsque la scrutation est en veille ou entre les balayages d'une scrutation. Pour arrêter le mode de surveillance et revenir à la page menu d'Accueil, appuyez à nouveau sur la touche **[Monitor]** ([Surveillance]).

En mode **DMM Digitize**, vous ne pouvez afficher que les données de surveillance du canal unique configuré pour **DMM Digitize**. Les données ne sont affichées que sous forme de nombre et de ses données minimum, maximum et maximum à maximum si la touche de fonction **Peak On/Off** est activée.

Cependant dans le mode **Scrutation**, vous pouvez choisir d'afficher les données de surveillance dans les formats suivants : **Nombre**, **Graphique à barres**, **Graphique des tendances**, ou **Histogramme**. Pour configurer, appuyez sur la touche **Display** (Écran) pour sélectionner le mode d'affichage souhaité. L'exemple des touches est illustré ci-dessous.



Nombre

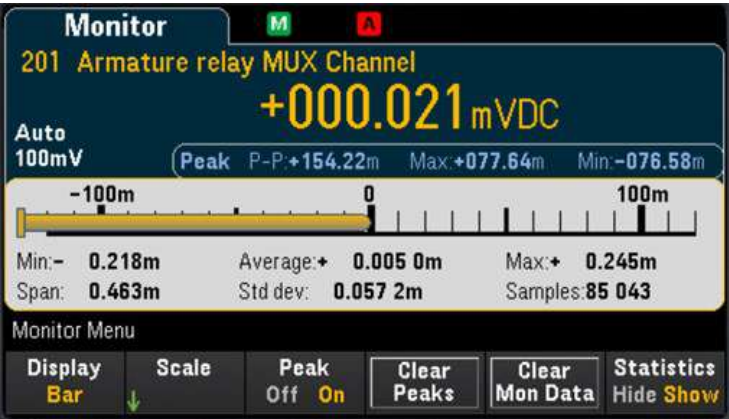
Affiche les lectures en tant que nombre

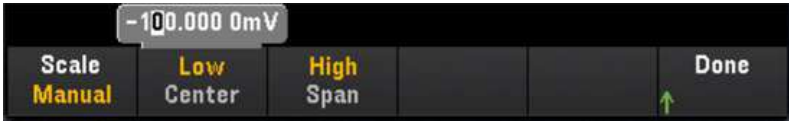


| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Peak Off/On          | Appuyez sur la touche <b>Peak</b> (Crête) pour basculer entre l'activation ( <b>On</b> ) et la désactivation ( <b>Off</b> ) de la mesure des valeurs Minimum, Maximum, et de Crête à crête acquises lors de l'ouverture de la mesure.                                                                                                                                           |
| Clear Peaks          | Appuyez sur la touche <b>Clear Peaks</b> (Effacer les crêtes) pour réinitialiser la mesure des valeurs de crête. La réinitialisation est réalisée en effaçant l'historique de la fonction crête à crête.                                                                                                                                                                        |
|                      | <div>REMARQUE</div> La touche Clear Peaks (Effacer les crêtes) ne s'affiche que lorsque la Crête est activée.                                                                                                                                                                                                                                                                   |
| Clear Mon Data       | Appuyez sur la touche <b>Clear Mon Data</b> (Effacer les données de surveillance) pour effacer les statistiques, le graphique des tendances, et l'histogramme sur la voie de surveillance.                                                                                                                                                                                      |
|                      | <div>REMARQUE</div> La touche Clear Mon Data (Effacer les données de surveillance) ne s'affiche que lorsque la Crête est activée.                                                                                                                                                                                                                                               |
| Statistics Hide/Show | Appuyez sur la touche <b>Statistics</b> (Statistiques) pour basculer entre <b>Hide</b> (Masquer) ou <b>Show</b> (Afficher) les statistiques de mesure pour la voie de surveillance. Les statistiques du canal du moniteur sont effacées lorsque le mode moniteur est activé, lorsque le canal du moniteur change ou lorsque la configuration du canal du moniteur est modifiée. |

## Graphique à barres

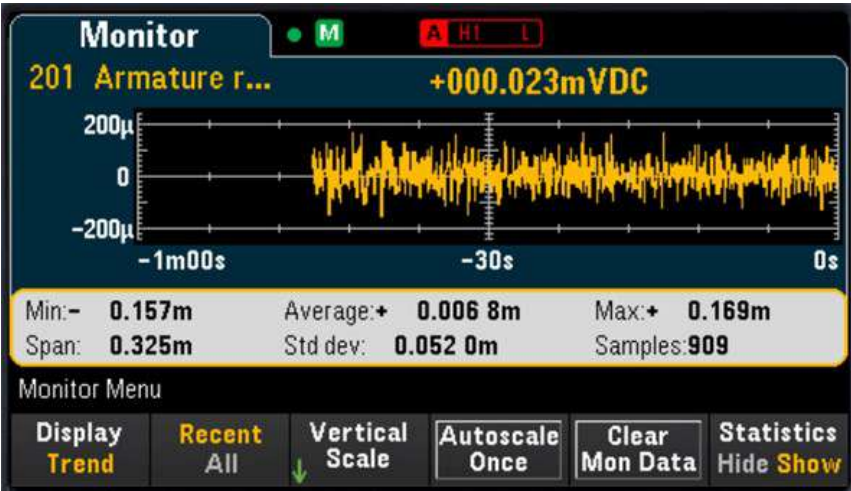
Le graphique à barres ajoute une barre de déplacement sous l'affichage du nombre standard.

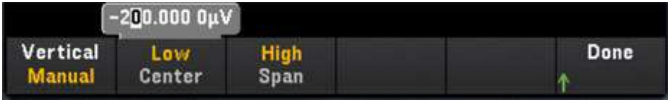


| Touche de fonction   |         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scale                | Default | <b>Default</b> (Par défaut) détermine l'échelle de la plage de mesure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                      | Manual  |  <p><b>Manual</b> (Manuel) vous permet de configurer l'échelle soit en tant que valeurs <b>Supérieure</b> et <b>Inférieure</b> soit en tant que <b>Étendue</b> autour d'une valeur de <b>Centre</b>. Par exemple, une échelle qui s'étend d'un seuil <b>Inférieur</b> de - 500 <math>\Omega</math> à un seuil <b>Supérieur</b> de 1 000 <math>\Omega</math> peut également être définie comme un <b>Centre</b> de 250 <math>\Omega</math> avec une <b>Étendue</b> de 1 500 <math>\Omega</math>.</p> |
|                      | Limits  | <b>Limits</b> (Limites) définit l'échelle des limites d'alarme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                      |         | <b>REMARQUE</b> Cette touche n'est disponible que lorsque vous configurez une alarme sur la voie sélectionnée en appuyant sur la touche <b>[Alarm]</b> ([Alarme]) sur le panneau avant.                                                                                                                                                                                                                                                                                                                                                                                               |
| Peak Off/On          |         | Appuyez sur la touche <b>Peak</b> (Crête) pour basculer entre l'activation ( <b>On</b> ) et la désactivation ( <b>Off</b> ) de la mesure des valeurs Minimum, Maximum, et de Crête à crête acquises lors de l'ouverture de la mesure.                                                                                                                                                                                                                                                                                                                                                 |
| Clear Peaks          |         | Appuyez sur la touche <b>Clear Peaks</b> (Effacer les crêtes) pour réinitialiser la mesure des valeurs de crête. La réinitialisation est réalisée en effaçant l'historique de la fonction crête à crête.                                                                                                                                                                                                                                                                                                                                                                              |
|                      |         | <b>REMARQUE</b> La touche Clear Peaks (Effacer les crêtes) ne s'affiche que lorsque la Crête est activée.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Clear Mon Data       |         | Appuyez sur la touche <b>Clear Mon Data</b> (Effacer les données de surveillance) pour effacer les statistiques, le graphique des tendances, et l'histogramme sur la voie de surveillance.                                                                                                                                                                                                                                                                                                                                                                                            |
|                      |         | <b>REMARQUE</b> La touche Clear Mon Data (Effacer les données de surveillance) ne s'affiche que lorsque la Crête est activée.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Statistics Show/Hide |         | Appuyez sur la touche <b>Statistics</b> (Statistiques) pour basculer entre <b>Hide</b> (Masquer) ou <b>Show</b> (Afficher) les statistiques de mesure pour la voie de surveillance. Les statistiques du canal du moniteur sont effacées lorsque le mode moniteur est activé, lorsque le canal du moniteur change ou lorsque la configuration du canal du moniteur est modifiée.                                                                                                                                                                                                       |

Graphique des tendances

Dans le mode de mesure en continu, le graphique des tendances affiche les tendances des données au fil du temps. Les données sont recueillies et affichées en colonnes de pixels comme décrit ci-dessous :



| Touche de fonction |         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Recent/All         |         | La touche <b>Recent/All</b> (Récents/Tous) indique si toutes les mesures ( <b>All</b> ) ou seulement les plus récentes ( <b>Recent</b> ) sont affichées sur le graphique des tendances. Quel que soit le choix, la mémoire de lecture ne sera pas effacée. Dans le mode <b>All</b> (Tous), le graphique de tendance affiche toutes les mesures prises et construit un graphique de gauche à droite. Une fois l’affichage rempli, les données sont compressées sur la gauche de l’écran et les nouvelles données sont ajoutées sur le côté droit de l’écran. Dans le mode <b>Recent</b> (Récent), le graphique de tendances affiche les données prises pendant un laps de temps donné. |
| Vertical Scale     | Default | Default (Par défaut) détermine l’échelle de la plage de mesure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                    | Auto    | Auto (Automatique) ajuste automatiquement l’échelle pour correspondre à la ligne actuellement affichée sur l’écran.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                    | Manual  | <div></div> <p>Manual (Manuel) vous permet de configurer l’échelle soit en tant que valeurs High (Supérieure) et Low (Inférieure) soit sous la forme d’une valeur de Center (Centre) avec une Span (Étendue). Par exemple, une échelle comprise entre une valeur inférieure de 0 V et une valeur Supérieure de 5 V est équivalente à un Centre de 2,5 V et une Étendue de 5 V.</p>                                                                                                                                                                                                                |
| Limits             |         | Limits (Limites) définit l’échelle des limites d’alarme. <div><div>REMARQUE</div><p>Cette touche n’est disponible que lorsque vous configurez une alarme sur la voie sélectionnée en appuyant sur la touche <b>[Alarm]</b> ([Alarme]) sur le panneau avant.</p></div>                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Autoscale Once     |         | Appuyez une fois sur la touche <b>Autoscale Once</b> (Mettre à l’échelle une fois) pour mettre à l’échelle automatiquement l’axe vertical du diagramme de tendance une fois, en fonction des mesures de mémoire de scrutation affichées à l’écran. Cela définit également le mode <b>Échelle verticale</b> sur <b>Manuel</b> .                                                                                                                                                                                                                                                                                                                                                        |
| Clear Mon Data     |         | Appuyez sur la touche <b>Clear Mon Data</b> (Effacer les données de surveillance) pour effacer les statistiques, le graphique des tendances, et l’histogramme sur la voie de surveillance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

REMARQUE

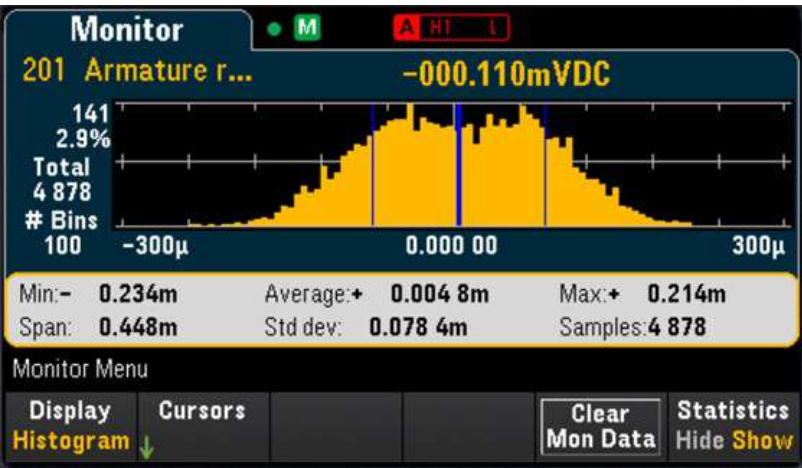
La touche Clear Mon Data (Effacer les données de surveillance) ne s'affiche que lorsque la Crête est activée.

Statistics  
Show/Hide

Appuyez sur la touche **Statistics** (Statistiques) pour basculer entre **Masquer** ou **Afficher** les statistiques de mesure pour la voie de surveillance. Les statistiques du canal du moniteur sont effacées lorsque le mode moniteur est activé, lorsque le canal du moniteur change ou lorsque la configuration du canal du moniteur est modifiée.

Histogramme

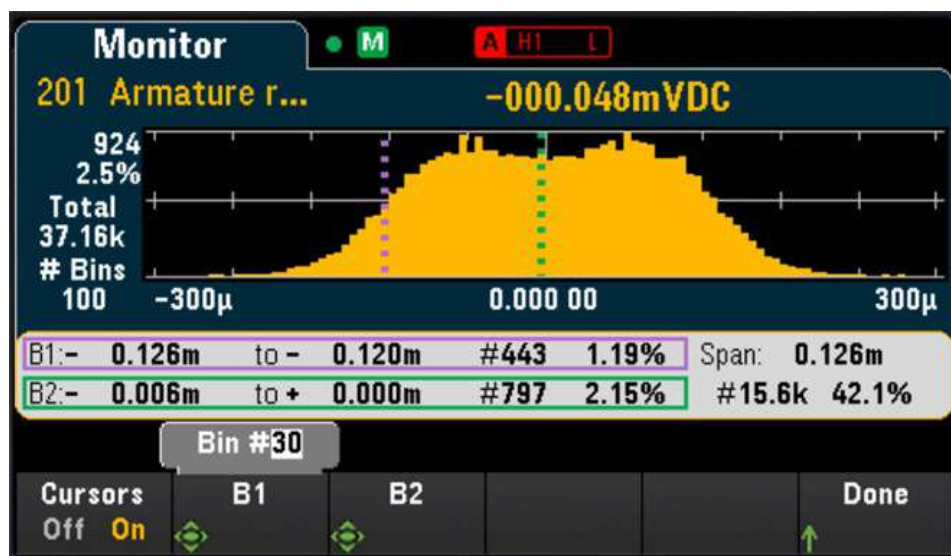
L'histogramme montre les données de mesures sous forme de représentation graphique de leur distribution. Les données sont regroupées en cases représentées par des barres verticales dans l'affichage sous forme d'histogramme.



| Touche de fonction      |                 | Description                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors                 | Cursors Off/ On | Appuyez sur la touche <b>Cursors</b> pour basculer entre l'activation (On) ou la désactivation (Off) des curseurs de l'histogramme                                                                                                                                                                                                                                              |
|                         | B1              | Utilisez la molette ou les touches fléchées pour régler la position du curseur B1 (ligne verticale violette en pointillés).                                                                                                                                                                                                                                                     |
|                         | B2              | Utilisez la molette ou les touches fléchées pour régler la position du curseur B2 (ligne verticale verte en pointillés).                                                                                                                                                                                                                                                        |
| Clear Mon Data          |                 | Appuyez sur la touche <b>Clear Mon Data</b> (Effacer les données de surveillance) pour effacer les statistiques, le graphique des tendances, et l'histogramme sur la voie de surveillance. <div>REMARQUELa touche Clear Mon Data (Effacer les données de surveillance) ne s'affiche que lorsque la Crête est activée.</div>                                                     |
| Statistics<br>Hide/Show |                 | Appuyez sur la touche <b>Statistics</b> (Statistiques) pour basculer entre <b>Hide</b> (Masquer) ou <b>Show</b> (Afficher) les statistiques de mesure pour la voie de surveillance. Les statistiques du canal du moniteur sont effacées lorsque le mode moniteur est activé, lorsque le canal du moniteur change ou lorsque la configuration du canal du moniteur est modifiée. |

Les curseurs de l'histogramme sont indiqués sous forme de nombres de case et affichent les plages de valeurs visées par ces cases, le décompte et le pourcentage du total. Le nombre total et le pourcentage du total, ainsi que la plage de mesure couverte, entre les case de curseur, sont également affichés.

Dans l'exemple ci-dessous, le curseur B1 (lignes verticales violettes) est placé sur la case numéro 30 et le curseur B2 (lignes verticales vertes) est placé sur la case numéro 50 (numéro de case indiqué au dessus de la touche B2). Les informations relatives à la case du curseur B1 sont indiquées dans la case violette et celles du curseur B2 dans la case verte.



D'après l'exemple ci-dessus, les informations relatives au curseur B1 peuvent être interprétées comme suit :

- 0,126m à 0,120m - Plage de valeurs de mesure du courant continu pour cette case.
- #443 - Nombre d'échantillons dans cette case.
- 1,19% - Pourcentage du nombre total d'échantillons dans cette case.

Les données entre les curseurs B1 et B2, y compris les données dans les cases B1 et B2, sont indiquées à droite des cases violette et verte. Dans le graphique ci-dessus :

- Plage : 0,126m - La plage de mesure couverte de B1 à B2.
- #15,6 k - Le nombre d'échantillons de B1 à B2.
- 42,1% - Le pourcentage du nombre total d'échantillons de B1 à B2.



## Menu [Home] ([Accueil])

Appuyez sur la touche **[Home]** ([Accueil]) pour accéder à la page d'**Accueil** de l'instrument. Sur la page d'**Accueil**, un aperçu de l'état actuel de l'instrument et de l'opération s'affiche sur l'écran principal. Dans le menu **Home** (Accueil), vous pouvez également accéder à des rubriques d'aide de l'instrument et configurer divers paramètres tels le mode acquisition de l'instrument, le décalage de la contrainte, les lignes matérielles de sortie d'alarme et les préférences de l'utilisateur.

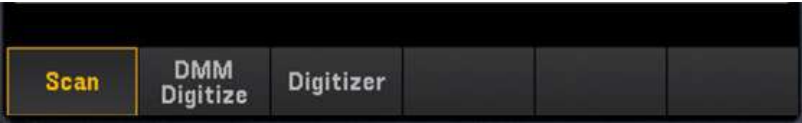
**REMARQUE**

L'instrument retourne à la page menu Accueil à l'arrêt du mode surveillance.



## Mode d'acquisition de données

Appuyez sur la touche **Acquire** (Acquérir) pour sélectionner un mode d'acquisition de données.



| Touche de fonction |               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acquire            | Scan          | L'instrument scanne continuellement toutes les voies configurées et effectue des mesures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                    | DMM Digitizer | L'appareil numérise les signaux d'une seule voie configurée à l'aide du multimètre numérique interne.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                    | Digitizer     | L'appareil numérise jusqu'à 4 voies configurées sur le numériseur simultanément pour chaque module enfichable DAQM909A inséré dans l'instrument en utilisant les numériseurs DAQM909A embarqués. En d'autres termes, un maximum de 12 voies configurées peuvent être numérisées simultanément quand DAQ970A/DAQ973A est installé avec 3 modules de plug-in DAQM909A. Il peut également fonctionner en parallèle à une opération de <b>Scrutation</b> ou d'acquisition de données <b>Numériser DMM</b> car il utilise les numériseurs DAQM909A embarqués au lieu du multimètre numérique (DMM) interne de l'instrument. |

**REMARQUE**

La touche **Numériseur** n'est disponible que si le module DAQM909A est inséré dans le châssis principal.

## Décalage de la contrainte

### REMARQUE

Cette touche programmable est disponible uniquement après que vous avez configuré le canal pour les mesures de contrainte en appuyant sur

[Channel] > **Measure**, puis sélectionnez **STRAIN** avec les modules DAQM900A, DAQM901A, DAQM902A, DAQM908A et DAQM909A. Pour de plus amples informations, reportez-vous à **Contrainte**.



Le décalage de la contrainte est également connu sous le nom de la valeur sans contrainte. Vous pouvez sélectionner une ou plusieurs voies sur lesquelles vous souhaitez mesurer la valeur de décalage. La formule de contrainte utilisera automatiquement cette valeur de décalage pour calculer le résultat de la mesure.



Pour configurer le décalage de la contrainte :

1. Utilisez le bouton ou les touches fléchées sur le panneau avant pour naviguer dans la liste et appuyez sur la touche **Select** (Sélectionner) pour activer la mesure du décalage de contrainte sur la voie en surbrillance. La voie sélectionnée est marquée d'un « X ». Appuyez à nouveau sur la touche **Select** (Sélectionner) pour désactiver la mesure du décalage sur la voie en surbrillance. Notez qu'appuyer sur cette touche activera également les touches **Measure Now** (Mesurer maintenant) et **Clear Offsets** (Effacer les décalages).

| Unstrained |                                |         |       |
|------------|--------------------------------|---------|-------|
| Check      | Channel                        | Offset  | Units |
| [x]        | 101 Armature relay MUX Channel | +0.0000 | mVDC  |
|            | 102 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +0.0000 | mVDC  |
|            | 104 Armature relay MUX Channel | +0.0000 | mVDC  |

2. Appuyez sur **Select All** (Sélectionner tout) pour activer la mesure du décalage sur toutes les voies répertoriées. Appuyez à nouveau sur cette touche pour désactiver la mesure du décalage sur toutes les voies répertoriées.

| Unstrained |                                |         |       |
|------------|--------------------------------|---------|-------|
| Check      | Channel                        | Offset  | Units |
| [x]        | 101 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 102 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 104 Armature relay MUX Channel | +0.0000 | mVDC  |

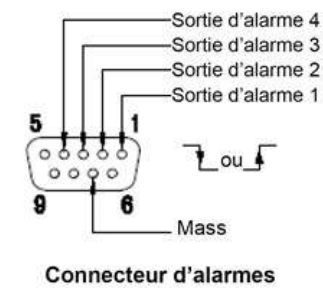
3. Appuyez sur **Measure Now** (Mesurer maintenant) pour mesurer immédiatement la valeur de décalage sur la ou les voies sélectionnées. Les lectures de décalage s'affichent à l'écran comme illustré ci-dessous :

| Unstrained |                                |           |       |
|------------|--------------------------------|-----------|-------|
| Check      | Channel                        | Offset    | Units |
| [x]        | 101 Armature relay MUX Channel | +827.0444 | mVDC  |
| [x]        | 102 Armature relay MUX Channel | +826.7458 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +825.8469 | mVDC  |
| [x]        | 104 Armature relay MUX Channel | +822.6777 | mVDC  |

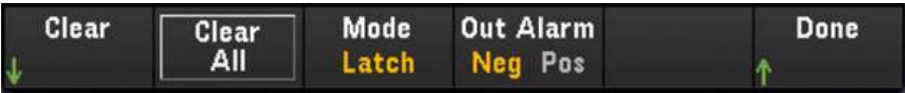
4. Appuyez sur la touche **Clear Offsets** (Effacer les décalages) si vous souhaitez rétablir immédiatement la valeur de décalage de la contrainte à 0 sur la ou les voies sélectionnées.

Alarm output (Sortie d'alarme)

Configure les quatre lignes matérielles de sortie d'alarme. Quatre sortie d'alarmes compatibles TTL sont disponibles sur le connecteur Ext Trig/Alarms (Déclenchement externe/Alarmes) du panneau arrière. Ces sorties matérielles permettent de déclencher des voyants ou des sirènes d’alarme externes ; il est également possible de les utiliser pour envoyer une impulsion compatible TTL au système de commande. Vous pouvez attribuer une alarme à toute voie configurée et affecter le même numéro d’alarme à plusieurs voies. Chaque ligne de sortie des alarmes représente le « OU » logique de toutes les voies auxquelles ce numéro d’alarme est attribué (une alarme générée sur l’une de ces voies émet une impulsion sur la ligne).



Appuyez sur la touche **Alarm Out** (Sortie alarme) pour configurer la sortie d'alarme.



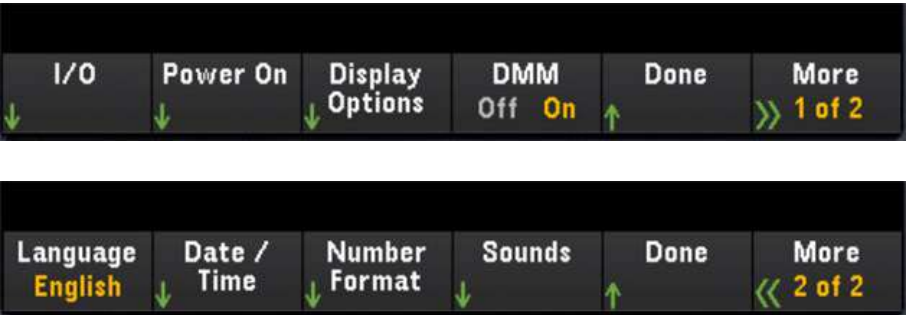
| Touche de fonction |         | Description                                                                                                                                                                                                                                                             |
|--------------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clear              | Alarm 1 | Efface l'état d'une ligne de sortie d'alarme donnée (alarmes 1 à 4).                                                                                                                                                                                                    |
|                    | Alarm 2 |                                                                                                                                                                                                                                                                         |
|                    | Alarm 3 |                                                                                                                                                                                                                                                                         |
|                    | Alarm 4 |                                                                                                                                                                                                                                                                         |
| Clear All          |         | Efface la configuration des quatre lignes de sortie d'alarme.                                                                                                                                                                                                           |
| Mode               | Latch   | L’alarme de sortie est déclenchée lorsqu’une lecture de voie dépasse la limite fixée et demeure déclenchée jusqu’à ce qu’elle soit manuellement annulée, que commence une nouvelle scrutation ou que l’on redémarre l’instrument.                                       |
|                    | Track   | L’alarme de sortie est déclenchée lorsqu’une lecture de voie dépasse la limite fixée et ne demeure déclenchée que pendant que les lectures postérieures demeurent hors limite. Lorsque la lecture rentre dans les limites, la sortie est automatiquement remise à zéro. |
| Out Alarm          | Neg     | Configure le niveau de toutes les quatre lignes de sortie d'alarme pour indiquer une alarme à 0 V (légèrement compatible avec la technologie TTL).                                                                                                                      |
|                    | Pos     | Configure le niveau de toutes les quatre lignes de sortie d'alarme pour indiquer une alarme à 3,3 V (très compatible avec la technologie TTL).                                                                                                                          |

Rubriques d’aide

Affiche les informations relatives à l’instrument et une liste de rubriques d'aide dans la langue locale sélectionnée. Pour de plus amples informations, reportez-vous à **Utilisez le système d'aide intégré**.

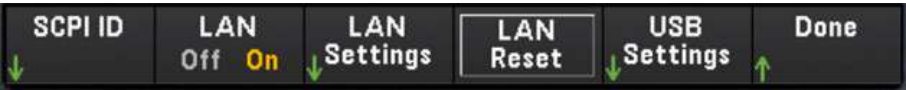
## Paramètres de l'utilisateur

Configure les préférences de l'utilisateur qui contrôlent la façon dont l'utilisateur interagit avec l'instrument. Ces paramètres sont enregistrés dans une mémoire non volatile et peuvent être enregistrés dans un fichier de préférences (.prf).



## E/S

Configure les paramètres d'E/S pour les opérations à distance sur l'interface LAN ou USB.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ID SCPI            | SCPI ID détermine le fabricant et le numéro de modèle renvoyés par la requête d'identification (commande *IDN?). Le numéro de série et les informations de version ne sont pas affectés. Utilisez ce paramètre pour éviter de modifier le code du système de test existant lorsque le fabricant ou le numéro de modèle est vérifié et pour optimiser la compatibilité rétroactive avec les modèles Keysight 34970A et 34972A. Le paramètre par défaut renvoie « Keysight Technologies » suivi du numéro de modèle « DAQ970A ». Pour plus d'informations, reportez-vous aux commandes de sous-système *IDN? et SYSTem:PERSon:MODEl dans le <i>guide de programmation Keysight DAQ970A/DAQ973A</i> .<br><br><b>Important :</b> Pour mettre à jour le micrologiciel de l'instrument à distance, le numéro de modèle de la réponse *IDN? doit correspondre au numéro de modèle réel de l'instrument. Si vous avez remplacé la réponse *IDN? de l'instrument par celle d'un autre instrument, vous verrez l'erreur suivante lorsque vous tenterez de mettre à jour le micrologiciel à distance : L'instrument n'est pas pris en charge par ce fichier de micrologiciel. Pour mettre à jour le micrologiciel, effectuez la mise à jour par la procédure en panneau avant ou, à distance, utilisez SYSTem:PERSon:MODEl pour définir l'*IDN? de façon à ce qu'il corresponde au numéro de modèle réel, effectuez la mise à jour, puis utilisez SYSTem:PERSon:MODEl à nouveau pour régler la réponse *IDN? sur un autre numéro de modèle. |
| LAN On/Off         | Voir <a href="#">Activez ou désactivez l'interface LAN</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| LAN Setting        | Voir <a href="#">Paramètres LAN</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| LAN Reset          | Voir <a href="#">Réinitialisation du LAN</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| USB Setting        | Voir <a href="#">Paramètres USB</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

Mise sous tension

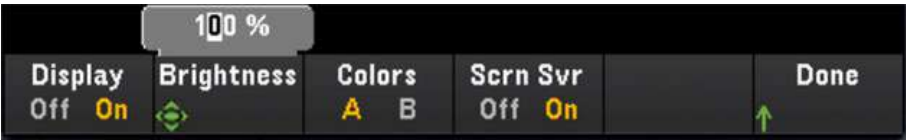
Configure l'état et le message à la mise sous tension de l'instrument.



| Touche de fonction |                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power On           | Last             | Au démarrage, l'instrument charge l'état dans lequel il se trouvait avant l'arrêt.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                    | User Defined     | Au démarrage, l'instrument charge un fichier d'état sélectionné par l'utilisateur.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                    | Factory Defaults | Au démarrage, l'instrument charge l'état configuré en usine par défaut.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Power On Message   |                  | <b>Power On Message</b> (Message à la mise sous tension) définit le message qui s'affiche lorsque l'appareil se met sous tension et lorsque vous appuyez sur <b>[Home] &gt; Help &gt; About</b> ([Accueil] > Aide > À propos de). Utilisez le bouton ou les touches fléchées du panneau avant et la touche <b>[Select]</b> (Sélectionner) pour sélectionner les lettres. Puis appuyez sur <b>Done</b> (Terminé) pour quitter et enregistrer le message. Le message apparaîtra comme indiqué ci-dessous lorsque vous allumez l'instrument ou que vous appuyez sur <b>[Home] &gt; Help &gt; About</b> . |

Options d'affichage

Configure l'écran de l'instrument.



Vous pouvez activer ou désactiver l'écran, régler la luminosité (10 à 100 %), choisir un jeu de couleurs et activer ou désactiver l'économiseur d'écran. Si vous éteignez l'écran, appuyez sur n'importe quelle touche du panneau avant pour le rallumer. Par défaut, l'économiseur d'écran augmente la durée de vie de l'affichage en atténuant sa luminosité pendant les longues périodes d'inactivité. Vous pouvez désactiver cet économiseur d'écran uniquement sur le panneau avant. L'écran est activé lorsque l'alimentation est appliquée après une réinitialisation de l'instrument (\*RST) ou lorsque vous revenez en mode local (face avant). Appuyez sur la touche **[Local]** ([Local] (touche [Save/Recall] (Sauveg./Rapp.)) pour revenir à l'état local.

DMM On/Off

Active ou désactive le multimètre numérique (DMM) interne. Le témoin  s'affiche lorsque le DMM interne est désactivé. Une fois désactivée, l'option Numériser DMM ne sera plus disponible lors de la sélection du mode d'acquisition de données.

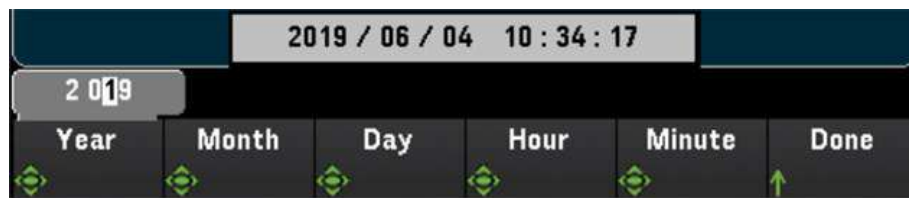
Langue

Sélectionne la langue d'utilisation du panneau avant.

Tous les messages, les aides contextuelles et les rubriques d'aide s'affichent dans la langue sélectionnée. Les libellés des touches de fonction ne sont pas traduits.

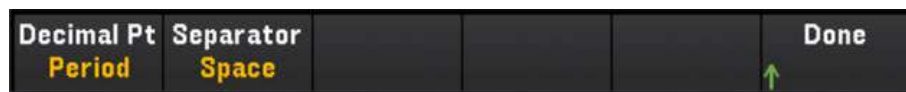
## Date/Heure

Fixe la date et l'heure de l'horloge en temps réel au format 24 heures. L'horloge en temps réel ne se règle pas automatiquement lors des changements de fuseau horaire ou le passage à l'heure d'été/d'hiver. Assurez-vous de régler la date et l'heure lorsque vous recevez votre instrument. Utilisez la poignée ou les touches de direction du panneau avant pour régler l'année, le mois, le jour, l'heure et les minutes.



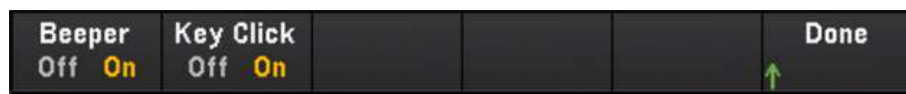
## Format numérique

Number Format (Format numérique) indique la façon dont les nombres sont affichés sur le panneau avant : 12,345.6 ou 12.345,6. D'autres possibilités sont disponibles. Vous pouvez par exemple utiliser l'espace comme séparateur.



## Signal sonore

Active ou désactive le signal sonore associé à la génération d'une erreur depuis le panneau avant ou l'interface à distance (Beeper (Signal sonore)), ou le son associé au clic des touches (Key Click (Clic des touches)).





## Menu [View] ([Affichage])

Appuyez sur **[View]** ([Affichage]) sur le panneau avant pour afficher les mesures de mémoire de scrutation, les mesures numérisées, la file d'alarmes ou la file d'attente des erreurs. Dans le menu Affichage, vous pouvez également effectuer diverses mesures post-traitement ainsi que l'analyse de puissance sur les mesures numériques.

### REMARQUE

Les options dans le menu **[View]** ([Affichage]) varient en fonction du mode d'acquisition de données sélectionné dans le menu **[Home]** ([Accueil]) (**[Home]**>**Acquire**>**Scan**, **DMM Digitize**, ou **Digitizer**, ([Accueil]>**Acquérir**>**Scrutation**, **Numériser DMM** ou **Numériseur**)).

## Menu [View] ([Affichage]) en mode Scrutation



## Sélection du mode d'affichage

Appuyez sur la touche **Display** (Écran) pour sélectionner un mode d'affichage.



### Liste

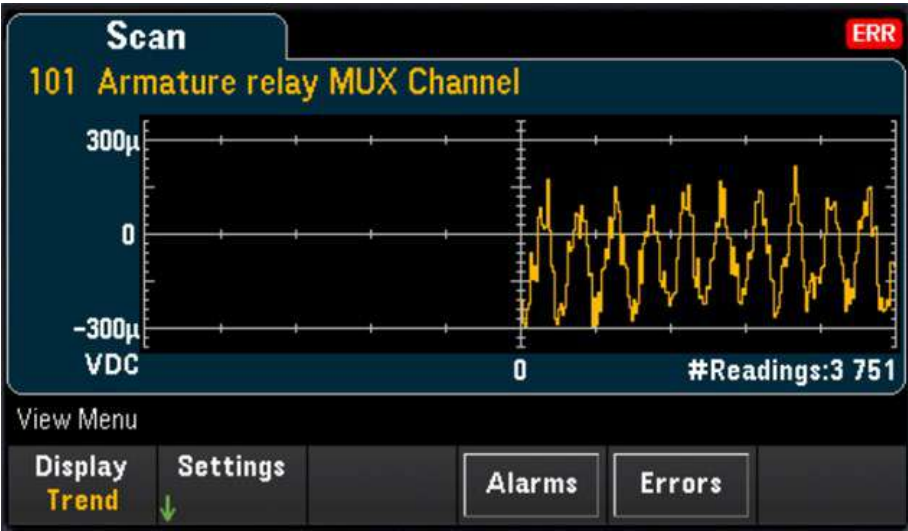
Affiche les lectures de mémoire de scrutation en liste. Utilisez le bouton et les touches fléchées pour faire défiler les mesures dans les différentes pages.



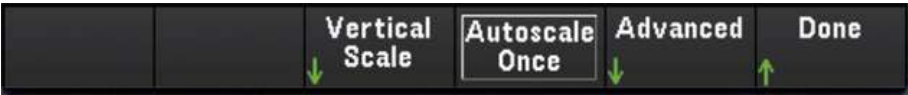
| Touche de fonction |            | Description                                                                                                              |
|--------------------|------------|--------------------------------------------------------------------------------------------------------------------------|
| Browse             | First Page | Appuyez sur la touche <b>First Page</b> (Première page) pour que l'affichage renvoie la liste de scrutation à la page 1. |
|                    | Last Sweep | Appuyez sur la touche <b>Last Sweep</b> (Dernier balayage) pour que les mesures commencent au balayage le plus récent.   |

Graphique des tendances

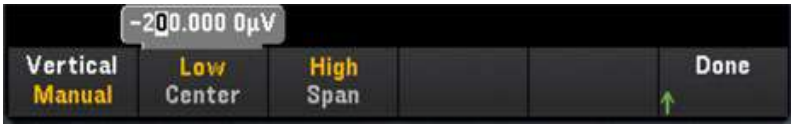
Affiche les lectures de mémoire de scrutation en format graphique de tendance. Utilisez le bouton et les touches fléchées pour faire défiler les mesures



Pour configurer le graphique des tendances, appuyez sur la touche **Settings** (Paramètres) pour afficher le menu des paramètres du graphique de tendances.



| Touche de fonction |         | Description                                                                                                         |
|--------------------|---------|---------------------------------------------------------------------------------------------------------------------|
| Vertical Scale     | Default | Default (Par défaut) détermine l'échelle de la plage de mesure.                                                     |
|                    | Auto    | Auto (Automatique) ajuste automatiquement l'échelle pour correspondre à la ligne actuellement affichée sur l'écran. |
|                    | Manual  |                                                                                                                     |



Manual (Manuel) vous permet de configurer l'échelle soit en tant que valeurs High (Supérieure) et Low (Inférieure) soit sous la forme d'une valeur de Center (Centre) avec une Span (Étendue). Par exemple, une échelle comprise entre une valeur inférieure de 0 V et une valeur Supérieure de 5 V est équivalente à un Centre de 2,5 V et une Étendue de 5 V.

|                |                                                                                                                                                                                                                                                                                                                                |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Autoscale Once | Appuyez une fois sur la touche <b>Autoscale Once</b> (Mettre à l'échelle une fois) pour mettre à l'échelle automatiquement l'axe vertical du diagramme de tendance une fois, en fonction des mesures de mémoire de scrutation affichées à l'écran. Cela définit également le mode <b>Échelle verticale</b> sur <b>Manuel</b> . |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |     |                                                                                                                                                                                                                                                                                                                                                                                |
|----------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advanced | Pan | Appuyez sur la touche <b>Pan</b> (Panoramique) pour passer en mode panoramique et sélectionner quelle lecture en mémoire est affichée au centre de l'écran. Appuyez sur une touche de déplacement puis relâchez pour déplacer le curseur d'un pixel d'affichage. Maintenez une touche de déplacement appuyée pour déplacer le curseur d'un incrément de 20 pixels d'affichage. |
|----------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**REMARQUE**

Le nombre de pixels de données affichés varie en fonction du niveau de zoom.

|      |                                                                                                                                                                                                                                                                                                                             |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zoom | Appuyez sur la touche <b>Zoom</b> et utilisez le bouton ou les touches de direction pour sélectionner la quantité de zoom, en pourcentage. Vous pouvez configurer le pourcentage de zoom du graphique des tendances à 0,02 %, 0,05 %, 0,1 %, 0,2 %, 0,5 %, 1 %, 2 %, 5 %, 10 %, 20 %, 50 %, 100 %, 200 %, 500 %, ou 1 000 % |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**REMARQUE**

Pour passer une seule mesure à la fois en mode panoramique, réglez le niveau de zoom à 1 000 %. Après avoir sélectionné une mesure qui vous intéresse, vous pouvez diminuer le niveau de zoom, si nécessaire, pour voir les signaux autour.

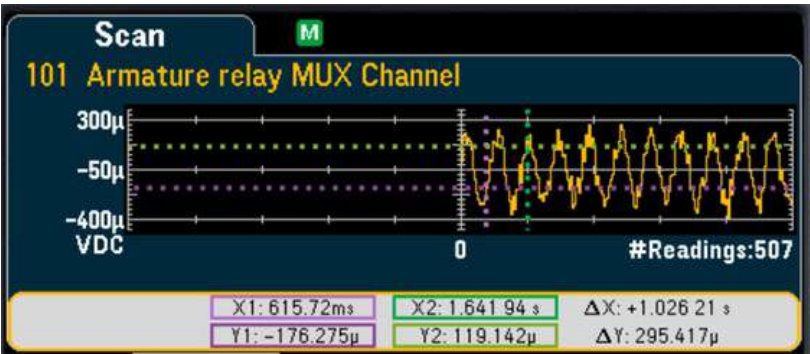
|         |                                                                                                                                                                                                                                                                                                                                        |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors | Affiche et contrôle les curseurs X1, X2, Y1, Y2, et de suivi (affichés en tant que lignes) sur le graphique des tendances. Les curseurs X sont des lignes verticales le long de l'échantillon ou de l'axe de temps et les curseurs Y sont des lignes horizontales sur l'axe de mesure (amplitude) en unités de la mesure sélectionnée. |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



- Appuyez sur la touche **Off** (Désactiver) pour désactiver les curseurs affichés.
- Appuyez sur la touche **X Only** (X uniquement) pour afficher les curseurs X1 et X2. Appuyez sur la touche **X1** ou **X2** et utilisez le bouton ou les touches fléchées pour régler la position du curseur le long de l'axe des X (temps). Pour maintenir les curseurs X1 et X2 à une distance fixe l'un de l'autre, appuyez sur la touche **ΔX Lock** (Verrouillage ΔX) pour l'activer ou la désactiver. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances.
- Appuyez sur la touche **Y Only** (Y uniquement) pour afficher les curseurs Y1 et Y2. Appuyez sur la touche **Y1** ou **Y2** et utilisez le bouton ou les touches fléchées pour régler la position du curseur le long de l'axe des Y (magnitude). Pour maintenir les curseurs Y1 et Y2 à une distance fixe l'un de l'autre, appuyez sur la touche **ΔY Lock** (Verrouillage ΔY) pour l'activer ou la désactiver. Pour définir le curseur Y1 ou Y2 à une valeur qui permet de l'afficher sur le graphique des tendances, appuyez sur la touche **Y1** ou **Y2** suivie de la touche **Place Y(Placer Y) n sur l'écran**. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances.
- Appuyez sur la touche **X et Y** pour afficher tous les curseurs X et Y sur le graphique des tendances. Appuyez sur les touches **X1**, **X2**, **Y1**, ou **Y2** et utilisez le bouton ou les touches fléchées pour régler la position du curseur le long de leur axe respectif. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances.
- Appuyez sur la touche **Track Rdn at X** (Suivre les mesures sur X) pour afficher l'heure et l'amplitude de deux points quelconques du graphique des tendances. Sélectionnez deux mesures à l'aide des touches **X1** et **X2** pour positionner les curseurs X1 et X2 sur le point d'intérêt le long de l'axe du temps. Les curseurs Y1 et Y2 suivent automatiquement la position des curseurs X1 et X2 respectivement et affichent les valeurs correspondantes sur l'axe d'amplitude. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances. Vous pouvez aussi fixer la distance entre les curseurs X1 et X2 en faisant basculer la touche **ΔX Lock** (Verrouillage ΔX).
- Pour enregistrer les données X et Y et les données de delta X et Y sous forme de capture d'écran, utilisez la capture d'écran depuis l'interface utilisateur Web, pas depuis l'écran du panneau avant.

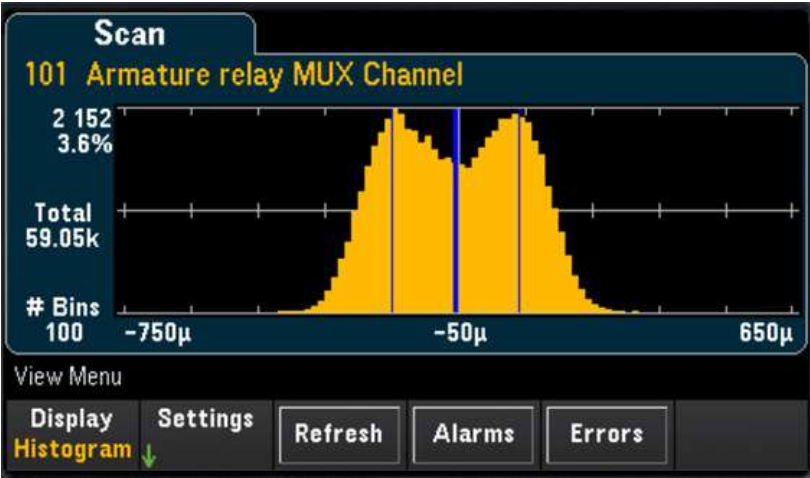
|           |                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------|
| Reset Pan | Appuyez sur la touche <b>Reset Pan</b> (Rétablir le panoramique) pour régler la lecture centrale sur la valeur « 0 ». |
|-----------|-----------------------------------------------------------------------------------------------------------------------|

Vous trouverez ci-dessous un exemple de graphique des tendances avec fonction **Track Rdnng at X** (Suivre les mesures sur X). Les lignes en pointillé de couleur violette sont les curseurs X1,Y1, celles de couleur verte sont les curseurs X2,Y2. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances.

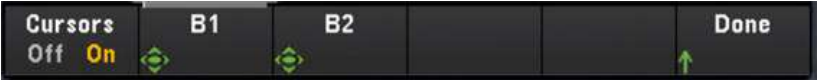


Histogramme

Affiche les lectures de mémoire de scrutation en format histogramme.



Appuyez sur la touche **Settings** (Paramètres) pour accéder au menu des curseurs.



| Touche de fonction |                 | Description                                                                                                                        |
|--------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|
| Cursors            | Cursors Off/ On | Appuyez sur la touche <b>Curseur</b> pour basculer entre l'activation (On) ou la désactivation (Off) des curseurs de l'histogramme |
|                    | B1              | Utilisez la molette ou les touches fléchées pour régler la position du curseur B1 (ligne verticale violette en pointillés).        |
|                    | B2              | Utilisez la molette ou les touches fléchées pour régler la position du curseur B2 (ligne verticale verte en pointillés).           |

Appuyez sur la touche **Refresh** (Actualiser) pour recalculer l'histogramme qui comprendra les nouvelles mesures.

## Statistiques

Affiche les lectures de mémoire de scrutation d'une voie sélectionnée en format statistique (Maximum, Minimum, Crête à crête, Moyenne et écart-type). Basculez entre **Statistics** (Statistiques) pour afficher des statistiques par voie et **Pk Times** (Temps Crête) pour afficher le temps d'occurrence des lectures de crête minimale et maximale par voie.

| Ch  | Max  | Min   | Pk-Pk | Average | StdDev |
|-----|------|-------|-------|---------|--------|
| 101 | 315μ | -419μ | 734μ  | -54.9μ  | 134.7μ |

View Menu Current Page: 1/1

Display Statistics Pk Times Alarms Errors

## Affichage de la file d'alarmes

Dans le menu **View** (Affichage), appuyez sur la touche **Alarms** (Alarmes) pour afficher les 20 premières alarmes, y compris la lecture et l'horodatage, dans la file d'alarmes. Vous ne pouvez voir cette file d'alarmes que lorsque la limite d'alarme est configurée sur la voie sélectionnée en appuyant sur **[Alarm]** ([Alarme]) sur le panneau avant. Pour plus d'informations, consultez **Menu [Alarm]** ([Alarme]).

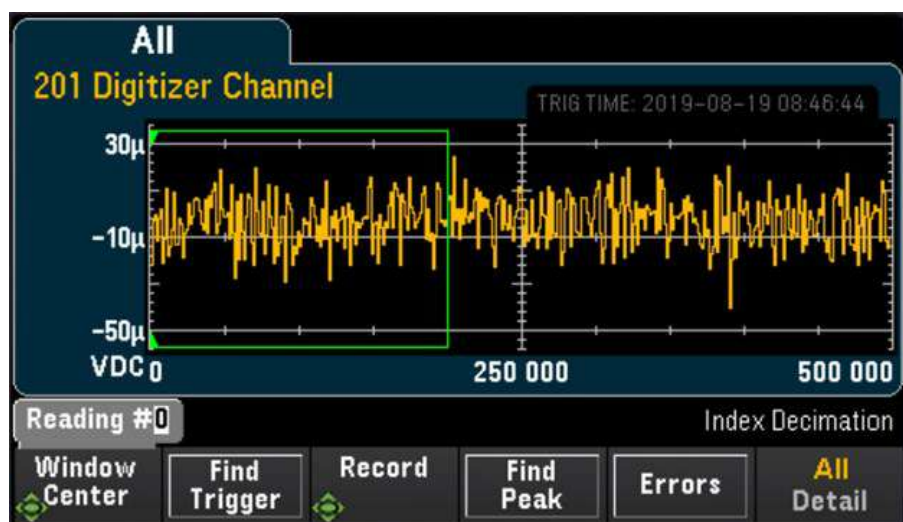
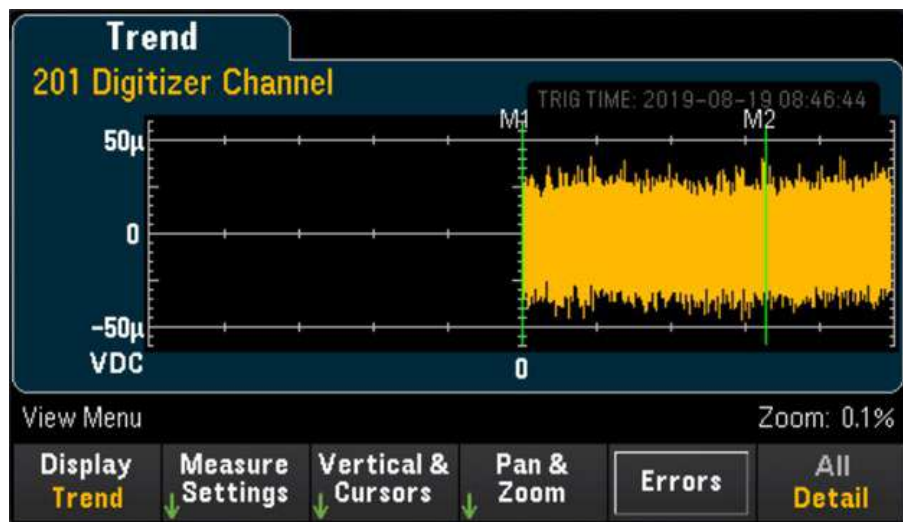
| Channel | Alarm | Limit | Reading | Unit | Date      | Time         |
|---------|-------|-------|---------|------|-----------|--------------|
| 101     | 1     | High  | 30.63   | °C   | 8/14/2019 | 14:47:06.137 |
| 101     | 1     | High  | 25.55   | °C   | 8/14/2019 | 14:47:06.383 |
| 101     | 1     | High  | 25.86   | °C   | 8/14/2019 | 14:47:06.465 |
| 101     | 1     | High  | 26.56   | °C   | 8/14/2019 | 14:47:06.547 |
| 101     | 1     | High  | 27.04   | °C   | 8/14/2019 | 14:47:07.368 |
| 101     | 1     | High  | 25.16   | °C   | 8/14/2019 | 14:47:08.107 |
| 101     | 1     | High  | 25.82   | °C   | 8/14/2019 | 14:47:08.928 |
| 101     | 1     | High  | 28.94   | °C   | 8/14/2019 | 14:47:09.010 |

Current Page: 1/1

## Affichage de la file d'erreurs

Dans le menu **View** (Affichage), appuyez sur **Errors** (Erreurs) pour afficher jusqu'à 20 erreurs dans la file d'erreurs. Le témoin erreur **ERR** est effacé lorsqu'elles sont consultées. L'indicateur Erreur (ERR) du panneau avant signale la détection d'une ou plusieurs erreurs de matériel, d'exécution ou de syntaxe de commande. Un journal contenant jusqu'à 20 erreurs est enregistré dans la file d'attente des erreurs de l'instrument. Les erreurs se retrouvent dans une file d'attente de type FIFO (première entrée, première sortie). La première erreur renvoyée est la première erreur enregistrée. Les erreurs sont effacées au fur et à mesure de leur consultation. Lorsque vous avez lu toutes les erreurs, l'indicateur ERR s'éteint et les erreurs sont effacées. L'instrument émet un signal sonore à chaque fois qu'une erreur est émise. Si plus de 20 erreurs se produisent, la dernière erreur enregistrée (la plus récente) est remplacée par « Error queue overflow » (Dépassement de la capacité de la file d'erreurs). Aucune erreur supplémentaire n'est enregistrée tant que vous ne supprimez pas des erreurs de la file. Si aucune erreur n'est survenue depuis la dernière consultation de la file d'erreurs, l'instrument indique « No error » (aucune erreur).

Menu [View] ([Affichage]) dans le mode Numériser DMM ou Numériseur



### Sélection du mode d'affichage

Appuyez sur la touche **Display** (Écran) pour sélectionner **Trend** (Tendance) ou **Power** (Puissance) comme mode d'affichage.

#### REMARQUE

Par défaut, seule l'option **Trend** (Tendance) s'affiche. L'option **Power** (Puissance) est disponible dans le menu Écran uniquement lorsque le mode d'acquisition de l'instrument est réglé sur **Digitizer** (Numériseur) dans le menu d'accueil et l'option **Pwr. Alys** (Analyse de puissance) est activée dans le menu Voie. Pour de plus amples informations, reportez-vous à [Présentation succincte du système](#).



## Touche Tous/Détail

Appuyez sur la touche **All/Détail** (Tous/Détails) pour modifier la façon dont le graphique des tendances s'affiche à l'écran.

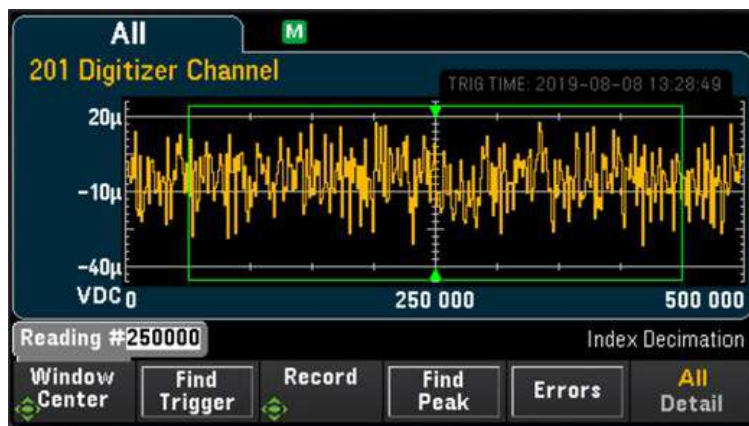
### REMARQUE

En mode d'acquisition de données **Numériser DMM**, la touche **All/Détail** (Tous/Détails) est disponible uniquement avec un minimum de 401 échantillons numérisés.

### Voir Tous

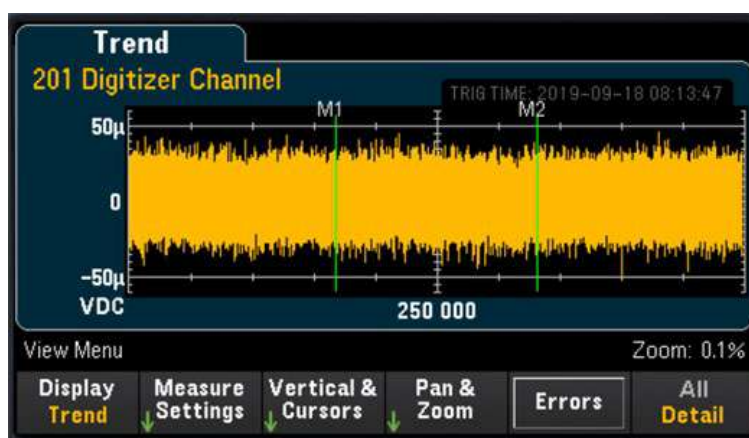
Quand **All** (Tous) est sélectionné, l'instrument affichera à l'écran tous les échantillons numérisés. Vous disposez ainsi d'un aperçu de l'ensemble des échantillons numérisés. Dans la vue **All** (Tous), une fenêtre vous permet d'afficher en mode panoramique les échantillons numérisés afin d'en sélectionner une partie, jusqu'à 400 000 échantillons (taille maximale de la fenêtre), à afficher à l'écran dans la vue **Détail** (Détails).

L'image ci-dessous montre un exemple où 500 000 échantillons ont été numérisés. Dans la vue **All** (Tous), l'ensemble des 500 000 échantillons est affiché à l'écran. La fenêtre contient 400 000 échantillons (Mesures numéro 50 000 à 450 000) où la mesure centrale est à la mesure numéro 250 000. Lorsque vous passez à la vue **Détail** (Détails), seules les mesures numéro 50 000 à 450 000 sont affichées à l'écran.



### Vue Détails

La vue **Détail** (Détails) permet d'isoler les points d'intérêt de l'ensemble des échantillons numérisés pour en faciliter le post-traitement. Lorsque la vue **Détail** (Détails) est sélectionnée, l'instrument affiche à l'écran jusqu'à 400 000 échantillons sur la base des échantillons compris dans la fenêtre de la vue **All** (Tous).



Paramètres de la vue Tous



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Window Centre      | <p>Appuyez sur la touche <b>Window Center</b> (Centre de la fenêtre) et utilisez le bouton ou les touches fléchées pour positionner la fenêtre sur l'écran. La mesure au centre de la fenêtre est indiquée par des pointeurs en haut et en bas de la fenêtre et son numéro est affiché au-dessus de la touche.</p> <div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Find Trigger       | <p>Appuyez sur la touche <b>Find Trigger</b> (Trouver le déclencheur) et l'instrument localisera les points de déclenchement et positionnera le centre de la fenêtre sur le point de déclenchement.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Record             | <p>Appuyez sur la touche <b>Record</b> (Enregistrer) et utilisez le bouton ou les touches fléchées pour faire défiler la liste des événements Armer et afficher l'ensemble des échantillons de données acquises pour chaque numéro d'événement Armer correspondant.</p> <p><b>Important :</b> Si les données d'un Enregistrement sont incomplètes, elles ne seront pas récupérables.</p> <ul style="list-style-type: none"><li>– <b>Exemple n° 1 :</b> La voie du numériseur est configurée de la manière suivante : <i>Nombre d'armements</i> = 1, <i>Nombre d'échantillons</i> = 1 000 000 et l'opération de numérisation est lancée. Si vous annulez l'opération avant que 1 000 000 d'échantillons aient été recueillis, aucune des données acquises dans le 1<sup>er</sup> enregistrement avant l'annulation ne pourra être récupérée.</li><li>– <b>Exemple n° 2 :</b> La voie du numériseur est configurée de la manière suivante : <i>Nombre d'armements</i> = 3, <i>Nombre d'échantillons</i> = 1 000 000 et l'opération de numérisation est lancée. Si vous annulez l'opération au cours du 3<sup>ème</sup> enregistrement avant que 1 000 000 d'échantillons aient été recueillis, aucune des données acquises dans le 3<sup>ème</sup> enregistrement avant l'annulation ne pourra être récupérée. Cependant, les données acquises au cours du 1<sup>er</sup> et du 2<sup>e</sup> enregistrement pourront être récupérées.</li></ul> <div><b>REMARQUE</b></div> <div>La touche <b>Record</b> (Enregistrement) est disponible uniquement lorsque le mode d'acquisition de données sélectionné est Numériseur ([Home]&gt;Acquire&gt;Digitizer ([Accueil]&gt;Acquérir&gt;Numériseur))</div> |
| Find Peak          | <p>Appuyez sur la touche <b>Find Peak</b> (Trouver la crête) pour effectuer une décimation sur un vaste ensemble de données numérisées. Vous pouvez interrompre le processus de décimation en appuyant sur la touche <b>Cancel</b> (Annuler) et le reprendre en appuyant sur la touche <b>Resume Find Pk.</b> (Reprendre la recherche de crête). Notez que les points de données décimés ne peuvent pas revenir à leur valeur d'origine.</p> <p>La fonction de décimation est utile pour améliorer le débit des données. Vous pouvez avoir besoin de numériser une grande quantité de données par enregistrement à une fréquence d'échantillonnage élevée pour garantir une</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



|        |                                                                                                                                                                                                                                                  |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | saisie des données complète, mais sans avoir à retourner toutes les valeurs enregistrées. Ainsi en effectuant une décimation, l'instrument retourne uniquement le minimum et maximum des échantillons numérisés de chaque groupe d'échantillons. |
| Errors | Appuyez sur la touche <b>Errors</b> (Erreurs) pour afficher jusqu'à 20 erreurs dans la file d'erreurs. Les témoins d'erreurs sont effacés au fur et à mesure de leur consultation.                                                               |

Paramètres de la vue Détails

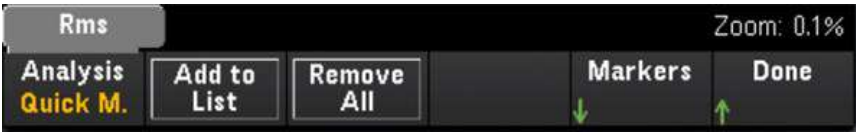


Paramètres de mesure

Appuyez sur la touche **Measure Settings** (Paramètres de mesure) pour configurer la position des marqueurs et régler le mode d'analyse des données.

REMARQUE

La touche **Measure Settings** (Paramètres de mesure) n'est disponible qu'après numérisation d'un minimum de 256 échantillons.



| Touche de fonction |            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis           | Quick M.   | <p>L'option Quick M. (Mesure rapide) vous permet d'ajouter jusqu'à quatre modes de mesure rapide à afficher à l'écran.</p> <p>Pour sélectionner les modes de mesure rapide pour l'analyse, appuyez sur <b>Analysis &gt; Quick M.</b> (Analyse&gt;Mes. rapide). Utilisez ensuite le bouton ou les touches fléchées pour parcourir les différentes options. Une fois l'option de mesure rapide sélectionnée, appuyez sur la touche <b>Add to List</b> (Ajouter à la liste) pour l'ajouter à la liste des mesures rapides qui seront affichées.</p> <p>Les options de mesure rapide disponibles sont :</p> <ul style="list-style-type: none"><li>– Rms : Moyenne quadratique</li><li>– DCycle : Cycle de service</li><li>– PWidth : Largeur positive</li><li>– NWidth : Largeur négative</li><li>– RTime : Temps montant</li><li>– FTime : Temps descendant</li><li>– Period : Période</li><li>– Freq : Fréquence</li></ul> |
|                    | Statistics | Appuyez sur <b>Analysis &gt; Statistics</b> (Analyses>Statistiques) pour afficher à l'écran des statistiques des données telles que le minimum, le maximum, la moyenne et l'écart-type.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Add to List                                                                                                                                                                                                      | Appuyez sur la touche <b>Add to List</b> (Ajouter à la liste) pour ajouter le mode de mesure rapide sélectionné à afficher à l'écran. Vous pouvez ajouter jusqu'à quatre modes de mesure rapide à afficher à l'écran. Veuillez noter que lorsque vous ajoutez plus de quatre modes de mesure, le mode de mesure le plus récent remplacera le premier mode de mesure qui a été ajouté (« premier entré, premier sorti »). |
| Remove All                                                                                                                                                                                                       | Appuyez sur la touche <b>Remove All</b> (Tout supprimer) pour supprimer tous les modes de mesure rapide affichés à l'écran.                                                                                                                                                                                                                                                                                              |
| Display Off/On                                                                                                                                                                                                   | Basculez la touche <b>Display Off/On</b> (Affichage Activé/Désactivé) pour activer ( <b>On</b> ) ou désactiver ( <b>Off</b> ) l'affichage des données de mesure rapide ou de statistiques. Ce paramètre sera reproduit sur toutes les autres voies.                                                                                                                                                                      |
| <div>REMARQUE</div> La touche <b>Display Off/On</b> (Affichage Activé/Désactivé) n'apparaît que lorsqu'un mode d'analyse (option <b>Statistics</b> (Statistique) <b>Quick M.</b> (Mes. rapide)) est sélectionné. |                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Markers                                                                                                                                                                                                          | Reportez-vous à <b>la touche Marqueurs</b> dans la section suivante pour plus d'informations.                                                                                                                                                                                                                                                                                                                            |

la touche Marqueurs



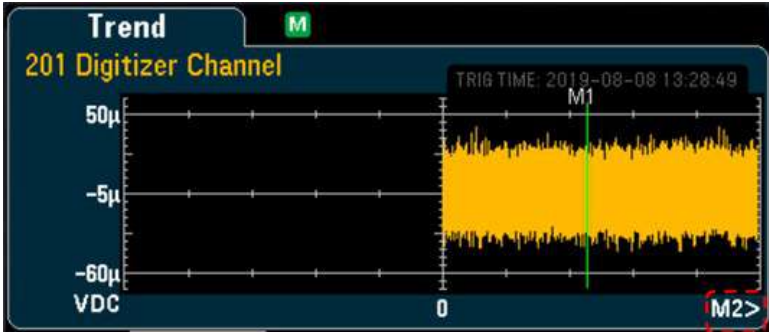
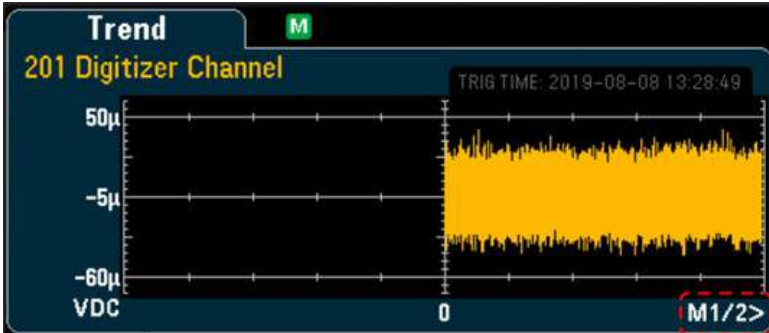
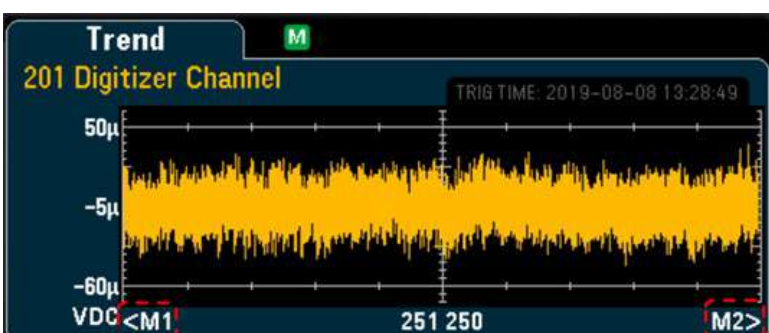
Les marqueurs déterminent une plage de points de données utilisés pour calculer les mesures rapides et les statistiques. Dans l'image ci-dessus, les deux marqueurs sont représentés par des lignes verticales vertes et nommés respectivement M1 et M2.

REMARQUE

 Entre le Marqueur 1 et le Marqueur 2, il y a un minimum de 256 points de données.

| Touche de fonction |                  | Description                                                                                                                                                                                                                   |
|--------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Markers            | Marker 1         | Appuyez sur la touche <b>Marker 1</b> (Marqueur 1) et utilisez le bouton ou les touches fléchées pour positionner le Marqueur 1 (M1).                                                                                         |
|                    | Marker 2         | Appuyez sur la touche <b>Marker 2</b> (Marqueur 2) et utilisez le bouton ou les touches fléchées pour positionner le Marqueur 2 (M2).                                                                                         |
|                    | LockMrkrs On/Off | Appuyez sur la touche de fonction <b>LockMrkrs</b> pour basculer entre le verrouillage des positions de M1 et M2 à distance fixe ( <b>On</b> ) ou permettant d'ajuster indépendamment la position de M1 ou M2 ( <b>Off</b> ). |

Voici quelques exemples de ce que vous pouvez observer à l'écran lorsque vous réglez la position des marqueurs :

| Exemple                                                                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>Dans l'image, les Marqueurs 1 et 2 sont positionnés sur des points de données qui sont visibles sur l'écran.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|    | <p>Dans cette image, le Marqueur 1 est positionné sur un point de données qui est visible sur l'écran et le Marqueur 2 est positionné sur un point de données qui ne l'est pas.</p> <p>Dans ces cas, un indicateur, <b>M2&gt;</b>, s'affiche en bas à droite de l'écran pour indiquer que le Marqueur 2 est positionné sur un point de données situé vers la droite.</p>                                                                                                                                                                                                                                                                       |
|   | <p>Dans les images, chaque marqueur est positionné sur des points de données qui ne sont pas visibles sur l'écran.</p> <p>Dans la première image, un indicateur, <b>M1/2&gt;</b>, apparaît en bas à droite de l'écran pour indiquer que les deux marqueurs sont situés vers la droite.</p>                                                                                                                                                                                                                                                                                                                                                     |
|  | <p>Pour ramener les marqueurs sur la vue : appuyez sur la touche M1 et tournez le bouton dans le sens inverse des aiguilles d'une montre. Cela permet de ramener le marqueur M1 à l'écran. Ensuite, appuyez sur la touche M2 et tournez à nouveau le bouton dans le sens inverse des aiguilles pour ramener le marqueur M2 à l'écran. Notez que la distance entre les marqueurs M1 et M2 est maintenant de 256 points de données.</p> <p>Dans la deuxième image, les marqueurs sont sur les côtés opposés. Dans ce cas, des indicateurs <b>&lt;M1</b> et <b>M2&gt;</b> apparaissent en bas de l'écran indiquant la direction de marqueurs.</p> |
|  | <p>Pour ramener les marqueurs sur la vue : appuyez sur la touche M1 et tournez le bouton dans le sens des aiguilles d'une montre. Cela permet de ramener le marqueur M1 sur la gauche de l'écran. Ensuite, appuyez sur la touche M2 et tournez le bouton dans le sens inverse des aiguilles pour ramener le marqueur M2 sur la droite de l'écran.</p>                                                                                                                                                                                                                                                                                          |

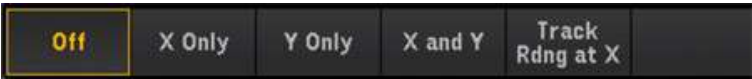
Vertical et curseurs

Appuyez sur la touche **Vertical** pour configurer l'échelle verticale du graphique de tendances et accéder au menu des curseurs.



| Touche de fonction |         | Description                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vertical           | Default | Default (Par défaut) détermine l'échelle de la plage de mesure.                                                                                                                                                                                                                                                                                                                    |
|                    | Auto    | Auto (Automatique) ajuste automatiquement l'échelle pour correspondre à la ligne actuellement affichée sur l'écran.                                                                                                                                                                                                                                                                |
|                    | Manual  | <div></div> <p>Manual (Manuel) vous permet de configurer l'échelle soit en tant que valeurs High (Supérieure) et Low (Inférieure) soit sous la forme d'une valeur de Center (Centre) avec une Span (Étendue). Par exemple, une échelle comprise entre une valeur inférieure de 0 V et une valeur Supérieure de 5 V est équivalente à un Centre de 2,5 V et une Étendue de 5 V.</p> |
| Autoscale Once     |         | Appuyez une fois sur la touche <b>Autoscale Once</b> (Mettre à l'échelle une fois) pour mettre à l'échelle automatiquement l'axe vertical du diagramme de tendance une fois, en fonction des points de données numérisées affichés à l'écran. Cela définit également le mode <b>Échelle verticale</b> sur <b>Manuel</b> .                                                          |

Appuyez sur la touche **Cursors** (Curseurs) pour accéder au menu Curseurs.



| Touche de fonction |         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors            | Off     | Appuyez sur la touche <b>Off</b> (Désactiver) pour désactiver les curseurs affichés.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                    | X only  | Appuyez sur la touche <b>X Only</b> (X uniquement) pour afficher les curseurs X1 et X2. Appuyez sur la touche <b>X1</b> ou <b>X2</b> et utilisez le bouton ou les touches fléchées pour régler la position du curseur le long de l'axe des X (temps). Pour maintenir les curseurs X1 et X2 à une distance fixe l'un de l'autre, appuyez sur la touche <b>ΔX Lock</b> (Verrouillage ΔX) pour l'activer ou la désactiver. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances.                                                                                                                                                                                                                      |
|                    | Y only  | Appuyez sur la touche <b>Y Only</b> (Y uniquement) pour afficher les curseurs Y1 et Y2. Appuyez sur la touche <b>Y1</b> ou <b>Y2</b> et utilisez le bouton ou les touches fléchées pour régler la position du curseur le long de l'axe des Y (magnitude). Pour maintenir les curseurs Y1 et Y2 à une distance fixe l'un de l'autre, appuyez sur la touche <b>ΔY Lock</b> (Verrouillage ΔY) pour l'activer ou la désactiver. Pour définir le curseur Y1 ou Y2 à une valeur qui permet de l'afficher sur le graphique des tendances, appuyez sur la touche <b>Y1</b> ou <b>Y2</b> suivie de la touche <b>Place Y(Placer Y) n sur l'écran</b> . Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances. |
|                    | X and Y | Appuyez sur la touche <b>X et Y</b> pour afficher tous les curseurs X et Y sur le graphique des tendances. Appuyez sur les touches <b>X1</b> , <b>X2</b> , <b>Y1</b> , ou <b>Y2</b> et utilisez le bouton ou les touches fléchées pour régler la position du curseur le long de leur axe respectif. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances.                                                                                                                                                                                                                                                                                                                                          |

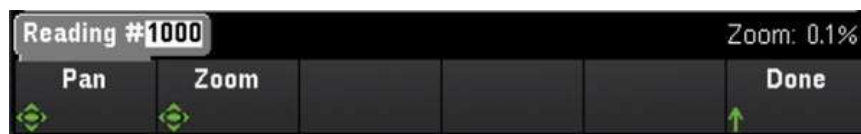
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|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Track<br>Rdng at X | <p>Appuyez sur la <b>Track Rdng at X</b> (Suivre les mesures sur X) pour afficher l'heure et l'amplitude de deux points quelconques du graphique des tendances. Sélectionnez deux mesures à l'aide des touches <b>X1</b> et <b>X2</b> pour positionner les curseurs X1 et X2 sur le point d'intérêt le long de l'axe du temps. Les curseurs Y1 et Y2 suivent automatiquement la position des curseurs X1 et X2 respectivement et affichent les valeurs correspondantes sur l'axe d'amplitude. Les valeurs de chaque point et le delta entre les deux points sont affichés sous le graphique des tendances. Vous pouvez aussi fixer la distance entre les curseurs X1 et X2 en faisant basculer la touche <b><math>\Delta</math>X Lock</b>(Verrouillage <math>\Delta</math>X). Voir l'<b>exemple</b> présenté pour de plus amples informations.</p> <p>Pour enregistrer les données X et Y et les données de delta X et Y sous forme de capture d'écran, utilisez la capture d'écran depuis l'interface utilisateur Web, pas depuis l'écran du panneau avant.</p> |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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## Panoramique et agrandissement

Appuyez sur la touche **Pan & Zoom** (Panoramique et agrandissement) pour afficher le graphique des tendances en panoramique et configurer le niveau d'agrandissement.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Panoramique        | Appuyez sur la touche <b>Pan</b> (Panoramique) pour passer en mode panoramique et sélectionner quelle lecture en mémoire est affichée au centre de l'écran. Appuyez sur la touche de déplacement puis relâchez pour déplacer le curseur d'un pixel d'affichage. Maintenez la touche de déplacement appuyée pour déplacer le curseur d'un incrément de 20 pixels d'affichage. |
| Zoom               | Appuyez sur la touche <b>Zoom</b> et utilisez le bouton ou les touches de direction pour sélectionner la quantité de zoom, en pourcentage. Vous pouvez configurer le pourcentage de zoom du graphique des tendances à 0,1 %, 0,2 %, 0,5 %, 1 %, 2 %, 5 %, 10 %, 20 %, 50 %, 100 %, 200 %, 500 %, ou 1 000 %                                                                  |

Le tableau ci-dessous montre la liste des pourcentages d'agrandissement avec le nombre de points de données par pixel d'affichage correspondant.

| Zoom (%) | Nombre de points de données par pixel d'affichage. |
|----------|----------------------------------------------------|
| 0,1 %    | 1000                                               |
| 0,2 %    | 500                                                |
| 0,5 %    | 200                                                |
| 1 %      | 100                                                |
| 2 %      | 50                                                 |
| 5 %      | 20                                                 |
| 10 %     | 10                                                 |
| 20 %     | 5                                                  |
| 50 %     | 2                                                  |
| 100 %    | 1                                                  |
| 200%     | 0,5                                                |
| 500%     | 0,2                                                |
| 1000%    | 0,1                                                |

### Affichage de la file d'erreurs

Appuyez sur la touche **Errors** (Erreurs) pour afficher jusqu'à 20 erreurs dans la file d'erreurs. Le témoin erreur  est effacé lorsqu'elles sont consultées. L'indicateur Erreur (ERR) du panneau avant signale la détection d'une ou plusieurs erreurs de matériel, d'exécution ou de syntaxe de commande. Un journal contenant jusqu'à 20 erreurs est enregistré dans la file d'attente des erreurs de l'instrument.

Les erreurs se retrouvent dans une file d'attente de type FIFO (première entrée, première sortie). La première erreur renvoyée est la première erreur enregistrée. Les erreurs sont effacées au fur et à mesure de leur consultation. Lorsque vous avez lu toutes les erreurs, l'indicateur ERR s'éteint et les erreurs sont effacées. L'instrument émet un signal sonore à chaque fois qu'une erreur est émise. Si plus de 20 erreurs se produisent, la dernière erreur enregistrée (la plus récente) est remplacée par « Error queue overflow » (Dépassement de la capacité de la file d'erreurs). Aucune erreur supplémentaire n'est enregistrée tant que vous ne supprimez pas des erreurs de la file. Si aucune erreur n'est survenue depuis la dernière consultation de la file d'erreurs, l'instrument indique « No error » (aucune erreur).

Analyse de puissance

Cette section décrit comment configurer les voies du numériseur DAQM909A pour effectuer une analyse de puissance en mode View.

Activation de la fonction d'analyse de puissance dans le menu [Channel] ([Voie])

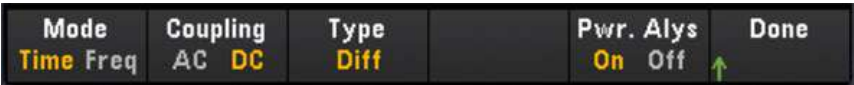
- 1. Dans le menu [Channel] ([Voie]), utilisez le bouton ou les touches fléchées pour sélectionner soit la **Voie 01** soit la **Voie 03**. Les Voies 02 et 04 du DAQM909A sont toujours affectées comme les voies de Couplage de puissance et sont couplées respectivement aux voies 01 et 03 lorsque la fonction d'analyse de puissance est activée. Par conséquent, tous les réglages sur les voies 02 et 04 seront omis lorsque l'analyse de puissance est activée.

| Voie principale |  | Voie de couplage de puissance |  |
|-----------------|--|-------------------------------|--|
| Voie 01         |  | Voie 02                       |  |
| Voie 03         |  | Voie 04                       |  |

- 2. Ensuite, appuyez sur la touche **Measure** (Mesure), sélectionnez **DCV** et configurer la plage de tension et la fréquence d'échantillonnage des.



- 3. Appuyez sur la touche **Advanced** (Avancé) puis sur la touche **Pwr. Alys** (Analyse de puissance) pour activer (**On**) ou désactiver (**Off**) la fonction d'analyse de puissance de la voie sélectionnée.



Lorsque vous activez la fonction d'analyse de puissance pour la voie sélectionnée , la voie adjacente associée sera automatiquement configurée comme voie de **Couplage de puissance**. Dans l'exemple ci-dessous, l'option **Pwr. Alys** est activé sur **On** pour la Voie 01 , et la voie 02 est automatiquement configurée comme voie de **Couplage de puissance**.

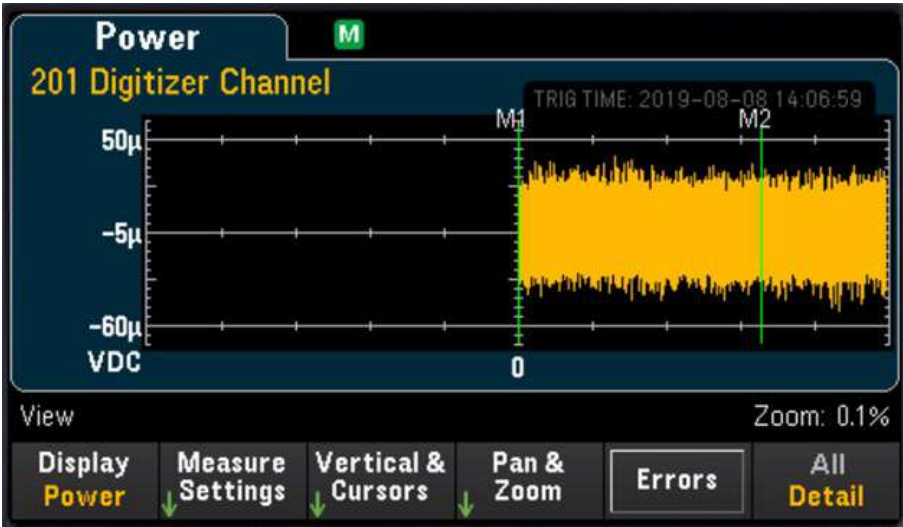


- 4. Appuyez sur la touche **[Scan/Start]** ([Scrutation/Démarrer]) pour commencer à numériser. Une fois terminé, appuyez sur la touche **[View]** ([Voir]) pour accéder au menu View (Affichage).



Affichage des résultats de l'analyse de puissance

Appuyez sur la touche [View] ([Voir]) pour accéder au menu **View** (Affichage).



Touche Écran

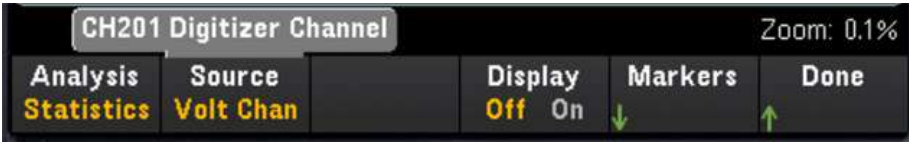
Appuyez sur la touche **Display** (Écran) puis sur la touche **Power** (Puissance) pour afficher les résultats de l'analyse de puissance.

REMARQUE

Vous pouvez continuer à afficher les données d'analyse de l'alimentation actuelles de chaque canal stockées en mémoire, tant que le canal spécifié n'a pas commencé une nouvelle opération de numérisation, car les anciennes données seraient écrasées.

Touche des Paramètres de mesure

Appuyez sur la touche **Measure Settings** (Paramètres de mesure) pour configurer les paramètres de l'analyse de puissance.



| Touche de fonction |            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis           | Statistics | Cette touche est statique, car c'est la seule option d'analyse de puissance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Source             | Volt Chan  | La source sélectionnée déterminera le graphique affiché à l'écran. <b>Volt Chan</b> (Voie Tens.) affiche les données de la voie à laquelle elle est attachée en fonction de la tension, <b>Curr Chan</b> (Voie Cour.) calcule les données de la voie qui lui est attachée et affiche les données en fonction du courant, et <b>V*I</b> calcule les données des voies tension et courant et affiche les données en fonction de la puissance. Appuyez sur la touche <b>Source</b> pour alterner entre la voie de tension ( <b>Volt Chan</b> (Voie Tens.)), la voie de courant ( <b>Curr Chan</b> (Voie Cour.)) ou la voie de puissance ( <b>V*I</b> ). Pour les voies <b>Volt Chan</b> (Voie Tens.) et <b>Curr Chan</b> (Voie Cour.), utilisez le bouton ou les touches fléchées pour attribuer les voies. |
|                    | Curr Chan  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                    | V * I      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Gain               |            | Appuyez sur la touche <b>Gain</b> et utilisez le bouton ou les touches fléchées pour définir la valeur de gain pour le calcul de la valeur actuelle de la voie Curr Chan.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|                 |                                                                                                                                                                |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Display Off/ On | Basculez la touche <b>Display Off/On</b> (Affichage Activé/Désactivé) pour activer (On) ou désactiver (Off) l'affichage des données de statistiques à l'écran. |
| Markers         | Pour plus d'informations, reportez-vous à la section <b>la touche Marqueurs</b> .                                                                              |

#### Touche Vertical et Curseurs

Pour plus d'informations, reportez-vous à la section **Vertical et curseurs**.

#### Touche Panoramique et Agrandissement

Pour plus d'informations, reportez-vous à la section **Panoramique et agrandissement**.

#### Affichage de la file d'erreurs

Appuyez sur la touche **Errors** (Erreurs) pour afficher jusqu'à 20 erreurs dans la file d'erreurs. Le témoin erreur  est effacé lorsqu'elles sont consultées. L'indicateur Erreur (ERR) du panneau avant signale la détection d'une ou plusieurs erreurs de matériel, d'exécution ou de syntaxe de commande. Un journal contenant jusqu'à 20 erreurs est enregistré dans la file d'attente des erreurs de l'instrument.

Les erreurs se retrouvent dans une file d'attente de type FIFO (première entrée, première sortie). La première erreur renvoyée est la première erreur enregistrée. Les erreurs sont effacées au fur et à mesure de leur consultation. Lorsque vous avez lu toutes les erreurs, l'indicateur ERR s'éteint et les erreurs sont effacées. L'instrument émet un signal sonore à chaque fois qu'une erreur est émise.

Si plus de 20 erreurs se produisent, la dernière erreur enregistrée (la plus récente) est remplacée par « Error queue overflow » (Dépassement de la capacité de la file d'erreurs). Aucune erreur supplémentaire n'est enregistrée tant que vous ne supprimez pas des erreurs de la file. Si aucune erreur n'est survenue depuis la dernière consultation de la file d'erreurs, l'instrument indique « No error » (aucune erreur).

## État du Menu [View] (Affichage)

Dans le cas où aucune donnée n'est disponible, le menu [View] (Affichage) affiche un texte d'état au bas de l'écran. Vous trouverez ci-dessous une liste des textes d'état et leur description respective.

| État                                                                                                | Description                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "The readings in memory were made with a different set of modules installed, and cannot be graphed" | L'instrument ne peut pas tracer les données de la dernière opération d'acquisition de données de scrutation parce que la carte du module a été désactivée. |
| "Pre-Storing"                                                                                       | L'instrument recueille des échantillons de pré-déclenchement avant de passer en Attente d'un déclenchement.                                                |
| "No scan data in memory"                                                                            | Aucune donnée acquise en mode Scrutation.                                                                                                                  |
| "No digitize data in memory"                                                                        | Aucune donnée acquise en mode Numériser DMM et en mode Numériseur.                                                                                         |
| "Scan in progress"                                                                                  | Le mode d'acquisition des données de scrutation est en cours.                                                                                              |
| "Digitize in progress"                                                                              | Le mode d'acquisition des données Numériser DMM et Numériseur est en cours.                                                                                |
| "Wait for arm event"                                                                                | Le numériseur est en attente d'un événement Armer pour lancer le processus de numérisation.                                                                |
| "Wait for external event"                                                                           | L'instrument est en attente d'un déclencheur externe pour lancer l'acquisition des données.                                                                |
| "Wait for internal event"                                                                           | L'instrument est en attente d'un déclencheur interne pour lancer l'acquisition des données.                                                                |
| "Wait for alarm event"                                                                              | L'instrument est en attente d'un déclencheur d'alarme pour lancer l'acquisition des données.                                                               |
| "Wait for manual event"                                                                             | L'instrument est en attente d'un déclencheur manuel pour lancer l'acquisition des données.                                                                 |
| "Wait for channel event"                                                                            | L'instrument est en attente d'un déclencheur de voie pour lancer l'acquisition des données.                                                                |

## Menu [Channel] ([Voie])

### Modules multiplexeurs : Mesures

Le DAQ970A/DAQ973A Keysight prend en charge de nombreuses fonctions de mesure communes avec le module multiplexeur. Appuyez sur **[Channel] > Measure** ([Voie] > Mesurer) pour configurer la fonction de mesure sur la voie sélectionnée.

En mode d'acquisition de données **Scan**, la sélection de **Off** désactive la fonction de mesure dans le canal actuellement sélectionné. Aucune fonction de mesure ne sera affichée dans la liste de scrutation de la voie sélectionnée. La fonction de mesure par défaut sera réglée sur la tension DCV(CC).

En mode d'acquisition de données **DMM Digitize**, par défaut, le premier canal approprié est automatiquement configuré pour **DMM Digitize** et une fonction de mesure lui est attribuée (DCV par défaut). Vous pouvez basculer vers un autre canal disponible sur le module plug-in et le configurer pour le fonctionnement DMM Digitize. Contrairement au mode Scan, il n'existe pas de fonction Off, car DMM Digitize ne peut utiliser qu'un seul canal configuré pour son opération de numérisation. Par conséquent, la fonction de mesure du canal sélectionné doit toujours être activée.

Le tableau ci-dessous montre un aperçu de chaque module multiplexeur pris en charge sur la fonction de mesure. Cliquez sur chaque lien pour voir le détail de chaque étape de configuration.

| Mesure<br>fonction         | Modules multiplexeurs |                  |          |                  |
|----------------------------|-----------------------|------------------|----------|------------------|
|                            | DAQM900A              | DAQM901A         | DAQM902A | DAQM908A         |
| Température - Thermocouple | ✓                     | ✓                | ✓        |                  |
| Température - RTD          |                       | ✓                | ✓        | ✓ <sup>[2]</sup> |
| Température - Thermistance |                       | ✓                | ✓        | ✓ <sup>[2]</sup> |
| Contrainte - Pont          | ✓                     | ✓                | ✓        | ✓                |
| Contrainte - Direct        |                       | ✓                | ✓        | ✓ <sup>[2]</sup> |
| Tension continue           | ✓                     | ✓                | ✓        | ✓                |
| Tension alternative        | ✓                     | ✓                | ✓        | ✓                |
| Courant continu            |                       | ✓ <sup>[1]</sup> |          |                  |
| Courant alternatif         |                       | ✓ <sup>[1]</sup> |          |                  |
| Résistance                 | ✓                     | ✓                | ✓        | ✓ <sup>[2]</sup> |
| Fréquence                  | ✓                     | ✓                | ✓        | ✓                |
| Période                    | ✓                     | ✓                | ✓        | ✓                |
| Diode                      |                       | ✓                | ✓        | ✓                |
| Capacité                   |                       | ✓                | ✓        | ✓                |

Remarques :

[1] Voies 21 et 22 uniquement.

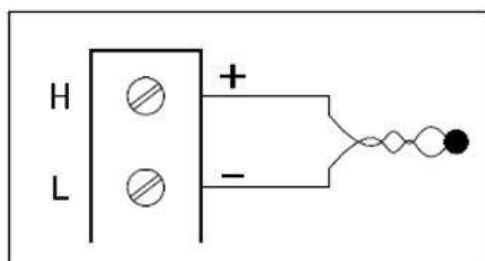
[2] Mesures à 2 fils uniquement. Les mesures à 4 fils ne sont pas prises en charge sur le multiplexeur DAQM908A. USB.

## Température

Cette section décrit comment configurer la voie sélectionnée pour les mesures de température depuis le panneau avant. Une sonde de capteur de température est nécessaire pour les mesures de température et les sondes prises en charge sont les thermocouples, les thermistances et les thermomètre à résistance (RTD).

### Thermocouple

1. Connectez un thermocouple aux bornes à vis du module.



2. Appuyez sur **[Channel]** > **Measure** ([Voie] > Mesurer) et sélectionnez **TEMP** (TEMPÉRATURE) dans le menu de sélection.



3. Appuyez sur la touche **Units (Unités)** pour définir les unités de mesure de la température en **°C** (Celsius), **°F** (Fahrenheit), ou **K** (Kelvin). Vous pouvez mélanger les unités de température sur des voies différentes au sein de l'instrument et sur le même module.
4. Appuyez sur **Sensor Settings** > **Sensor** (Paramètres de la sonde > Sonde), réglez le type de sonde du capteur sur **TCouple** et appuyez sur la touche **Type** (Type) pour sélectionner le type de thermocouple. J (défaut), K, E, T, N, R, B, et S sont les différents types pris en charge.



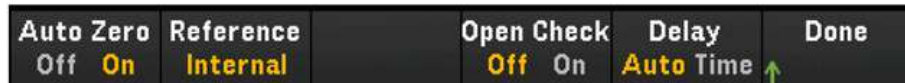
5. Appuyez sur la touche **Integrated Settings** (Paramètres intégrés) pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time** (Temps)). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.



| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

## Paramètres avancés

Appuyez sur la touche **Advanced** (Avancé) pour configurer les paramètres avancés de la mesure.



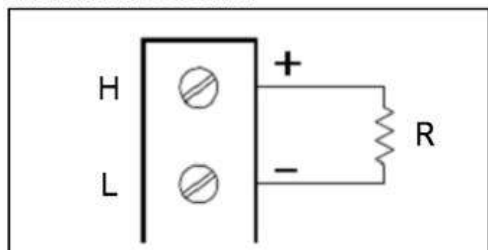
| Touche de fonction    |          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On  | Internal | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. |
|                       | External | Les mesures de thermocouples requièrent une température de jonction de référence. Vous pouvez saisir une température de jonction de référence fixe connue (généralement utilisée pour des jonctions de référence externe), utiliser la température interne mesurée sur le module, la thermistance externe ou la mesure de RDT. Réglez la source de jonction de référence sur <b>Interne</b> , <b>Externe</b> ou <b>Fixe</b> .                                                                                                                                                                                                                                                                                                                                         |
|                       | Fixed    | <b>REMARQUE</b> L'option de la touche <b>External</b> (Externe) n'est pas disponible lorsque le mode <b>Numériser DMM</b> est sélectionné comme mode d'acquisition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Open Check<br>Off/ On |          | Active (On) ou désactive (Off) la fonction de vérification du thermocouple pour vérifier que les thermocouples sont correctement connectés pour les mesures. Lorsque cette option est activée, l'instrument mesure la résistance avec chaque température pour vérifier la présence d'un circuit ouvert. Si un circuit ouvert est détecté, le résultat sera affiché comme +Overload (+Surcharge). Si cette vérification n'est pas effectuée, la mesure d'un circuit ouvert peut produire une tension proche de zéro ce qui entraîne une lecture de température non valide.                                                                                                                                                                                             |
|                       |          | <b>REMARQUE</b> Ce paramètre est disponible uniquement lorsque le mode d'acquisition sélectionné est <b>Scan</b> (Scrutation).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Delay<br>Auto/Temps   |          | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                  |
|                       |          | <b>REMARQUE</b> Ce paramètre est disponible uniquement lorsque le mode d'acquisition sélectionné est <b>Scan</b> (Scrutation).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Thermistance en 2 et 4 fils

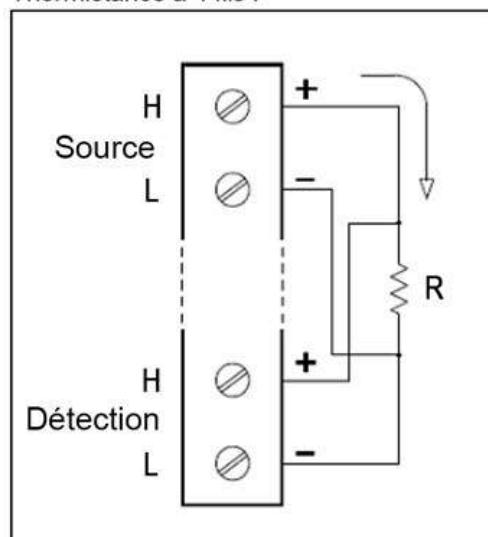
**REMARQUE** Ce paramètre est disponible uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

1. Connectez une thermistance aux bornes à vis du module.

Thermistance à 2 fils :



Thermistance à 4 fils :



2. Appuyez sur [Channel] > Measure ([Voie] > Mesurer) et sélectionner **TEMP** (TEMPÉRATURE) dans le menu de sélection.



3. Appuyez sur la touche Units (Unités) pour définir les unités de mesure de la température en **°C** (Celsius), **°F** (Fahrenheit), ou **K** (Kelvin). Vous pouvez mélanger les unités de température sur des voies différentes au sein de l'instrument et sur le même module.
4. Appuyez sur **Sensor Settings** > **Sensor** (Paramètres du capteur > Capteur) et sélectionnez **Thermistor** (Thermistance). Puis, basculez la touche **2-Wire/4-Wire** (2 fils/4 fils) pour définir le type de sonde de capteur de température utilisée comme **Thermistance** à 2 fils ou 4 fils. Appuyez ensuite sur la touche **Type** pour sélectionner le type de thermistance. Les types pris en charge sont 2,2 K, 5 K (par défaut), et 10 K.





5. Basculez la touche **Use as ref** (Utiliser comme ref) pour activer (**On**) ou désactiver (**Off**) l'utilisation de la voie sélectionnée comme la voie de référence pour les mesures suivantes de thermocouple qui précisent une référence externe.
6. Appuyez sur la touche **Integrate Settings** (Intégrer les paramètres) pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (NPLC) ou directement en secondes (Time (Temps)). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

### Paramètres avancés

Appuyez sur la touche **Advanced** (Avancé) pour configurer les paramètres avancés de la mesure.

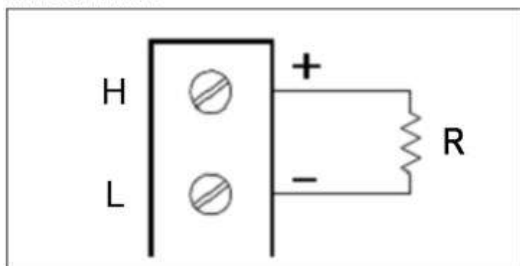
|                            |  |  |                            |                           |                  |
|----------------------------|--|--|----------------------------|---------------------------|------------------|
| <b>Auto Zero</b><br>Off On |  |  | <b>Low Power</b><br>Off On | <b>Delay</b><br>Auto Time | <b>Done</b><br>↑ |
|----------------------------|--|--|----------------------------|---------------------------|------------------|

| Touche de fonction   |  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On |  | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| Low Power<br>Off/ On |  | Sélectionne la mesure de résistance à faible puissance. Cela fournit moins de courant, ce qui donne une plus faible dissipation de puissance et moins d'auto-échauffement de la résistance soumise au test. Généralement, cela est d'environ 1/10 du courant généré pour les mesures de résistances standard. Le courant généré approximatif pour chaque plage de mesures est indiqué au bas des touches de fonction des plages de résistances, par exemple : (~ 1 mA).                                                                                                                                                                                                                                                                                                                                                                        |
| Delay<br>Auto/Time   |  | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

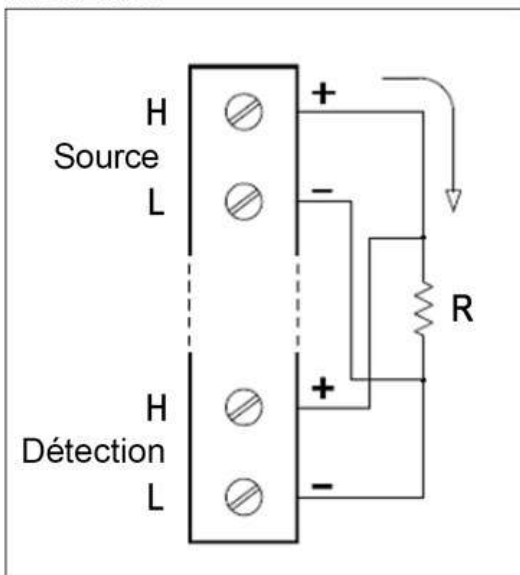
## RTD en 2 et 4 fils

1. Connectez un RTD aux bornes à vis du module.

RTD à 2 fils :



RTD à 4 fils :

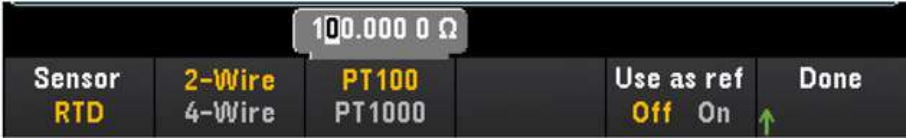


2. Appuyez sur [Channel] > Measure ([Voie] > Mesurer) et sélectionner TEMP (TEMPÉRATURE) dans le menu de sélection.



3. Appuyez sur la touche Units (Unités) pour définir les unités de mesure de la température en °C (Celsius), °F (Fahrenheit), ou K (Kelvin). Vous pouvez mélanger les unités de température sur des voies différentes au sein de l'instrument et sur le même module.

4. Appuyez sur **Sensor Settings** > **Sensor** (Paramètres du capteur>Capteur) et sélectionnez **RTD**. Puis, basculez la touche **2-Wire/4-Wire** (2 fils/4 fils) pour définir le type de sonde de capteur de température utilisée comme RTD à **2 fils** ou **4 fils**. Puis, basculez la touche **PT100/PT1000** pour sélectionner la résistance nominale,  $R_0$ , sur **PT100** (100  $\Omega$ ) ou **PT1000** (1 000  $\Omega$ ).  $R_0$  est la résistance nominale d'un RTD à 0 °C.



5. Appuyez sur **Use as ref** (Utiliser comme ref) pour activer (**On**) ou désactiver (**Off**) l'utilisation de la voie sélectionnée comme la voie de référence pour les mesures suivantes de thermocouple qui précisent une source de référence externe. Cette option n'est disponible qu'en mode **Numériser DMM**.
6. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

## Paramètres avancés

**REMARQUE**

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur la touche **Advanced** (Avancé) pour configurer les paramètres avancés de la mesure.



| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| OffstComp            | La compensation de décalage supprime les effets de petites tensions continues dans le circuit mesuré. La technique implique la prise de la différence entre les deux mesures de résistances, une pour la source de courant fixée à la valeur normale et une autre pour la source de courant fixée à une valeur inférieure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Low Power<br>Off/ On | Sélectionne la mesure de résistance à faible puissance. Cela fournit moins de courant, ce qui donne une plus faible dissipation de puissance et moins d'auto-échauffement de la résistance soumise au test. Généralement, cela est d'environ 1/10 du courant généré pour les mesures de résistances standard. Le courant généré approximatif pour chaque plage de mesures est indiqué au bas des touches de fonction des plages de résistances, par exemple : (~ 1 mA).                                                                                                                                                                                                                                                                                                                                                                        |
| Delay<br>Auto/Time   | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

## Contrainte

Cette section décrit comment configurer la voie sélectionnée pour les mesures de contrainte depuis le panneau avant. Lorsqu'une force est appliquée à un corps, celui-ci se déforme. La déformation par unité de longueur est appelée contrainte ( $\epsilon$ ). La contrainte peut être en extension (+) ou en compression (-). Le DAQ970A/DAQ973A prend en charge deux types de mesures de contrainte : la configuration en pont et la méthode résistive directe.

Une fois la fonction de mesure de la contrainte configurée sur toutes les voies de contrainte, appuyez sur **[Home]** > **Strain Offset** ([Accueil] > Décalage de la contrainte) pour mesurer ou définir le décalage sans contrainte qui sera soustrait des mesures, avant la conversion de la contrainte.

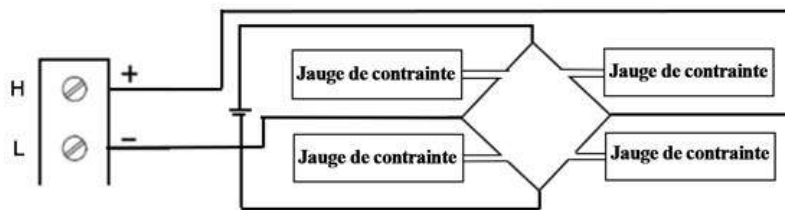
## Configuration en pont

### Pont complet et demi pont selon un agencement en flexion

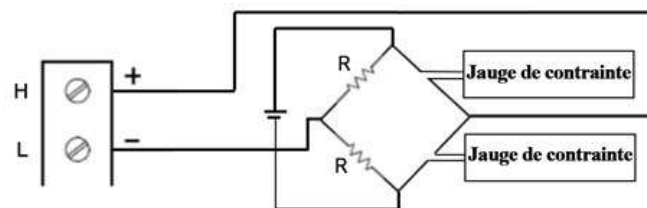
Cette section décrit comment configurer la voie sélectionnée pour les mesures de la jauge de contrainte en demi pont de flexion depuis le panneau avant.

1. Connectez une source de configuration en pont aux bornes à vis du module.

Pont de flexion complète :



Pont de demi flexion :



2. Appuyez sur **[Channel]** > **Measure** ([Voie] > Mesurer) et sélectionnez **STRAIN** (CONTRAINTTE) dans le menu de sélection.



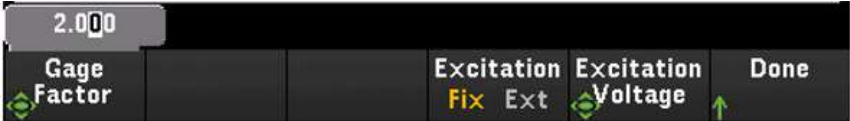
3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. La sélection de plage automatique est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle. L'option **Auto** n'est disponible qu'en mode d'acquisition de données **Digitize DMM**.



4. Appuyez sur **Sense Settings > Sense** (Paramètres de mesure > Mesure), définissez la méthode de mesure de contrainte en tant qu'agencement en flexion en pont complet et en demi pont.



5. Appuyez sur les **Gage Settings (Paramètres de jauge)**, et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir les différents paramètres de jauge de contrainte.



| Touche de fonction     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Le facteur de jauge est le rapport entre la variation fractionnelle de la résistance et la variation fractionnelle de la longueur (contrainte) le long de l'axe de jauge. Plus la valeur est élevée, plus la sensibilité de la jauge de contrainte est élevée. Un facteur de jauge est une quantité sans dimension. La valeur normale est approximativement 2.                                                                                                                                                                                                                                                                                                                                                  |
| Excitation<br>Fix/ Ext | Les conversions de pont de contrainte requièrent la tension d'excitation de pont externe. Pour cette tension, vous pouvez dédier une voie de multiplexeur à la mesure de la tension d'excitation ou définir une valeur de tension fixe connue. Fixe ( <b>Fix</b> ) - La valeur fixe indiquée par la touche de Tension d'excitation sera utilisée pour la conversion de la contrainte. Externe ( <b>Ext</b> ) - Les mesures VCC sur la voie de référence activée seront utilisées pour les mesures de pont de contrainte suivantes qui précisent une source de tension d'excitation externe. La voie de référence VCC externe doit être une voie possédant un numéro inférieur à celui de la voie du numériseur. |
| Excitation<br>Voltage  | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la tension d'excitation fixe appliquée au pont par une source de tension externe. Cette valeur sera utilisée pour convertir les mesures de pont de contrainte sur la voie sélectionnée.                                                                                                                                                                                                                                                                                                                                                                                                                                                |

6. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

### Paramètres avancés

#### REMARQUE

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



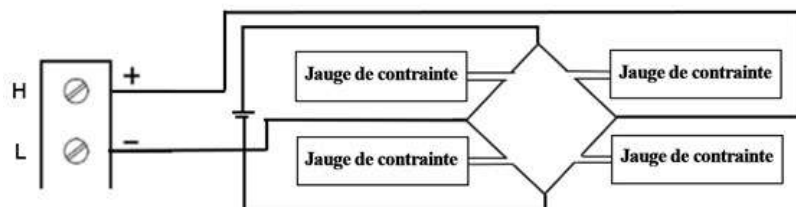
| Touche de fonction   |  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On |  | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| Delay<br>Auto/Time   |  | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

### Pont complet et demi pont selon un agencement de Poisson

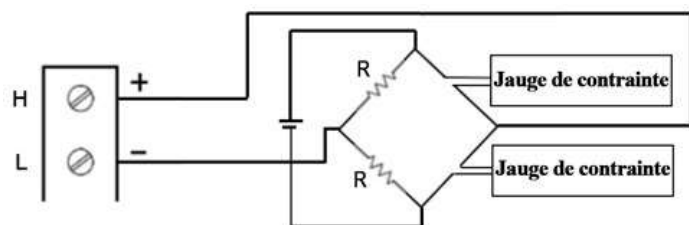
Cette section décrit comment configurer la voie sélectionnée pour les mesures de la jauge de contrainte en pont et demi pont de Poisson depuis le panneau avant.

1. Connectez une source de configuration en pont aux bornes à vis du module.

Pont de flexion complète :



Pont de demi flexion :



2. Appuyez sur [Channel] > Measure ([Voie] > Mesurer) et sélectionnez **STRAIN** (CONTRAINTE) dans le menu de sélection.



3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. Sélection automatique de plage est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.





4. Appuyez sur **Sense Settings > Sense** (Paramètres de mesure > Mesure), définissez la méthode de mesure de contrainte en tant qu'agencement en pont complet et en demi pont de Poisson.



5. Appuyez sur les **Gage Settings (Paramètres de jauge)**, et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir les différents paramètres de jauge de contrainte.



| Touche de fonction     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Le facteur de jauge est le rapport entre la variation fractionnelle de la résistance et la variation fractionnelle de la longueur (contrainte) le long de l'axe de jauge. Plus la valeur est élevée, plus la sensibilité de la jauge de contrainte est élevée. Un facteur de jauge est une quantité sans dimension. La valeur normale est approximativement 2.                                                                                                                                                                                                                                                                                                                                                  |
| Poisson Ratio          | Indique le ratio Poisson de la jauge de contrainte. Le coefficient de Poisson est le ratio négatif de la contrainte dans le sens transversal sur la contrainte dans le sens longitudinal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Excitation<br>Fix/ Ext | Les conversions de pont de contrainte requièrent la tension d'excitation de pont externe. Pour cette tension, vous pouvez dédier une voie de multiplexeur à la mesure de la tension d'excitation ou définir une valeur de tension fixe connue. Fixe ( <b>Fix</b> ) - La valeur fixe indiquée par la touche de Tension d'excitation sera utilisée pour la conversion de la contrainte. Externe ( <b>Ext</b> ) - Les mesures VCC sur la voie de référence activée seront utilisées pour les mesures de pont de contrainte suivantes qui précisent une source de tension d'excitation externe. La voie de référence VCC externe doit être une voie possédant un numéro inférieur à celui de la voie du numériseur. |
| Excitation<br>Voltage  | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la tension d'excitation fixe appliquée au pont par une source de tension externe. Cette valeur sera utilisée pour convertir les mesures de pont de contrainte sur la voie sélectionnée.                                                                                                                                                                                                                                                                                                                                                                                                                                                |

6. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |       | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Intégration        | NPLC  | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Temps | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

### Paramètres avancés

#### REMARQUE

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



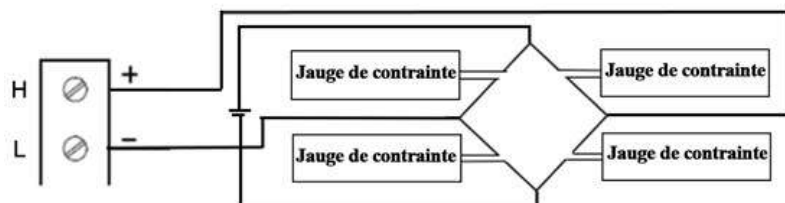
| Touche de fonction   |  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On |  | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
|                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Delay<br>Auto/Time   |  | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

### Pont complet selon un agencement de Poisson en flexion

Cette section décrit comment configurer la voie sélectionnée pour les mesures de la jauge de contrainte en pont de Poisson en flexion depuis le panneau avant.

1. Connectez une source de configuration en pont aux bornes à vis du module.

Pont de flexion complète :



2. Appuyez sur [Channel] > Measure ([Voie] > Mesurer) et sélectionnez **STRAIN** (CONTRAINTE) dans le menu de sélection.



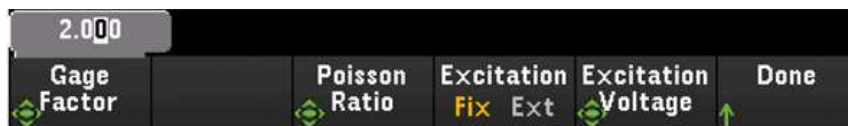
3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. Sélection automatique de plage est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.



4. Appuyez sur **Sense Settings** > **Sense** (Paramètres de mesure > Mesure), définissez la méthode de mesure de contrainte en tant qu'agencement en pont complet de Poisson en flexion.



5. Appuyez sur les **Gage Settings (Paramètres de jauge)**, et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir les différents paramètres de jauge de contrainte.



| Touche de fonction     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Le facteur de jauge est le rapport entre la variation fractionnelle de la résistance et la variation fractionnelle de la longueur (contrainte) le long de l'axe de jauge. Plus la valeur est élevée, plus la sensibilité de la jauge de contrainte est élevée. Un facteur de jauge est une quantité sans dimension. La valeur normale est approximativement 2.                                                                                                                                                                                                                                                                                                                                                  |
| Poisson Ratio          | Indique le ratio Poisson de la jauge de contrainte. Le coefficient de Poisson est le ratio négatif de la contrainte dans le sens transversal sur la contrainte dans le sens longitudinal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Excitation<br>Fix/ Ext | Les conversions de pont de contrainte requièrent la tension d'excitation de pont externe. Pour cette tension, vous pouvez dédier une voie de multiplexeur à la mesure de la tension d'excitation ou définir une valeur de tension fixe connue. Fixe ( <b>Fix</b> ) - La valeur fixe indiquée par la touche de Tension d'excitation sera utilisée pour la conversion de la contrainte. Externe ( <b>Ext</b> ) - Les mesures VCC sur la voie de référence activée seront utilisées pour les mesures de pont de contrainte suivantes qui précisent une source de tension d'excitation externe. La voie de référence VCC externe doit être une voie possédant un numéro inférieur à celui de la voie du numériseur. |
| Excitation<br>Voltage  | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la tension d'excitation fixe appliquée au pont par une source de tension externe. Cette valeur sera utilisée pour convertir les mesures de pont de contrainte sur la voie sélectionnée.                                                                                                                                                                                                                                                                                                                                                                                                                                                |

6. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

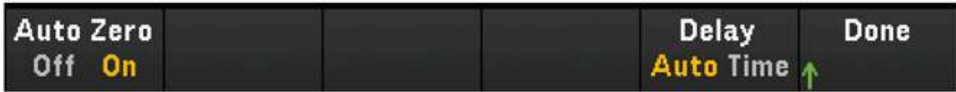
| Touche de fonction  | Description                                                                                                                                                                                                                                                                                                                                |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
| Time                | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

Paramètres avancés

REMARQUE

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.

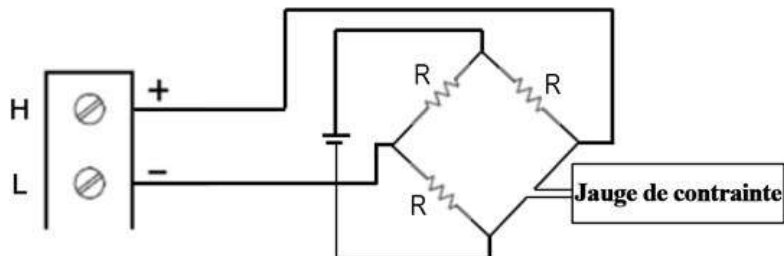


| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| Delay<br>Auto/Time   | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

### Agencement en quart de pont

Cette section décrit comment configurer la voie sélectionnée pour les mesures de la jauge de contrainte en quart de pont depuis le panneau avant.

1. Connectez une source de configuration en pont aux bornes à vis du module.



2. Appuyez sur **[Channel] > Measure ([Voie] > Mesurer)** et sélectionnez **STRAIN** (CONTRAINTE) dans le menu de sélection.



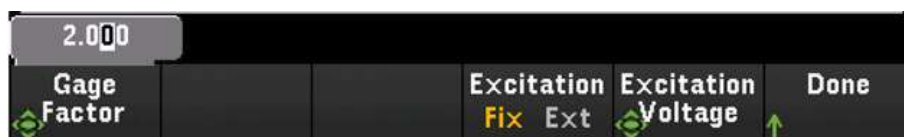
3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. Sélection automatique de plage est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.



4. Appuyez sur **Sense Settings > Sense** (Paramètres de mesure > Mesure), définissez la méthode de mesure de contrainte en tant qu'agencement en quart de pont.



5. Appuyez sur les **Gage Settings (Paramètres de jauge)**, et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir les différents paramètres de jauge de contrainte.



| Touche de fonction     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Le facteur de jauge est le rapport entre la variation fractionnelle de la résistance et la variation fractionnelle de la longueur (contrainte) le long de l'axe de jauge. Plus la valeur est élevée, plus la sensibilité de la jauge de contrainte est élevée. Un facteur de jauge est une quantité sans dimension. La valeur normale est approximativement 2.                                                                                                                                                                                                                                                                                                                                                  |
| Excitation<br>Fix/ Ext | Les conversions de pont de contrainte requièrent la tension d'excitation de pont externe. Pour cette tension, vous pouvez dédier une voie de multiplexeur à la mesure de la tension d'excitation ou définir une valeur de tension fixe connue. Fixe ( <b>Fix</b> ) - La valeur fixe indiquée par la touche de Tension d'excitation sera utilisée pour la conversion de la contrainte. Externe ( <b>Ext</b> ) - Les mesures VCC sur la voie de référence activée seront utilisées pour les mesures de pont de contrainte suivantes qui précisent une source de tension d'excitation externe. La voie de référence VCC externe doit être une voie possédant un numéro inférieur à celui de la voie du numériseur. |
| Excitation<br>Voltage  | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la tension d'excitation fixe appliquée au pont par une source de tension externe. Cette valeur sera utilisée pour convertir les mesures de pont de contrainte sur la voie sélectionnée.                                                                                                                                                                                                                                                                                                                                                                                                                                                |

6. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction     | Description                                                                                                                                                                                                                                                                                                                                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrateate      NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
| Time                   | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

## Paramètres avancés

**REMARQUE**

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| Delay<br>Auto/Time   | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

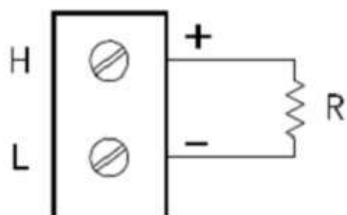


## Méthode résistive directe

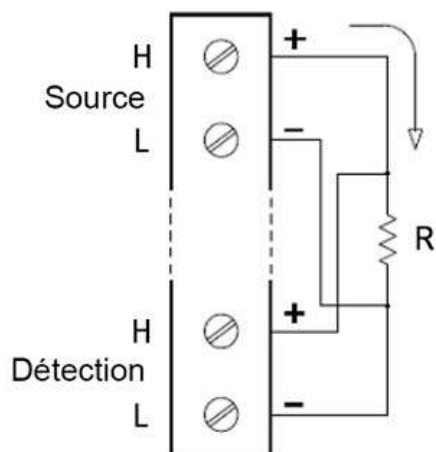
Cette section décrit comment configurer la voie sélectionnée pour les mesures directes de la jauge de contrainte à 2 et 4 fils depuis le panneau avant. Les configurations de mesure pour les résistives directes à 2 et 4 fils sont les mêmes, les descriptions ci-dessous sont expliquées par rapport aux mesures de résistance à 2 fils.

1. Connectez une source de résistive directe aux bornes à vis du module.

Contrainte directe à 2 fils :



Contrainte directe à 4 fils :



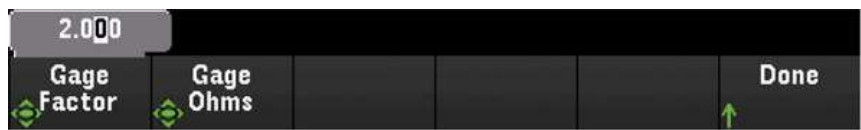
2. Appuyez sur [Channel] > **Measure** ([Voie] > Mesurer) et sélectionnez **STRAIN** (CONTRAINTe) dans le menu de sélection.



3. Appuyez sur **Sense Settings** > **Sense** (Paramètres de mesure > Mesure), définissez la méthode de mesure de contrainte en tant que directe à 2 fils ou 4 fils. Notez que la touche de fonction **Range** (comme indiqué à l'étape 2) ne sera plus disponible pour la configuration une fois la méthode directe à 2 ou 4 fils sélectionnée.



4. Appuyez sur les **Gage Settings (Paramètres de jauge)**, et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir les différents paramètres de jauge de contrainte.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                    |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor        | Le facteur de jauge est le rapport entre la variation fractionnelle de la résistance et la variation fractionnelle de la longueur (contrainte) le long de l'axe de jauge. Plus la valeur est élevée, plus la sensibilité de la jauge de contrainte est élevée. Un facteur de jauge est une quantité sans dimension. La valeur normale est approximativement 2. |
| Gage Ohms          | Résistance de jauge à utiliser pour convertir des mesures de contrainte directe de la voie sélectionnée.                                                                                                                                                                                                                                                       |

5. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

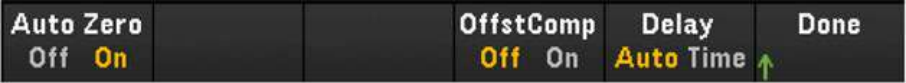
| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC<br>Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time<br>Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

Paramètres avancés

REMARQUE

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.

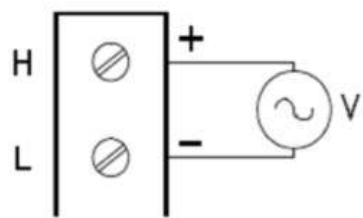


| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| OffstComp<br>Off/ On | La compensation de décalage supprime les effets de petites tensions continues dans le circuit mesuré. La technique implique la prise de la différence entre les deux mesures de résistances, une pour la source de courant fixée à la valeur normale et une autre pour la source de courant fixée à une valeur inférieure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Delay<br>Auto/Time   | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

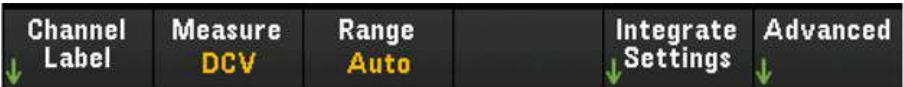
Tension continue

Cette section décrit comment configurer la voie sélectionnée pour les mesures de tension CC à partir du panneau avant.

- 1. Connectez la source de tension aux bornes à vis du module.



- 2. Appuyez sur [Channel] > Measure ([Voie] > Mesure), et sélectionnez DCV depuis le menu de sélection.



- 3. Appuyez sur Range (Plage) et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. Le mode Auto (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. La sélection de plage automatique est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.

**REMARQUE** La sélection de plage automatique n'est pas prise en charge sur le mode acquisition spectrale données Numériser DMM.



- 4. Appuyez sur la touche Integrate Settings (Intégrer les paramètres) pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (NPLC) ou directement en secondes (Time (Temps)). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

## Paramètres avancés

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.

|                                   |                                   |  |                                    |             |
|-----------------------------------|-----------------------------------|--|------------------------------------|-------------|
| <b>Auto Zero</b><br>Off <b>On</b> | <b>Input Z</b><br><b>10M</b> Auto |  | <b>Delay</b><br><b>Auto</b> Time ↑ | <b>Done</b> |
|-----------------------------------|-----------------------------------|--|------------------------------------|-------------|

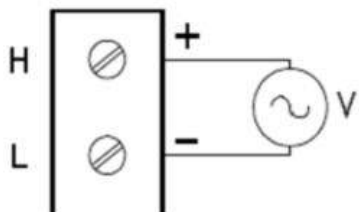
| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | <p>Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé (<b>On</b>), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé (<b>Off</b>), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils).</p> <p><b>REMARQUE</b> Ce paramètre est disponible lorsque <b>Scan (Scrutation)</b> ou <b>DMM Digitize (Numériser DMM)</b> est sélectionné mode d'acquisition de données.</p> |
| Input Z<br>10M/ Auto | <p>Indique l'impédance d'entrée de la borne de mesure, soit 10 M<math>\Omega</math> (<b>10M</b>) soit une haute impédance (<b>Auto</b>). Le mode Auto sélectionne l'impédance haute (&gt; 10 G<math>\Omega</math>) pour les plages 100 mV, 1 V, et 10 V et 10 M<math>\Omega</math> pour les plages 100 V et 300 V. Dans la plupart des situations, 10 M<math>\Omega</math> est suffisamment élevé pour ne pas charger la plupart des circuits, mais suffisamment bas pour effectuer des lectures adaptées aux circuits à impédance élevée. Cette valeur provoque également des lectures présentant moins de bruit que l'option haute impédance, qui est incluse dans les situations où la charge 10 M<math>\Omega</math> est pertinente.</p> <p><b>REMARQUE</b> Ce paramètre est disponible lorsque <b>Scan (Scrutation)</b> ou <b>DMM Digitize (Numériser DMM)</b> est sélectionné mode d'acquisition de données.</p>                                                                                                      |
| Delay<br>Auto/Time   | <p>Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.</p> <p><b>REMARQUE</b> Ce paramètre est disponible uniquement lorsque le mode d'acquisition sélectionné est <b>Scan (Scrutation)</b>.</p>                                                                                                                                                                                                                                                                                                           |

## Tension alternative

**REMARQUE** Cette option de mesure de la tension est disponible uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

Cette section décrit comment configurer la voie sélectionnée pour les mesures de tension CA à partir du panneau avant.

1. Connectez la source de tension CA aux bornes à vis du module.



2. Appuyez sur [Channel] > Measure ([Voie] > Mesure), et sélectionnez **ACV** dans le menu de Sélection.

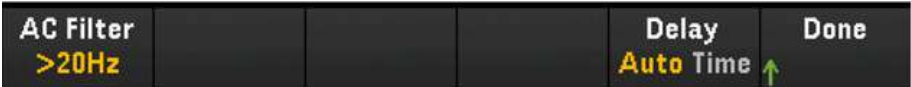
| Channel<br>Label | Measure<br><b>ACV</b> | Range<br><b>Auto</b> |  |  | Advanced |
|------------------|-----------------------|----------------------|--|--|----------|
| ↓                |                       |                      |  |  | ↓        |

3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. La sélection de plage automatique est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.

| Select AC Voltage Range |       |    |     |      |      |
|-------------------------|-------|----|-----|------|------|
| <b>Auto</b>             | 100mV | 1V | 10V | 100V | 300V |

Paramètres avancés

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter          | Indique le filtre CA à utiliser. L'instrument utilise trois filtres CA différents qui vous permettent d'optimiser la précision en basse fréquence ou d'obtenir une stabilisation plus rapide en courant alternatif suite à un changement d'amplitude du signal d'entrée. Les trois filtres sont <b>3 Hz</b> , <b>20 Hz</b> et <b>200 Hz</b> et vous devez généralement sélectionner le filtre à plus haute fréquence dont la fréquence est inférieure au signal que vous mesurez, car les filtres à plus haute fréquence permettent des mesures plus rapides. Par exemple, lorsque vous mesurez un signal entre 20 et 200 Hz, vous devez utiliser le filtre 20 Hz. Si la vitesse de mesure n'est pas une priorité, un filtre à plus basse fréquence peut permettre des mesures plus silencieuses, en fonction du signal que vous mesurez. |
| Delay<br>Auto/Time | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                      |

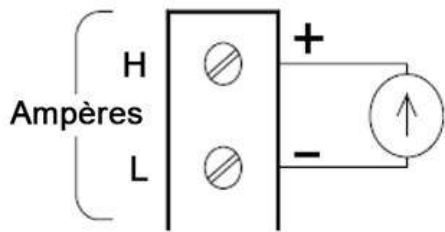
Courant continu

REMARQUE

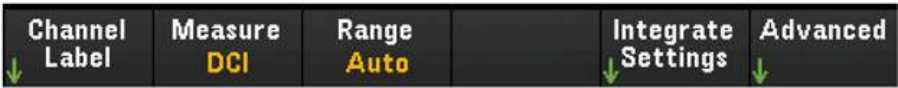
La mesure de courant DC est prise en charge uniquement sur les voies 21 et 22 du DAQM901A.

Cette section décrit comment configurer la voie sélectionnée pour les mesures de courant continu sur le panneau avant.

1. Connectez une source de courant continu aux bornes à vis du module.



2. Appuyez sur [Channel] > Measure ([Voie] > Measure), et sélectionnez DCI depuis le menu de sélection.



3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. Sélection automatique de plage est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle. L'option **Auto** n'est disponible qu'en mode d'acquisition de données **Digitize DMM**.



4. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate          | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

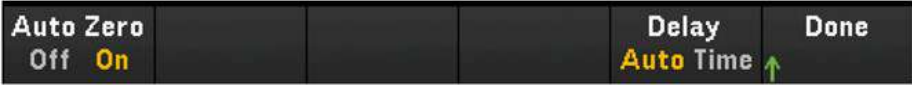


Paramètres avancés

REMARQUE

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| Delay<br>Auto/Time   | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

## Courant alternatif

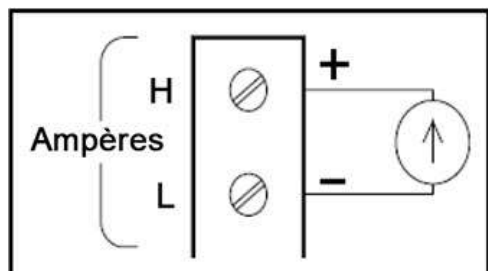
### REMARQUE

Cette option de mesure du courant alternatif est disponible uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

La mesure de courant AC est prise en charge uniquement sur les voies 21 et 22 du DAQM901A.

Cette section décrit comment configurer la voie sélectionnée pour les mesures de courant alternatif à partir du panneau avant.

1. Connectez une source de courant aux bornes à vis d'un module.



2. Appuyez sur [Channel] > **Measure** ([Voie] > Mesure), et sélectionnez **ACI** dans le menu de Sélection.



3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** le mode (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. Sélection automatique de plage est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.



Paramètres avancés

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



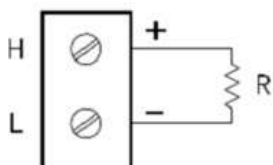
| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter          | Indique le filtre CA à utiliser. L'instrument utilise trois filtres CA différents qui vous permettent d'optimiser la précision en basse fréquence ou d'obtenir une stabilisation plus rapide en courant alternatif suite à un changement d'amplitude du signal d'entrée. Les trois filtres sont <b>3 Hz</b> , <b>20 Hz</b> et <b>200 Hz</b> et vous devez généralement sélectionner le filtre à plus haute fréquence dont la fréquence est inférieure au signal que vous mesurez, car les filtres à plus haute fréquence permettent des mesures plus rapides. Par exemple, lorsque vous mesurez un signal entre 20 et 200 Hz, vous devez utiliser le filtre 20 Hz. Si la vitesse de mesure n'est pas une priorité, un filtre à plus basse fréquence peut permettre des mesures plus silencieuses, en fonction du signal que vous mesurez. |
| Delay<br>Auto/Time | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                      |

## Résistance

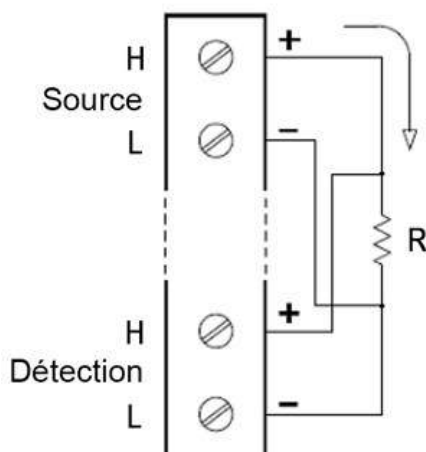
Cette section décrit comment configurer la voie sélectionnée pour les mesures à 2 et 4 fils depuis le panneau avant. Les configurations de mesure pour les résistances à 2 et 4 fils sont les mêmes, les descriptions ci-dessous sont expliquées par rapport aux mesures de résistance à 2 fils.

1. Connectez une source de résistance aux bornes à vis du module.

Résistances en deux fils :



Résistances en quatre fils :



2. Appuyez sur **[Channel] > Measure** ([Voie] > Mesurer) et sélectionner **OHMS** (RÉSISTANCE) ou **OHMS 4W** (RÉSISTANCE 4 W) dans le menu de sélection.

|                  |                 |               |  |                       |          |
|------------------|-----------------|---------------|--|-----------------------|----------|
| Channel<br>Label | Measure<br>OHMS | Range<br>Auto |  | Integrate<br>Settings | Advanced |
| ↓                |                 |               |  | ↓                     | ↓        |

3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. **Automatique** (*disponible uniquement lorsque le mode d'acquisition de données sélectionné est **Scan (Scrutation)***) sélectionne automatiquement la plage de mesure selon l'entrée. La sélection de plage automatique est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle. L'option **Auto** n'est disponible qu'en mode d'acquisition de données **Digitize DMM**.



4. Appuyez sur la touche **Integrate Settings (Intégrer les paramètres)** pour déterminer si le temps d'intégration de la mesure sera spécifié en termes de Nombre de cycles de tension d'alimentation (**NPLC**) ou directement en secondes (**Time (Temps)**). Seuls 1, 2, 10, 20, 100 et 200 PLC fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 200 PLC fournit les meilleurs rejet et résolution du bruit, mais les mesures les plus lentes.

| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integraten         | NPLC | Définit le temps d'intégration à 0,001 ; 0,002 ; 0,006 ; 0,02 ; 0,06 ; 0,2 ; 1 ; 2 ; 10 ; 20 ; 100 et 200 cycles sur courant porteur (PLC). Seuls 1 PLC et des temps plus importants fournissent un rejet en mode normal (bruit de la fréquence de ligne). Sélectionner 100 ou 200 PLC fournit les meilleurs rejet et résolution du bruit. |
|                    | Time | Définit directement le temps d'intégration en secondes.                                                                                                                                                                                                                                                                                    |

## Paramètres avancés

**REMARQUE**

Dans le mode d'acquisition de données **Numériser DMM**, seul le paramètre **Auto Zero** (Zéro automatique) est disponible dans les paramètres **Avancés**.

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.

|                  |  |                  |                  |              |             |
|------------------|--|------------------|------------------|--------------|-------------|
| <b>Auto Zero</b> |  | <b>OffstComp</b> | <b>Low Power</b> | <b>Delay</b> | <b>Done</b> |
| Off On           |  | Off On           | Off On           | Auto Time ↑  |             |

| Touche de fonction   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Le Auto Zero (Zéro automatique) fournit les mesures les plus précises, mais demande plus de temps de mesure en raison de la gestion du zéro. Lorsque le zéro automatique est activé ( <b>On</b> ), l'instrument mesure en interne le décalage après chaque mesure. Il soustrait ensuite cette mesure de la lecture précédente. Cette méthode évite que des tensions de décalage présentes sur le circuit d'entrée de l'instrument ne perturbent la précision de la mesure. Lorsque le zéro automatique est désactivé ( <b>Off</b> ), l'instrument mesure une fois le décalage et le soustrait de toutes les mesures suivantes. L'instrument recueille une nouvelle mesure du décalage à chaque fois que vous changez de fonction, de plage ou de temps d'intégration. (Il n'y a pas de réglage de zéro automatique pour les mesures à 4 fils). |
| OffstCmp<br>Off/ On  | La compensation de décalage supprime les effets de petites tensions continues dans le circuit mesuré. La technique implique la prise de la différence entre les deux mesures de résistances, une pour la source de courant fixée à la valeur normale et une autre pour la source de courant fixée à une valeur inférieure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Low Power<br>Off/ On | Sélectionne la mesure de résistance à faible puissance. Cela fournit moins de courant, ce qui donne une plus faible dissipation de puissance et moins d'auto-échauffement de la résistance soumise au test. Généralement, cela est d'environ 1/10 du courant généré pour les mesures de résistances standard. Le courant généré approximatif pour chaque plage de mesures est indiqué au bas des touches de fonction des plages de résistances, par exemple : (~ 1 mA).                                                                                                                                                                                                                                                                                                                                                                        |
| Delay<br>Auto/Time   | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                           |

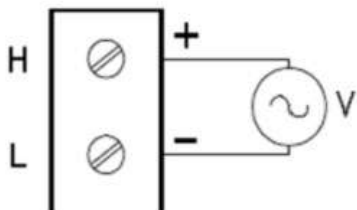
## Fréquence et période

### REMARQUE

Cette option de mesure de la Fréquence et de la Période est disponible uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

Cette section décrit comment configurer la voie sélectionnée pour les mesures de fréquence et de période à partir du panneau avant.

1. Connectez une source alternative aux bornes à vis du module.



2. Appuyez sur **[Channel] > Measure** ([Voie] > Mesurer) et sélectionnez **FREQ** (FRÉQUENCE) ou **PERIOD** (PÉRIODE) dans le menu de sélection.

| Channel Label | Measure     | Range       | Gate Time    | Advanced |
|---------------|-------------|-------------|--------------|----------|
| ↓             | <b>FREQ</b> | <b>Auto</b> | <b>100ms</b> | ↓        |

3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. Le mode **Auto** (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l'entrée. La sélection de plage automatique est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.

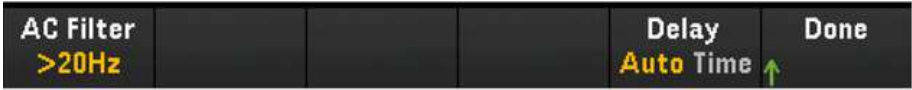
| Select Frequency Voltage Range |       |    |     |      |      |
|--------------------------------|-------|----|-----|------|------|
| <b>Auto</b>                    | 100mV | 1V | 10V | 100V | 300V |

4. Appuyez sur **Gate Time** (Temps de porte) pour régler l'ouverture de la mesure (temps d'intégration) à 1 ms, 10 ms, 100 ms, ou 1 s.

| Select Gate Time |      |              |    |  |  |
|------------------|------|--------------|----|--|--|
| 1ms              | 10ms | <b>100ms</b> | 1s |  |  |

Paramètres avancés

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter          | Indique le filtre CA à utiliser. L'instrument utilise trois filtres CA différents qui vous permettent d'optimiser la précision en basse fréquence ou d'obtenir une stabilisation plus rapide en courant alternatif suite à un changement d'amplitude du signal d'entrée. Les trois filtres sont <b>3 Hz</b> , <b>20 Hz</b> et <b>200 Hz</b> et vous devez généralement sélectionner le filtre à plus haute fréquence dont la fréquence est inférieure au signal que vous mesurez, car les filtres à plus haute fréquence permettent des mesures plus rapides. Par exemple, lorsque vous mesurez un signal entre 20 et 200 Hz, vous devez utiliser le filtre 20 Hz. Si la vitesse de mesure n'est pas une priorité, un filtre à plus basse fréquence peut permettre des mesures plus silencieuses, en fonction du signal que vous mesurez. |
| Delay<br>Auto/Time | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais.                                                                                                                                                                                                                                                                      |



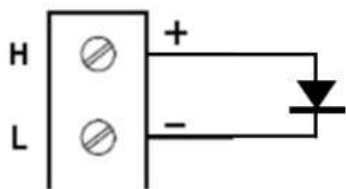
Diode

REMARQUE

L’option de mesure de la Diode est disponible uniquement lorsque le mode d’acquisition sélectionné est **Scan** (Scrutation).

Cette section décrit comment configurer la voie sélectionnée pour le test de diode depuis le panneau avant.

1. Connectez une source alternative aux bornes à vis du module.

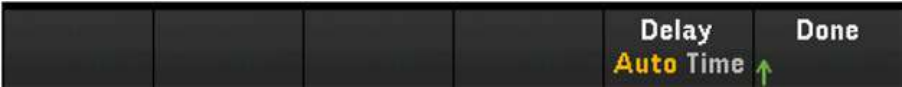


2. Appuyez sur [Channel] > Measure ([Voie] > Mesurer) et sélectionnez **DIODE** dans le menu de sélection.



Paramètres avancés

Appuyez sur **Advanced** (Avancé) pour configurer les paramètres avancés de la mesure.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delay<br>Auto/Time | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais. |

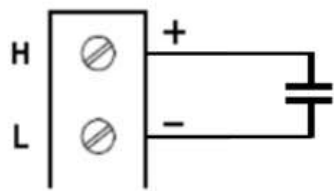
Capacité

REMARQUE

L’option de mesure de capacitance est disponible uniquement lorsque le mode d’acquisition sélectionné est **Scan** (Scrutation).

Cette section décrit comment configurer la voie sélectionnée pour les mesures de capacité depuis le panneau avant.

1. Connectez une source de capacité aux bornes à vis d'un module.



2. Appuyez sur **[Channel]** > **Measure** ([Voie] > Mesurer) et sélectionnez **CAP** dans le menu de sélection.



3. Appuyez sur **Range (Plage)** et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la plage de mesure. Le mode Auto (sélection automatique de la plage) sélectionne automatiquement la plage de mesure selon l’entrée. La sélection de plage automatique est pratique, mais demande plus de temps pour réaliser les mesures que la sélection manuelle. La sélection de plage automatique augmente à 120 % de la plage actuelle, descend sous 10 % de la plage actuelle.



Paramètres avancés

Appuyez sur **Advanced (Avancé)** pour configurer les paramètres avancés de la mesure.

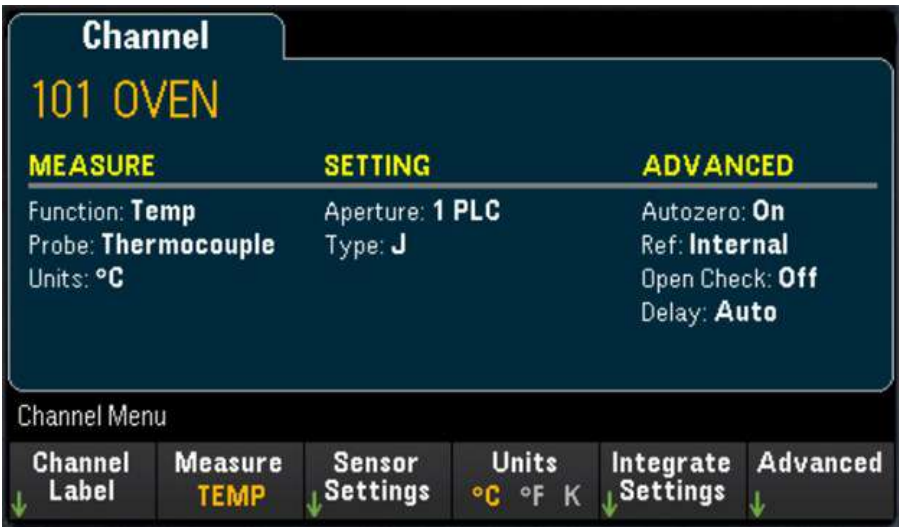


| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delay<br>Auto/Time | Sélectionne si le délai entre les canaux dans la liste de scrutation sera automatiquement ou manuellement sélectionné. Si <b>Auto</b> est sélectionné, l'instrument détermine automatiquement le délai de voie selon la fonction de mesure, la plage, le temps d'intégration et le paramètres de filtre CA. Si <b>Time (Temps)</b> est sélectionné, le délai défini (temps en secondes) est inséré entre la fermeture du relais et la mesure réelle recueillie sur chaque voie, en plus de tout délai produit implicitement par le temps de stabilisation du relais. |

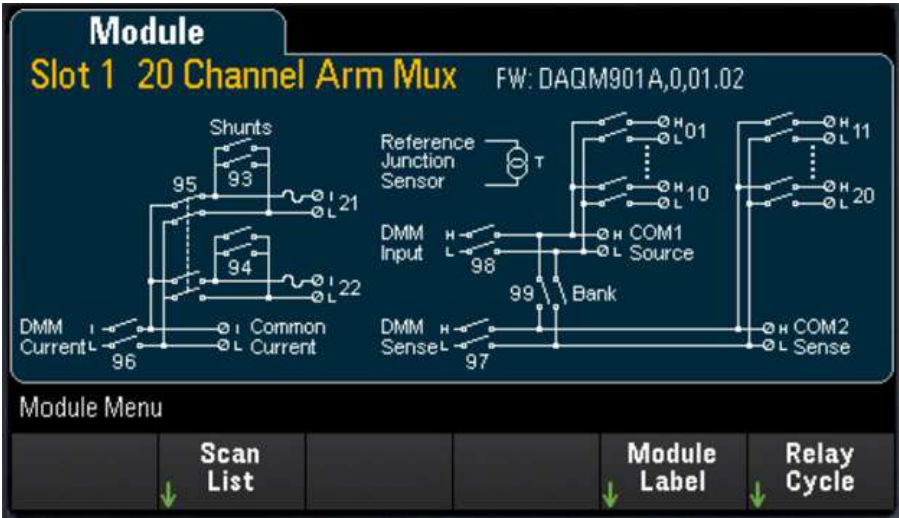
## Modules multiplexeurs : Changer de mode

Les modules multiplexeurs (DAQM900A, DAQM901A, DAQM902A, et DAQM908A) sont également capables de fonctionner en mode commutateur ce qui vous permet d'ouvrir et fermer les voies de façon indépendante. La section ci-dessous décrit les étapes nécessaires pour activer et configurer le mode commutateur.

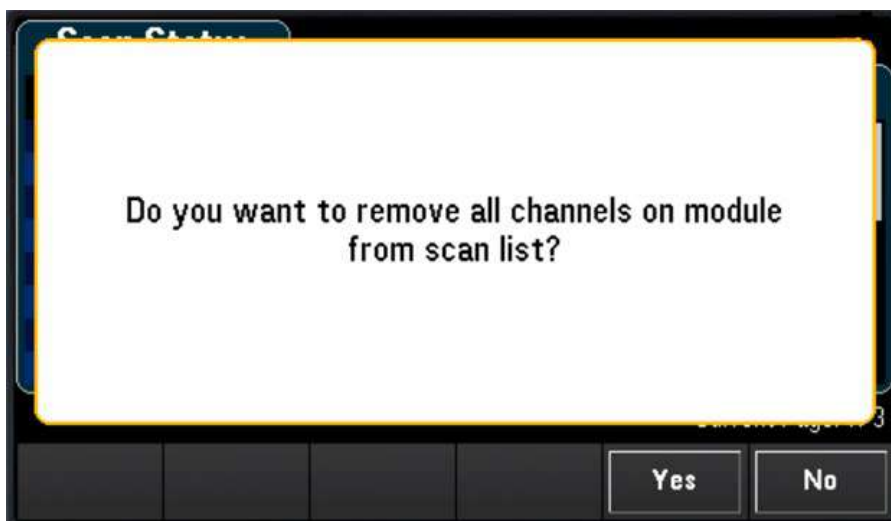
1. Appuyez sur la touche **[Channel]** ([Voie]) pour accéder au menu Channel (Voie). Dans l'exemple ci-dessous, la voie 101 d'un module DAQM901A situé dans le logement 1, identifié comme OVEN (FOUR), est réglée pour mesurer la température en degrés °C à l'aide d'un thermocouple de type J.



2. Appuyez sur la touche **[Module]** pour accéder au menu Module. Appuyez ensuite sur la touche **Scan List** (Liste de scrutation).



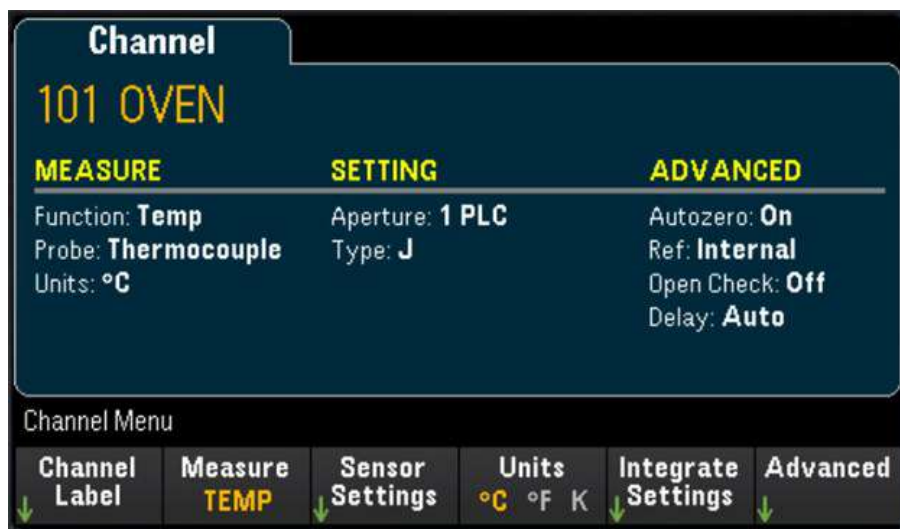
3. Vous remarquerez que la voie 101 est identifiée comme OVEN (FOUR) et l'État de la scrutation est activé (ON). Appuyez sur la touche **Remove From Scan** (Retirer de la scrutation). Vous êtes invité à confirmer votre action. Appuyez sur la touche **Yes** (Oui) pour confirmer la suppression de toutes les voies du module de la liste de scrutation. Cette action désactive les mesures pour les voies du module et le place en mode commutateur.



4. Appuyez sur la touche **[Channel]** ([Voie]) pour revenir au menu Channel (Voie). Notez que les touches **Open** (Ouvrir) et **Close** (Fermer) sont à présent disponibles puisque le module est maintenant en mode commutateur. L'identification de la voie est conservée. Vous pouvez appuyer sur la touche **Close** (Fermer) pour changer l'état de la voie.



5. Pour revenir au mode scrutation, appuyez sur la touche **Measure** (Mesure) et sélectionnez un mode de mesure. Dans l'exemple ci-dessous, TEMP est sélectionné et le module est maintenant de retour en mode scrutation. La mesure de température est rétablie et les touches **Open** (Ouvrir) et **Close** (Fermer) ne sont plus disponibles.



## Module multifonction – DAQM907A

La section suivante décrit comment configurer chacune des voies du module DAQM907A. 7 voies sont disponibles sur le module multifonction DAQM907A comme indiqué dans le tableau ci-dessous :

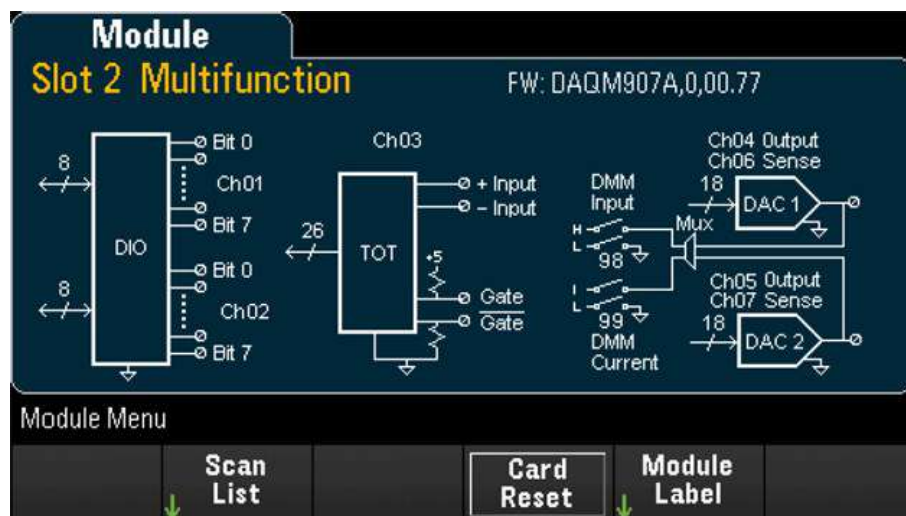
| Numéro de la voie | Libellé de la voie                                             |
|-------------------|----------------------------------------------------------------|
| 01                | Voie d'E/S numérique 8 bits                                    |
| 02                | Voie d'E/S numérique 8 bits                                    |
| 03                | Voie du totalisateur                                           |
| 04                | Voie de sortie du convertisseur numérique-analogique           |
| 05                | Voie de sortie du convertisseur numérique-analogique           |
| 06                | Voie de mesure de sortie du convertisseur numérique-analogique |
| 07                | Voie de mesure de sortie du convertisseur numérique-analogique |

### Voies d'E/S numérique (DIO) (Voies 01 et 02)

Le module multifonction DAQM907A comporte deux ports non isolés d'entrées/sorties sur 8 bits que vous pouvez utiliser pour lire des séquences numériques. Vous pouvez lire l'état actif des bits sur le port ou vous pouvez configurer une scrutation afin qu'elle comprenne une lecture numérique.

#### Configurer la voie DIO

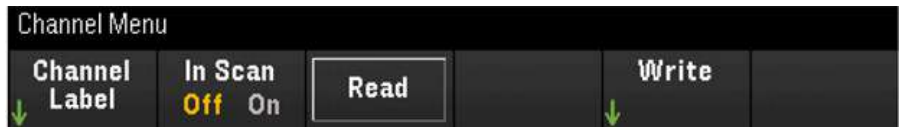
1. Appuyez sur **[Module]** et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner le logement contenant le module multifonction.



2. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner les voies DIO (Voies 01 et 02).



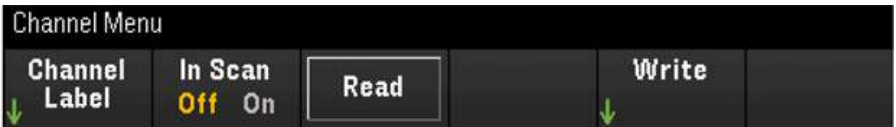
3. Appuyez sur **In Scan** (En scrutation) pour indiquer s'il faut inclure (**On**) ou exclure (**Off**) la voie DIO dans la liste de scrutation.



| Touche de fonction | Description                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------|
| Read               | Appuyez sur la touche Read (Lire) pour lire les séquences de bits d'un port d'entrée numérique.    |
| Write              | Appuyez sur la touche Write (Écrire) pour indiquer et envoyer la séquence de bits au port indiqué. |

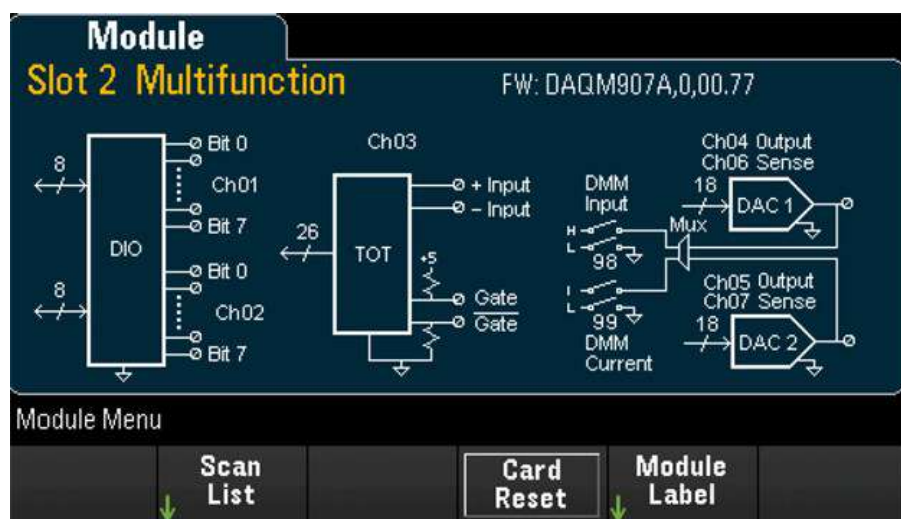
**Lire un port d'entrée numérique**

Appuyez sur la touche **Read** (Lire) pour définir la direction DIO comme entrée.



## Écrire sur une entrée numérique

1. Appuyez sur **[Module]** et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner le logement contenant le module multifonction.



2. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner les voies DIO (Voies 01 et 02).





3. Appuyez sur **Write > Base** (Écrire > Base) et utilisez le bouton ou les touches fléchées du panneau avant pour sélectionner la base de numération utilisée (**Hexadécimale**, **Binaire** ou **Décimale**), et appuyez sur **Pattern** (Séquence) pour définir chaque séquence de sortie de la base sélectionnée.



4. Appuyez sur **Write Pattern** (Écrire la séquence) pour produire la séquence de bits sur le port de sortie numérique sélectionné. La direction DIO sera définie sur Sortie.



5. Appuyez sur **Clear** (Effacer) pour régler la séquence de sortie sur « 0 ».



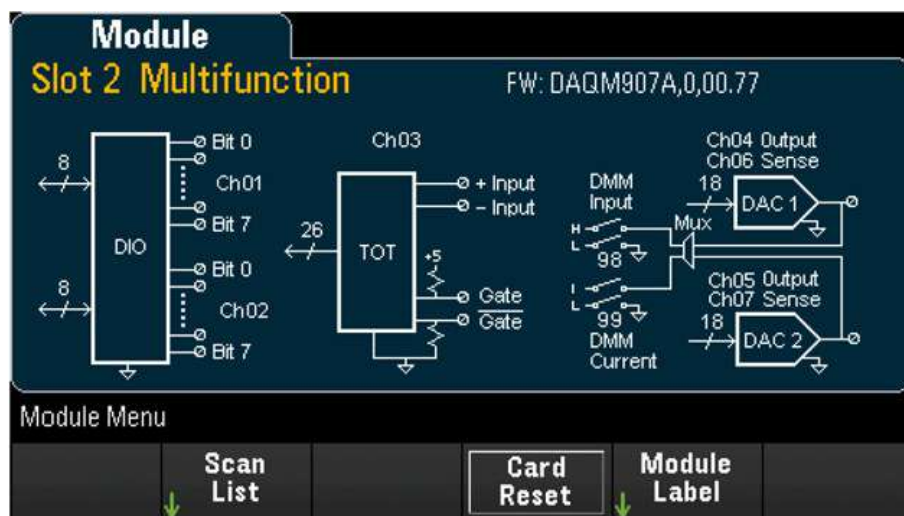
### Voie du totalisateur

Le module multifonction DAQM907A comporte un totaliseur 26 bits pouvant compter des impulsions compatibles TTL à la fréquence de 100 kHz. La voie du totalisateur est numérotée « s03 », où « s » représente le numéro de logement. La voie de totalisateur est numérotée voie 03.

Vous pouvez lire manuellement le comptage du totalisateur ou vous pouvez configurer une scrutation pour lire ce comptage.

Pour configurer la voie du totalisateur avec le module multifonctions :

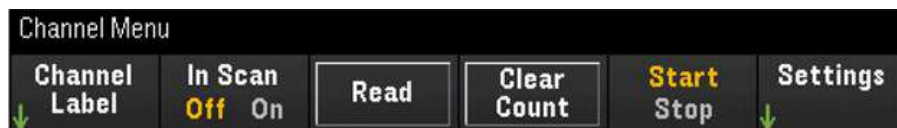
1. Appuyez sur **[Module]** et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner le logement contenant le module multifonction DAQM907A.



2. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner la voie du totalisateur (Voie 03).



3. Appuyez sur **In Scan** (En scrutation) pour indiquer s'il faut inclure (**On**) ou exclure (**Off**) la voie du totalisateur dans la liste de scrutation.



4. Appuyez sur **Settings > Edge** (Paramètres > Front) pour indiquer si la voie du totalisateur doit être comptabilisée sur le front montant (**Pos**) ou le front descendant (**Neg**) d'un signal d'entrée, puis appuyez sur **Read Reset** (Lire Remettre à zéro) pour indiquer si la voie du totalisateur doit être automatiquement remise à zéro (**On**) ou non (**Off**) lors de la lecture.



5. Appuyez sur **Read** (Lire) pour lire le compteur du totalisateur. Le comptage est lu une fois à chaque fois que vous appuyez sur Read (Lire) ; le comptage ne s'actualise pas automatiquement à l'écran.



6. Appuyez sur **Clear Count** (Effacer le compteur) pour réinitialiser à « 0 » le compteur du totalisateur.
7. Appuyez sur la touche Start/Stop (Démarrer/Arrêter) pour alterner entre **Start** (Démarrer) pour commencer le décompte de la voie du totalisateur actuelle ou **Stop** (Arrêter) pour l'arrêter.

### Voies de sortie de CNA et de mesure (Voies 04 à 07)

Le module multifonctions DAQM907A dispose de deux voies de sortie de CNA (voies 04 et 05), et deux voies de mesure de sortie de CNA (voies 06 et 07). Une scrutation peut être réalisée sur chacune de ces voies.

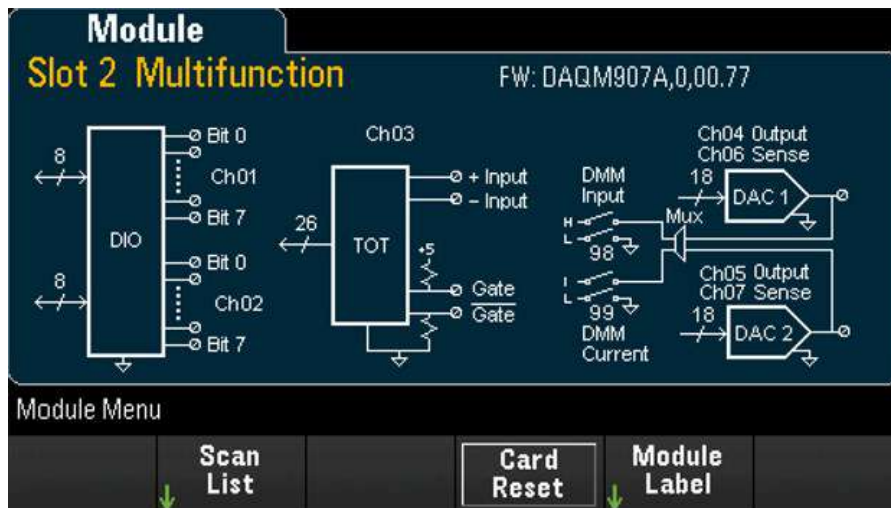
Pour les voies de sortie CNA, aucune mesure de sortie réelle n'est réalisée ; la valeur de scrutation sera la valeur de sortie programmée (tension ou courant).

Les voies de mesure de sortie CNA seront une mesure complémentaire (tension ou courant) basée sur le mode de sortie de la voie de sortie du CNA correspondante :

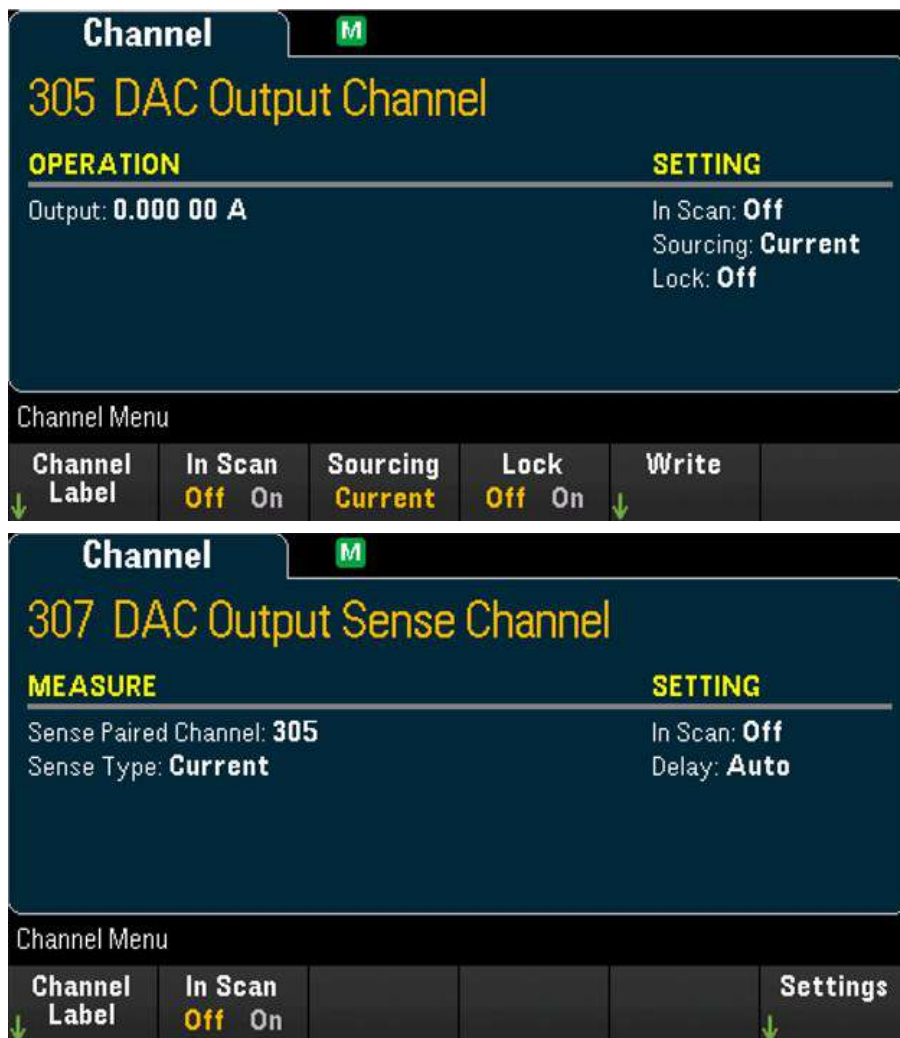
- La voie 06 prendra la mesure basée sur le mode de sortie défini pour la voie 04.
- La voie 07 prendra la mesure basée sur le mode de sortie défini pour la voie 05.

Si la voie 04 de sortie du CNA est réglée sur le mode tension, alors la voie 06 de mesure du CNA correspondante mesurera le courant. Si la voie de sortie est réglée sur mode courant, la voie de mesure mesurera la tension.

1. Appuyez sur **[Module]** et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner le logement contenant le module multifonction.



- Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées du panneau avant pour sélectionner les voies de sortie du CNA (voies 04 et 05) ou les voies de mesure du CNA (voies 06 et 07).



- Appuyez sur **In Scan** (En scrutation) pour indiquer s'il faut inclure (On) ou exclure (Off) la voie du CNA dans la liste de scrutation.
- Appuyez sur **Sourcing** (Génération de source) pour définir le mode de sortie dans la voie de sortie du CNA sur **Voltage** (Tension) ou **Current** (Courant).
- Basculez sur **Lock (On)** (Verrouillage (On)) pour verrouiller le mode voie de sortie du CNA ou sur **Lock (Off)** (Verrouillage (Off)) pour désactiver le verrouillage du mode voie de sortie du CNA.
- Appuyez sur **Write > Output** (Écrire > Sortie) pour définir le niveau de tension/courant de sortie, puis appuyez sur **Write Output** (Écrire sortie) pour produire une tension/un courant de la voie de sortie du CNA sélectionnée.

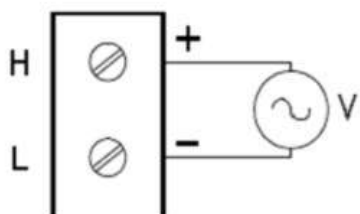
## Module numériseur 4 voies 24 bits – DAQM909A

Le module DAQM909A peut être configuré pour numériser la tension DC (courant alternatif) et la contrainte. La section suivante décrit comment configurer les voies du module DAQM909A.

### Tension CC (tension alternative)

Cette section décrit comment configurer les voies sur le module DAQM909A pour les mesures de tension CC à partir du panneau avant.

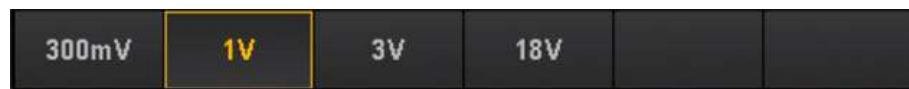
1. Connectez la source de tension aux bornes à vis du module.



2. Appuyez sur [Channel] > Measure ([Voie] > Mesure), et sélectionnez DCV depuis le menu de sélection.

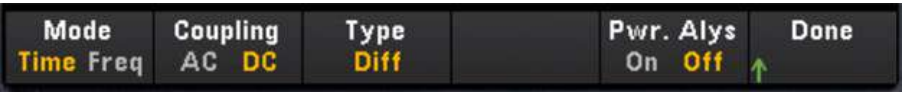


3. Appuyez sur la **Volt Range** (Plage de tension) pour définir la plage de mesures de tension alternative. Vous pouvez sélectionner 300 mV, 1 V (valeur par défaut), 3 V, ou 18 V.



Paramètres avancés

Appuyez sur Advanced (Avancé) pour configurer les paramètres avancés pour le numériseur.



| Touche de fonction   |      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>Time/Freq    |      | Détermine le mode de filtrage ADC. Appuyez sur la touche <b>Mode</b> pour régler l'entrée en mode domaine de temps ( <b>Time</b> (Temps)) ou en mode domaine de fréquence ( <b>Freq</b> (Fréquence)). Lorsque le mode <b>Time</b> (Temps) est sélectionné, l'ADC embarqué est configuré pour utiliser le filtre Sinc5. Lorsque le mode <b>Freq</b> (Fré-<br>quence) est sélectionné, l'ADC embarqué est configuré pour utiliser le filtre large bande. |
| Coupling<br>AC/DC    |      | Appuyez sur la touche <b>Coupling</b> (Couplage) pour modifier la façon dont le graphique est affiché, en mode AC ou DC. En mode <b>AC</b> , le couplage en courant alternatif affiche le signal DC normalisé à une moyenne de zéro. En mode DC, le couplage en courant continu affiche le signal initial à l'écran.                                                                                                                                   |
| Type                 | Diff | L'entrée différentielle ( <b>Diff</b> ) mesure les signaux d'entrée des bornes d'entrée haute et basse.                                                                                                                                                                                                                                                                                                                                                |
|                      | Send | L'entrée unipolaire ( <b>Send</b> ) mesure les signaux d'entrée de la borne d'entrée haute et de la borne d'entrée basse à la terre.                                                                                                                                                                                                                                                                                                                   |
|                      | lepe | Le capteur Integrated Electronics Piezo Electric ( <b>lepe</b> ) (IEPE en 2 fils avec masse 100 Ohms LO) mesure les signaux d'entrée avec un courant direct fourni aux bornes d'entrée haute et basse.                                                                                                                                                                                                                                                 |
| Pwr. Alys<br>On/ Off |      | Appuyez sur la touche <b>Pwr. Alys</b> (Analyse de puissance) pour activer ( <b>On</b> ) ou désactiver ( <b>Off</b> ) la fonction d'analyse de puissance de la voie sélectionnée pendant le post-traitement des données dans le menu View (Vue).                                                                                                                                                                                                       |

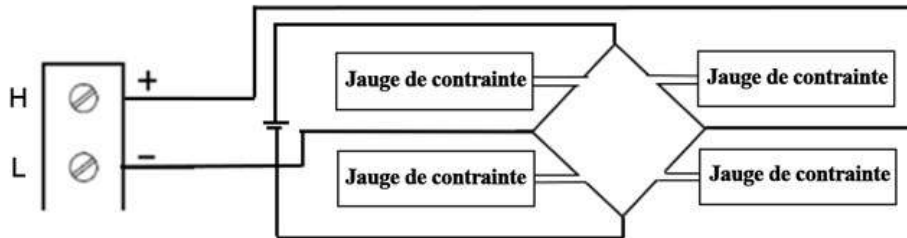
**REMARQUE** Voir **Analyse de puissance** pour plus de détails

## Contrainte

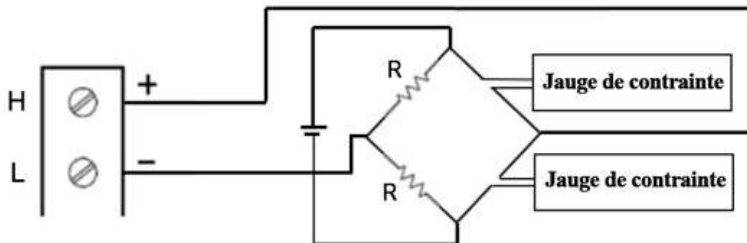
Cette section décrit comment configurer les voies sur le module DAQM909A pour les mesures de contrainte à partir du panneau avant.

1. Connectez la source de configuration en pont souhaitée aux bornes à vis du module.

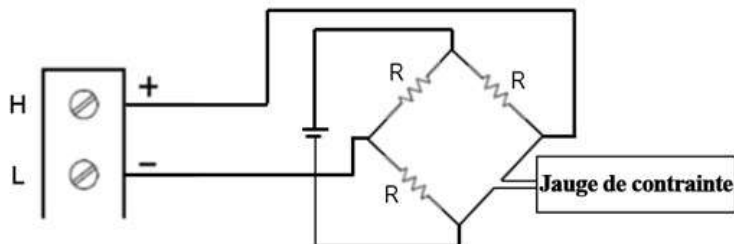
Pont de flexion complète :



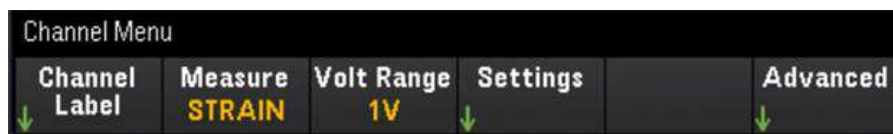
Pont de demi flexion :



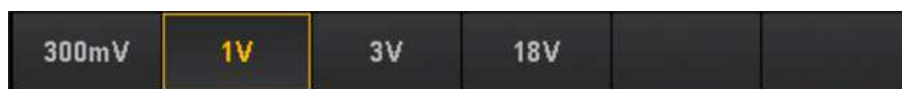
Quart de pont :



2. Appuyez sur **[Channel] > Measure ([Voie] > Mesurer)** et sélectionnez **STRAIN** (CONTRAINTE) dans le menu de sélection.



3. Appuyez sur la **Volt Range** (Plage de tension) pour définir la plage de mesures de tension alternative. Vous pouvez sélectionner 300 mV, 1 V (valeur par défaut), 3 V, ou 18 V.





4. Appuyez sur la Param touche **Settings > Sense** (Paramètres>Captation) pour définir la méthode de mesure de contrainte selon la configuration du pont paramétrée à l'étape 1.



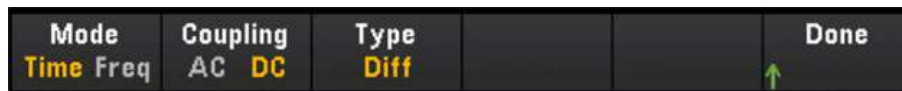
5. Appuyez sur la Param touche **Gage Settings** (Jauge) pour définir les différents paramètres de la jauge de contrainte.



| Touche de fonction                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor                                                                                                                                                         | Le facteur de jauge est le rapport entre la variation fractionnelle de la résistance et la variation fractionnelle de la longueur (contrainte) le long de l'axe de jauge. Plus la valeur est élevée, plus la sensibilité de la jauge de contrainte est élevée. Un facteur de jauge est une quantité sans dimension. La valeur normale est approximativement 2. |
| Poisson Ratio                                                                                                                                                       | Indique le ratio Poisson de la jauge de contrainte. Le coefficient de Poisson est le ratio négatif de la contrainte dans le sens transversal sur la contrainte dans le sens longitudinal.                                                                                                                                                                      |
| <div>REMARQUE</div> La touche du coefficient de Poisson n'est disponible que lorsque « Poisson » est défini en tant que type dans le menu <b>Sense</b> (Captation). |                                                                                                                                                                                                                                                                                                                                                                |
| Excitation Voltage                                                                                                                                                  | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la tension d'excitation fixe appliquée au pont par une source de tension externe. Cette valeur sera utilisée pour convertir les mesures de pont de contrainte sur la voie sélectionnée.                                                                                               |

## Paramètres avancés

Appuyez sur Advanced (Avancé) pour configurer les paramètres avancés pour le numériseur.



| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>Time/Freq  |      | Détermine le mode de filtrage ADC. Appuyez sur la touche <b>Mode</b> pour régler l'entrée en mode domaine de temps ( <b>Time</b> (Temps)) ou en mode domaine de fréquence ( <b>Freq</b> (Fréquence)). Lorsque le mode <b>Time</b> (Temps) est sélectionné, l'ADC embarqué est configuré pour utiliser le filtre Sinc5. Lorsque le mode <b>Freq</b> (Fréquence) est sélectionné, l'ADC embarqué est configuré pour utiliser le filtre large bande. |
| Coupling<br>AC/DC  |      | Appuyez sur la touche <b>Coupling</b> (Couplage) pour modifier la façon dont le graphique est affiché, en mode AC ou DC. En mode <b>AC</b> , le couplage en courant alternatif affiche le signal DC normalisé à une moyenne de zéro. En mode DC, le couplage en courant continu affiche le signal initial à l'écran.                                                                                                                              |
| Type               | Diff | L'entrée différentielle ( <b>Diff</b> ) mesure les signaux d'entrée des bornes d'entrée haute et basse.                                                                                                                                                                                                                                                                                                                                           |
|                    | Send | L'entrée unipolaire ( <b>Send</b> ) mesure les signaux d'entrée de la borne d'entrée haute et de la borne d'entrée basse à la terre.                                                                                                                                                                                                                                                                                                              |
|                    | lepe | Le capteur Integrated Electronics Piezo Electric ( <b>lepe</b> ) (IEPE en 2 fils avec masse 100 Ohms LO) mesure les signaux d'entrée avec un courant direct fourni aux bornes d'entrée haute et basse                                                                                                                                                                                                                                             |

## Voie calculée

Une voie calculée effectue des opérations mathématiques sur les lectures des voies de mesure ou d'autres voies calculées. Pour configurer, appuyez sur **Channel** (Voie) et utilisez le bouton ou la touche fléchée de droite pour sélectionner l'une des voies calculées (voies 401 à 420).

**REMARQUE**

Vous devez configurer la (les) voie(s) de mesure avant d'effectuer les opérations mathématiques sur la voie calculée.

La surveillance des voies calculées n'est disponible que pendant la scrutation et n'affiche que les mesures du balayage le plus récent.

La voie calculée n'est pas disponible lorsque le mode Numériser DMM ou Numériseur est sélectionné comme mode d'acquisition de données.



Appuyez sur **In Scan** (En scrutation) pour indiquer si la voie calculée est incluse (On) ou non (Off) de la liste de scrutation. Appuyez sur **Equation** (Équation) pour indiquer l'équation à utiliser pour la voie calculée. Les choix d'équations peuvent être classés en trois catégories principales : Maths de base, cinquième ordre polynomial et statistiques.

## Mathématiques de base

Le tableau ci-dessous montre les opérations mathématiques de base disponibles avec le libellé de la touche correspondante.

| Opération      | Libellé de la touche de fonction | Équation |
|----------------|----------------------------------|----------|
| Addition       | A + B                            |          |
| Soustraction   | A - B                            |          |
| Multiplication | A * B                            |          |
| Division       | A / B                            |          |
| Réciproque     | 1 / A                            |          |
| Carré          | A <sup>2</sup>                   |          |
| Racine carrée  | Sqrt(A)                          |          |

Par exemple, pour effectuer l'opération Addition des voies de mesures (voies 101 et 102) sur la voie calculée (voie 401) :

1. Appuyez sur **Equation** > **A+B** (Équation > A+B), pour définir la touche **Channel A** (Voie A) sur la voie 101 et la touche **Channel B** (Voie B) sur la voie 102.



2. Appuyez une fois sur la touche **[Scan/ Début]** ([Scrutation]) pour lancer une scrutation. Vous pouvez afficher les mesures de mémoire de scrutation en appuyant sur la touche **[View]** ([Afficher]). Le résultat de l'opération d'ajout des canaux 101 et 102 au canal 401 sera affiché comme suit :

*Voie 401 = Voie 101 + Voie 102*

| Date      | Time         | Channel               | Reading      |
|-----------|--------------|-----------------------|--------------|
| 17/4/2018 | 11:36:51.664 | 101 Armature relay... | -148.32 μVDC |
| 17/4/2018 | 11:36:51.816 | 102 Armature relay... | -159.01 μVDC |
| 17/4/2018 | 11:36:51.822 | 401 Computed Cha...   | -307.33 μ    |

3. Répétez les étapes ci-dessus pour le reste des opérations mathématique de base (soustraction, multiplication, etc.). Si vous souhaitez calculer à partir d'une seule voie d'opérande, réglez les touches des voies A et B sur la même voie. Les lectures calculées seront le résultat des lectures d'addition de la voie sélectionnée elle-même. Par exemple : Voie 401 = Voie 101 + Voie 101

| Date      | Time         | Channel               | Reading      |
|-----------|--------------|-----------------------|--------------|
| 17/4/2018 | 18:21:48.186 | 101 Armature relay... | -50.556 μVDC |
| 17/4/2018 | 18:21:48.186 | 401 Computed Cha...   | -101.11 μ    |

Polynôme de cinquième degré

Pour effectuer cette opération par la voie d'opérande (voie 101) sur la voie calculée (voie 401) :

- 1. Appuyez sur **Equation** > **5th Order** (Équation > 5e degré), et utilisez le bouton ou les touches fléchées sur le panneau avant pour définir la touche **Channel A** vers le canal 101.



- 2. Appuyez sur **Coef** pour afficher successivement les ordres de coefficient (**Coef #5**, **Coef #4**, **Coef #3**, **Coef #2**, **Coef #1**, et **Coef #0**). Définissez les paramètres du coefficient pour chaque ordre de coefficient.
- 3. Appuyez une fois sur la touche **[Scan/ Début]** ([Scrutation]) pour lancer une scrutation. Vous pouvez afficher les mesures de mémoire de scrutation en appuyant sur la touche **[View]** ([Afficher]). Le résultat du polynôme de 5e degré s'affiche comme suit :

| Scan Memory |              |                          |          |      |
|-------------|--------------|--------------------------|----------|------|
| Date        | Time         | Channel                  | Reading  |      |
| 6/19/2019   | 10:37:22.226 | 101 Armature relay MU... | 19       | μVDC |
| 6/19/2019   | 10:37:22.310 | 401 Computed Channel     | 1.000 02 |      |

Statistiques

Le tableau ci-dessous présente les opérations statistiques disponibles avec les libellés de touche correspondants. En termes de statistiques, (liste) désigne l'ensemble des voies d'opérande du calcul.

| Opération  | Libellé de la touche de fonction Statistiques | Description                                                                                                                                                            |
|------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Moyenne    | Moy(liste)                                    | Renvoie les lectures moyennes d'une liste de canaux d'opérandes, où Lecture moyenne = Somme totale de toutes les lectures / nombre de canaux d'opérandes sélectionnés. |
| Maximum    | Max(liste)                                    | Renvoie la valeur maximale à partir d'une liste de voies d'opérande                                                                                                    |
| Minimum    | Min(liste)                                    | Renvoie la valeur minimale à partir d'une liste de voies d'opérande                                                                                                    |
| Écart type | SDev(liste)                                   | Renvoie l'écart type à partir d'une liste de voies d'opérande                                                                                                          |

Par exemple, pour effectuer l'opération Moyenne à partir des voies de mesure (Voies 101 à 103) sur la voie calculée (Voie 401) :

- 1. Appuyez sur **Equation** > **Avg(list)** (Équation > Moy(liste)), utilisez le bouton ou les touches fléchées du panneau avant pour sélectionner les voies d'opérande dans la touche **Select** (Sélectionner), puis appuyez sur **Add to List** (Ajouter à la liste) pour ajouter la voie d'opérande sélectionnée à la liste de voies d'opérande. Appuyez plusieurs fois sur cette touche pour ajouter la voie d'opérande suivante à la liste de voies d'opérande.



2. Lorsque le nombre de voies d'opérande ajouté est atteint, la touche **Remove from List** (Supprimer de la liste) s'affiche. Appuyez sur cette touche pour supprimer la précédente voie d'opérande sélectionnée de la liste de voies d'opérande.



3. Appuyez sur **View List** (Afficher la liste) pour afficher une liste des voies de mesure disponibles. Les voies d'opérande actuellement sélectionnées sont marquées d'un « X ». Appuyez sur **Clear** (Effacer) pour supprimer toutes les voies d'opérande sélectionnées de la liste de voies d'opérande.

| Check | Channel                        | In Scan |
|-------|--------------------------------|---------|
| [x]   | 101 Armature relay MUX Channel | Yes     |
| [x]   | 102 Armature relay MUX Channel | Yes     |
| [x]   | 103 Armature relay MUX Channel | Yes     |

4. Appuyez une fois sur la touche **[Scan/ Début]** ([Scrutation]) pour lancer une scrutation. Vous pouvez afficher les mesures de mémoire de scrutation en appuyant sur la touche **[View]** ([Afficher]). Le résultat de l'opération Moyenne s'affiche comme suit : *Voie 401 = (Voie 101+102+103)/3*

| Date      | Time         | Channel               | Reading       |
|-----------|--------------|-----------------------|---------------|
| 17/4/2018 | 12:25:47.944 | 101 Armature relay... | -941,53 μVDC  |
| 17/4/2018 | 12:25:47.996 | 102 Armature relay... | -1,214.8 mVDC |
| 17/4/2018 | 12:25:48.048 | 103 Armature relay... | -1,391.3 mVDC |
| 17/4/2018 | 12:25:48.049 | 401 Computed Cha...   | -1,182.5 m    |

**REMARQUE**

Le format des nombres affichés ici utilise la virgule comme séparateur décimal et un point tous les trois chiffres lorsque le séparateur de milliers est réglé sur On. Pour de plus amples informations, reportez-vous à la section **Format numérique**.

Vous pouvez également inclure la voie calculée en tant que voie d'opérande dans la liste de voies calculées. Par exemple, pour inclure la voie calculée 401 de l'exemple ci-dessus sur une autre voie calculée (voie 402) :

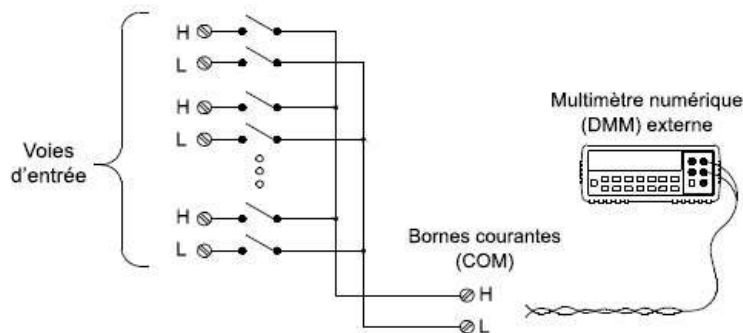
1. Répétez les étapes 1 à 4 comme indiqué ci-dessus.
2. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour sélectionner la voie du totalisateur (Voie 402). Appuyez sur **In Scan** (En scrutation) et activez la touche pour inclure la voie 402 dans la liste de scrutation. Appuyez ensuite sur **Equation > Avg(list)** (Équation > Moy(liste)), et utilisez le bouton ou les touches fléchées sur le panneau avant pour régler la touche **Channel A** (Voie A) sur la voie 101 et la touche **Channel B** (Voie B) sur la voie calculée 401.
3. Appuyez une la touche **[Scan/ Début]** ([Scrutation]) pour lancer une scrutation. Vous pouvez afficher les mesures de mémoire de scrutation en appuyant sur la touche **[View]** ([Afficher]). Le résultat de l'opération Moyenne s'affiche comme suit :

*Voie 402 = (Voie 101 + 102 + 103 + 401)/4*

| Date      | Time         | Channel               | Reading  |      |
|-----------|--------------|-----------------------|----------|------|
| 17/4/2018 | 12:43:47.090 | 101 Armature relay... | -1,303.0 | mVDC |
| 17/4/2018 | 12:43:47.142 | 102 Armature relay... | -1,221.3 | mVDC |
| 17/4/2018 | 12:43:47.195 | 103 Armature relay... | -1,146.8 | mVDC |
| 17/4/2018 | 12:43:47.195 | 401 Computed Cha...   | -1,223.7 | m    |
| 17/4/2018 | 12:43:47.195 | 402 Computed Cha...   | -1,223.7 | m    |

## Scrutation avec des instruments externes

Dans cette configuration, vous pouvez utiliser le modèle DAQ970A/DAQ973A pour acheminer des signaux ou contrôler des applications. Si vous installez un module multiplexeur enfichable, vous pouvez utiliser le modèle DAQ970A/DAQ973A pour des scrutations avec un instrument externe. Vous pouvez connecter un instrument externe, comme un multimètre numérique (DMM), aux bornes COM du multiplexeur.



Pour contrôler la scrutation avec un instrument externe, il existe deux lignes de contrôle. Lorsque le DAQ970A/DAQ973A et l'instrument externe sont configurés correctement, vous pouvez synchroniser une séquence de scrutation entre les deux.

Dans cette configuration, vous devez définir une liste de scrutation regroupant toutes les voies de multiplexeur ou multifonction désirées. Les voies absentes de la liste sont ignorées pendant la scrutation. L'instrument effectue automatiquement la scrutation des voies de la liste par ordre croissant depuis le logement 100 jusqu'au logement 300.

Pour une scrutation contrôlée extérieurement, vous devez désactiver le DMM interne en appuyant sur **[Home] > User Settings > DMM Off** ([Accueil] > Paramètres de l'utilisateur > DMM Off). Puisque le multimètre numérique (DMM) interne est désactivé, les lectures des voies de multiplexeur ne sont pas enregistrées dans la mémoire interne de lectures.

Des connexions externes sont nécessaires pour synchroniser la séquence de scrutation entre le modèle DAQ970A/DAQ973A et l'instrument externe. Le modèle DAQ970A/DAQ973A doit prévenir l'instrument externe quand un relais est fermé et stable (en incluant le retard de voie). Le modèle DAQ970A/DAQ973A délivre une impulsion de Voie fermée sur la broche 5 du connecteur du panneau arrière. En réponse, l'instrument externe doit prévenir le modèle DAQ970A/DAQ973A qu'il a terminé sa mesure et est prêt à passer à la voie suivante de la liste de scrutation. Le modèle DAQ970A/DAQ973A accepte un signal d'incrément de voie sur la ligne d'entrée de Déclenchement externe (broche 6).

Vous pouvez configurer l'événement ou l'action qui commande le déclenchement de chaque cycle de balayage de la liste (un cycle de balayage correspond à une mesure de toutes les voies de la liste). Lorsque le multimètre numérique (DMM) est désactivé, la source d'intervalle de scrutation est « Automatique » (immédiat). Pour de plus amples informations, reportez-vous à la section Intervalle entre scrutations. Il est possible de configurer l'événement ou l'action qui indique au DAQ970A/DAQ973A de passer à la voie suivante de la liste. Notez que la source Channel Advance (Passage à la voie suivante) utilise les mêmes sources que l'intervalle entre les scrutations. Toutefois, une erreur est générée si vous tentez d'utiliser la même source pour Channel Advance que pour l'intervalle entre scrutation.

Vous pouvez définir le nombre de fois que l'instrument balaiera la liste de scrutation. Une fois le nombre spécifié de balayages atteint, la scrutation s'arrête.



Une scrutation contrôlée extérieurement peut aussi inclure une lecture d'un port numérique ou une lecture du comptage d'un totaliseur sur le module multifonction. Lorsque l'incréméntation des voies atteint la première voie numérique, l'instrument effectue la scrutation de toutes les voies numériques du logement et enregistre les lectures en mémoire (un seul signal d'incréméntation de voie est nécessaire).

Vous pouvez configurer la liste des voies pour une scrutation externe en 4 fils. Lorsqu'activé, l'instrument associe automatiquement la voie  $n$  à la voie  $n+10$ .

## Étiquetage des voies

Appuyez sur la touche **Channel Label** (Libellé de la voie) pour définir un libellé pour la voie sélectionnée. Utilisez la poignée ou les touches de direction du panneau avant pour entrer les paramètres des différents canaux sur l'écran. Veuillez noter que le libellé peut contenir jusqu'à 10 caractères, y compris des lettres, des chiffres et des caractères spéciaux. Pour rétablir le libellé de la voie par défaut, appuyez sur **Channel Label** > **Clear All** > **Done** (Libellé de voie > Tout effacer > Terminé). Ce paramètre s'applique à tous les modules installés ainsi qu'aux voies calculées.



## Menu [Interval] ([Intervalle])

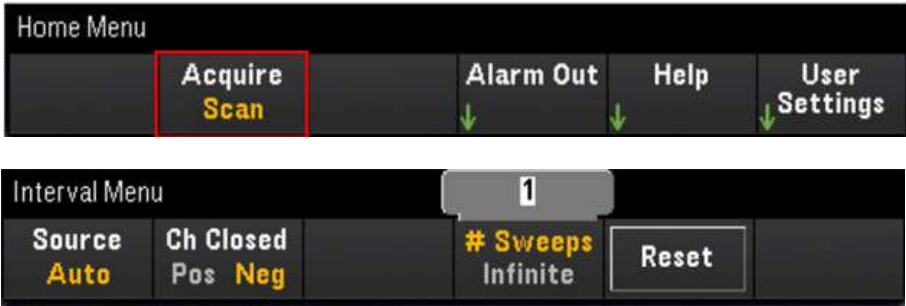
Appuyez sur la touche **[Interval]** ([Intervalle]) du panneau avant pour configurer ce qui déclenche chaque balayage et le nombre de balayages par scrutation.

REMARQUE

Les options dans le menu **[Interval]** ([Intervalle]) varient en fonction du mode d'acquisition de données sélectionné dans le menu **[Home]**([Accueil]) (**[Home]**>**Acquire**>**Scan**, **DMM Digitize**, ou **Digitizer**, ([Accueil]>Acquérir>Scrutation, Numériser DMM ou Numériseur)).

Lorsque vous appuyez sur **[Home]** > **Acquire** > **DMM Digitize** ou **Digitizer** ([Accueil]>Acquérir>Scrutation, Numériser DMM ou Numériseur)), le menu **[Interval]** ([Intervalle]) ne sera disponible qu'après configuration de la ou des voies.

### Menu [Interval] ([Intervalle]) en mode Scrutation



### Sélection de la source de déclenchement

Appuyez sur la touche **Source** pour sélectionner la source de déclenchement pour lancer un balayage. Un balayage est un passage complet sur la liste de scrutation.



| Touche de fonction |      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source             | Auto | <div><div>Interval Menu</div><div><div>Source Auto</div><div>Ch Closed Pos Neg</div><div># Sweeps Infinite</div><div>Reset</div></div></div> <p>Sélectionne un déclenchement immédiat. Si la scrutation est commencée, chaque balayage commencera automatiquement.</p>                                                                                                                                                                                                                                 |
|                    | Time | <div><div>Interval Menu</div><div><div>Source Time</div><div>Ch Closed Pos Neg</div><div>Time 00.000 s</div><div># Sweeps Infinite</div><div>Reset</div></div></div> <p>Règle le temporisateur interne de l'instrument pour qu'il déclenche automatiquement les balayages à intervalles spécifiques. Une fois sélectionnée comme source de déclenchement, appuyez sur la touche <b>Time</b> (Temps) pour configurer un intervalle de temps entre 0 secondes et 360 000 secondes(100:00:00 heures).</p> |

Manual



Sélectionne un déclenchement manuel. Un balayage est lancé manuellement en appuyant une fois sur la touche **[Scan/Start]** ([Scrutation/Démarrer]) sur le panneau avant.

External



Lance un balayage lorsqu'une impulsion de déclenchement externe compatible TTL est reçue du connecteur Ext Trig/Alarms (Déclenchement externe/Alarmes) situé sur le panneau arrière. Une fois sélectionnée comme source de déclenchement, appuyez sur la touche **Ext Trig** (Déclenchement externe) pour définir la polarité du signal Ext Trig comme front montant (**Pos**) ou front descendant (**Neg**).

On Alarm



Démarre un balayage lorsqu'une condition d'alarme est détectée pendant une scrutation sur la voie surveillée, ou sur une voie DIO ou de totalisateur. Une fois sélectionnée comme source de déclenchement, appuyez sur la touche **On Alarm** (En cas d'alarme) pour indiquer laquelle des quatre alarmes utiliser comme condition d'alarme sur la voie affichée.

## Sélection de la polarité de déclenchement de la sortie



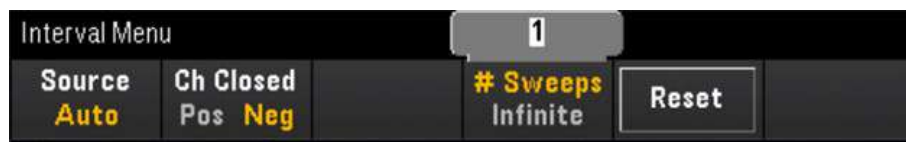
Appuyez sur la touche **Ch Closed (Voie fermée)** pour sélectionner le front montant (**Pos**) ou le front descendant (**Neg**) comme signal de Voie fermée sur le connecteur Déclenchement externe/Alarme sur le panneau arrière.

### REMARQUE

Le déclenchement de sortie (signal de fermeture de voie) fonctionne différemment lors d'une scrutation interne ou externe.

- Pour les scrutations internes (multimètre numérique (DMM) interne activé), elle est générée à la FIN d'un balayage plutôt qu'au début.
- Pour les scrutations externes (DMM interne désactivé), elle est générée à la clôture de chaque voie et peut être utilisée pour déclencher la mesure sur le DMM externe.

## Définition du nombre de balayages pendant la scrutation

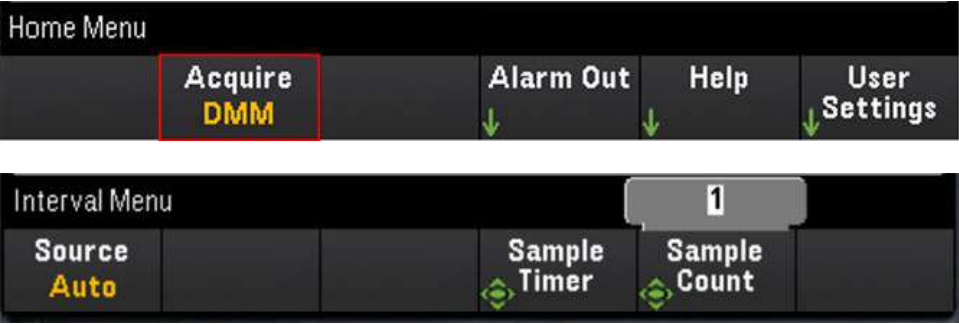


Définit un nombre de balayages de la liste de scrutation (**# Sweeps** (# Balayages)) ou balayage en continu (**Infini**).

- **# Sweeps** (# Balayages) – Définit le nombre de balayages (entre 1 et 1 000 000 balayages) de la liste de scrutation, une fois la scrutation lancée. Appuyez sur **Reset** (Réinitialiser) pour définir le nombre de balayage à 1.
- **Infinite** (Infini) – Définit la poursuite d'une scrutation indéfiniment jusqu'à l'arrêt manuel à l'aide de la touche **[Scan/Start]** (Scrutation/Démarrer) du panneau avant ou l'envoi de la commande SCPI "ABORT" ou l'envoi du message "Device Clear" depuis l'interface distante.

L'instrument peut contenir jusqu'à 1 000 000 mesures dans la mémoire de lectures, après quoi le témoin **MEM** s'affiche indiquant un dépassement de la capacité de la mémoire. Toute nouvelle mesure effacera la mesure la plus ancienne enregistrée ; les mesures les plus récentes sont toujours conservées.

Menu [Interval] ([Intervalle]) dans le mode Numériser DMM



Sélection de la source de déclenchement

Appuyez sur la touche **Source** pour sélectionner la source de déclenchement.



| Touche de fonction |          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source             | Auto     | <div>Interval Menu</div> <p>Sélectionne un déclenchement immédiat. L'instrument se déclenche automatiquement immédiatement lorsque vous appuyez sur la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                    | Manual   | <div>Interval Menu</div> <p>La voie indiquée se déclenche en appuyant deux fois sur la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]) du panneau avant. La première fois que la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]) est pressée, la voie est initialisée. La seconde fois que la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]) est pressée, la voie est déclenchée manuellement et commence l'opération de numérisation.</p>                                                                                                                                                                                                                                                                                                                         |
|                    | External | <div>Interval Menu</div> <p>Sélectionne le déclenchement externe. L'instrument est déclenché lorsqu'une impulsion de déclenchement externe compatible TTL est reçue du connecteur Ext Trig (Déclenchement externe) situé sur le panneau arrière. Une fois cette option sélectionnée en tant que source de déclenchement :</p> <ul style="list-style-type: none"> <li>– Vous pouvez appuyer sur la touche <b>Ext Trig</b> (Déclenchement externe) pour définir la polarité du signal de déclenchement externe en tant que front montant (<b>Pos</b>) ou montant (<b>Neg</b>).</li> <li>– Vous pouvez également appuyer sur la touche <b>PreTrigger Count</b> (Nombre de pré-déclenchement) pour définir un nombre de pré-déclenchement compris entre 0 et 999 999.</li> </ul> |

Source      Level

Sélectionne le niveau de déclenchement. L'instrument est déclenché lorsqu'une condition de seuil de mesure donnée est atteinte.

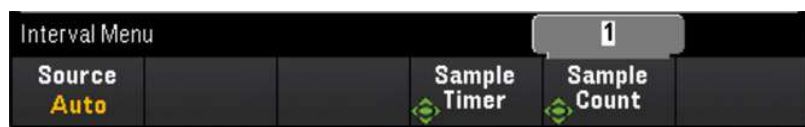
- Vous pouvez appuyer sur la touche **Ext Trig** (Déclenchement externe) pour définir la polarité du signal de déclenchement externe en tant que front montant (**Pos**) ou montant (**Neg**).
- Vous pouvez également appuyer sur la touche **PreTrigger Count** (Nombre de pré-déclenchement) pour définir un nombre de pré-déclenchement compris entre 0 et 999 999.

**REMARQUE**

Après avoir défini un nombre de pré-déclenchement, les mesures sont prises et enregistrées dans un tampon en attendant que l'événement de déclenchement se produise. Lorsque l'événement déclencheur se produit, les mesures mises en tampon sont transférées vers la mémoire de mesures et les autres relevés sont enregistrés comme d'habitude. Si l'événement déclencheur se produit avant le relevé des mesures de pré-déclenchement, l'événement déclencheur sera toujours efficace et la numérisation sera effectuée sans que toutes les mesures de pré-déclenchement aient été prises.

Le nombre de pré-déclenchement est limité à un nombre inférieur au nombre total de mesures défini par le paramètre de nombre d'échantillons. Si le nombre d'échantillons = 1, la touche **Pretrigger** (Pré-déclenchement) sera masquée.

## Définition du minuteur d'échantillonnage

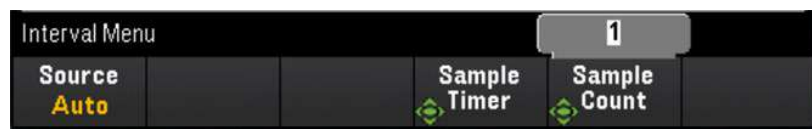


| Touche de fonction | Description                                                                                                                                                        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sample Timer       | Utilisez le bouton ou la touche fléchée pour définir une valeur de minuteur d'échantillonnage (temps entre les échantillons) comprise entre 20 $\mu$ s et 3 600 s. |

**REMARQUE**

Cette valeur configurée du Minuteur d'échantillonnage reste identique même si vous modifiez la fonction de mesure de la voie dans le menu **[Channel]** ([Voie]).

## Définition du nombre d'échantillons



| Touche de fonction | Description                                                                                                                                                        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sample Count       | Utilisez le bouton ou la touche fléchée pour définir le nombre total d'échantillons à numériser compris entre 1 échantillon et au maximum 50 331 648 échantillons. |

### REMARQUE

Cette valeur configurée du Nombre d'échantillons reste identique même si vous modifiez la fonction de mesure de la voie dans le menu **[Channel]** ([Voie]) .

Lorsque le nombre de pré-déclenchement est différent de 0, l'instrument limite le nombre d'échantillons à 1 000 000.

## Définition du temps de retard

Appuyez sur la touche **Delay** (Retard) et utilisez le bouton ou les touches fléchées pour définir le temps de retard avant la numérisation.

### REMARQUE

L'option **Delay** (Retard) n'est disponible que dans les configurations suivantes :

- Lorsque **Source** > **Auto** (Source>Automatique) est sélectionné.
- Lorsqu'une valeur **PreTrigger Count** (Nombre de pré-déclenchement) est paramétrée.

Menu [Interval] ([Intervalle]) en mode Numériseur.

REMARQUE

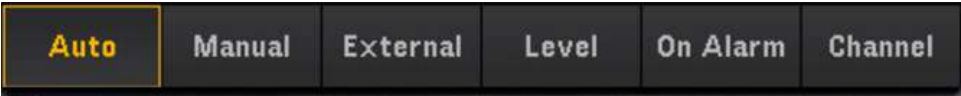
Ce menu est uniquement disponible lorsque le module DAQM909A est connecté.

Les configurations d'intervalle seront réinitialisées aux analogiques au défaut lorsque la touche **Pwr. Alys** (Analyse de puissance) est activée dans le menu **[Channel]** ([Voie]).



Définition des paramètres de déclenchement

Appuyez sur la touche de fonction **Paramètres de déclenchement**> **Source** pour sélectionner la source de déclenchement.



| Touche de fonction |          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source             | Auto     | <div><div>Source Auto</div><div>Done</div></div> <p>La voie du numériseur indiquée se déclenche automatiquement immédiatement lorsque vous appuyez sur la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                    | Manual   | <div><div>Source Manual</div><div>Delay Done</div></div> <p>La voie du numériseur indiquée se déclenche en appuyant deux fois sur la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]) du panneau avant. La première fois que la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]) est pressée, la voie du numériseur est initialisée. La seconde fois que la touche <b>[Scan/Start]</b> ([Scrutation/Démarrer]) est pressée, la voie du numériseur est déclenchée manuellement et commence l'opération de numérisation. Appuyez sur la touche <b>Delay</b> (Retard) et utilisez le bouton ou les touches fléchées pour définir un temps de retard avant la numérisation.</p> |
|                    | External | <div><div>Source Ext Trig Pos Neg</div><div>Delay Done</div></div> <p>La voie du numériseur indiquée se déclenche lorsqu'une impulsion de déclenchement externe compatible TTL est reçue du connecteur Ext Trig (Déclenchement externe) de chaque module enfichable DAQM909A. Une fois sélectionnée comme source de déclenchement, vous pouvez appuyer sur la touche <b>Ext Trig</b> (Déclenchement externe) pour définir la polarité du signal Ext Trig comme front montant (<b>Pos</b>) ou front descendant (<b>Neg</b>). Appuyez sur la touche <b>Delay</b> (Retard) et utilisez le bouton ou les touches fléchées pour définir un temps de retard avant la</p>              |



numérisation.

| Touche de fonction | Description |
|--------------------|-------------|
|--------------------|-------------|

Source Level

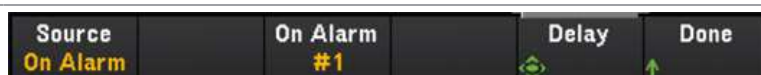


Le canal de numériseur spécifié est déclenché lorsque le signal d'entrée franchit le niveau de déclenchement spécifié à la pente spécifiée. Une fois sélectionnée comme source de déclenchement, vous pouvez appuyer sur la touche **Slope** (Inclinaison) pour définir la polarité du signal déclenchement interne comme front montant (Pos) ou front descendant (Neg). Appuyez sur la touche **Delay (Retard)** et utilisez le bouton ou les touches fléchées pour définir un temps de retard avant la numérisation.

**REMARQUE**

Pour plus d'informations, reportez-vous à la section Déclenchement sur niveau.

On Alarm



Le canal du numériseur indiqué se déclenche lorsqu'une condition d'alarme est détectée. Appuyez sur la **On Alarm** (En cas d'alarme) pour indiquer laquelle des quatre alarmes sera utilisée pour déclencher la voie lorsque les conditions d'alarme sont atteintes. Appuyez sur la touche **Delay (Retard)** et utilisez le bouton ou les touches fléchées pour définir un temps de retard avant la numérisation.

Channel



La voie du numériseur indiquée est déclenchée lorsque la voie maître l'est. N'importe quelle voie de numériseur peut être configurée et sélectionnée en tant que voie maître même si la voie est sur un autre module. Appuyez sur la touche **Delay (Retard)** et utilisez le bouton ou les touches fléchées pour définir un temps de retard avant la numérisation.

**REMARQUE**

L'option Channel (Voie) n'est disponible qu'une fois les conditions suivantes remplies :

- L'une des voies du numériseur doit d'abord être configurée en tant que voie de déclenchement avant qu'elle puisse être sélectionnée en tant que source pour le reste des voies du numériseur.
- La source de déclenchement de la voie de déclenchement n'est pas définie sur Auto.

Règles pour la configuration d'une voie de déclenchement :

- La source de déclenchement de la voie de déclenchement ne peut pas être définie sur Auto.
- Une voie de numériseur ne peut pas se choisir elle-même en tant que voie de déclenchement.
- Une voie peut être le déclencheur maître de plusieurs voies, mais une voie ne peut pas avoir de groupes de déclenchement multiples.
- En cas de chaîne de voies de déclenchement, une voie de déclenchement ne peut pas être la voie enfant d'une autre voie de déclenchement de la chaîne.
- Les configurations de voies de déclenchement reprendront leurs valeurs par défaut lors de la désactivation de la voie du numériseur.

Définition des paramètres d’Armement

Appuyez sur la touche Trigger Settings (Paramètres de déclenchement) pour définir les paramètres de déclenchement du numériseur.



**REMARQUE** La touche programmable **Source** ne sera pas disponible pour la configuration si le mode d'acquisition de données **DMM Digitize** est activé sur un autre canal de modules de plug-in.

| Touche de fonction                                                                                                                                                                                          |       | Description                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Source                                                                                                                                                                                                      | Auto  | Le numériseur est armé dès qu’il passe à l’état En attente d’armement (armement immédiat).                                                    |
|                                                                                                                                                                                                             | Sweep | La voie du numériseur est armée au début de chaque balayage lors de la scrutation sur les modules multiplexeurs.                              |
| <div><b>REMARQUE</b> L'option <b>Sweep</b> (Balayage) n'est disponible que si ces modules enfichables sont insérés et configurés sur l'instrument : DAQM900A, DAQM901A, DAQM902A, DAQM907A, DAQM908A.</div> |       |                                                                                                                                               |
| Arm Count                                                                                                                                                                                                   |       | Appuyez sur la touche <b>Arm Count</b> (Nombre d’armements) et utilisez le bouton ou les touches fléchées pour définir le nombre d’armements. |

### Définition des Paramètres d'échantillonnage

Appuyez sur la touche **Sample Settings** (Paramètres d'échantillonnage) pour définir les paramètres de déclenchement du numériseur.



| Touche de fonction | Description |
|--------------------|-------------|
|--------------------|-------------|

|                  |           |      |      |      |      |     |                |
|------------------|-----------|------|------|------|------|-----|----------------|
| Trigger Settings | Samp Rate | 800K | 400K | 200K | 100K | 50K | More<br>1 of 2 |
|------------------|-----------|------|------|------|------|-----|----------------|

appuyez sur la touche **Samp Rate** (Fréquence d'échantillonnage) pour définir la fréquence d'échantillonnage souhaitée (en Hz). Vous pouvez choisir un taux d'échantillonnage dans la liste d'options proposées, entre 1,5625 KHz et 800 KHz.

**REMARQUE** La même valeur de fréquence d'échantillonnage configurée sera reflétée sur tous les canaux du module DAQM909A avec le même filtre ADC.

|                  |                                                                                                                                                                          |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sample Count     | Appuyez sur la touche <b>Sample Count</b> (Nombre d'échantillons) et utilisez le bouton ou les touches fléchées pour définir le nombre d'échantillons.                   |
| PreTrigger Count | Appuyez sur la touche <b>PreTrigger Count</b> (Nombre de pré-déclenchements) et utilisez le bouton ou les touches fléchées pour définir le nombre de pré-déclenchements. |

**REMARQUE** La valeur de **Pretrigger Count** (Nombre de pré-déclenchements) est limitée à la valeur de **Sample Count** (Nombre d'échantillons) moins un.

Le paramètre **PreTrigger Count** (Nombre de pré-déclenchements) n'est disponible que lorsque **Source** > **Auto** est sélectionné.

**REMARQUE** L'instrument attribue une quantité fixe de mémoire aux modules enfichables DAQM909A. Cette mémoire est également divisée par le nombre total de voies du numériseur disponibles, selon le nombre de modules DAQM909A insérés dans l'appareil.

Comme une quantité fixe de mémoire, dans votre application, est attribuée à chaque voie du numériseur, vous pouvez choisir d'utiliser la totalité de la mémoire pour un seul enregistrement avec un nombre maximal d'échantillons, ou d'avoir plusieurs enregistrements avec un nombre d'échantillons plus petit.

Le nombre d'enregistrements d'une voie du numériseur est déterminé par la valeur indiquée pour le nombre d'armements. Ainsi, afin d'obtenir le nombre d'enregistrements maximum, réglez le nombre d'échantillons au minimum.

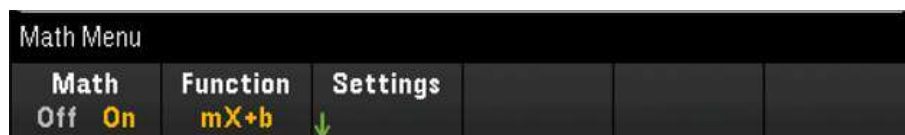
## Menu [Math] ([Math])

### REMARQUE

Les fonctions du menu [Math] sont uniquement disponibles lorsque le mode **Numériser DMM** ou **Numériseur** est sélectionné comme mode d'acquisition de données.

Vous devez configurer la voie avant d'appliquer des valeurs de réglage d'échelle.

Dans la page menu Math, appuyez sur la touche **Math** pour activer (**On**) ou désactiver (**Off**) la mise à l'échelle de la mesure.



### REMARQUE

Math est réglée sur Off lorsque vous modifiez les fonctions de mesure (par exemple, lorsque vous passez de V CC à V CA). Vous devez ré-activer l'option Math après modification des fonctions de mesure.

Appuyez sur la touche **Function** (Fonction) pour sélectionner une fonction de mise à l'échelle sur la voie sélectionnée. Les fonctions dBm et dB ne sont disponibles que sur les voies configurées pour mesurer la tension de courant continu ou alternatif.



Sélectionnez une fonction de mise à l'échelle et appuyez sur **Settings** (Paramètres) pour effectuer divers réglages de mise à l'échelle. Les valeurs de réglage d'échelle sont enregistrées dans la mémoire non volatile pour la voie sélectionnée.

## Mise à l'échelle mX + b

La fonction de mise à l'échelle mX+b vous permet d'effectuer une mise à l'échelle linéaire avec opération de décalage, en appliquant des valeurs de gain (m) et de décalage (b) à toutes les mesures sur une voie sélectionnée pendant une scrutation. Pour configurer, sélectionnez **mX +b** comme fonction de mise à l'échelle et appuyez sur **Settings** (Paramètres) pour ouvrir le menu de configuration.



| Touche de fonction |                    | Description                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gain (m)           |                    | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la valeur du Gain.                                                                                                                                                                                                                                                                                                         |
| Offset (B)         |                    | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la valeur du Décalage.                                                                                                                                                                                                                                                                                                     |
| Measure Offset     |                    | Appuyez sur la touche <b>Measure Offset</b> (Mesurer le décalage) pour mesurer immédiatement le décalage et enregistrer la valeur pour la mesure suivante.                                                                                                                                                                                                                                          |
| Clear Offset       |                    | Appuyez sur <b>Clear Offset</b> (Effacer le décalage) pour remettre les valeurs de décalage à 0.                                                                                                                                                                                                                                                                                                    |
| User Units         | User Units On/ Off | Appuyez sur <b>User Units &gt; User Units Off/On</b> (Unités utilisateur > Unités utilisateur Off/On) pour afficher ( <b>On</b> ) ou désactiver ( <b>Off</b> ) les unités de mesure définies par l'utilisateur. Si <b>On</b> est sélectionné, l'unité affichée sera celle définie par la touche Modifier les unités ; si <b>Off</b> est sélectionné, les unités par défaut seront affichées (V CC). |
|                    | Edit Units         | Appuyez sur <b>User Units &gt; Edit Units</b> (Unités utilisateur > Modifier les Unités) pour définir une chaîne contenant jusqu'à trois caractères qui s'affiche à la place des unités de mesure standard. Ces unités sont ensuite utilisées pour l'entrée de divers paramètres de l'instrument tels que les limites et la mise à l'échelle graphique.                                             |
|                    | Default Units      | Appuyez sur <b>Default Units</b> (Unités par défaut) pour revenir aux unités par défaut pour le type de mesure sélectionné. Par exemple, si vous configurez la voie sélectionnée comme une mesure de température, appuyez sur cette touche pour revenir à l'unité par défaut en °C.                                                                                                                 |

### Mise à l'échelle en %

La Mise à l'échelle en % effectue un calcul de variation en pourcentage. Le résultat est la différence exprimée en pourcentage entre la mesure et la valeur de référence.

$$Result = \frac{reading - reference}{reference} \times 100$$

Pour configurer, sélectionnez la fonction de mise à l'échelle en % et appuyez sur Settings (Paramètres) pour ouvrir le menu de configuration.



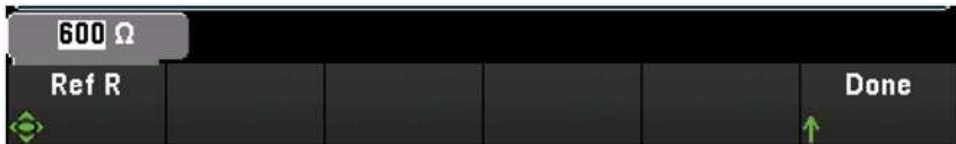
| Touche de fonction | Description                                                                                                                                                                                                                                                              |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ref Value          | Utilisez le bouton ou les touches fléchées du panneau avant pour définir la valeur de la Référence.                                                                                                                                                                      |
| Measure Reference  | Appuyez <b>Measure Reference</b> (Mesurer la référence) pour prendre immédiatement une mesure de référence et enregistrer la valeur de référence pour les mesures suivantes, ou appuyez sur <b>Ref Value</b> (Valeur de référence) pour définir une valeur de référence. |
| Default Reference  | Appuyez sur <b>Default Reference</b> (Référence par défaut) Enter pour régler la valeur de référence sur son paramètre d'usine par défaut.                                                                                                                               |

### Mise à l'échelle dBm

Sélectionne la mise à l'échelle dBm pour la fonction de mesure actuelle. Le résultat est le calcul de la puissance fournie à une résistance de référence (définie par la touche R Ref), relative à 1 milliwatt.

$$dBm = 10 \times \log_{10} (reading^2 / reference\ resistance / 1\ mW)$$

Pour configurer, sélectionnez la fonction de mise à l'échelle dBm et appuyez sur Settings (Paramètres) pour ouvrir le menu de configuration.



La valeur de la résistance de référence (R Ref) peut être 50, 75, 93, 110, 124, 125, 135, 150, 250, 300, 500, 600 (par défaut), 800, 900, 1000, 1200, ou 8000 Ω. Appuyez sur **R Ref** pour définir la valeur de la résistance de référence pour convertir les mesures de tension en dBm.

## Mise à l'échelle dB

Sélectionne la mise à l'échelle dB pour la fonction de mesure actuelle. Le résultat est à la différence entre le signal en entrée et une valeur relative de référence dB enregistrée, les deux valeurs étant converties en dBm.

$$dB = \text{measurement in dBm} - \text{reference value in dB}$$

Pour configurer, sélectionnez la fonction de mise à l'échelle **dB** et appuyez sur **Settings** (Paramètres) pour ouvrir le menu de configuration.



La valeur de référence peut être une mesure convertie en dBm (touche **Measure Ref Value** (Valeur de référence de la mesure)), ou une valeur de référence que vous avez définie (touche **dB Ref Value** (Valeur de référence dB)). Appuyez sur **Clear dB Ref** (Effacer la référence dB) pour effacer la valeur de référence pour les mesures dB.

## Menu [Copy] ([Copier])

### REMARQUE

La voie source (la voie à partir de laquelle copier la configuration) doit être incluse dans la liste de scrutation avant d'effectuer cette fonctionnalité.

La fonction copier/coller est uniquement disponible pour les voies disposant d'une fonction de mesure similaire (par exemple, de V CC à V CC) ; pour lesquelles la voie de départ et celle d'arrivée sont situées sur le même emplacement de module.

Les fonctions du menu [Copy] ([Copier]) sont uniquement disponibles lorsque le mode **Numériser DMM** est sélectionné comme mode d'acquisition de données.

Appuyez sur la touche **[Copy]** (Copier) sur le panneau avant pour copier la configuration de mesure des voies sélectionnées vers les autres. Cette fonctionnalité simplifie la configuration de plusieurs voies pour la même mesure. Lorsque vous copiez la configuration d'une voie à une autre, les autres informations de configuration, comme la fonction de mesure, la fonction de mise à l'échelle, la configuration des alarmes et les configurations de mesure avancées sont automatiquement copiées sur les autres voies.

Trois options sont disponibles :

### Copier/coller d'une seule voie vers une seule voie (une à une)

Par exemple, pour copier/coller la configuration de mesure de la voie 01 à la voie 02 :

1. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour configurer le canal 1 comme DCV (Autorange).



2. Appuyez sur **[Copy] > Source Chan(s)** ([Copier] > Voies source). Le canal de départ et le canal de fin s'affichent avec le canal sélectionné 01 car il n'existe aucun autre canal source configuré à l'exception de ce canal. Cliquez sur **Done (Terminé)** pour quitter ce menu.





3. Appuyez sur **Dest. Chan(s)**. (Voies de destination) pour sélectionner la voie de destination du collage. L'instrument va automatiquement sélectionner la voie suivante comme choix par défaut de la voie de destination. Dans cet exemple, utilisez le bouton ou les touches de direction du panneau avant pour déterminer à la fois le **canal de début** et le **canal de fin** en tant que canal 02. Appuyez sur **Terminé** pour continuer.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 102        |
| CH 101 Armature relay MUX Channel | CH 102        |
| 1 CH SELECTED                     | 1 CH SELECTED |

4. Appuyez sur **Copy Now** (Copier maintenant). La configuration de la mesure de la voie 01 sera copiée sur la voie 02. "COMPLETE"
- Ce message apparaîtra au bas de l'écran une fois l'opération terminée. Appuyez sur **Copy Now** (Copier maintenant) pour copier plusieurs fois la même configuration sur les nouvelles voies sélectionnées (voie 03, voie 04 et ainsi de suite).

| <b>Copy</b> <span>M</span>        |               |
|-----------------------------------|---------------|
| <b>Configuration Summary</b>      |               |
| SOURCE CHAN(S)                    | DEST. CHAN(S) |
| CH 101 Armature relay MUX Channel | CH 103        |
| CH 101 Armature relay MUX Channel | CH 103        |
| 1 CH SELECTED                     | 1 CH SELECTED |
| <b>COMPLETED</b>                  |               |

## Copier/coller d'une seule voie vers plusieurs (une à plusieurs)

Par exemple, pour copier/coller la configuration de mesure de la voie 01 aux voies 02 et 03 :

1. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour configurer le canal 1 comme DCV (Autorange).
2. Appuyez sur **[Copy]** > **Source Chan(s)** ([Copier] > Voies source). Le canal de départ et le canal de fin s'affichent avec le canal sélectionné 01 car il n'existe aucun autre canal source configuré à l'exception de ce canal. Cliquez sur **Done (Terminé)** pour quitter ce menu.
3. Appuyez sur **Dest. Chan(s)**. (Voies de destination) pour sélectionner la voie de destination du collage. L'instrument va automatiquement sélectionner la voie suivante comme choix par défaut des voies de destination. Dans cet exemple, utilisez le bouton ou les touches fléchées sur le panneau avant pour déterminer la Start Channel (Voie de départ) comme voie 02 et la End Channel (Voie de fin) comme voie 03. Appuyez sur **Done (Terminé)** pour terminer.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 102        |
| CH 101 Armature relay MUX Channel | CH 103        |
| 1 CH SELECTED                     | 2 CH SELECTED |

4. Appuyez sur **Copy Now** (Copier maintenant). La configuration de la mesure de la voie 01 sera copiée sur les voies 02 et 03. Le message « **TERMINÉ** » apparaîtra à la fin de l'opération. Appuyez sur **Copy Now** (Copier maintenant) pour copier plusieurs fois la même configuration sur les nouvelles voies sélectionnées (voie 04, voie 05 et ainsi de suite).

| Copy <span>M</span>               |               |
|-----------------------------------|---------------|
| Configuration Summary             |               |
| SOURCE CHAN(S)                    | DEST. CHAN(S) |
| CH 101 Armature relay MUX Channel | CH 104        |
| CH 101 Armature relay MUX Channel | CH 104        |
| 1 CH SELECTED                     | 1 CH SELECTED |
| COMPLETED                         |               |

## Copier/coller de plusieurs voies vers plusieurs voies (plusieurs à plusieurs)

Par exemple, pour copier/coller la configuration de mesure des voies 01 à 04 vers les voies 05 à 08 :

- Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour configurer la voie du déclenchement :
  - Voies 01 et 02 (V CC avec sélection automatique de plage)
  - Voies 03 et 04 (résistance 2 fils, avec plage de 100  $\Omega$ )
- Appuyez sur **[Copy]** > **Source Chan(s)** ([Copier] > Voies source). Utilisez le bouton ou les touches fléchées du panneau avant pour déterminer la Start Channel (Voie de départ) comme voie 01 et la End Channel (Voie de fin) comme voie 04. Cliquez sur **Done (Terminé)** pour quitter ce menu.
- Appuyez sur **Dest. Chan(s)**. (Voies de destination) pour sélectionner la voie de destination du collage. L'instrument va automatiquement sélectionner la voie suivante comme choix par défaut des voies de destination. Appuyez sur **[Channel]** ([Voie]) et utilisez le bouton ou les touches fléchées sur le panneau avant pour déterminer Start Channel comme le canal 05.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 105        |
| CH 104 Armature relay MUX Channel | CH 108        |
| 4 CH SELECTED                     | 4 CH SELECTED |

La touche Voie de fin n'est pas disponible dans cette option, l'instrument va automatiquement effectuer le copier/coller dans les N voies de destination suivantes, selon les N voies source sélectionnées. Par exemple, si vous définissez la Voie de départ comme la voie 06, les voies de destination sélectionnées seront les voies 06 à 09. Appuyez sur Done (Terminé) pour terminer.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 106        |
| CH 104 Armature relay MUX Channel | CH 109        |
| 4 CH SELECTED                     | 4 CH SELECTED |

- Appuyez sur **Copy Now** (Copier maintenant). La configuration de mesure des voies 01 à 04 sera copiée sur les voies 06 à 09. Le message « TERMINÉ » apparaîtra à la fin de l'opération. Appuyez sur **Copy Now** (Copier maintenant) pour copier plusieurs fois la même configuration sur les nouvelles voies sélectionnées (voies 09 à 11).

| Copy <span>M</span>               |               |
|-----------------------------------|---------------|
| Configuration Summary             |               |
| SOURCE CHAN(S)                    | DEST. CHAN(S) |
| CH 101 Armature relay MUX Channel | CH 110        |
| CH 104 Armature relay MUX Channel | CH 113        |
| 4 CH SELECTED                     | 4 CH SELECTED |
| COMPLETED                         |               |

# Menu [Alarm] ([Alarme])

Appuyez sur la touche **[Alarm]** (Alarme) sur le panneau avant pour configurer l'alarme sur la voie sélectionnée. Il y a quatre alarmes configurables dans cet instrument. Vous devez configurer la voie avant de définir toute limite d'alarme. Si vous modifiez la configuration des mesures, les alarmes sont désactivées et les limites, effacées. Si vous prévoyez d'utiliser la **fonction de réglage d'échelle** sur une voie qui utilisera aussi des alarmes, veuillez à configurer d'abord les valeurs de réglage d'échelle.

**REMARQUE**

Les fonctions du menu [Alarm] ([Alarme]) sont uniquement disponibles lorsque le mode **Numériser DMM** ou **Numériseur** est sélectionné comme mode d'acquisition de données.

## Configuration des limites d'alarme sur le module multiplexeur

1. Dans la page du menu Alarme, appuyez sur **Output** (sortie) pour sélectionner laquelle des quatre alarmes sera utilisée pour signaler des conditions d'alarme sur la voie sélectionnée. Vous pouvez affecter plusieurs voies à l'une quelconque des quatre alarmes disponibles (numérotées de 1 à 4).



2. Appuyez sur Alarm (Alarme) pour désactiver (Off) ou définissez une limite d'alarme (haute, basse ou les deux), puis appuyez sur **Set Limits** (Définir des limites) afin de déterminer les valeurs de la limite. L'instrument va générer une alarme lorsqu'une mesure scrutée ou de surveillance dépasse la limite indiquée.

| Touche Alarme | Régler la touche Limites                                                                                                                                                                                                             |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Off           | S/O - L'alarme est désactivée                                                                                                                                                                                                        |
| High + Low    | Indiquez les limites sous la forme de valeurs basses et hautes ou sous la forme d'une valeur centrale avec une envergure. Appuyez sur la 1 <sup>ère</sup> ou 2 <sup>e</sup> touche pour basculer entre les deux options. <div></div> |
| High          | Indiquez la valeur de la limite supérieure à l'aide du bouton ou des touches fléchées du panneau avant. La limite supérieure doit toujours être supérieure ou égale à la limite inférieure. <div></div>                              |

Low

Indiquez la valeur de la limite inférieure à l'aide du bouton ou des touches fléchées du panneau avant. La limite inférieure doit toujours être inférieure ou égale à la limite supérieure.



3. Appuyez **Clear** (Effacer) pour la valeur limite par défaut, 0.
4. Appuyez sur **[Scan/ Début]** (Scrutation) pour déclencher la scrutation et enregistrer les mesures dans la mémoire de lectures. Si une alarme survient sur une voie en cours de scrutation, l'état d'alarme de cette voie est enregistré dans la mémoire de lecture en même temps que les mesures sont effectuées. À chaque nouvelle scrutation, l'instrument efface de la mémoire toutes les lectures (y compris les données d'alarme) de la précédente scrutation.
5. Les alarmes sont également consignées dans une file d'alarmes séparée de la mémoire de lecture. Appuyez sur **[View] > Alarms** ([Vue] > Alarmes) pour afficher la file d'attente d'alarme.

## Configuration des limites d'alarme avec le module multifonction

Vous pouvez configurer le module multifonction DAQM907A pour qu'une alarme se produise lorsqu'une séquence de bits donnée, ou un changement de séquence de bits est détecté sur des voies d'entrées/sorties numériques (voies 01 et 02), ou encore lorsqu'une voie de totalisateur (voie 03) atteint une valeur donnée.

### Pour configurer une alarme sur une voie E/S numérique

1. Sur un emplacement de module multifonction, appuyez sur **[Alarm]** ([Alarme]) et sélectionnez la voie E/S numérique.
2. Appuyez sur **Set Pattern > Pattern** (Définir une séquence > Séquence), et utilisez le bouton ou les touches fléchées du panneau avant pour définir les données de masque numérique pour une comparaison de séquences 8 bits.



3. Définit chaque bit à « 0 », « 1 », ou « X » en appuyant sur les touches **Set to all 0's** (Tout définir à 0), **Set to all 1's** (Tout définir à 1), ou **Set to all X's** (Tout définir à X). Les bits définis à X sont exclus de la comparaison de séquence numérique.
4. Appuyez sur **Fail On** (Échec à) pour configurer la génération d'une alarme par la voie sélectionnée lorsqu'une mesure de séquence 8 bits données est égale ou non à une mesure de données numériques.

### Pour configurer une alarme sur une voie du totalisateur

1. Sur un emplacement de module multifonction, appuyez sur **[Alarm]** ([Alarme]) et sélectionnez la voie du totalisateur.

2. Appuyez sur **Set Limits** > **Limit Count** (Définir des limites > Comptage de limites) pour définir un comptage de limite. Une alarme sera générée à partir d'un certain nombre lors de la scrutation.



## Indications sur les limites d'alarme

L'affichage utilise des couleurs pour indiquer les limites et les violations de limite.

### Nombre

La couleur rouge vif (voir ci-dessous) indique que la mesure affichée dépasse les limites.



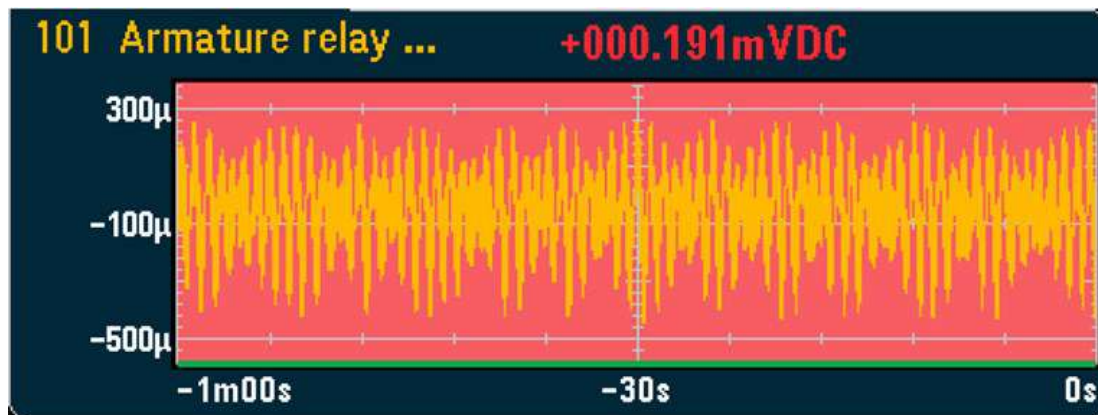
### Graphique à barres

Le graphique à barres (ci-dessous) utilise les mêmes couleurs. L'exemple suivant illustre une violation de la limite. Le mot **FAIL** (ÉCHEC) indique qu'une limite a été dépassée.



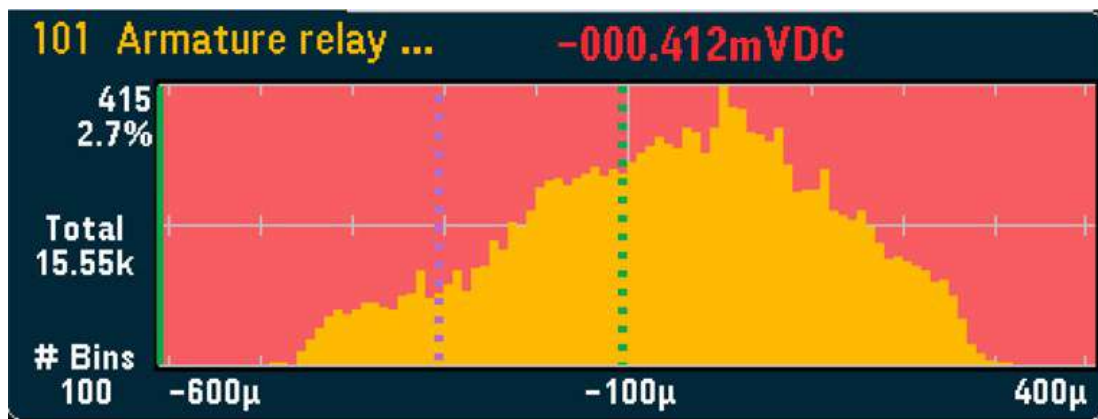
## Graphique des tendances

Le graphique des tendances (ci-dessous) utilise les mêmes couleurs. L'exemple suivant illustre une violation de la limite.



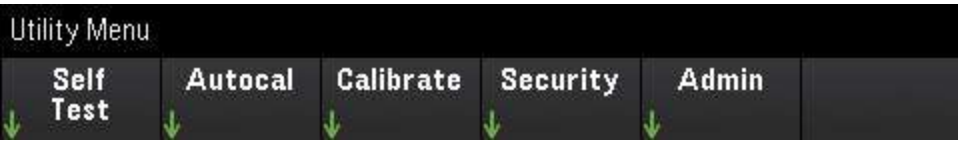
## Histogramme

L'histogramme (ci-dessous) utilise les mêmes couleurs. L'exemple suivant illustre une violation de la limite.





# Menu [Utility] ([Utilitaire])



## Auto-test

L'auto-test vérifie le bon fonctionnement de l'instrument. Reportez-vous au guide d'entretien du *Guide de maintenance DAQ970A/DAQ973A Keysight* pour plus de détails sur les procédures d'auto-test.

## Autocal

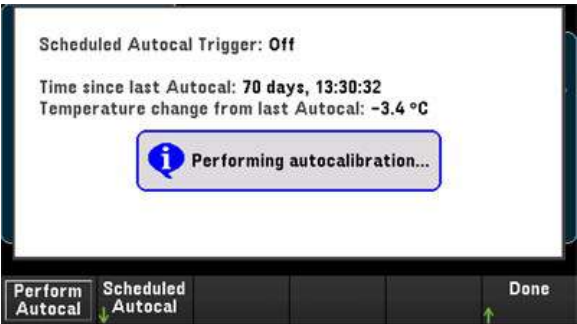


### Auto étalonnage

L'étalonnage automatique compense les dérives internes du multimètre numérique (DMM) interne ou des modules DAQ970A/DAQ973A causées par le temps et les variations de température. Il peut aider à éliminer les erreurs pour atteindre de meilleures performances. Dans ce modèle DAQ970A/DAQ973A, l'étalonnage automatique est effectué sur le DMM interne et sur la sortie du convertisseur numérique-analogique et les voies de mesure (voies 04 à 07) sur le module multifonction DAQM907A et le module numériseur DAQM909A.

| Touche de fonction | Description |
|--------------------|-------------|
|--------------------|-------------|

|                 |                                                                                                                                                 |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Perform Autocal | Pour effectuer un auto-étalonnage, appuyez sur la touche <b>Perform Autocal</b> (Effectuer un auto-étalonnage) et l'écran ci-dessous s'affiche. |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|



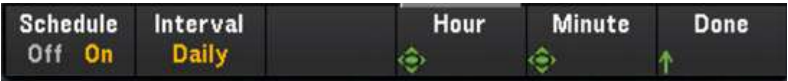
La durée estimée du processus d'auto-étalonnage selon les différents modules est indiquée ci-dessous :

| Zone                               | Temps estimé (s) | Exemple de calcul de la durée totale                                                                                                      |
|------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Multimètre numérique (DMM) interne | ~15 secondes     | Auto-étalonnage complet avec 3 modules DAQM909A dans un châssis principal :<br>DMM interne + (3 modules DAQM909A) = ~15 s + (3 x ~20 s) = |

|          |              |       |
|----------|--------------|-------|
| DAQM907A | ~ 6 secondes | ~75 s |
| DAQM909A | ~20 secondes |       |

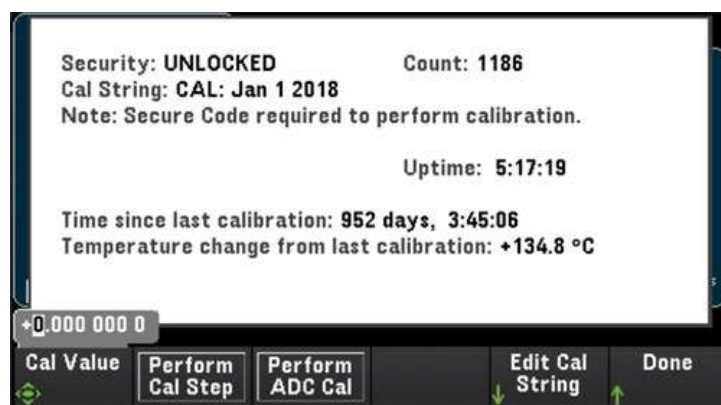
## Planifier un étalonnage automatique

Vous pouvez aussi programmer l'instrument pour faire un auto-étalonnage selon un actuelle. Pour utiliser cette fonction, appuyez sur **Scheduled Autocal > Schedule > On** (Auto étalonnage programmé > Calendrier > On). Pour régler la fréquence, appuyez sur **Interval > Daily/ Weekly/ Monthly** (Intervalle>Quotidien/Hebdomadaire/Mensuel).

| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interval Daily     |  <ol style="list-style-type: none"> <li>1. Pour programmer l'instrument pour qu'il effectue un auto-étalonnage quotidien, appuyez sur <b>Interval &gt; Daily</b> (Intervalle&gt;Quotidien)</li> <li>2. Pour régler l'heure de l'auto-étalonnage quotidien, appuyez sur les touches <b>Hour</b> (Heure) ou <b>Minute</b> respectivement et utilisez le bouton ou les touches fléchées du panneau avant pour définir l'heure souhaitée. Une fois terminé, appuyez sur <b>Done</b> (Terminé)</li> </ol>                                                           |
| Weekly             |  <ol style="list-style-type: none"> <li>1. Pour programmer l'instrument pour qu'il effectue un auto-étalonnage hebdomadaire, appuyez sur <b>Interval &gt; Weekly</b> (Intervalle&gt;Hebdomadaire)</li> <li>2. Pour régler l'heure de l'auto-étalonnage hebdomadaire, appuyez sur les touches <b>Week Day</b> (Jour de la semaine) <b>Hour</b> (Heure) ou <b>Minute</b> respectivement et utilisez le bouton ou les touches fléchées du panneau avant pour définir le jour et l'heure souhaités. Une fois terminé, appuyez sur <b>Done</b> (Terminé)</li> </ol> |
| Monthly            |  <ol style="list-style-type: none"> <li>1. Pour programmer l'instrument pour qu'il effectue un auto-étalonnage mensuel, appuyez sur <b>Interval &gt; Monthly</b> (Intervalle&gt;Mensuel)</li> <li>2. Pour régler l'heure de l'auto-étalonnage mensuel, appuyez sur les touches <b>Day</b> (Jour) <b>Hour</b> (Heure) ou <b>Minute</b> respectivement et utilisez le bouton ou les touches fléchées du panneau avant pour définir le jour et l'heure souhaités. Une fois terminé, appuyez sur <b>Done</b> (Terminé)</li> </ol>                                |

## Étalonner

Étalonner accède à la procédure d'étalonnage de l'instrument. Voir le *Guide de maintenance du DAQ970A/DAQ973A Keysight* pour plus de détails.



Sécurité

**Sécurité** affiche l'état de sécurité actuel de l'instrument et vous permet de verrouiller ou de déverrouiller l'instrument ou de saisir un nouveau code de sécurité. L'instrument doit être déverrouillé pour réaliser l'étalonnage, mettre à jour le micrologiciel ou modifier le code de sécurité.

Si le mode Sécurité est activé, il offre un aperçu des paramètres d'E/S de l'instrument et un accès à la fonction NISPOM Sanitize et à la configuration d'E/S. L'instrument doit être déverrouillé pour effectuer NISPOM Sanitize ou pour activer/désactiver les E/S. Le Décompte de sécurité augmente dès qu'une opération associée au code de sécurité est réalisée.



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| New Code           | Appuyez sur la touche de fonction <b>New Code</b> (Nouveau code) pour entrer et définir un nouveau code sécurisé pour déverrouiller la sécurité de l'instrument. Le code doit commencer par une lettre et peut contenir jusqu'à 12 lettres, chiffres ou trait de soulignement.                                                                                                                                           |
| LOCK               | Verrouille la sécurité de l'instrument en utilisant le code de sécurité actuel. Le code de sécurité est défini en usine sur « DAQ970A » pour les modèles DAQ970A et DAQ973A.                                                                                                                                                                                                                                             |
| Secure             | Basculer la touche <b>Activez Secure</b> Enter Sécuriser) - Active ( <b>On</b> ) ou désactive ( <b>Off</b> ) la sécurité de l'instrument. Lorsqu'elle est activée, la touche <b>NISPOM Sanitize</b> apparaît et la sécurité doit être déverrouillée pour apporter des modifications aux E/S et permettre la configuration.                                                                                               |
| NISPOM Sanitize    | Appuyez sur la touche de fonction <b>NISPOM Sanitize</b> pour assainir toute la mémoire de l'instrument accessible à l'utilisateur, à l'exception des constantes d'étalonnage. Cette procédure est conforme aux exigences du Chapitre 8 du National Instrument Security Program Operating Manual (NISPOM). Lorsqu'elle est désactivée, les modifications des E/S peuvent être effectuées sans déverrouiller la sécurité. |

**REMARQUE** L'instrument redémarre dès que le nettoyage est terminé.

ATTENTION

La touche NISPOM Sanitize et la commande SYSTem:SECurity:IMMEdiate sont équivalentes. Ces commandes sont recommandées pour les clients (ex. sous-traitants militaires) qui doivent satisfaire les conditions NISPOM.

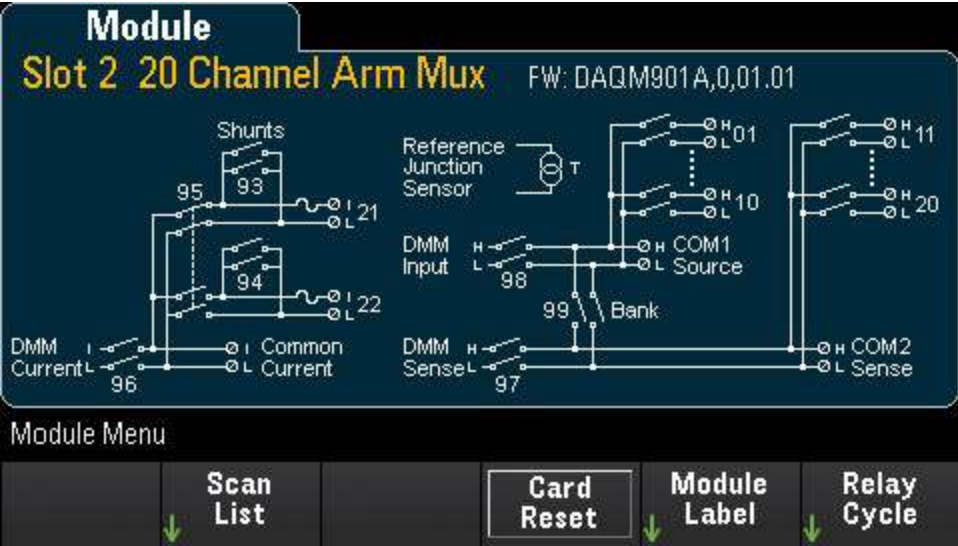
Cette fonctionnalité détruit toutes les informations d'état définies par l'utilisateur, les données de mesure et les paramètres d'E/S définis par l'utilisateur comme l'adresse IP. Il n'est pas recommandé d'utiliser cette fonctionnalité dans les applications de routine en raison des risques de perte involontaire de données.

Admin

Appuyez **Admin** > sur **Firmware Update** (Mise à jour du micrologiciel) pour mettre à jour le micrologiciel de l'instrument vers une nouvelle version. Pour plus d'informations, consultez **Mise à jour du micrologiciel**.

## Menu [Module] ([Module])

Appuyez sur la touche **[Module]** pour accéder au menu Module. Dans la page Module, vous pouvez voir la liste de scrutation de l'instrument, réinitialiser les modules, renommez l'étiquette d'un module, et vérifier les cycles de relais du multimètre numérique (DMM) interne et des modules enfichables.



### Liste de scrutation

**REMARQUE** Les options sont disponibles uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

Appuyez sur la touche **Scan List** (Liste de scrutation) pour afficher les voies disponibles sur le module incluses dans la liste de scrutation (État de la scrutation = ON). Appuyez sur la touche **Remove From Scan** (Retirer de la scrutation) pour désactiver les mesures sur toutes les voies du module, et retirer les voies de la liste de scrutation. Si la liste de voies est plus longue qu'une page, utilisez les touches fléchées haut/bas sur le panneau avant pour parcourir les autres pages.

The screenshot shows the 'Scan Status' menu with a table of channels and their scan status. The table has two columns: 'Channel' and 'Scan Status'. The channels listed are 201 through 208, all labeled 'Armature relay MUX Channel', and all have a status of 'OFF'. At the bottom right, it says 'Current Page: 1/3'. Below the table are two buttons: 'Remove From Scan' and 'Done'. A green arrow points up from the 'Done' button.

| Channel                        | Scan Status |
|--------------------------------|-------------|
| 201 Armature relay MUX Channel | OFF         |
| 202 Armature relay MUX Channel | OFF         |
| 203 Armature relay MUX Channel | OFF         |
| 204 Armature relay MUX Channel | OFF         |
| 205 Armature relay MUX Channel | OFF         |
| 206 Armature relay MUX Channel | OFF         |
| 207 Armature relay MUX Channel | OFF         |
| 208 Armature relay MUX Channel | OFF         |

Current Page: 1/3

Remove From Scan Done

## Réinitialisation de carte

**REMARQUE** Les options sont disponibles uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

Appuyez sur la touche **Card Reset** (Réinitialisation de carte) pour réinitialiser le module. Cette opération ouvre toutes les voies du module. Dans le module multifonction, cela configure aussi les ports numériques E/S comme entrées et définit les sorties du convertisseur numérique-analogique au mode de tension (s'il n'est pas verrouillé) et le niveau de sortie à 0.

## Étiquetage du module

Appuyez sur la touche **Module Label** (Libellé du module) pour définir un libellé pour le module sélectionné. Utilisez la poignée ou les touches de direction du panneau avant pour entrer les paramètres des différents canaux sur l'écran. Veuillez noter que le libellé peut contenir jusqu'à 10 caractères, y compris des lettres, des chiffres et des caractères spéciaux. Pour réinitialiser libellé par défaut, appuyez sur **Module Label** > **Clear All** > **Done** (Libellé du module > Effacer tout > Terminé).



### Cycle du relais

Appuyez sur la touche **Relay Cycle** (Cycle du relais) pour afficher le nombre de cycles sur chaque relais du multimètre numérique (DMM) interne et des modules enfichables. Utilisez cette fonctionnalité pour assurer le suivi des pannes de relais et pour prévoir le moment où une opération de maintenance sera nécessaire. Pour plus d'informations, consultez [Durée de vie des relais et maintenance préventive](#).



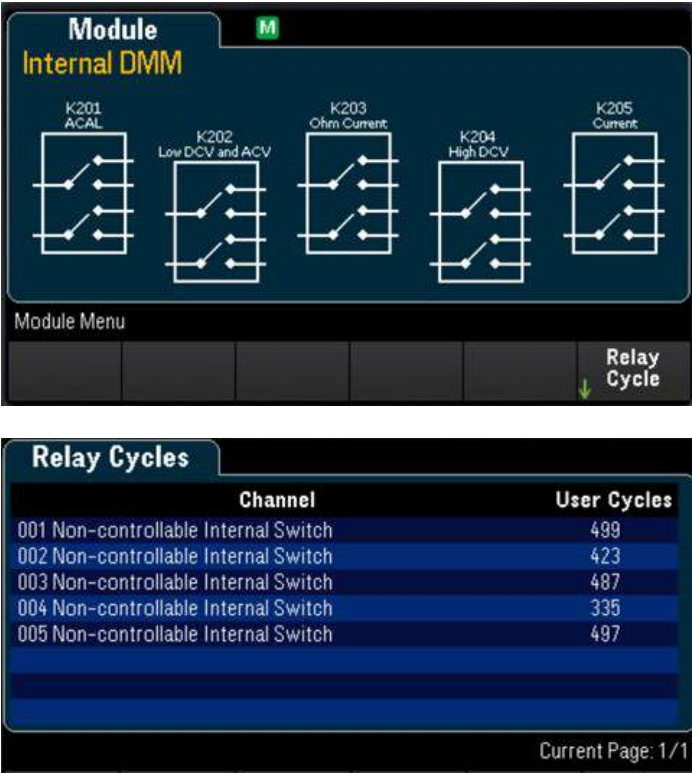
| Channel                        | User Cycles |
|--------------------------------|-------------|
| 201 Armature relay MUX Channel | 6497        |
| 202 Armature relay MUX Channel | 5609        |
| 203 Armature relay MUX Channel | 1489        |
| 204 Armature relay MUX Channel | 1427        |
| 205 Armature relay MUX Channel | 1079        |
| 206 Armature relay MUX Channel | 1050        |
| 207 Armature relay MUX Channel | 797         |
| 208 Armature relay MUX Channel | 229         |

Current Page: 1/4

Done

**REMARQUE**

Pour accéder à la page du multimètre numérique (DMM) interne dans le menu **Module**, tournez le bouton dans le sens inverse des aiguilles, ou appuyez sur la touche flèche vers la gauche jusqu'à ce que la page du module apparaisse. Après cela, appuyez sur la touche Relay Cycle (Cycle du relais) pour afficher le cycle du relais du DMM interne.



**Module** M

**Internal DMM**

K201 ACAL   K202 Low DCV and ACV   K203 Ohm Current   K204 High DCV   K205 Current

Module Menu

Relay Cycle

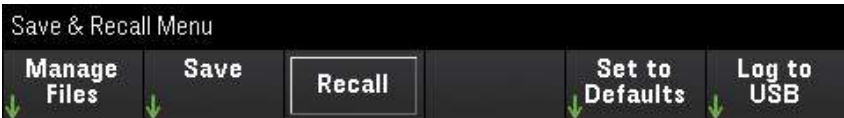
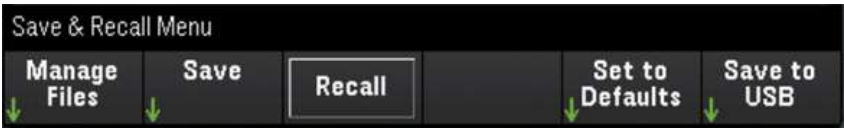
  

| Channel                              | User Cycles |
|--------------------------------------|-------------|
| 001 Non-controllable Internal Switch | 499         |
| 002 Non-controllable Internal Switch | 423         |
| 003 Non-controllable Internal Switch | 487         |
| 004 Non-controllable Internal Switch | 335         |
| 005 Non-controllable Internal Switch | 497         |

Current Page: 1/1



## Menu [Save Recall] ([Enreg./Rappel])

| Mode d'acquisition de données | Touches du menu [Save Recall] ([Enreg./Rappel])                                    |
|-------------------------------|------------------------------------------------------------------------------------|
| Scrutation                    |  |
| Numériser DMM, Numériseur     |  |

## Gérer les fichiers

La touche **Manage Files** (Gérer les fichiers) vous permet de créer, copier, supprimer et renommer des fichiers et des dossiers dans la mémoire flash interne de l'instrument ou sur un lecteur USB connecté au panneau avant. Lorsque vous appuyez sur la touche **Manage Files** (Gérer les fichiers), les options suivantes s'affichent :



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action :           | <div>Delete</div> <ol style="list-style-type: none"> <li>Pour supprimer un fichier ou un dossier, appuyez sur la touche <b>Delete</b> &gt; <b>Browse</b> pour parcourir le répertoire de fichiers et localiser le fichier ou le dossier souhaité dans le répertoire.</li> <li>Une fois le fichier ou le dossier souhaité mis en surbrillance, appuyez sur <b>Select</b> &gt; <b>Perform Delete</b> &gt; <b>Done</b> (Sélectionner &gt;Effectuer une suppression &gt;Retour).</li> </ol>                                  |
| Folder             | <ol style="list-style-type: none"> <li>Pour créer un nouveau dossier, appuyez sur <b>Folder</b> &gt; <b>Browse</b> (Dossier &gt;Parcourir) pour accéder au répertoire de fichiers dans lequel vous souhaitez créer le nouveau dossier.</li> <li>Appuyez sur <b>File Name</b> (Nom du fichier), saisissez un nom de fichier et appuyez sur <b>Done</b> (Terminé). Appuyez sur <b>Create Folder</b> &gt; <b>Done</b> (Créer un dossier &gt; Terminé)</li> </ol>                                                            |
| Copy               | <ol style="list-style-type: none"> <li>Pour copier un fichier ou un dossier, appuyez sur <b>Copy</b> &gt; <b>Browse</b> (Copier &gt;Parcourir) pour accéder au répertoire contenant le fichier ou le dossier que vous voulez copier et appuyez sur <b>Select</b> (Sélectionner).</li> <li>Appuyez sur <b>Copy path</b> (Chemin de copie) et sélectionnez un chemin de copie interne ou externe. Appuyez sur <b>Perform Copy</b> &gt; <b>Done</b> (Effectuer une copie &gt; Retour).</li> </ol>                           |
| Rename             | <ol style="list-style-type: none"> <li>Pour renommer un fichier ou un dossier, appuyez sur <b>Rename</b> &gt; <b>Browse</b> (Renommer &gt; Parcourir) pour accéder au répertoire contenant le fichier ou le dossier que vous voulez renommer et appuyez sur <b>Select</b> (Sélectionner).</li> <li>Appuyez sur <b>New Name</b> (Nouveau nom), saisissez un nouveau nom et appuyez sur <b>Done</b> (Terminé). Appuyez sur <b>Perform Rename</b> &gt; <b>Done</b> (Effectuer un changement de nom &gt; Retour).</li> </ol> |
| Browse             | La touche <b>Browse</b> (Parcourir) ouvre le répertoire dans lequel vous pouvez sélectionner le fichier ou dossier sur lequel l'action sera exécutée. Utilisez le bouton et les touches fléchées du panneau avant et appuyez sur <b>[Select]</b> ([Sélectionner]) pour naviguer dans le répertoire de fichiers. Les flèches à gauche et à droite réduisent ou développent un dossier.                                                                                                                                    |



|              |                                                                                                                                                                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Copy Path    | La touche <b>Copy path</b> (Chemin de copie) sélectionne un chemin de copie interne ou externe. Utilisez le bouton et les touches fléchées du panneau avant et appuyez sur <b>[Select]</b> ([Sélectionner]) pour naviguer dans le répertoire de fichiers. Les flèches à gauche et à droite réduisent ou développent un dossier. |
| Perform Copy | La touche <b>Perform Copy</b> (Effectuer la copie) copie le fichier ou dossier sélectionné sur son nouvel emplacement.                                                                                                                                                                                                          |

## Save (Enreg.)

La touche **Save** (Enregistrer) permet d'enregistrer l'état de l'instrument, les préférences de l'utilisateur, et des captures d'écran.

**REMARQUE** Les options de la 4<sup>ème</sup> touche changent selon l'option choisie pour la touche [Action:]

| Touche de fonction | Description |
|--------------------|-------------|
|--------------------|-------------|

Action : State



Enregistre l'état de l'instrument ou les préférences de l'utilisateur. Les fichiers peuvent être avoir n'importe quel nom, mais il doit se terminer par l'extension (.sit) pour les fichiers d'État et par (.prf) pour les fichiers de préférences respectivement. Les états de l'instrument enregistrés par le SCPI (commande \*SAV) sont enregistrés dans les noms de fichiers STATE\_0.sta à STATE\_4.sta.

1. Pour enregistrer l'état ou les préférences de l'utilisateur de l'instrument, appuyez sur **State** > **Browse** pour parcourir le répertoire de fichiers jusqu'à l'emplacement où vous souhaitez enregistrer le fichier, puis appuyez sur Sélectionner.
2. Appuyez sur **New File** (Nouveau fichier), saisissez un nom de fichier et appuyez sur **Done** (Terminé).
3. Appuyez sur la touche **State/Preference** (État/Préférences) pour choisir entre enregistrer l'état de l'instrument actuel (État) ou les préférences de l'utilisateur (Préférence).
4. Appuyez sur la touche de **Save State/Save Preference** (Enregistrer l'état/Enregistrer la préférence) pour enregistrer l'état de l'instrument ou les préférences de l'utilisateur à l'emplacement désigné dans le répertoire de fichiers.

**REMARQUE** **État** : Enregistre la configuration de mesures, incluant les configurations de canaux et les paramètres de scrutation.  
**Préférences** : Enregistre les paramètres non volatils associés à l'instrument, y compris les préférences d'utilisateur et les paramètres E/S.

Readings



1. Pour enregistrer les mesures, appuyez sur **Readings** > **Browse** pour parcourir le répertoire de fichiers jusqu'à l'emplacement où vous souhaitez enregistrer le fichier, puis appuyez sur Choisir.
2. Appuyez sur **New File** (Nouveau fichier), saisissez un nom de fichier et appuyez sur **Done** (Terminé).
3. Appuyez sur la touche **Separator** (Séparateur) pour définir le caractère (**Comma**, **Tab**, ou **Semicolon** (Virgule, tabulation, ou point-virgule)) qui sera utilisé pour séparer les informations de chaque ligne.

- Appuyez sur la touche **Save Readings** (Enregistrer les mesures) pour enregistrer le fichier à l'emplacement défini dans le répertoire de fichiers.

Capture



- Pour enregistrer une capture d'écran de l'affichage, appuyez sur **Capture** > **Browse** pour naviguer dans le répertoire de fichiers jusqu'à l'emplacement où vous souhaitez enregistrer le fichier, puis appuyez sur Choisir.
- Appuyez sur **New File** (Nouveau fichier), saisissez un nom de fichier et appuyez sur **Done** (Terminé).
- Appuyez sur la touche **Format** pour définir le format du fichier image (.bmp ou .png) à enregistrer.
- Appuyez sur la touche **Save Screen** (Enregistrer l'écran) pour enregistrer la capture d'écran à l'emplacement défini dans le répertoire de fichiers.

Naviguer

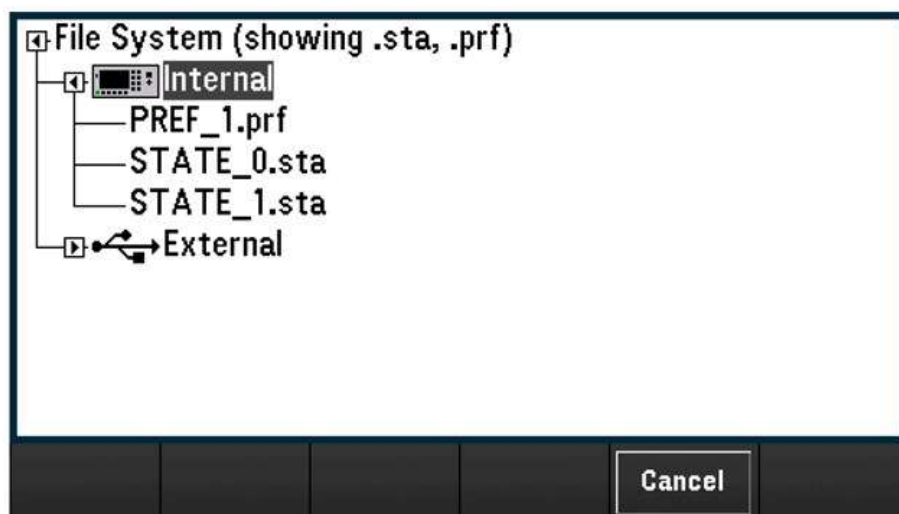
La touche **Browse** (Parcourir) ouvre le répertoire dans lequel vous pouvez sélectionner le fichier ou dossier sur lequel l'action sera exécutée. Utilisez le bouton et les touches fléchées du panneau avant et appuyez sur **[Select]** ([Sélectionner]) pour naviguer dans le répertoire de fichiers. Les flèches à gauche et à droite réduisent ou développent un dossier.

Nom du fichier

La touche **File Name** (Nom du fichier) vous permet de définir le nom du fichier ou du dossier pour l'action sélectionnée. Pour définir un nom de fichier ou de dossier, utilisez le bouton ou les touches fléchées du panneau avant pour sélectionner les caractères souhaités et appuyez sur **[Select]** ([Sélectionner]) pour saisir le caractère sélectionné et passer au suivant. Lorsque vous avez terminé d'entrer le nom de fichier souhaité, appuyez sur **Done**.

## Rappeler

La touche **Recall** (Rappeler) vous permet de rappeler un fichier d'état précédemment enregistré (extension .sta) ou un fichier de préférence (extension .prf). Utilisez la poignée ou les touches de direction du panneau avant pour naviguer dans un système de fichiers interne ou dans une clé USB externe jusqu'au fichier voulu. Utilisez la touche flèche droite pour développer un dossier. Appuyez sur **Select** (Sélectionner) pour rappeler le fichier sélectionné.



## Rétablir les valeurs par défaut

La touche **Set to Defaults** (Définir les valeurs par défaut) vous permet de rétablir les valeurs par défaut et les valeurs prédéfinies. Lorsque vous appuyez sur la touche **Set to Defaults** (Définir les valeurs par défaut), les options suivantes s'affichent :

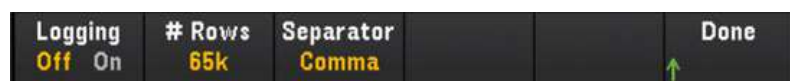


| Touche de fonction | Description                                                                                                                                                                           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Factory Reset      | Rétablit la configuration d'usine sur l'instrument. Cette touche n'affecte aucun paramètre d'E/S ou de configuration précédemment enregistré, comme l'adresse IP.                     |
| Default Pref       | Rétablit toutes les préférences sur les valeurs par défaut qui incluent les préférences de l'utilisateur et le paramètre d'E/S qui sont stockés dans une mémoire non volatile         |
| Preset State       | Prérègle l'instrument. Toutes les mesures sont effacées et toutes les voies sont ouvertes. Les configurations de voies n'ont pas été modifiées à l'exception du module multifonction. |

## Enregistrez sur la clé USB

**REMARQUE** L'option est disponible uniquement lorsque le mode d'acquisition sélectionné est **Scan** (Scrutation).

La touche **Log to USB** (Enregistrer sur la clé USB) vous permet d'enregistrer des lectures de mémoire de scrutation sur une clé USB connectée sur le port hôte USB du panneau avant. Le témoin USB s'affiche dès qu'une clé USB est connectée. Lorsque vous appuyez sur la touche **Log to USB** (Enregistrer sur la clé USB), les options suivantes s'affichent :



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Logging            | La touche <b>Logging On/Off</b> (Enregistrement On/Off) active ( <b>On</b> ) ou désactive ( <b>Off</b> ) l'enregistrement des mesures de mémoire de scrutation sur une clé USB connectée au port hôte USB du panneau avant. Lorsque l'enregistrement de données USB est activé, les mesures sont enregistrées dans les fichiers sur la clé USB. Cependant, les mesures ne seront pas restaurées dans la mémoire de lecture après un cycle de mise sous tension.                                                                                                                                                                                       |
| # Rows             | La touche <b># Rows</b> (Nombre de lignes) vous permet de définir la limite de lignes (nombre maximal de lignes pour les données de balayage) qui seront écrites dans chaque fichier d'enregistrement des données. Vous pouvez choisir entre trois options : <b>65k</b> (la limite pour chaque fichier d'enregistrement de données est de 65 536 lignes par fichier), <b>1M</b> (la limite pour chaque fichier d'enregistrement de données est de 1 048 576 lignes par fichier), ou <b>Infinite (Infini)</b> (la limite est le nombre d'octets autorisés par le système de fichiers - jusqu'à 4 gigaoctets ou selon l'espace de stockage disponible.) |

|                    |                                                                                                                                                                                                                                                                             |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Separator          | La touche <b>Separator</b> (Séparateur) vous permet de définir le caractère (( <b>Comma</b> , <b>Tab</b> , ou <b>Semicolon</b> (virgule, tabulation, ou point-virgule)) à utiliser pour séparer les informations de chaque ligne.                                           |
| Log to<br>New file | La touche Log to New (Consigner vers un nouveau fichier) s'affiche lorsque la consignation des données est en cours. Chaque fois que vous appuyez sur la touche <b>Log to New</b> (Consigner dans un nouveau fichier), les données sont consignées dans un nouveau fichier. |

## Structure de dossiers et des fichiers

### Description d'un dossier

Chaque scrutation sauvegardée sera enregistrée dans un dossier de niveau supérieur désignée :

`/DAQ97xA/[instrument_SN]/[yyyymmdd_hhmmssmmm]`

- Les crochets ([ ]) ne font pas partie du nom du répertoire.
- instrument\_SN indique le numéro de série de l'instrument.
- aaaammjj\_hhmmssmmm est un horodatage indiquant le début approximatif de l'analyse. Le format est l'année (aaaa), le mois (mm), le jour (dd), le trait de soulignement (\_), les heures (hh), les minutes (mm), les secondes (ss) et les millisecondes (mmm).

Par exemple, le dossier nommé : `/DAQ970A/MY00012345/20191127_134523123` désignerait une scrutation sur l'instrument MY00012345 qui aurait débuté approximativement 23,123 secondes après 1:45 pm (13:45) le mercredi 27 novembre 2019.

### Descriptions des fichiers

Le dossier de niveau supérieur décrit ci-dessus contient deux types de fichiers.

#### 1. config.csv

Il s'agit d'un fichier texte qui documente la configuration de l'instrument pour cette scrutation. L'horodatage est décrit ci-dessus. Le fichier décrit la configuration de l'instrument en langage directement lisible.

#### 2. dat#####.csv

Si vous utilisez la commande `MMEMory:FORMat:READing:RLIMit OFF`, toutes les données seront enregistrées dans un seul fichier, nommé `dat00001.csv`.

Si vous avez envoyé la commande `MMEMory:FORMat:READing:RLIMit ON` pour limiter les données à 64K - 1 (65,535) balayages par fichier, dans ce cas les balayages seront enregistrées dans plusieurs fichiers, nommés `dat00001.csv`, `dat00002.csv`, `dat00003.csv`, etc. C'est utile pour importer des données dans une feuille de calcul ou dans d'autres programmes d'analyse de données. Notez que certaines feuilles de calcul ou certains programmes d'analyse de données peuvent importer les données plus facilement si vous modifiez l'extension de `csv` en `txt`. Si votre programme n'importe pas correctement les données, essayez de changer l'extension des fichiers de données.

### Contenu des fichiers de données

L'enregistrement dans des fichiers de données n'est possible que pour les voies appartenant à une liste de scrutation. Les voies possibles sont indiquées dans le tableau ci-dessous ; notez que s désigne le numéro de logement qui est 1, 2 ou 3.

Par exemple, le module DAQM901A pourrait comporter les voies 101-120, 201-220 ou 301-320.

| Module   | Description                                                    | Voies          |
|----------|----------------------------------------------------------------|----------------|
| DAQM900A | Multiplexeur à transistor à effet de champ 20 voies            | s01 - s20      |
| DAQM901A | Multiplexeur à relais électromagnétiques 20 voies bifilaires   | s01 - s20      |
| DAQM902A | Multiplexeur à relais à lame souple 16 voies bifilaires        | s01 - s16      |
| DAQM907A | Entrées numériques 2 voies                                     | s01 - s02      |
| DAQM907A | Totalisateur 1 voie, CAN 4 voies                               | s03, s04 - s27 |
| DAQM908A | Multiplexeur à relais électromagnétiques 40 voies asymétriques | s01 - s40      |

Le format de tous les fichiers de données USB est semblable à ce que produit Keysight BenchLink Data Logger par défaut. Le séparateur de champs par défaut est une virgule, mais vous pouvez utiliser la touche **Seperator** (Séparateur) pour en choisir un autre.

Un exemple de fichier est illustré ci-dessous :

| Sweep # (N° balayage) | Temps                   | Chan 201 (VDC) | Chan 202 (VDC) |
|-----------------------|-------------------------|----------------|----------------|
| 1                     | 11/27/2019 08:07:12:237 | 0,36823663     | 1,23895216     |
| 2                     | 11/27/2019 08:07:13:237 | 0,62819233     | 0,98372939     |
| 3                     | 11/27/2019 08:07:13:237 | 0,38238212     | 0,39382906     |
| 4                     | 11/27/2019 08:07:13:237 | 0,46773299     | 0,55543345     |
| 6                     | 11/27/2019 08:07:13:237 | 1,32323567     | 0,21213335     |

- Les numéros de voies et les unités associées sont indiqués dans la ligne d'en-tête.
- Si la limite de ligne est activée (ON) et que les données s'étendent sur plusieurs fichiers, la numérotation de scrutation continue là où elle a été abandonnée dans le fichier précédent. Ainsi la première scrutation du deuxième fichier de données porterait le numéro 65 536, la première scrutation du troisième fichier 131 071, etc.

## Enregistrer sur la clé USB

**REMARQUE**

Cette option n'est pas disponible lorsque le mode **Numériser DMM** ou **Numériseur** est sélectionné comme mode d'acquisition de données.

La touche **Save to USB** (Enregistrer sur la clé USB) vous permet d'enregistrer les données numérisées sur une clé USB connectée sur le port hôte USB du panneau avant. Le témoin USB s'affiche dès qu'une clé USB est connectée. Lorsque vous appuyez sur la touche **Save to USB** (Enregistrer sur la clé USB), les options suivantes s'affichent :



| Touche de fonction | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Save On/Off   | <p>La touche <b>Auto Save</b> (Enregistrement automatique) active (<b>On</b>) ou désactive (<b>Off</b>) l'enregistrement des données numérisées sur une clé USB connectée au port hôte USB du panneau avant. Si la fonction <b>Auto Save</b> (Enregistrement automatique) est activée, l'instrument va commencer l'enregistrement du fichier de données dans la clé USB lorsque l'opération de numérisation est terminée.</p> <p><b>REMARQUE</b> Si l'instrument ne détecte pas de clé USB, il empêchera l'initialisation d'un processus de numérisation jusqu'à ce qu'une clé USB soit détectée ou que la fonction Auto Save (Enregistrement automatique) soit désactivée.</p> <p>Vous pouvez commencer à voir les résultats dans le menu <b>[View]</b> ([Affichage]) pendant que l'opération d'enregistrement automatique s'exécute en arrière-plan.</p> |
| Separator          | <p>La touche <b>Separator</b> (Séparateur) vous permet de définir le caractère ((<b>Comma</b>, <b>Tab</b>, ou <b>Semicolon</b> (virgule, tabulation, ou point-virgule)) à utiliser pour séparer les informations de chaque ligne du fichier de données.</p> <p><b>REMARQUE</b> Ce paramètre est disponible uniquement lorsque le mode <b>Numériser DMM</b> est sélectionné comme mode d'acquisition de données.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Path Name          | <p>Sélectionne un emplacement ou un dossier sur le lecteur USB pour enregistrer les données numérisées.</p> <p>Appuyez sur la touche <b>Browse</b> (Naviguer) et utilisez le bouton ou les touches fléchées pour sélectionner l'emplacement souhaité pour l'enregistrement. Appuyez ensuite sur le <b>File Name</b> (Nom de fichier) pour définir le nom de fichier souhaité. Appuyez sur <b>Done</b> (Terminé) pour terminer le processus.</p> <div><p>Action: Config Digitizer auto save path</p><p>Path: External\</p><p>File: AUTOSAVE.dat</p><p>Action: Auto Save Browse File Name Done</p></div>                                                                                                                                                                                                                                                     |

---

**REMARQUE** Après chaque opération de numérisation, un nouvel ensemble de données est écrit dans le même fichier indiqué dans le paramètre Nom du chemin ; écraser les anciennes données. Par conséquent, si vous souhaitez enregistrer différents ensembles de données issues de différentes opérations de numérisation, vous devez sélectionner un autre fichier dans le chemin d'enregistrement chaque fois avant de lancer le numériseur.

---



## Format de fichier Enregistrer vers la clé USB

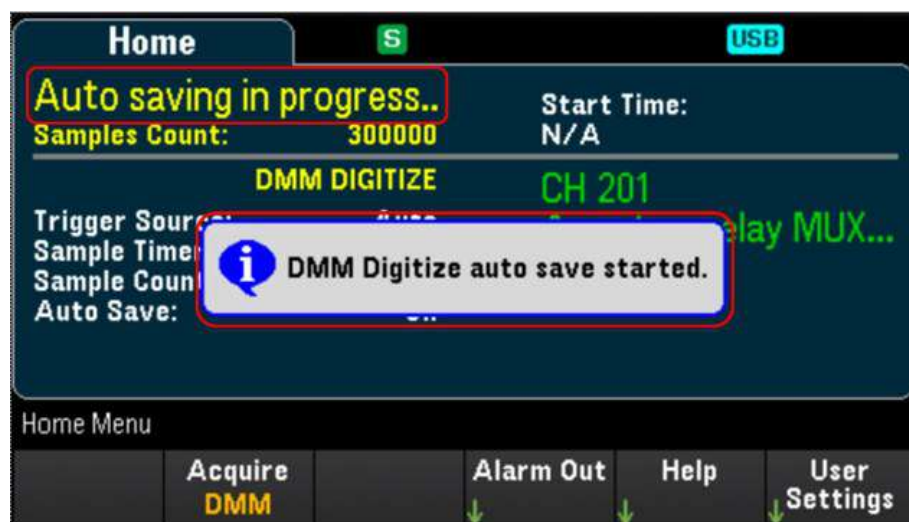
Dans le mode **Numériseur**, tous les fichiers de données sont enregistrés dans le format de fichier **.dat** lorsqu'ils sont enregistrés sur le lecteur USB. Le suffixe de l'extension de fichier **.dat** est fixe et ne peut pas être modifié.

Dans le mode **Numériser DMM**, par défaut, tous les fichiers de données sont enregistrés dans le format **.csv**. Cependant, vous pouvez choisir d'enregistrer le fichier de données avec une extension de fichier **.dat**. Pour cela, ajoutez **.dat** à la fin du nom de fichier lorsque vous le nommez.

## Enregistrer sur l'affichage du panneau avant USB

Des indicateurs apparaîtront sur l'écran du panneau avant pour vous informer que la sauvegarde automatique est en cours. Ces indicateurs (surlignés en rouge) apparaissent dans les images ci-dessous :

Mode d'acquisition de données DMM Digitize :



Mode d'acquisition de données Digitizer :



## Interface Web

Le Système d'acquisition de données DAQ970A/DAQ973A Keysight comprend une interface Web intégrée pour la surveillance et le contrôle de l'instrument sur un navigateur Web.

Pour accéder à l'Interface Web, deux options sont disponibles :

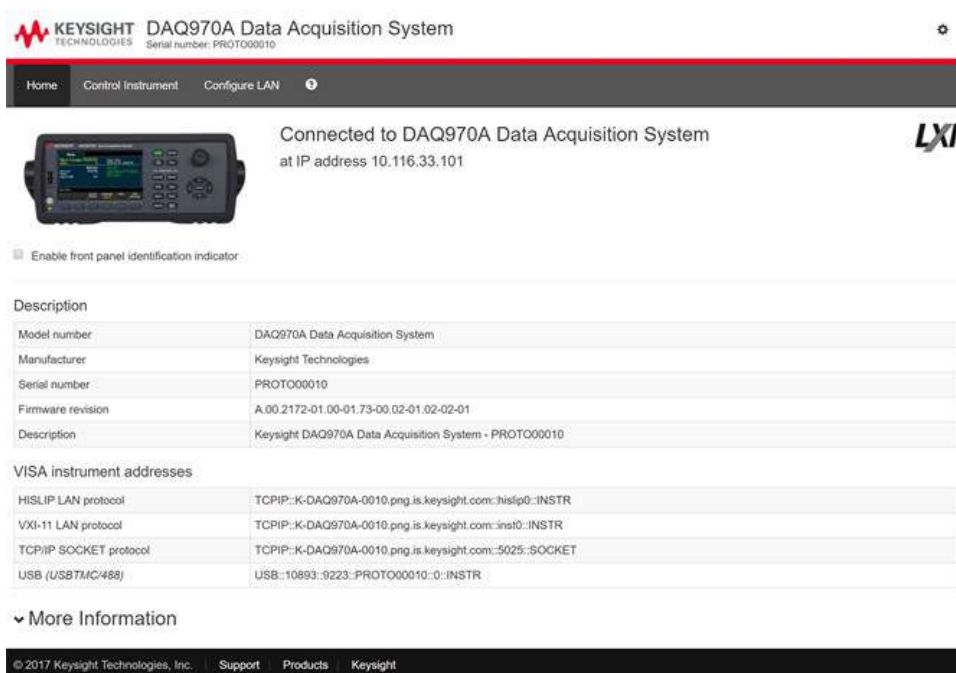
- **Interface au réseau local (LAN) :** Branchez votre instrument sur l'interface LAN et saisissez l'adresse IP de l'instrument dans la barre d'adresse en haut de votre navigateur Web.
- **Keysight IO Libraries Suite :** Sélectionnez l'instrument dans Connection Expert et cliquez sur le bouton Interface utilisateur Web. Assurez-vous que la suite Keysight IO Libraries est installée avant de procéder à la configuration de l'interface distante.

### REMARQUE

Ce qui suit est un aperçu des onglets de l'interface Web affichés en haut de la fenêtre de l'interface. Dans l'Interface Web, ouvrez un onglet et cliquez sur le bouton Aide (?) pour afficher les rubriques d'aide associées à cet onglet.

## Page d'accueil

La page d'accueil affiche des informations de base relatives à l'instrument. Cliquez sur More Information (Plus d'informations) ou Less Information (Moins d'information) pour afficher des détails relatifs au LAN ou à la conformité LXI. Pour modifier les informations affichées sur cette page, utilisez la page Instrument de contrôle.



**KEYSIGHT TECHNOLOGIES DAQ970A Data Acquisition System**  
Serial number: PROTO00010

Home Control Instrument Configure LAN ?

Connected to DAQ970A Data Acquisition System  
at IP address 10.116.33.101

☒ Enable front panel identification indicator

| Description       |                                                       |
|-------------------|-------------------------------------------------------|
| Model number      | DAQ970A Data Acquisition System                       |
| Manufacturer      | Keysight Technologies                                 |
| Serial number     | PROTO00010                                            |
| Firmware revision | A.00.2172-01.00-01.73-00.02-01.02-02-01               |
| Description       | Keysight DAQ970A Data Acquisition System - PROTO00010 |

| VISA instrument addresses |                                                          |
|---------------------------|----------------------------------------------------------|
| HISLIP LAN protocol       | TCPIP::K-DAQ970A-0010.png.is.keysight.com::hisip0::INSTR |
| VXI-11 LAN protocol       | TCPIP::K-DAQ970A-0010.png.is.keysight.com::inst0::INSTR  |
| TCP/IP SOCKET protocol    | TCPIP::K-DAQ970A-0010.png.is.keysight.com::5025::SOCKET  |
| USB (USB7M/488)           | USB::10893::9223::PROTO00010::0::INSTR                   |

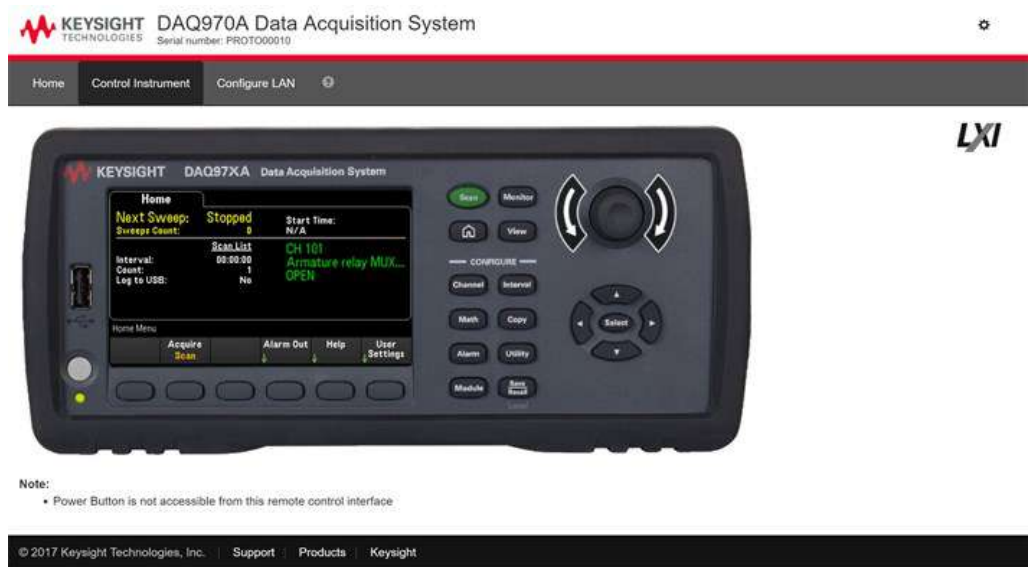
▼ More Information

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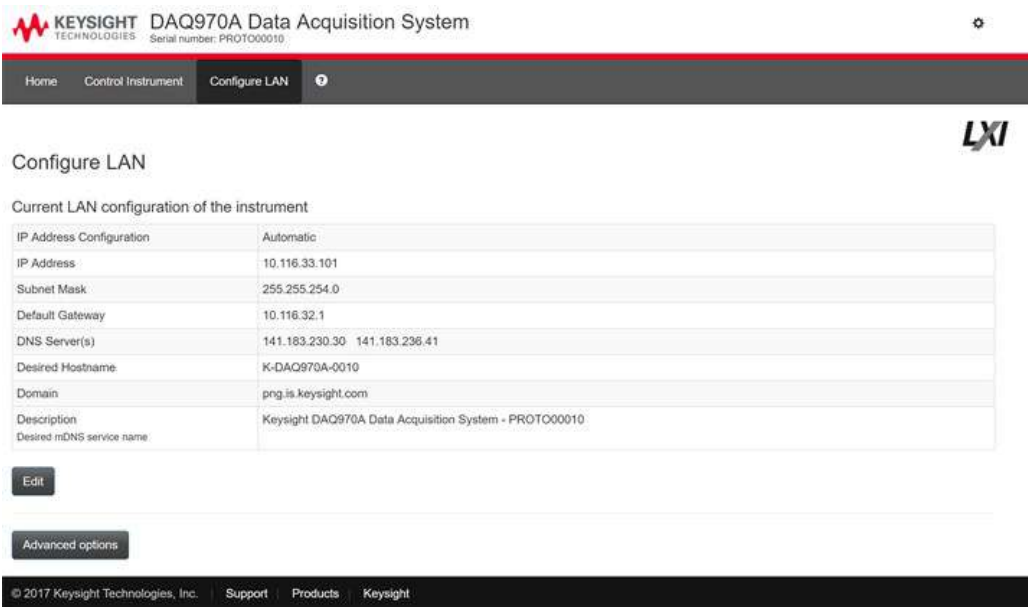
Cochez la case « Activer l'indicateur d'identification du panneau avant » pour activer un indicateur visuel qui identifie le DAQ970A/DAQ973A. Cela peut vous aider à localiser physiquement l'instrument sur une baie, par exemple.

Le type et la position de l'indicateur peuvent varier. Les indicateurs communs sont les LED, un message à l'écran ou un message affiché dans une boîte de dialogue. Décochez la case pour désactiver l'indicateur.

Page de l'instrument de contrôle



Page Configurer le LAN



Cliquez sur le bouton **Edit** (Modifier) pour modifier la page de configuration réseau.

Une fois terminé, cliquez sur **Apply Changes** (Appliquer les modifications) pour accepter les nouveaux paramètres ou cliquez sur **Cancel** (Annuler) pour ignorer les modifications.

Cliquez sur le bouton **Advanced options** (Options avancées) pour réinitialiser les options de configuration réseau.

## Page Aide

Des rubriques d'aide sont disponibles pour chacun des onglets décrits ci-dessus. Par exemple :

**KEYSIGHT**  
TECHNOLOGIES

DAQ970A Data Acquisition System  
Help

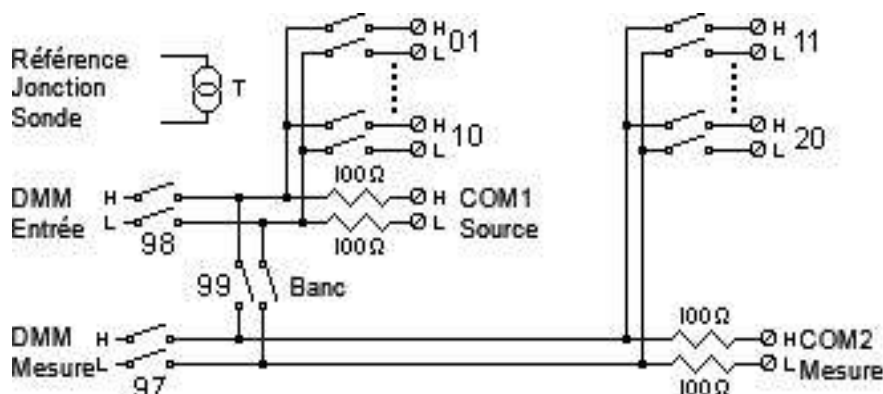
## Présentation des modules

Cette section décrit chaque module enfichable avec un schéma de principe et de câblage. Un journal de câblage est également inclus afin de documenter facilement votre configuration de câblage de chaque module.

- Module multiplexeur à transistor à effet de champ 20 voies DAQM900A
- Module multiplexeur à relais électromagnétiques 20 voies DAQM901A
- Module multiplexeur à relais à lame souple 16 voies DAQM902A
- Module Actionneur/commutateur à usage général 20 voies DAQM903A
- Matrice de commutation 4x8 deux fils DAQM904A
- Module multiplexeur RF (50  $\Omega$ ) double 4 voies vers 1 DAQM905A
- Module multifonction DAQM907A
- Multiplexeur asymétrique 40 voies DAQM908A
- Module numériseur 4 voies 24 bits DAQM909A

## Module multiplexeur à transistor à effet de champ 20 voies DAQM900A

Ce module est divisé en deux bancs de 10 voies bifilaires chacun. Toutes les 20 voies commutent le niveau haut (HI) et le niveau bas (LO), offrant ainsi des entrées totalement isolées pour le multimètre numérique interne ou un instrument externe. Lors des mesures de résistance à 4 fils, les voies du Banc A (voie n) sont automatiquement couplées avec les voies du Banc B (voie n+10) pour fournir des connexions de mesure et de source. Le module possède une jonction de référence à thermocouple intégré pour réduire les erreurs dues aux gradients thermiques lors de la mesure de thermocouples.



### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

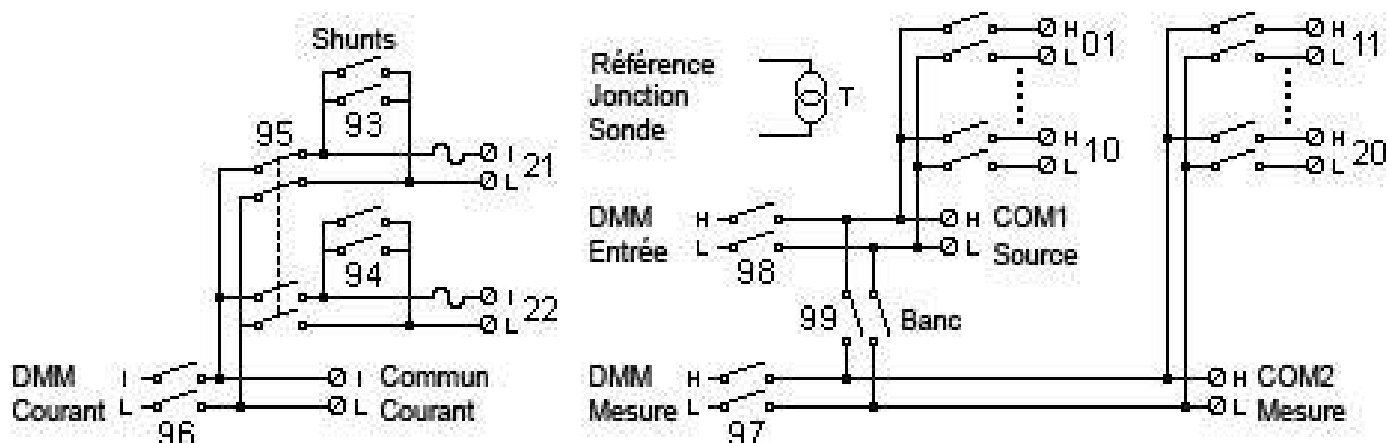
Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

## Module multiplexeur à relais électromagnétiques 20 voies DAQM901A

Ce module est divisé en deux bancs de 10 voies bifilaires chacun. Deux voies supplémentaires protégées par fusible sont disponibles sur le module (total 22 voies) pour réaliser des mesures étalonnées directes de courant continu ou alternatif avec le multimètre interne (des résistances de shunt externes ne sont pas nécessaires). Toutes les 22 voies commutent le niveau haut (HI) et le niveau bas (LO), offrant ainsi des entrées totalement isolées pour le multimètre numérique interne ou un instrument externe. Lors des mesures de résistance à 4 fils, les voies du Banc A (voie n) sont automatiquement couplées avec les voies du Banc B (voie n+10) pour fournir des connexions de mesure et de source. Le module possède une jonction de référence à thermocouple intégré pour réduire les erreurs dues aux gradients thermiques lors de la mesure de thermocouples.



### REMARQUE

Une seule des voies 21 et 22 peut être connectée au multimètre numérique (DMM) interne et /ou à la sortie COM à la fois ; la connexion d'une voie fermant l'autre (court-circuitant ainsi les entrées "I" et "LO").

### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

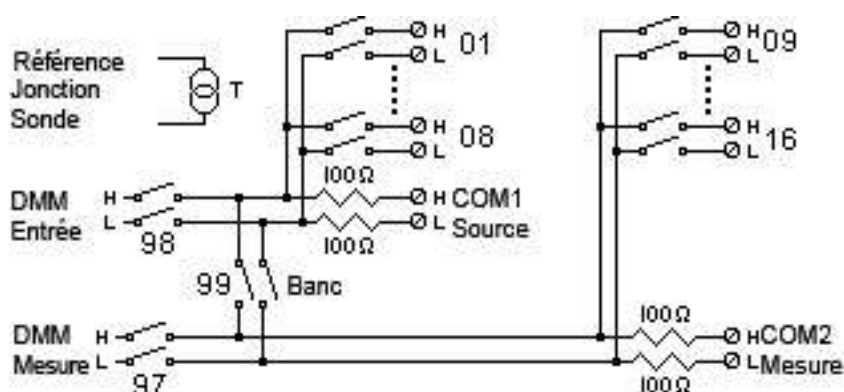
#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.



## Module multiplexeur à relais à lame souple 16 voies DAQM902A

Ce module est divisé en deux bancs de 8 voies bifilaires chacun. Utilisez ce module pour les applications qui nécessitent une scrutation à haute vitesse et pour les applications de tests automatisées à haut débit. Toutes les 16 voies commutent le niveau haut (HI) et le niveau bas (LO), offrant ainsi des entrées totalement isolées pour le multimètre numérique interne ou un instrument externe. Lors des mesures de résistance à 4 fils, les voies du Banc A (voie n) sont automatiquement couplées avec les voies du Banc B (voie n+8) pour fournir des connexions de mesure et de source. Le module possède une jonction de référence à thermocouple intégré pour réduire les erreurs dues aux gradients thermiques lors de la mesure de thermocouples.



### REMARQUE

Les mesures de courant sur ce module nécessiteront des résistances de shunt externes.

### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

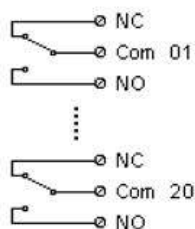
Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.



## Module Actionneur/commutateur à usage général 20 voies DAQM903A

Ce module contient 20 relais inverseurs unipolaires à deux positions (forme C) indépendants à verrouillage. Ce module peut commuter 300 V, 1 A (puissance maximale commutée de 50 W) vers votre dispositif à tester ou pour actionner des dispositifs externes. Les bornes à vis sur le module donnent accès au contact travail, au contact repos et commun de chacun des 20 inverseurs. Ce module ne se connecte pas au multimètre numérique interne. Utilisez ce module pour des applications exigeant des contacts de haute intégrité ou des connexions de qualité de signaux non multiplexés.

Une zone libre de composants est située près des bornes à vis pour implanter des circuits personnalisés, comme des filtres simples, des circuits de protection et des diviseurs de tension. Cette zone comporte l'espace nécessaire pour insérer vos propres composants mais elle ne comporte pas de trace de circuit imprimé. Vous devez ajouter vos propres circuits et trajets de signaux.



### REMARQUE

Vous pouvez fermer plusieurs voies simultanément sur ce module.

Les commandes CLOSE et OPEN contrôlent l'état de la connexion entre le contact travail (NO) et le contact COM de chaque voie. Par exemple, CLOSE 201 relie le contact travail au contact COM de la voie 01.

### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

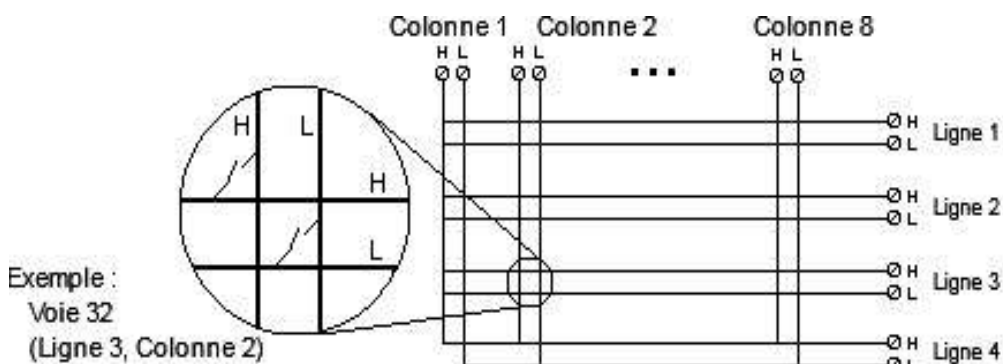
#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

## Matrice de commutation 4x8 deux fils DAQM904A

Ce module comporte 32 points d'intersection à deux fils organisés selon une configuration de 4 lignes par 8 colonnes. Vous pouvez connecter des lignes et des colonnes entre plusieurs modules afin d'élaborer des matrices plus importantes comme 8× 8 et 4×16, avec un maximum de 96 points de croisement dans un seul appareil. Utilisez ce module pour connecter plusieurs instruments en plusieurs points, ou toute combinaison d'entrée et de sortie, de votre dispositif à tester en même temps.

Ce module ne se connecte pas au multimètre numérique interne. Chaque relais au point d'intersection possède son propre libellé de voie unique représentant la ligne et la colonne. Par exemple, la voie 32 représente la connexion du point d'intersection de la ligne 3 avec la colonne 2 comme le montre la figure ci-dessous :



### REMARQUE

vous pouvez fermer plusieurs voies simultanément sur ce module.

### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

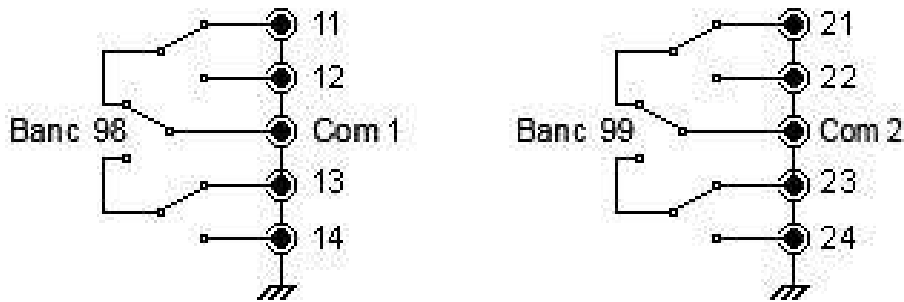
#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

## Module multiplexeur RF (50 $\Omega$ ) double 4 voies vers 1 DAQM905A

Ces modules se composent de deux bancs indépendants de multiplexeurs 4 voies vers 1 qui offrent des possibilités de commutation large bande pour des signaux haute fréquence ou pulsés. Les voies de chaque banc sont réparties selon une structure « arborescente » afin de présenter une meilleure isolation et un faible ROS en tension. Les deux modules partagent la même terre et présentent une faible diaphonie et d'excellentes performances de perte d'insertion. Pour créer des multiplexeurs RF plus importants, vous pouvez connecter plusieurs bancs en cascade.

Ce module ne se connecte pas au multimètre numérique interne. Vous pouvez brancher vos signaux directement sur les connecteurs SMB de la carte ou aux câbles d'adaptation SMB-BNC fournis avec le module.



### REMARQUE

Vous ne pouvez fermer qu'une seule voie par banc à la fois sur ces modules ; la fermeture d'une voie d'un banc provoquant l'ouverture de la voie précédemment fermée. Une voie de chaque banc est toujours reliée à la borne COM.

Ces modules répondent seulement à la commande CLOSE (la commande OPEN est sans objet). Pour ouvrir une voie, envoyez la commande CLOSE (FERMER) à une autre voie du même banc.

### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

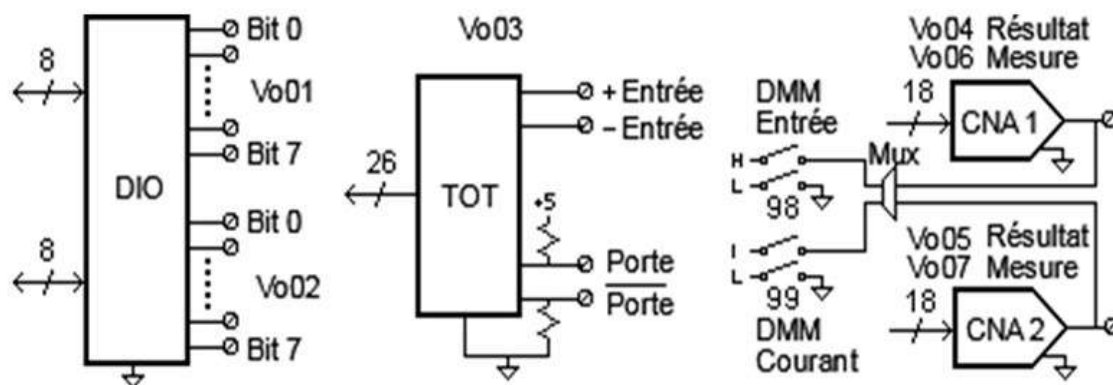
Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

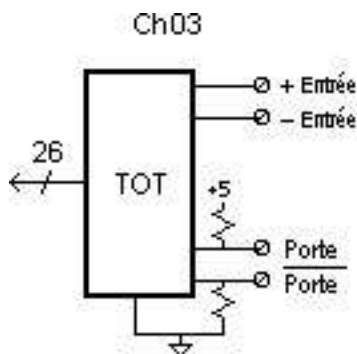
## Module multifonction DAQM907A

Ce module regroupe deux ports d'entrées-sorties numériques à 8 bits, un totalisateur 100 kHz et deux sorties analogiques de  $\pm 12$  V (CAN). Pour une plus grande commodité, vous pouvez lire les entrées numériques et le comptage sur le totalisateur pendant une scrutation. Utiliser ce module pour détecter l'état et contrôler des dispositifs externes comme des solénoïdes, des relais de puissance et des commutateurs hyperfréquence.



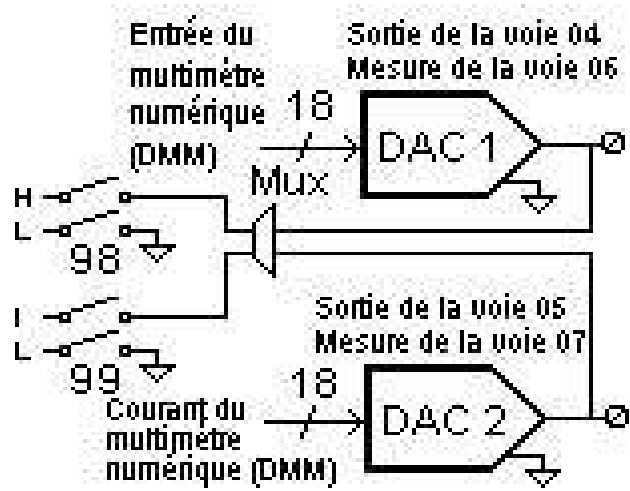
Les E-S numériques se composent de deux ports à 8 bits avec des entrées et sorties compatibles TTL. Les sorties à drains ouverts peuvent absorber jusqu'à 400 mA. Depuis le panneau avant, vous ne pouvez lire les données issues que d'un seul port d'entrée à 8 bits à la fois. Depuis l'interface à distance, vous pouvez lire les deux ports simultanément comme un mot de 16 bits à condition qu'aucun port n'appartienne à la liste de scrutation.

### Entrée du totaliseur



Le totaliseur 26 bits peut compter des impulsions à la fréquence de 100 kHz. Vous pouvez configurer le totalisateur afin qu'il compte les fronts montants ou les fronts descendants du signal d'entrée. Un signal TTL de niveau haut appliqué à la borne «**G**» active le comptage et un signal de niveau bas le désactive. Un signal compatible TTL de niveau bas appliqué à la borne « **$\bar{G}$** » active le comptage et un signal de niveau haut le désactive. Le totalisateur ne compte que lorsque les deux bornes sont activées. Déplacez le cavalier Seuil de totalisation sur la position « AC » pour détecter les variations jusqu'à 0 volt. Déplacez le cavalier sur la position « TTL » (réglage d'usine) pour détecter les variations jusqu'aux niveaux des seuils TTL.

Sortie analogique (Convertisseur numérique-analogique) Sortie et mesure



Les deux sorties analogiques (voies 04 et 05) et de mesure (voies 06 et 07) sont capables de produire des tensions ou des courants calibrés avec une résolution de 18 bits. Vous devez les limiter à un courant de sortie total de 40 mA pour chaque logement (deux voies de convertisseur au total). Le tableau ci-dessous indique les valeurs de sortie du convertisseur en mode courant et tension :

| Mode         | Courant | Tension |
|--------------|---------|---------|
| Current Mode | ±24 mA  | ± 12 V  |
| Voltage Mode | ±15 mA  | ± 12 V  |

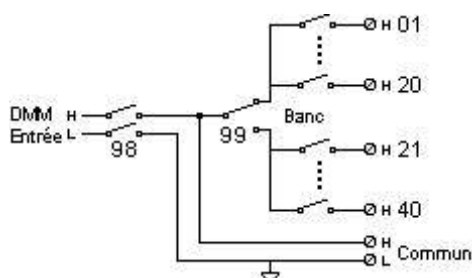
**AVERTISSEMENT**

**POUR EVITER TOUT CHOC ELECTRIQUE**

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

## Multiplexeur asymétrique 40 voies DAQM908A

Ce module est divisé en deux bancs de 20 voies chacun. L'ensemble des 40 voies ne commute que le niveau haut (HI) avec un niveau bas (LO) commun pour le module. Utilisez ce module pour des applications de multiplexage à haute densité nécessitant des entrées asymétriques avec le commun au niveau bas.



### REMARQUE

Une seule voie peut être fermée à la fois ; la fermeture d'une voie entraîne l'ouverture de la voie précédemment fermée.

Ce module ne convient pas à la mesure directe d'un courant ou aux mesures de résistance en 4 fils.

### AVERTISSEMENT

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

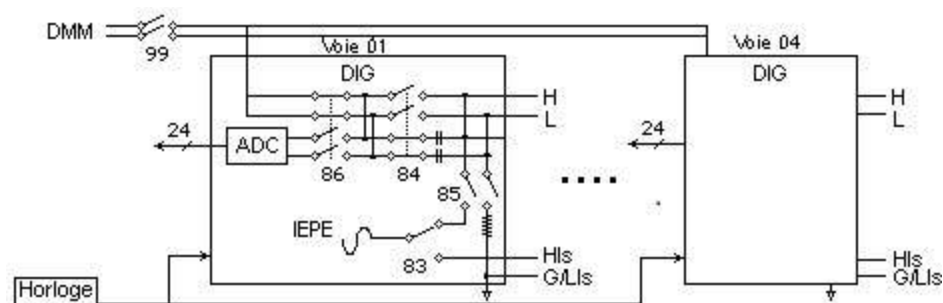
#### ATTENTION AUX TENSIONS DANGEREUSES

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

## Module numériseur 4 voies 24 bits DAQM909A



Le module DAQM909A est un numériseur à 4 voies capable de fournir quatre voies échantillonnées simultanément avec une fréquence d'échantillonnage pouvant atteindre 800 000 échantillons par seconde avec une résolution maximale de 24 bits. Les voies d'entrée du DAQM909A peuvent être configurées comme une entrée différentielle ou une entrée unipolaire et chaque voie peut fournir jusqu'à 4 mA de courant constant pour alimenter un capteur IEPE. Lorsque trois modules DAQM909A sont insérés dans le même instrument, les 12 voies peuvent être synchronisées pour fournir un échantillonnage simultané.

### AVERTISSEMENT

#### NE PAS MESURER PLUS QUE LA TENSION NOMINALE

La tension d'entrée maximale de mesure est de  $\pm 18$  Vpk (unipolaire) pour les broches hautes et basses.

#### POUR EVITER TOUT CHOC ELECTRIQUE

Pour éviter tout choc électrique, utilisez seulement du fil prévu pour la tension la plus élevée sur une voie quelconque. Avant de retirer le couvercle d'un module, supprimez toutes les alimentations des dispositifs externes connectés au module.

#### ATTENTION AUX SIGNAUX MULTIPLES

Pour éviter la possibilité que plusieurs sources de signal soient connectées ensemble, nous vous recommandons, lors du multiplexage de plusieurs sources, de les connecter sur des modules séparés ou sur des banques séparées du même module.

#### ATTENTION AUX TENSIONS DANGEREUSES

Lorsqu'une voie est connectée à une source de tension dangereuse, toutes les voies du module doivent être traitées comme dangereuses et tous les câblages de voie dans le module doivent être adaptés à la tension maximale appliquée. Les thermocouples fixés à n'importe quelle autre voie du module doivent comporter une isolation adaptée à la tension maximale, ou une isolation supplémentaire adaptée à la tension maximale et doivent être isolés des parties conductrices par un composé ou une bande thermique adapté à la tension maximale appliquée. Ne pas installer, déplacer ou supprimer de thermocouple lorsque l'appareil testé est connecté à une source d'alimentation.

#### ENVIRONNEMENT, SANTÉ ET SÉCURITÉ

Lorsqu'une voie est connectée à une source de tension dangereuse, l'instrument et l'appareil testé doivent être supervisés selon les pratiques EHS locales pour limiter l'accès.

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# 4 Didacticiels pour la réalisation de mesures

Câblage et connexions du système

Principes de mesures fondamentaux

Mesures de numérisation

Actionneurs et commutation à usage général

Matrice de commutation

Multiplexage de signaux RF

Module multifonction

Durée de vie des relais et maintenance préventive

Ce chapitre décrit les méthodes que vous pouvez utiliser afin de réduire les erreurs pouvant affecter vos mesures. Vous y trouverez aussi des informations destinées à vous aider à mieux comprendre comment le DAQ970A/DAQ973A recueille les mesures et ce que vous pouvez faire afin d'obtenir les meilleurs résultats.

## Câblage et connexions du système

Cette section décrit les méthodes destinées à réduire les erreurs de mesure pouvant être introduites par le câblage de votre système. De nombreuses erreurs dues au câblage du système peuvent être réduites ou éliminées en sélectionnant les câbles et le schéma appropriés de mise à la terre (masse).

- **Spécifications des câbles**
- **Techniques de mise à la masse ou à la terre**
- **Techniques de blindage**
- **Séparation des signaux à hauts et faibles niveaux**
- **Sources d'erreurs dues au câblage du système**

### Spécifications des câbles

Une grande variété de câbles à usage universel et personnalisé est disponible. Les facteurs suivants détermineront le type de câble que vous choisirez.

- Conditions propres aux signaux transportés – telles que tension, fréquence, précision et vitesse de mesure.
- Conditions d'interconnexion – telles que section, longueurs et trajet des câbles.
- Conditions de maintenance – telles que connecteurs intermédiaires, terminaisons des câbles, serre-câbles, longueurs et trajets des câbles.

Les câbles sont désignés de diverses manières. Veillez à respecter les spécifications suivantes pour le type de câble que vous avez l'intention d'utiliser.

- Impédance caractéristique (résistance d'isolement) – Varie avec la fréquence du signal d'entrée. Vérifiez entre les points HI et LO, entre les voies et entre les points HI ou LO et le blindage. Les applications RF à haute fréquence ont des exigences spécifiques pour l'impédance des câbles.
- Tension de claquage du diélectrique – doit être suffisamment élevée pour votre application.

#### **AVERTISSEMENT**

Pour éviter les risques de chocs électriques et d'endommager l'équipement, isolez toutes les voies pour la tension la plus élevée présente dans le système. Il est recommandé d'utiliser un fil avec un isolement nominal de 600 V minimum.

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- Résistance des câbles – Varie avec la section et la longueur des câbles. Utilisez la section la plus forte possible et essayez de conserver la longueur des câbles aussi courte que possible pour réduire leur résistance. Le tableau suivant indique la résistance nominale des câbles en fil de cuivre pour plusieurs sections (le coefficient de température pour le fil de cuivre est de 0,35% par °C).

| AWG               | $\Omega$ /pied (2 conducteurs) à 25 °C |
|-------------------|----------------------------------------|
| 14                | 5 M $\Omega$                           |
| 16                | 10 M $\Omega$                          |
| 18                | 15 M $\Omega$                          |
| 20 <sup>[1]</sup> | 20 M $\Omega$                          |
| 22                | 30 M $\Omega$                          |
| 24                | 50 M $\Omega$                          |

- Capacité des câbles – Varie avec le type d'isolant, la longueur et le blindage des câbles. Le câble doit être aussi court que possible pour réduire sa capacité. Dans certains cas, des câbles à faible capacité peuvent être utilisés.

Le tableau ci-dessous indique les spécifications nominales de certains types de câbles.

| Type de câble                   | Impédance caractéristique            | Capacité        | Atténuation                     |
|---------------------------------|--------------------------------------|-----------------|---------------------------------|
| Paire torsadée                  | 100 $\Omega$ à 1 MHz                 | 10 à 20 pF/pied | Jusqu'à 1 dB/100 pied à 1 MHz   |
| Paire torsadée blindée          | 100 $\Omega$ à 1 MHz                 | 10 à 20 pF/pied | Jusqu'à 1 dB/100 pied à 1 MHz   |
| Coaxial                         | 50 $\Omega$ ou 75 $\Omega$ à 100 MHz | 15 à 25 pF/pied | Jusqu'à 6 dB/100 pied à 100 MHz |
| Câble en nappe à paire torsadée | 100 $\Omega$ à 1 MHz                 | 15 à 20 pF/pied | Jusqu'à 1 dB/100 pied à 1 MHz   |

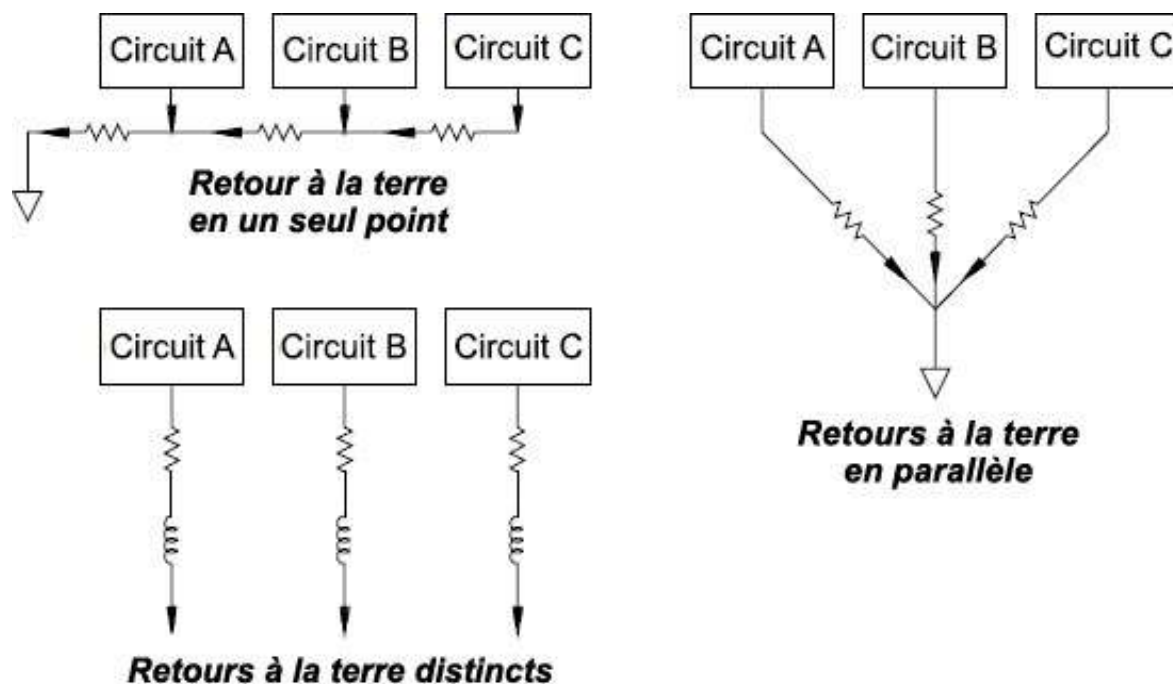
<sup>[1]</sup>recommandée pour les bornes à vis des modules enfichables du modèle DAQ970A/DAQ973A.

## Techniques de mise à la masse ou à la terre

Le but de la mise à la terre est d'éviter les boucles de masse et de réduire le bruit. La plupart des systèmes doivent avoir trois retours à la terre distincts.

1. Un retour à la terre pour les signaux. Vous pouvez aussi souhaiter disposer de retours à la terre distincts entre les signaux de forts niveaux, de faibles niveaux et les signaux numériques.
2. Un deuxième retour à la terre est utilisé pour les matériels électriquement bruyants comme les relais, les moteurs et les équipements à haute puissance.
3. Un troisième retour à la terre est utilisé pour les châssis, baies et armoires. La mise à la terre de l'alimentation secteur doit être généralement reliée à ce troisième point.

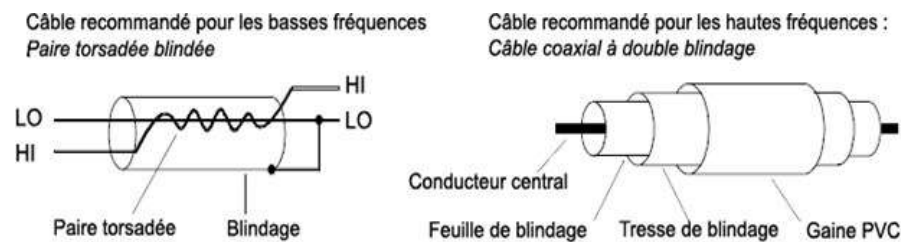
En général, pour des fréquences en dessous de 1 MHz ou pour des signaux de faible niveau, utilisez un retour à la terre en un seul point (voir l'image ci-dessous). La mise à la terre en parallèle est meilleure mais est aussi plus coûteuse et plus difficile à câbler. Si la mise à la terre en un point unique convient, les points les plus critiques (ceux pour les signaux de plus faible niveau et/ou pour les exigences de mesures les plus précises) doivent être placés près du point principal de mise à la terre. Pour des fréquences au-dessus de 10 MHz, utilisez un système de mise à la terre distinct. Pour des signaux entre 1 MHz et 10 MHz, vous pouvez utiliser un système à point unique si le plus long trajet de retour à la terre est maintenu inférieur à  $1/20$  de la longueur d'onde du signal. Dans tous les cas, la résistance et l'inductance du retour à la terre doivent être réduits à leur minimum.



## Techniques de blindage

Le blindage contre le bruit doit s'adresser à la fois au couplage capacitif (électrique) et inductif (magnétique). L'addition d'un blindage mis à la terre autour du conducteur est hautement efficace contre le couplage capacitif. Dans les réseaux de multiplexage, ce blindage prend souvent la forme de câbles et de connecteurs coaxiaux. Pour des fréquences supérieures à 100 MHz, le câble coaxial à double blindage est recommandé pour accroître l'efficacité du blindage.

La réduction des surfaces de boucle est la méthode la plus efficace pour protéger du couplage magnétique. En dessous de quelques centaines de kHz, les paires torsadées peuvent être utilisées contre le couplage magnétique. Utilisez des paires torsadées pour leur immunité contre le captage magnétique et capacitif. Pour une protection maximale en dessous de 1 MHz, veillez à ce que le blindage ne soit pas l'un des conducteurs du signal.



## Séparation des signaux à hauts et faibles niveaux

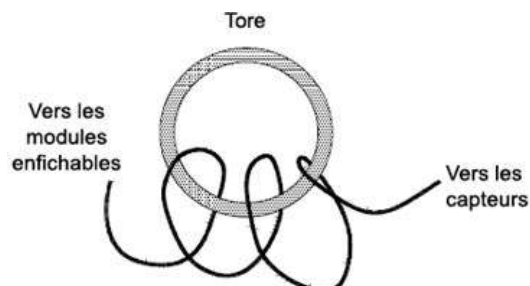
Les signaux dont les niveaux dépassent un rapport de 20 à 1 doivent être autant que possible séparés physiquement. Le trajet du signal complet doit être examiné y compris le câblage et les connexions adjacentes. Toutes les lignes non utilisées doivent être reliées à la terre (ou au point LO) et placées entre les trajets de signaux sensibles. Lors de la réalisation de votre câblage aux bornes à vis des modules, veillez à câbler les fonctions apparentées sur des voies adjacentes.

## Sources d'erreurs dues au câblage du système

### Interférences radio fréquences

La plupart des instruments de mesure de tension peuvent produire de fausses lectures en présence de signaux haute fréquence. Les sources possibles de signaux haute fréquence comprennent les émetteurs de radio et de télévision environnants, les écrans d'ordinateurs et les téléphones cellulaires. Les énergies à haute fréquence peuvent aussi être couplées au multimètre numérique (DMM) interne par le câblage du système. Pour réduire les interférences, essayez de minimiser l'exposition du câblage du système aux sources RF haute fréquence.

Si votre application est extrêmement sensible aux IRF rayonnées par l'instrument, utiliser des inductances d'arrêt de mode commun comme illustrées ci-dessous pour atténuer les émissions de l'instrument.



## Erreurs EMF thermiques

Les tensions thermoélectriques sont souvent à l'origine d'erreurs dans les mesures de basse tension continue. Les tensions thermoélectriques sont générées lorsque vous réalisez des raccordements de circuit à l'aide de métaux différents et à des températures différentes. Chaque jonction entre deux métaux différents constitue un thermocouple, qui génère une tension proportionnelle à la différence de température de la jonction. Veillez à prendre toutes les précautions nécessaires pour minimiser les tensions de thermocouple et les variations de température lors de vos mesures de basse tension. Les meilleures connexions sont réalisées de manière sertie cuivre sur cuivre. Le tableau ci-dessous présente les différentes tensions thermoélectriques pour des raccordements créés avec différents métaux.

| Cuivre sur            | approx. $\mu\text{V}/^{\circ}\text{C}$ |
|-----------------------|----------------------------------------|
| Cuivre                | < 0,3                                  |
| Or                    | 0,5                                    |
| Argent                | 0,5                                    |
| Bronze                | 3                                      |
| Cuivre béryllium      | 5                                      |
| Aluminium             | 5                                      |
| Kovar ou alliage 42   | 40                                     |
| Silicone              | 500                                    |
| Cuproxyde             | 1000                                   |
| Brasure cadmium/étain | 0,2                                    |
| Soudure plomb-étain   | 5                                      |

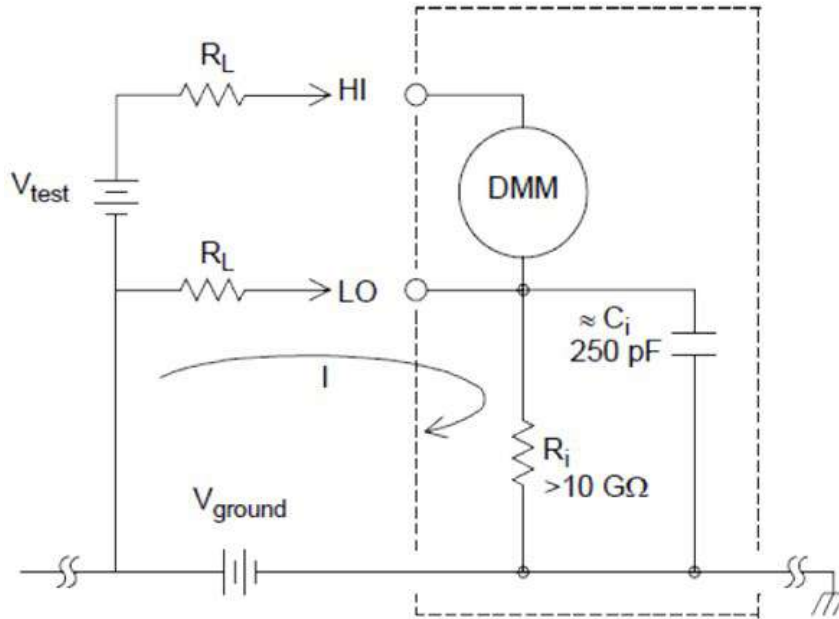
## Bruit provoqué par les champs magnétiques

Si vous réalisez des mesures à proximité de champs magnétiques, veillez à ne pas induire de tensions dans les connexions de mesure. Des tensions peuvent être induites par le mouvement du câblage des connexions d'entrée dans un champ magnétique fixe ou par la variation du champ magnétique. Un fil d'entrée non blindé mal fixé se déplaçant dans le champ magnétique terrestre peut générer plusieurs millivolts. La variation du champ magnétique autour des fils d'alimentation secteur peut également induire des tensions de plusieurs centaines de millivolts. Vous devez faire particulièrement attention lorsque vous travaillez à proximité de conducteurs qui transportent des courants élevés.

Autant que possible, vous devez acheminer le câblage loin des champs magnétiques. Des champs magnétiques sont toujours présents autour des moteurs électriques, des générateurs, des récepteurs de télévision et des écrans d'ordinateurs. Veillez à ce que votre câblage d'entrée soit fixé fermement avec des serre-câbles lorsque vous travaillez près de champs magnétiques. Pour la connexion vers l'instrument, utilisez des connexions à paire torsadée afin de réduire la surface de la boucle de captage du bruit ou disposez les fils aussi près que possible l'un de l'autre.

## Bruit causé par des boucles de terre

Lors de la mesure de tensions dans des circuits où le multimètre (DMM) et le dispositif testé sont référencés à une masse commune, il se forme une boucle de masse. Comme le montre la figure ci-dessous, toute différence de tension entre les deux points de référence à la masse ( $V_{\text{ground}}$ ) engendre un courant dans le cordon de mesure LO (niveau bas). Cela provoque une tension d'erreur ( $V_L$ ) qui s'ajoute à la tension mesurée.



$$I = \text{Current flow caused by } V_{\text{ground}} = \frac{V_{\text{ground}}}{R_L + Z}$$

$$Z \approx Z_{ci} = \frac{1}{2\pi fC} \approx 10\text{M}\Omega \text{ or } 60\text{Hz}$$

$$V_L = I \times R_L$$

où :

$R_L$  = Résistance des cordons de mesure

$R_i$  = Résistance d'isolement du multimètre numérique (DMM)

$C_i$  = Capacité d'isolement du multimètre (DMM)

$V_{\text{ground}}$  = Tension de bruit de masse

Pour réduire les erreurs dues à la boucle de masse :

- Si  $V_{\text{ground}}$  est une tension continue, maintenez  $R_L$  faible par rapport à  $R_i$ .
- Si  $V_{\text{ground}}$  est une tension alternative, maintenez  $R_L$  faible par rapport à  $Z$ , et réglez le temps d'intégration du multimètre numérique (DMM) à 1 PLC au moins.

## Erreurs de mesure liées à des basses tensions alternatives

Si vous mesurez des tensions alternatives inférieures à 100 mV, sachez que ces mesures sont particulièrement vulnérables aux erreurs introduites par des sources de bruit externes. Ainsi, un cordon dont l'extrémité de test resté à l'air se comporte comme une antenne et le multimètre (DMM) mesurera les signaux captés par cette antenne. La voie de mesure complète, ligne d'alimentation secteur comprise, se comporte comme une antenne cadre. Les courants circulant dans cette antenne cadre créent des tensions d'erreur aux bornes de toutes les impédances en série avec l'entrée de l'instrument. C'est pourquoi il faut utiliser des câbles blindés pour appliquer des tensions alternatives de faible niveau à l'instrument. Connectez le blindage à la borne de niveau bas (LO).

Veillez également à réduire la surface des boucles de masse qui ne peuvent pas être évitées. Une source de haute impédance est plus favorable à la collecte de bruit qu'une source de faible impédance. Vous pouvez réduire l'impédance en haute fréquence d'une source en plaçant un condensateur en parallèle avec les bornes d'entrée de l'instrument. Vous devrez peut-être faire plusieurs essais afin de déterminer la valeur correcte de ce condensateur pour votre application.

La majeure partie du bruit externe n'est pas corrélée au signal d'entrée. Vous pouvez évaluer l'erreur à l'aide de l'équation suivante :

$$\textit{Voltage Measured} = \sqrt{V_{in}^2 + \textit{Noise}^2}$$

Le bruit corrélé, bien que rare, a des effets négatifs. En effet, il s'ajoute toujours directement au signal d'entrée. La mesure d'un signal de bas niveau avec la même fréquence que la ligne électrique locale est un cas de figure courant à l'origine de cette erreur.

Prenez toutes les précautions possibles lors de la commutation de signaux de forts et de bas niveaux sur le même module. Il est possible que des tensions chargées de haut niveau chargé puissent se décharger dans une voie de bas niveau. Nous vous recommandons d'utiliser deux modules différents ou de séparer les signaux de forts niveaux de ceux de faibles niveaux par une voie non utilisée connectée à la masse.



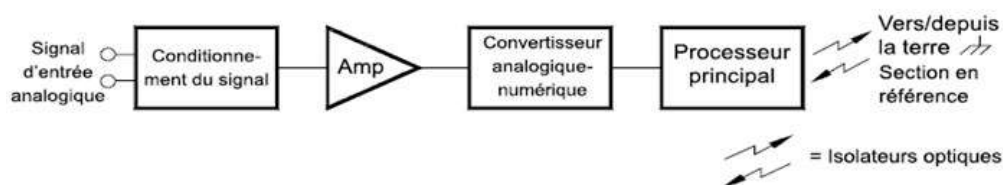
## Principes de mesures fondamentaux

Cette section explique comment le modèle DAQ970A/DAQ973A réalise les mesures et décrit les sources d'erreur les plus courantes pour ces mesures.

- Le multimètre numérique (DMM) interne
- Mesures de température
- Mesures de tension CC
- Mesures d'une tension alternative
- Mesures de courant
- Mesure de résistance
- Mesures de la jauge de contrainte
- Mesures de la fréquence et de la période
- Mesures de capacité
- Mesures de numérisation
- Déclenchement sur niveau

### Le multimètre numérique (DMM) interne

Le multimètre numérique (DMM) interne comporte une entrée universelle frontale pour mesurer une grande diversité de types de capteurs sans qu'il soit nécessaire d'ajouter de circuit de conditionnement (mise en forme) de signal externe. Il comprend des circuits de conditionnement, d'amplification (ou d'atténuation) de signaux et un convertisseur analogique-numérique à haute résolution (jusqu'à 22 bits). Un schéma simplifié du multimètre numérique (DMM) interne est illustré ci-dessous.



Le multimètre numérique (DMM) interne peut réaliser directement les types de mesures suivants : Chacune de ces mesures est décrite dans les sections suivantes de ce chapitre :

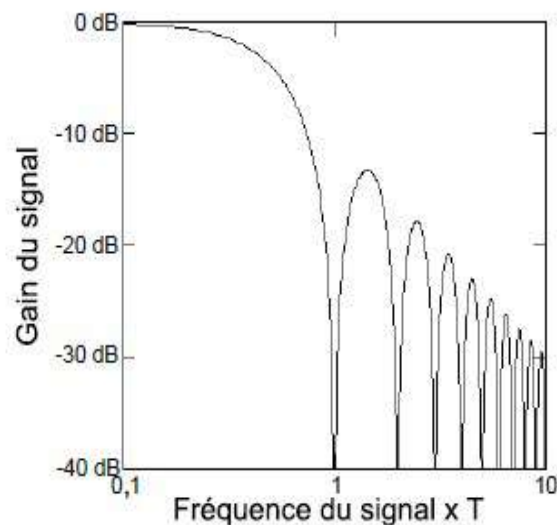
- Température (thermocouple, RTD en 2 et 4 fils, thermistance en 2 et 4 fils)
- Tension (continue et alternative jusqu'à 300 V)
- Résistance (2 et 4 fils jusqu'à 1 GΩ)
- Courant (continu et alternatif jusqu'à 1 A)

- Fréquence et période (jusqu'à 300 kHz)
- Contrainte (méthodes en pont et directes)

## Rejet des tensions bruyantes dans les lignes électriques

Une caractéristique souhaitable d'un convertisseur analogique-numérique (A-N) à intégration est son aptitude à rejeter les signaux parasites. Les techniques d'intégration rejettent le bruit corrélé à la tension d'alimentation secteur, présent avec les signaux en tension continue à l'entrée. Cette caractéristique s'appelle rejet de mode normal (RMN). Le rejet du bruit de mode normal est obtenu lorsque le multimètre numérique (DMM) interne mesure la moyenne du signal d'entrée en "l'intégrant" sur une période de temps fixe. Si vous réglez le temps d'intégration du signal d'entrée parasite sur un nombre entier de cycles de la tension d'alimentation (PLC), ces erreurs (et leurs harmoniques) tendent vers zéro par pondération.

Lorsque vous mettez le multimètre numérique (DMM) interne sous tension, il mesure la fréquence de la tension d'alimentation (50 Hz ou 60 Hz), et utilise cette mesure pour déterminer le temps d'intégration. Le graphique suivant illustre l'atténuation des signaux en courant alternatif mesurée avec la fonction de mesure de tension continue pour diverses valeurs du temps d'intégration du convertisseur A-N. Notez que les signaux de fréquences multiples de  $1/T$  présentent la plus forte atténuation.



## Mesures de température

Une mesure de température par capteur est habituellement une mesure de résistance ou de tension convertie en une température équivalente par des routines de conversion logicielle internes à l'instrument. La conversion mathématique se fonde sur des propriétés spécifiques aux divers capteurs. La précision de cette conversion mathématique (précision du capteur non comprise) pour chaque type de capteur est indiquée ci-dessous :

| Capteur          | Précision de conversion            |
|------------------|------------------------------------|
| Thermocouple     | $\pm 0,05\text{ }^{\circ}\text{C}$ |
| RTD              | $\pm 0,02\text{ }^{\circ}\text{C}$ |
| Thermorésistance | $\pm 0,05\text{ }^{\circ}\text{C}$ |

Les erreurs associées aux mesures de température comprennent toutes celles listées ailleurs dans ce chapitre pour les mesures de tension continue et de résistance. La plus grande source d'erreur de mesure de température est généralement celle du capteur lui-même.

Vos conditions de mesures vous aideront à déterminer le type de capteur de température à utiliser. Chaque type de capteur a une plage de température, une précision et un coût particuliers. Le tableau ci-dessous résume certaines spécifications nominales pour chaque type de capteur. Utilisez ces informations pour sélectionner le capteur nécessaire à votre application. Les fabricants de capteurs peuvent vous fournir les spécifications exactes d'un capteur particulier.

| Paramètre              | Thermocouple                                                     | RTD                                       | Thermorésistance                    |
|------------------------|------------------------------------------------------------------|-------------------------------------------|-------------------------------------|
| Plage de températures  | -210 à 1820 °C                                                   | -200 °C à 850 °C                          | -80 °C à 150 °C                     |
| Type de mesure         | Tension                                                          | Résistance en 2 ou 4 fils                 | Résistance en 2 ou 4 fils           |
| Sensibilité du capteur | 6 $\mu\text{V}/^\circ\text{C}$ à 60 $\mu\text{V}/^\circ\text{C}$ | $\approx R_0 \times 0.004/^\circ\text{C}$ | $\approx 400 \Omega/^\circ\text{C}$ |
| Précision              | 0,5 °C à 5 °C                                                    | 0,01 °C à 0,1 °C                          | 0,1 °C à 1 °C                       |
| Coût (en Dollars U.S.) | 1 \$/pied                                                        | 20 à 100 \$ chacune                       | \$10 à \$100 chacune                |
| Durabilité             | Résistant                                                        | Fragile                                   | Fragile                             |

## Mesures de RTD

Un RTD est fabriqué en métal (habituellement en platine) dont la résistance varie avec une variation de température de manière connue avec précision. Le multimètre numérique (DMM) interne mesure la résistance du RTD et calcule à partir de là la température équivalente.

Un RTD a la meilleure stabilité de tous les capteurs de température. La sortie d'un RTD est aussi très linéaire. Cela fait d'un RTD un bon choix pour des mesures de haute précision et sur un long terme. Le modèle DAQ970A/DAQ973A accepte les RTD avec un  $\alpha = 0,00385$  (DIN / CEI 751) avec les conversions logicielles ITS-90. « PT100 » est une désignation spéciale parfois utilisée pour désigner un RTD avec  $\alpha = 0,00385$  et  $R_0 = 100 \Omega$ .

La résistance d'un RTD est nominale à 0 °C et est désignée par  $R_0$ . Le modèle DAQ970A/DAQ973A peut mesurer des RTD avec des valeurs de  $R_0$  comprises entre  $100 \Omega \pm 1 \%$  ou  $1\,000 \Omega \pm 1 \%$ .

Vous pouvez mesurer des RTD avec une méthode de mesure en 2 ou 4 fils. La mesure de RTD en 4 fils est la méthode la plus précise pour les résistances de faible valeur. La résistance des fils de connexion est compensée automatiquement avec la méthode à 4 fils.

## Mesures par thermistances

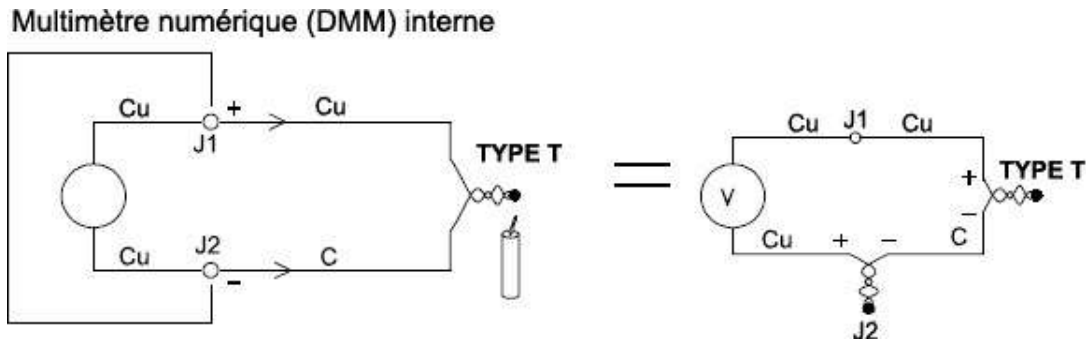
Une thermistance est fabriquée dans un matériau dont la résistance varie non linéairement avec les variations de température. Le multimètre numérique (DMM) interne mesure la résistance de la thermistance et calcule à partir de là la température équivalente.

Les thermistances ont une sensibilité plus élevée que les thermocouples ou les RTD. Cela fait d'une thermistance un bon choix pour mesurer de très petites variations de température. Les thermistances sont, en revanche, très non linéaires, en particulier aux températures élevées, et fonctionnent mieux en dessous de 100 °C.

En raison de leur résistance élevée, les thermistances peuvent être mesurées à l'aide d'une méthode de mesure à 2 fils. Le multimètre numérique (DMM) interne prend en charge les thermistances 2,2 k $\Omega$  (44004), 5 k $\Omega$  (44007) et 10 k $\Omega$  (44006). Les routines de conversion des thermistances utilisées par le modèle DAQ970A/DAQ973A sont compatibles avec l'échelle internationale des températures de 1990 (ITS-90).

## Mesures de thermocouples

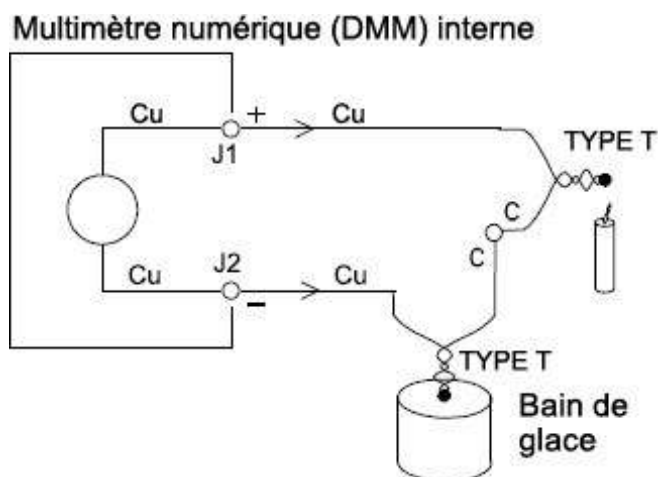
Un thermocouple convertit la température en une tension. Lorsque deux fils composés de métaux différents sont joints, une tension est produite. La tension est une fonction de la température de jonction et des types de métaux des fils du thermocouple. Puisque les caractéristiques de température de nombreux couples de métaux différents sont bien connues, une conversion de la tension produite en une température de la jonction peut être réalisée. Par exemple, une mesure de tension d'un thermocouple de type T (constitué d'un fil de cuivre et de constantan) pourrait ressembler à ceci.



Notez toutefois que la connexion réalisée entre le fil du thermocouple et le multimètre numérique (DMM) interne constitue un second thermocouple indésirable là où ce fil de constantan (C) est en contact avec la borne d'entrée en cuivre (Cu) du multimètre. La tension produite par ce second thermocouple perturbe la mesure de tension du thermocouple de type T.

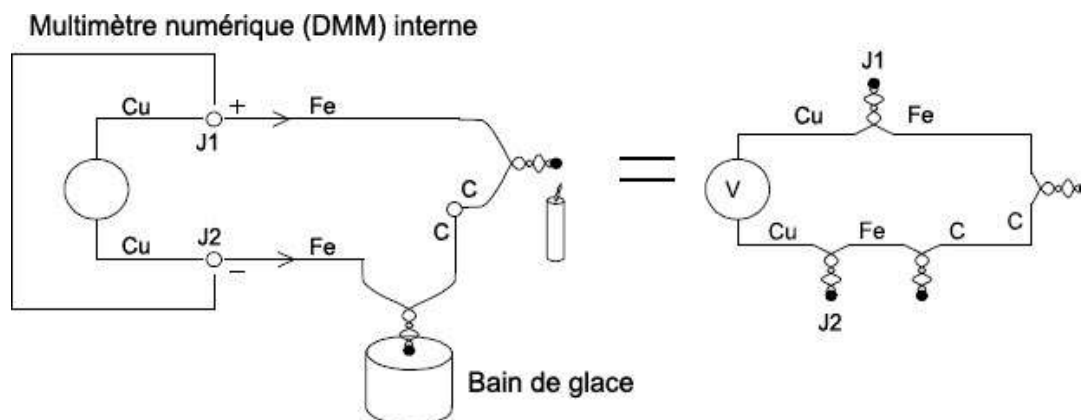
Si la température du thermocouple créé en J2 (la borne d'entrée LO) est connue, la température du thermocouple de type T peut être calculée. Une manière de faire cela est de connecter ensemble deux thermocouples de type T pour créer seulement des connexions cuivre sur cuivre aux bornes d'entrée du multimètre numérique (DMM) interne, et de maintenir le second thermocouple à une température connue.

Un *bain de glace* est utilisé pour créer une température de référence connue (0 °C). Une fois que la température de référence et le type de thermocouple sont connus, la température du thermocouple de mesure peut être calculée.



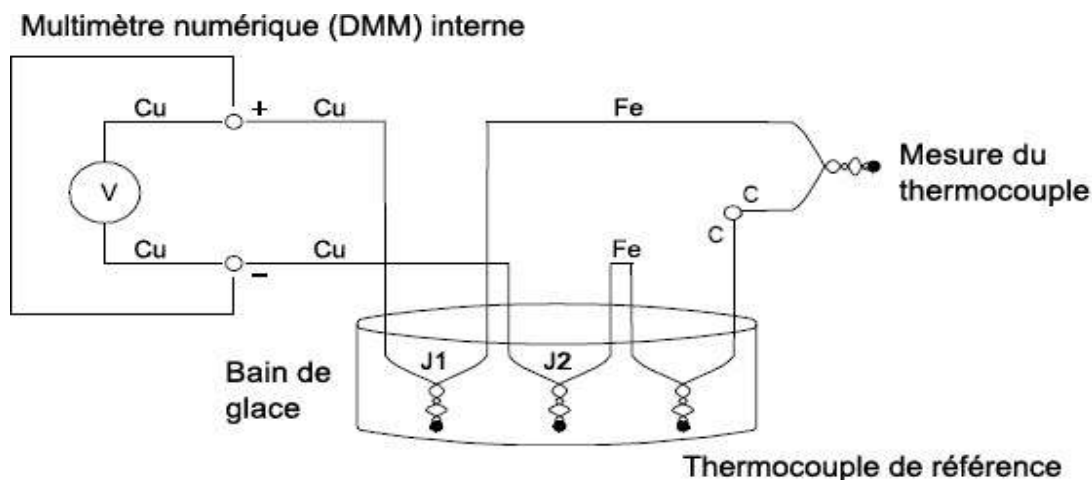
Le thermocouple de type T est un cas unique puisque l'un des conducteurs (en cuivre) est fabriqué dans le même métal que celui des bornes d'entrée du multimètre numérique (DMM). Si un autre type de thermocouple est utilisé, deux thermocouples supplémentaires seront créés.

Voyez par exemple les connexions avec un thermocouple de type J (fer et constantan).

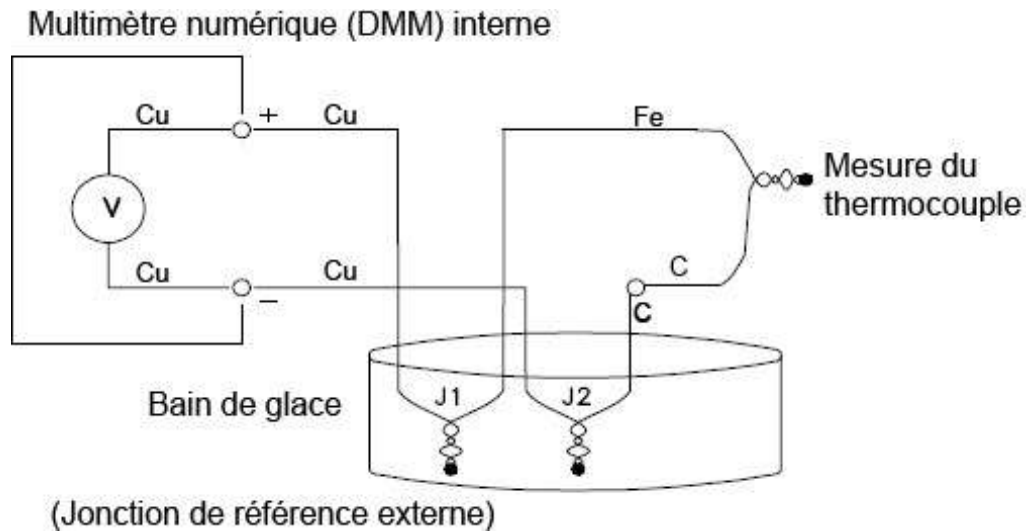


Deux thermocouples supplémentaires ont été créés là où le fil de fer (Fe) se relie aux bornes d'entrée en cuivre (Cu) du multimètre numérique (DMM) interne. Puisque ces deux jonctions génèrent des tensions opposées, leurs effets s'annuleront mutuellement. En revanche, si les bornes d'entrée ne sont pas à la même température, une erreur sera créée dans la mesure.

Pour faire une mesure plus précise, vous devrez prolonger les cordons de test en cuivre du multimètre numérique (DMM) interne au plus près de la mesure et maintenir les connexions aux thermocouples à la même température.



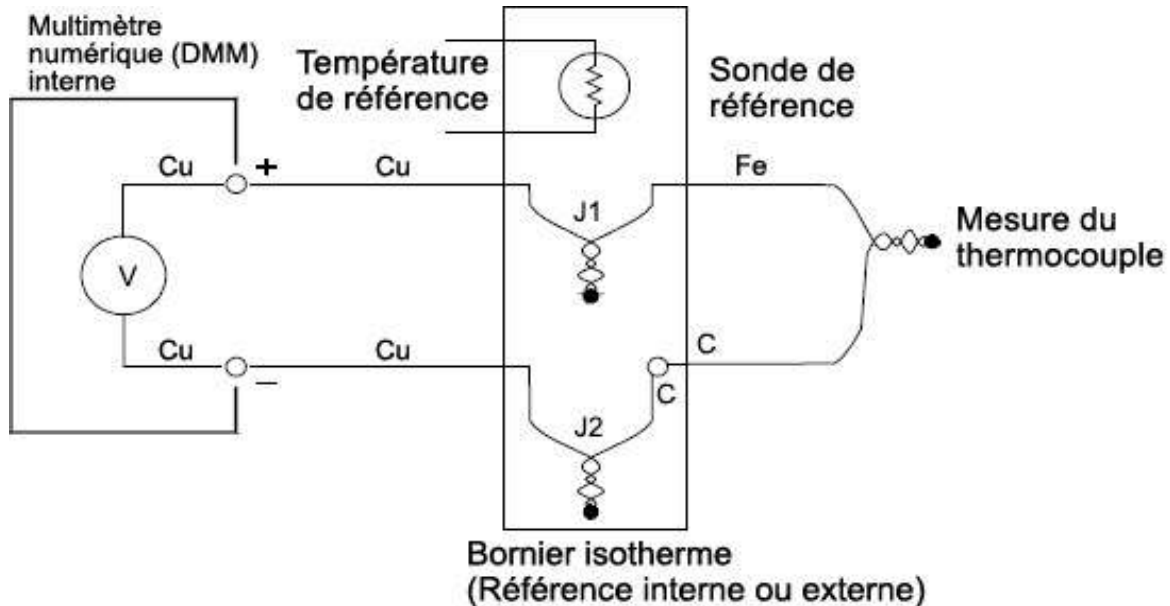
Ce circuit permettra d'effectuer des mesures de température précises. En revanche, il n'est pas très pratique de faire deux connexions de thermocouples et de les maintenir toutes à une température connue. La Loi des métaux intermédiaires élimine le besoin d'une connexion supplémentaire. Cette loi empirique établit qu'un troisième métal (le fer (Fe) dans cet exemple) inséré entre deux métaux différents n'aura aucun effet sur la tension de sortie, pourvu que les jonctions formées soient à la même température. Le retrait du thermocouple de référence simplifie les connexions.



*Ce circuit constitue la meilleure solution pour des connexions de thermocouples précises.*

En revanche, dans certains cas il serait bien de supprimer le besoin du bain de glace (ou de toute autre référence fixe externe). Pour cela, un bornier isotherme est utilisé pour réaliser les connexions. Un bornier isotherme est un isolant électrique mais un très bon conducteur de chaleur. Les thermocouples supplémentaires créés en J1 et J2 sont à présent maintenus à la même température par le bornier isotherme.

Une fois la température du bornier isotherme connue, des mesures de température précises peuvent être réalisées. Un capteur de température est installé sur le bornier isotherme pour mesurer sa température.



Les thermocouples sont disponibles dans divers types. Le type est désigné par une seule lettre. Le tableau suivant indique les types de thermocouples les plus couramment utilisés et certaines caractéristiques importantes de chacun.

#### REMARQUE

Les routines de conversion des thermocouples utilisées par le modèle DAQ970A/DAQ973A sont compatibles avec l'échelle internationale des températures de 1990 (ITS-90).

## Types de thermocouple :

| Type T/C  | Fil pos (+)          | Fil neg (-)          | Plage de températures | Précision         | Commentaires                                                                                                                      |
|-----------|----------------------|----------------------|-----------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| B         | Platine -30% Rhodium | Platine -60% Rhodium | 250°C - 1820°C        | ±0,5°C            | Température élevée.<br>Attention à la contamination.<br>Ne pas insérer dans des tubes en métal.                                   |
| Américain | Gris                 | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | S/O                  | S/O                  |                       |                   |                                                                                                                                   |
| DIN       | Rouge                | Gris                 |                       |                   |                                                                                                                                   |
| Japonais  | Rouge                | Gris                 |                       |                   |                                                                                                                                   |
| Français  | S/O                  | S/O                  |                       |                   |                                                                                                                                   |
| E         | Nickel-Chrome        | Constantan           | -200°C - 1000°C       | ± 1°C - 1,7°C     | Tension de sortie la plus élevée.<br>Résolution la plus élevée.                                                                   |
| Américain | Violet               | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | Marron               | Bleu                 |                       |                   |                                                                                                                                   |
| DIN       | Rouge                | Noir                 |                       |                   |                                                                                                                                   |
| Japonais  | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Français  | Jaune                | Bleu                 |                       |                   |                                                                                                                                   |
| J         | Fer                  | Constantan           | -210°C - 1200°C       | ± 1,1°C - 2,2°C   | Pour des environnements oxydants.<br>Le moins cher<br>Non recommandé à basse température.                                         |
| Américain | Blanc                | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | Jaune                | Bleu                 |                       |                   |                                                                                                                                   |
| DIN       | Rouge                | Bleu                 |                       |                   |                                                                                                                                   |
| Japonais  | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Français  | Jaune                | Noir                 |                       |                   |                                                                                                                                   |
| K         | Nickel-Chrome        | Nickel-Aluminium     | -200°C - 1370°C       | ± 1,1°C - 2,2°C   | Pour les environnements oxydants.<br>Bonne linéarité au dessus de 8 °C                                                            |
| Américain | Jaune                | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | Marron               | Bleu                 |                       |                   |                                                                                                                                   |
| DIN       | Rouge                | Vert                 |                       |                   |                                                                                                                                   |
| Japonais  | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Français  | Jaune                | Violet               |                       |                   |                                                                                                                                   |
| N         | Nicrosil             | Nisil                | -200°C - 1300°C       | ± 1,1°C - 2,2°C   | Stabilité supérieure au type K à plus haute température.                                                                          |
| Américain | Orange               | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | S/O                  | S/O                  |                       |                   |                                                                                                                                   |
| DIN       | S/O                  | S/O                  |                       |                   |                                                                                                                                   |
| Japonais  | S/O                  | S/O                  |                       |                   |                                                                                                                                   |
| Français  | S/O                  | S/O                  |                       |                   |                                                                                                                                   |
| R         | Platine -13% Rhodium | Rhodium              | -50°C - 1760°C        | ± 0,6°C - 1,5°C   | Température plus élevée.<br>Attention à la contamination.<br>Ne pas insérer dans des tubes en métal.                              |
| Américain | Noir                 | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | Blanc                | Bleu                 |                       |                   |                                                                                                                                   |
| DIN       | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Japonais  | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Français  | Jaune                | Vert                 |                       |                   |                                                                                                                                   |
| S         | Platine -10% Rhodium | Platine              | -50°C - 1760°C        | ± 0,6 °C - 1,5 °C | Faible erreur, bonne stabilité.<br>Température élevée.<br>Attention à la contamination.<br>Ne pas insérer dans des tubes en métal |
| Américain | Noir                 | Rouge                |                       |                   |                                                                                                                                   |
| Anglais   | Blanc                | Bleu                 |                       |                   |                                                                                                                                   |
| DIN       | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Japonais  | Rouge                | Blanc                |                       |                   |                                                                                                                                   |
| Français  | Jaune                | Vert                 |                       |                   |                                                                                                                                   |



| Type T/C  | Fil pos (+) | Fil neg (-) | Plage de températures | Précision     | Commentaires                      |
|-----------|-------------|-------------|-----------------------|---------------|-----------------------------------|
| T         | Cuivre      | Constantan  | -200°C - 400°C        | ± 0,5°C - 1°C | Supporte l'humidité.              |
| Américain | Bleu        | Rouge       |                       |               | Comporte un fil de cuivre.        |
| Anglais   | Blanc       | Bleu        |                       |               |                                   |
| DIN       | Rouge       | Marron      |                       |               | Applications à basse température. |
| Japonais  | Rouge       | Blanc       |                       |               |                                   |
| Français  | Jaune       | Bleu        |                       |               |                                   |

**REMARQUE**

Constantan = Cuivre-Nickel; Nicrosil = Nickel-Chrome-Silicium; Nisil = Nickel-Silicium-Magnésium;  
S/O = sans objet

## Sources d'erreur des mesures par thermocouples

### erreur de jonction de référence

Un thermocouple est habituellement formé par la soudure de deux fils ensemble pour réaliser la jonction. La soudure introduit un troisième métal dans la jonction. Si les deux côtés du thermocouple sont à la même température, le troisième métal a peu d'effet.

Les thermocouples vendus dans le commerce sont soudés à l'aide d'une décharge capacitive. Cette technique est utilisée pour éviter la surchauffe des fils du thermocouple près de la jonction et pour éviter la diffusion des gaz de soudure et de l'atmosphère dans les fils du thermocouple.

Une soudure mauvaise ou une connexion mal soudée peut également induire des erreurs lors de la mesure du thermocouple. On peut détecter des jonctions de thermocouples ouvertes en vérifiant leur résistance. Une résistance mesurée de plus de 5 k $\Omega$  révèle habituellement un thermocouple défectueux. Le modèle DAQ970A/DAQ973A comporte une fonction intégrée de vérification automatique des thermocouples. Si vous activez cette fonction, l'instrument mesure la résistance de la voie après chaque mesure de thermocouple pour vérifier que la connexion est correcte.

### Erreur de diffusion

La diffusion dans un fil de thermocouple est le processus de modification du type d'alliage le long du fil lui-même. Les particules atmosphériques peuvent réellement se diffuser dans le métal. Ces modifications de l'alliage du fil peuvent introduire de petites variations de tension mesurée. La diffusion est provoquée par l'exposition aux températures élevées le long du fil ou par des contraintes physiques appliquées au fil comme l'étirement ou les vibrations.

Les erreurs de température dues à la diffusion sont difficiles à détecter puisque le thermocouple répondra toujours aux variations de température et donnera des résultats presque corrects. Les effets de la diffusion se détectent habituellement par une dérive des mesures de température.

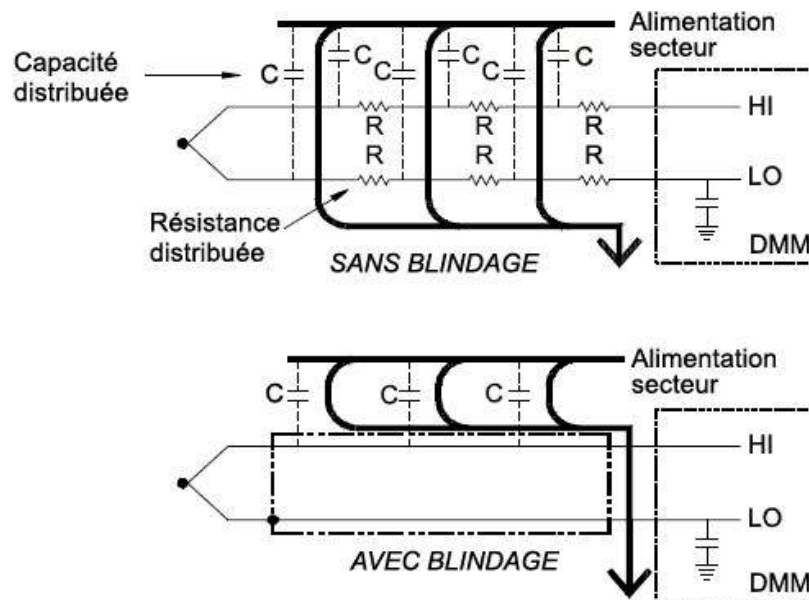
Le remplacement d'un thermocouple qui présente une erreur de diffusion peut ne pas résoudre le problème. Les fils de prolongement et les connexions sont aussi tous sensibles à la diffusion. Examinez le trajet complet du signal de mesure pour rechercher les traces de températures extrêmes ou de contraintes physiques. Autant que possible, maintenez la différence de température le long des fils de prolongement à un minimum.

## Impédance en parallèle

L'isolant des fils du thermocouple et des fils de prolongement peut être dégradé par des températures élevées ou des atmosphères corrosives. Ces détériorations se traduisent par une résistance en parallèle avec la jonction du thermocouple. Cette résistance apparaît en particulier dans les systèmes qui utilisent un fil de section faible dont la résistance en série est élevée.

## Blindage

Le blindage réduit l'effet du bruit de mode commun sur une mesure de thermocouple. Le bruit de mode commun est induit par des sources telles que l'alimentation secteur et les moteurs électriques. Le bruit est couplé aux fils non blindés des thermocouples à travers leur capacité répartie. Comme le courant induit circule vers la terre à travers le multimètre numérique (DMM) interne, des tensions d'erreur sont produites le long de la résistance répartie des fils du thermocouple. L'ajout d'un blindage sur les fils du thermocouple dérivera le bruit de mode commun vers la terre et protégera la mesure.



Le bruit de mode commun peut perturber considérablement le multimètre numérique (DMM) interne. Une sortie de thermocouple habituelle est de quelques millivolts et quelques millivolts de bruit de mode commun peuvent surcharger l'entrée du multimètre numérique (DMM) interne.

## Erreur de calcul

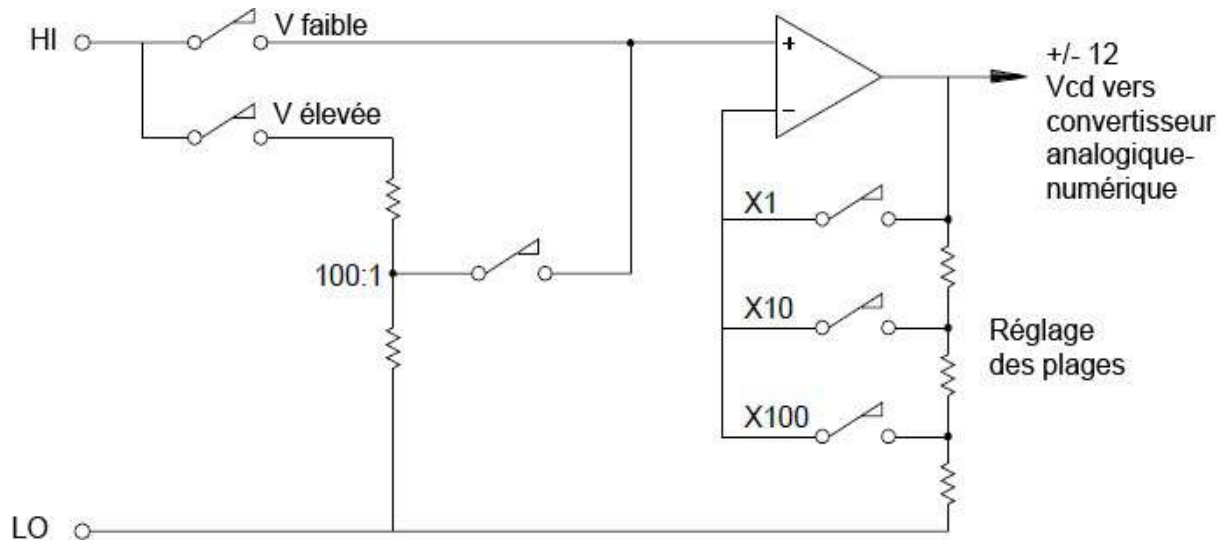
Une erreur est inhérente à la manière avec laquelle une tension de thermocouple est convertie en une température. Cette erreur de calcul est en principe très petite par rapport aux erreurs inhérentes au thermocouple, aux connexions des fils et à la jonction de référence.

## Mesures de tension CC

Pour constituer un multimètre en courant continu utilisable, un “frontal” est nécessaire pour conditionner le signal d'entrée avant la conversion analogique-numérique. Le conditionnement du signal augmente la résistance d'entrée, amplifie les petits signaux et atténue les grands signaux pour produire une sélection de plage de mesure.

### Conditionnement des signaux pour les mesures en courant continu

Le conditionnement du signal d'entrée pour les mesures de tension continue inclut à la fois une amplification et une atténuation. Un schéma simplifié de l'entrée du multimètre numérique (DMM) interne est illustré ci-dessous :



Pour des tensions d'entrée inférieures à 12 VCC, le commutateur V faible est fermé et applique le signal d'entrée directement à l'amplificateur d'entrée. Pour des tensions plus élevées, le commutateur V élevée est fermé et le signal est divisé par 100 avant d'être appliqué à l'amplificateur d'entrée. Le gain de l'amplificateur d'entrée est réglé à l'une des trois valeurs (x1, x10 ou x100) pour appliquer un signal dans la plage de  $\pm 12$  VCC sur le convertisseur analogique-numérique.

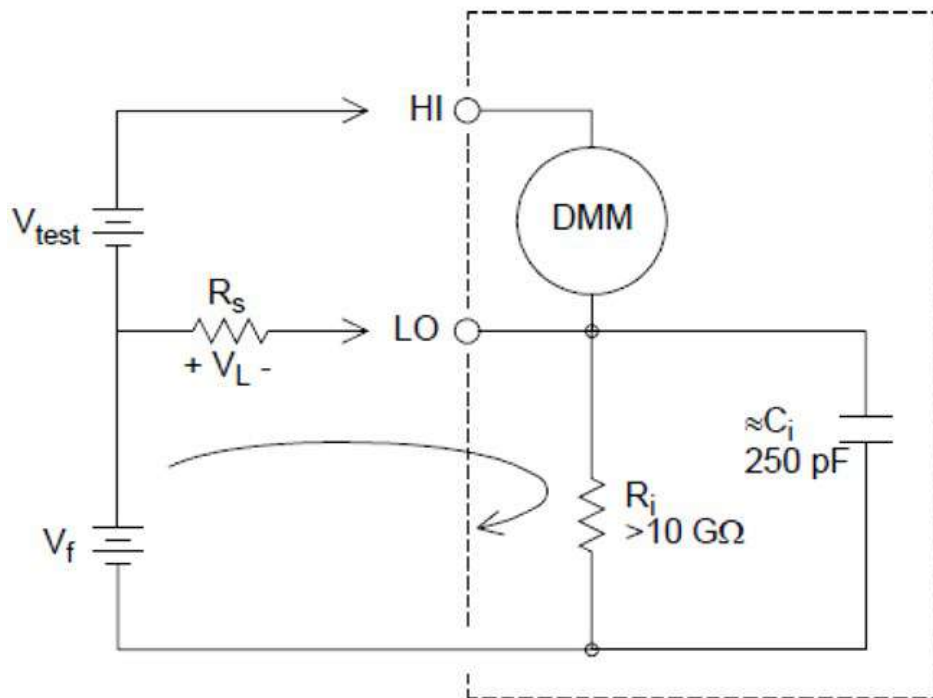
Pour les tensions plus basses, la résistance d'entrée du multimètre numérique (DMM) interne est essentiellement celle de l'amplificateur d'entrée. L'amplificateur d'entrée utilise un étage à transistor à effet de champ à faible courant de polarisation (moins de 50 pA) offrant une résistance d'entrée supérieure à 10 GW. Sur les plages de tension d'entrée de 100 V et 300 V, la résistance d'entrée est déterminée par la résistance totale du diviseur 1/100. Vous pouvez également régler la résistance d'entrée sur 10 M $\Omega$  en fermant de manière permanente le commutateur V élevée.

## Sources d'erreurs des mesures de tension continue

### Réjection de mode commun

Idéalement, le multimètre numérique (DMM) interne est complètement isolé des circuits référencés à la terre. Toutefois, il existe une résistance et une capacité finies entre la borne d'entrée LO et la terre. Si les bornes d'entrée sont toutes deux pilotées par un signal référencé à la terre ( $V_f$ ), alors un courant circulera à travers  $R_s$  et créera une chute de tension  $V_L$  comme l'illustre la figure ci-dessous :

Toute tension résultante ( $V_L$ ) apparaîtra comme une tension d'entrée sur le multimètre numérique (DMM) interne. Lorsque la valeur de  $R_s$  tend vers zéro, l'erreur aussi. De plus, si  $V_f$  est à la fréquence de l'alimentation secteur (50 Hz ou 60 Hz), le bruit peut être considérablement réduit en réglant le temps d'intégration du multimètre numérique (DMM) interne à 1 PLC ou plus.



$$\text{Error } (V_L) = \frac{V_f \times R_s}{R_s + Z}$$

où :

$V_f$  = Tension flottante de mode commun

$R_s$  = Résistance du fil de mesure LO

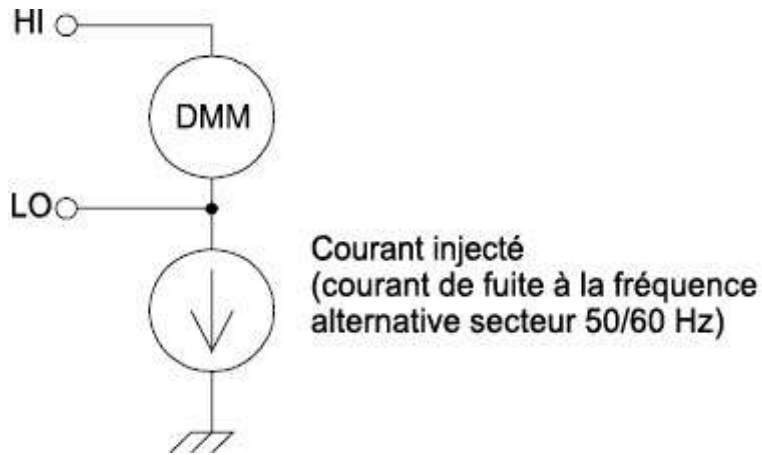
$R_i$  = Résistance d'isolement

$C_i$  = Capacité d'isolement

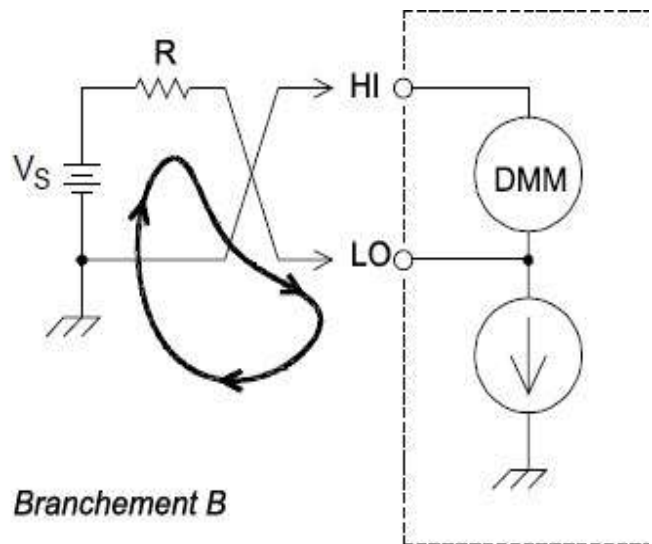
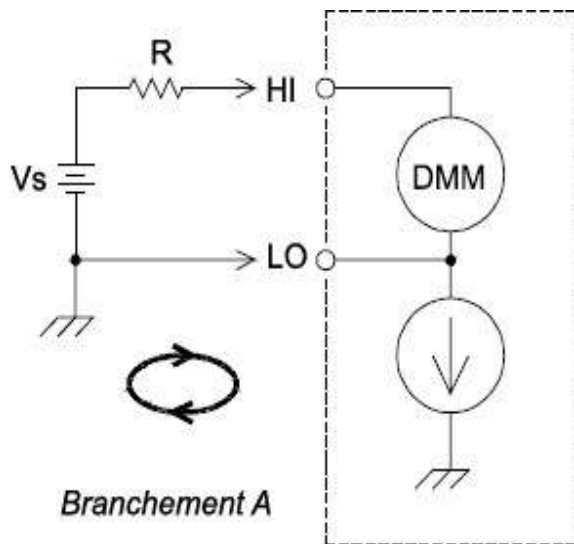
$Z_i$  = Impédance parallèle de  $R_i + C_i$

### Bruit provoqué par le courant injecté

Les capacités résiduelles du transformateur d'alimentation de l'instrument provoquent la circulation de faibles courants entre la borne LO du multimètre numérique (DMM) interne et la terre. La fréquence du « courant injecté » est celle de l'alimentation secteur ou éventuellement des harmoniques de celle-ci. Le courant injecté dépend de la fréquence et de la configuration de l'alimentation secteur. Un circuit simplifié est illustré ci-dessous :



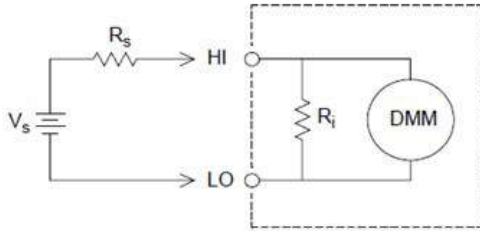
Avec le Branchement A (voir ci-dessous), le courant injecté circule entre la connexion de terre assurée par le circuit vers la borne LO du multimètre numérique (DMM) interne. Cette configuration n'ajoute aucun bruit à la mesure. En revanche, avec le Branchement B, le courant injecté circule à travers la résistance R, ajoutant ainsi du bruit à la mesure. Avec ce Branchement B, plus la valeur de R est élevée, plus elle aggrave le problème.



Le bruit de mesure provoqué par le courant injecté peut se réduire sensiblement en réglant le temps d'intégration du multimètre numérique (DMM) interne à 1 PLC au moins.

### Erreurs dues à la charge provoquée par la résistance d'entrée

Les erreurs de mesure dues à la charge se produisent lorsque la résistance de sortie du dispositif testé (DUT) représente un pourcentage appréciable de la résistance d'entrée propre de l'instrument. Le schéma ci-dessous illustre cette source d'erreur :



$$\text{Error (\%)} = \frac{-100 \times R_s}{R_s + R_i}$$

où :

$V_s$  = Tension de sortie idéale du dispositif testé

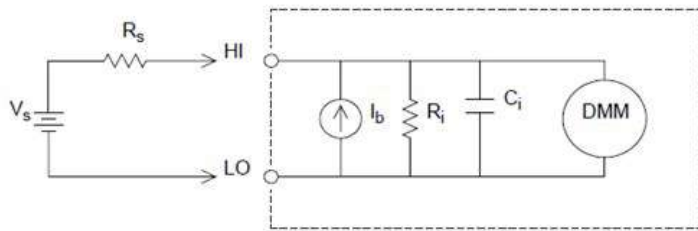
$R_s$  = Résistance de sortie du dispositif testé

$R_i$  = Résistance d'entrée (10 M $\Omega$  ou > 10 G $\Omega$ )

Pour minimiser les erreurs dues à la charge, réglez la résistance d'entrée de courant continu du DMM sur une valeur supérieure à 10 G $\Omega$  si nécessaire.

### Erreurs dues à la charge provoquée par le courant de polarisation d'entrée

Les composants à semi-conducteur utilisés dans les circuits d'entrée du multimètre numérique (DMM) interne présentent de faibles courants de fuite appelés courants de polarisation. L'effet du courant de polarisation d'entrée est d'engendrer une erreur due à la charge aux bornes d'entrée du multimètre numérique (DMM) interne. Le courant de fuite double approximativement pour chaque augmentation de la température de 10 °C, rendant le problème beaucoup plus visible pour les températures élevées.



$$\text{Error (V)} = I_b \times R_s$$

où :

$I_b$  = Courant de polarisation du multimètre numérique (DMM)

$R_s$  = Résistance de sortie du dispositif testé

$R_i$  = Résistance d'entrée (10 M $\Omega$  ou > 10 G $\Omega$ )

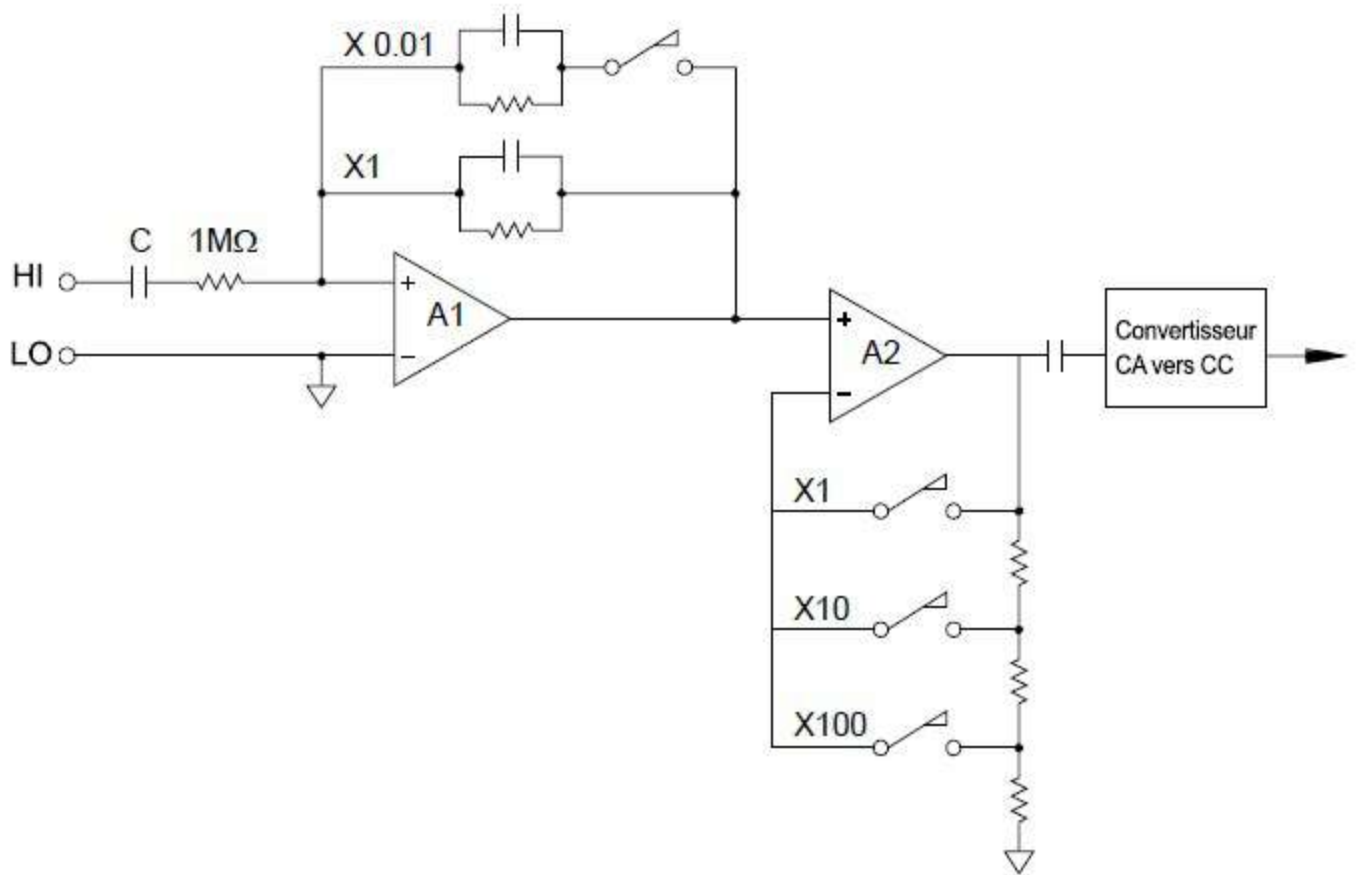
$i_c$  = Capacité d'entrée du multimètre numérique (DMM)

## Mesures d'une tension alternative

Le but principal du « frontal » en courant alternatif est de transformer une tension alternative en une tension continue mesurable par le convertisseur analogique-numérique.

### Conditionnement des signaux pour les mesures en courant alternatif

Le conditionnement du signal d'entrée pour les mesures de tension alternative inclut à la fois une amplification et une atténuation. Un condensateur de couplage d'entrée (C) bloque la composante en courant continu du signal d'entrée de sorte que seule la composante en courant alternatif soit mesurée. La commutation de plage est réalisée en associant l'atténuation du signal de l'amplificateur du premier étage au gain de l'amplificateur du second étage.

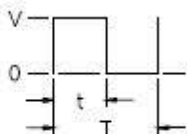


Le premier étage met en œuvre un atténuateur compensé commutable à haute impédance d'entrée (1 MΩ). Le second étage est constitué par un amplificateur de signal à gain variable destiné à ajuster l'amplitude du signal d'entrée du convertisseur CA à un niveau de pleine échelle. Tout décalage en courant continu issu de l'atténuateur et de l'amplificateur est bloqué par un condensateur.

Un frontal de tension alternative semblable à celui décrit ci-dessus est également utilisé pour mesurer le courant alternatif. Des résistances de shunt convertissent le courant alternatif en une tension alternative qui est alors mesurable. Les résistances de shunt sont commutées pour assurer la sélection de plage de courant alternatif.

## Mesures de valeur efficace vraie du courant alternatif

Les multimètres répondant à la valeur efficace vraie mesurent le potentiel « thermique » de la tension appliquée. Contrairement à une mesure « répondant à la valeur moyenne », une mesure de valeur efficace vraie est utilisée pour déterminer la puissance dissipée dans une résistance. Cette puissance est proportionnelle au carré de la tension efficace vraie mesurée, indépendamment de la forme du signal. Un multimètre en courant alternatif répondant à la valeur moyenne est étalonné pour indiquer la même valeur qu'un multimètre en valeur efficace vraie pour des signaux d'entrée sinusoïdaux seulement. Pour les autres formes de signaux, un multimètre répondant à la valeur moyenne présentera des erreurs appréciables indiquées ci-dessous :

| Forme du signal                                                                   | Facteur de crête (F.C.) | CA eff.                                                                        | CA + CC eff.            | Erreur de réponse à la valeur moyenne |
|-----------------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------------------------|-------------------------|---------------------------------------|
|  | 1.414                   | $\frac{V}{1.414}$                                                              | $\frac{V}{1.414}$       | Étalonné sans erreur                  |
|  | 1.732                   | $\frac{V}{1.732}$                                                              | $\frac{V}{1.732}$       | -3.9%                                 |
|  | $\sqrt{\frac{T}{t}}$    | $\frac{V}{\text{F.C.}} \times \sqrt{1 - \left(\frac{1}{\text{F.C.}}\right)^2}$ | $\frac{V}{\text{F.C.}}$ | -46% pour F.C. = 4                    |

Les fonctions de voltmètre et d'ampèremètre en courant alternatif du multimètre numérique (DMM) interne mesurent la valeur efficace vraie en couplage de courant alternatif. C'est en contradiction avec la valeur efficace vraie ca+cc illustrée ci-dessus. Seul le « potentiel thermique » de la composante alternative du signal d'entrée est mesuré (la composante continue est rejetée). Pour des signaux sinusoïdaux, triangulaires et carrés, les valeurs CA et CA+CC sont égales puisque ces signaux ne contiennent pas de composante continue. Les signaux non symétriques, comme les trains d'impulsions, contiennent des composantes continues rejetées par les mesures de valeur efficace vraie couplée en courant alternatif.

Il est souhaitable de pouvoir effectuer une mesure de valeur efficace vraie en couplage ca lorsque l'on mesure des signaux alternatifs de faible amplitude en présence de fortes tensions continues de décalage. C'est une situation fréquente lors de la mesure de la tension alternative d'ondulation d'une alimentation en courant continu. Dans certains cas, cependant, vous souhaitez connaître la valeur efficace vraie des composantes continue et alternative (CA + CC). Vous pouvez calculer cette valeur en associant les résultats des mesures CA et CC, comme illustré ci-dessous. Vous devez effectuer la mesure en courant continu avec un temps d'intégration de 10 cycles de tension d'alimentation au moins pour une meilleure réjection de la composante alternative.

$$AC + DC = \sqrt{AC^2 + DC^2}$$



## Réalisation de mesures en courant alternatif à grande vitesse

Les fonctions de voltmètre et d'ampèremètre en courant alternatif du multimètre numérique (DMM) interne mettent en œuvre trois filtres à basse fréquence. Ces filtres vous permettent de faire un compromis entre la précision en basse fréquence et la vitesse de scrutation. Le filtre rapide se stabilise en 0,12 seconde ; il est approprié pour les mesures au-dessus de 200 Hz. Le filtre moyen se stabilise en 1 seconde ; il est approprié pour les mesures au-dessus de 20 Hz. Le filtre lent se stabilise en 7 secondes ; il est approprié pour les mesures au-dessus de 3 Hz.

Moyennant quelques précautions, vous pouvez effectuer des mesures en courant alternatif jusqu'à 100 lectures par seconde (en utilisant la commutation de plage manuelle pour éliminer les retards dus à la commutation automatique). En réglant les retards de stabilisation préprogrammés des voies à zéro, chaque filtre permettra une scrutation jusqu'à 100 voies par seconde. En revanche, la mesure ne sera peut-être pas très précise puisque le filtre ne sera pas totalement stabilisé. Dans des applications de scrutation où les niveaux d'échantillons à échantillons varient fortement, le filtre moyen (20 Hz) sera stabilisé pour 1 lecture par seconde, et le filtre rapide (200 Hz) sera stabilisé pour 10 lectures par seconde.

Si les niveaux d'échantillons à échantillons sont semblables, le temps de stabilisation nécessaire à chaque nouvelle lecture est réduit. Dans ces conditions, il est possible d'obtenir des résultats à précision réduite à raison de 5 lectures par seconde avec le filtre moyen (20 Hz) et de 50 lectures par seconde avec le filtre rapide (200 Hz). Un temps de stabilisation supplémentaire peut être requis lorsque la tension continue varie d'un échantillon à l'autre.

Le circuit de blocage de la composante continue inclus dans le multimètre numérique (DMM) interne a une constante de temps de stabilisation de 0,2 seconde. Ce temps de stabilisation n'affecte la précision des mesures que lorsque les niveaux de la tension continue de décalage varient d'un échantillon à l'autre. Si vous recherchez une vitesse de mesure maximale dans un système de scrutation de voies, vous souhaitez peut-être ajouter un circuit externe de blocage de composante continue aux voies à tension continue élevée. Ce circuit de blocage peut être simplement constitué d'une résistance et d'un condensateur.

| Filtre CA       | Retard de voie | Temps de stabilisation |
|-----------------|----------------|------------------------|
| 200 Hz (rapide) | AUTOMATIQUE    | 0,12 seconde           |
| 20 Hz (Moyen)   | AUTOMATIQUE    | 1 seconde              |
| 3 Hz (lent)     | AUTOMATIQUE    | 7 seconde              |
| 200 Hz (rapide) | 0              | 0,02 seconde           |
| 20 Hz (Moyen)   | 0              | 0,2 seconde            |
| 3 Hz (lent)     | 0              | 1,5 seconde            |

*Temps de stabilisation du circuit de blocage (1 constante de temps) = 0.2 seconde.*

## Sources d'erreurs des mesures de tension alternative

Beaucoup d'erreurs associées aux mesures de tension continue s'appliquent aussi aux mesures de tension alternative. Des erreurs additionnelles propres aux mesures de tension alternative sont décrites dans cette section.

### Erreurs dues au facteur de crête (signaux d'entrée non sinusoïdaux)

Une erreur répandue consiste à penser que « puisque le multimètre numérique (DMM) interne mesure la valeur efficace vraie, sa précision en signaux sinusoïdaux s'applique à toutes les formes de signaux ». En réalité, la forme du signal peut affecter considérablement la précision des mesures. Un moyen courant de caractériser les formes de signaux est le facteur de crête. Le facteur de crête est le quotient de la valeur de crête par la valeur efficace du signal.

De manière générale, plus le facteur de crête est important, plus l'énergie contenue dans les harmoniques de rang élevé est importante. Tous les multimètres présentent des erreurs qui dépendent du facteur de crête. Notez qu'elles ne s'appliquent pas aux signaux d'entrée en dessous de 100 Hz lorsque le filtre CA lent est utilisé.

Vous pouvez estimer l'erreur de mesure due au facteur de crête du signal de la manière suivante :

$$\textbf{Total Error} = \textbf{Error}_{\textit{sine}} + \textbf{Error}_{\textit{crest factor}} + \textbf{Error}_{\textit{bandwidth}}$$

où :

$\text{Error}_{\textit{sine}}$  = Précision du multimètre numérique (DMM) en signaux sinusoïdaux

$\text{Erreur}_{\text{facteur de crête}}$  = Erreur due au facteur de crête du multimètre numérique (DMM)

$$\text{Error}_{\text{bandwidth}} = \frac{-C.F.^2 \times F}{4\pi \times BW}$$

où :

C.F. = facteur de crête du signal

F = Fréquence fondamentale du signal d'entrée

BW = Bande passante à 3dB du multimètre numérique (DMM) (1 MHz pour le modèle DAQ970A/DAQ973A)

### Exemple : calcul de l'erreur de mesure

Calculez l'erreur de mesure approximative pour un train d'impulsions en entrée ayant un facteur de crête de 3 et une fréquence fondamentale de 20 kHz. Le multimètre numérique (DMM) interne est réglé sur la plage 1 V. Pour cet exemple, utilisez les spécifications de précision sur 90 jours  $\pm (0,05 \% \text{ de la lecture} + 0,04 \% \text{ de la plage})$ .

$$\text{Error}_{\textit{sine}} = \pm(0.05\% + 0.04\%) = \pm 0.09\%$$

$$\text{Erreur}_{\text{facteur de crête}} = 0,15 \%$$

$$\text{Error}_{\text{bandwidth}} = \frac{-3^2 \times 20000}{4\pi \times 1000000} \times 100 = 1.4\%$$

$$\text{Erreur totale} = 0,09\% + 0,15 \% + 1,4 \% = 1,6 \%$$

### Erreurs dues à la charge en courant alternatif

Pour la fonction de voltmètre alternatif, l'entrée du multimètre (DMM) apparaît comme une résistance de 1 MΩ en parallèle avec une capacité de 150 pF. Le câblage utilisé pour connecter les signaux à l'instrument ajoute également une capacité et une charge. Le tableau ci-dessous indique la résistance d'entrée approximative du multimètre à diverses fréquences.

| Fréquence d'entrée | Résistance d'entrée |
|--------------------|---------------------|
| 100 Hz             | 700 kΩ              |
| 1 kHz              | 600 kΩ              |
| 10 kHz             | 100 kΩ              |
| 100 kHz            | 10 kΩ               |

En basses fréquences :

$$\text{Error} (\%) = \frac{-100 \times R_s}{R_s + M\Omega}$$

Erreur additionnelle en haute fréquence :

$$\text{Error} (\%) = 100 \times \left[ \frac{1}{1 + (2\pi \times F \times R_s \times C_{in})^2} - 1 \right]$$

où :

F = Fréquence d'entrée

R<sub>s</sub> = Résistance de sortie

C<sub>in</sub> = Capacité d'entrée (150 pF) + Capacité du câble

Utilisez des câbles à faible capacité pour mesurer des signaux alternatifs à haute fréquence.

### Erreurs de mesure liées à des basses tensions alternatives

Si vous mesurez des tensions alternatives inférieures à 100 mV, sachez que ces mesures sont particulièrement vulnérables aux erreurs introduites par des sources de bruit externes. Ainsi, un cordon dont l'extrémité de test reste à l'air se comporte comme une antenne et le multimètre (DMM) mesurera les signaux captés par cette antenne. La voie de mesure complète, ligne d'alimentation secteur comprise, se comporte comme une antenne cadre. Les courants circulant dans cette antenne cadre créent des tensions d'erreur aux bornes de toutes les impédances en série avec l'entrée de l'instrument. C'est pourquoi il faut utiliser des câbles blindés pour appliquer des tensions alternatives de faible niveau à l'instrument. Connectez le blindage à la borne de niveau bas (LO).

Veillez également à réduire la surface des boucles de masse qui ne peuvent pas être évitées. Une source de haute impédance est plus favorable à la collecte de bruit qu'une source de faible impédance. Vous pouvez réduire l'impédance en haute fréquence d'une source en plaçant un condensateur en parallèle avec les bornes d'entrée de l'instrument. Vous devrez peut-être faire plusieurs essais afin de déterminer la valeur correcte de ce condensateur pour votre application.

La majeure partie du bruit externe n'est pas corrélée au signal d'entrée. Vous pouvez évaluer l'erreur à l'aide de l'équation suivante :

$$\text{Voltage Measured} = \sqrt{V_{in}^2 + \text{Noise}^2}$$

Le bruit corrélé, bien que rare, a des effets négatifs. En effet, il s'ajoute toujours directement au signal d'entrée. La mesure d'un signal de bas niveau avec la même fréquence que la ligne électrique locale est un cas de figure courant à l'origine de cette erreur. Prenez toutes les précautions possibles lors de la commutation de signaux de forts et de bas niveaux sur le même module. Il est possible que des tensions chargées de haut niveau chargé puissent se décharger dans une voie de bas niveau. Nous vous recommandons d'utiliser deux modules différents ou de séparer les signaux de forts niveaux de ceux de faibles niveaux par une voie non utilisée connectée à la masse.

### Mesures en dessous de la puissance maximale

La mesure de courant alternatif atteint son maximum de précision lorsque la lecture du multimètre numérique (DMM) interne approche de la pleine échelle de la plage sélectionnée. La commutation de plage se produit à 10 % et 120 % de la pleine échelle. Cela vous permet de mesurer certaines entrées à la puissance maximale pour une plage et à 10 % pour la plage la plus élevée suivante. Notez que la précision de la mesure sera sensiblement différente entre les deux cas. Pour une meilleure précision, vous devrez utiliser la commutation de plage manuelle afin de sélectionner la plage la plus basse possible pour la mesure.

### Erreurs dues au coefficient de température et au dépassement de plage

Le multimètre numérique (DMM) interne utilise une technique de mesure en courant alternatif qui mesure et supprime périodiquement les tensions de décalage internes lorsque vous sélectionnez une fonction ou une plage différente. Lors de la commutation manuelle sur une nouvelle plage en condition de dépassement, la mesure de décalage interne peut être dégradée sur cette nouvelle plage. En principe, une erreur de plage additionnelle de 0,01 % peut être introduite. Cette erreur additionnelle demeurera jusqu'au prochain retrait périodique (normalement 15 minutes).

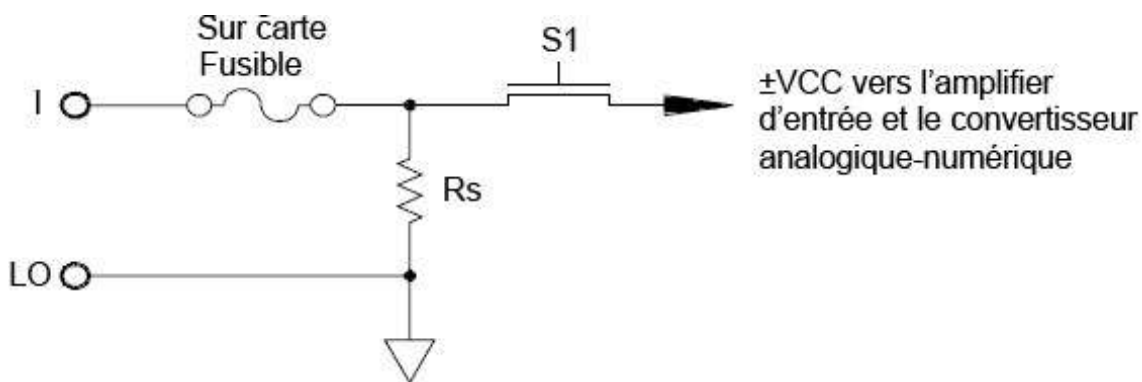
## Mesures de courant

### REMARQUE

Uniquement pris en charge sur le module multiplexeur DAQM901A

Un ampèremètre détecte le courant circulant à travers ses connexions d'entrée – approximativement un court-circuit entre ses bornes d'entrée. Il doit être connecté en série avec le circuit ou le dispositif mesuré de sorte que le courant circule à la fois à travers l'ampèremètre et le circuit testé.

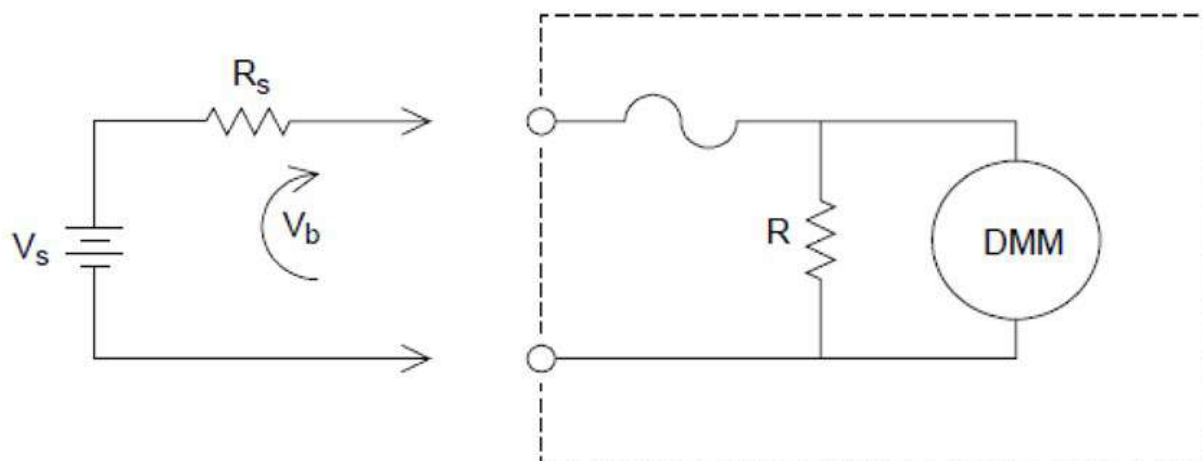
Une résistance,  $R_s$  dans le schéma ci-dessous, est connectée entre les bornes d'entrée de sorte qu'une chute de tension proportionnelle au courant d'entrée soit produite. La valeur de  $R_s$  sélectionnée est aussi faible que possible pour minimiser la chute de tension,  $R_{SI}$  aux bornes de l'instrument. Cette chute de tension est détectée par le multimètre numérique (DMM) interne et mise à l'échelle correspondant à la valeur de courant correcte pour réaliser la mesure (voir l'explication de la page suivante).



Les mesures de courant alternatif sont très semblables à celles de courant continu. La sortie du capteur courant-tension est mesurée par un voltmètre en courant alternatif. Les bornes d'entrée sont couplées en direct (couplage ca+cc) au shunt de sorte que le multimètre numérique (DMM) interne maintient la continuité en courant continu dans le circuit de test. La réalisation de mesures de courant alternatif exige une précaution supplémentaire. La chute de tension (en charge) varie avec la fréquence et l'inductance d'entrée, provoquant souvent un comportement inattendu du circuit testé.

### Sources d'erreurs des mesures de courant continu

Lorsque vous connectez le multimètre (DMM) interne en série avec un circuit testé, en vue de mesurer le courant, une erreur de mesure est introduite. Une chute de tension série du multimètre est à l'origine de cette erreur. Une tension se développe aux bornes de la résistance de câblage et de la résistance de shunt de courant du multimètre numérique (DMM) interne, comme l'illustre la figure ci-dessous :



$$\text{Error} (\%) = \frac{-100\% \times V_b}{V_s}$$

où :

$V_s$  = Tension de source

$R_s$  = Résistance de sortie

$V_b$  = Résistance du shunt de courant

### Sources d'erreurs des mesures de courant alternatif

Les erreurs de chute de tension s'appliquant au courant continu sont également valables pour les mesures de courant alternatif. Toutefois, la chute de tension est plus importante pour les mesures de courant alternatif, en raison de l'inductance série du multimètre numérique (DMM) interne et des connexions de mesure. Les chutes de tension augmentent à mesure que la fréquence d'entrée s'accroît. Certains circuits peuvent se mettre à osciller lors de la réalisation de mesures de courant, à cause de l'inductance série du multimètre (DMM) et des connexions de mesure.

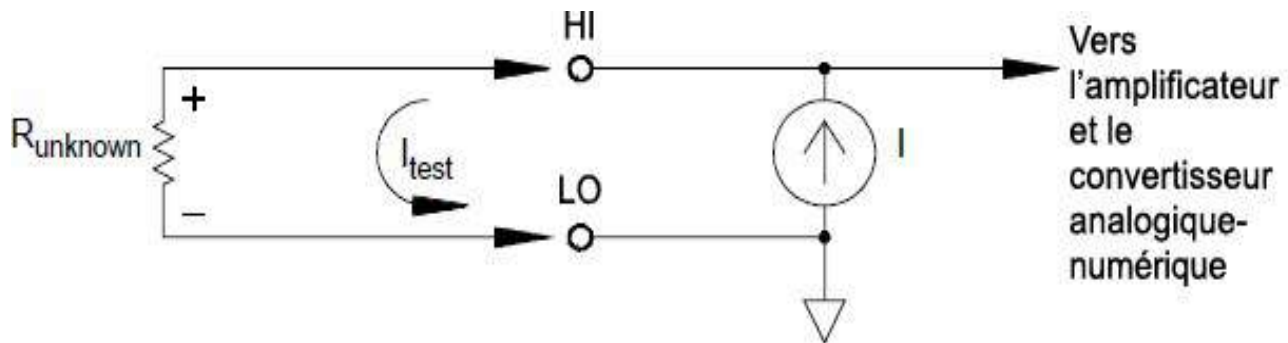
## Mesure de résistance

### REMARQUE

Les mesures de résistance à 2 fils ne sont prises en charge que sur les modules multiplexeur DAQM900A, DAQM901A, DAQM902A, et DAQM908A.

Les mesures de résistance à 4 fils ne sont prises en charge que sur les modules multiplexeur DAQM900A, DAQM901A, et DAQM902A.

Un ohmmètre mesure la résistance en courant continu d'un dispositif ou d'un circuit connecté à son entrée. Les mesures de résistance sont effectuées en injectant un courant continu connu dans la résistance inconnue et en mesurant la chute de tension aux bornes de cette résistance.



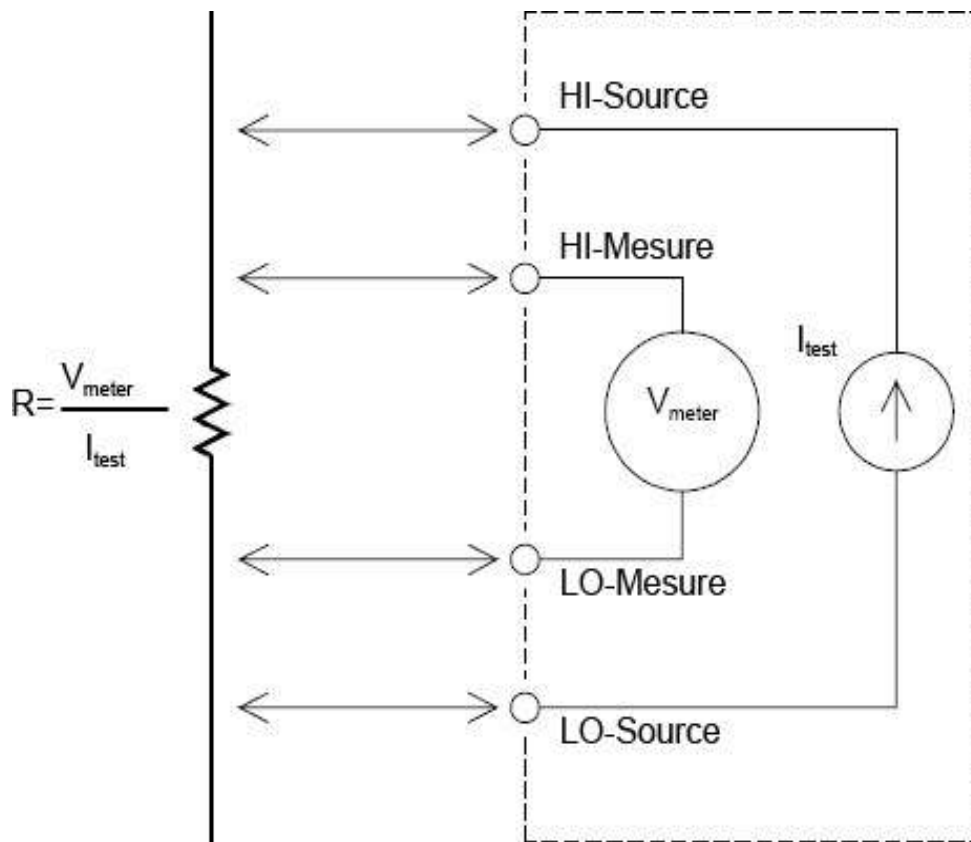
Le multimètre numérique interne propose deux méthodes pour mesurer la résistance : en 2 et 4 fils. Pour les deux méthodes, le courant de test circule depuis la borne d'entrée de niveau haut (HI) et traverse la résistance mesurée. Lors d'une mesure de résistance en 2 fils, la chute de tension aux bornes de la résistance est mesurée dans le multimètre numérique interne. De ce fait, la résistance des cordons de test est également mesurée. Pour une résistance en 4 fils, des raccordements de « captation » distincts sont nécessaires. Aucun courant ne circulant dans ces connexions, leur résistance n'engendre pas d'erreur.

### Mesures de résistance en 4 fils

La mesure de résistance en 4 fils est la méthode la plus précise pour les résistances de faible valeur. Elle réduit automatiquement la résistance des cordons de test, du multiplexeur et des contacts. La méthode de mesure à 4 fils est souvent utilisée dans les systèmes de tests automatisés où des câbles longs, des connexions d'entrée et un multiplexeur sont situés entre le multimètre numérique (DMM) interne et le dispositif testé.

Les connexions recommandées pour les mesures de résistance en 4 fils sont illustrées par le schéma de la page suivante. Une source de courant constant injecte un courant  $I$  à travers la résistance inconnue  $R$ , et développe une tension mesurée par un frontal de tension continue. La résistance inconnue est alors calculée à l'aide de la Loi d'Ohm.

La méthode de mesure en 4 fils est utilisée dans des systèmes où la résistance des fils peut devenir importante et variable, et dans les applications de tests automatisés lorsque les câbles peuvent être plutôt longs. Elle présente l'inconvénient de nécessiter deux fois plus de commutateurs et deux fois plus de câbles que la méthode en 2 fils. Et elle est presque utilisée exclusivement pour mesurer des résistances de faibles valeurs dans n'importe quelle application, en particulier lorsque les valeurs n'excèdent pas  $10\ \Omega$ , et lorsqu'une haute précision est nécessaire comme pour la mesure des capteurs de température à RTD.



## Compensation du décalage

Presque toutes les connexions d'un système utilisent des matériaux produisant de faibles tensions continues dues au contact entre deux métaux différents (effet de thermocouple) ou des batteries électrochimiques. Ces tensions continues ajoutent aussi des erreurs aux mesures de résistance. La mesure à décalage compensé est conçue pour permettre des mesures de résistance en présence de ces faibles tensions continues.

La compensation de décalage effectue deux mesures sur le circuit connecté à la voie d'entrée. La première mesure est une mesure de résistance traditionnelle. La seconde est identique sauf que la source de courant de test du multimètre numérique (DMM) interne est désactivée (c'est essentiellement une mesure de tension continue normale). La seconde mesure est soustraite de la première avant mise à l'échelle du résultat, donnant ainsi une mesure de résistance plus précise.

La compensation de décalage est utilisable pour les mesures de résistance en 2 ou 4 fils (mais pas pour les mesures de RTD ou de thermistances). Le modèle DAQ970A/DAQ973A désactive la compensation de décalage lors du changement de fonction de mesure ou après une réinitialisation usine (commande \*RST). Le pré-réglage de l'instrument (commande SYSTem:PRESet) et la réinitialisation de la carte (commande SYSTem:CPON) ne modifient pas le réglage.

Si la résistance mesurée ne répond pas rapidement aux variations du courant, la compensation de décalage ne produira pas une mesure précise. Les résistances présentant une composante inductive importante ou celles ayant une capacité en parallèle également importante devraient appartenir à cette catégorie. Dans ces cas, on peut augmenter le paramètre de retard de voie pour permettre de disposer d'un temps de stabilisation plus long après l'activation ou la désactivation de la source de courant, ou la compensation de décalage peut être désactivée.



## Sources d'erreur des mesures de résistance

### Tensions externes

Toutes tensions présentes dans le câblage ou les connexions du système perturberont la mesure de résistance. Les effets de certaines de ces tensions peuvent être inhibés en utilisant la compensation de décalage (décrite à la section précédente).

### Effets du temps de stabilisation

Le multimètre numérique (DMM) interne offre la possibilité d'ajouter automatiquement des retards de stabilisation des mesures. Ces retards facilitent les mesures de résistance lorsque la capacité parasite dans les câbles et le composant est inférieure à 200 pF. Ils sont particulièrement importants lorsque vous mesurez des résistances de plus de 100 k $\Omega$ . La stabilisation due aux effets de la constante de temps RC peut demander un temps assez long. Certaines résistances de précision, ainsi que certains calibrateurs multifonctions, utilisent des condensateurs parallèles à valeur élevée (de 1000 pF à 0,1  $\mu$ F) avec des résistances élevées pour filtrer les courants de bruit injectés par leurs circuits internes. Une capacité non idéale des câbles et d'autres appareils peut imposer des temps de stabilisation plus longs que ceux prévus, à cause des constantes de temps RC dues aux effets d'absorption (diffusion) diélectrique. Les erreurs seront mesurées lors de la stabilisation après la connexion initiale ou un changement de plage, ou lors de l'utilisation de la compensation de décalage. Vous devrez peut-être augmenter le temps de retard de voie avant la mesure dans ces situations.

### Erreurs de mesure de résistance élevée

Lorsque vous mesurez des résistances importantes, des erreurs conséquentes peuvent se produire en raison de la résistance de l'isolation et de la propreté des surfaces. Veillez à prendre toutes les précautions nécessaires pour maintenir « propre » le système haute résistance. Les cordons de test et les parties fixes sont susceptibles de fuir en raison de l'absorption d'humidité dans les matériaux d'isolation et les surfaces « sales ». Le nylon et le PVC sont d'assez piètres isolants ( $10^9$  ohms), comparés aux isolants PTFE ( $10^{13}$  ohms). La résistance de fuite des isolants en nylon ou en PVC peut engendrer une erreur de 0,1 % lors de la mesure d'une résistance de 1 M $\Omega$  dans un environnement humide. Le tableau ci-dessous présente plusieurs matériaux isolants courants et leurs résistances nominales.

| Matériau isolant         | Plage de résistance           | Absorbant d'humidité |
|--------------------------|-------------------------------|----------------------|
| PTFE                     | 1 T $\Omega$ à 1 P $\Omega$   | N°                   |
| Nylon                    | 1 G $\Omega$ à 10 T $\Omega$  | Oui                  |
| PVC                      | 10 G $\Omega$ à 10 T $\Omega$ | Oui                  |
| Polystyrène              | 100 G $\Omega$ à 1 P $\Omega$ | N°                   |
| Céramique                | 1 G $\Omega$ à 1 P $\Omega$   | N°                   |
| Verre Epoxy (FR-4, G-10) | 1 G $\Omega$ à 10 T $\Omega$  | Oui                  |
| Papier phénolique        | 10 M $\Omega$ à 10 G $\Omega$ | Oui                  |

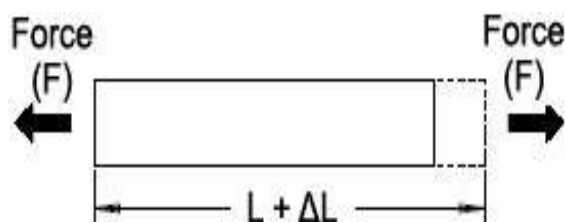
## Mesures de la jauge de contrainte

Vous pouvez mesurer une jauge de contrainte par mesure de résistance à 4 fils avec mise à l'échelle.

Lorsqu'une force est appliquée à un corps, celui-ci se déforme. La déformation par unité de longueur est appelée contrainte ( $\epsilon$ ). La contrainte peut être en extension (+) ou en compression (-). En pratique, les valeurs de contrainte sont habituellement plutôt faibles (de l'ordre de moins de 0,005 mm/mm pour la plupart des métaux) et sont souvent exprimées en micro-contraintes ( $\mu\epsilon$ ). Il existe trois types principaux de mesures de contrainte comme l'illustrent les figures ci-dessous :

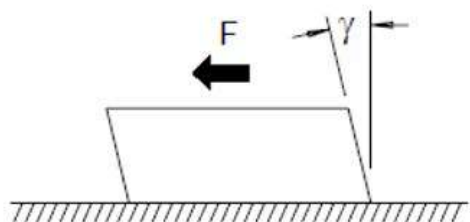
### 1. Contrainte Normale ( $\epsilon$ )

La Contrainte Normale ( $\epsilon$ ) est une mesure de la déformation le long de l'axe de la force appliquée, où  $\epsilon = \Delta L/L$



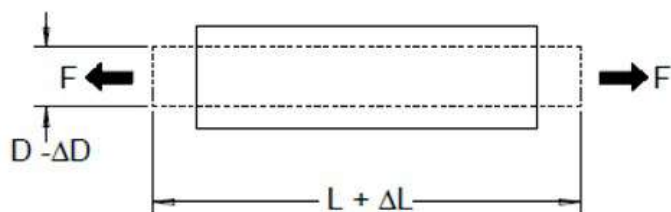
### 2. Contrainte de cisaillement ( $\gamma$ )

La Contrainte de Cisaillement ( $\gamma$ ) est une mesure de la déformation angulaire d'un corps. C'est approximativement la tangente de l'angle formé par la variation angulaire entre deux segments de droites qui étaient parallèles à l'état non déformé.



### 3. Contrainte de Poisson ( $\nu$ )

La Contrainte de Poisson ( $\nu$ ) mesure une propriété des matériaux connue sous le terme de Coefficient de Poisson. Il s'agit du rapport négatif de la contrainte transversale divisée par la contrainte longitudinale normale lorsque le corps est soumis à une force d'extension longitudinale, où  $\nu = -\epsilon_t/\epsilon$ , où  $\epsilon_t = \Delta D/D$  et  $\epsilon = \Delta L/L$



## Stress

Le stress est un terme utilisé pour comparer la charge appliquée à un matériau avec son aptitude à porter la charge. Le stress ( $\sigma$ ) d'un matériau n'est pas mesurable directement ; il doit être calculé d'après les propriétés du matériau et des quantités mesurables comme la contrainte et la force.

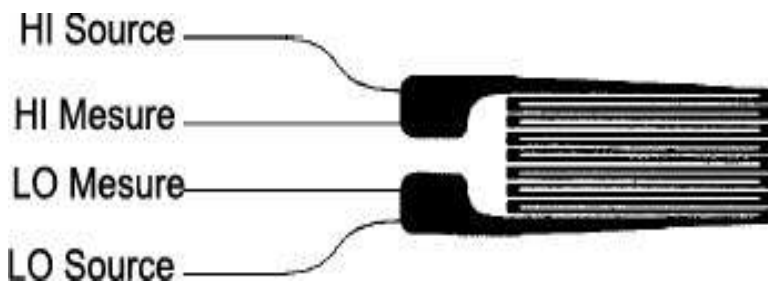
## Jauges de contrainte

La jauge de contrainte à résistances de feuilles de métal est de loin le capteur de mesure de contrainte le plus largement utilisé. Elle se compose d'un treillis mince de feuilles de métal collé sur un matériau adhésif isolant mince. La résistance de la feuille varie linéairement avec la contrainte. La contrainte du corps testé est simplement le quotient de la résistance de la feuille sous contrainte divisée par celle de la feuille sans contrainte :  $\epsilon = \Delta R/R$ .

## Facteur de jauge (GF)

Le Facteur de jauge (GF) indique la sensibilité d'une jauge de contrainte et est une mesure de la variation de la résistance fractionnelle par unité de contrainte :  $GF = (\Delta R/R) / \epsilon$ . La jauge avec un facteur de jauge élevé présente une variation de résistance plus élevée par unité de contrainte appliquée.

Les jauges de contrainte existent avec divers nombres et configurations d'éléments. L'élément le plus courant est la jauge simple illustrée ci-dessous. Des jauges de contrainte multi-éléments, également appelées rosettes, sont utilisées pour mesurer des composantes de contrainte dans des directions différentes. Des configurations à deux (90°) et à trois éléments (45° ou 60°) sont les plus courantes.



## Utilisations courantes des jauges de contrainte

Les jauges de contrainte sont utilisées pour détecter de nombreux types de paramètres physiques. Les jauges de contraintes sont principalement des composants sensibles à l'effort appliqué. L'effort est mesuré indirectement en mesurant la déformation d'un corps testé sous un effort appliqué connu produisant ainsi une variation de résistance proportionnelle à cet effort appliqué. De nombreuses autres grandeurs physiques peuvent être mesurées au travers de mesures d'efforts. Les applications courantes des jauges de contrainte s'étendent des mesures de poids à celles de pression, de débit et de niveau.

## Réalisation des mesures de jauges de contrainte

Un pont de Wheatstone est utilisé couramment pour permettre aux instruments ayant des possibilités de mesure à faible sensibilité de mesurer de petites variations de résistance courantes dans les mesures de contrainte. Des instruments ayant des possibilités de mesure de résistance avec une résolution élevée, comme le multimètre numérique (DMM) interne du modèle DAQ970A/DAQ973A, peuvent mesurer directement des petites variations de résistance avec une précision et une linéarité élevées. Vous devrez utiliser la méthode de mesure de résistance en 4 fils pour mesurer des jauges de contrainte afin d'éliminer les erreurs dues au câblage du système.

Une mesure de résistance initiale de la jauge sans contrainte servira de mesure de référence ( $R_0$ ) à partir de laquelle la contrainte ( $\Delta R/R_0$ ) sera mesurée. Pour de meilleurs résultats, vous devez réaliser cette mesure de référence après l'installation de la jauge de contrainte sur le corps testé. Le tableau ci-dessous indique les variations de résistance correspondant à une contrainte de  $1 \mu\epsilon$  pour un facteur de jauge courant et des valeurs de résistance de jauge sans contrainte courantes.

| Contrainte      | GF  | $R_0$         | $\Delta R$             | Sensibilité de multimètre numérique (DMM)   |
|-----------------|-----|---------------|------------------------|---------------------------------------------|
| $1 \mu\epsilon$ | 2,0 | $120 \Omega$  | $0,24 \text{ M}\Omega$ | $0.1 \text{ m}\Omega$ ( $0.4 \mu\epsilon$ ) |
| $1 \mu\epsilon$ | 2,0 | $350 \Omega$  | $0,70 \text{ M}\Omega$ | $1.0 \text{ m}\Omega$ ( $1.4 \mu\epsilon$ ) |
| $1 \mu\epsilon$ | 2,0 | $1000 \Omega$ | $2,0 \text{ M}\Omega$  | $1.0 \text{ m}\Omega$ ( $0.5 \mu\epsilon$ ) |

L'utilisation de la fonction de réglage d'échelle ( $mX+b$ ) avec les équations indiquées ci-dessous vous permettra d'afficher directement la contrainte sur l'écran du panneau avant du modèle DAQ970A/DAQ973A. Vous pouvez utiliser une unité de mesure personnalisée pour afficher directement les lectures en «  $\mu\epsilon$  » (micro-contrainte). L'instrument ajoutera automatiquement le préfixe micro («  $\mu$  ») d'après les valeurs calculées réelles.

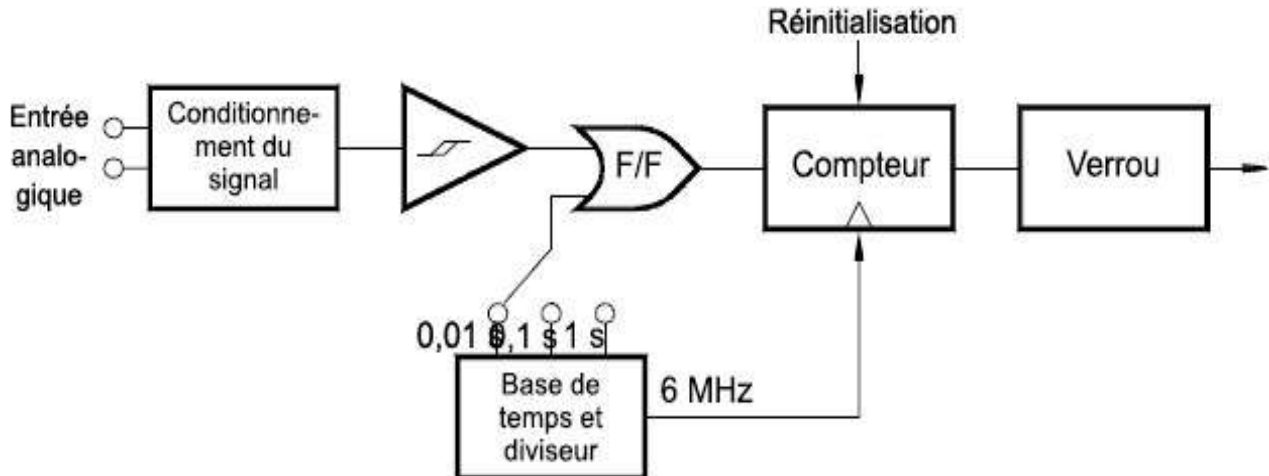
$$m = \frac{1}{GF \times R_0} \quad b = -\frac{1}{GF}$$

## Effets de la température

L'élément résistif d'une jauge de contrainte produira une variation de résistance  $\Delta R$  due à la contrainte mesurée, mais aussi aux variations de la température de la jauge. Cela créera une variation de contrainte « apparente » et indésirable. Une seconde jauge de type identique peut être utilisée pour détecter les variations de température, et ainsi éliminer cette source d'erreur. Vous devez installer cette seconde jauge à proximité immédiate et à  $90^\circ$  de la première, répondant ainsi aux variations de la température ambiante, mais non aux variations de contrainte. La soustraction des mesures de la seconde jauge éliminera les erreurs indésirables de contrainte.

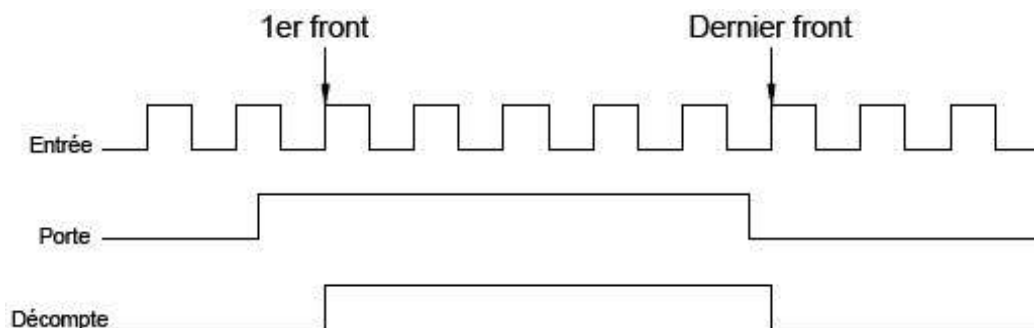
## Mesures de la fréquence et de la période

Pour mesurer la fréquence et la période, le multimètre numérique (DMM) interne utilise une méthode de comptage réciproque. Cette méthode garantit la constance de la résolution de la mesure à toutes les fréquences d'entrée. La section de mesure de tension alternative du multimètre numérique (DMM) interne réalise le conditionnement du signal d'entrée pour mesurer la fréquence et la période.



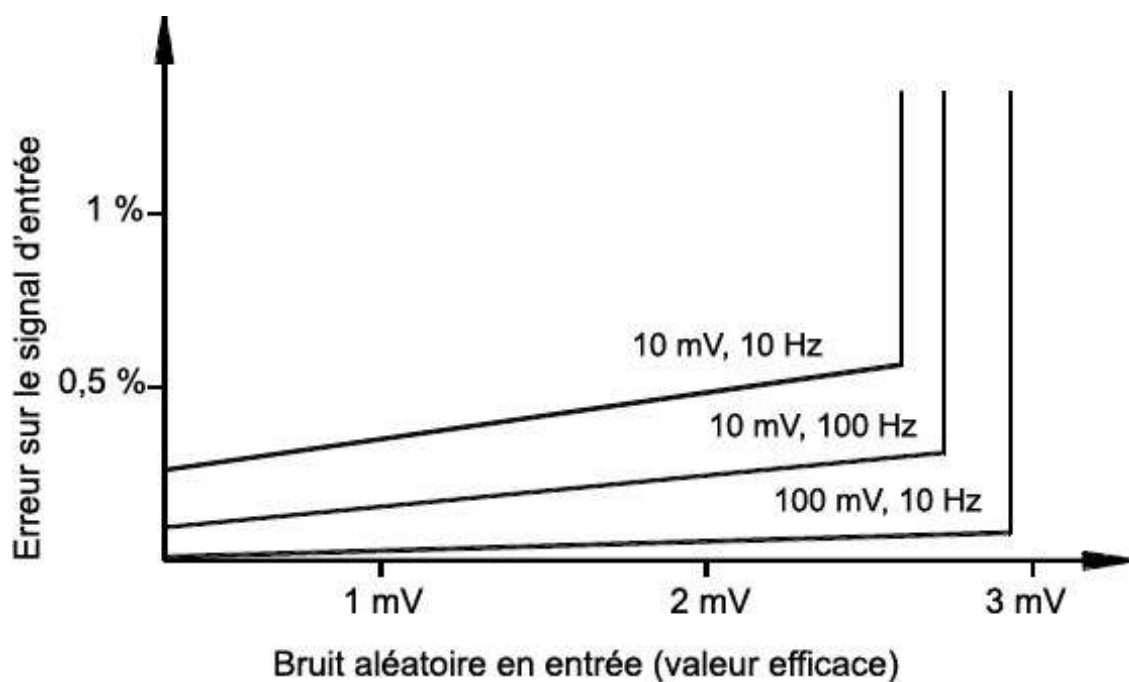
La base de temps est divisée pour délivrer le signal de porte. Les signaux de porte et d'entrée sont associés pour activer le compteur. Pendant la durée « d'ouverture », le compteur mesure le signal de base de temps de 6 MHz. À chaque fin de la durée du signal de porte, le total compté est verrouillé et le résultat est divisé par la fréquence connue de la base de temps pour déterminer la fréquence du signal d'entrée. Le compteur est remis à zéro avant la durée suivante du signal de porte. La résolution de la mesure est liée à la base de temps, et non à la fréquence du signal d'entrée. La vitesse de mesure est ainsi augmentée en particulier aux fréquences basses.

Le compteur réciproque présente l'avantage d'un nombre de chiffres affichés constant, quelle que soit la fréquence du signal d'entrée. Avec un compteur réciproque, le nombre de chiffres de résolution s'ajuste avec la durée du signal de porte. Un signal de porte d'1 seconde donne une résolution de six chiffres, un signal de porte de 0,1 seconde donne une résolution de cinq chiffres, et ainsi de suite.



## Sources d'erreur des mesures de fréquence et de période

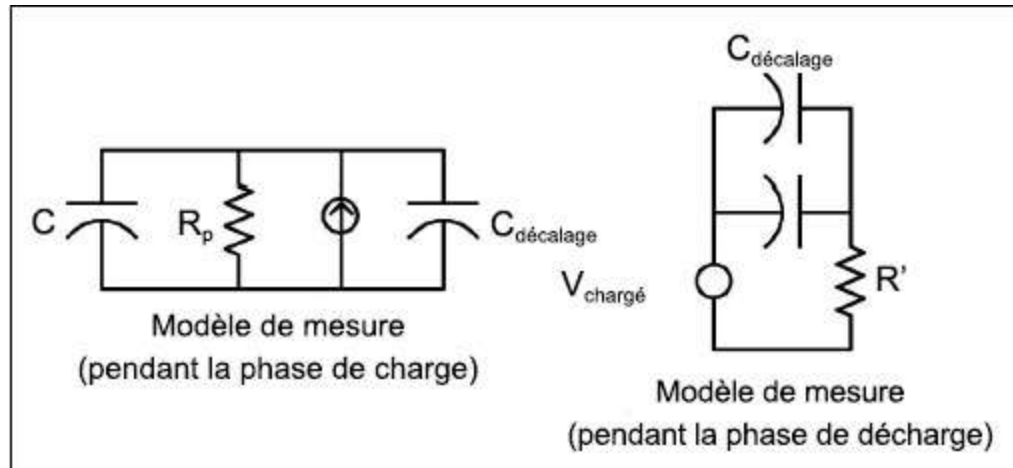
La partie du multimètre (DMM) qui mesure la tension alternative assure le conditionnement du signal d'entrée. Tous les fréquencemètres sont sensibles aux erreurs lors de la mesure de signaux à basse tension et basse fréquence. Les effets du bruit interne et de la collecte de bruit externe constituent un facteur déterminant dans la mesure de signaux dits « lents ». L'erreur est inversement proportionnelle à la fréquence. Des erreurs de mesure se produiront également lorsque l'on tente de mesurer la fréquence (ou la période) d'un signal d'entrée après une variation de la tension continue de décalage. Avant de réaliser une mesure de fréquence, laissez se stabiliser le condensateur de blocage de la tension continue à l'entrée du multimètre numérique (DMM) interne.



Si le captage du bruit externe devient suffisamment important pour dépasser l'hystérésis des circuits de mesure, la fonction de fréquencemètre peut réellement devenir inutilisable. Le blindage externe et le filtrage passe-bas peuvent contribuer à résoudre le problème.

## Mesures de capacité

Le modèle DAQ970A/DAQ973A mesure la capacité en appliquant un courant connu pour charger la capacité puis une résistance pour la décharger comme indiqué ci-dessous :



La capacité est calculée en mesurant la variation de tension (DV) pendant un temps « d'ouverture court » (Dt). Cette mesure est répétée à deux moments différents pendant la croissance exponentielle. À partir des données de ces quatre points, et en linéarisant la croissance exponentielle pendant ces « ouvertures courtes », un algorithme calcule précisément la valeur de capacité.

Le cycle de mesure se compose de deux parties : une phase de charge (illustré dans le graphique) et une phase de décharge. La constante de temps pendant la phase de décharge est plus longue, à cause d'une résistance de protection de 100 k $\Omega$  dans le chemin de mesure. La constante de temps joue un rôle important dans la vitesse de lecture résultante (temps de mesure). Les temps incrémentiels (ou « temps d'échantillonnage ») ainsi que la largeur des « ouvertures courtes », varient en plage afin de réduire le bruit et d'améliorer la précision des mesures. Pour obtenir une précision optimale, effectuez une mesure avec la fonction Null et des sondes ouvertes pour éliminer la capacité des cordons avant de les relier au condensateur à mesurer.

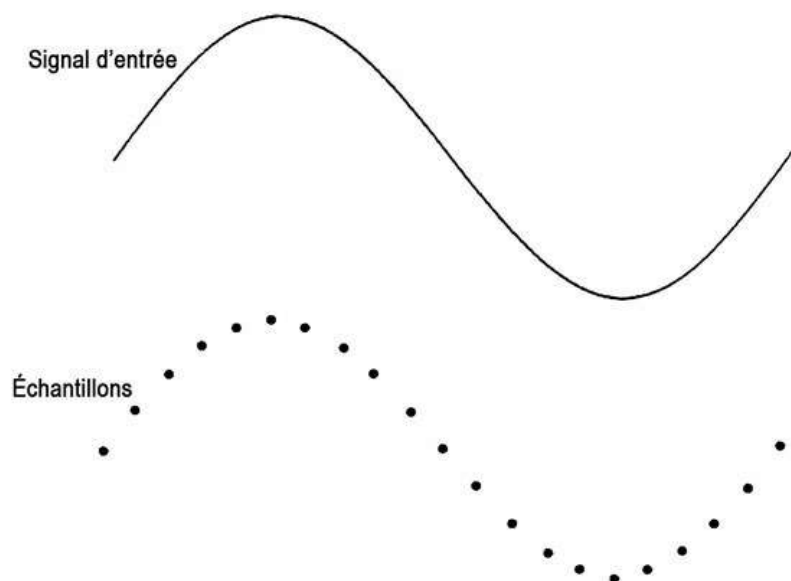
### Considérations relatives aux mesures de capacité

Les condensateurs qui ont un facteur de dissipation élevé ou des caractéristiques non idéales auront une incidence sur les mesures de capacité. Les condensateurs avec un facteur de dissipation élevé peuvent présenter un écart entre la valeur mesurée par le multimètre et la méthode à fréquence unique de certains autres multimètres LCR. La méthode à fréquence unique présente également plus de variations à différentes fréquences. Par exemple, certains boîtiers de substitution de capacité bon marché, lorsqu'ils sont mesurés avec le multimètre, présentent une différence de près de 5 % par rapport à la même capacité mesurée avec la méthode de fréquence unique d'un multimètre LCR. Le multimètre LCR présentera également des valeurs différentes à différentes fréquences.

Les condensateurs avec des constantes de temps longues (absorption diélectrique) généreront un long délai de stabilisation des mesures et prendront quelques secondes pour se stabiliser. Vous pouvez le constater lors du premier branchement d'un condensateur ou lorsque le délai de mesure est modifié. Cet effet est généralement le moins présent dans un condensateur à film de haute qualité et le plus présent dans un condensateur électrolytique, les condensateurs céramiques se situent généralement au milieu.

## Mesures de numérisation

Le mode Numérisation est disponible sur les DAQ970A/DAQ973A avec le mode d'acquisition de données de la **Numérisation du multimètre numérique**. La numérisation est le procédé qui consiste à convertir un signal analogique, tel qu'une onde sinusoïdale, en une série d'échantillons distincts (lectures). La figure ci-dessous montre le résultat de la numérisation d'une onde sinusoïdale. Ce chapitre traite des différentes manières de numériser des signaux. L'importance de la fréquence d'échantillonnage et la façon d'utiliser le déclenchement sur niveau.



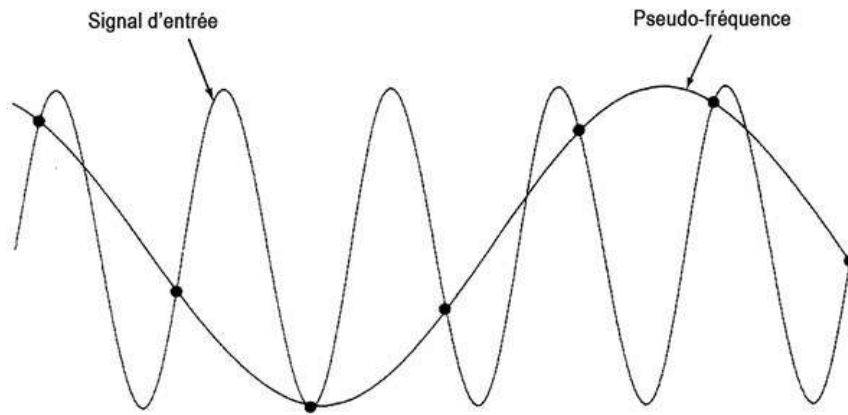
### Fréquence d'échantillonnage

Selon le théorème de Nyquist ou d'échantillonnage : Si un signal continu de bande passante limitée ne contient aucun composant de fréquence supérieur à  $F$ , alors le signal d'origine peut-être rétabli sans distorsion (repli de spectre) s'il est échantillonné à un taux plus élevé que  $2F$  échantillons par seconde.

Dans la pratique, le taux d'échantillonnage du multimètre doit être supérieur au double du composant de fréquence le plus fort du signal mesuré. Vous pouvez sélectionner sur le panneau avant une fréquence d'échantillonnage en nombre d'échantillons par seconde ou sélectionner un intervalle d'échantillonnage (temps entre échantillons) en basculant la touche **Échantillon**.

La figure ci-dessous présente une courbe sinusoïdale échantillonnée à un taux légèrement inférieur à  $2F$ . Comme indiqué par la ligne en pointillés, le résultat est une fréquence alias très différente de la fréquence du signal mesuré. Certains numériseurs disposent d'un filtre anti-repliement passe-bas avec une pointe de coupure nette, à une fréquence égale à  $1/2$  de la fréquence d'échantillonnage du numériseur. La bande passante du signal d'entrée est ainsi limitée de manière à éviter tout repliement. La fréquence d'échantillonnage du multimètre étant variable pour la numérisation VCC, et pour réserver la bande passante supérieure aux mesures à haute fréquence, aucun filtre anti-repliement n'est fourni dans le multimètre. Si le repliement est un problème potentiel, ajoutez un filtre anti-repliement externe.





Certains numériseurs disposent d'un filtre anti-repliement passe-bas avec une pointe de coupure nette, à une fréquence égale à  $1/2$  de la fréquence d'échantillonnage du numériseur. La bande passante du signal d'entrée est ainsi limitée de manière à éviter tout repliement. La fréquence d'échantillonnage du multimètre étant variable pour la numérisation VCC, et pour réserver la bande passante supérieure aux mesures à haute fréquence, aucun filtre anti-repliement n'est fourni dans le multimètre. Si le repliement est un problème potentiel, ajoutez un filtre anti-repliement externe.

### Déclenchement sur niveau

Lors de la numérisation, il est important de commencer l'échantillonnage à un point défini du signal d'entrée, comme le point où le signal passe par une tension nulle ou lorsqu'il atteint la moitié de son amplitude maximale positive ou négative. Le déclenchement sur niveau vous permet de définir quand commencer l'échantillonnage (en termes de tension et d'inclinaison). Consultez [Déclenchement sur niveau](#) pour plus d'informations.

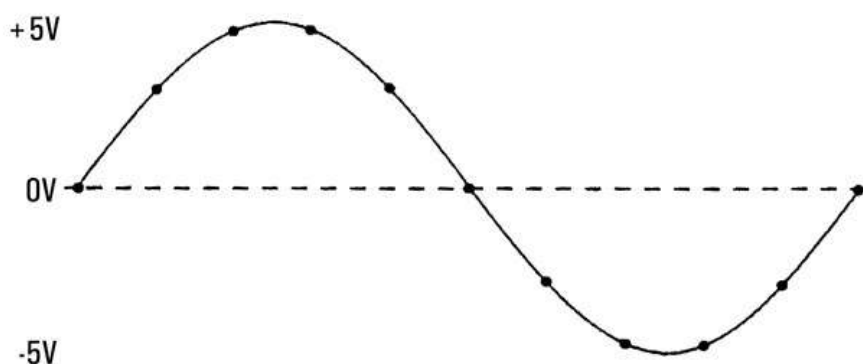
### À propos du mode Numériser DMM

- Le mode Numériser DMM est disponible pour les DAQ970A/DAQ973A.
- Le mode Numériser DMM vous permet de capturer des échantillons du signal d'entrée, à une **Fréquence d'échantillonnage** (par exemple, 50 kHz) ou à un **Intervalle d'échantillonnage** (par exemple, 20  $\mu$ S) définis. Vous pouvez définir la Durée sous forme d'un Délai ou d'un nombre de Mesures (échantillons). Vous pouvez utiliser soit Auto, Externe, ou Déclenchement sur niveau. Après avoir appuyé sur **[Home] ([Accueil])**, appuyez sur **Acquire > DMM Digitize (Acquérir > Numériser DMM)**. Vous pouvez ensuite sélectionner les paramètres de déclenchement/numérisation. Après avoir configuré les paramètres de numérisation, appuyez sur **[Scan/Start] ([Scrutation/Démarrer])**. La numérisation commence lorsque l'événement déclencheur sélectionné se produit.
- L'option Numériser DMM offre des fonctions de pré-déclenchement, de déclenchement sur niveau et de délai de déclenchement.
- Avec le pré-déclenchement, si un déclenchement survient avant réception de tous les pré-déclenchements, il est exécuté pour commencer les mesures.

- Tous les échantillons prélevés au cours de la numérisation sont enregistrés dans une mémoire volatile. Après avoir effectué une opération de numérisation, appuyez sur la touche **[Save Recall]>Save>Readings** ([Enregistrer rappel]>Enregistrer> Mesures) et définissez un fichier pour enregistrer les mesures numériques dans un fichier.
- Le nombre maximum de mesures qui peuvent être recueillies dépend de l'espace de mémoire volatile disponible.
- Les mesures enregistrées sont effacées au début de chaque nouvelle acquisition.

### Déclenchement sur niveau

Le déclenchement sur niveau vous permet de déclencher des mesures à un point défini du signal d'entrée, comme le point où le signal passe par une tension nulle ou lorsqu'il atteint la moitié de son amplitude maximale positive ou négative. Par exemple, ce graphique montre un début d'échantillonnage au point où le signal passe par une tension nulle avec une pente positive :



### À propos du déclenchement sur niveau

Le déclenchement sur niveau est disponible pour ces fonctions de mesure :

- Tension CC et courant CC
- Contrainte
- Résistances en 2 et 4 fils, avec compensation de décalage et basse puissance désactivées
- Température (capteur RTD uniquement)

Le déclenchement sur niveau est sensible à la direction. C'est-à-dire que l'instrument doit détecter une modification de la quantité mesurée d'un côté du paramètre de niveau à l'autre (direction contrôlée par le réglage de l'inclinaison). Par exemple, si l'inclinaison est positive, alors la quantité mesurée doit d'abord atteindre une valeur inférieure au niveau défini avant qu'un événement déclencheur puisse être détecté. Les performances du déclenchement sur niveau ne sont pas uniformes. Son exactitude, sa latence et sa sensibilité dépendent des autres fonctionnalités du DMM.

## Multiplexage et commutation de signaux de bas niveau

Les multiplexeurs pour signaux de bas niveau sont disponibles dans les types suivants : 1 fil, 2 fils et 4 fils. Les sections suivantes de ce chapitre décrivent chaque type de multiplexeur. Les modules multiplexeurs suivants pour signaux de bas niveau sont disponibles avec le modèle DAQ970A/DAQ973A.

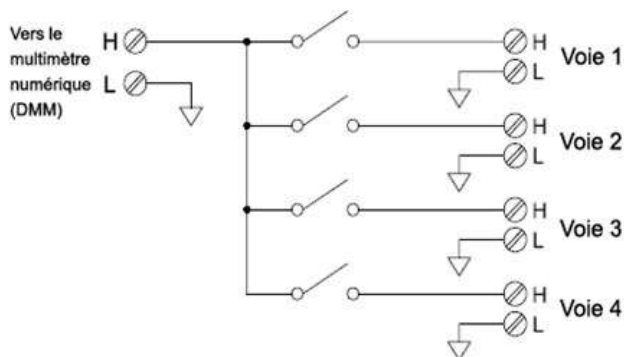
- Multiplexeur à transistor à effet de champ 20 voies DAQM900A
- Multiplexeur à relais électromagnétiques 20 voies DAQM901A
- Multiplexeur à relais à lame souple 16 voies DAQM902A
- Multiplexeur asymétrique 40 voies DAQM908A

Une caractéristique importante d'un multiplexeur utilisé comme voie d'entrée du multimètre numérique (DMM) est qu'une seule voie est connectée à la fois. Par exemple, en utilisant un module multiplexeur et le DMM interne, vous pouvez configurer une mesure de tension sur la voie 1 et une mesure de température sur la voie 2. L'instrument ferme d'abord le relais de la voie 1, réalise la mesure de tension, et ouvre ensuite le relais de la voie 1 avant de passer à la voie 2 (commutation qualifiée de sans chevauchement).

- Actionneur 20 voies DAQM903A
- Matrice 4x8 à 2 fils DAQM904A

### Multiplexeurs un fil (asymétriques)

Sur le multiplexeur DAQM908A, l'ensemble des 40 voies ne commute que le niveau haut (HI) avec un niveau bas (LO) commun pour le module. Le module fournit également une jonction de référence du thermocouple pour effectuer des mesures du thermocouple.

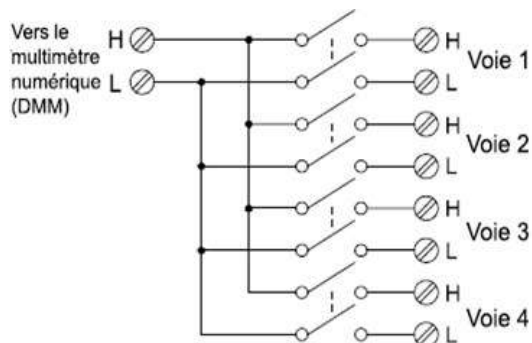


#### REMARQUE

une seule voie peut être fermée à la fois ; la fermeture d'une voie entraîne l'ouverture de la voie précédemment fermée.

## Multiplexeurs deux fils,

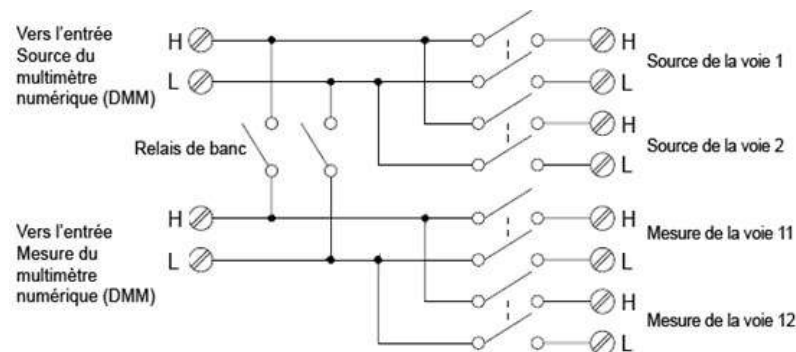
Les multiplexeurs DAQM900A, DAQM901A, et DAQM902A commutent à la fois le niveau haut (HI) et le niveau bas (LO), offrant ainsi des entrées totalement isolées pour le multimètre numérique (DMM) interne ou un instrument externe. Ces modules fournissent également une jonction de référence du thermocouple pour effectuer des mesures du thermocouple.



## Multiplexeurs quatre fils,

Vous pouvez réaliser des mesures de résistance en 4 fils à l'aide des multiplexeurs DAQM900A, DAQM901A, et DAQM902A. Pour cela, les voies sont réparties en deux bancs indépendants en ouvrant le relais de banc.

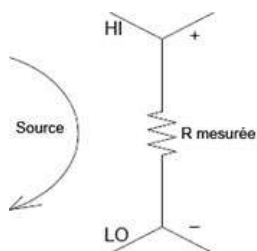
Pour les mesures en 4 fils, l'instrument couple automatiquement la voie  $n$  avec la voie  $n+10$  (DAQM901A) ou  $n+8$  (DAQM902A) pour obtenir les connexions de source et de mesure (sense). Par exemple, il réalise les connexions de source aux bornes HI et LO de la voie 2 et les connexions de mesure (sense) aux bornes HI et LO de la voie 12.



### REMARQUE

Si plusieurs voies sont configurées comme faisant partie de la liste de scrutation, vous ne pouvez en fermer plusieurs à la fois ; la fermeture d'une voie provoquant l'ouverture de celle précédemment fermée.

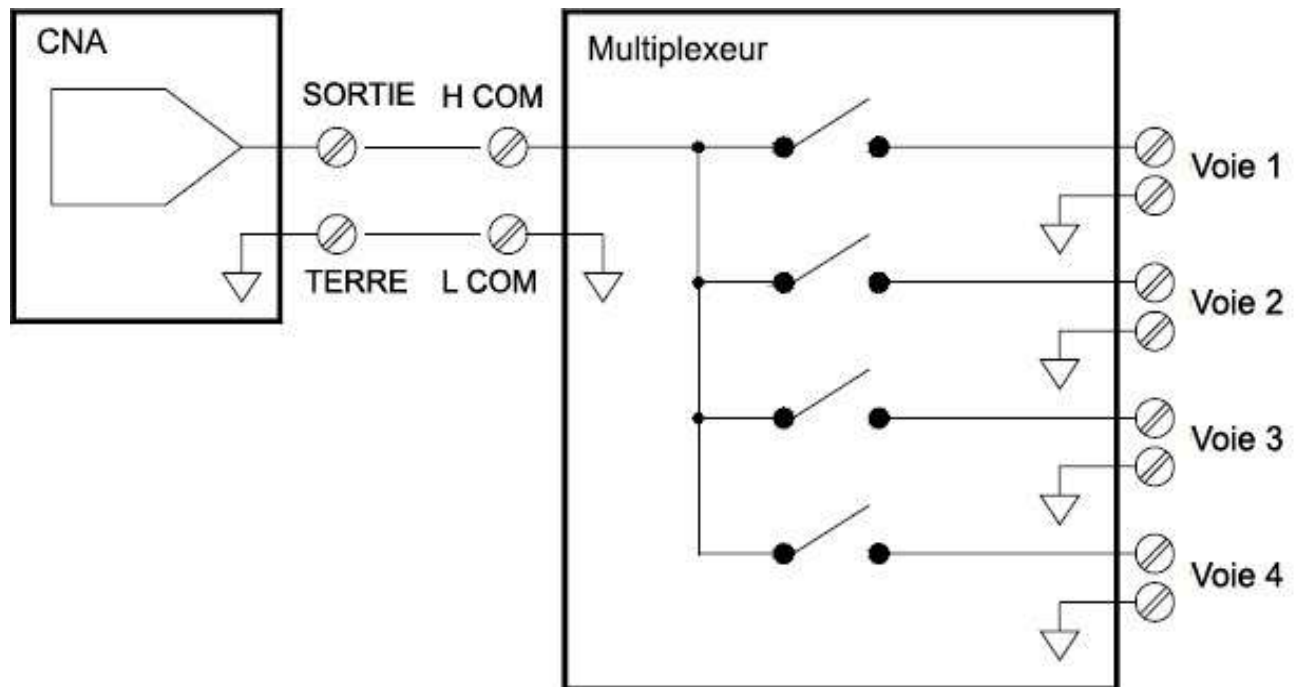
Lors de la réalisation de mesures en 4 fils, le courant de test circule à travers les connexions de source de la borne HI (Niveau haut), puis à travers la résistance mesurée. Pour éliminer la résistance des fils de test, un jeu distinct de connexions de mesure (Sense) est utilisé comme l'illustre la figure ci-dessous :



## Acheminement et multiplexage de signaux

Lorsque les multiplexeurs sont utilisés de manière autonome pour acheminer des signaux (sans scrutation ou connexion au multimètre numérique (DMM) interne), plusieurs voies des multiplexeurs DAQM901A et DAQM902A peuvent être fermées en même temps. Vous devez prendre garde à ce que cela ne crée pas de conditions à risque (par exemple, la connexion de deux tensions d'alimentation secteur ensemble).

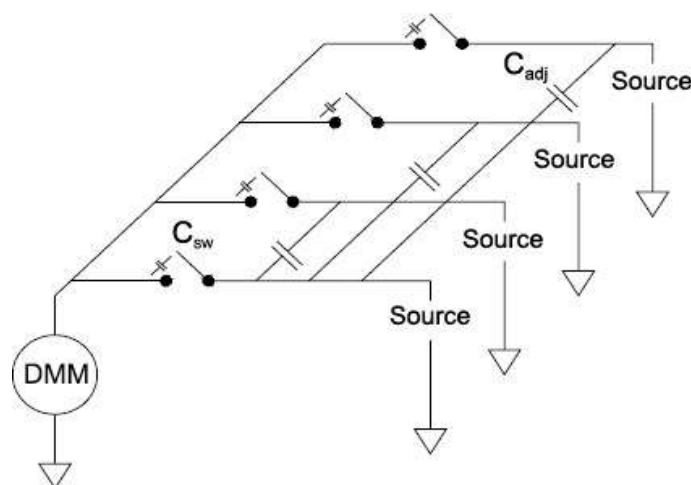
Notez qu'un multiplexeur n'est pas directionnel. Par exemple, vous pouvez utiliser un multiplexeur avec une source (telle qu'un convertisseur numérique-analogique) pour connecter cette seule source en plusieurs points de test comme l'illustre le schéma ci-dessous :



## Sources d'erreurs en multiplexage et commutation

Le bruit peut être induit à l'intérieur d'un commutateur par son circuit de commande, des FEM thermiques à l'intérieur du commutateur ou par induction parmi les trajets de signaux. Il peut également être produit en dehors du réseau et conduit ou induit dans le commutateur. Bien que les problèmes de bruit s'appliquent au système dans son intégralité, ils peuvent devenir particulièrement aigus pour la commutation. Les réseaux de commutateurs contiennent une forte concentration de signaux, qui augmentent les erreurs. La plupart des problèmes avec le bruit électrique sont liés à un blindage et une mise à la terre incorrects.

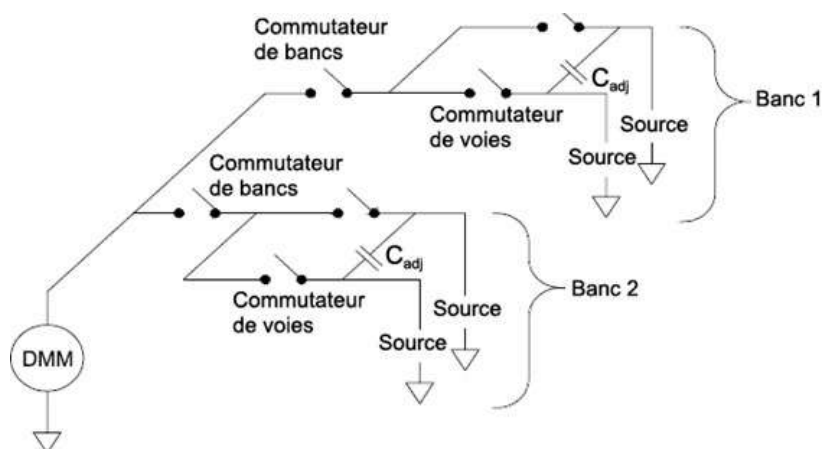
Le bruit peut être couplé de manière capacitive entre des voies physiquement adjacentes dans le système de commutation. Il peut être couplé entre les contacts du commutateur eux-mêmes ( $C_{sw}$ ) ou entre des câblages adjacents ( $C_{adj}$ ).



Le couplage capacitif du bruit est fonction de la surface et de la proximité. Une méthode simple pour réduire le couplage du bruit est de séparer physiquement les commutateurs et les câbles les uns des autres. Ce n'est toutefois pas forcément pratique pour toutes les applications.

Une autre solution consiste à bien séparer les signaux de forte amplitude de ceux à faible amplitude. Groupez ensemble les signaux ayant des fonctions similaires (hautes tensions, basses tensions, analogiques et numériques). Si c'est possible, utilisez deux modules distincts ; un pour les signaux de forte amplitude et l'autre pour les signaux de faible amplitude. Si vous utilisez un seul module pour la commutation de signaux mixtes, laissez une voie non utilisée et reliée à la terre entre les groupes. Reliez également à la terre toutes les voies non utilisées sur le module.

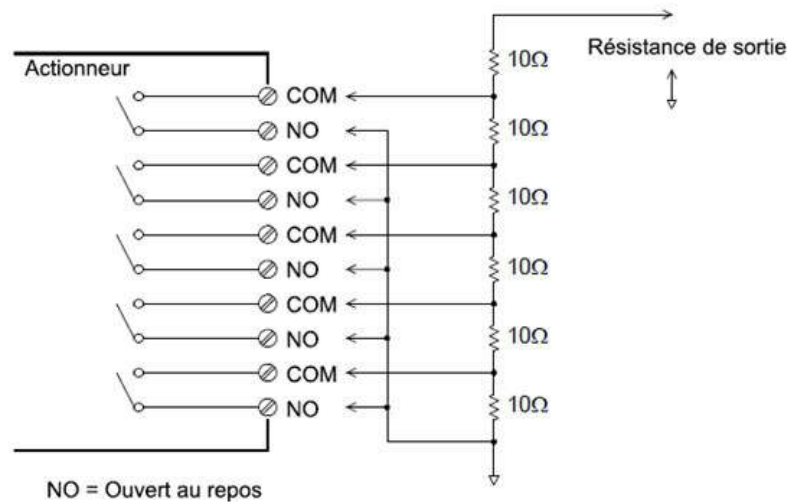
Les multiplexeurs DAQM901A et DAQM902A comportent un relais supplémentaire, appelé commutateur de banc ou d'arborescence, qui contribue à réduire le bruit entre les voies ( $C_{adj}$ ). Les voies des multiplexeurs sont réparties en deux bancs. Le commutateur de banc isole un banc de voies de l'autre, en supprimant effectivement toute capacité parallèle adjacente du banc isolé. Lors d'une scrutation, l'instrument commande automatiquement les commutateurs de banc.



| Module   | Banc 1       | Bancs 2       |
|----------|--------------|---------------|
| DAQM900A | Voies 1 à 10 | Voies 11 à 20 |
| DAQM901A | Voies 1 à 10 | Voies 11 à 20 |
| DAQM902A | Voies 1 à 8  | Voies 9 à 16  |
| DAQM908A | Voies 1 à 20 | Voies 21 à 40 |

## Actionneurs et commutation à usage général

L'actionneur DAQM903A contient 20 inverseurs indépendants isolés forme C (appelés aussi unipolaires, deux positions). Ce module offre une commutation en tout ou rien utilisable pour commander des dispositifs de puissance ou pour des applications de commutation personnalisées. Par exemple, vous pouvez utiliser un actionneur pour contrôler une échelle de résistances comme l'illustre le schéma ci-dessous :

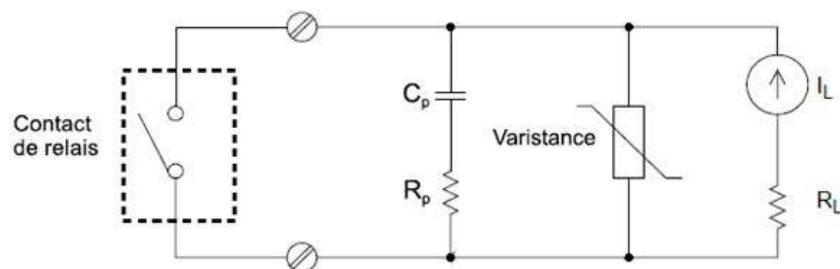


Dans le schéma ci-dessus, la résistance est de  $60\Omega$  lorsque toutes les voies de l'actionneur sont ouvertes (non reliées au COMMUN). Notez que lorsque les voies de l'actionneur sont ouvertes, comme le monte le schéma, les contacts repos normalement fermés (non représentés) sont connectés au COMMUN. Des valeurs de résistance comprises entre  $10\Omega$  et  $50\Omega$  sont sélectionnées en fermant la (les) voie(s) appropriée(s) sur le module.

### Circuits de protection

À chaque fois que des contacts de relais s'ouvrent ou se ferment, une décharge ou un arc électrique peut se produire entre les contacts. Cela peut provoquer un rayonnement de bruit en haute fréquence, des pointes de tension et de courant, et détériorer les contacts du relais.

Une zone libre de composants est située sur le modèle DAQM903A pour implanter des circuits personnalisés, comme des filtres simples, des circuits de protection et des diviseurs de tension. Cette zone comporte l'espace nécessaire pour insérer vos propres composants mais elle ne comporte pas de trace de circuit imprimé. Vous pouvez implanter des réseaux de composants destinés à protéger les contacts des relais lors de la commutation de tensions alternatives sur des charges réactives. Bien que de nombreux types de réseaux de protection de contacts puissent être utilisés, seuls les réseaux RC et les varistances sont décrits dans cette section.



## Réseaux de protection RC

Lors de la conception de réseaux de protection RC, la valeur de la résistance de protection  $R_p$  est un compromis entre deux valeurs. La valeur minimale de  $R_p$  est déterminée par le courant maximal admissible par les contacts du relais ( $I_{max}$ ). Pour le modèle DAQM903A, ce courant ( $I_{max}$ ) est de 1 CC ou CA efficace. Par conséquent, la valeur minimale de  $R_p$  est égale à  $V/I_o$ , où  $V$  est la valeur crête de la tension d'alimentation.

$$R_p = \frac{V}{I_{max}} = \frac{V}{2}$$

La valeur maximale de  $R_p$  est habituellement rendue égale à la résistance de charge  $R_L$ . Par conséquent, la valeur de  $R_p$  peut être sélectionnée comme suit :

$$\frac{V}{I_{max}} < R_p < R_L$$

Notez que la valeur réelle du courant ( $I_o$ ) dans le circuit est déterminée par l'équation :

$$I_o = \frac{V}{R_L}$$

où  $V$  est la valeur crête de la tension d'alimentation et  $R_L$  est la résistance de la charge. La valeur de  $I_o$  sera utilisée pour déterminer la valeur du condensateur de protection ( $C_p$ ).

Pour déterminer la valeur du condensateur du réseau de protection ( $C_p$ ), vous devez prendre en considération plusieurs choses. tout d'abord, la capacité totale du circuit ( $C_{tot}$ ) doit être telle que la tension crête entre les contacts ouverts du relais ne doit pas dépasser 300 V eff. L'équation destinée à déterminer la capacité minimale admissible pour le circuit est :

$$C_{tot} \geq (I_o/300)^2 \times L$$

où  $L$  est l'inductance de la charge et  $I_o$  est la valeur du courant calculée précédemment.

La capacité totale du circuit ( $C$ ) est réellement constituée par la capacité du câblage plus la valeur du condensateur du réseau de protection ( $C_p$ ). Par conséquent, la valeur minimale de  $C_p$  devra être obtenue à partir de la capacité totale du circuit ( $C$ ). Notez que la valeur réelle utilisée pour  $C_p$  devra être notablement supérieure à celle calculée pour  $C$ .

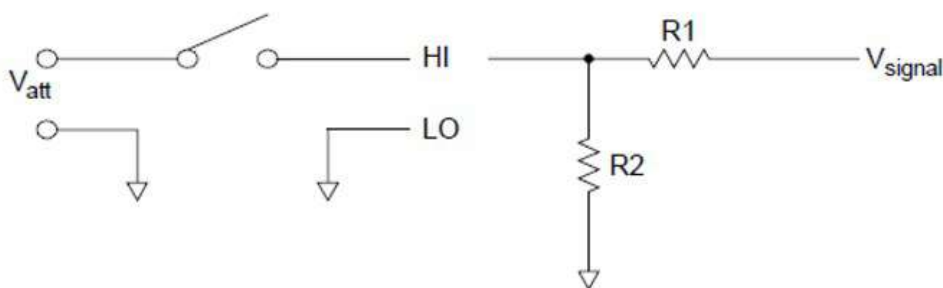


## Utilisation de varistances

Utilisez une varistance pour ajouter une limite de tension absolue entre les contacts des relais. Il existe des varistances avec une large gamme de tension et de limitation d'énergie. Une fois que la tension dans le circuit a atteint la tension nominale de la varistance, la résistance de celle-ci diminue rapidement. Une varistance peut être ajoutée en complément d'un réseau RC, et est particulièrement utile lorsque la valeur requise pour le condensateur ( $C_p$ ) est trop élevée.

## Utilisation d'atténuateurs

Une place a été réservée sur la carte du circuit du module DAQM903A afin d'installer des atténuateurs simples ou des réseaux de filtrage. Un atténuateur se compose de deux résistances se comportant comme un diviseur de tension. Un atténuateur simple est illustré ci-dessous :



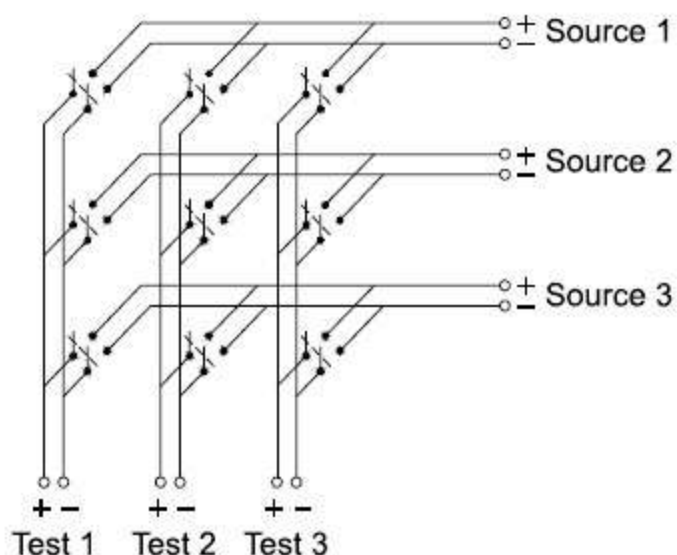
Pour sélectionner les composants de l'atténuateur, utilisez l'équation suivante :

$$V_{att} = V_{signal} \times \frac{R_2}{R_1 + R_2}$$

Classiquement, le composant en dérivation sera utilisé par exemple avec des capteurs de 4 à 20 mA. Une résistance de 50  $\Omega$ ,  $\pm 1\%$ , 0,5 watt peut être installée à la place R2. La chute de tension résultante (courant du capteur à travers la résistance) peut être mesurée par le multimètre numérique (DMM) interne. Ainsi, la résistance de 50  $\Omega$ W convertit le courant de 4 à 20 mA en une tension de 0,2 à 1 volt.

## Matrice de commutation

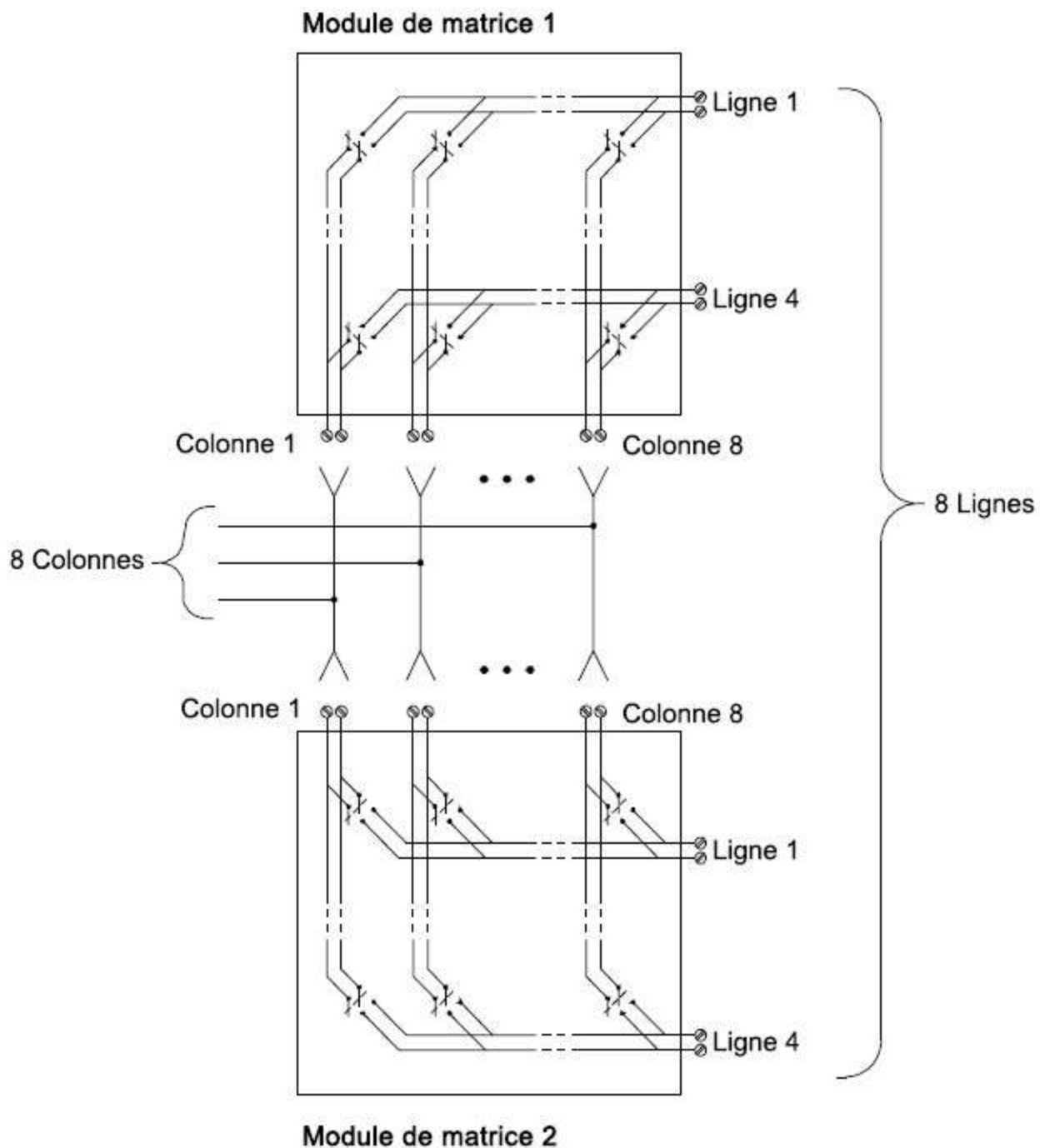
Une matrice de commutation connecte plusieurs entrées à plusieurs sorties, et offre par conséquent plus de souplesse de commutation qu'un multiplexeur. Utilisez une matrice pour commuter des signaux à basse fréquence (inférieure à 10 MHz) seulement. Une matrice se compose de lignes et de colonnes. Par exemple, une matrice simple 3x3 peut être utilisée pour connecter trois sources à trois points de test comme l'illustre la figure ci-dessous :



N'importe laquelle des sources de signaux peut être connectée à n'importe laquelle des entrées de test. Prenez garde avec une matrice, car il est possible de connecter plusieurs sources en même temps. Il est important de vérifier que des conditions dangereuses ou indésirables ne sont pas créées par ces connexions.

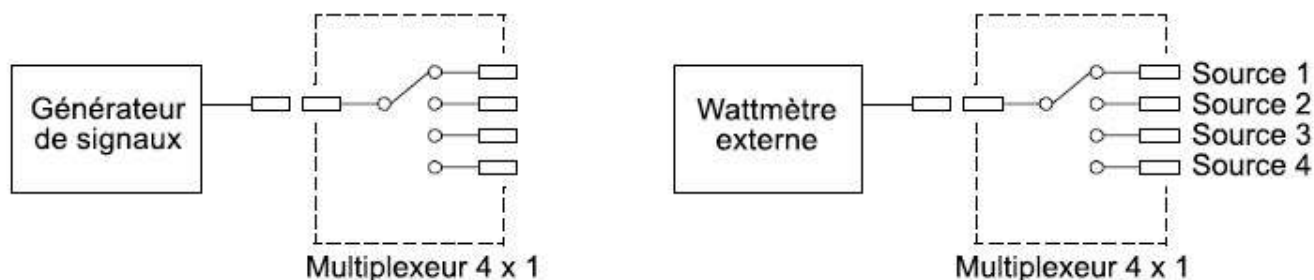
## Combinaison de matrices

Vous pouvez combiner deux matrices et plus pour obtenir un système de commutation plus complexe. Par exemple, le modèle DAQM904A est une matrice de 4 lignes par 8 colonnes. Vous pouvez combiner deux de ces modules afin d'obtenir une matrice de 4 lignes par 16 colonnes ou de 8 lignes par 8 colonnes. Une matrice 8x8 est illustrée ci-dessous :

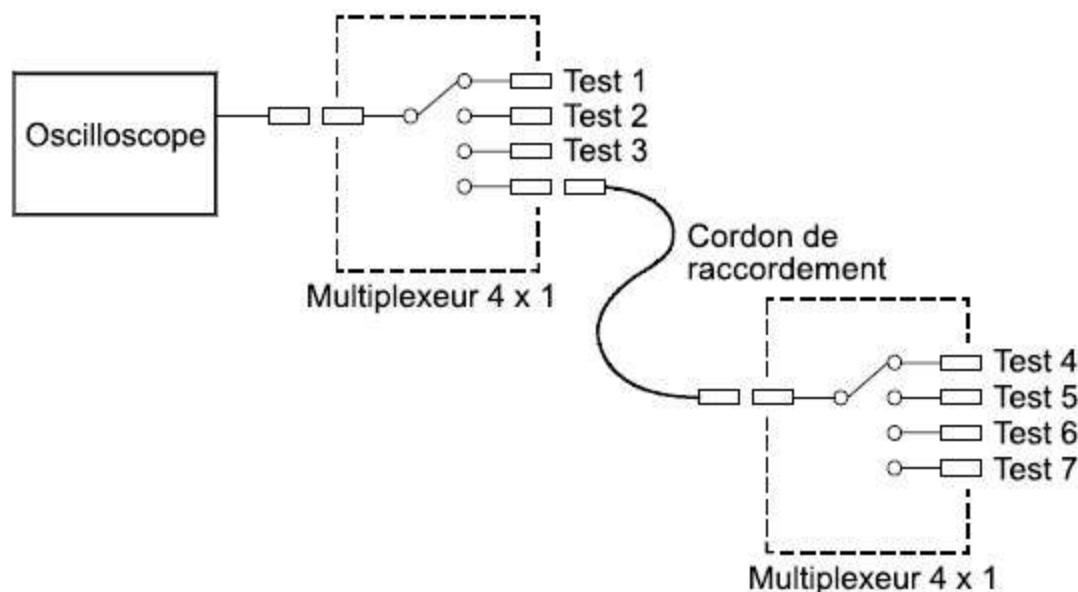


## Multiplexage de signaux RF

Un type spécial de multiplexeur est le multiplexeur RF. Il utilise des composants spéciaux pour maintenir une impédance caractéristique de 50  $\Omega$  tout le long de la ligne de signal commutée. Dans un système de test, ces commutateurs sont souvent utilisés pour acheminer des signaux de test entre une source de signal et le composant testé. Les commutateurs sont bidirectionnels. Le schéma ci-dessous illustre deux exemples d'utilisation d'un multiplexeur 4 voies vers 1 dans un système de test.



En utilisant des cordons de raccordement, vous pouvez étendre le multiplexeur RF afin de disposer d'entrée et de sorties supplémentaires. Par exemple, vous pouvez associer deux multiplexeurs 4 vers 1 pour créer un multiplexeur 7 vers 1 comme l'illustre le schéma ci-dessous :



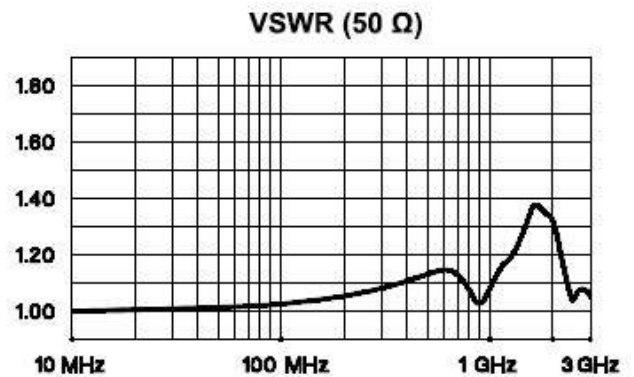
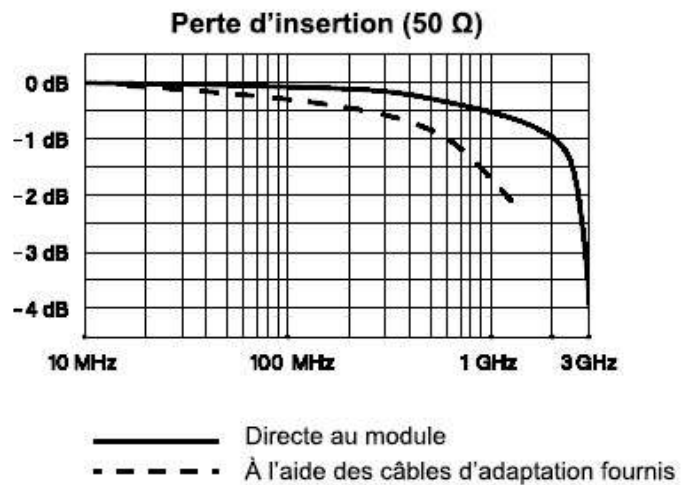
Sur les multiplexeurs RF DAQM905A (50  $\Omega$ ), vous ne pouvez fermer qu'une seule voie par banc à la fois ; la fermeture d'une voie d'un banc ouvrira la voie fermée précédemment. Ces modules ne répondent qu'à la commande CLOSE (FERMER) (la commande OPEN (OUVRIR) n'a aucun effet). Pour ouvrir une voie, envoyez la commande CLOSE (FERMER) à une autre voie du même banc. Notez que le module DAQM905A n'assure pas automatiquement la terminaison des voies ouvertes.

## Sources d'erreurs en commutation RF

La désadaptation d'impédance peut provoquer diverses erreurs dans un système de multiplexage RF. Ces erreurs peuvent provoquer de la distorsion de signaux et des conditions de surtension ou de tension insuffisante.

Pour minimiser la désadaptation d'impédance RF :

- Utilisez les câbles et les connecteurs correspondant à l'impédance caractéristique du circuit (50  $\Omega$ ).
- Veillez à ce que tous les câbles et trajets de signaux soient correctement terminés avec leur impédance caractéristique. Des sections de lignes ouvertes peuvent ressembler pratiquement à des courts-circuits aux fréquences RF.

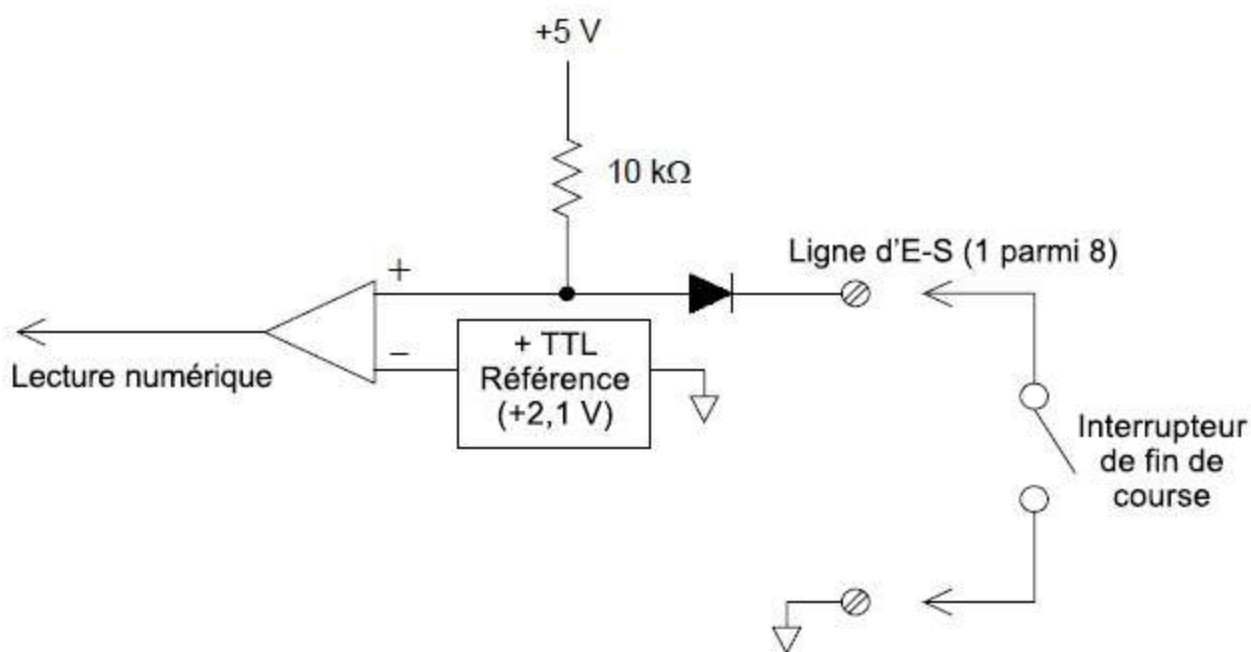


## Module multifonction

### Entrée numérique

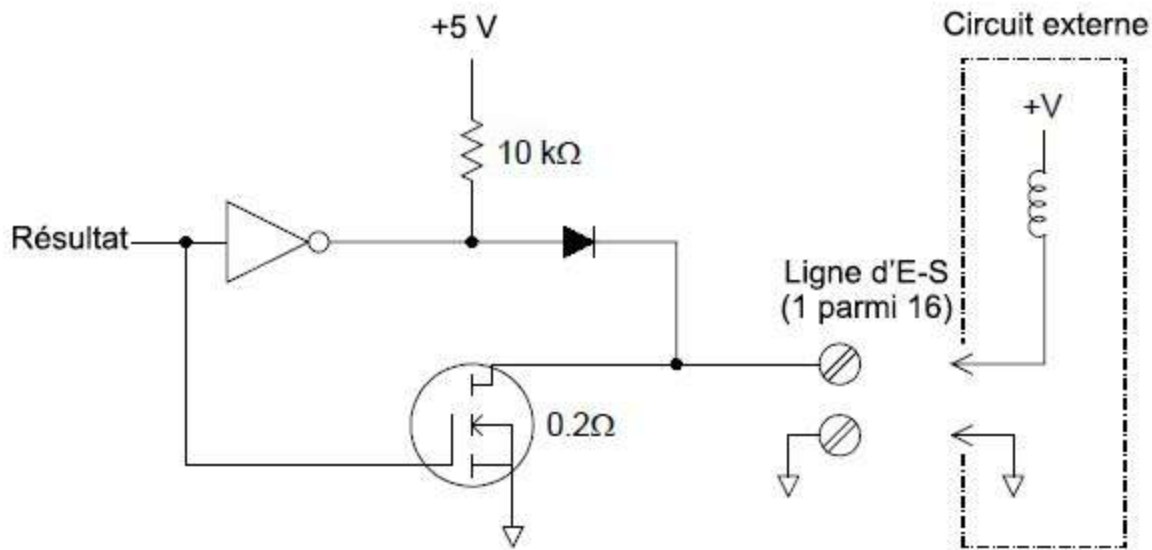
Le module multifonction DAQM907A comporte deux ports non isolés d'entrées/sorties sur 8 bits que vous pouvez utiliser pour lire des séquences numériques.

- Vous pouvez lire l'état actif des bits sur le port ou vous pouvez configurer une scrutation afin qu'elle comprenne une lecture numérique.
- Une alarme peut être émise lorsqu'une séquence de bits spécifique ou une modification de séquence est détectée sur une voie d'entrée numérique. Pour qu'une voie puisse provoquer une alarme, il n'est pas nécessaire qu'elle figure dans la liste de scrutation.
- Le circuit interne de rappel à +5 V vous permet d'utiliser l'entrée numérique pour détecter des fermeture de contacts comme celles de micro-interrupteurs ou d'interrupteurs de fin de course. Une entrée ouverte est portée à +5 V et est lue comme un « 1 ». Une entrée court-circuitée à la masse est lue comme un « 0 ». Un exemple de détection de fermeture de contacts est illustré ci-dessous :



## Sortie numérique

Le module DAQM907A comporte deux ports non isolés d'entrées/sorties sur 8 bits que vous pouvez utiliser pour délivrer des séquences numériques. Vous pouvez associer les deux ports afin de délivrer des mots de 16 bits. Un schéma simplifié d'un simple bit de sortie est illustré ci-dessous :



- Chaque bit de sortie est capable de piloter directement jusqu'à 10 charges TTL (moins de 1 mA). Le tampon de chaque port est utilisé pour piloter une sortie de niveau élevé depuis l'alimentation interne +5 V à travers la diode. Le pilote est prévu à +2.4 V minimum à 1 mA.
- Chaque bit de sortie est aussi un absorbeur actif, capable d'absorber un courant jusqu'à 400 mA depuis l'alimentation externe. Le transistor à effet de champ est utilisé pour absorber des courants et a une résistance nominale à l'état passant de 0,2 Ω.
- Pour une logique non TTL, vous devez disposer une résistance de rappel externe. Le calcul de cette résistance est exposé à de la section suivante.
- En cas d'utilisation avec une alimentation externe et une résistance de rappel, cette alimentation doit délivrer une tension supérieure à +5 VCC et inférieure à +42 VCC.

## Utilisation d' résistance de rappel externe

En général, une résistance de rappel externe est nécessaire seulement lorsque vous souhaitez que la valeur du niveau « haut » de sortie soit supérieure aux niveaux TTL. Par exemple, pour utiliser une alimentation externe de +12 V, la valeur de la résistance de rappel externe sera calculée de la manière suivante :

$$V_{cc} = 12 \text{ VDC}$$

$$I_{max} = I_{out\ low} \times \text{safty factor} = 1 \text{ mA} \times 0.5 + 0.5 \text{ mA}$$

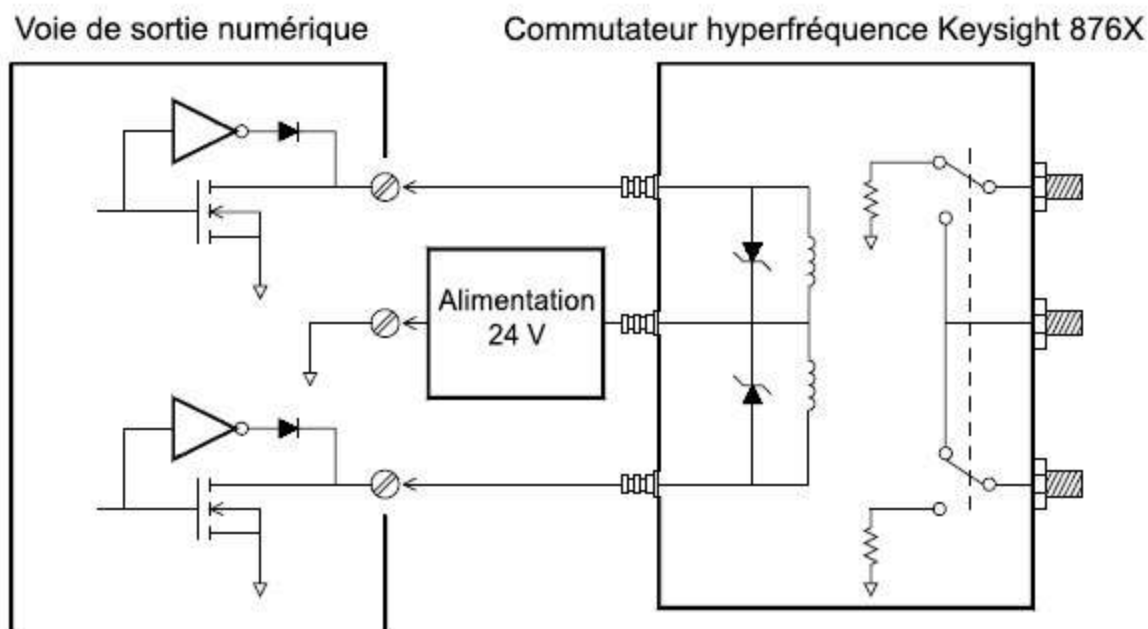
$$R = \frac{V_{cc}}{I_{max}} = \frac{12}{0.0005} = 24 \text{ k}\Omega$$

La valeur du niveau logique « haut » avec la résistance de rappel externe de 24 kΩ est calculée de la manière suivante :

$$V_{high} = V_{cc} \times \frac{R_{external}}{R_{external} + R_{external}} = 12 \times \frac{24 \text{ k}\Omega}{24 \text{ k}\Omega + 10 \text{ k}\Omega} = 8.47 \text{ VDC}$$

## Commande de commutateurs externes

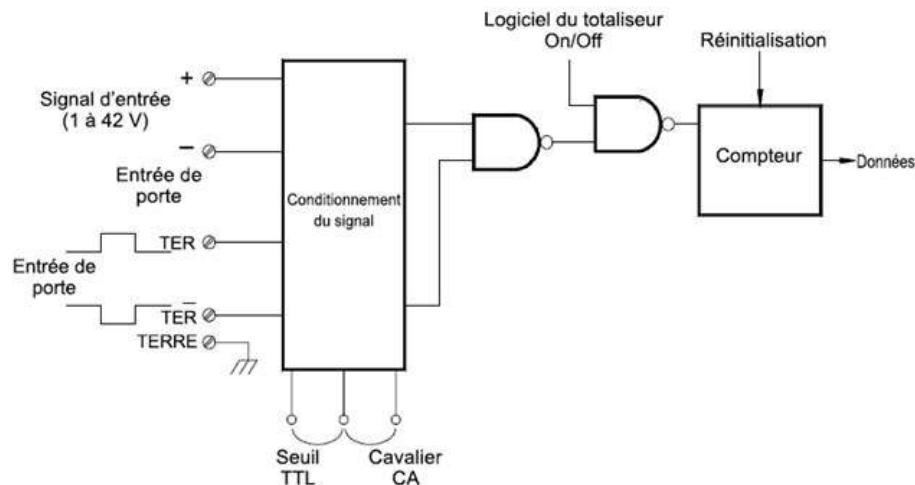
Vous pouvez utiliser deux voies de sortie numérique pour commander un commutateur externe. Par exemple, vous pouvez des commutateurs hyperfréquence Keysight série 876X à l'aide d'une alimentation externe et de deux voies de sortie numérique. L'état du multiplexeur 2 vers 1 est modifié par la mise à l'état bas (0) du bit de sortie approprié.





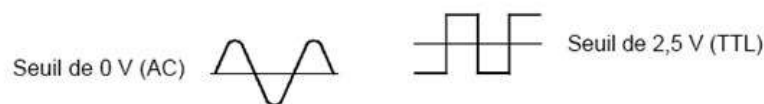
## Totalisateur

Le module DAQM907A comporte un totaliseur 26 bits pouvant compter des impulsions à la fréquence de 100 kHz. Vous pouvez lire manuellement le comptage du totaliseur ou vous pouvez configurer une scrutation pour lire ce comptage.



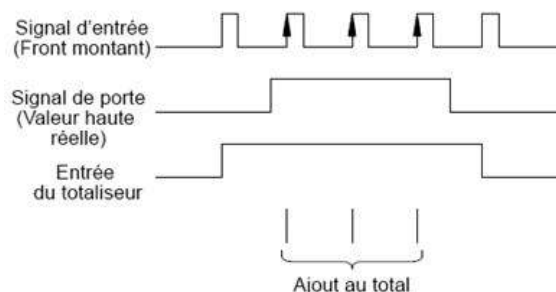
Vous pouvez configurer le totalisateur afin qu'il compte les fronts montants ou les fronts descendants du signal d'entrée.

À l'aide du cavalier étiqueté « Totalize Threshold » (Seuil de totalisation) du module, vous pouvez contrôler le seuil à partir duquel un front est détecté. Placez le cavalier sur la position « AC » pour détecter les variations jusqu'à 0 volt. Placez le cavalier sur la position « TTL » (réglage d'usine) pour détecter les variations jusqu'aux niveaux des seuils TTL.



Le comptage maximum est de 67 108 863 (2<sup>26</sup>-1). Le comptage retourne à « 0 » après avoir atteint la valeur maximale autorisée.

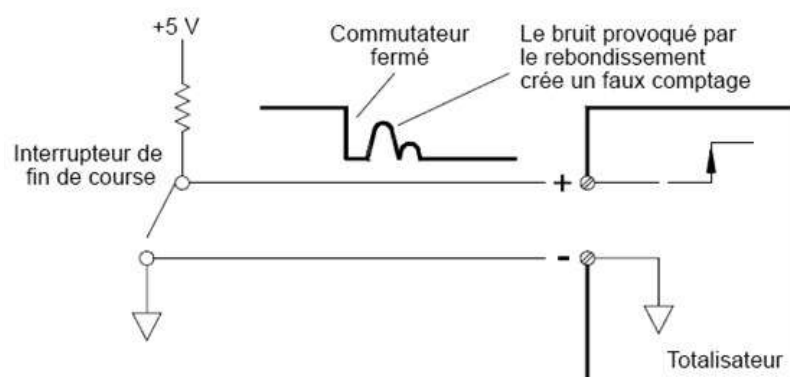
Vous pouvez contrôler le moment où le totalisateur enregistre réellement les comptages en appliquant un signal de porte ( $\bar{G}$  ou  $\bar{G}$  du module). Un signal TTL de niveau haut appliqué sur la borne « T<sub>ER</sub> » active le comptage et un signal de niveau bas le désactive. Un signal TTL de niveau bas appliqué à la borne  $\bar{G}$  active le comptage et un signal de niveau haut le désactive. Le totalisateur ne compte que lorsque les deux bornes sont activées. Vous pouvez utiliser soit la borne T<sub>ER</sub>, soit la  $\bar{G}$ , soit les deux. Lorsque qu'aucun signal de porte n'est appliqué, les bornes sont activées en permanence, créant une condition réelle de « porte toujours ouverte ».



## Erreurs du totalisateur

Le bruit à l'entrée du totalisateur peut constituer un problème, en particulier avec des signaux ayant un temps de montée long. Ce bruit peut provoquer une fausse indication de franchissement du seuil. Voir **Câblage et connexions du système** pour plus d'informations.

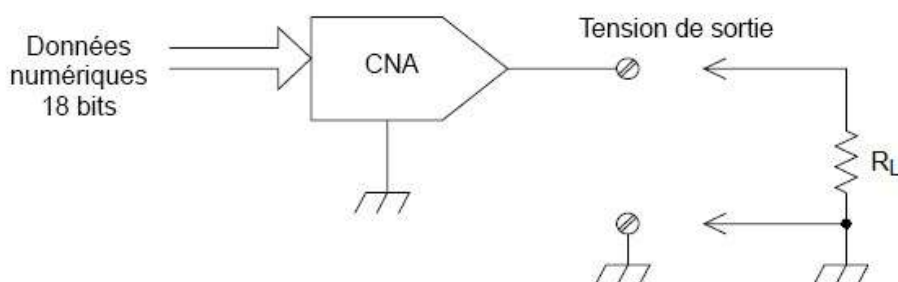
Le rebondissement des contacts sur les commutateurs externes peut provoquer de faux comptages. Tous les commutateurs mécaniques rebondissent lorsqu'ils s'ouvrent et se ferment. Utilisez un condensateur externe pour filtrer le rebondissement des contacts.



## Sorties analogiques (Convertisseur numérique-analogique)

Le module DAQM907A comporte deux mesures et sorties analogiques pouvant délivrer des tensions étalonnées ou des courants avec une résolution de 18 bits.

Chaque voie de CNA (Convertisseur numérique-analogique) peut servir de source de tension ou de courant programmable pour commander l'entrée analogique d'autres dispositifs.



Vous pouvez régler la tension de sortie à toute valeur comprise entre +12 VCC et -12 VCC par paliers de 0,1 mV. Chaque convertisseur numérique-analogique est référencé à la terre ; il ne peut être flottant.

Chaque voie de convertisseur numérique-analogique peut délivrer un courant maximal de 15 mA.

### REMARQUE

**Vous devez les limiter à un courant de sortie total de 40 mA pour chaque logement (deux voies de convertisseur au total).**

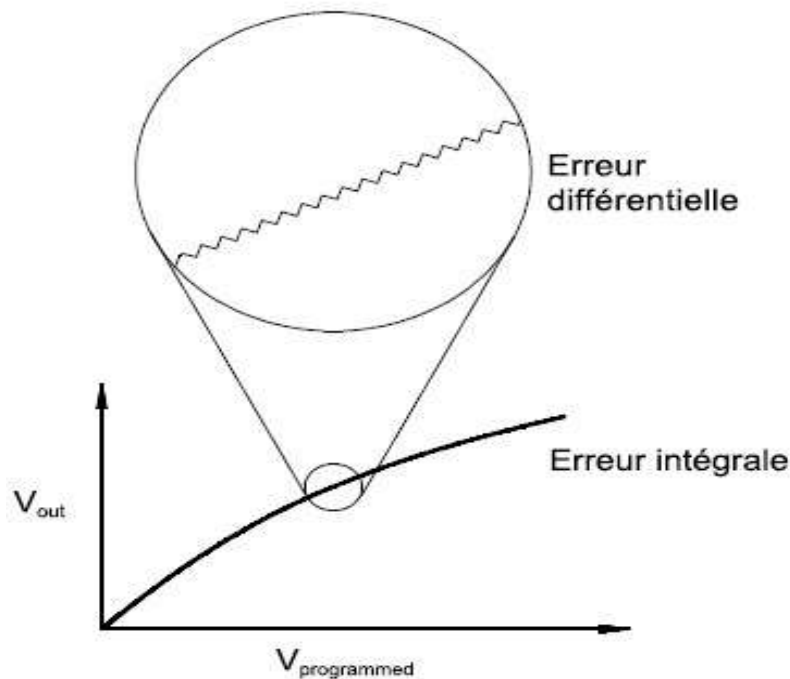
Pour conserver la précision nominale de la sortie, la résistance de charge ( $R_L$  dans le schéma ci-dessus) doit être supérieure à 1 k $\Omega$ .

## Erreurs de conversion numérique-analogique

La sortie d'un convertisseur numérique-analogique varie avec la température. Si possible, vous devez utiliser l'instrument à une température stable et aussi proche que possible de celle d'étalonnage du convertisseur pour une meilleure précision, ou procéder à un étalonnage automatique pour réétalonner le convertisseur si la température a fortement changé par rapport à la température d'étalonnage.

La sortie d'un CNA présente aussi deux autres types d'erreurs : l'erreur différentielle et l'erreur intégrale.

| Types d'erreurs       | Description                                                                                                                                                                                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Erreur différentielle | Désigne la plus petite variation possible de tension. La sortie du CNA n'est pas linéaire, mais présente des paliers progressifs au fur et à mesure que des tensions de plus en plus élevées (ou faibles) sont programmées. L'étape est de $100\ \mu\text{V}$ . |
| Erreur intégrale      | Désigne la différence entre la tension programmée et la tension de sortie réelle du CNA.                                                                                                                                                                        |



## Durée de vie des relais et maintenance préventive

Le système de maintenance des relais du modèle DAQ970A/DAQ973A compte automatiquement le nombre de commutations de chaque relais et stocke ce nombre en mémoire non volatile pour chaque module multiplexeur. Utilisez cette fonctionnalité pour assurer le suivi des pannes de relais et pour prévoir le moment où une opération de maintenance sera nécessaire.

Les relais sont des composants électromécaniques sujets à usure. La durée de vie d'un relais, ou le nombre de commutations réelles avant panne, dépend de la manière avec laquelle le relais est utilisé (charge appliquée, fréquence de commutation et environnement).

Vous pouvez utiliser les graphiques de cette section pour estimer la durée de vie des relais selon votre application. D'autres informations documentaires sont également diffusées pour vous faire mieux comprendre les mécanismes d'usure des relais. En général, la durée de vie des relais dépend fortement des signaux commutés et des types de mesures effectuées.

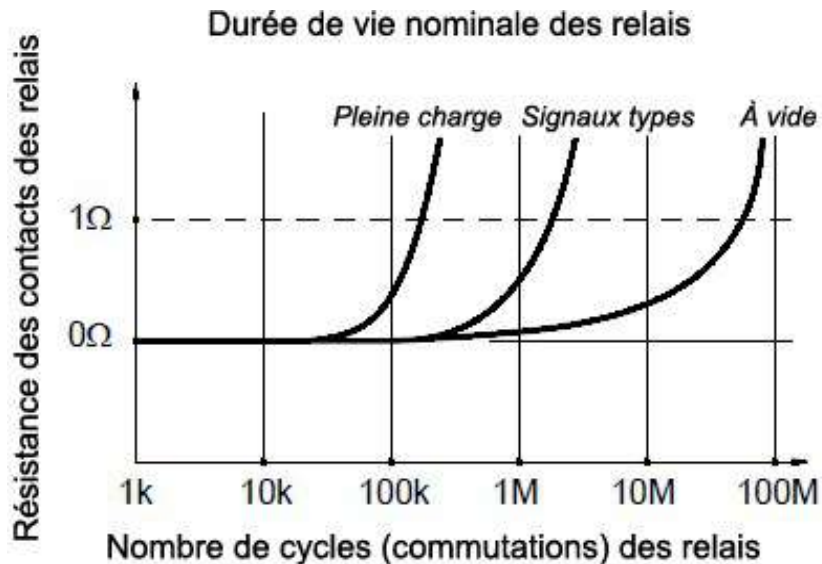
- La commutation de signaux à niveaux nominaux se traduira par une durée de vie de 1 000 000 à 10 000 000 cycles.
- La commutation de fortes puissances (> 25 % des valeurs nominales) ou de hautes tensions (> 100 V) se traduira par une durée de vie de 100 000 à 1 000 000 cycles.
- La commutation de basses tensions (< 25 % des valeurs nominales) et de faibles courants (< 10 mA) se traduira par une durée de vie de 10 000 000 cycles.
- Les applications de commutation RF présentent rarement une durée de vie dépassant 1 000 000 de cycles en raison des exigences plus rigoureuses concernant la résistance des Constantes (en principe moins de 0,2  $\Omega$ ).

Le tableau suivant indique le temps nécessaire pour atteindre le nombre de cycles spécifié pour plusieurs vitesses de commutation.

| Vitesse de commutation<br>constante | Cycles de commutation |           |            |
|-------------------------------------|-----------------------|-----------|------------|
|                                     | 100 000               | 1 000 000 | 10 000 000 |
| 1/heure                             | 12 ans                | S/O       | S/O        |
| 1/minute                            | 10 semaines           | 2 ans     | S/O        |
| 1/Seconde                           | 1 jour                | 12 jours  | 4 mois     |
| 10/Seconde                          | 3 heures              | 1 jour    | 12 jours   |

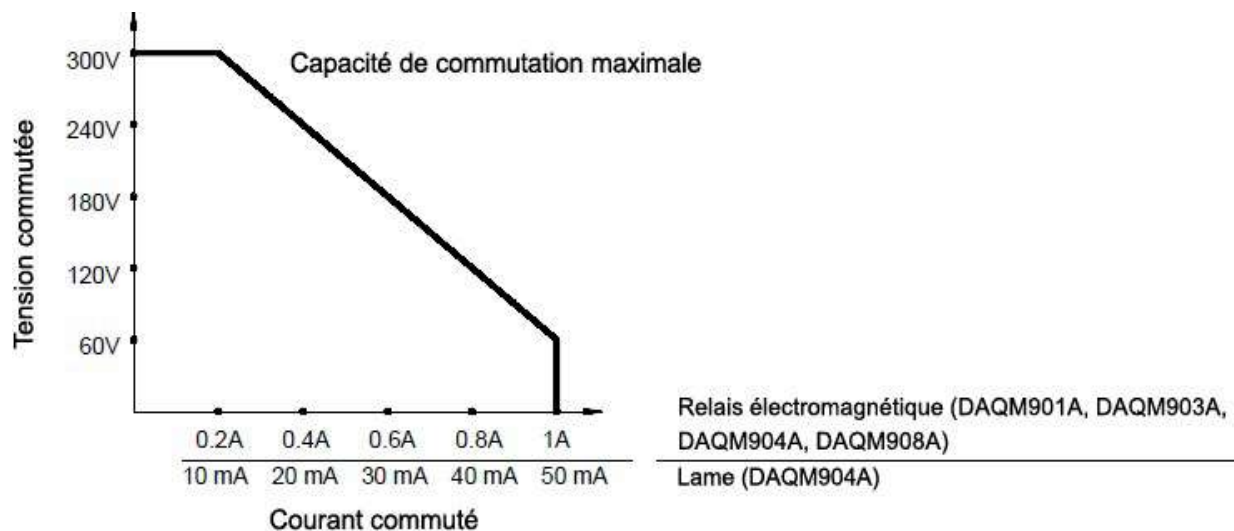
## Durée de vie des relais

Lorsqu'un relais est utilisé, les contacts commencent à s'user et la résistance des contacts fermés augmente. La résistance initiale des contacts d'un relais neuf est normalement d'environ 50 mΩ (plus la résistance des fils). Lorsque la résistance des contacts dépasse 20 à 50 fois cette valeur initiale, la résistance devient très incertaine, et le relais devra probablement être remplacé. Pour la plupart des applications, un relais avec une résistance de contacts supérieure à 1 Ω doit être remplacé. Le graphique ci-dessous illustre les caractéristiques de résistance des contacts des relais utilisés dans les modules de commutation du modèle DAQ970A/DAQ973A.



## Charge des relais

Pour la plupart des applications, la charge commutée par le relais est le facteur le plus déterminant pour sa durée de vie. Comme le montre le graphique suivant, la durée de vie du relais est maximale en commutant des puissances faibles. Elle diminue lorsque la puissance commutée augmente.



## Fréquence de commutation

Les contacts d'un relais s'échauffent lorsqu'ils commutent des puissances importantes. La chaleur est dissipée dans les fils et dans le corps du relais. Lorsque vous augmentez la fréquence de commutation en approchant de son maximum, la chaleur ne peut plus se dissiper avant le cycle suivant. La température des contacts augmente et la durée de vie du relais diminue.

## Stratégie de remplacement

Il existe essentiellement deux stratégies applicables pour la maintenance préventive des relais des modules de commutation. Celle que vous choisirez dépend de votre application, des conséquences d'une panne de relais dans votre système et du nombre de cycles des relais pendant une session de mesure.

La première stratégie consiste à remplacer chaque relais au coup par coup lorsqu'il tombe en panne ou devient douteux. C'est intéressant si vous commutez des charges importantes avec quelques relais seulement du module. L'inconvénient de cette stratégie est de devoir remplacer continuellement des relais à tout moment lorsqu'ils approchent de la fin de leur durée de vie.

La seconde stratégie consiste à remplacer tous les relais sur le module ou plus simplement à acheter un nouveau module lorsque les relais approchent de la fin de leur durée de vie. Cette stratégie est mieux adaptée aux applications où tous les relais du module commutent des charges semblables. La panne de plusieurs relais sur un court laps de temps peut laisser présager des pannes imminentes sur les autres relais commutant des charges semblables. Cette stratégie diminue le risque de panne pendant l'utilisation réelle au prix du remplacement de certains relais qui auraient pu encore fonctionner un certain temps.

### REMARQUE

Pour la fréquence de commutation et la stratégie de remplacement comme décrit ci-dessus, vous pouvez utiliser le système de maintenance des relais du modèle DAQ970A/DAQ973A pour suivre et même prévoir les pannes des relais.

---

Ces informations peuvent faire l'objet  
de modifications sans préavis.

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DAQ97-90004

[www.keysight.com](http://www.keysight.com)

Guía del usuario

# Keysight DAQ970A/DAQ973A Sistema de adquisición de datos





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## Revisión de software

Periódicamente, Keysight lanza actualizaciones de software para resolver defectos conocidos e incorporar mejoras a los productos. Para buscar actualizaciones de software, así como la documentación de su producto, vaya a la página del producto en:

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

Una parte del software en este producto se distribuye según los términos de la Licencia Pública General Versión 2 (GPLv2). El texto de la licencia y el código fuente se puede encontrar en [www.keysight.com/find/GPLV2](http://www.keysight.com/find/GPLV2).

Este producto utiliza Microsoft Windows CE. Keysight recomienda enfáticamente que todos los equipos basados en Windows conectado a los instrumentos Windows CE utilicen un software anti-virus actualizado. Para obtener más información, vaya a la página del producto respectivo en:

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

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## Equipos electrónicos y eléctricos en los desperdicios (WEEE)

Este instrumento cumple con el requisito de rotulado de la Directiva WEEE. La etiqueta adherida al producto (ve más abajo) indica que usted no debe desechar este producto eléctrico/electrónico junto con los desperdicios domésticos.

Categoría del producto: En cuanto a los tipos de equipos del Anexo 1 de la directiva WEEE europea, este instrumento se clasifica como “Instrumento de control y supervisión”. No desechar con desperdicios del hogar.

Para devolver productos no deseado, póngase en contacto con su oficina Keysight o visite [Http://about.keysight.com/en/companyinfo/environment/takeback.shtml](http://about.keysight.com/en/companyinfo/environment/takeback.shtml) para obtener más información.



## Declaración de conformidad

Las declaraciones de conformidad de este producto y otros productos Keysight se pueden descargar de Internet. Vaya a <https://regulations.about.keysight.com/DoC/default.htm>. Puede buscar por número de modelo del producto para ver la declaración de conformidad más reciente.

# Información reglamentaria y de seguridad

## Consideraciones de seguridad

Las siguientes precauciones generales de seguridad deben respetarse en todas las fases de operación, servicio y reparación de este instrumento. Si no se respetan estas precauciones o las advertencias específicas mencionadas en este manual, se violan las normas de seguridad de diseño, fabricación y uso intencional del instrumento, y podría causar un choque eléctrico o lesiones personales. Keysight Technologies no asumirá ninguna responsabilidad si el cliente no cumple con estos requisitos.

### ADVERTENCIA

#### ANTES DE CONECTAR LA ELECTRICIDAD

Verifique que se tomen todas las precauciones de seguridad. Realice todas las conexiones antes de conectar la electricidad.

#### CONECTE A TIERRA EL INSTRUMENTO

Este producto está provisto de terminales de conexión tierra de protección. Para reducir el riesgo de descarga eléctrica, el instrumento debe conectarse a la red eléctrica de CA a través de un cable de alimentación con conexión a tierra, y el conjunto de cables de conexión a tierra debe conectarse a una toma de tierra eléctrica (toma de tierra de seguridad) con conductor de protección (de puesta a tierra). Cualquier interrupción en el terminal de conexión de puesta a tierra, originará un peligro potencial de electrochoque que podría resultar en lesiones.

#### ANTES DE ENCENDER O APAGAR

Antes de encender el instrumento, asegúrese de que todas las fuentes de señal conectadas a los módulos estén apagadas. Encienda las fuentes de señal después de encender el instrumento. Apague las fuentes de señal antes de que se apague el instrumento.

#### NO quite LA CUBIERTA DEL INSTRUMENTO

Solo el personal de reparación calificado y consciente de los peligros debe encargarse de extraer las cubiertas del instrumento. Desconecte siempre el cable de alimentación y cualquier circuito externo antes de quitar la cubierta del instrumento.

#### CUBIERTA DE LOS MÓDULOS

Siempre reemplace las cubiertas del módulo después del cableado del terminal y antes de insertarlo en la unidad principal.

#### NO UTILICE EL PRODUCTO EN UNA ATMOSFERA EXPLOSIVA

No utilice el instrumento en presencia de emanaciones o gases inflamables.

#### NO MODIFIQUE EL INSTRUMENTO

No instale repuestos ni realice modificaciones no autorizadas en el producto. Si el producto precisa reparaciones, devuélvalo a la oficina de ventas y reparaciones de Keysight para asegurarse de que se mantengan las medidas de seguridad.



#### NO MIDA MÁS QUE EL VOLTAJE INDICADO

El voltaje máximo indicado en cada módulo es el siguiente:

- a) DAQM900A: 120 Vrms
- b) DAQM901A, DAQM902A, DAQM903A, DAQM904A, DAQM908A: 300 Vrms
- c) DAQM905A, DAQM907A: 42 Vpk
- d) DAQM909A: +/-18 Vpk (un extremo) para pines HI y LO.

#### NO CONECTE CANALES DE MÓDULOS A LA FUENTE DE ALIMENTACIÓN

La categoría de medición del instrumento está clasificada como CAT "Otros", los terminales no deben conectarse directamente a la red eléctrica.

#### CABLE DE ALIMENTACIÓN DE CA

El método de desconexión para quitar la alimentación del instrumento es extraer el cable de alimentación de CA. Asegúrese de contar con el acceso adecuado al cable de alimentación para permitir la desconexión de la alimentación de CA. Use solo el cable de alimentación especificado por Keysight para el país de uso o uno con clasificaciones equivalentes.

#### PRUEBA AUTOMÁTICA

Antes de medir cualquier voltaje o corriente peligrosa, ejecute la consulta \*TST? desde la interfaz remota y lea el resultado para verificar que el instrumento funciona correctamente. La consulta \*TST? es una prueba automática que devuelve +0 si el instrumento aprueba dicha prueba y +1 si el instrumento falla. También puede realizar esta consulta desde el panel frontal si presiona **[Utility] > Self Test > Quick Test**. Si esta prueba automática falla, asegúrese de reparar el instrumento y de que pase la prueba automática antes de continuar.

#### PRECAUCIÓN

El diseño del aparato de medición lo hace sensible y su rendimiento se puede ver disminuido cuando se expone al fenómeno electromagnético continuo ambiental. Consideraciones de medición: utilice un cable blindado o trenzado, use un obturador de modo común, una abrazadera de ferrita y una resistencia de amortiguación antes de conectar DAQ970A/DAQ973A.

#### LIMPIEZA

Para evitar descargas eléctricas, desconecte el instrumento de la alimentación de CA antes de limpiarlo. Limpie el exterior del instrumento con un paño suave que no deje pelusas humedecido. No utilice detergentes, líquidos volátiles ni químicos disolventes. No intente limpiar el interior del producto. Si es necesario, comuníquese con una oficina de ventas y servicios de Keysight Technologies para coordinar la limpieza adecuada y garantizar que se mantienen las características de seguridad y el rendimiento.

#### NOTA

Conecte el cable USB con núcleo de ferrita al puerto USB del panel posterior del instrumento.

## Símbolo de seguridad y marcas normativas

| Símbolo                                                                             | Descripción                      |
|-------------------------------------------------------------------------------------|----------------------------------|
|  | Corriente Alterna (CA).          |
|  | Terminal a tierra de protección. |

|                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      | Terminal de conexión a tierra                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                      | Precaución, peligro (consulte este manual para obtener información específica respecto de Advertencia o Precaución).                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                      | Terminal de conexión a tierra del marco o chasis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                      | Traba de cable del instrumento.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                      | Este producto posee la marca ACMA RCM para indicar que cumple con las normas de Australia/ Nueva Zelanda. Para obtener una copia de la Declaración de conformidad del fabricante en Australia para este instrumento, comuníquese con su representante de ventas local de Keysight Technologies                                                                                                                                                                                                                           |
|                                      | Este símbolo indica el período durante el cual se espera que ningún elemento de sustancias peligrosas o tóxicas se filtre o se deteriore por el uso normal. Cuarenta años es la vida útil esperada del producto.                                                                                                                                                                                                                                                                                                         |
|                                      | La marca CSA es una marca comercial registrada de la Canadian Standards Association. Si incluye una 'C' y 'US' como subíndice, significa que el instrumento está certificado con las normas aplicables de Canadá y los Estados Unidos, respectivamente.                                                                                                                                                                                                                                                                  |
|  <b>ICES/NMB-001<br/>ISM GRP 1-A</b> | <p>La marca CE es una marca registrada de la Comunidad Europea. Esta marca CE indica que el producto cumple con todas las Directivas legales europeas relevantes.</p> <p><b>ICES/NMB-001</b> indica que este dispositivo ISM cumple con la norma canadiense ICES-001.</p> <p><i>Cet appareil ISM est conforme a la norme NMB-001 du Canada.</i></p> <p><b>ISM GRP 1-A:</b> indica que se trata de un producto de Clase A, Grupo 1, Científico y Médico Industrial (ISM).</p>                                             |
|                                    | <p>Este símbolo es una declaración de EMC clase A de Corea del Sur, y el código de identificación del producto es "R-REM-Kst-GM16412".</p> <p><b>R</b> identifica el prefijo de autorización.</p> <p><b>REM</b> identifica la información de certificación básica.</p> <p><b>Kst</b> identifica la información del solicitante.</p> <p><b>GM16412</b> es la identificación del producto.</p> <p>Se trata de un instrumento de clase A diseñado para uso profesional y en entornos electromagnéticos fuera del hogar.</p> |
| <b>ADVERTENCIA</b>                                                                                                    | Una señal de ADVERTENCIA indica peligro. Informa sobre una práctica, un procedimiento operativo o alguna tarea similar que, si no se realiza o cumple en forma correcta, podría causar lesiones o la muerte. En caso de encontrar una señal de ADVERTENCIA no prosiga hasta que se hayan comprendido y cumplido totalmente las condiciones indicadas.                                                                                                                                                                    |
| <b>PRECAUCIÓN</b>                                                                                                     | Una señal de PRECAUCIÓN indica peligro. Informa sobre un procedimiento operativo o alguna tarea similar que, si no se realiza o se cumple en forma correcta, puede resultar en daños al producto o destrucción de partes de este. En caso de encontrar una señal de PRECAUCIÓN no prosiga hasta que se hayan comprendido y cumplido totalmente las condiciones indicadas.                                                                                                                                                |
| <b>NOTA</b>                                                                                                           | La señal NOTA indica información importante. Informa sobre una práctica, un procedimiento operativo, una condición o alguna situación similar que es importante resaltar. Información reglamentaria y de seguridad 12                                                                                                                                                                                                                                                                                                    |

## Declaración de EMC clase A de Corea del Sur

### Información al usuario:

Este instrumento ha sido evaluado para su conformidad en entornos empresariales. En un entorno residencial, este equipo puede causar interferencias de radio. Esta declaración de EMC se aplica al equipo solo para uso en el entorno empresarial.

#### 사 용 자 안 내 문

이 기 기 는 업 무 용 환 경 에 서 사 용 할 목 적 으 로 적 합 성 평 가 를 받 은 기 기 로 서 가 정 용 환 경 에 서 사 용 하 는 경 우 전 파 간 섭 의 우 려 가 있 습 니 다 .

사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

## Normativa y cumplimiento del producto

El DAQ970A/DAQ973A cumple con los requisitos de seguridad y CEM.

Consulte la Declaración de Conformidad en <http://www.keysight.com/go/conformity> para conocer la última revisión.

### NOTA

Los transitorios máximos en todas las entradas se limitan a 1500 Vpk de referencia con conexión a tierra, excepto para DAQM900A, DAQM905A, DAQM907A y DAQM909A que son de 0 Vpk. La medición está clasificada como CAT «ninguna», y los terminales no deben conectarse directamente a la red eléctrica. No utilice este equipo para medir circuitos con sobretensiones que podrían superar este nivel.

## Condiciones ambientales

El Keysight DAQ970A/DAQ973A está diseñado para uso en interiores y en un área con baja condensación. La tabla a continuación muestra los requisitos ambientales generales y las características generales para este instrumento.

| Condición ambiental    | Requisito                                                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperatura            | Condiciones de funcionamiento: 0 °C a 55 °C<br>Condiciones de almacenamiento: -40 °C a 70 °C                                                                                                                     |
| Humedad                | Condiciones de funcionamiento: Hasta 80 % de HR a 40 °C (sin condensación), disminuyendo linealmente a 50 % HR a 55 °C (sin condensación)<br>Condiciones de almacenamiento: Hasta 50% HR a 55 °C (sin condensar) |
| Altitud                | Hasta 3000m                                                                                                                                                                                                      |
| Grado de contaminación | 2                                                                                                                                                                                                                |

A continuación, verá un resumen de los requisitos eléctricos (de alimentación) del DAQ970A/DAQ973A.

| Características generales              | Requisito                                                                                             |
|----------------------------------------|-------------------------------------------------------------------------------------------------------|
| Fuente de alimentación                 | 100 - 240 VAC (La fluctuación de la alimentación eléctrica de la red no puede exceder el $\pm 10\%$ ) |
| Frecuencia de la línea de alimentación | 50/60/400 Hz                                                                                          |
| Consumo de energía                     | 45 vatios                                                                                             |

### ADVERTENCIA

**NO UTILICE EL PRODUCTO EN UNA ATMOSFERA EXPLOSIVA O AMBIENTES HÚMEDOS.**

No utilice el instrumento cerca de gases o emanaciones inflamables, vapores o en ambientes húmedos



# 1 Introducción al Instrumento

Breve descripción del instrumento

Breve descripción del panel frontal

Indicadores del instrumento

Breve descripción del panel posterior

Breve descripción de los módulos plug-in

Diagrama de dimensión

Configuración de la interfaz remota

Procedimiento de configuración LAN

Actualización de firmware

Póngase en contacto con Keysight Technologies

Este capítulo presenta la descripción general y las funciones básicas del DAQ970A/DAQ973A.

## Breve descripción del instrumento

El DAQ970A/DAQ973A combina la capacidad de medición de precisión con conexiones de señal flexibles para sus sistemas de prueba de producción y desarrollo. Hay tres ranuras de módulo integradas en la parte posterior del instrumento para aceptar cualquier combinación de módulos de conmutación o adquisición de datos. La combinación de las funciones de adquisición de datos y registro de datos USB hacen que este instrumento sea una solución versátil para sus requisitos de prueba, ahora y en el futuro.

### Visualice, guarde y documente fácilmente los resultados de sus mediciones

- Gracias a la interfaz de usuario intuitiva y controlada por menú se obtiene una gran facilidad de uso.
- La pantalla a color de alta resolución permite ver histogramas, gráficos de tendencias, multímetros y vistas numéricas.
- Es compatible con interfaces LAN y USB.
- Permite arrastrar y soltar, además de brindar conectividad USB sin controlador.

### Posee características de registro de datos prácticas

- Permite medición directa de temperatura (termopares, RTD y termistores), deformación, voltaje de CC, voltaje de CA, resistencia de 2 y 4 cables, frecuencia, período, diodo, capacitancia, corriente de CC y corriente de CA.
- El rendimiento patentado a nivel de metrología sirve de base para todas las mediciones.
- Permite escaneo a intervalos con almacenamiento de hasta 1 000 000 lecturas de fecha y hora.
- Posee configuración de canal independiente con función, escala de medición y límites de alarma disponibles por canal.
- La interfaz de usuario es intuitiva con teclado de navegación con perilla de control, permite la entrada de datos desde teclas de función (teclas de menú dentro de la vista de pantalla) y teclas fijas (teclas de menú en la parte frontal del instrumento).
- Posee un estuche portátil y resistente con bases antideslizantes.
- El software BenchVue Data Acquisition (DAQ) para Microsoft® Windows® se puede descargar desde [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

### Posee recursos flexibles de adquisición y conmutación de datos

- Permite hasta 60 canales por instrumento (120 canales de un solo extremo).
- Permite tasas de lectura de más de 5000 lecturas por segundo en un solo canal y tasas de escaneo de hasta 450 canales por segundo.
- Permite elegir multiplexación, matriz, conmutación de forma C para fines generales, conmutación de RF, E/S digital, totalización, salida de DAC y funciones de lectura de DAC.
- Ofrece una interfaz web incorporada para supervisar y controlar el instrumento a través de un navegador web.

### Lenguaje de programación

- Compatible con el lenguaje de programación SCPI (Comandos estándar para instrumentos programables).

## Breve descripción del panel frontal



| Etiqueta | Descripción                                                                              |
|----------|------------------------------------------------------------------------------------------|
| 1        | Puerto USB                                                                               |
| 2        | Interruptor On/Standby (encendido/en espera) con indicador LED                           |
| 3        | Pantalla                                                                                 |
| 4        | Teclas de función                                                                        |
| 5        | Menú de operación de medición (para controlar el inicio de las mediciones)               |
| 6        | Menú de configuración de mediciones (para configurar los parámetros para las mediciones) |
| 7        | Perilla                                                                                  |
| 8        | Teclado de navegación del cursor                                                         |

### Teclas del panel frontal

#### NOTA

Presione la tecla **Save Recall Local** para que el instrumento vuelva al control local cuando este se encuentra en control remoto (lo muestra el indicador **RMT**).



## Indicadores del instrumento

La siguiente tabla muestra los distintos indicadores que están disponibles en el DAQ970A/DAQ973A. Los indicadores se mostrarán en la parte superior de la pantalla cuando se cumplan las condiciones correspondientes.

| Indicador                                                                          | Descripción                                                                                                                             |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
|   | El modo Monitor está habilitado.                                                                                                        |
|   | La digitalización está en curso.                                                                                                        |
|   | El escaneo/la digitalización del DMM está en curso.                                                                                     |
|   | A: las alarmas están presentes en la cola de alarmas.<br>H1234L: se ha producido una condición de alarma alta o baja.                   |
|   | El DMM interno está deshabilitado. El instrumento está configurado para un intervalo de escaneo externo cuando el DMM está desactivado. |
|   | Flujo excesivo de 1 000 000 lecturas en la memoria de lectura. Las nuevas lecturas sobrescribirán las lecturas más antiguas.            |
|   | Se inserta una unidad USB en el puerto de host USB del panel frontal.                                                                   |
|   | El instrumento está en modo remoto (interfaz remota)                                                                                    |
|  | Los errores están presentes en la cola de errores. Presione [View] > Errors para ver la lista de errores.                               |

## Breve descripción del panel posterior



| Etiqueta | Descripción                                                                                             |
|----------|---------------------------------------------------------------------------------------------------------|
| 1        | Identificador de ranura (100, 200, 300)                                                                 |
| 2        | Interfaz de GPIB ( <b>disponible solo en el DAQ973A</b> )                                               |
| 3        | Entrada de alimentación de CA                                                                           |
| 4        | Conector de interfaz LAN                                                                                |
| 5        | Conector de interfaz USB                                                                                |
| 6        | Entrada de disparador externo, salidas de alarma, entrada avanzada de canal y salida de cierre de canal |
| 7        | Tornillo de conexión a tierra del chasis                                                                |

## Breve descripción de los módulos plug-in

El DAQ970A/DAQ973A ofrece una selección completa de módulos plug-in para proporcionar recursos de medición, conmutación y control de gran calidad. Para obtener más detalles, consulte [Descripción general del módulo](#).

Módulos compatibles en el DAQ970A/DAQ973A:

- Módulo Multiplexor FET de 20 canales DAQM900A
- Módulo Multiplexor Armature de 20 canales DAQM901A
- Módulo Multiplexor Reed de 16 canales DAQM902A
- Módulo de conmutación/Accionador de 20 canales DAQM903A
- Módulo de conmutación Matrix de dos alambres 4x8 DAQM904A
- Módulo Multiplexor (50  $\Omega$ ) RF 1:4 doble DAQM905A
- Módulo multifunción DAQM907A
- Módulo Multiplexor de un solo extremo de 40 canales DAQM908A
- Módulo digitalizador de 24 bits y 4 canales DAQM909A

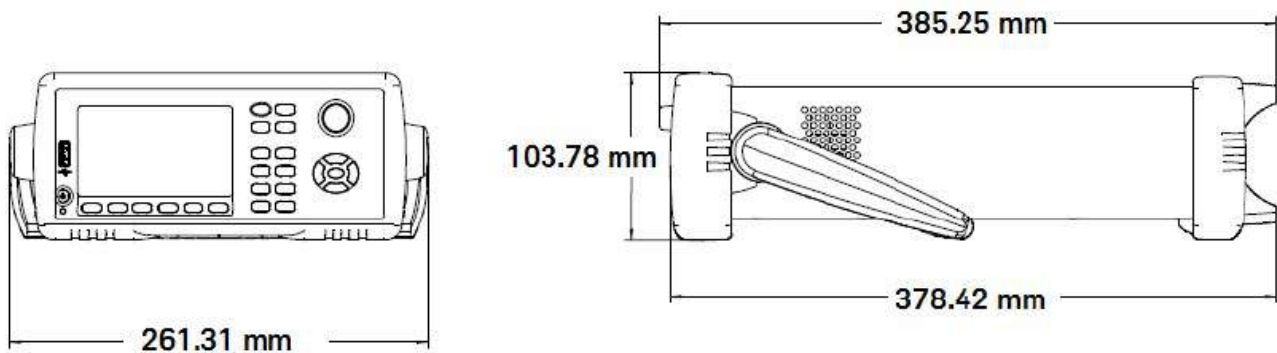
### NOTA

Consulte la hoja de datos del producto en <http://literature.cdn.keysight.com/litweb/pdf/5992-3168EN.pdf> para obtener las especificaciones completas de todos los módulos compatibles.

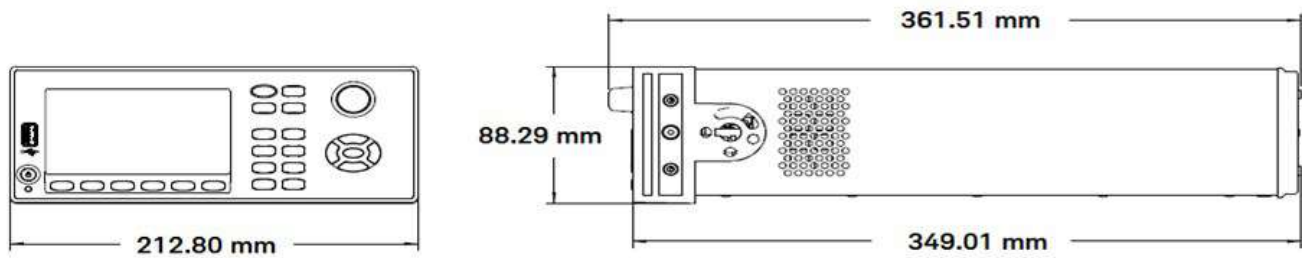
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## Diagrama de dimensión

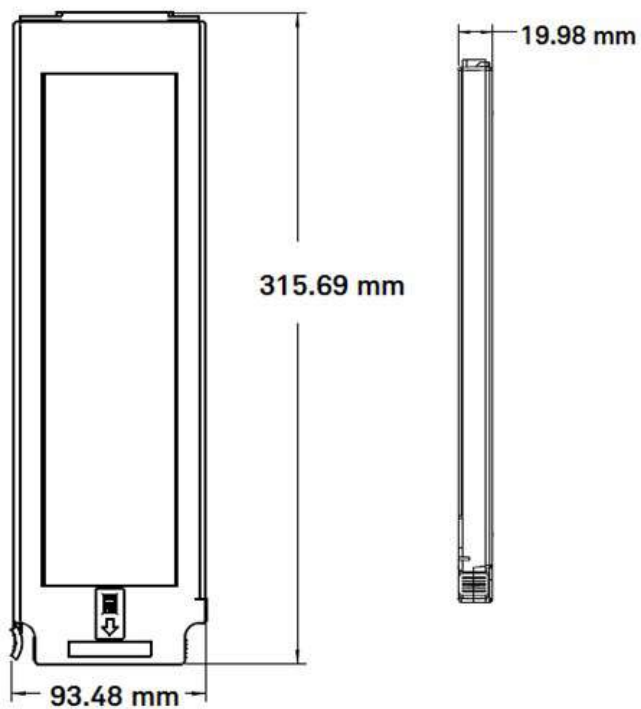
Dimensión del banco:



Dimensión del bastidor:



Dimensión del módulo:



## Configuración de la interfaz remota

### ADVERTENCIA

#### FUNCIONAMIENTO REMOTO

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

### NOTA

Si el modo Secure está habilitado, el instrumento debe desbloquearse con el código de seguridad correcto para realizar muchas de estas acciones. Consulte **Security** para obtener más información.

El DAQ970A admite la comunicación de interfaz remota a través de dos interfaces: No obstante, el DAQ973A admite una interfaz de GPIB adicional, además de la interfaz LAN y USB. Cuando el instrumento sale de fábrica, todas las interfaces están “activas” al momento del encenderse.

- **Interfaz LAN:** De forma predeterminada, el DHCP (Protocolo de configuración dinámica de host) está activado. Este es un protocolo para asignar direcciones IP dinámicas a dispositivos de red, lo que puede permitir la comunicación a través de LAN. Con el direccionamiento dinámico, un dispositivo puede tener una dirección IP diferente cada vez que se conecta a la red. Consulte **Configuraciones de LAN** para obtener más información.
- **Interfaz USB:** Utilice el conector de interfaz USB del panel posterior para comunicarse con el instrumento mediante su PC. Consulte **USB Settings (Configuración USB)** para obtener más información.
- **Interfaz GPIB (solo DAQ973A):** Establezca la dirección de GPIB del instrumento y conéctela a su PC mediante un cable GPIB.

## Keysight IO Libraries Suite

### NOTA

Asegúrese de que Keysight IO Libraries Suite esté instalado antes de continuar con la configuración de la interfaz remota.

Keysight IO Libraries Suite es una colección de software de control de instrumentos gratuito que detecta automáticamente los instrumentos y le permite controlarlos a través de interfaces LAN y USB. Para obtener más información, o para descargar las bibliotecas IO, vaya a [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite).

### Configuraciones de GPIB (solo en DAQ973A)

Cada dispositivo de la interfaz GPIB (IEEE-488) debe tener una dirección numérica completa y exclusiva entre 0 y 30. El instrumento se comercializa con una dirección predeterminada de 9, y la dirección de GPIB se muestra al inicio.

Esta configuración no es volátil, no se modificará al encender y apagar el instrumento ni si se restablecen los valores de fábrica (\*RST) o los valores preestablecidos del instrumento (SYSTem:PRESet). La dirección de la tarjeta de interfaz GPIB no debe entrar en conflicto con ningún instrumento del bus de la interfaz.

| Panel frontal                                                                                                                                                                        | Interfaz remota                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>GPIB</b> .                                                                                                           | SYSTem:COMMunicate:GPIB:ADDRes <address>    |
| Desde este menú, puede establecer la dirección de GPIB y activar o desactivar GPIB. Después de hacer cambios, debe apagar y encender el instrumento para que el cambio surta efecto. | SYSTem:COMMunicate:ENABLE {ON 1 OFF 0},GPIB |

## Configuraciones de LAN

Las siguientes secciones describen las funciones principales de configuración de LAN del panel frontal, incluidos los comandos SCPI, donde corresponda. En la *Guía de programación de DAQ970A/DAQ973A*, consulte "Subsistema SYSTem - Comandos de configuración de la interfaz remota" para conocer todos los comandos de configuración de LAN.

### NOTA

Algunas configuraciones de LAN requieren que apague y encienda el equipo para activarlas. El instrumento muestra brevemente un mensaje cuando este es el caso. Observe la pantalla con atención mientras cambia la configuración de LAN.

### Habilitar o deshabilitar la interfaz LAN

| Panel frontal                                                                                                                   | Interfaz remota                           |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN</b><br>Configure la tecla de función en encendido o apagado | SYSTem:COMMunicate:ENABle {OFF   ON}, LAN |

### Ver el estado de la LAN, el estado de MAC y la configuración actual de la LAN

Una vez que la interfaz LAN está habilitada, puede ver el estado de la LAN, la dirección MAC y la configuración actual de la LAN desde el panel frontal. El estado de la LAN puede ser diferente de los ajustes del menú de configuración del panel frontal, que dependen de la configuración de la red. Si las configuraciones son diferentes, es porque la red ha asignado automáticamente sus propias configuraciones. Si el instrumento se pone en modo remoto, todos los cambios de LAN se desactivarán y la pantalla pasará a una pantalla diferente. La nueva selección con la página LAN Settings mostrará la nueva configuración si se realizó un reinicio de LAN.

| Panel frontal                                                                    | Interfaz remota |
|----------------------------------------------------------------------------------|-----------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> | (ninguno)       |

### Modificar la configuración

Tal como se envía de fábrica, los ajustes preconfigurados del instrumento (el DHCP está encendido) deberían funcionar en la mayoría de los entornos de LAN. No obstante, si desea establecer manualmente una dirección IP, máscara de subred o puerta de enlace predeterminada, apague el DHCP y luego cambie la configuración de IP tal y como se describe a continuación.

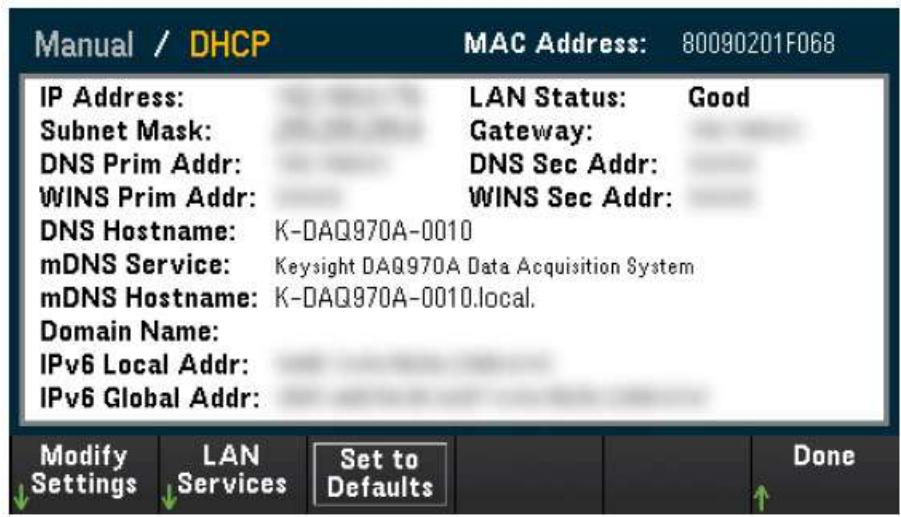
#### Manual/DHCP

El modo DHCP puede asignar automáticamente una dirección IP dinámica a un dispositivo LAN. Esta suele ser la forma más fácil de configurar el instrumento para LAN. Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valores preestablecidos del instrumento (comando SYSTem:PRESet).

Al deshabilitar el DHCP se habilitará la configuración Manual y viceversa.

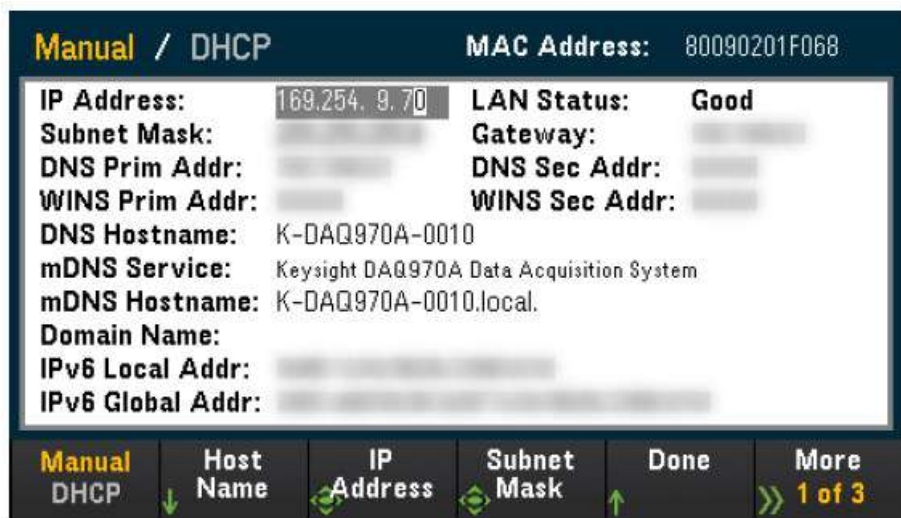
| Panel frontal                                                                                                         | Interfaz remota                      |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modifique la configuración.</b> | SYSTem:COMMunicate:LAN:DHCP {OFF ON} |

Para activar DHCP:



| Paso | Panel frontal                                                                                                             | Interfaz remota                |
|------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 1    | Presione [Home] > User Settings > I/O > LAN Settings > Modify Settings.<br>Configure la primera tecla de función en DHCP. | SYSTem:COMMunicate:LAN:DHCP ON |
| 2    | Si cambia este parámetro, debe presionar [Done] > [Apply Changes] para que el cambio surta efecto.                        | SYSTem:COMMunicate:LAN:UPDate  |

Para desactivar DHCP:



| Paso | Panel frontal                                                                                                               | Interfaz remota                 |
|------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1    | Presione [Home] > User Settings > I/O > LAN Settings > Modify Settings.<br>Configure la primera tecla de función en Manual. | SYSTem:COMMunicate:LAN:DHCP OFF |
| 2    | Si cambia este parámetro, debe presionar [Done] > [Apply Changes] para que el cambio surta efecto.                          | SYSTem:COMMunicate:LAN:UPDate   |

Una vez que se deshabilite el DHCP, los siguientes parámetros estarán disponibles para la configuración manual:

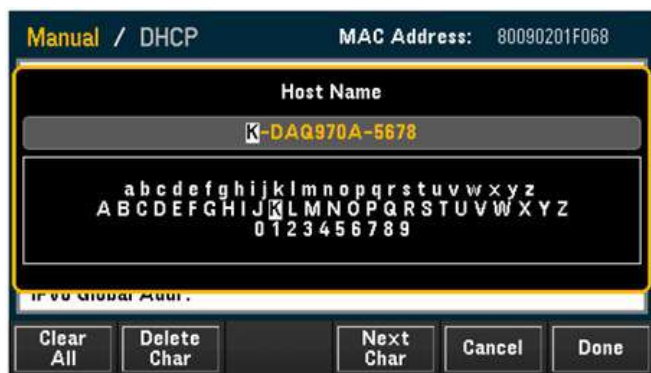
- Host Name (Nombre del host)
- IP Address
- Subnet Mask (Máscara de subred)
- Gateway (Puerta de enlace)
- Primary and Secondary DNS (DNS principal y secundario)
- Primary and Secondary WINS (WINS principal y secundaria)
- Service mDNS (Servicio mDNS)

### Host Name (Nombre del host)

El nombre de host es la parte de host del nombre de dominio, que se traduce en una dirección IP.

| Paso | Panel frontal                                                                                                                                                                                                                   | Interfaz remota                 |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Configure la primera tecla de función en <b>Manual</b> y presione <b>Host Name</b> para ingresar el nombre de host. | SYSTem:COMMunicate:LAN:HOSTname |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                | SYSTem:COMMunicate:LAN:UPDate   |

Cada instrumento se envía con un nombre de host predeterminado con el formato: K-modelnumber-serialnumber, donde modelnumber es el número de modelo de 7 caracteres del instrumento (por ejemplo, DAQ970A), y serialnumber son los últimos cinco caracteres del número de serie del instrumento de 10 caracteres ubicado en la etiqueta en la parte superior de la unidad (por ejemplo, 5678 si el número de serie es MY12345678).



- El instrumento recibe un nombre de host único en la fábrica, pero puede cambiarlo. El nombre de host debe ser único en la LAN.
- El nombre debe comenzar con la letra, los demás caracteres pueden ser mayúsculas o minúsculas, dígitos numéricos o guiones "-".
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valores preestablecidos del instrumento (comando SYSTem:PRESet).



## IP Address

Puede ingresar una dirección IP estática para el instrumento como un entero de cuatro bytes expresado en notación de puntos. Cada byte es un valor decimal, sin ceros iniciales (por ejemplo, 169.254.2.20). Consulte [Más información sobre direcciones IP y notación de puntos](#) para ver más detalles.

| Paso | Panel frontal                                                                                                                                                                                                                            | Interfaz remota                  |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Configure la primera tecla de función en <b>Manual</b> y presione <b>IP Address</b> para configurar la dirección IP deseada. | SYSTem:COMMunicate:LAN:IPAdDress |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                                         | SYSTem:COMMunicate:LAN:UPDate    |

- Si el modo DHCP está activado, intenta asignar una dirección IP al instrumento. Si falla, Auto-IP intenta asignar una dirección IP al instrumento.
- Póngase en contacto con su administrador de LAN para obtener una dirección IP.
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valores preestablecidos del instrumento (comando SYSTem:PRESet).

## Subnet Mask (Máscara de subred)

La división en subredes permite al administrador de la LAN subdividir una red para simplificar la administración y reducir el tráfico de la red. La máscara de subred indica la parte de la dirección de host utilizada para indicar la subred.

| Paso | Panel frontal                                                                                                                                                                                                                                               | Interfaz remota               |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> . Configure la primera tecla de función en <b>Manual</b> y presione <b>Subnet Mask</b> para configurar la dirección de máscara de subred deseada. | SYSTem:COMMunicate:LAN:SMASk  |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                                                            | SYSTem:COMMunicate:LAN:UPDate |

- Póngase en contacto con su administrador de LAN para obtener una dirección IP.
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valores preestablecidos del instrumento (comando SYSTem:PRESet).

## Gateway (Puerta de enlace)

Una puerta de enlace es un dispositivo de red que conecta redes. La configuración de la puerta de enlace predeterminada es la dirección IP del instrumento.

| Paso | Panel frontal                                                                                                                                                                                                                                                | Interfaz remota                |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Configure la primera tecla de función en <b>Manual</b> y presione <b>Gateway</b> para configurar la dirección de la puerta de enlace deseada. | SYSTem:COMMunicate:LAN:GATeway |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                                                             | SYSTem:COMMunicate:LAN:UPDate  |

- No configure una dirección de puerta de enlace cuando el modo DHCP esté activo (valor predeterminado de fábrica).
- Póngase en contacto con su administrador de LAN para obtener una dirección IP.
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valore preestablecidos del instrumento (comando SYSTem:PRESet).

## Primary and Secondary DNS (DNS principal y secundario)

El DNS (Servicio de nombres de dominio) es un servicio de Internet que transforma los nombres de dominio en direcciones IP. La dirección del servidor DNS es la dirección IP de un servidor que presta este servicio.

| Paso | Panel frontal                                                                                                                                                                                                                                                          | Interfaz remota                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Configure la primera tecla de función como <b>Manual</b> y presione <b>Primary DNS</b> o <b>Second DNS</b> para establecer la dirección de DNS deseada. | SYSTem:COMMunicate:LAN:DNS[{{1 2}}]<br><br>Nota: La sintaxis {{1 2}} indica el tipo de dirección del servidor DNS principal (1) o secundario (2). |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                                                                       | SYSTem:COMMunicate:LAN:UPDate                                                                                                                     |

- Normalmente, DHCP detecta la información de la dirección DNS. Solo necesita cambiar esto si el modo DHCP no está en uso o no funciona.
- Póngase en contacto con su administrador de LAN para obtener una dirección IP.
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valore preestablecidos del instrumento (comando SYSTem:PRESet).

## Primary and Secondary WINS (WINS principal y secundaria)

Un WINS (Sistema de nombres de Internet de Windows) es un sistema que permite a Windows identificar sistemas NetBIOS en una red TCP/IP.

| Paso | Panel frontal                                                                                                                                                                                                                                                             | Interfaz remota                                                                                                                                       |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Configure la primera tecla de función como <b>Manual</b> y presione <b>Primary WINS</b> o <b>Second WINS</b> para establecer la dirección de WINS deseada. | SYSTem:COMMunicate:LAN:WINS[{{1 2}}]<br><br>Nota: La sintaxis [{{1 2}}] indica el tipo de dirección del servidor WINS principal (1) y secundario (2). |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                                                                          | SYSTem:COMMunicate:LAN:UPDate                                                                                                                         |

- Normalmente, DHCP detecta la información de la dirección WINS. Solo necesita cambiar esto si el modo DHCP no está en uso o no funciona
- Póngase en contacto con su administrador de LAN para obtener una dirección IP.
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valore preestablecidos del instrumento (comando SYSTem:PRESet).

## Service mDNS (Servicio mDNS)

Un mDNS (servicio de nombre de dominio de multidifusión) es un servicio de Internet que se registra con el servicio de nombre seleccionado.

| Paso | Panel frontal                                                                                                                                                                                                                                                                               | Interfaz remota               |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Modify Settings</b> .<br>Configure la primera tecla de función como <b>Manual</b> y presione <b>Service mDNS</b> en la tercera página del menú para establecer el nombre de servicio mDNS de deseado. | LXI:MDNS:SNAME:DESired        |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                                                                                                                                            | SYSTem:COMMunicate:LAN:UPDate |

Cada instrumento se envía con un nombre de servicio predeterminado con el formato:

*Keysight Technologies\_<modelNumber>\_ - serial*

Donde modelNumber es el número de modelo de 7 caracteres del instrumento (por ejemplo, DAQ970A), y el nombre del producto (Sistema de Adquisición de datos) y serialNumber son los últimos cinco caracteres del número de serie del instrumento de 10 caracteres ubicado en la etiqueta en la parte superior de la unidad (por ejemplo, 45678 si el número de serie es MY12345678).

- El instrumento recibe un nombre de servicio mDNS único en la fábrica, pero puede cambiarlo. El nombre del servicio mDNS debe ser único en la LAN.
- El nombre debe comenzar con la letra, los demás caracteres pueden ser mayúsculas o minúsculas, dígitos numéricos o guiones "-".
- Esta configuración no es volátil, no se modificará al encender y apagar el instrumento, si se restablece a los valores de fábrica (comando \*RST) o los valore preestablecidos del instrumento (comando SYSTem:PRESet).

## LAN Restart (Reinicio de LAN)

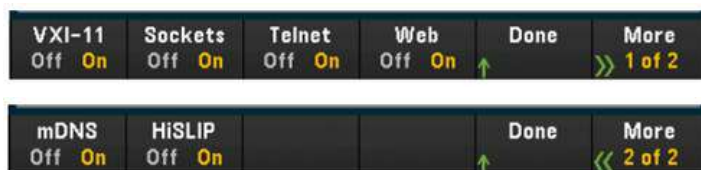
Cualquier modificación en la configuración de LAN descrita anteriormente reiniciará la LAN después de presionar Apply Changes. Este recurso reinicia la red usando TODAS las configuraciones de la LAN actuales. El reinicio de la LAN no borra la contraseña de la interfaz web.

### Interfaz remota

LXI:REStart

## LAN Services (Servicios de LAN)

Activa (On) o desactiva (Off) los servicios de LAN en el instrumento.



| Paso | Panel frontal                                                                                                                                                                | Interfaz remota               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1    | Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>LAN Services</b><br>Presione On para activar u Off para desactivar cada configuración. | (ninguno)                     |
| 2    | Si cambia este parámetro, debe presionar <b>[Done]</b> > <b>[Apply Changes]</b> para que el cambio surta efecto.                                                             | SYSTem:COMMunicate:LAN:UPDate |

- Consulte la ayuda de Keysight IO Libraries para obtener información sobre los protocolos HiSLIP, VXI-11 y Sockets.
- Telnet: el puerto telnet del instrumento es 5024. Abra sesiones SCPI en la conexión Telnet. Para ello, escriba: telnet IP address 5024
- Web: active o desactive la programación del instrumento desde la interfaz web del instrumento.
- mDNS: el servicio mDNS se utiliza en redes donde no se instala ningún servidor DNS convencional. Encender o apagar el dispositivo o restablecer la LAN siempre activa el servicio mDNS.

## Set to Defaults

Esta función restablece la configuración de LAN a los valores predeterminados de fábrica correspondientes.

| Panel frontal                                                                                             | Interfaz remota |
|-----------------------------------------------------------------------------------------------------------|-----------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Settings</b> > <b>Set to Defaults</b> | (Ninguno)       |

## LAN Reset

Restablece la LAN con su configuración actual y activa el modo DHCP y el servicio mDNS. El restablecimiento de la LAN también borra cualquier contraseña de interfaz de usuario web (UI web) definida por el usuario.

| Panel frontal                                                                 | Interfaz remota |
|-------------------------------------------------------------------------------|-----------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>LAN Reset</b> | LXI:RESet       |

### Interfaz web

El DAQ970A/DAQ973A incluye una interfaz web incorporada para acceder y controlar de forma remota el instrumento a través de LAN mediante un navegador web. Para obtener más detalles, consulte [Interfaz web](#).

### Más información sobre direcciones IP y notación de puntos

Las direcciones de notación de puntos (“nnn.nnn.nnn.nnn” donde “nnn” es un valor de byte de 0 a 255) deben expresarse con cuidado, ya que la mayoría del software web de las PC interpreta los valores de bytes con ceros iniciales como números octales (de base 8). Por ejemplo, “192.168.020.011” es en realidad equivalente al decimal “192.168.16.9” debido a que “.020” se interpreta como “16” expresado en octal, y “.011” como “9”. Para evitar confusiones, use solo valores decimales de 0 a 255, sin ceros iniciales.

## USB Settings (Configuración USB)

USB Settings configura los conectores USB del panel frontal (almacenamiento) y USB del panel posterior (conectividad).



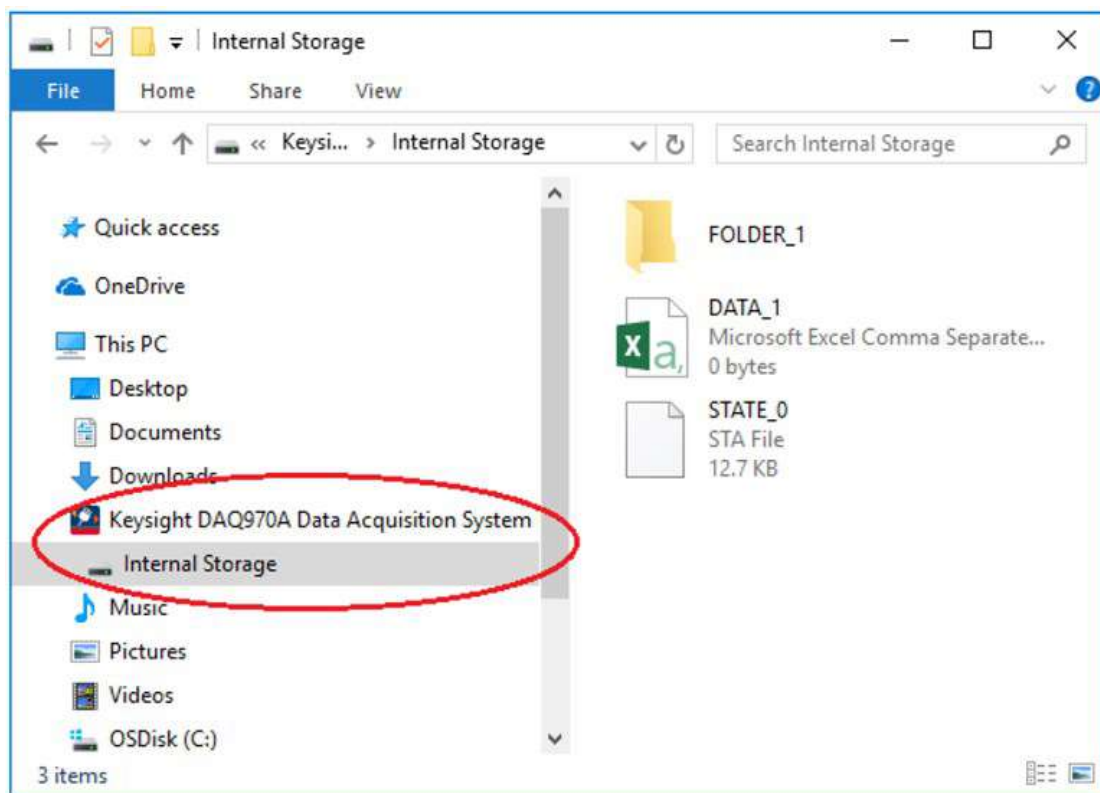
| Panel frontal                                                                    | Interfaz remota                           |
|----------------------------------------------------------------------------------|-------------------------------------------|
| Presione <b>[Home]</b> > <b>User Settings</b> > <b>I/O</b> > <b>USB Settings</b> | SYSTEM:COMMunicate:ENABle {OFF   ON}, USB |

## USB SCPI

USB SCPI activa (On) o desactiva (Off) el puerto de control USB del instrumento en el panel posterior. Una vez que se cambia el estado de la interfaz, debe apagar y encender el instrumento para que el cambio surta efecto. Cuando está desactivado, la interfaz no se puede configurar en la utilidad Keysight IO Libraries Connection Expert.

## Easy File Access (tecla de función File Access)

Easy File Access le permite transferir archivos fácilmente entre el instrumento y su PC. Simplemente conecte el puerto de control USB del panel posterior del instrumento a un puerto USB en su PC y luego use la ventana que aparece en su PC para copiar los archivos del instrumento a su PC.



Puede usar las funciones estándar de administración de archivos de su PC para copiar archivos del instrumento a su PC.

**NOTA**

Para usar Easy File Access al mismo tiempo que está programando de forma remota el instrumento con SCPI a través de la interfaz USB (USB SCPI), debe tener instalado en su PC Keysight IO Libraries Suite 16.3 o posterior. Puede descargar la última versión en [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite).

Para usar Easy File Access en una PC con el sistema operativo Windows XP, asegúrese de tener Microsoft Windows Media Player 11 para Windows XP SP1, o si está utilizando Microsoft Windows XP SP2, SP3 o una versión más reciente de Windows. Puede descargar este software en [www.microsoft.com/en-us/-download/details.aspx?id=8163](http://www.microsoft.com/en-us/-download/details.aspx?id=8163).

## Show USB ID (Mostrar el ID de USB)

Muestra la cadena de dirección USB como se usa en las aplicaciones de programación VISA.

## Detalles técnicos de la conexión

En la mayoría de los casos, puede conectarse fácilmente al instrumento con IO Libraries Suite o la interfaz web. En ciertas circunstancias, puede ser útil conocer la siguiente información.

| Interfaz     | Detalles                                                                                                                                      |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| LAN          | Cadena VISA: TCPIP0::<IP Address>::inst0::INSTR<br>Ejemplo: TCPIP0::192.168.10.2::inst0::INSTR                                                |
| Interfaz web | Puerto número 80, URL <a href="http://&lt;IP address&gt;/">http://&lt;IP address&gt;/</a>                                                     |
| USB          | El ID de USB ID tiene la forma USB0::<Vendor ID>::<Prod ID>::<Serial Number>::0::INSTR<br>Ejemplo: USB0::0x2A8D::0x0902::MY55160003::0::INSTR |

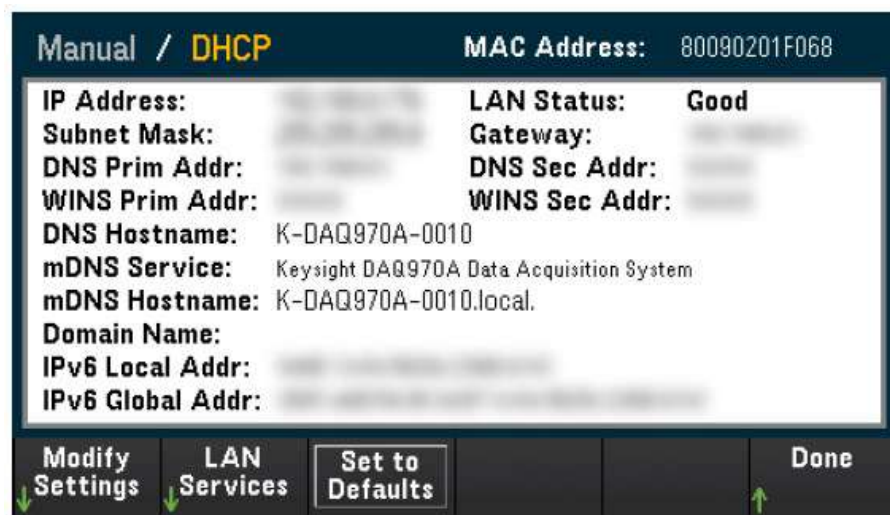
## Procedimiento de configuración LAN

Es posible que deba configurar varios parámetros para establecer la comunicación de red mediante la interfaz LAN. En primer lugar, tendrá que establecer una dirección IP. Es posible que deba ponerse en contacto con su administrador de red para obtener ayuda para establecer la comunicación con la interfaz LAN.

### NOTA

Si el modo Secure está habilitado, el instrumento debe desbloquearse con el código de seguridad correcto para realizar muchas de estas acciones. Consulte [Security](#) para obtener más información.

1. Presione [Home] > User Settings > I/O > LAN Settings.
2. Puede seleccionar **Modify Settings** para cambiar la configuración de LAN, seleccionar **LAN Services** para habilitar (On) o deshabilitar (Off) los servicios de LAN en el instrumento, o seleccionar **Set to Defaults** para restaurar la configuración de la LAN a su configuración predeterminada de fábrica.



3. Para cambiar la configuración, presione **Modify Settings**. Para acceder a la mayoría de los elementos en esta pantalla, use la primera tecla de función para cambiar de **DHCP** a **Manual**. Con el DHCP activado, el DHCP (Dynamic Host Configuration Protocol o Protocolo de configuración dinámica de host) establecerá automáticamente una dirección IP cuando conecte el instrumento a la red, siempre que se encuentre el servidor DHCP y pueda hacerlo. El DHCP también trata automáticamente con la máscara de subred, la dirección de la puerta de enlace, los DNS, el WINS y el nombre de dominio, si es necesario. Normalmente, esta es la forma más fácil de establecer la comunicación LAN para su instrumento. Todo lo que debe hacer es dejar el ajuste DHCP activado. Póngase en contacto con su administrador de LAN para obtener más detalles.



#### 4. Establecer una “IP Setup” (Configuración de IP)

Si no está utilizando el DHCP (la primera tecla de función está configurada en Manual), debe establecer una configuración de IP, incluida una dirección IP, y posiblemente una máscara de subred y una dirección de puerta de enlace. Las teclas de función IP Address y Subnet Mask se encuentran en la pantalla principal. Presione More para configurar otros ajustes.

Póngase en contacto con el administrador de la red para obtener la dirección IP, la máscara de subred y la puerta de enlace. Todas las direcciones IP toman la forma de notación de punto “nnn.nnn.nnn.nnn” donde “nnn” en cada caso es un valor de byte en el rango de 0 a 255. Puede ingresar una nueva dirección IP con la perilla o las teclas de flecha del panel frontal. **No escriba ceros iniciales.**

## 5. Configurar la "DNS Setup" (configuración de DNS, opcional)

El DNS (Servicio de nombres de dominio) es un servicio de Internet que transforma los nombres de dominio en direcciones IP. Pregunte a su administrador de red si se usan ajustes de DNS. Si es así, pregunte el nombre de host, el nombre de dominio y la dirección del servidor DNS que debe usar.

- a. Configure el "hostname" (nombre de host). Presione **Host Name** e ingrese el nombre de host. El nombre de host es la parte de host del nombre de dominio, que se traduce en una dirección IP. El nombre de host se escribe como una cadena usando las teclas de flecha del panel frontal para seleccionar y cambiar los caracteres. El nombre de host puede incluir letras, números y guiones ("-").
- b. Configure las direcciones del "DNS Server" (servidor de DNS). Desde la pantalla de configuración de LAN, presione **More** para ir al segundo grupo de teclas de función.

Ingrese el **Primary DNS** y el **Second DNS**. Consulte con su administrador de red para obtener más detalles.

## Actualización de firmware

### PRECAUCIÓN

Nunca apague el instrumento durante una actualización.

---

1. Presione **[Home]** > **Help** > **About** para determinar la revisión de firmware que está instalada actualmente.
2. Vaya a [www.keysight.com/find/DAQ970AFirmware](http://www.keysight.com/find/DAQ970AFirmware) para encontrar la revisión de firmware más reciente. Si coincide con la revisión instalada en su instrumento, no es necesario continuar con este procedimiento. De lo contrario, descargue la utilidad de actualización del firmware y un archivo ZIP del firmware. Las instrucciones detalladas de firmware se encuentran en las Instrucciones de la Utilidad de actualización de firmware en la página de descarga.
3. Descomprima el archivo ZIP y use la utilidad de actualización de firmware para preparar una unidad USB con el firmware actualizado.
4. Conecte la unidad USB al panel frontal del instrumento y presione **[Utility]** > **Admin** > **Firmware Update** para actualizar el firmware. Si el modo seguro está habilitado, desbloquee el instrumento con el código de seguridad antes de instalar el firmware.

**Importante:** Para actualizar el firmware del instrumento de forma remota, el número de modelo en la respuesta \*IDN? debe coincidir con el número de modelo del instrumento real. Si ha cambiado la respuesta \*IDN? del instrumento a otro instrumento, cuando intente actualizar el firmware de forma remota, verá este error: "The instrument is not supported by this firmware file" (El instrumento no es compatible con este archivo de firmware). Para actualizar el firmware, puede usar el procedimiento del panel frontal o hacerlo de forma remota. Para ello use SYSTem:PERSon:MODEL para configurar el \*IDN? para que coincida con el número de modelo, actualice el firmware y luego use SYSTem:PERSon:MODEL nuevamente para configurar la respuesta \*IDN? para el otro número de modelo.

## Póngase en contacto con Keysight Technologies



Puede ponerse en contacto con Keysight Technologies para obtener garantía, asistencia de servicios o soporte técnico.

En los Estados Unidos: (800) 829-4444

En Europa: 31 20 547 2111

En Japón: 0120-421-345

Utilice [www.keysight.com/find/assist](http://www.keysight.com/find/assist) para ponerse en contacto con Keysight en todo el mundo o póngase en contacto con su representante de Keysight Technologies.

## 2 Inicio Rápido

Preparación del instrumento para su uso

Conexión e instalación del cableado del módulo

Conexión de los cables de alimentación y de E/S

Uso del sistema de ayuda incorporado

Ajuste de la manija para transportar

Montaje del instrumento en un bastidor

Software Keysight BenchVue Data Acquisition (DAQ)

## Preparación del instrumento para su uso

Controle si recibió los siguientes elementos. Si falta algo, póngase en contacto con la oficina de ventas de Keysight más cercana o con un distribuidor autorizado de Keysight.

- Cable de alimentación (para el país de destino)
- Certificado de calibración (opcional)
- Paquete de documentación complementaria
- Cable USB 2.0
- Un termopar tipo J y un destornillador de punta plana

El software Keysight BenchVue Data Acquisition (DAQ) se puede descargar desde [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

Cualquier módulo plug-in que haya pedido se entrega en un embalaje separado. También se incluye un kit de cable adicional (50  $\Omega$ ) cuando ordena el Módulo Multiplexor RF 1:4 doble DAQM905A (50  $\Omega$ ).

La documentación más reciente del producto está disponible en:

- [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A)
- [www.keysight.com/find/DAQ973A](http://www.keysight.com/find/DAQ973A)

## Conexión e instalación del cableado del módulo

### ADVERTENCIA

Para evitar descargas eléctricas, use solo cables que estén clasificados para el voltaje máximo aplicado a cualquier canal.

Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben considerarse peligrosos.

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado.

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado.

No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de señal.

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

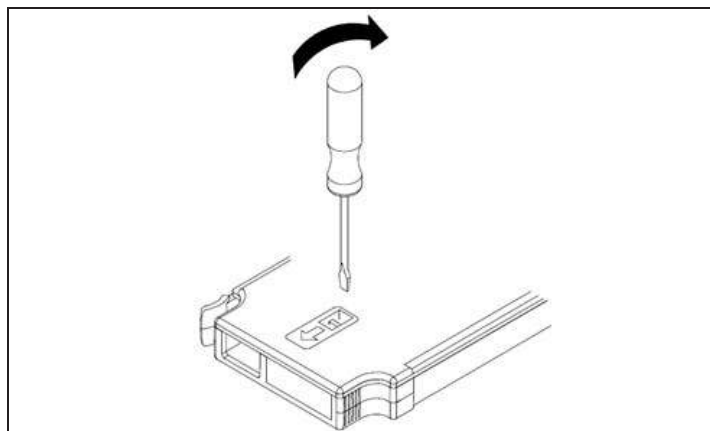
### PRECAUCIÓN

Durante el encendido, cualquier acción para instalar o desinstalar los módulos desde el panel posterior reiniciará el instrumento.

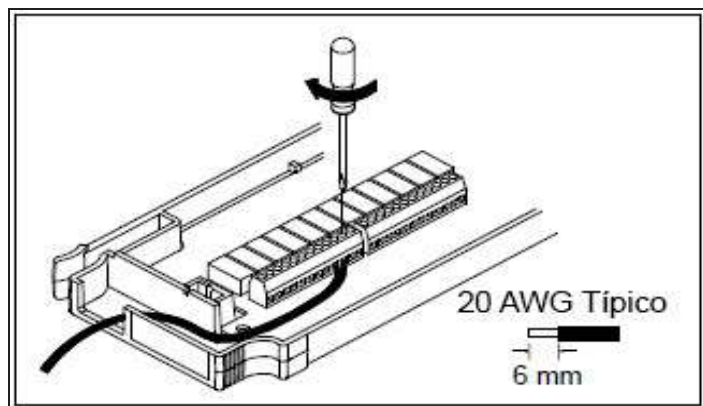
### Instalar el módulo

Para conectar el cableado a un módulo e instalarlo en el panel posterior del instrumento, siga los cinco pasos que se muestran a continuación:

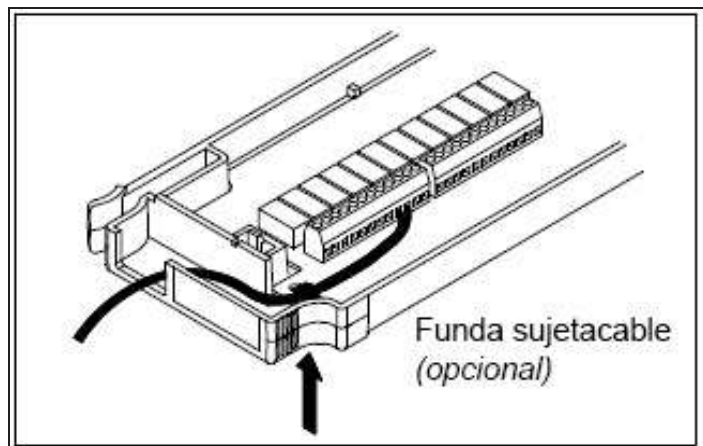
1. Con un destornillador de punta plana, empuje la lengüeta hacia adelante y levante la cubierta para separarla del módulo.



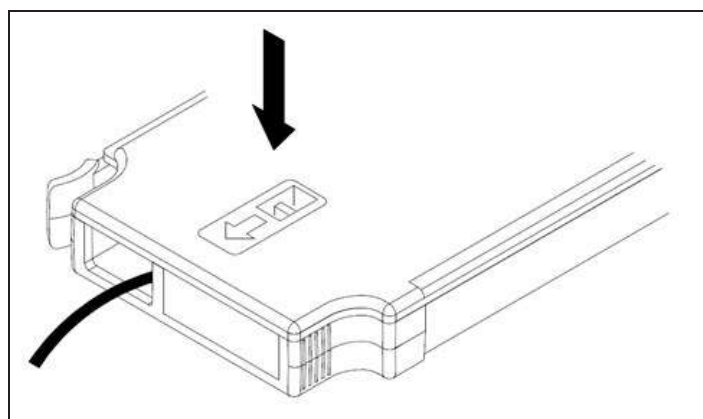
2. Conecte el cableado a los terminales del tornillo



3. Pase el cableado a través del anillo pasacables.

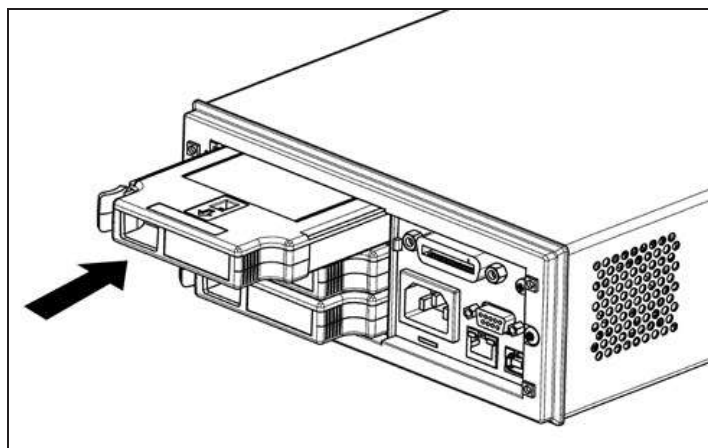


4. Vuelva a colocar la cubierta del módulo.



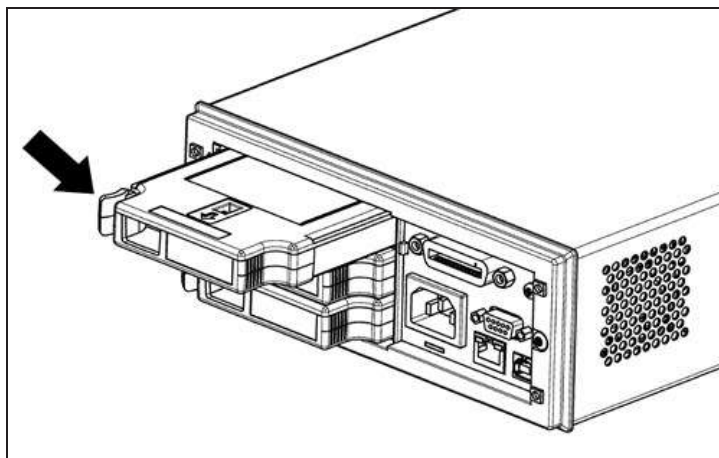


5. Instale el módulo en el instrumento (en el panel posterior)



## Desinstalar el módulo

Para desenchufar o reemplazar cualquier módulo, empuje hacia adentro el clip ubicado en la parte posterior izquierda del módulo y luego quítelo del panel posterior.



## Conexión de los cables de alimentación y de E/S

### Encender el instrumento

Antes de encender el instrumento, asegúrese de que todas las fuentes de señal estén apagadas. Encienda las fuentes de señal después de encender el instrumento. Apague las fuentes de señal antes de que se apague el instrumento. Conecte el cable de alimentación y el cable LAN o USB como desee. Presione el interruptor On/Standby (encendido/en espera) en el panel frontal. Tome en cuenta que este interruptor es solo para propósitos de espera. Para desconectar la alimentación del instrumento, retire el cable de alimentación. Si el instrumento no se enciende, verifique que el cable de alimentación esté firmemente conectado.

La siguiente tabla muestra los estados del color del LED que se muestran mientras el instrumento está encendido:

| Color del LED | Estado del instrumento                                                         |
|---------------|--------------------------------------------------------------------------------|
| LED apagado   | No hay alimentación de CA conectada.                                           |
| LED ámbar     | El instrumento está en modo de espera con la alimentación de CA aún conectada. |
| LED verde     | El instrumento está encendido.                                                 |

### Prueba automática al encenderse

Después de encenderse, el instrumento ejecuta una prueba automática de encendido y muestra un mensaje sobre cómo obtener ayuda, junto con la dirección IP actual.

La pantalla del panel frontal se iluminará brevemente mientras el instrumento realiza su prueba automática de encendido, con todos los canales de medición apagados. Si la prueba automática de encendido falla, el indicador de error **ERR** se muestra en la pantalla. Consulte “Mensajes de error de SCPI” en la *Guía de programación de DAQ970A/DAQ973A* para obtener más información sobre los códigos de error y los mensajes de error de SCPI.

#### NOTA

Una prueba automática completa ejecuta muchas más pruebas que las realizadas en el encendido. Consulte la *Guía de servicio de DAQ970A/DAQ973A* para obtener más información sobre el procedimiento de prueba automática completa del instrumento.

La función de medición predeterminada del instrumento es el voltaje de CC (CCV), con el rango automático habilitado.

### Para apagar el instrumento

Mantenga presionado el interruptor On/Standby durante aproximadamente medio segundo. Esto evita que apague accidentalmente el instrumento al rozar el interruptor de encendido.

#### NOTA

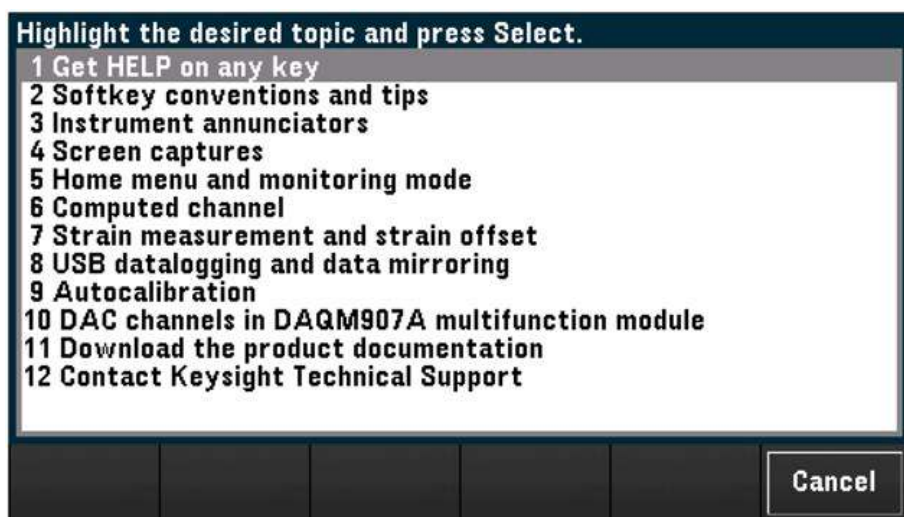
Si apaga el instrumento porque desconecta la fuente de alimentación (no se recomienda), el instrumento se enciende tan pronto como se vuelva a conectar la alimentación. Debe presionar nuevamente el interruptor On/Standby.

## Uso del sistema de ayuda incorporado

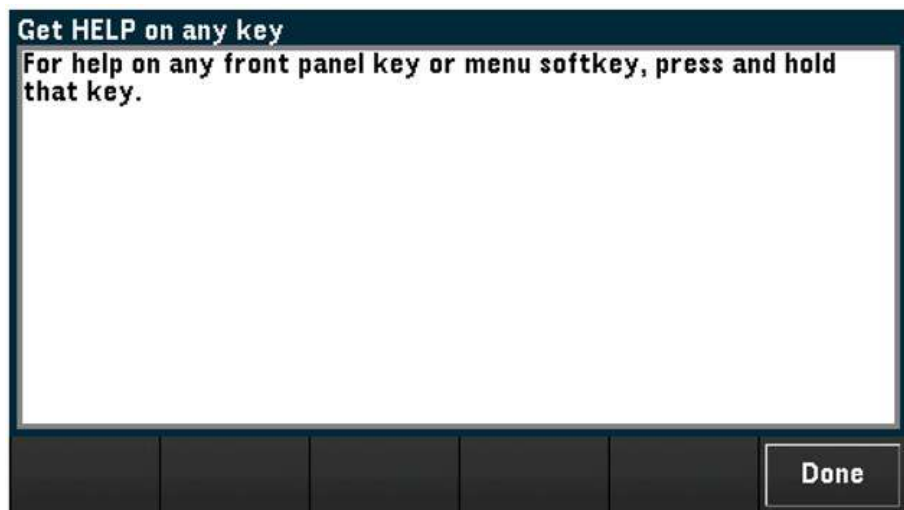
El sistema de ayuda incorporado proporciona ayuda de acuerdo con el contexto en cualquier tecla del panel frontal o tecla de función del menú. También encontrará disponible una lista de temas de ayuda que pueden ayudarlo a aprender sobre el instrumento. Todos los mensajes, la ayuda contextual y los temas de ayuda aparecerán en el idioma seleccionado. Las etiquetas de las teclas de función del menú no se traducen.

### Ver la lista de temas de ayuda

Presione [Home] > Help > Help Topics para ver la lista de temas de ayuda. Use la perilla o las teclas de flecha del panel frontal para resaltar el tema deseado y presione [Select] para ver el contenido de la ayuda.



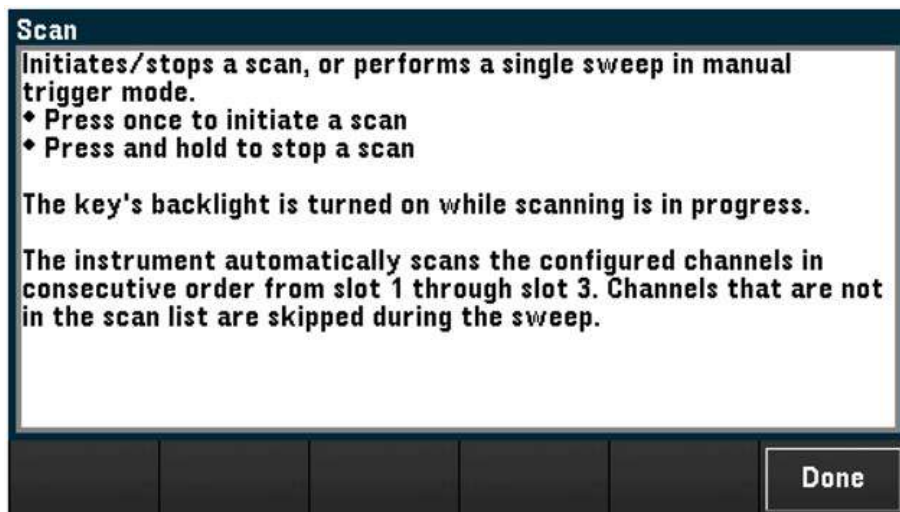
En este ejemplo, se seleccionó 1 Get HELP on any key (Obtener ayuda en cualquier tecla). Aparece el siguiente tema de ayuda en la pantalla:



Presione Done para salir de la ayuda.

## Ver la información de ayuda para una tecla del panel frontal

Mantenga presionada cualquier tecla del panel frontal o tecla de función para obtener ayuda de acuerdo con el contexto, como **[Scan]**. Si el mensaje contiene más información de la que entra en la pantalla, use la perilla o las teclas de flecha del panel frontal para pasar a la página anterior/siguiente.



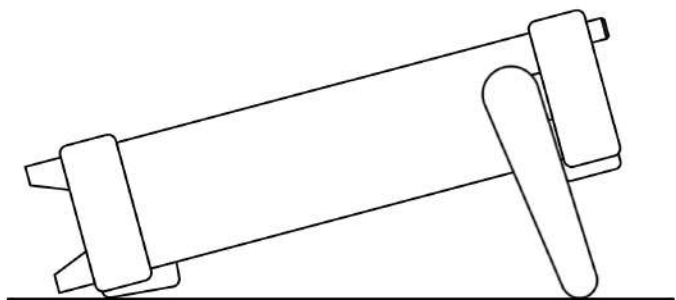
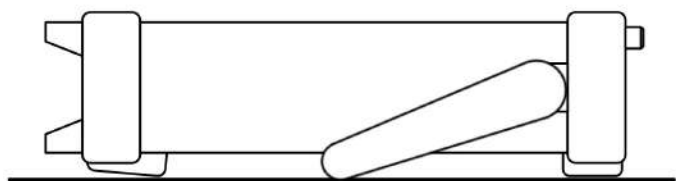
Presione **Done** para salir de la ayuda.

## Ver la información del instrumento.

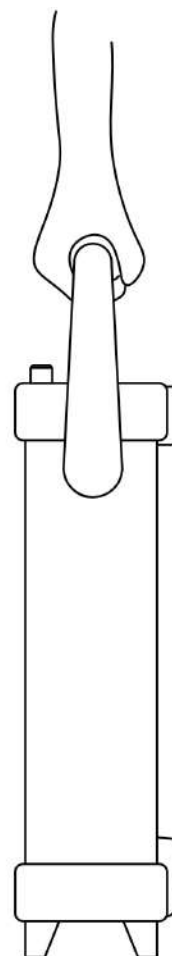
Presione **[Home]** > **Help** > **About** para ver la información del instrumento, como el número de serie del producto, la dirección IP (cuando está conectado a la interfaz LAN) y la revisión del firmware instalado actualmente. Presione **Done** para salir.

## Ajuste de la manija para transportar

La manija para transportar tiene tres posiciones (como se muestra a continuación). Para ajustar la posición de la manija, tome los lados, tire hacia afuera y gire la manija.



Posiciones de visualización superior del banco



Posición de transporte

## Montaje del instrumento en un bastidor

Puede montar el instrumento en un bastidor/gabinete de 19 pulgadas estándar al pedir el kit de montaje en bastidor con el número de pieza que se proporciona a continuación. Con cada kit se incluyen las instrucciones y el hardware de montaje. Cualquier instrumento Keysight System II del mismo tamaño se puede montar en un bastidor junto al DAQ970A/DAQ973A.

### PRECAUCIÓN

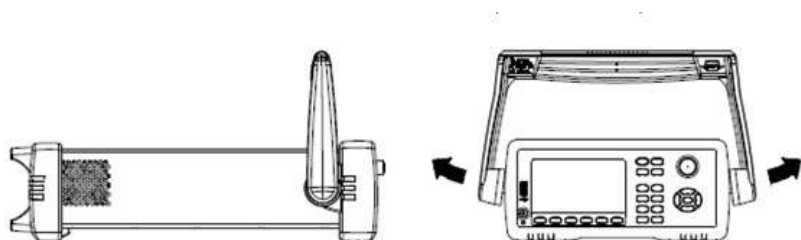
Para evitar el sobrecalentamiento, no bloquee el flujo de aire hacia o desde el instrumento. Deje suficiente espacio en la parte posterior, los laterales y la parte inferior del instrumento para permitir un flujo de aire interno adecuado.

### NOTA

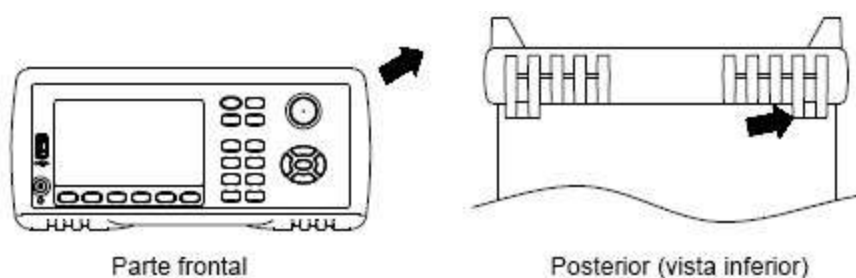
Retire la manija para transporte y los topes de goma delanteros y posteriores antes de montar el instrumento en el bastidor.

### Desmontaje de la manija y los topes

Para quitar la manija, gírela a la posición vertical y tire de los extremos hacia afuera.

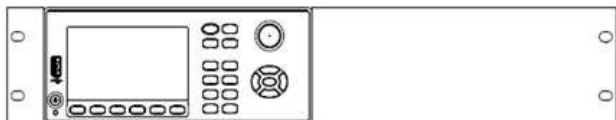


Para quitar los topes de goma delanteros y posteriores, estire una esquina y luego deslícelo hacia afuera.



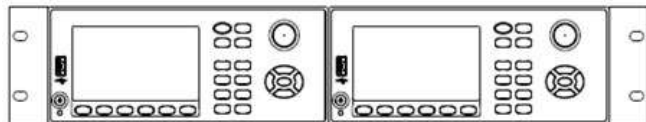
### Montaje de un único instrumento en un bastidor

Para montar un único instrumento, ordene el kit adaptador (número de pieza: DAQA190A o 1CM124A).



## Montaje de instrumentos lado a lado en un bastidor

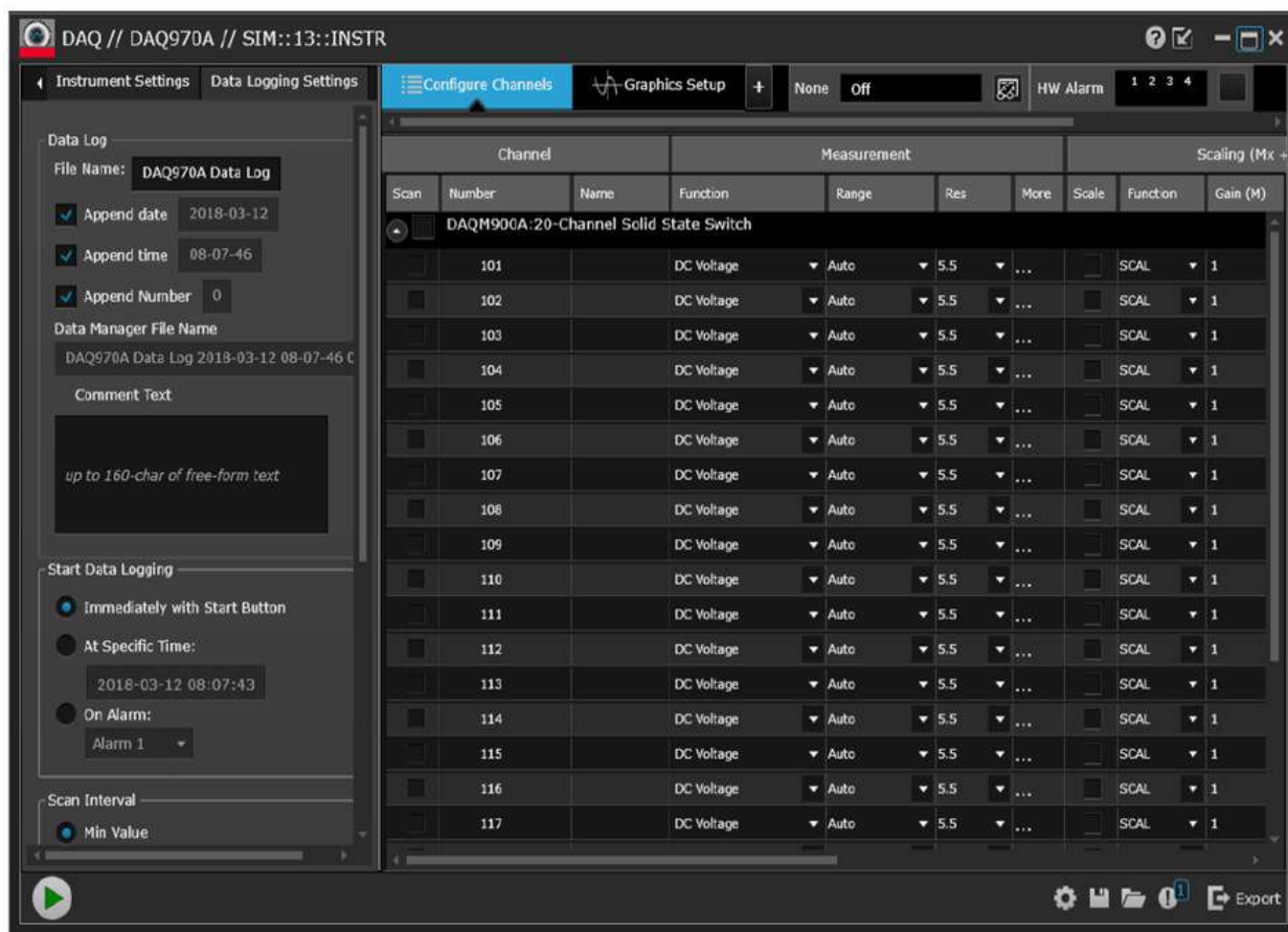
Para montar dos instrumentos, uno al lado del otro, ordene el kit de enlace cerrado (número de pieza: DAQA194A o 34194A) y el kit de pestaña (número de pieza: DAQA191A o 1CM107A). Asegúrese de utilizar los rieles de soporte dentro del gabinete del bastidor.



## Software Keysight BenchVue Data Acquisition (DAQ)

El software Keysight BenchVue Data Acquisition (DAQ) es una aplicación basada en Windows que facilita el uso del instrumento con su PC para recopilar y analizar mediciones. Utilice este software para configurar su prueba, adquirir y archivar datos de medición y realizar una visualización y análisis en tiempo real de sus mediciones. El software Keysight BenchVue Data Acquisition (DAQ) se puede descargar desde [www.keysight.com/find/benchvue](http://www.keysight.com/find/benchvue).

Pantalla principal de la aplicación:



## Licencias de software de BenchVue Data Acquisition (DAQ)

Para evaluar una aplicación de BenchVue durante un periodo de prueba gratuito de 30 días, vaya a la vista de BenchVue Application, haga clic una vez en la aplicación deseada y luego haga clic en el botón "Start Trial" (Iniciar prueba). El periodo de prueba se basa en la cantidad de días calendario restantes. Después de que termine el periodo de prueba, se le solicitará que compre una licencia de software para esa aplicación. Las opciones de licencia flexibles de Keysight le permiten seleccionar el tipo de licencia y los términos de licencia que mejor se adapten a sus necesidades de software. Para obtener más información sobre la compra e instalación de una licencia de software, consulte las Opciones de licencia del software de BenchVue en la Ayuda del software Keysight BenchVue Data Acquisition (DAQ).



# 3 Funciones y operaciones

Descripción general del sistema

Referencias del menú del panel frontal

Tecla [Scan/Start]

Menú [Monitor]

Menú [Home]

Menú [View]

Menú [Channel]

Menú [Interval]

Menú [Math]

Menú [Copy]

Menú [Alarm]

Menú [Utility]

Menú [Module]

Menú [Save Recall]

Interfaz web

Descripción general del módulo

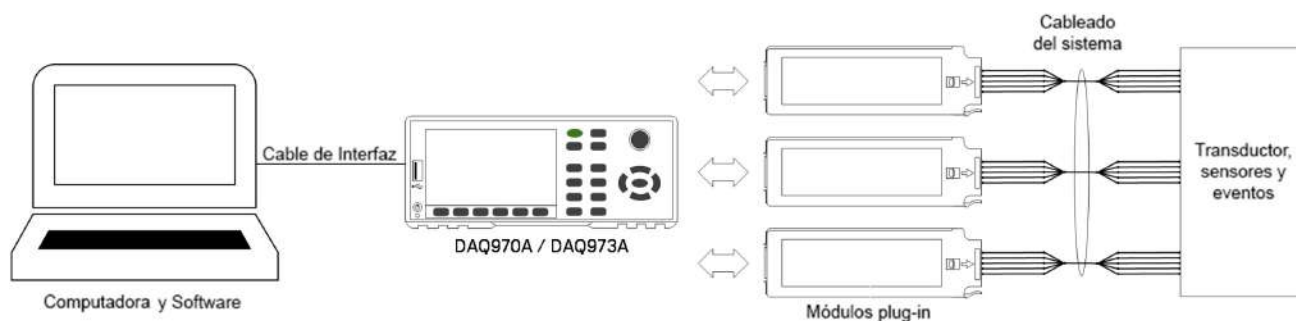
## Descripción general del sistema

Esta sección proporciona una descripción general de un sistema basado en computadora y describe las partes de un sistema de adquisición de datos.

- Descripción general del sistema de adquisición de datos
- 
- Salida de control

## Descripción general del sistema de adquisición de datos

Puede usar el Keysight DAQ970A/DAQ973A como un instrumento independiente, pero hay muchas aplicaciones que puede aprovechar debido a las funciones de conectividad de PC incorporadas. A continuación, se muestra un sistema típico de adquisición de datos:

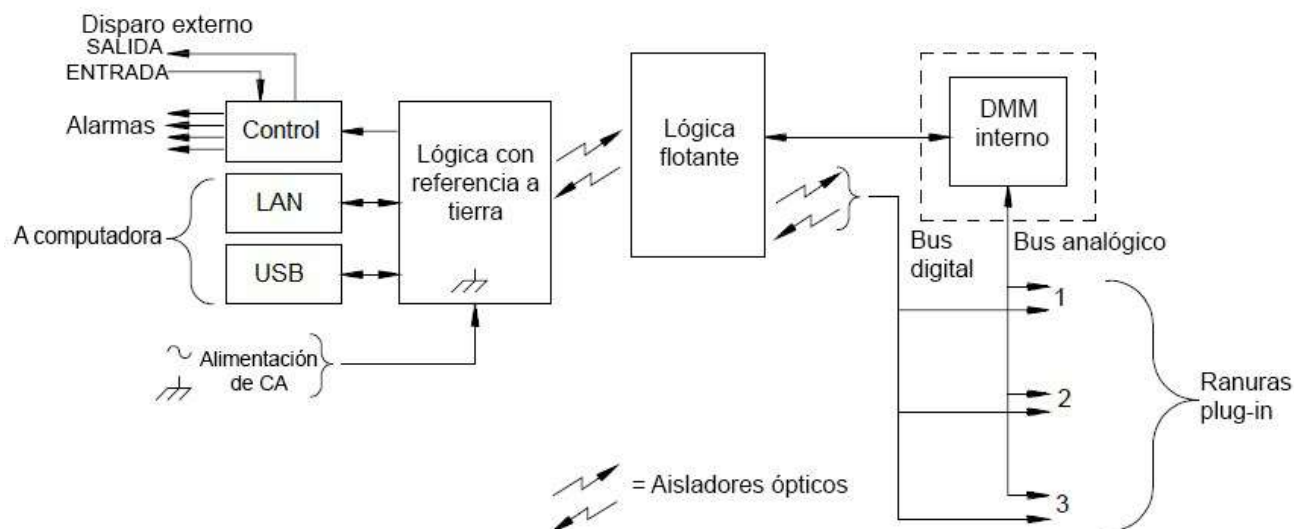


La configuración ofrece las siguientes ventajas:

- Puede usar el DAQ970A/DAQ973A para realizar almacenamiento de datos, reducción de datos, cálculos matemáticos y conversión a unidades de ingeniería. Puede utilizar la PC para facilitar la configuración y la presentación de datos.
- Puede eliminar los sensores de medición y las señales analógicas del entorno ruidoso de la PC y aislarlos eléctricamente de la PC y la conexión a tierra.
- Puede obtener una sola PC para supervisar múltiples instrumentos y puntos de medición mientras realiza otras tareas basadas en PC.

## DAQ970A/DAQ973A Circuito lógico

Como se muestra a continuación, el circuito lógico para el DAQ970A/DAQ973A está dividido en dos secciones: con puesta a tierra y flotante. Estas dos secciones están aisladas entre sí para mantener la precisión y repetibilidad de la medición. Consulte **Ruido causado por bucles de tierra** para obtener más detalles sobre los bucles de tierra.



Los circuitos de puesta a tierra y flotante se comunican entre sí a través de un enlace de datos aislado ópticamente. La sección de puesta a tierra se comunica con la sección flotante para proporcionar conectividad a la PC. El DAQ970A/DAQ973A se entrega con conectividad de interfaces LAN y USB.

La sección de puesta a tierra también proporciona cuatro salidas de alarma de hardware y líneas de disparo externas. Puede usar las líneas de salida de alarma para activar sirenas, luces de alarma externas o enviar un pulso compatible con TTL a su sistema de control.

La sección flotante contiene el procesador principal del sistema y controla todas las funciones básicas del instrumento. Aquí es donde el instrumento se comunica con los módulos plug-in, escanea el teclado, controla la pantalla del panel frontal y controla el DMM interno. Las secciones flotantes también realizan escalas de medición, monitorean las condiciones de alarma, convierten las mediciones del transductor en unidades de ingeniería, marcan las mediciones escaneadas y guardan los datos en la memoria no volátil.

## Módulos plug-in

El DAQ970A/DAQ973A ofrece una selección completa de módulos plug-in para proporcionar medición, conmutación y capacidades de control de gran calidad. Los módulos plug-in se comunican con la lógica flotante a través del bus digital interno aislado. Los módulos multiplexores también se conectan al DMM interno a través del bus analógico interno. Cada módulo tiene su propio microprocesador para descargar el procesador de la unidad principal y minimizar las comunicaciones del panel posterior para un rendimiento más rápido. Consulte [Descripción general del módulo](#) para obtener más información.

| Número de módulo                | Usos comunes                                                                                                                     |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Entrada de medición</b>      |                                                                                                                                  |
| DAQM900A                        | Escaneo y medición directa de temperatura, voltaje, resistencia, frecuencia y corriente (solo DAQM901A) mediante el DMM interno. |
| DAQM901A                        |                                                                                                                                  |
| DAQM902A                        |                                                                                                                                  |
| DAQM907A                        | Entrada digital, conteo de eventos.                                                                                              |
| DAQM908A                        | Escaneo y medición directa de temperatura, voltaje, resistencia mediante el DMM interno.                                         |
| DAQM909A                        | Digitalizar la medición del voltaje y la deformación mediante el uso de digitalizadores de la placa.                             |
| <b>Enrutamiento de la señal</b> |                                                                                                                                  |
| DAQM900A                        | No disponible                                                                                                                    |
| DAQM901A                        | Multiplexación de señales hacia o desde instrumentos externos.                                                                   |
| DAQM902A                        | No disponible                                                                                                                    |
| DAQM904A                        | Conmutación de matriz de 32 puntos de cruce.                                                                                     |
| DAQM905A                        | Aplicaciones de alta frecuencia de 50 $\Omega$ (<2 GHz).                                                                         |
| DAQM908A                        | No disponible                                                                                                                    |
| <b>Salida de control</b>        |                                                                                                                                  |
| DAQM903A                        | Conmutación y control de uso general mediante los conmutadores de Forma C (SPDT).                                                |
| DAQM907A                        | Salida digital, salidas de voltaje (DAC).                                                                                        |

## Cableado del sistema

Los módulos plug-in tienen conectores de terminal de tornillo para facilitar la conexión del cableado de su sistema. El tipo de cableado que utiliza para conectar sus señales, transductores y sensores al módulo es fundamental para el éxito de la medición. Algunos tipos de transductores, como los termopares, tienen requisitos muy específicos respecto del tipo de cable que debe usar para hacer las conexiones. Asegúrese de considerar el entorno de uso al elegir calibre del cable y las cualidades de aislamiento. El aislamiento del cable consiste típicamente en materiales tales como PVC o PTFE. La siguiente tabla enumera varios tipos de cables comunes y describe sus usos típicos.

**NOTA**

El aislamiento y el uso del cableado se describen con más detalle en [Sistema de cableado y conexiones](#).

| Tipos de cables                                 | Usos comunes                                                    | Comentarios                                                                                                                                                                                                                                                                                |
|-------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cable de extensión del termopar                 | Mediciones de termopares.                                       | Disponible en tipos específicos de termopares. También disponible en cable blindado para mayor inmunidad al ruido.                                                                                                                                                                         |
| Par trenzado,<br>Par trenzado blindado          | Salidas de mediciones, salidas de voltaje, conmutación, conteo. | El cable más común para entradas de medición de baja frecuencia. El par trenzado reduce el ruido de modo común. El par trenzado blindado proporciona inmunidad al ruido adicional.                                                                                                         |
| Coaxial blindado,<br>Coaxial con doble blindaje | Conmutación de señal VHF.                                       | El cable más común para enrutamiento de señales de alta frecuencia. Disponible en valores de impedancia específica (50 $\Omega$ o 75 $\Omega$ ). Proporciona excelente inmunidad al ruido. El cable de doble blindaje mejora el aislamiento entre canales. Requiere conectores especiales. |
| Cinta plana,<br>Cinta de par trenzado           | Entrada/Salida Digital                                          | A menudo se utiliza con conectores de terminación de masa. Estos cables proporcionan poca inmunidad al ruido.                                                                                                                                                                              |

## Transductores y sensores.

Los transductores y sensores convierten una cantidad física en una cantidad eléctrica. La cantidad eléctrica se mide y el resultado se convierte en unidades de ingeniería. Por ejemplo, al medir un termopar, el instrumento mide un voltaje de CC y lo convierte matemáticamente a la temperatura correspondiente en °C, °F o K.

| Medición    | Tipos de transductores comunes | Salidas de transductores comunes                           |
|-------------|--------------------------------|------------------------------------------------------------|
| Temperatura | Termopar                       | 0 mV a 80 mV                                               |
|             | RTD                            | Resistencia de 2 o 4 alambres de 5 $\Omega$ a 500 $\Omega$ |
|             | Termistor                      | Resistencia de 2 alambres de 10 $\Omega$ a 1M $\Omega$     |
| Presión     | Estado sólido                  | $\pm 10$ DVC                                               |
| Flujo       | Tipo rotatorio                 | 4 mA a 20 mA                                               |
|             | Tipo térmico                   |                                                            |
| Deformación | Elementos resistivos           | Resistencia de 4 alambres de 10 $\Omega$ a 10 k $\Omega$   |
| Eventos     | Interruptores de límite        | Tren de impulsos de 0 V o 5 V                              |
|             | Contadores ópticos             |                                                            |
|             | Codificador rotatorio          |                                                            |
| Digital     | Estado del sistema             | Niveles compatibles con TTL                                |

## Límites de alarma

El DAQ970A/DAQ973A tiene cuatro salidas de alarma que puede configurar para que le avisen cuando una lectura excede los límites especificados en un canal durante un escaneo. Puede asignar un límite alto, un límite bajo o ambos a cualquier canal configurado en la lista de escaneo. Puede asignar varios canales a cualquiera de las cuatro alarmas disponibles (numeradas del 1 al 4). Por ejemplo, puede configurar el instrumento para generar una alarma en la Alarma 1 cuando se excede un límite en cualquiera de los canales 103, 205 o 320.

También puede asignar alarmas a los canales en el módulo multifunción. Por ejemplo, genere una alarma cuando se detecte un patrón de bits específico o un cambio de patrón de bits en un canal de entrada digital o cuando se alcance un conteo específico en un canal totalizador. Con el módulo multifunción, los canales no tienen que formar parte de la lista de escaneo para generar una alarma.

### Enrutamiento y conmutación de la señal

Las capacidades de conmutación de los módulos plug-in disponibles con el DAQ970A/DAQ973A proporcionan flexibilidad y capacidad de expansión del sistema de prueba. Puede usar los módulos plug-in de conmutación para enrutar señales hacia y desde su sistema de prueba o multiplexar señales al DMM interno o a instrumentos externos.

Los relés son dispositivos electromecánicos que están sujetos a modos de falla por desgaste. La vida útil de un relé, o el número de operaciones reales antes del fallo, depende de cómo se use: carga aplicada, frecuencia de conmutación y entorno. El sistema de mantenimiento de relés del DAQ970A/DAQ973A cuenta automáticamente los ciclos de cada relé en el instrumento y almacena el conteo total en la memoria no volátil en cada módulo de conmutación. Utilice esta función para rastrear fallas de relé y para predecir los requisitos de mantenimiento del sistema.

### Topologías de conmutación

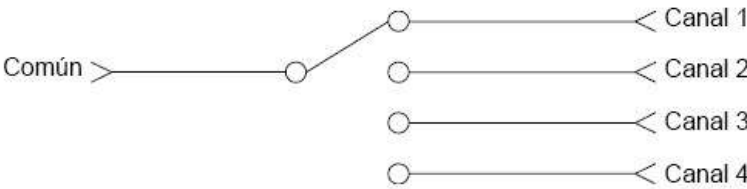
Hay varios módulos de plug-in de conmutación disponibles con diferentes topologías para varias aplicaciones:

| Topologías de conmutación        | Módulos plug-in                                  |
|----------------------------------|--------------------------------------------------|
| Multiplexor                      | DAQM900A, DAQM901A, DAQM902A, DAQM905A, DAQM908A |
| Matrix                           | DAQM904A                                         |
| Forma C (polo único, doble tiro) | DAQM903A                                         |

Las siguientes secciones describen cada una de estas topologías de conmutación.

#### Conmutación del multiplexor

Los multiplexores le permiten conectar uno de varios canales a un canal común, uno a la vez. A continuación se muestra un multiplexor de 4 a 1 simple. Cuando combina un multiplexor con un dispositivo de medición, como el DMM interno, crea un escáner. Para obtener más información sobre el escaneo, consulte [Escaneo](#).

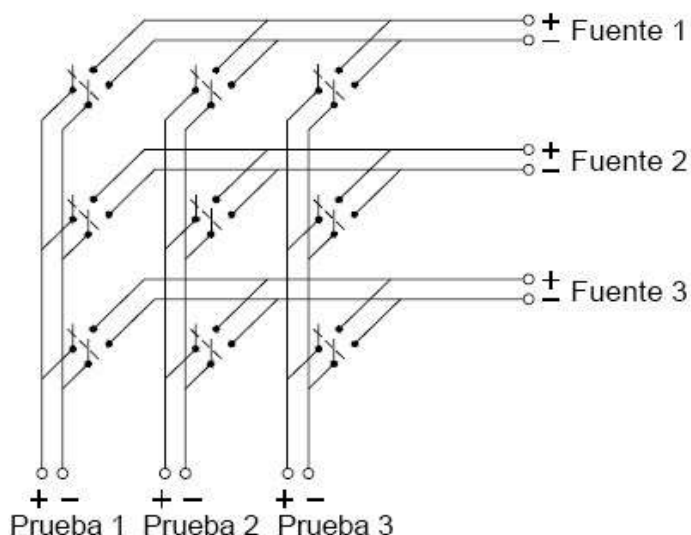


Los multiplexores están disponibles en varios tipos:

| Tipo de multiplexor     | Uso común                                                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Un alambre (un extremo) | Para mediciones de LO comunes. Para obtener más información, consulte <a href="#">Multiplexores de un alambre (un extremo)</a> .                                       |
| Dos alambres            | Para mediciones flotantes. Para obtener más detalles, consulte <a href="#">Multiplexores de dos alambres</a> .                                                         |
| Cuatro alambres         | Para mediciones de resistencia y RTD. Para obtener más información, consulte <a href="#">Multiplexores de cuatro alambres</a> .                                        |
| Señales RF              | Muy alta frecuencia (VHF) para frecuencias de conmutación de hasta 2,8 GHz.<br>Para obtener más información, consulte <a href="#">Multiplexores para señal de RF</a> . |

### Conmutación de matriz

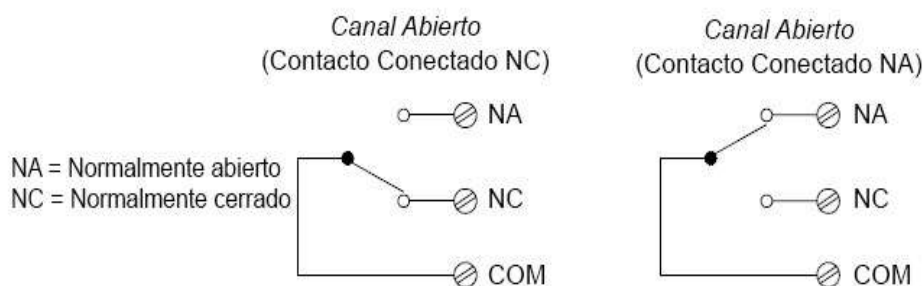
Un conmutador de matriz conecta múltiples entradas a múltiples salidas y, por lo tanto, ofrece más flexibilidad de conmutación que un multiplexor. Use una matriz para conmutar señales de baja frecuencia (menos de 10 MHz) solamente. Una matriz está dispuesta en filas y columnas. Por ejemplo, una matriz simple de 3x3 podría usarse para conectar tres fuentes a tres puntos de prueba, como se muestra a continuación:



Cualquiera de las fuentes de señal se puede conectar a cualquiera de las entradas de prueba. Tome en cuenta que con una matriz, es posible asegurarse de que estas conexiones no creen condiciones peligrosas o no deseadas.

### Conmutación de forma C (SPDT)

El DAQM903A contiene 20 interruptores de Forma C (también llamados de polo único, doble tiro). Puede usar los interruptores de Forma C para enrutar las señales, pero generalmente se usan para controlar dispositivos externos.





## Entrada de medición

El DAQ970A/DAQ973A le permite combinar un DMM (ya sea interno o externo) con los canales del multiplexor para crear un escaneo. Durante un escaneo, el instrumento conecta el DMM a los canales del multiplexor configurados uno a la vez y realiza una medición en cada canal.

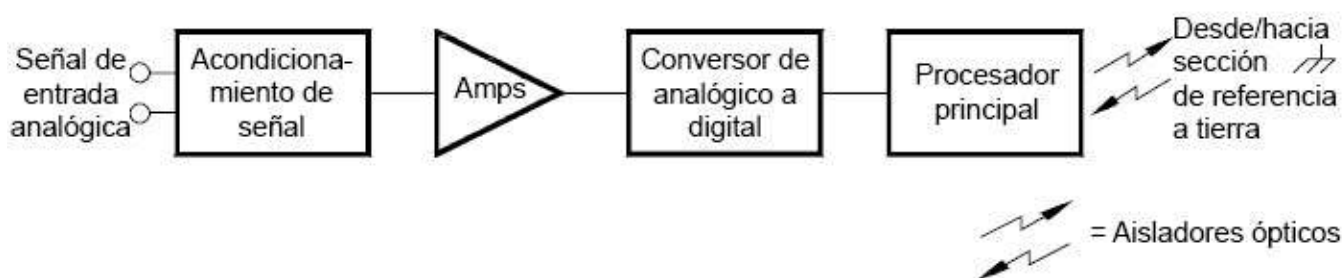
Cualquier canal que el instrumento pueda “leer” también puede incluirse en un escaneo. Esto incluye cualquier combinación de mediciones de temperatura, voltaje, resistencia, corriente, frecuencia o período en los canales del multiplexor. Un escaneo también puede incluir una lectura de un puerto digital, una lectura mediante el detector de canal o una lectura del conteo del totalizador en el módulo multifunción.

## El DMM interno

Un transductor o sensor convierte una cantidad física que se mide en una señal eléctrica que puede ser medida por el DMM interno. Para realizar estas mediciones, el DMM interno incorpora las siguientes funciones:

- Temperatura (termopar, RTD y termistor)
- Voltaje (CC y CA hasta 300 V)
- Resistencia (2 y 4 alambres hasta 1 G $\Omega$ )
- Corriente (CC y CA hasta 1 A)
- Frecuencia y período (hasta 300 kHz)

El DMM interno proporciona un front-end de entrada universal para medir una variedad de tipos de transductores sin la necesidad de un acondicionamiento de señal externo adicional. El DMM interno incluye acondicionamiento de señal, amplificación (o atenuación) y un convertidor analógico a digital de alta resolución (hasta 22 bits). A continuación, se muestra un diagrama simplificado del DMM interno:



### **Acondicionamiento de señales, rango y amplificación.**

Las señales de entrada analógica se multiplexan en la sección de acondicionamiento de señal del DMM interno, que generalmente incluye circuitos de conmutación, rango y amplificación. Si la señal de entrada es un voltaje de CC, el acondicionador de señal está compuesto por un atenuador para los voltajes de entrada más altos y un amplificador de CC para los voltajes de entrada más bajos. Si la señal de entrada es un voltaje de CA, se utiliza un conversor para convertir la señal de CA a su valor de CC equivalente (valor RMS verdadero). Las mediciones de resistencia se realizan suministrando una corriente de CC conocida a una resistencia desconocida y midiendo la caída de voltaje de CC a través de la resistencia. El circuito de conmutación y rango de la señal de entrada, junto con el circuito del amplificador, convierte la entrada a un voltaje de CC que está dentro del rango de medición del conversor analógico a digital (ADC) del DMM interno.

Puede permitir que el instrumento seleccione automáticamente el rango de medición utilizando el rango automático o puede seleccionar un rango de medición fijo usando el rango manual. Conviene utilizar el rango automático porque el instrumento selecciona automáticamente el rango a usar para cada medición en función de la señal de entrada. Para una operación de escaneo más rápida, use el rango manual para cada medición (se requiere algo de tiempo adicional para un cambio de rango ya que el instrumento tiene que hacer una selección de rango).

### **Conversión de analógico a digital (ADC)**

La ADC toma un voltaje de CC preescalado del circuito de acondicionamiento de señal y lo convierte en datos digitales para su salida y visualización en el panel frontal. La ADC controla algunas de las características de medición más básicas.

Estas incluyen la resolución de la medición, la velocidad de lectura y la capacidad de rechazar el ruido no esencial. Existen varias técnicas de conversión de analógico a digital, pero se pueden dividir en dos tipos: integradoras y no integradoras. Las técnicas de integración miden el valor de entrada promedio en un intervalo de tiempo definido, rechazando así muchas fuentes de ruido. Las técnicas de no integración ofrecen una muestra del valor instantáneo de la entrada, más el ruido, durante un intervalo muy corto. El DMM interno utiliza una técnica de integración de ADC.

### **Procesador principal**

El procesador principal, ubicado en la sección de lógica flotante, controla el acondicionamiento de la señal de entrada, el rango y el ADC. El procesador principal acepta comandos y envía los resultados de las mediciones a la sección de lógica con puesta a tierra. El procesador principal sincroniza las mediciones durante las operaciones de escaneo y control. El procesador principal utiliza un sistema operativo multitarea para administrar los diversos recursos y demandas del sistema.

El procesador principal también calibra los resultados de las mediciones, realiza el escalado  $Mx+B$ , supervisa las condiciones de alarma, convierte las mediciones del transductor en unidades de ingeniería, marca el tiempo de las mediciones escaneadas y almacena los datos en una memoria no volátil.

## Escaneo

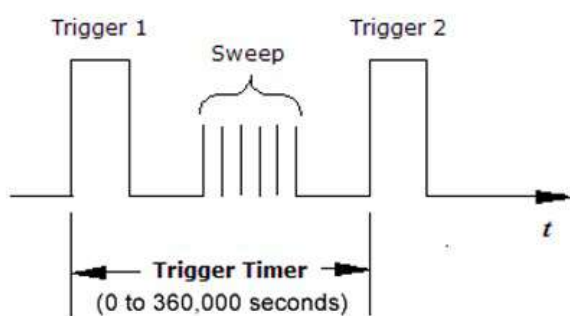
El instrumento le permite combinar un DMM (ya sea interno o externo) con los canales del multiplexor para crear un escaneo. Durante un escaneo, el instrumento conecta el DMM a los canales del multiplexor configurados uno a la vez y realiza una medición en cada canal.

Antes de iniciar un escaneo, debe configurar una lista de escaneo para incluir todos los canales digitales o multiplexores deseados. Los canales que no están en la lista de escaneo se omiten durante el escaneo. El instrumento escanea automáticamente la lista de canales en orden ascendente desde la ranura 1 a la ranura 3. Las mediciones se realizan solo durante un escaneo y solo en aquellos canales que están incluidos en la lista de escaneo.

Puede almacenar hasta 1,000,000 lecturas en una memoria no volátil durante un escaneo. Las lecturas se almacenan solo durante un escaneo y todas las lecturas se marcan automáticamente con la hora. Cada vez que inicia un nuevo escaneo, el instrumento borra todas las lecturas almacenadas en la memoria del escaneo anterior. Por lo tanto, todas las lecturas almacenadas actualmente en la memoria pertenecen al escaneo más reciente.

Puede configurar el evento o la acción que controla el inicio de cada barrido a través de la lista de escaneo (un barrido es una pasada a través de la lista de escaneo).

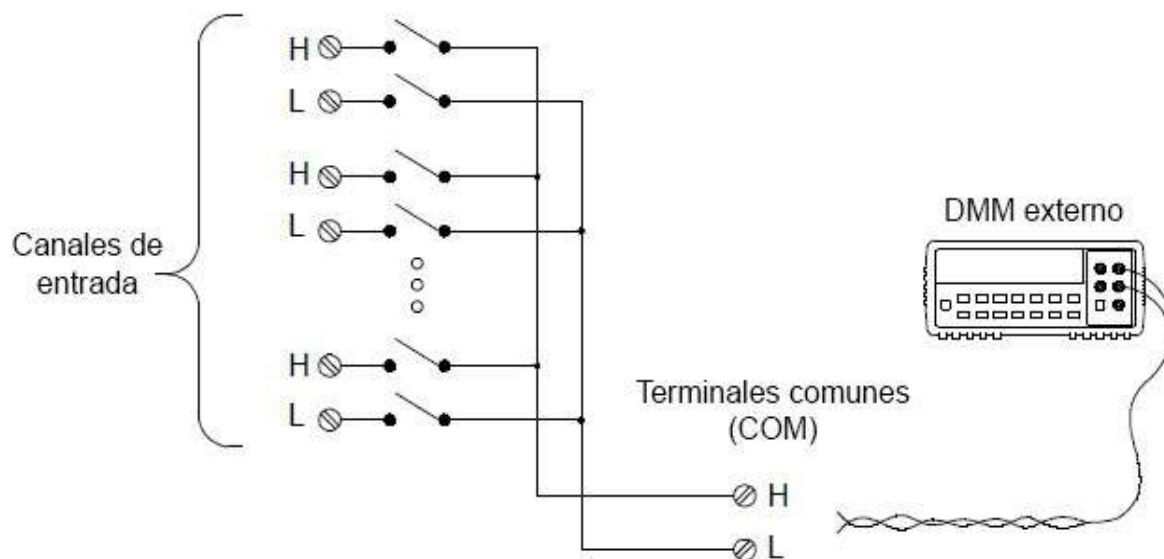
- Puede configurar el temporizador interno del instrumento para escanear automáticamente en un intervalo específico como se muestra a continuación. También puede programar un retraso de tiempo entre los canales en la lista de escaneo.



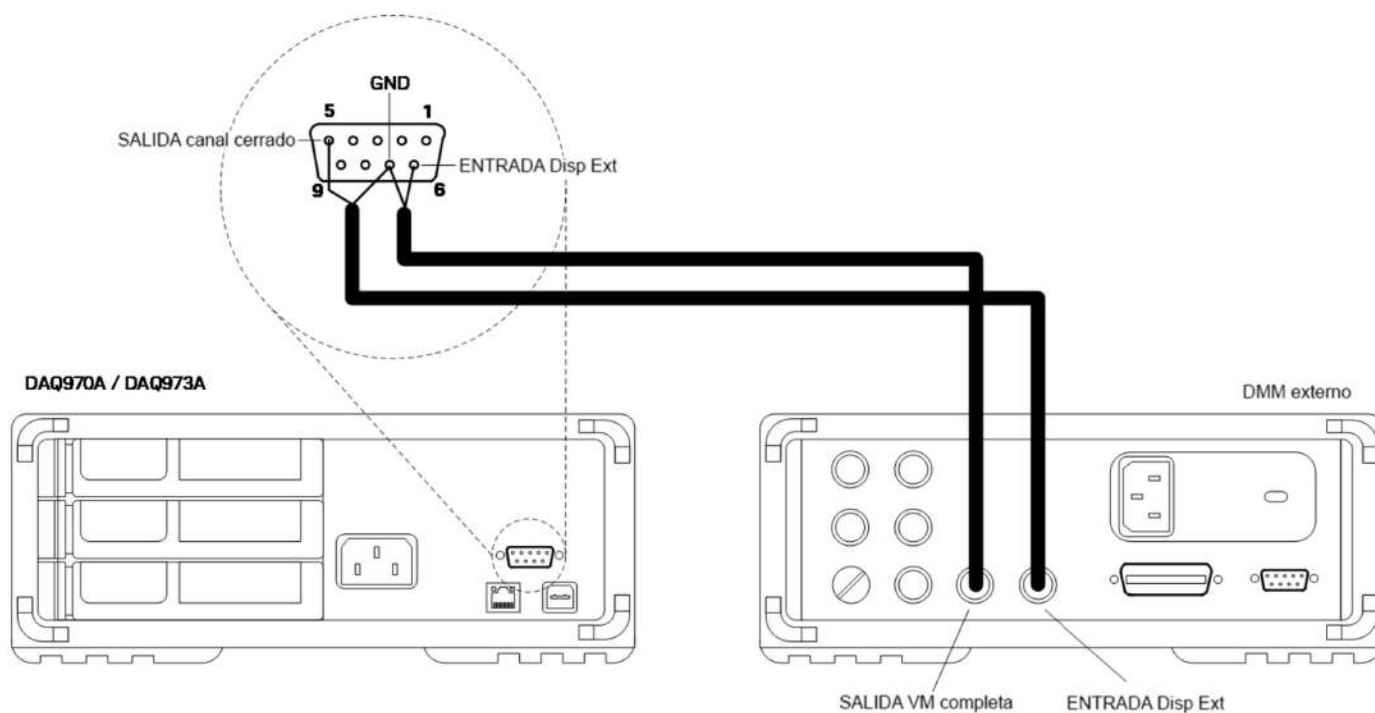
- Puede controlar manualmente un escaneo presionando repetidamente la tecla **[Scan/Start]** desde el panel frontal.
- Puede iniciar un escaneo enviando un comando de software desde la interfaz remota.
- Puede iniciar un escaneo cuando se recibe un impulso de disparo compatible con TTL externo.
- Puede iniciar un escaneo cuando se registra una condición de alarma en el canal que se está monitoreando.

## Escaneo con instrumentos externos

Puede usar el DAQ970A/DAQ973A para enrutamiento de señal o aplicaciones de control. Si instala un módulo plug-in multiplexor, puede usar el DAQ970A/DAQ973A para escanear con un instrumento externo. Puede conectar un instrumento externo (como un DMM) a la terminal COM del multiplexor.



Para controlar el escaneo con un instrumento externo, se proporcionan dos líneas de control. Cuando el DAQ970A/DAQ973A y el instrumento externo están configurados correctamente, puede sincronizar una secuencia de exploración entre los dos.



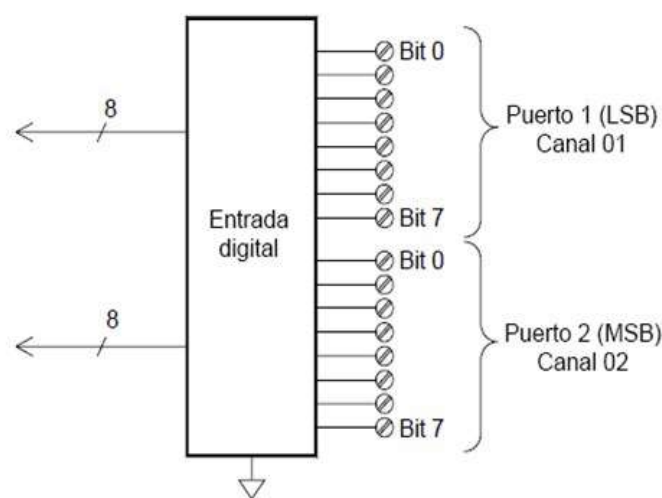
## El módulo multifunción

El módulo multifunción (DAQM907A) agrega dos funciones de entrada de medición adicional al sistema: entrada digital y totalización de evento.

El módulo multifunción también contiene una salida de voltaje dual (DAC). Para obtener más detalles, consulte [Transductores y sensores..](#)

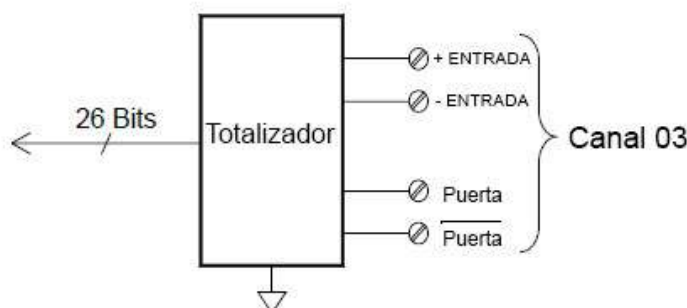
### Entrada digital

El módulo multifunción tiene dos puertos de entrada/salida de 8 bits no aislados que puede utilizar para leer patrones digitales. Puede leer el estado en vivo de los bits en el puerto o puede configurar un escaneo para que incluya una lectura digital. Cada puerto tiene un número de canal separado en el módulo y contiene 8 bits. Puede combinar los dos puertos para leer una palabra de 16 bits.



### Totalizador

El módulo multifunción tiene un totalizador de 26 bits que puede contar pulsos compatibles a una velocidad de 100 kHz. Puede leer manualmente el conteo del totalizador o puede configurar un escaneo para que lea el conteo.



Puede configurar el totalizador para que cuente con el borde ascendente o el borde descendente de la señal de entrada. La cuenta máxima es 67,108,863 ( $2^{26}-1$ ). La cuenta se desplaza a "0" después de alcanzar el valor máximo permitido. Puede configurar el totalizador para leer sin afectar el conteo o restablecer el conteo a cero sin perder ningún conteo.

## Salida de control

Además del enrutamiento y la medición de la señal, también puede usar el DAQ970A/DAQ973A para proporcionar salidas de control simples. Por ejemplo, puede controlar relés externos de alta potencia utilizando el módulo accionador o un canal de salida digital.

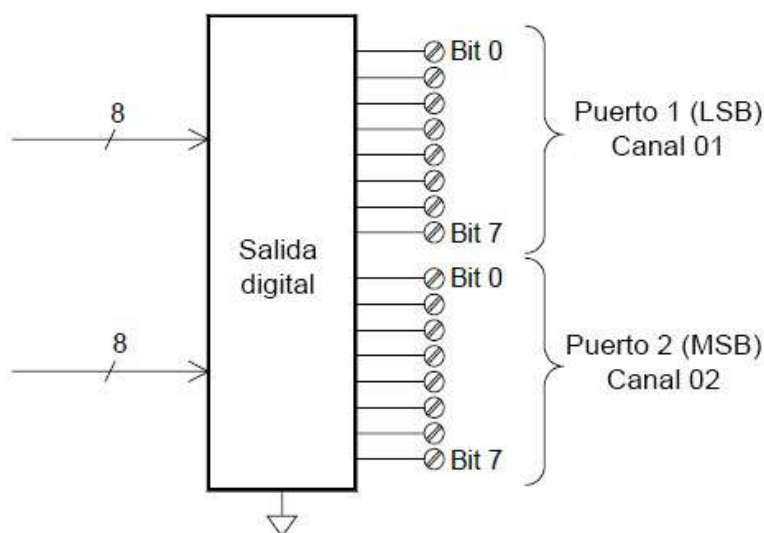
### El módulo multifunción

El módulo multifunción (DAQM907A) agrega dos recursos adicionales de salida de control al sistema: salida digital y salida de voltaje (DAC).

El módulo multifunción también contiene entradas digitales y capacidades de totalizador de eventos. Para obtener más detalles, consulte [El módulo multifunción](#).

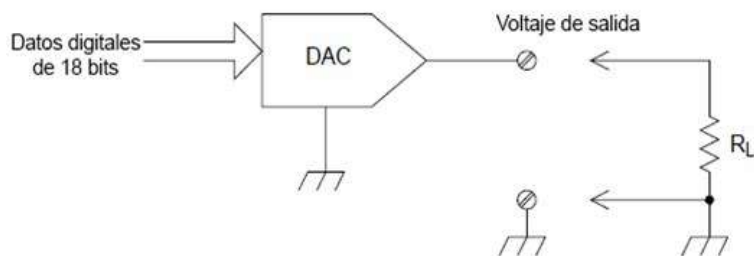
#### Salida digital

El módulo multifunción tiene dos puertos de entrada/salida de 8 bits no aislados que puede utilizar para generar patrones digitales. Cada puerto tiene un número de canal separado en el módulo y contiene 8 bits. Puede combinar los dos puertos para generar una palabra de 16 bits.



#### Salida de voltaje (DAC)

El módulo multifunción tiene dos salidas analógicas que pueden emitir voltajes calibrados entre  $\pm 12$  V con 18 bits de resolución. Cada canal DAC (Convertidor digital a analógico) se puede usar como una fuente de voltaje programable para el control de la entrada analógica de otros dispositivos. A continuación se muestra un diagrama simplificado:



Puede configurar el voltaje de salida en cualquier valor entre  $\pm 12$  VCC, en pasos de  $100\ \mu\text{V}$ . Cada DAC está conectado a tierra, no puede flotar. Cada canal DAC puede suministrar una corriente máxima de  $15\ \text{mA}$  durante el modo de voltaje de salida. O puede configurar el DAC en modo de corriente constante, para emitir cualquier corriente entre  $\pm 24\ \text{mA}$ , en pasos de  $0,2\ \mu\text{A}$ .

Cada canal DAC puede suministrar una corriente máxima de  $24\ \text{mA}$ .

**NOTA**

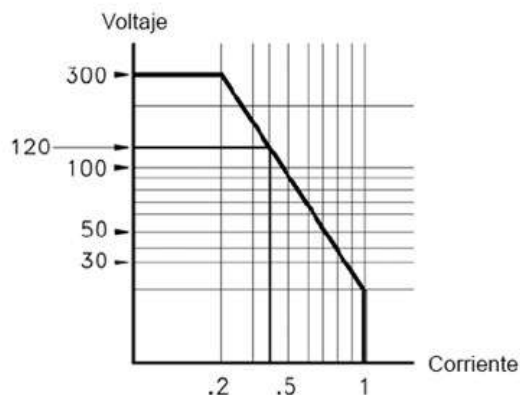
Debe limitar la corriente de salida a  $40\ \text{mA}$  para cada ranura (dos canales DAC).

### Accionador/interruptor de uso general

Puede pensar en el accionador DAQM903A como una salida de control porque a menudo se usa para controlar dispositivos de alimentación externos. El accionador proporciona 20 interruptores independientes aislados de Forma C (SPDT).



Cada canal puede conmutar hasta  $300\ \text{V CC}$  o  $\text{CA rms}$ . Cada interruptor también puede conmutar hasta  $1\ \text{A CC}$  o  $\text{CA rms}$  hasta un máximo de  $50\ \text{W}$ . Por ejemplo, la corriente máxima que puede conmutar a  $120\ \text{V}$  es  $0,45\ \text{A}$  como se muestra a continuación:



Para aplicaciones de control, el accionador tiene las siguientes ventajas:

Mayor voltaje y potencia nominal que los canales de salida digital. Los interruptores del accionador también pueden usarse para controlar dispositivos de potencia.

Sin embargo, cuando se utiliza con dispositivos de alta potencia, es fundamental que proporcione protección de cargas capacitivas e inductivas al interruptor para garantizar la máxima vida útil del relé.

Para obtener más información sobre los atenuadores, consulte [Utilización de atenuadores](#).



## Referencias del menú del panel frontal

La siguiente tabla resume las teclas del panel frontal y la estructura del menú.

| Tecla                                                                               | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <ul style="list-style-type: none"> <li>– Inicia/detiene un proceso de escaneo/digitalización, o realiza un único barrido en el modo de disparador manual.</li> <li>– Presione una vez para iniciar un escaneo/digitalización; mantenga pulsado para detener la operación.</li> <li>– La luz de fondo de la tecla se enciende mientras el escaneo/digitalización están en curso.</li> <li>– En los modos de adquisición de datos DMM Digitize y Digitizer, la luz de fondo de la tecla también se enciende mientras el guardado automático está en curso</li> <li>– En el modo de adquisición de datos Scan, el instrumento detecta los canales configurados en orden consecutivo de la ranura 1 a la 3. Los canales que no están configurados se omiten.</li> <li>– En el modo de adquisición de datos DMM Digitize, el instrumento inicia automáticamente la operación de digitalización del DMM en un solo canal configurado.</li> <li>– En el modo de adquisición Digitizer (admitido solo en el módulo plug-in DAQM909A), el instrumento inicia automáticamente la operación de digitalización de todos los canales configurados de forma simultánea.</li> </ul> |
|    | <ul style="list-style-type: none"> <li>– Monitorea los datos de medición de un canal que son útiles para la resolución de problemas del instrumento y la observación de una señal importante.</li> <li>– Puede optar por visualizar las mediciones de monitor en números, en una barra contadora, en un gráfico de tendencias o en formato de histograma.</li> <li>– La luz de fondo de la tecla se enciende mientras el control está activado. El indicador del monitor también se mostrará, y el indicador de muestra parpadeará cuando se realice la supervisión. En caso de que esté habilitado el modo de adquisición de datos Digitizer, la luz de fondo de la tecla se apaga pero el indicador continúa en la pantalla mostrando que la operación del monitor se sigue ejecutando en segundo plano.</li> <li>– Para detener el modo de monitor y volver a la página del menú de Inicio, vuelva a presionar esta tecla en la página del menú de Monitor.</li> </ul>                                                                                                                                                                                            |
|  | <ul style="list-style-type: none"> <li>– Muestra la página de Inicio donde aparece la información del instrumento y una lista de temas de ayuda en el idioma local seleccionado.</li> <li>– Selecciona el modo de adquisición de datos que se va a usar (Scan, DMM Digitize o Digitizer).</li> <li>– Mide la compensación en los canales de deformación.</li> <li>– Configura las cuatro líneas de hardware de salida de alarma.</li> <li>– Configura varias preferencias de usuario.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|  | <ul style="list-style-type: none"> <li>– Muestra lecturas de memoria escaneadas.</li> <li>– Ve las lecturas digitalizadas.</li> <li>– Muestra la cola de alarmas.</li> <li>– Muestra la cola de errores.</li> <li>– Realiza y muestra los análisis de potencia.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|  | <ul style="list-style-type: none"> <li>– Etiquetado de canales.</li> <li>– Cierra o abre los interruptores de los canales de conmutación.</li> <li>– Selecciona la función de medición.</li> <li>– Selecciona el rango o el rango automático de medición.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | <ul style="list-style-type: none"> <li>– Selecciona el tiempo de integración.</li> <li>– Configura las características avanzadas de medición.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Interval</b>                  | <ul style="list-style-type: none"> <li>– Configura qué inicia cada barrido, o el intervalo entre barridos, y el número de barridos durante el escaneo.</li> <li>– Configura el temporizador de la muestra, el conteo de muestras y las configuraciones del disparador del digitalizador.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Math</b>                      | <ul style="list-style-type: none"> <li>– Configura la escala de medición (mX+b, %, dBm, o dB) en el canal de corriente.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Copy</b>                      | <ul style="list-style-type: none"> <li>– Copia la configuración de medición del (de los) canal(es) seleccionado(s) a otro(s) canal(es).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Alarm</b>                     | <ul style="list-style-type: none"> <li>– Configura la alarma en el canal seleccionado. Puede configurar cuatro alarmas en este instrumento.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Utility</b>                   | <ul style="list-style-type: none"> <li>– Prueba automática.</li> <li>– Calibración.</li> <li>– Autocalibración. Seguridad del instrumento (NISPO).</li> <li>– Actualización de firmware.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Module</b>                    | <ul style="list-style-type: none"> <li>– Vista general de la lista de escaneo del módulo.</li> <li>– Realiza un restablecimiento del módulo.</li> <li>– Etiquetado de módulos.</li> <li>– Ve la información sobre el DMM interno.</li> <li>– Ve la información sobre el ciclo del relé de los módulos.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Save<br/>Recall<br/>Local</b> | <ul style="list-style-type: none"> <li>– Guarda y recupera los archivos de estado (extensión.sta) y los archivos de preferencias (extensión.prf) de los instrumentos.</li> <li>– Gestión de archivos.</li> <li>– Guarda las lecturas del gráfico de tendencias o del histograma.</li> <li>– Captura y guarda la imagen de la pantalla.</li> <li>– Restablecimiento de fábrica del instrumento y la preselección del sistema.</li> <li>– Registro de datos en una unidad USB en el panel frontal.</li> <li>– Guarda automáticamente los datos del digitalizador en una unidad USB en el panel frontal.</li> <li>– Hace que el instrumento vuelva al modo de control local cuando está en modo de control remoto.</li> </ul> |

## Tecla [Scan/Start]

Presione la tecla **[Scan/Start]** en el panel frontal para iniciar o detener cualquier operación de escaneo o digitalización, o para realizar un solo barrido/registro al operar en el modo de disparador manual. Consulte el **Menú [Interval]** para obtener más información sobre cómo se utiliza la tecla **[Scan/Start]** cuando se selecciona el modo de disparador manual.

La luz de fondo de la tecla **[Scan/Start]** se enciende mientras el escaneo/digitalización está en curso. Para detener la operación de escaneo o digitalización, mantenga presionada la tecla **[Scan/Start]** durante más de dos segundos. En el modo de adquisición de datos Scan, aparece "Scan stopped" (Se detuvo el escaneo) cuando concluye la operación. De la misma forma, en los modos de adquisición de datos DMM Digitize y Digitizer, aparecerán respectivamente "DMM Digitize stopped" (Se detuvo DMM Digitize) y "Digitizer stopped" (Se detuvo Digitizer) cuando termine la operación.

### NOTA

Cuando el recurso de guardado automático (Auto Save) del menú **[Save Recall]** se active para el modo de adquisición de datos DMM Digitize/Digitizer, la operación de digitalización no empezará a menos que el instrumento detecte una unidad USB conectada al puerto USB del panel frontal.

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## Menú [Monitor]

**NOTA**

Los recursos del menú [Monitor] no están disponibles para el modo de adquisición de datos **Digitizer**.

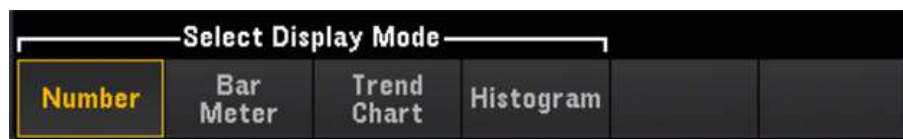
En el modo **Scan/DMM Digitize**, puede supervisar los datos de medición en un canal seleccionado si presiona la tecla **[Monitor]**. La luz de fondo de la tecla se enciende mientras el control está activado. El indicador del monitor también se mostrará, y el indicador de muestra parpadeará cuando se realicen las mediciones del monitor.

En el modo **Scan**, puede ver los datos del monitor en todos los canales, excepto los canales computarizados (canales 401 a 420). La supervisión de los canales computados solo está disponible durante el escaneo y solo mostrará las lecturas del barrido más reciente. También puede ver los datos del monitor en los canales de E/S digital y totalizadores del DAQM907A incluso si no están en la lista de escaneo.

Las mediciones del monitor se realizan repetitivamente cuando el escaneo está inactivo o entre barridos de un escaneo. Para detener el modo de control y volver a la página del menú Inicio, presione esta tecla **[Monitor]** nuevamente en la página del menú Monitor.

En el modo **DMM Digitize**, solo puede ver los datos de supervisión del único canal que está configurado para **DMM Digitize**. Los datos solo se mostrarán como un número y sus datos relacionados Minimum (mínimo), Maximum (máximo) y Peak to Peak (pico a pico) si la tecla de función **Peak On/Off** está **On**.

No obstante, en el modo **Scan**, puede elegir mostrar los datos de supervisión en los siguientes formatos: **Number**, **Bar Meter**, **Trend Chart** o **Histogram**. Para configurarlos, presione la tecla de función **Display** para seleccionar su modo de presentación deseado. A continuación se muestra el ejemplo de las teclas de función.



## Número

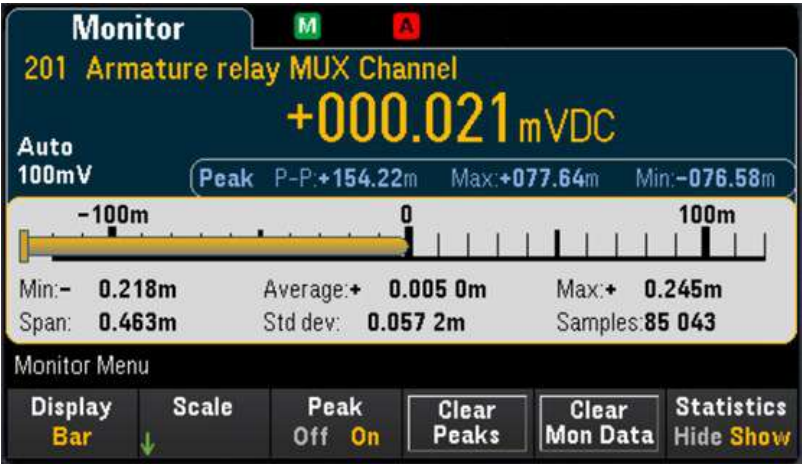
Muestra las lecturas como un número



| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                  |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Peak On/Off          | Presione la tecla de función <b>Peak</b> para habilitar ( <b>On</b> ) o deshabilitar ( <b>Off</b> ) la medición de los valores mínimo, máximo y pico a pico adquiridos dentro de la apertura de medición.                                                                                                                                                    |
| Clear Peaks          | Presione la tecla de función <b>Clear Peaks</b> para restablecer la lectura de los valores pico. Esto se hace al borrar el historial acumulado de la función pico a pico. <div><div>NOTA</div>La tecla de función <b>Clear Peaks</b> solo aparecerá cuando <b>Peak</b> esté habilitado (<b>On</b>).</div>                                                    |
| Clear Mon Data       | Presione la tecla de función <b>Clear Mon Data</b> para borrar las estadísticas, el gráfico de tendencias y el histograma en el canal del monitor. <div><div>NOTA</div>La tecla de función <b>Clear Mon Data</b> solo aparecerá cuando <b>Statistics</b> (Estadística) esté establecido en <b>Show</b> (mostrar).</div>                                      |
| Statistics Hide/Show | Presione la tecla de función <b>Statistics</b> para alternar entre <b>Hide</b> (ocultar) o <b>Show</b> (mostrar) las estadísticas de medición para el canal del monitor. Las estadísticas del canal del monitor se eliminan cuando el modo Monitor está activado, cuando cambia el canal del monitor o cuando cambia la configuración del canal del monitor. |

Multímetro de barras

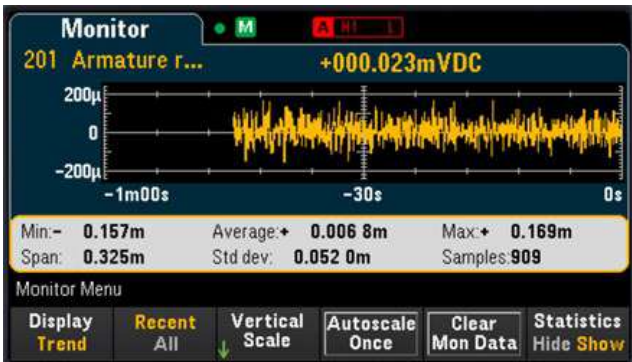
El multímetro de barras agrega una barra móvil debajo de la pantalla Number estándar.

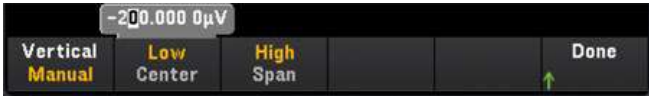


| Tecla de función     |                                                                                                                                                                                                                                                                                                                                                              | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scale                | Default                                                                                                                                                                                                                                                                                                                                                      | <b>Default</b> configura la escala al rango de medición.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                      | Manual                                                                                                                                                                                                                                                                                                                                                       | <div> </div> <p><b>Manual</b> le permite configurar la escala como valores <b>High</b> (alto) y <b>Low</b> (bajo) o como un <b>Span</b> (intervalo) alrededor de un valor <b>Center</b> (medio). Por ejemplo, una escala que va desde un valor bajo (<b>Low</b>) de -500 <math>\Omega</math> a un valor alto (<b>High</b>) de 1000 <math>\Omega</math> también podría especificarse como un valor medio (<b>Center</b>) de 250 <math>\Omega</math> con un intervalo (<b>Span</b>) de 1500 <math>\Omega</math>.</p> |
|                      | Limits                                                                                                                                                                                                                                                                                                                                                       | <b>Limits</b> configura la escala de los límites de alarma.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                      |                                                                                                                                                                                                                                                                                                                                                              | <div> <p><b>NOTA</b></p> </div> <p>Esta tecla de función solo está disponible cuando configura la alarma en el canal seleccionado al presionar la tecla <b>[Alarm]</b> en el panel frontal.</p>                                                                                                                                                                                                                                                                                                                   |
| Peak On/Off          | Presione la tecla de función <b>Peak</b> para habilitar ( <b>On</b> ) o deshabilitar ( <b>Off</b> ) la medición de los valores mínimo, máximo y pico a pico adquiridos dentro de la apertura de medición.                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Clear Peaks          | Presione la tecla de función <b>Clear Peaks</b> para restablecer la lectura de los valores pico. Esto se hace al borrar el historial acumulado de la función pico a pico.                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                      |                                                                                                                                                                                                                                                                                                                                                              | <div> <p><b>NOTA</b></p> </div> <p>La tecla de función <b>Clear Peaks</b> solo aparecerá cuando <b>Peak</b> esté habilitado (<b>On</b>).</p>                                                                                                                                                                                                                                                                                                                                                                      |
| Clear Mon Data       | Presione la tecla de función <b>Clear Mon Data</b> para borrar las estadísticas, el gráfico de tendencias y el histograma en el canal del monitor.                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                      |                                                                                                                                                                                                                                                                                                                                                              | <div> <p><b>NOTA</b></p> </div> <p>La tecla de función <b>Clear Mon Data</b> solo aparecerá cuando <b>Statistics</b> (Estadística) esté establecido en <b>Show</b> (mostrar).</p>                                                                                                                                                                                                                                                                                                                                 |
| Statistics Hide/Show | Presione la tecla de función <b>Statistics</b> para alternar entre <b>Hide</b> (ocultar) o <b>Show</b> (mostrar) las estadísticas de medición para el canal del monitor. Las estadísticas del canal del monitor se eliminan cuando el modo Monitor está activado, cuando cambia el canal del monitor o cuando cambia la configuración del canal del monitor. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## Trend Chart

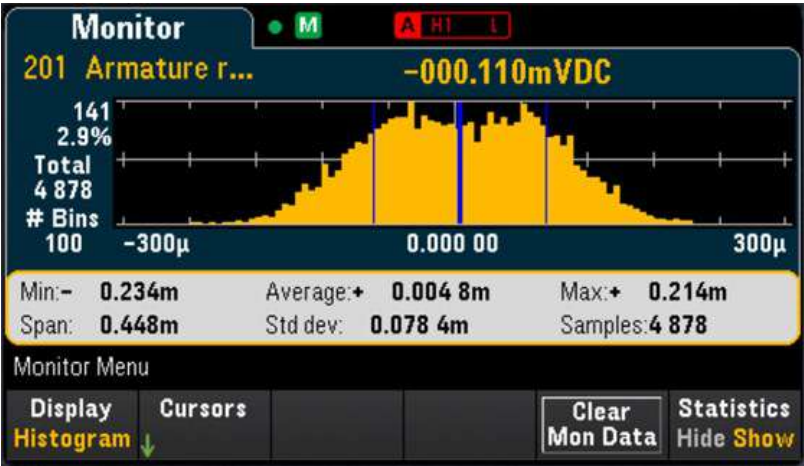
En el modo de medición continua, el gráfico de tendencias muestra las tendencias de los datos a lo largo del tiempo. Los datos se recopilan y se muestran en columnas de píxeles, como se describe a continuación:



| Tecla de función     |                                                                                                                                                                                                                                                                                                                                                              | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Recent/All           |                                                                                                                                                                                                                                                                                                                                                              | La tecla de función <b>Recent/All</b> especifica si se muestran todas las mediciones ( <b>All</b> ) o solo las mediciones más recientes ( <b>Recent</b> ) en el gráfico de tendencias. Ninguna de las dos selecciones borra la memoria de lectura. En el modo <b>All</b> , el gráfico de tendencias muestra todas las lecturas que se toman y lo hace de izquierda a derecha. Una vez que se llena la pantalla, los datos se comprimen en el lado izquierdo de la pantalla a medida que se agregan nuevos datos en el lado derecho de esta. En el modo <b>Recent</b> , el gráfico de tendencias muestra los datos tomados durante un período de tiempo específico. |
| Vertical Scale       | Default                                                                                                                                                                                                                                                                                                                                                      | Default configura la escala al rango de medición.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                      | Auto                                                                                                                                                                                                                                                                                                                                                         | Ajusta de forma automática la escala a la línea que se muestra actualmente en la pantalla.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                      | Manual                                                                                                                                                                                                                                                                                                                                                       | <div></div> Manual le permite configurar la escala como valores High (alto) y Low (bajo) o como un Span (intervalo) alrededor de un valor Center (medio). Por ejemplo, una escala desde un nivel Low de 0 V hasta un valor High de 5 V es equivalente a un valor Center de 2,5 V y un Span de 5 V.                                                                                                                                                                                                                                                                             |
|                      | Limits                                                                                                                                                                                                                                                                                                                                                       | Limits configura la escala de los límites de alarma. <div><div>NOTA</div>Esta tecla de función solo está disponible cuando configura la alarma en el canal seleccionado al presionar la tecla <b>[Alarm]</b> en el panel frontal.</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Autoscale Once       | Presione la tecla de función <b>Autoscale Once</b> para escalar automáticamente el eje vertical del gráfico de tendencias una vez, según las lecturas de la memoria escaneada que se muestran en la pantalla. Esto también configura el modo <b>Vertical Scale</b> en <b>Manual</b> .                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Clear Mon Data       | Presione la tecla de función <b>Clear Mon Data</b> para borrar las estadísticas, el gráfico de tendencias y el histograma en el canal del monitor. <div><div>NOTA</div>La tecla de función <b>Clear Mon Data</b> solo aparecerá cuando <b>Statistics (Estadística)</b> esté establecido en <b>Show (mostrar)</b>.</div>                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Statistics Hide/Show | Presione la tecla de función <b>Statistics</b> para alternar entre <b>Hide</b> (ocultar) o <b>Show</b> (mostrar) las estadísticas de medición para el canal del monitor. Las estadísticas del canal del monitor se eliminan cuando el modo Monitor está activado, cuando cambia el canal del monitor o cuando cambia la configuración del canal del monitor. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Histograma

El histograma muestra los datos de medición como una representación gráfica de la distribución de los datos de medición. Los datos se agrupan en intervalos representados por barras verticales en la pantalla del histograma.

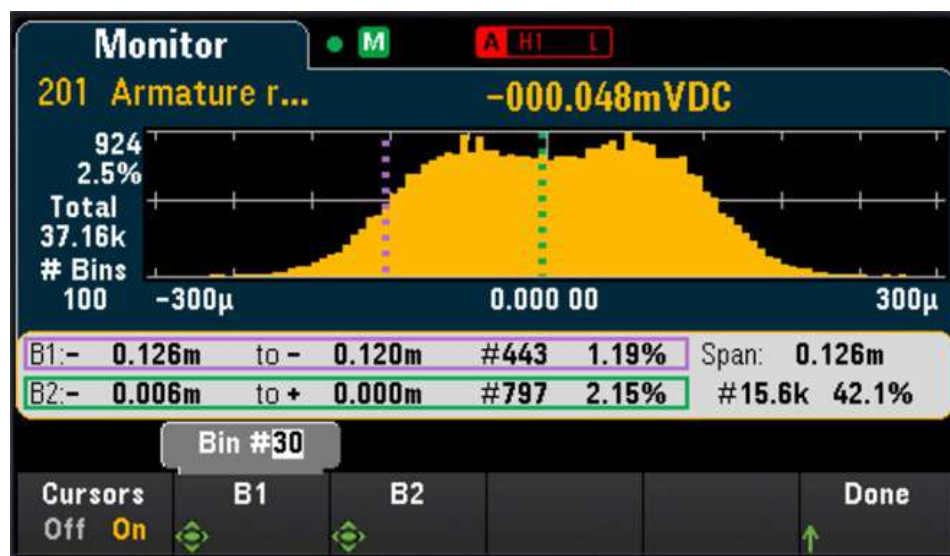


| Tecla de función     |                 | Descripción                                                                                                                                                                                                                                                                                                                                                  |
|----------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors              | Cursors Off/ On | Presione la tecla de función <b>Cursors</b> para habilitar (On) o deshabilitar (Off) los cursores del histograma                                                                                                                                                                                                                                             |
|                      | B1              | Use la perilla o las teclas de flecha para ajustar la posición del cursor B1 (línea vertical de puntos violeta).                                                                                                                                                                                                                                             |
|                      | B2              | Use la perilla o las teclas de flecha para ajustar la posición del cursor B2 (línea vertical de puntos verdes).                                                                                                                                                                                                                                              |
| Clear Mon Data       |                 | Presione la tecla de función <b>Clear Mon Data</b> para borrar las estadísticas, el gráfico de tendencias y el histograma en el canal del monitor. <div><div>NOTA</div>La tecla de función Clear Mon Data solo aparecerá cuando Statistics (Estadística) esté establecido en Show (mostrar).</div>                                                           |
| Statistics Hide/Show |                 | Presione la tecla de función <b>Statistics</b> para alternar entre <b>Hide</b> (ocultar) o <b>Show</b> (mostrar) las estadísticas de medición para el canal del monitor. Las estadísticas del canal del monitor se eliminan cuando el modo Monitor está activado, cuando cambia el canal del monitor o cuando cambia la configuración del canal del monitor. |



Los cursores en el histograma se especifican como números binarios y muestran el rango de valores cubiertos por estos, el conteo y el porcentaje del total. Se muestra el conteo total y el porcentaje del total, así como el rango de medición cubierto, entre los intervalos de cursor.

En el siguiente ejemplo, el cursor B1 (líneas verticales violetas) se coloca en el intervalo del número 30 y el cursor B2 (líneas verticales verdes) en el intervalo del número 50 (el número de intervalos se muestra arriba de la tecla de función B2). La información del intervalo para el cursor B1 se muestra en el cuadro violeta, la información del intervalo para el cursor B2 se muestra en el cuadro verde.



Según el ejemplo anterior, la información del cursor B1 se puede interpretar de la siguiente forma:

- 0.126m a 0.120m: el rango de valores de medición de DCV para este intervalo.
- #443: es el número de muestras en este intervalo.
- 1.19%: es el porcentaje del número total de muestras en este intervalo.

Los datos entre los cursores B1 y B2, incluidos los datos en los intervalos B1 y B2, se muestran a la derecha de los cuadros violeta y verde. En el gráfico anterior:

- Span: 0.126m: es el rango de medición cubierto de B1 a B2.
- #15.6k: es el número de muestras de B1 a B2.
- 42.1%: es el porcentaje del número total de muestras de B1 a B2.

## Menú [Home]

Presione la tecla **[Home]** para acceder a la página **Home** (inicial) del instrumento. En la pantalla principal de la página **Home**, se mostrará una descripción general del funcionamiento y el estado actual del instrumento. En el menú **Home**, también podrá acceder a los temas de ayuda del instrumento y ajustar diversas configuraciones como el modo de adquisición de datos, la compensación de deformación, las líneas de hardware de salida de alarma y las preferencias del usuario.

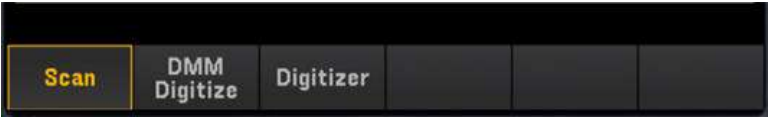
NOTA

El instrumento volverá a la página del menú Home cuando se detenga el modo de supervisión.



## Modo de adquisición de datos

Presione la tecla de función **Acquire** para seleccionar un modo de adquisición de datos.



| Tecla de función |              | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acquire          | Scan         | El instrumento continuamente realiza detecciones en todos los canales configurados y hace mediciones.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                  | DMM Digitize | El instrumento digitaliza las señales de un solo canal configurado mediante el DMM interno.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                  | Digitizer    | El instrumento digitaliza hasta 4 canales de digitalizador configurados simultáneamente para cada módulo plug-in DAQM909A insertado en el instrumento mediante los digitalizadores incorporados del DAQM909A. En otras palabras, se puede digitalizar simultáneamente un máximo de 12 canales configurados cuando el DAQ970A/DAQ973A está instalado con 3 módulos plug-in DAQM909A. También puede funcionar en paralelo con una operación de adquisición de datos <b>Scan</b> o <b>DMM Digitize</b> en la medida en que utilice los digitalizadores incorporados de DAQM909A en vez del DMM interno del instrumento. |

NOTA

La tecla de función **Digitizer** solo estará disponible cuando el módulo DAQM909A esté insertado en el sistema principal.

## Strain offset

**NOTA**

Esta tecla de función solo está disponible después de que haya configurado el canal para las mediciones de deformación al presionar [Channel] > Measure, y seleccionar **STRAIN** con los módulos with DAQM900A, DAQM901A, DAQM902A, DAQM908A y DAQM909A. Consulte **Deformación** para conocer más detalles.



La compensación de deformación también se conoce como el valor sin restricciones. Puede seleccionar uno o más canales en los que desea medir el valor de compensación. La fórmula de deformación utilizará automáticamente este valor de compensación al calcular el resultado de la medición.



Para configurar la compensación de deformación:

1. Use la perilla o las teclas de flecha del panel frontal para navegar en la lista y presione la tecla de función **Select** para habilitar la medición de la compensación de deformación en el canal resaltado. El canal seleccionado está marcado con una "X". Vuelva a presionar la tecla de función **Select** para deshabilitar la medición de la compensación en el canal resaltado. Note que, al presionar esta tecla de función, también se habilitan las teclas de función **Measure Now** (medir ahora) y **Clear Offsets** (borrar las compensaciones).

| Unstrained |                                |         |       |
|------------|--------------------------------|---------|-------|
| Check      | Channel                        | Offset  | Units |
| [x]        | 101 Armature relay MUX Channel | +0.0000 | mVDC  |
|            | 102 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +0.0000 | mVDC  |
|            | 104 Armature relay MUX Channel | +0.0000 | mVDC  |

2. Presione **Select All** para habilitar la medición de compensación en todos los canales enumerados. Presione esta tecla de función nuevamente para deshabilitar la medición de compensación en todos los canales enumerados.

| Unstrained |                                |         |       |
|------------|--------------------------------|---------|-------|
| Check      | Channel                        | Offset  | Units |
| [x]        | 101 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 102 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +0.0000 | mVDC  |
| [x]        | 104 Armature relay MUX Channel | +0.0000 | mVDC  |

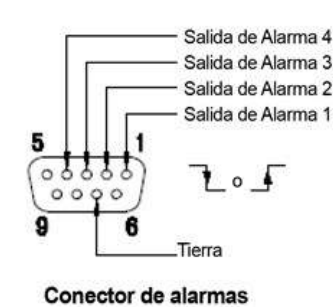
3. Presione **Measure Now** para medir inmediatamente el valor de compensación en los canales seleccionados. Las lecturas de compensación se mostrarán en la pantalla como se muestra a continuación:

| Unstrained |                                |           |       |
|------------|--------------------------------|-----------|-------|
| Check      | Channel                        | Offset    | Units |
| [x]        | 101 Armature relay MUX Channel | +827.0444 | mVDC  |
| [x]        | 102 Armature relay MUX Channel | +826.7458 | mVDC  |
| [x]        | 103 Armature relay MUX Channel | +825.8469 | mVDC  |
| [x]        | 104 Armature relay MUX Channel | +822.6777 | mVDC  |

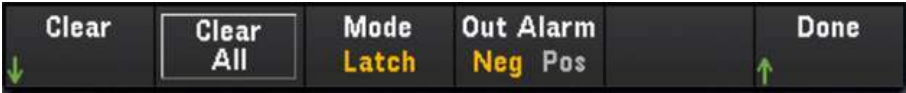
4. Presione la tecla de función **Clear Offsets** si desea borrar inmediatamente el valor de compensación de deformación y regresarlo a 0 en los canales seleccionados.

## Alarm output

Configura las cuatro líneas de hardware de salida de alarma. Hay cuatro salidas de alarma compatibles con TTL disponibles en el conector de Ext Trig/Alarms del panel posterior. Puede usar estas salidas de hardware para activar sirenas, luces de alarma externas o enviar un pulso compatible con TTL a su sistema de control. Puede asignar una alarma a cualquier canal configurado y pueden asignarse múltiples canales al mismo número de alarma. Cada línea de salida de alarma representa el “OR” lógico de todos los canales asignados a ese número de alarma (una alarma en cualquiera de los canales asociados pulsará la línea).



Presione la tecla de función **Alarm Out** para configurar la alarma de salida.



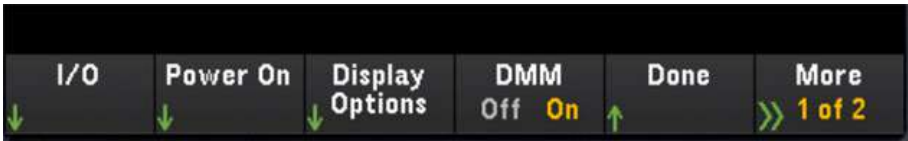
| Tecla de función |         | Descripción                                                                                                                                                                                                                                            |
|------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clear            | Alarm 1 | Borra el estado de una línea de salida de alarma especificada (alarmas del 1 al 4).                                                                                                                                                                    |
|                  | Alarm 2 |                                                                                                                                                                                                                                                        |
|                  | Alarm 3 |                                                                                                                                                                                                                                                        |
|                  | Alarm 4 |                                                                                                                                                                                                                                                        |
| Clear All        |         | Borra el estado de todas las cuatro líneas de salida de alarma.                                                                                                                                                                                        |
| Mode             | Latch   | La salida de alarma se impone cuando la lectura de un canal supera un límite, y se mantiene impuesta hasta que se libera manualmente, se inicia un nuevo escaneo o se apaga y vuelve a encender el instrumento.                                        |
|                  | Track   | La salida de alarma se impone cuando la lectura de un canal supera un límite y se mantiene impuesta solo mientras las lecturas siguientes se mantienen fuera del límite. Cuando una lectura regresa a los límites, la salida se borra automáticamente. |
| Out Alarm        | Neg     | Configura el nivel de las cuatro líneas de salida de alarma que indican una alarma a 0 V (baja compatibilidad con TTL).                                                                                                                                |
|                  | Pos     | Configura el nivel de las cuatro líneas de salida de alarma que indican una alarma en 3.3 V (alta compatibilidad con TTL).                                                                                                                             |

## Help topics

Muestra la información del instrumento y una lista de temas de ayuda en el idioma local seleccionado. Consulte **Uso del sistema de ayuda incorporado** para conocer más detalles.

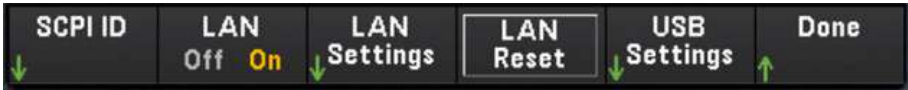
## User settings

Configura las preferencias del usuario que controlan cómo este interactúa con el instrumento. Estas configuraciones se guardan en una memoria no volátil y se pueden guardar en un archivo de preferencias (.prf).



### I/O

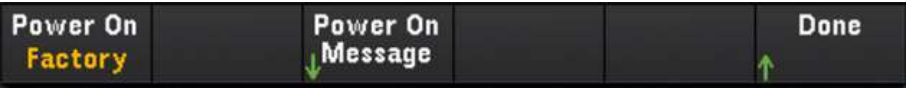
Configura los parámetros de I/O (E/S) para operaciones remotas a través de las interfaces LAN y USB.



| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCPI ID          | SCPI ID determina el fabricante y el número de modelo que aparecen luego de la consulta de identificación (comando *IDN?). El número de serie y la información de la versión no se ven afectados. Use esta configuración para evitar cambiar el código del sistema de prueba actual donde se verifican el fabricante o el número de modelo y para ampliar la compatibilidad retroactiva con Keysight 34970A y 34972A. La configuración predeterminada retorna "Keysight Technologies" seguido del número de modelo "DAQ970A". Para obtener más información, consulte los comandos de subsistema IDN? y SYSTem:PERSonA en la <i>Guía de programación de Keysight DAQ970A/DAQ973A</i> .<br><br><b>Importante:</b> Para actualizar el firmware del instrumento de forma remota, el número de modelo en la respuesta *IDN? debe coincidir con el número de modelo del instrumento real. Si ha cambiado la respuesta *IDN? del instrumento a otro instrumento, cuando intente actualizar el firmware de forma remota, verá este error: El instrumento no es compatible con este archivo de firmware. Para actualizar el firmware, puede usar el procedimiento del panel frontal o hacerlo de forma remota. Para ello use SYSTem:PERSonA:MODeL para configurar el *IDN? para que coincida con el número de modelo, actualice el firmware y luego use SYSTem:PERSonA:MODeL nuevamente para configurar la respuesta *IDN? para el otro número de modelo. |
| LAN On/Off       | Consulte <a href="#">Habilitar o deshabilitar la interfaz LAN</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| LAN Setting      | Consulte <a href="#">Configuraciones de LAN</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| LAN Reset        | Consulte <a href="#">LAN Reset</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| USB Setting      | Consulte <a href="#">USB Settings (Configuración USB)</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Power On

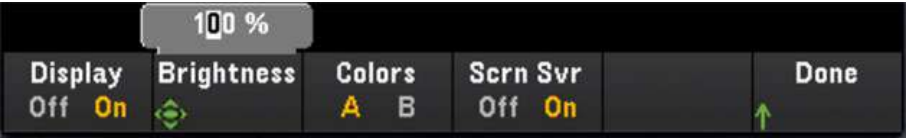
Configura el estado de encendido del instrumento y el mensaje de encendido.



| Tecla de función |                                                                                                                                                                                                                                                                                                                                                                                                                                         | Descripción                                                                           |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Power On         | Last                                                                                                                                                                                                                                                                                                                                                                                                                                    | Al encenderlo, el instrumento carga el estado en el que estaba cuando se apagó.       |
|                  | User Defined                                                                                                                                                                                                                                                                                                                                                                                                                            | Al encenderse, el instrumento carga un archivo de estado seleccionado por el usuario. |
|                  | Factory Defaults                                                                                                                                                                                                                                                                                                                                                                                                                        | Al encenderlo, el instrumento carga el estado predefinido de fábrica.                 |
| Power On Message | <b>Power On Message</b> configura un mensaje que se muestra cuando se enciende el instrumento y cuando presiona [Home] > Help > About. Utilice la perilla o las teclas de flecha del panel frontal y las teclas [Select] para seleccionar las letras. Presione <b>Done</b> para salir y guardar el mensaje. El mensaje solo aparecerá como se muestra a continuación cuando encienda el Instrumento al presionar [Home] > Help > About. |                                                                                       |

Display Options

Configura la pantalla del instrumento.



Puede habilitar o deshabilitar la pantalla, ajustar el brillo (10 a 100 %), elegir un esquema de color y habilitar o deshabilitar el protector de pantalla. Si apaga la pantalla, presione cualquier tecla del panel frontal para volver a encenderla. De forma predeterminada, el protector de pantalla aumenta la vida útil de la pantalla al atenuar la pantalla durante largos períodos de inactividad. Puede desactivar este protector de pantalla solo desde el panel frontal. La pantalla se habilita cuando se apaga y se enciende la alimentación, después de un reinicio del instrumento (\*RST) o cuando regresa a la operación local (panel frontal). Presione la tecla [Local] (tecla [Save Recall]) para volver al estado local.

DMM On/Off

Activa o desactiva el DMM interno. Se mostrará el  indicador cuando el DMM interno esté deshabilitado. Una vez deshabilitado, la opción DMM Digitize no estará disponible al seleccionar el modo de adquisición de datos.

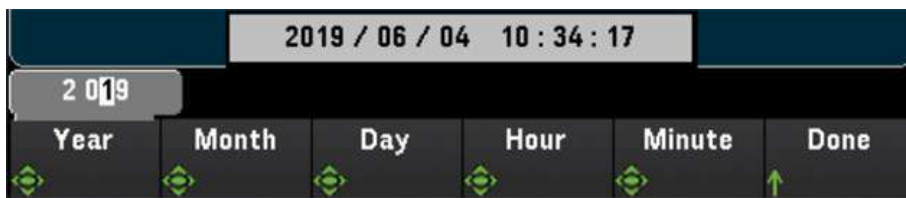
Language

Selecciona el idioma local que se usa en el panel frontal.

Todos los mensajes, la ayuda contextual y los temas de ayuda aparecerán en el idioma seleccionado. Las etiquetas de las teclas de función del menú no se traducen.

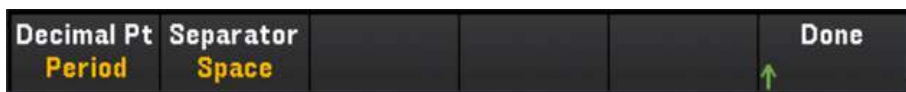
## Date/Time

Configura la fecha y la hora del reloj en tiempo real en formato de 24 horas. El reloj en tiempo real no se ajusta automáticamente a los cambios de huso horario ni al horario de verano. Asegúrese de configurar la fecha y hora cuando reciba su instrumento por primera vez. Use la perilla o las teclas de flecha del panel frontal para configurar el año, mes, día, hora y minutos.



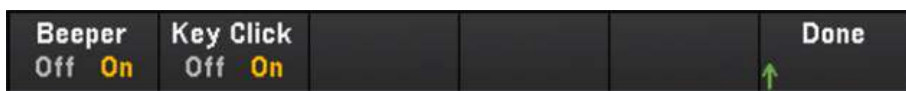
## Number Format

Number Format especifica cómo se muestran los números en el panel frontal: 12,345.6 o 12.345,6. También existen otras posibilidades. Por ejemplo, puede usar el espacio como separador.



## Sounds

Habilita o deshabilita el tono escuchado asociado cuando se genera un error desde el panel frontal o la interfaz remota (Beeper), o el clic que se escucha cuando se presionan las teclas (Key Click).





## Menú [View]

Presione **[View]** en el panel frontal para ver las lecturas de la memoria detectadas, las lecturas digitalizadas y la cola de alarmas o la cola de error. En el menú View, también puede realizar varias mediciones de post procesamiento, así como el análisis de potencia de las lecturas digitalizadas.

**NOTA**

Las opciones dentro del menú **[View]** van a variar según el modo de adquisición de datos seleccionado en el menú **[Home]** (**[Home]**>**Acquire**>**Scan**, **DMM Digitize** o **Digitizer**).

### Menú [View] en el modo Scan



### Selección del modo de presentación

Presione la tecla de función **Display** para mostrar un modo de presentación.



### List

Muestra las lecturas de la memoria detectada en formato de lista. Use la perilla y las teclas de flecha para desplazarse por las lecturas en diferentes páginas.

The image shows a screenshot of the 'Scan Memory' display. It features a table with the following data:

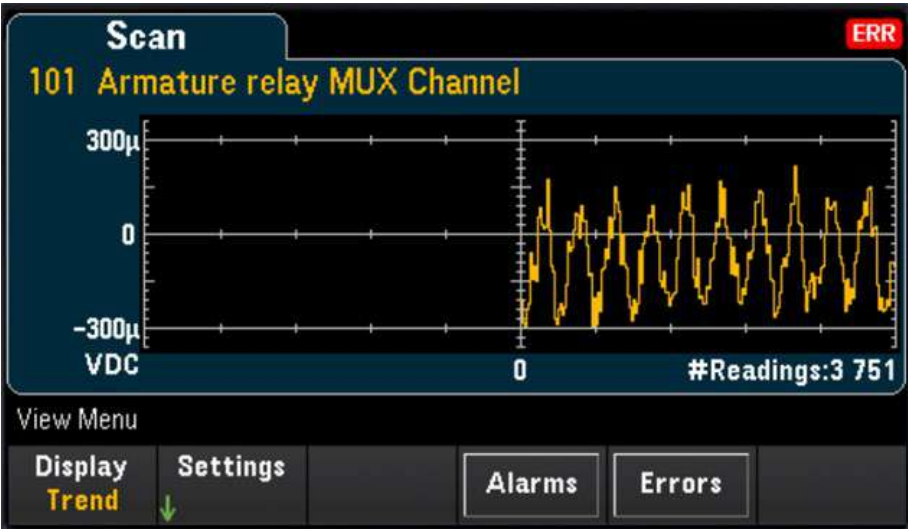
| Date      | Time         | Channel                  | Reading     |
|-----------|--------------|--------------------------|-------------|
| 6/10/2019 | 16:07:11.557 | 101 Armature relay MU... | -8.409 mVDC |
| 6/10/2019 | 16:07:11.598 | 101 Armature relay MU... | -180 μVDC   |
| 6/10/2019 | 16:07:11.639 | 101 Armature relay MU... | -102 μVDC   |
| 6/10/2019 | 16:07:11.680 | 101 Armature relay MU... | -109 μVDC   |
| 6/10/2019 | 16:07:11.721 | 101 Armature relay MU... | -160 μVDC   |
| 6/10/2019 | 16:07:11.762 | 101 Armature relay MU... | -294 μVDC   |
| 6/10/2019 | 16:07:11.803 | 101 Armature relay MU... | -234 μVDC   |
| 6/10/2019 | 16:07:11.844 | 101 Armature relay MU... | -249 μVDC   |

Below the table, the 'View Menu' is visible, showing 'Display List' (highlighted with a green box and a green downward arrow), 'Browse', 'Alarms', and 'Errors'. The text 'Current Page: 1/292' is also displayed.

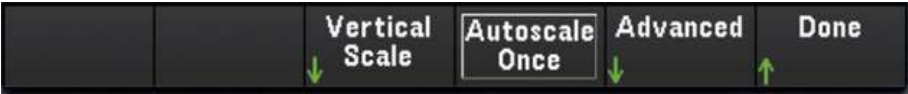
| Tecla de función |            | Descripción                                                                                                |
|------------------|------------|------------------------------------------------------------------------------------------------------------|
| Browse           | First Page | Presione la tecla de función <b>First Page</b> y la pantalla devolverá la lista de escaneos a la Página 1. |
|                  | Last Sweep | Presione la tecla de función <b>Last Sweep</b> y aparecerán las lecturas del barrido más reciente.         |

Trend Chart

Muestra las lecturas de la memoria detectada en formato de gráfico de tendencias. Use la perilla y las teclas de flecha para desplazarse por las lecturas



Para configurar el gráfico de tendencias, presione la tecla de función **Settings** para que aparezca el menú de configuración del gráfico de tendencias.



| Tecla de función |         | Descripción                                                                                                                                                                                                                                                                                                               |
|------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vertical Scale   | Default | Default configura la escala al rango de medición.                                                                                                                                                                                                                                                                         |
|                  | Auto    | Ajusta de forma automática la escala a la línea que se muestra actualmente en la pantalla.                                                                                                                                                                                                                                |
|                  | Manual  | <div></div>                                                                                                                                                                                                                                                                                |
| Autoscale Once   |         | Presione la tecla de función <b>Autoscale Once</b> para escalar automáticamente el eje vertical del gráfico de tendencias una vez, según las lecturas de la memoria detectada que se muestran en la pantalla. Esto también configura el modo <b>Vertical Scale</b> en <b>Manual</b> .                                     |
| Advanced         | Pan     | Presione la tecla de función <b>Pan</b> para hacer un paneo y seleccionar cuál lectura de la memoria se muestra en el centro de la pantalla. Presione y suelte la tecla de flecha para mover el cursor en un píxel de la pantalla. Mantenga sujeta una tecla de flecha para mover el cursor en incrementos de 20 píxeles. |

**NOTA**

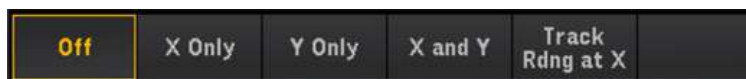
La cantidad de píxeles mostrados varía según el nivel de zoom.

**Zoom** Presione la tecla de función **Zoom** y use la perilla o las teclas de flecha arriba/abajo para seleccionar la cantidad de zoom, en porcentaje. Puede configurar el porcentaje de zoom a 0,02 %, 0,05 %, 0,1 %, 0,2 %, 0,5 %, 1 %, 2 %, 5 %, 10 %, 20 %, 50 %, 100 %, 200 %, 500 % o 1000 %.

**NOTA**

Para hacer un paneo por una lectura a la vez, establezca el nivel de zoom a 1000 %. Después de seleccionar una lectura de su interés, puede disminuir el nivel de zoom, si es necesario, para ver la señal circundante.

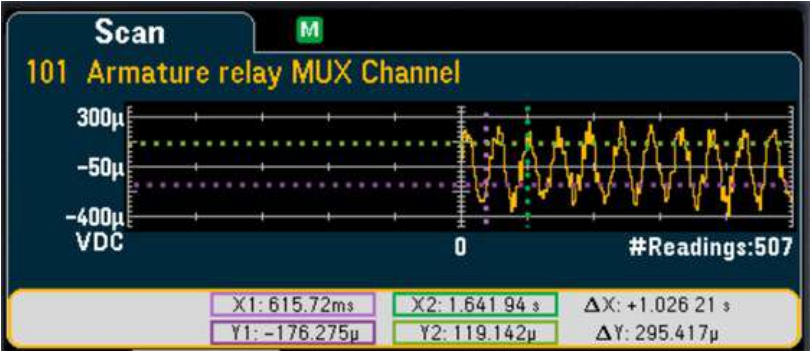
**Cursors** Muestra y controla los cursores X1, X2, Y1, Y2 y de seguimiento (se muestran como líneas) en el gráfico de tendencias. Los cursores X son líneas verticales junto al eje de tiempo o la muestra y los cursores Y son las líneas horizontales a lo largo del eje de medición (magnitud) en unidades de la medición seleccionada.



- Presione la tecla de función **Off** para deshabilitar los cursores mostrados.
- Presione la tecla de función **X Only** para mostrar los cursores X1 y X2. Presione las teclas de función **X1** o **X2** y use la perilla o las teclas de flecha para ajustar la posición del cursor a lo largo del eje X (tiempo). Para mantener los cursores X1 y X2 a una distancia fija entre sí, presione la tecla de función **ΔX Lock** para ponerla en On. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.
- Presione la tecla de función **Y Only** para mostrar los cursores Y1 y Y2. Presione las teclas de función **Y1** o **Y2** y use la perilla o las teclas de flecha para ajustar la posición del cursor a lo largo del eje Y (magnitud). Para mantener los cursores Y1 y Y2 a una distancia fija entre sí, presione la tecla de función **ΔY Lock** para ponerla en On. Para establecer el cursor Y1 o Y2 en un valor que lo haga visible en el gráfico de tendencias, presione la tecla de función **Y1** o **Y2** seguido de la tecla de función **Place Yn on Screen**. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.
- Presione la tecla de función **X and Y** para mostrar todos los cursores X e Y en el gráfico de tendencias. Presione las teclas de función **X1**, **X2**, **Y1** o **Y2** y use la perilla o las teclas de flecha para ajustar la posición del cursor a lo largo de su eje respectivo. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.
- Presione **Track Rdnng at X** para ver los valores de tiempo y magnitud de cualesquier dos puntos en el gráfico de tendencias. Primero, seleccione dos lecturas usando las teclas de función **X1** y **X2** para colocar los cursores X1 y X2 en el punto de interés a lo largo del eje de tiempo. Los cursores Y1 y Y2 rastrearán de forma automática la posición de los cursores X1 y X2 respectivamente y mostrarán los valores del eje de magnitud de los cursores X1 y X2. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias. También puede fijar la distancia de los cursores X1 y X2 al activar la tecla de función **ΔX Lock**.
- Para grabar los datos X e Y y los datos delta X e Y como captura de pantalla, realice una captura de pantalla de la interfaz de usuario web, no la utilidad de captura de pantalla del panel frontal.

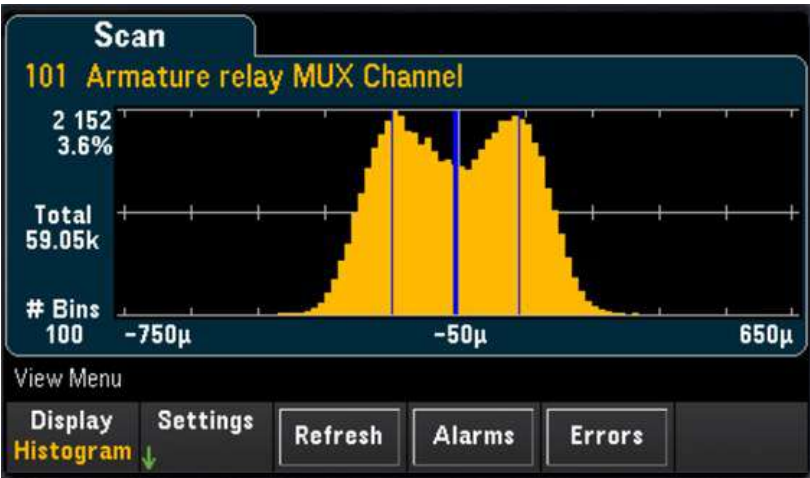
**Reset Pan** Presione la tecla de función **Reset Pan** para establecer la lectura central en “0”.

A continuación hay un ejemplo de un gráfico de tendencias con la función **Track Rdng at X**. Las líneas de puntos violeta son los cursores X1,Y1 mientras que las líneas de puntos verde son los cursores X2,Y2. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.

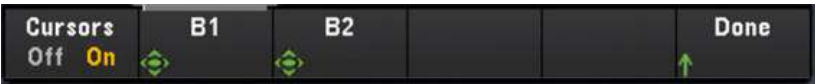


Histogram

Muestra las lecturas de la memoria detectada en formato de histograma.



Presione la tecla de función **Settings** para acceder al menú de los cursores.



| Tecla de función |                 | Descripción                                                                                                      |
|------------------|-----------------|------------------------------------------------------------------------------------------------------------------|
| Cursors          | Cursors Off/ On | Presione la tecla de función <b>Cursors</b> para habilitar (On) o deshabilitar (Off) los cursores del histograma |
|                  | B1              | Use la perilla o las teclas de flecha para ajustar la posición del cursor B1 (línea vertical de puntos violeta). |
|                  | B2              | Use la perilla o las teclas de flecha para ajustar la posición del cursor B2 (línea vertical de puntos verdes).  |

Presione la tecla de función **Refresh** para recalcular el histograma que incluirá nuevas lecturas.

## Statistics

Muestra las lecturas de memoria detectadas de un canal seleccionado en formato de estadísticas (máximo, mínimo, pico a pico, promedio y desviación estándar). Alterne entre **Statistics** para mostrar las estadísticas por canal y **Pk Times** para mostrar el tiempo de aparición de las lecturas de pico mínimas y máximas por canal.

| <b>Scan Stats</b> |            |            |              |                |               |
|-------------------|------------|------------|--------------|----------------|---------------|
| <b>Ch</b>         | <b>Max</b> | <b>Min</b> | <b>Pk-Pk</b> | <b>Average</b> | <b>StdDev</b> |
| 101               | 315μ       | -419μ      | 734μ         | -54.9μ         | 134.7μ        |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |
|                   |            |            |              |                |               |

View Menu Current Page: 1/1

Display Statistics
Statistics Pk Times
Alarms
Errors

Ver la cola de alarmas

En la página del menú **View**, presione la tecla de función **Alarms** para mostrar las primeras 20 alarmas, incluidas la lectura y la marca de tiempo, en la cola de alarmas. Solo puede ver esta cola de alarmas cuando el límite de alarma está configurado en el canal seleccionado si presiona la tecla **[Alarm]** en el panel frontal. Consulte **Menú [Alarm]** para obtener más información.

Alarms

S

A HI

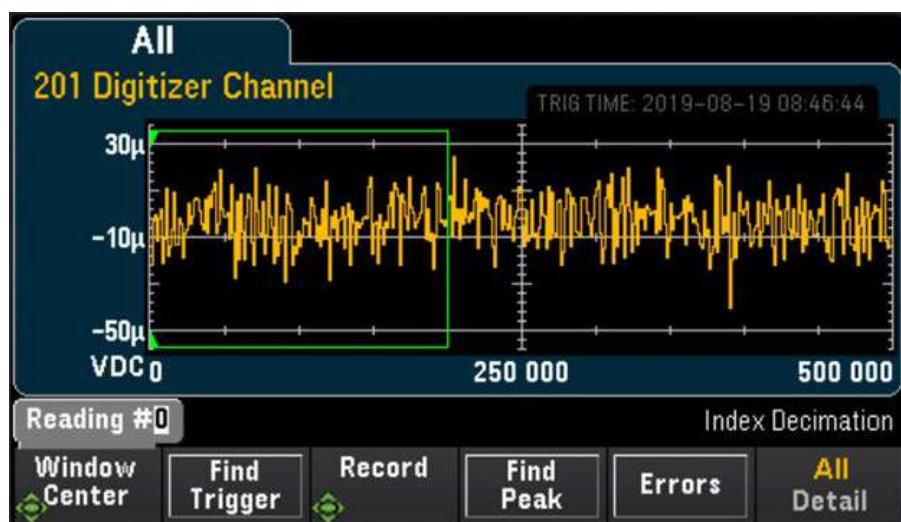
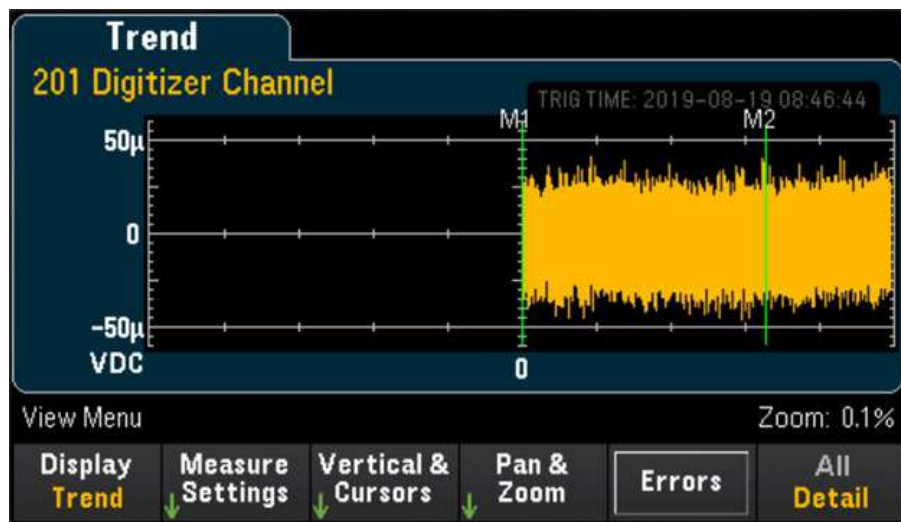
| Channel | Alarm | Limit | Reading | Unit | Date      | Time         |
|---------|-------|-------|---------|------|-----------|--------------|
| 101     | 1     | High  | 30.63   | °C   | 8/14/2019 | 14:47:06.137 |
| 101     | 1     | High  | 25.55   | °C   | 8/14/2019 | 14:47:06.383 |
| 101     | 1     | High  | 25.86   | °C   | 8/14/2019 | 14:47:06.465 |
| 101     | 1     | High  | 26.56   | °C   | 8/14/2019 | 14:47:06.547 |
| 101     | 1     | High  | 27.04   | °C   | 8/14/2019 | 14:47:07.368 |
| 101     | 1     | High  | 25.16   | °C   | 8/14/2019 | 14:47:08.107 |
| 101     | 1     | High  | 25.82   | °C   | 8/14/2019 | 14:47:08.928 |
| 101     | 1     | High  | 28.94   | °C   | 8/14/2019 | 14:47:09.010 |

Current Page: 1/1

Ver la cola de errores

En la página del menú View, presione Errors para mostrar hasta 20 errores en la cola de errores. El indicador de Error,  se borra a medida que los lee. Cuando el indicador de error (ERR) del panel frontal se enciende, se han detectado uno o más errores de hardware, de ejecución o de sintaxis de comandos. Se guarda un registro de hasta 20 errores en la cola de errores del instrumento. Los errores se recuperan en el orden de primero en entrar, primero en salir (FIFO). El primer error devuelto es el primer error que se guardó. Los errores se borran a medida que los lee. Cuando ha leído todos los errores de la cola, el indicador ERR se apaga y los errores se borran. El instrumento emite un pitido cada vez que se genera un error. Si se han producido más de 20 errores, el último error guardado en la cola (el error más reciente) se reemplaza por "Error queue overflow" (Desbordamiento de cola de errores). No se almacenan errores adicionales hasta que eliminan los errores de la cola. Si no se han producido errores al leer la cola de errores, el instrumento responde "No error" (Sin errores).

## Menú [View] en el modo DMM Digitize o Digitizer



## Selección del modo de presentación

Presione la tecla de función **Display** para seleccionar **Trend** (tendencias) o **Power** (potencia) como modo de presentación.

**NOTA**

De forma predeterminada, solo se mostrará la opción **Trend**. La opción **Power** solo estará disponible en el menú **Display** cuando el modo de adquisición del instrumento esté establecido en **Digitizer** en el menú **Home** y la opción **Pwr. Alys** (Power Analysis) esté activada en el menú **Channel**. Consulte para obtener más información.



## Tecla de función All/Detail

Presione la tecla de función **All/Detail** para alternar entre la forma en que se muestra el gráfico de tendencias en la pantalla.

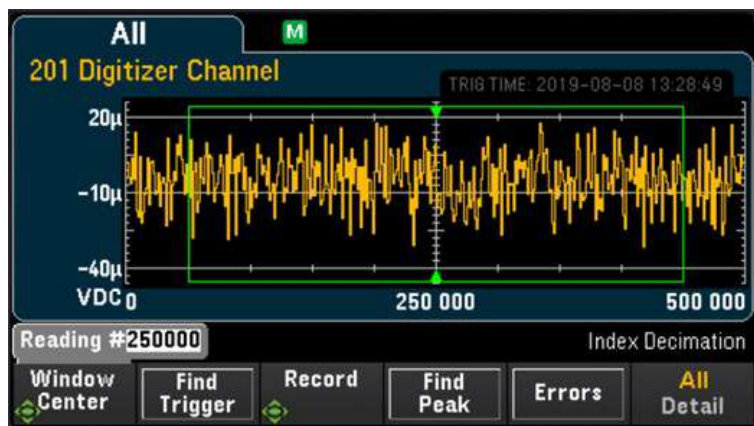
### NOTA

En el modo de adquisición de datos **DMM Digitize**, la tecla de función All/Detail solo estará disponible cuando haya un mínimo de 401 muestras digitalizadas.

### Vista All

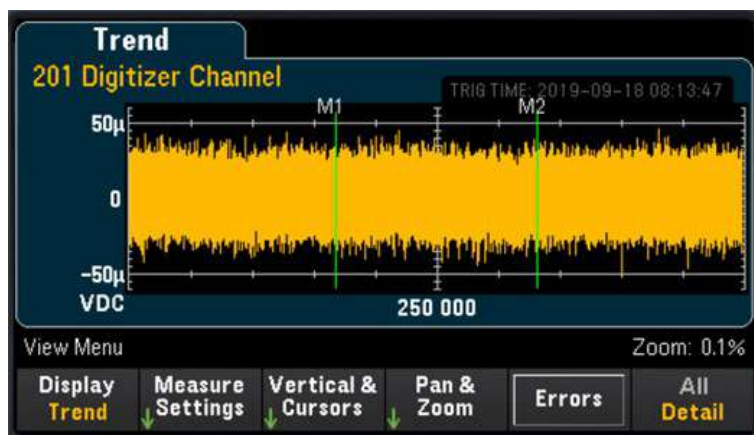
Cuando se selecciona **All**, el instrumento presentará todas las muestras digitalizadas en la pantalla. Esto le permite tener una descripción general de todas las muestras digitalizadas. En la vista **All**, también habrá una ventana en la que puede ver las muestras digitalizadas para seleccionar una parte de las muestras digitalizadas, hasta 400 000 muestras (tamaño máximo de la ventana), que aparecerán en la pantalla de la vista **Detail**.

En la imagen que se muestra a continuación, hay un ejemplo en el que se digitalizaron 500 000 muestras y en la vista **All**, se muestran todas en la pantalla. La ventana engloba 400 000 muestras (lecturas #50 000 a #450 000) donde el centro está en la lectura #250 000. Cuando pasa a la vista **Detail**, solo se muestran en la pantalla las lecturas #50 000 a #450 000.



### Vista Detail

La vista **Detail** ayuda a aislar los puntos de interés de todo el conjunto de muestras digitalizadas para facilitar el post procesamiento de los puntos de interés. Cuando se selecciona la vista **Detail**, el instrumento mostrará hasta 400 000 muestras en la pantalla según las muestras que están dentro de la ventana en la vista **All**.



Configuraciones de la vista All



| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Window<br>Centro | <p>Presione la tecla de función <b>Window Center</b> y use la perilla o las teclas de flecha para cambiar la posición de la ventana en la pantalla. La lectura del centro de la ventana está indicada por los punteros de la parte superior e inferior de la ventana y el número se mostrará arriba de la tecla de función.</p> <div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Find Trigger     | <p>Presione la tecla de función <b>Find Trigger</b> y el instrumento encontrará los puntos de disparador y colocará el centro de la ventana donde ocurre el disparo.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Record           | <p>Presione la tecla de función <b>Record</b> y use la perilla o las teclas de flecha para desplazarse en la lista de los eventos Arm para ver el conjunto de muestras de datos adquirido a partir de cada número de evento Arm respectivo.</p> <p><b>Importante:</b> Si hay un dato de Record (registro) incompleto, los datos de Record no se podrán recuperar.</p> <ul style="list-style-type: none"><li>– <b>Ejemplo 1:</b> El canal digitalizador está configurado como - <i>Arm Count</i> = 1, <i>Sample Count</i> = 1,000,000 y se inicia la operación de digitalización. Si aborta la operación antes de haber adquirido 1 000 000 muestras, no se podrán recuperar todos los datos adquiridos en el 1º Record antes de la suspensión de la operación.</li><li>– <b>Ejemplo 2:</b> El canal digitalizador está configurado como - <i>Arm Count</i> = 3, <i>Sample Count</i> = 1,000,000 y se inicia la operación de digitalización. Si aborta la operación durante el 3º Record antes de que se hayan adquirido 1 000 000 muestras, no se podrán recuperar todos los datos adquiridos en el 3º Record antes de la suspensión de la operación. No obstante, los datos adquiridos en el 1º y el 2º Record siguen siendo recuperables.</li></ul> <div><div>NOTA</div><div>La tecla de función <b>Record</b> solo estará disponible cuando se seleccione Digitizer como modo de adquisición de datos ([Home]&gt;Acquire&gt;Digitizer)</div></div> |
| Find Peak        | <p>Presione la tecla de función <b>Find Peak</b> para realizar la aniquilación de un conjunto grande de datos digitalizados. Puede pausar el proceso de aniquilación al presionar la tecla de función <b>Cancel</b> y reanudar el proceso al presionar la tecla de función <b>Resume Find Pk.</b> Tome en cuenta que los puntos de datos que se han aniquilado no volverán a su valor original.</p> <p>El recurso de aniquilación es útil para mejorar la velocidad de los resultados de datos. Puede digitalizar una cantidad de datos grande por registro a una frecuencia de muestreo alta para garantizar una captura de datos exhaustiva, pero no necesita retornar todos los valores guardados. Por lo tanto, al aplicar la aniquilación, el instrumento retorna solo el mínimo y el máximo de las muestras reales digitalizadas de cada grupo de muestras.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Errors           | <p>Presione la tecla de función <b>Errors</b> para mostrar hasta 20 errores en la cola de errores. El indicador de error se borra a medida que los lee.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



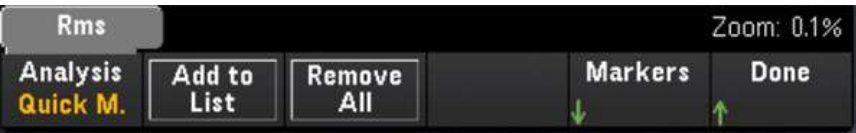
Configuraciones de la vista Detail



Measure Settings

Presione la tecla de función **Measure Settings** para configurar la posición de los marcadores y establecer el modo del análisis de datos.

**NOTA** La tecla de función **Measure Settings** solo estará disponible cuando se hayan digitalizado 256 muestras como mínimo.



| Tecla de función |            | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis         | Quick M.   | <p>La opción Quick M. (Quick Measurement) le permite agregar hasta cuatro modos de medición rápida que se mostrarán en la pantalla.</p> <p>Para seleccionar los modos de medición rápida para el análisis, presione <b>Analysis &gt; Quick M.</b> Luego, use la perilla o las teclas de flecha para navegar por las diferentes opciones. Una vez que haya seleccionado su opción de medición rápida deseada, presione la tecla de función <b>Add to List</b> para agregarla a la lista de mediciones rápidas que se mostrará.</p> <p>Las opciones de medición rápida disponibles son:</p> <ul style="list-style-type: none"><li>– Rms: Media cuadrática</li><li>– DCycle: Ciclo de trabajo</li><li>– PWidth: Ancho positivo</li><li>– NWidth: Ancho negativo</li><li>– RTime: Tiempo de ascenso</li><li>– FTime: Tiempo de descenso</li><li>– Periodo</li><li>– FrEq Frecuencia</li></ul> |
|                  | Statistics | <p>Presione <b>Analysis &gt; Statistics</b> para mostrar los datos estadísticos (como el mínimo, el máximo, el promedio y la desviación estándar) en la pantalla.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Add to List      |            | <p>Presione la tecla de función <b>Add to List</b> para agregar el modo de medición rápida seleccionado que aparecerá en la pantalla. Puede agregar hasta cuatro modos de medición rápida para mostrar. Tome en cuenta que, al agregar más de cuatro modos de medición, el modo de medición más reciente reemplazará al primer modo de medición que se agregó (con la lógica de que el primero que entra es el primero que sale).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Remove All       |            | <p>Presione la tecla de función <b>Remove All</b> para eliminar todos los modos de medición rápida que aparecen en la pantalla.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

Pantalla  
Off/On

Alterne la tecla de función **Display Off/On** para habilitar (**On**) o deshabilitar (**Off**) la presentación de los datos de mediciones rápidas o los datos estadísticos. Esta configuración se reflejará en todos los otros canales.

NOTA

La tecla de función **Display Off/On** solo aparecerá cuando se haya seleccionado un modo de análisis (**Statistics** o una opción **Quick M.**).

Markers

Consulte **Tecla de función Markers** en la siguiente sección para obtener más información.

Tecla de función Markers



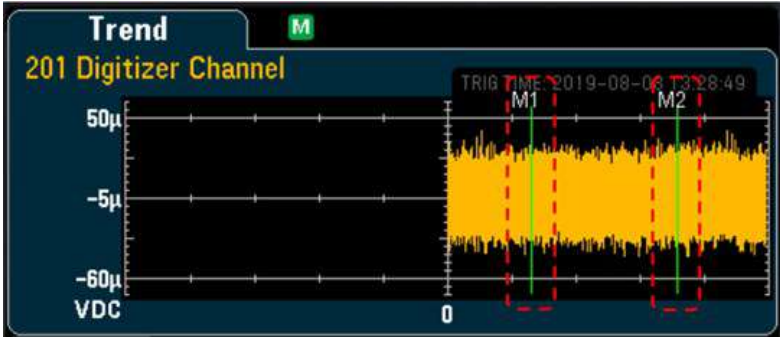
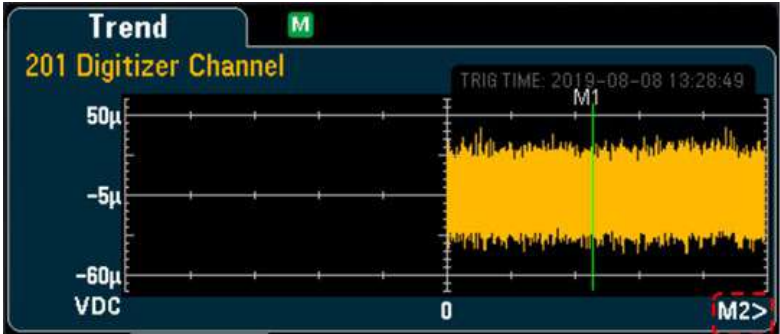
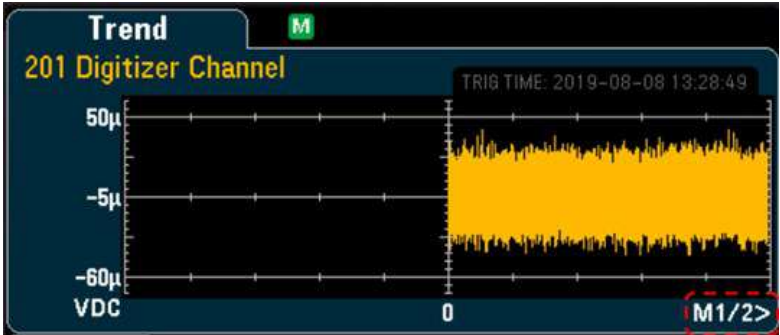
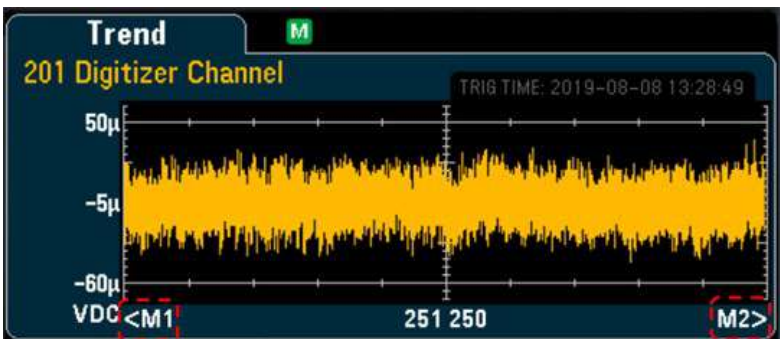
Markers determina un rango de puntos de datos que se usan para calcular las mediciones rápidas y las estadísticas. En la imagen anterior, los dos marcadores están representados por las líneas verticales verdes y las etiquetas M1 y M2, respectivamente.

NOTA

Entre el Marker 1 y el Marker 2, habrá como mínimo 256 puntos de datos.

| Tecla de función |                  | Descripción                                                                                                                                                                                                                 |
|------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Markers          | Marker 1         | Presione la tecla de función <b>Marker 1</b> y use la perilla o las teclas de flecha para ajustar la posición del Marker 1 (M1).                                                                                            |
|                  | Marker 2         | Presione la tecla de función <b>Marker 2</b> y use la perilla o las teclas de flecha para ajustar la posición del Marker 2 (M2).                                                                                            |
|                  | LockMrkrs On/Off | Presione la tecla de función <b>LockMrkrs</b> para alternar entre bloquear las posiciones de M1 y M2 en una distancia fija ( <b>On</b> ) o permitir que la posición de M1 o M2 se ajuste independientemente ( <b>Off</b> ). |

A continuación hay algunos ejemplos de lo que podría observar en la pantalla cuando ajusta la posición de los marcadores:

| Ejemplo                                                                             | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | En la imagen, los Markers 1 y 2 están colocados en los puntos de datos visibles en la pantalla.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|    | <p>En esta imagen, el Marker 1 está colocado en un punto de datos visible en la pantalla, mientras que el Marker 2 está colocado en un punto de datos que no se ve en la pantalla.</p> <p>En tales casos, aparecerá un indicador, <b>M2&gt;</b>, en la parte inferior derecha de la pantalla para indicar que el Marker 2 está ubicado en un punto de datos hacia la derecha.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|  | <p>En ambas imágenes mostradas, los dos marcadores están colocados en puntos de datos que no se ven en la pantalla.</p> <p>En la primera imagen, aparece un indicador, <b>M1/2&gt;</b>, en la parte inferior derecha de la pantalla para indicar que ambos marcadores están ubicados hacia la derecha.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|  | <p>Para que los marcadores se puedan volver a ver; primero, presione la tecla de función M1 y gire la perilla en el sentido antihorario. Esto hará que el marcador M1 vuelva al borde de la pantalla. Luego, presione la tecla de función M2 y vuelva a girar la perilla en el sentido antihorario para que el marcador M2 vaya al borde de la pantalla. Tome en cuenta que la distancia entre los marcadores M1 y M2 ahora es de 256 puntos de datos.</p> <p>En la segunda imagen, ambos marcadores están en lados opuestos. En tales casos, los indicadores <b>&lt;M1</b> y <b>M2&gt;</b> aparecerán en la parte inferior de la pantalla indicando la dirección de los marcadores.</p> <p>Para que los marcadores vuelvan a estar visibles; primero, presione la tecla de función M1 y gire la perilla en sentido horario. Esto llevará el marcador M1 al borde izquierdo de la pantalla. Luego, presione la tecla de función M2 y gire la perilla en el sentido antihorario para que el marcador M2 vaya al borde derecho de la pantalla.</p> |

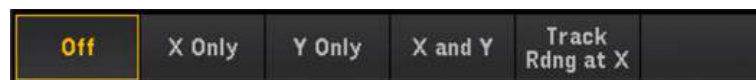
Vertical & Cursors

Presione la tecla de función **Vertical** para configurar la escala vertical del gráfico de tendencias y acceder al menú de los cursores.



| Tecla de función |         | Descripción                                                                                                                                                                                                                                                                                                                            |
|------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vertical         | Default | Default configura la escala al rango de medición.                                                                                                                                                                                                                                                                                      |
|                  | Auto    | Ajusta de forma automática la escala a la línea que se muestra actualmente en la pantalla.                                                                                                                                                                                                                                             |
|                  | Manual  | <div></div> <p>Manual le permite configurar la escala como valores High (alto) y Low (bajo) o como un Span (intervalo) alrededor de un valor Center (medio). Por ejemplo, una escala desde un nivel Low de 0 V hasta un valor High de 5 V es equivalente a un valor Center de 2,5 V y un Span de 5 V.</p> |
| Autoscale Once   |         | Presione la tecla de función <b>Autoscale Once</b> para escalar automáticamente el eje vertical del gráfico de tendencias una vez, según los puntos de datos digitalizados que se muestran en la pantalla. Esto también configura el modo <b>Vertical Scale</b> en <b>Manual</b> .                                                     |

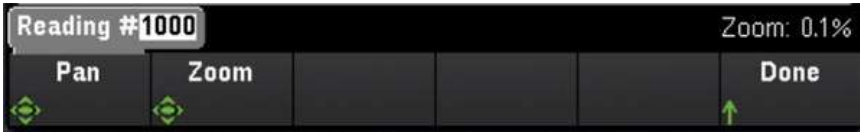
Presione la tecla de función **Cursors** para acceder al menú Cursors.



| Tecla de función |                  | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors          | Off              | Presione la tecla de función <b>Off</b> para deshabilitar los cursores mostrados.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                  | X only           | Presione la tecla de función <b>X Only</b> para mostrar los cursores X1 y X2. Presione las teclas de función <b>X1</b> o <b>X2</b> y use la perilla o las teclas de flecha para ajustar la posición del cursor a lo largo del eje X (tiempo). Para mantener los cursores X1 y X2 a una distancia fija entre sí, presione la tecla de función <b>ΔX Lock</b> para ponerla en On. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.                                                                                                                                                                                                                                                                                                                   |
|                  | Y only           | Presione la tecla de función <b>Y Only</b> para mostrar los cursores Y1 e Y2. Presione las teclas de función <b>Y1</b> o <b>Y2</b> y use la perilla o las teclas de flecha para ajustar la posición del cursor a lo largo del eje Y (magnitud). Para mantener los cursores Y1 e Y2 a una distancia fija entre ellos, presione la tecla de función <b>ΔY Lock</b> para pasarla a On. Para establecer el cursor Y1 o Y2 en un valor que lo haga visible en el gráfico de tendencias, presione la tecla de función <b>Y1</b> o <b>Y2</b> seguido de la tecla de función <b>Place Yn on Screen</b> . Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.                                                                                                  |
|                  | X and Y          | Presione la tecla de función <b>X and Y</b> para mostrar todos los cursores X e Y en el gráfico de tendencias. Presione las teclas de función <b>X1</b> , <b>X2</b> , <b>Y1</b> o <b>Y2</b> y use la perilla o las teclas de flecha para ajustar la posición del cursor a lo largo de su eje respectivo. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias.                                                                                                                                                                                                                                                                                                                                                                                          |
|                  | Track Rdnng at X | Presione la tecla de función <b>Track Rdnng at X</b> para ver los valores de tiempo y magnitud de dos puntos cualesquiera en el gráfico de tendencias. Primero, seleccione dos lecturas usando las teclas de función <b>X1</b> y <b>X2</b> para colocar los cursores X1 y X2 en el punto de interés a lo largo del eje de tiempo. Los cursores Y1 e Y2 rastrearán de forma automática la posición de los cursores X1 y X2 respectivamente y mostrarán los valores del eje de magnitud de los cursores X1 y X2. Los valores de cada punto y el delta entre los dos puntos se muestran debajo del gráfico de tendencias. También puede fijar la distancia de los cursores X1 y X2 al activar la tecla de función <b>ΔX Lock</b> . Consulte el <a href="#">ejemplo</a> que se muestra para ver más detalles. |
|                  |                  | Para grabar los datos X e Y y los datos delta X e Y como captura de pantalla, realice una captura de pantalla de la interfaz de usuario web, no la utilidad de captura de pantalla del panel frontal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

Pan & Zoom

Presione la tecla de función **Pan & Zoom** para hacer un recorrido (paneo) sobre el gráfico de tendencias y configurar el nivel de zoom.



| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pan              | Presione la tecla de función <b>Pan</b> para hacer un paneo y seleccionar cuál lectura de la memoria se muestra en el centro de la pantalla. Presione y suelte la tecla de flecha para mover el cursor en un píxel de la pantalla. Mantenga sujeta una tecla de flecha para mover el cursor en incrementos de 20 píxeles. |
| Zoom             | Presione la tecla de función <b>Zoom</b> y use la perilla o las teclas de flecha arriba/abajo para seleccionar la cantidad de zoom, en porcentaje. Puede configurar el porcentaje de zoom del gráfico de tendencias a 0,1 %, 0,2 %, 0,5 %, 1 %, 2 %, 5 %, 10 %, 20 %, 50 %, 100 %, 200 %, 500 %, or 1000 %.               |

La siguiente tabla muestra la lista de porcentajes de zoom con su número correspondiente de puntos de datos por píxel.

| Zoom (%) | Cantidad de puntos de datos por píxel |
|----------|---------------------------------------|
| 0,1 %    | 1000                                  |
| 0,2 %    | 500                                   |
| 0,5 %    | 200                                   |
| 1 %      | 100                                   |
| 2 %      | 50                                    |
| 5 %      | 20                                    |
| 10 %     | 10                                    |
| 20 %     | 5                                     |
| 50 %     | 2                                     |
| 100 %    | 1                                     |
| 200 %    | 0,5                                   |
| 500 %    | 0,2                                   |
| 1000 %   | 0,1                                   |

## Ver la cola de errores

Presione la tecla de función **Errors** para mostrar hasta 20 errores en la cola de errores. El indicador de Error,  se borra a medida que los lee. Cuando el indicador de error (ERR) del panel frontal se enciende, se han detectado uno o más errores de hardware, de ejecución o de sintaxis de comandos. Se guarda un registro de hasta 20 errores en la cola de errores del instrumento.

Los errores se recuperan en el orden de primero en entrar, primero en salir (FIFO). El primer error devuelto es el primer error que se guardó. Los errores se borran a medida que los lee. Cuando ha leído todos los errores de la cola, el indicador ERR se apaga y los errores se borran. El instrumento emite un pitido cada vez que se genera un error. Si se han producido más de 20 errores, el último error guardado en la cola (el error más reciente) se reemplaza por "Error queue overflow" (Desbordamiento de cola de errores). No se almacenan errores adicionales hasta que eliminen los errores de la cola. Si no se han producido errores al leer la cola de errores, el instrumento responde "No error" (Sin errores).

## Power Analysis

Esta sección describe cómo configurar los canales digitalizadores de DAQM909A para realizar análisis de potencia en el modo View.

### Habilitar la función Power Analysis en el menú [Channel]

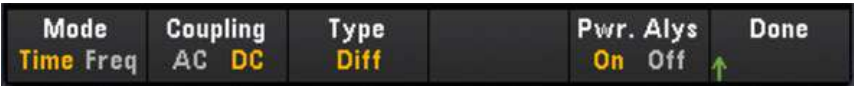
1. En el menú [Channel], use la perilla o las teclas de flecha para seleccionar **Channel 01** o **Channel 03**. El Channel 02 y el Channel 04 de DAQM909A siempre están asignados como canales de Power Coupling (acoplamiento de potencia) que se acoplan al Channel 01 y al Channel 03, respectivamente, cuando se habilita la función del análisis de potencia. Por lo tanto, cualquier configuración del Channel 02 y el Channel 04 se omitirán cuando esté habilitado el análisis de potencia.

| Main Channel | Power Coupling Channel |
|--------------|------------------------|
| Channel 01   | Channel 02             |
| Channel 03   | Channel 04             |

2. Luego, presione la tecla de función **Measure** y seleccione **DCV** para configurar el rango de voltaje y los parámetros de la frecuencia de muestreo.



3. Presione la tecla de función **Advanced** seguida de la tecla de función **Pwr. Alys** para habilitar (**On**) o deshabilitar (**Off**) la función de análisis de potencia del canal seleccionado.



Cuando habilita la función de análisis de potencia para el canal seleccionado, el canal adyacente vinculado a él se configurará automáticamente como el canal de **Power Coupling**. En el siguiente ejemplo, **Pwr. Alys** está **On** para el Channel 01 y el Channel 02 está configurado automáticamente como el canal de **Power Coupling**.

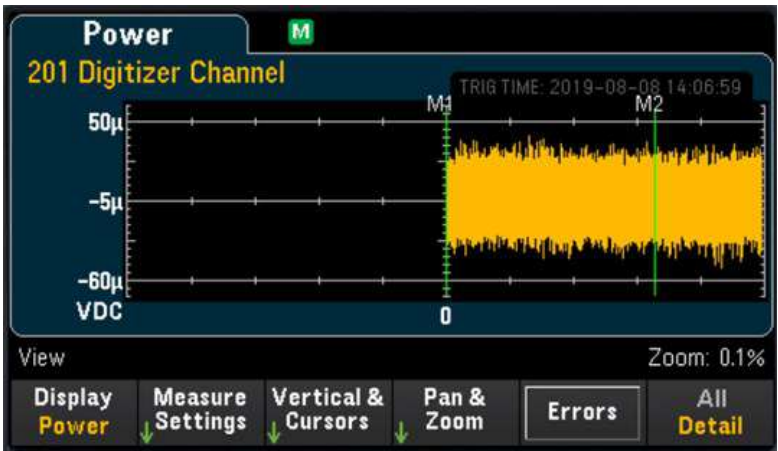


4. Presione la tecla [Scan/Start] para empezar la digitalización. Una vez que ha concluido, presione la tecla [View] para ir al menú View.



Ver los resultados de Power Analysis

Presione la tecla [View] para acceder al menú View.



Tecla de función Display

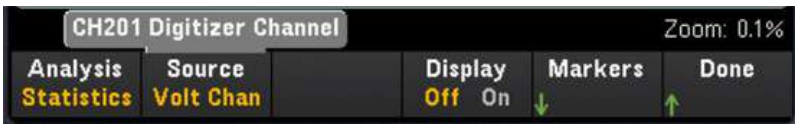
Presione la tecla de función **Display** seguida de la tecla de función **Power** para ver los resultados del análisis de potencia.

NOTA

Puede seguir viendo los datos del análisis de potencia actuales de cada canal que están almacenados en la memoria, siempre y cuando el canal especificado no empiece una nueva operación de digitalización porque esto sobrescribirá los datos antiguos.

Tecla de función Measure Settings

Presione la tecla de función **Measure Settings** para configurar los parámetros del análisis de potencia.



| Tecla de función |            | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analysis         | Statistics | Esta tecla de función es estática porque la única opción de análisis de Power Analysis (análisis de potencia).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Source           | Volt Chan  | La fuente seleccionada determinará el gráfico que aparece en la pantalla. <b>Volt Chan</b> mostrará los datos del canal asignados a ella como una función de voltaje, <b>Curr Chan</b> calculará los datos del canal asignado a ella y aparecerá como una función de corriente, y <b>V*I</b> calcula los datos de Volt Chan y Curr Chan y muestra los datos como una función de potencia. Presione la tecla de función <b>Source</b> para alternar entre el canal de voltaje ( <b>Volt Chan</b> ), el canal actual ( <b>Curr Chan</b> ) o el canal de potencia ( <b>V*I</b> ). En el caso de <b>Volt Chan</b> y <b>Curr Chan</b> , use la perilla o las teclas de flecha para asignar los canales. |
|                  | Curr Chan  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                  | V * I      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Gain             |            | Presione la tecla de función <b>Gain</b> y use la perilla o las teclas de flecha para especificar el valor de ganancia del cálculo del valor actual de Curr Chan.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Pantalla Off/ On |            | Alterne la tecla de función <b>Display Off/On</b> para habilitar (On) o deshabilitar (Off) la aparición de las estáticas en la pantalla.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Markers          |            | Consulte <b>Tecla de función Markers</b> para obtener más información.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

### Tecla de función Vertical & Cursors

Consulte [Vertical & Cursors](#) para obtener más información.

### Tecla de función Pan & Zoom

Consulte [Pan & Zoom](#) para obtener más información.

### Ver la cola de errores

Presione la tecla de función **Errors** para mostrar hasta 20 errores en la cola de errores. El indicador de Error,  se borra a medida que los lee. Cuando el indicador de error (ERR) del panel frontal se enciende, se han detectado uno o más errores de hardware, de ejecución o de sintaxis de comandos. Se guarda un registro de hasta 20 errores en la cola de errores del instrumento.

Los errores se recuperan en el orden de primero en entrar, primero en salir (FIFO). El primer error devuelto es el primer error que se guardó. Los errores se borran a medida que los lee. Cuando ha leído todos los errores de la cola, el indicador ERR se apaga y los errores se borran. El instrumento emite un pitido cada vez que se genera un error.

Si se han producido más de 20 errores, el último error guardado en la cola (el error más reciente) se reemplaza por "Error queue overflow" (Desbordamiento de cola de errores). No se almacenan errores adicionales hasta que eliminen los errores de la cola. Si no se han producido errores al leer la cola de errores, el instrumento responde "No error" (Sin errores).

## Estado del menú [View]

En los casos en que no hay datos disponibles para mostrar, el menú [View] mostrará un texto de estado en la parte inferior de la pantalla. A continuación hay una lista del texto de estado y su respectiva descripción.

| Estado                                                                                              | Descripción                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "The readings in memory were made with a different set of modules installed, and cannot be graphed" | El instrumento no logra trazar los datos de la última operación de adquisición de datos Scan completada porque la tarjeta del módulo se extrajo.                |
| "Pre-Storing" (Almacenamiento previo)                                                               | El instrumento actualmente está recolectando las muestras de PreTrigger (pre-disparador) antes de entrar al estado Wait for Trigger (En espera del disparador). |
| "No scan data in memory" (No hay datos de escaneo en la memoria)                                    | No se adquirieron datos en el modo Scan.                                                                                                                        |
| "No digitize data in memory" (No hay datos de la digitalización en la memoria)                      | No se adquirieron datos en los modos DMM Digitize y Digitizer.                                                                                                  |
| "Scan in progress" (Escaneo en curso)                                                               | El modo de adquisición de datos Scan está en curso.                                                                                                             |
| "Digitize in progress" (Digitalización en curso)                                                    | El modo de adquisición de datos DMM Digitize/ Digitizer está en curso.                                                                                          |
| "Wait for arm event" (Esperar un evento de Arm)                                                     | El digitalizador está esperando un evento Arm antes de iniciar el proceso de digitalización.                                                                    |
| "Wait for external event" (Esperar un evento externo)                                               | El instrumento espera un disparador externo antes de iniciar la adquisición de datos.                                                                           |
| "Wait for internal event" (Esperar un evento interno)                                               | El instrumento espera un disparador interno antes de iniciar la adquisición de datos.                                                                           |
| "Wait for alarm event"                                                                              | El instrumento espera un disparador de alarma antes de iniciar la adquisición de datos.                                                                         |
| "Wait for manual event"                                                                             | El instrumento espera un disparador manual antes de iniciar la adquisición de datos.                                                                            |
| "Wait for channel event" (Esperar un evento de canal)                                               | El instrumento espera un disparador de canal antes de iniciar la adquisición de datos.                                                                          |

## Menú [Channel]

### Módulos de multiplexor: Mediciones

El Keysight DAQ970A/DAQ973A admite muchas funciones de medición comunes con el módulo multiplexor. Puede configurar la función de medición en el canal seleccionado si presiona **[Channel] > Measure**.

En el modo de adquisición de datos **Scan**, si selecciona **Off** se deshabilita la función de medición en el canal seleccionado en ese momento. No se mostrarán funciones de medición en la lista de escaneo del canal seleccionado. La función de medición predeterminada se ajustará al voltaje de CC (DCV).

En el modo de adquisición de datos **DMM Digitize**, de forma predeterminada, se configurará automáticamente para **DMM Digitize** el primer canal apto y se asignará una función de medición (DCV, de forma predeterminada). También puede pasar a otro canal disponible en el módulo plug-in y configurarlo para la operación de DMM Digitize. En contraste con el modo **Scan**, no hay función Off disponible porque DMM Digitize solo puede utilizar un solo canal configurado para su operación de digitalización. Por lo tanto, la función de medición del canal seleccionado siempre debe estar habilitada.

La siguiente tabla muestra la descripción general de cada módulo multiplexor compatible en la función de medición. Haga clic en cada enlace para ver los detalles de cada paso de configuración.

| Medición de medición    | Módulos de multiplexor |                  |          |                  |
|-------------------------|------------------------|------------------|----------|------------------|
|                         | DAQM900A               | DAQM901A         | DAQM902A | DAQM908A         |
| Temperatura - Termopar  | √                      | √                | √        |                  |
| Temperatura - RTD       |                        | √                | √        | √ <sup>[2]</sup> |
| Temperatura - Termistor |                        | √                | √        | √ <sup>[2]</sup> |
| Deformación - Puente    | √                      | √                | √        | √                |
| Deformación - Directa   |                        | √                | √        | √ <sup>[2]</sup> |
| Voltaje de CC           | √                      | √                | √        | √                |
| Voltaje de CA           | √                      | √                | √        | √                |
| Corriente de CC         |                        | √ <sup>[1]</sup> |          |                  |
| Corriente de CA         |                        | √ <sup>[1]</sup> |          |                  |
| Resistencia             | √                      | √                | √        | √ <sup>[2]</sup> |
| Frecuencia              | √                      | √                | √        | √                |
| Periodo                 | √                      | √                | √        | √                |
| Diodo                   |                        | √                | √        | √                |
| Capacitancia            |                        | √                | √        | √                |

Notas:

[1] Solo el canal 21 y 22.

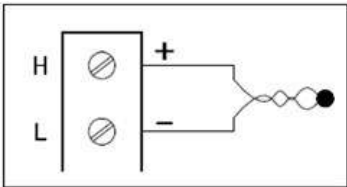
[2] Solo para las mediciones de 2 alambres. Las mediciones de 4 alambres no son compatibles con el módulo multiplexor DAQM908A

Temperatura

En esta sección se describe cómo configurar el canal seleccionado para mediciones de temperatura desde el panel frontal. Las mediciones de temperatura requieren una sonda de transducción de temperatura y las sondas admitidas son termopar, termistor y termómetro de resistencia (RTD).

Termopar

- 1. Conecte un termopar a los terminales de tornillo del módulo.



- 2. Presione **[Channel]>Measure** y seleccione **TEMP** en el menú de selección.



- 3. Presione la tecla de función **Units** para especificar las unidades de medición de temperatura como **°C** (Celsius), **°F** (Fahrenheit) o **K** (Kelvin). Puede mezclar unidades de temperatura en diferentes canales dentro del instrumento y en el mismo módulo.
- 4. Presione **Sensor Settings > Sensor**, especifique el tipo de sonda de transducción utilizada como **TCouple** y presione la tecla de función **Type** para seleccionar el tipo de termopar. Los tipos admitidos son J (predeterminado), K, E, T, N, R, B y S.



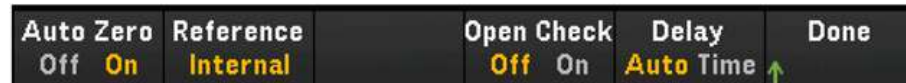
- 5. Presione la tecla de función **Integrated Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**). Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.



| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

## Configuración avanzada

Presione la tecla de función **Advanced** para configurar los ajustes avanzados para la medición.



| Tecla de función      |          | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Referencia            | Internal | Las mediciones del termopar requieren una temperatura de unión de referencia. Puede ingresar una temperatura de unión de referencia fija conocida (generalmente utilizada para uniones de referencia externas), usar la temperatura medida internamente en el módulo como la temperatura de la unión de referencia, o usar el termistor externo o la medición RTD. Seleccione la fuente de la unión de referencia como <b>Internal</b> , <b>External</b> o <b>Fixed</b> .                                                                                                                                                                                                                                              |
|                       | External |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                       | Fixed    | <div>NOTA</div> <p>La opción de la tecla de función <b>External</b> no está disponible cuando se ha seleccionado <b>DMM Digitize</b> como el modo de adquisición.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Open Check<br>Off/ On |          | <p>Habilita (On) o deshabilita (Off) la función de verificación de termopar para comprobar que los termopares estén conectados correctamente para las mediciones. Cuando está habilitado, el instrumento realiza una medición de resistencia con cada temperatura para verificar si hay un circuito abierto. Si se detecta uno, el resultado se mostrará como +Overload (Sobrecarga). Si no se realiza esta comprobación, la medición de un circuito abierto puede producir una lectura de voltaje cercana a cero que resulta en una lectura de temperatura no válida.</p> <div>NOTA</div> <p>Esta configuración solo está disponible cuando se selecciona <b>Scan</b> como modo de adquisición.</p>                   |
| Delay<br>Auto/ Time   |          | <p>Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b>, el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b>, se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.</p> <div>NOTA</div> <p>Esta configuración solo está disponible cuando se ha seleccionado <b>Scan</b> como el modo de adquisición.</p> |

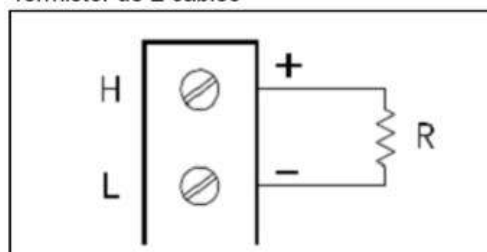
## Termistor de 2 y 4 alambres

### NOTA

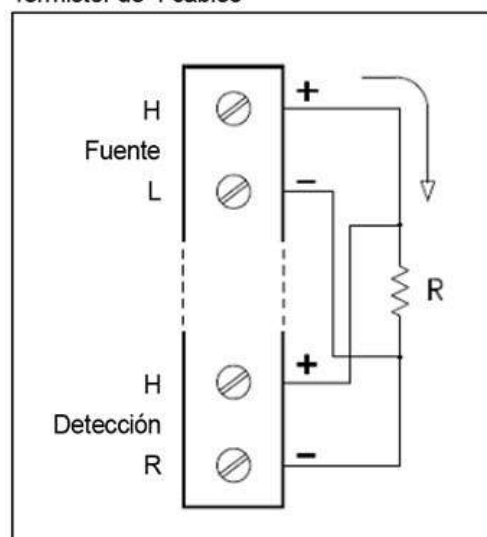
Este recurso solo está disponible cuando se selecciona **Scan** como el modo de adquisición.

1. Conecte un termistor a los terminales de tornillo del módulo.

Termistor de 2 cables



Termistor de 4 cables



2. Presione [Channel] > Measure y seleccione TEMP en el menú de selección.



3. Presione la tecla de función Units para especificar las unidades de medición de temperatura como °C (Celsius), °F (Fahrenheit) o K (Kelvin). Puede mezclar unidades de temperatura en diferentes canales dentro del instrumento y en el mismo módulo.
4. Presione **Sensor Settings** > **Sensor** y seleccione **Thermistor**. Luego, alterne la tecla de función **2-Wire/4-Wire** para especificar el tipo de sonda de transducción usada como **2-wire** o **4-wire Therm**. Después, presione la tecla de función **Type** para seleccionar el tipo de termistor. Los tipos admitidos son 2.2K, 5K (predeterminado) y 10K.



5. Presione **Use as ref** para habilitar (**On**) o deshabilitar (**Off**) el canal seleccionado actualmente que se usará como el canal de referencia para las mediciones de termopares subsiguientes y que especifica una fuente de referencia externa.
6. Presione la tecla de función **Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de NPLC (cantidad de ciclos de entrada de alimentación) o directamente en segundos (**Time**). Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

### Configuración avanzada

Presione la tecla de función **Advanced** para configurar los ajustes avanzados para la medición.



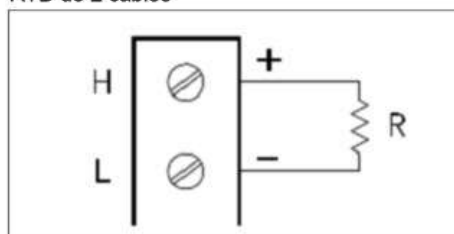
| Tecla de función     |  | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On |  | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
|                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Low Power<br>Off/ On |  | Selecciona la medición de resistencia a baja potencia. Esto suministra menos corriente, lo que da como resultado una menor disipación de energía y un menor nivel de autocalentamiento en la resistencia sometida a pruebas. Normalmente, esto representa cerca de 1/10 de la corriente suministrada para las mediciones de resistencia estándar. El valor aproximado de la corriente suministrada para cada rango de medición se muestra en la parte inferior de las teclas de función de rango de resistencia, por ejemplo: (~ 1 mA).                                                                                                                                                                                                                                                                                                 |
|                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Delay<br>Auto/ Time  |  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |
|                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



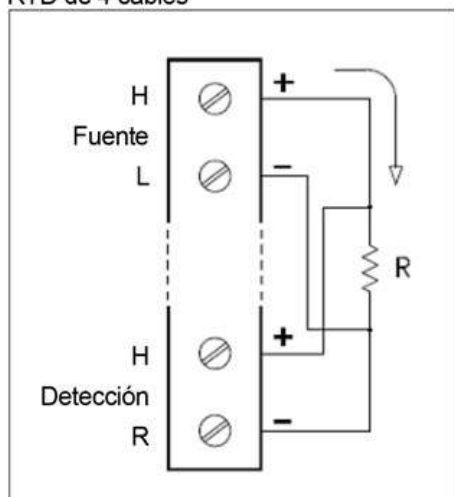
## 2-wire and 4-wire RTD

1. Conecte un RTD a los terminales de tornillo del módulo.

RTD de 2 cables



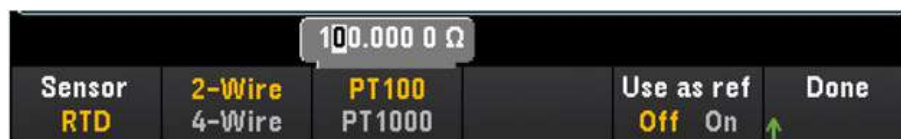
RTD de 4 cables



2. Presione [Channel] > Measure y seleccione TEMP en el menú de selección.



3. Presione la tecla de función Units para especificar las unidades de medición de temperatura como °C (Celsius), °F (Fahrenheit) o K (Kelvin). Puede mezclar unidades de temperatura en diferentes canales dentro del instrumento y en el mismo módulo.
4. Presione Sensor Settings > Sensor y seleccione RTD. Luego, presione la tecla de función 2-Wire/4-Wire para especificar el tipo de sonda de transducción utilizada como 2-wire o 4-wire RTD. Luego, presione la tecla de función PT100/PT1000 para seleccionar la resistencia nominal,  $R_0$ , como PT100 (100  $\Omega$ ) o PT1000 (1000  $\Omega$ ).  $R_0$  es la resistencia nominal de un RTD a 0 °C.



5. Presione Use as ref para habilitar (On) o deshabilitar (Off) el canal seleccionado actualmente que se usará como el canal de referencia para las mediciones de termopares subsiguientes y que especifica una fuente de referencia externa. Esta opción no está disponible en el modo DMM Digitize.

6. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**). Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

### Configuración avanzada

#### NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione la tecla de función **Advanced** para configurar los ajustes avanzados para la medición.

|                  |  |                  |                  |              |             |
|------------------|--|------------------|------------------|--------------|-------------|
| <b>Auto Zero</b> |  | <b>OffstComp</b> | <b>Low Power</b> | <b>Delay</b> | <b>Done</b> |
| Off On           |  | Off On           | Off On           | Auto Time ↑  |             |

| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| OffstComp            | La compensación elimina los efectos de los pequeños voltajes de CC en el circuito que se está midiendo. Esta técnica incluye considerar la diferencia entre dos mediciones de resistencia, una con la fuente de corriente configurada con el valor normal, y una con la fuente de corriente configurada con un valor más bajo.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Low Power<br>Off/ On | Selecciona la medición de resistencia a baja potencia. Esto suministra menos corriente, lo que da como resultado una menor disipación de energía y un menor nivel de autocalentamiento en la resistencia sometida a pruebas. Normalmente, esto representa cerca de 1/10 de la corriente suministrada para las mediciones de resistencia estándar. El valor aproximado de la corriente suministrada para cada rango de medición se muestra en la parte inferior de las teclas de función de rango de resistencia, por ejemplo: (~ 1 mA).                                                                                                                                                                                                                                                                                                 |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

## Deformación

En esta sección se describe cómo configurar el canal seleccionado para mediciones de deformación desde el panel frontal. Cuando se aplica una fuerza a un cuerpo, el cuerpo se deforma. La deformación por unidad de longitud se llama deformación ( $\epsilon$ ). La deformación puede ser de tracción (+) o de compresión (-). El DAQ970A/DAQ973A admite dos tipos de mediciones de deformación que son la configuración del puente y el método resistivo directo.

Una vez que haya configurado la función de medición de deformación en todos los canales de voltaje, presione **Home]** > **Strain Offset** para medir o especificar la compensación no deformada que se restará de las mediciones de deformación antes de que se realice la conversión de deformación.

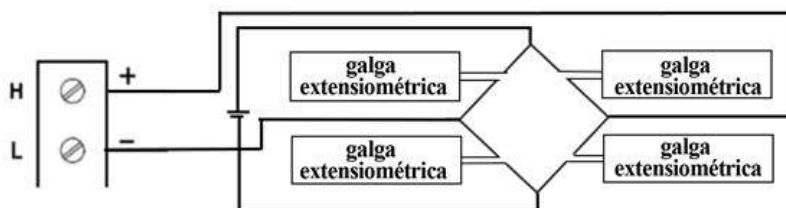
## Configuración del puente

### Puente completo y medio en la distribución de flexión

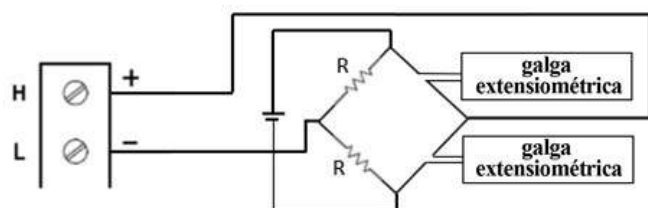
En este capítulo se describe cómo configurar el canal seleccionado para mediciones de galgas extensométricas de puente de flexión completo y medio desde el panel frontal.

1. Conecte la fuente de configuración del puente a los terminales de tornillo del módulo.

Puente completo de flexión:



Puente medio de flexión:



2. Presione **[Channel]** > **Measure** y seleccione **STRAIN** en el menú de selección.



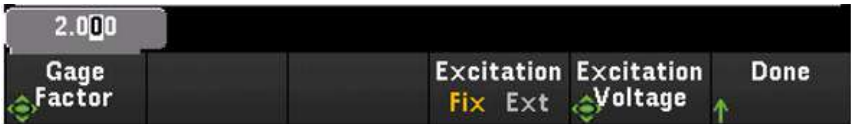
3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (autorango) selecciona automáticamente el rango para la medición en función de la entrada. El cambio automático de rango es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual. La opción **Auto** no está disponible en el modo de adquisición de datos **DMM Digitize**.



4. Presione **Sense Settings** > **Sense**, especifique el método de medición de la deformación como puente completo y medio en la distribución de flexión.



5. Presione **Gage Settings** y use la perilla o las teclas de flecha del panel frontal para especificar varias configuraciones de las galgas extensométricas.



| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor         | Gage Factor (factor de galga) es la relación entre el cambio fraccional en la resistencia y el cambio fraccional en la longitud (deformación) a lo largo del eje de las galgas. Cuanto mayor sea el valor, más sensible son las galgas extensométricas. El factor de galga es una cantidad sin dimensión. El valor típico es de aproximadamente 2.                                                                                                                                                                                                                                                                                                                                                                                                         |
| Excitation Fix/ Ext | Las conversiones de puente de deformación requieren el voltaje de la excitación externa del puente. Para este voltaje, usted puede dedicar un canal de multiplexor para medir el voltaje de excitación, o puede especificar un valor de voltaje fijo conocido. Fijo ( <b>Fix</b> ): el valor fijo especificado por la tecla de función Excitation Voltage se utilizará para la conversión de deformación. Externo ( <b>Ext</b> ): las mediciones de DCV en el canal de referencia habilitado se utilizarán para las mediciones de puentes de deformación posteriores que especifiquen una fuente de voltaje de excitación externa. Tome en cuenta que el canal de referencia DCC externo debe ser un canal de número más bajo que el canal de deformación. |
| Excitation Voltage  | Use la perilla o las teclas de flecha del panel frontal para especificar el voltaje de excitación fijo aplicado al puente por una fuente de voltaje externa. Este valor se utilizará para convertir las mediciones de puentes de deformación en el canal seleccionado.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

6. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**). Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

### Configuración avanzada

#### NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.



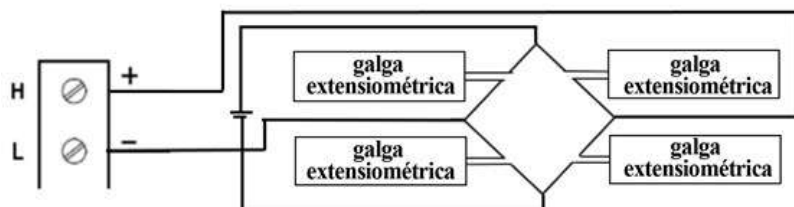
| Tecla de función     |      | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Off  | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
|                      | On   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Delay<br>Auto/ Time  | Auto | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |
|                      | Time |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

### Puente completo y medio en distribución de Poisson

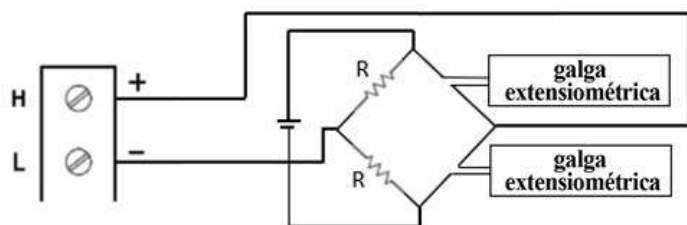
En este capítulo se describe cómo configurar el canal seleccionado para mediciones de galgas extensométricas de puente de Poisson completo y medio desde el panel frontal.

1. Conecte la fuente de configuración del puente a los terminales de tornillo del módulo.

Puente completo de flexión:



Puente medio de flexión:



2. Presione [Channel] > Measure y seleccione STRAIN en el menú de selección.



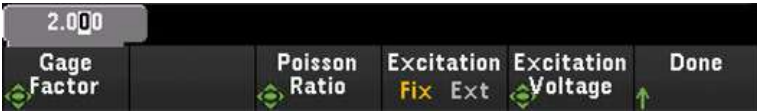
3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (autorange) selecciona automáticamente el rango para la medición en función de la entrada. El rango automático es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.



4. Presione **Sense Settings > Sense**, especifique el método de medición de la deformación como puente completo y medio en la distribución de Poisson.



5. Presione **Gage Settings** y use la perilla o las teclas de flecha del panel frontal para especificar varias configuraciones de las galgas extensométricas.



| Tecla de función        | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor             | Gage Factor (factor de galga) es la relación entre el cambio fraccional en la resistencia y el cambio fraccional en la longitud (deformación) a lo largo del eje de las galgas. Cuanto mayor sea el valor, más sensible son las galgas extensométricas. El factor de galga es una cantidad sin dimensión. El valor típico es de aproximadamente 2.                                                                                                                                                                                                                                                                                                                                                                                                         |
| Poisson Ratio           | Especifica el coeficiente de Poisson de la galga extensométrica. El coeficiente de Poisson se define como la relación negativa de la deformación en la dirección transversal a la deformación en la dirección longitudinal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Excitation<br>Fix/ Ext  | Las conversiones de puente de deformación requieren el voltaje de la excitación del puente externo. Para este voltaje, usted puede dedicar un canal de multiplexor para medir el voltaje de excitación, o puede especificar un valor de voltaje fijo conocido. Fijo ( <b>Fix</b> ): el valor fijo especificado por la tecla de función Excitation Voltage se utilizará para la conversión de deformación. Externo ( <b>Ext</b> ): las mediciones de DCV en el canal de referencia habilitado se utilizarán para las mediciones de puentes de deformación posteriores que especifiquen una fuente de voltaje de excitación externa. Tome en cuenta que el canal de referencia DCC externo debe ser un canal de número más bajo que el canal de deformación. |
| Excitation Vol-<br>tage | Use la perilla o las teclas de flecha del panel frontal para especificar el voltaje de excitación fijo aplicado al puente por una fuente de voltaje externa. Este valor se utilizará para convertir las mediciones de puentes de deformación en el canal seleccionado.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

6. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**). Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

### Configuración avanzada

#### NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.



| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

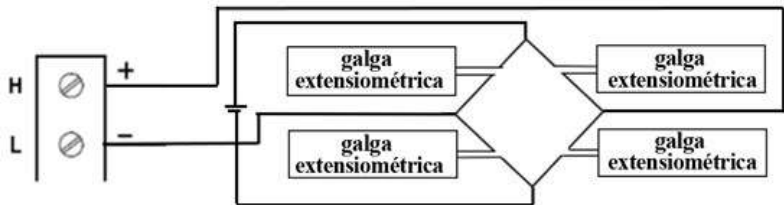


**Puente completo en distribución de Poisson y flexión**

En este capítulo se describe cómo configurar el canal seleccionado para mediciones de galgas extensométricas de puente completo en la distribución de Poisson y flexión desde el panel frontal.

- 1. Conecte la fuente de configuración del puente a los terminales de tornillo del módulo.

Puente completo de flexión:



- 2. Presione [Channel] > Measure y seleccione STRAIN en el menú de selección.



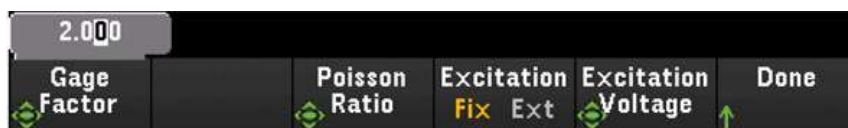
- 3. Presione Range y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. Auto (autorango) selecciona automáticamente el rango para la medición en función de la entrada. El rango automático es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.



- 4. Presione Sense Settings > Sense, especifique el método de medición de la deformación como puente completo en la distribución de Poisson y flexión.



5. Presione **Gage Settings** y use la perilla o las teclas de flecha del panel frontal para especificar varias configuraciones de las galgas extensométricas.



| Tecla de función        | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor             | Gage Factor (factor de galga) es la relación entre el cambio fraccional en la resistencia y el cambio fraccional en la longitud (deformación) a lo largo del eje de las galgas. Cuanto mayor sea el valor, más sensible son las galgas extensométricas. El factor de galga es una cantidad sin dimensión. El valor típico es de aproximadamente 2.                                                                                                                                                                                                                                                                                                                                                                                                         |
| Poisson Ratio           | Especifica el coeficiente de Poisson de la galga extensométrica. El coeficiente de Poisson se define como la relación negativa de la deformación en la dirección transversal a la deformación en la dirección longitudinal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Excitation<br>Fix/ Ext  | Las conversiones de puente de deformación requieren el voltaje de la excitación del puente externo. Para este voltaje, usted puede dedicar un canal de multiplexor para medir el voltaje de excitación, o puede especificar un valor de voltaje fijo conocido. Fijo ( <b>Fix</b> ): el valor fijo especificado por la tecla de función Excitation Voltage se utilizará para la conversión de deformación. Externo ( <b>Ext</b> ): las mediciones de DCV en el canal de referencia habilitado se utilizarán para las mediciones de puentes de deformación posteriores que especifiquen una fuente de voltaje de excitación externa. Tome en cuenta que el canal de referencia DCC externo debe ser un canal de número más bajo que el canal de deformación. |
| Excitation Vol-<br>tage | Use la perilla o las teclas de flecha del panel frontal para especificar el voltaje de excitación fijo aplicado al puente por una fuente de voltaje externa. Este valor se utilizará para convertir las mediciones de puentes de deformación en el canal seleccionado.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

6. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**) Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

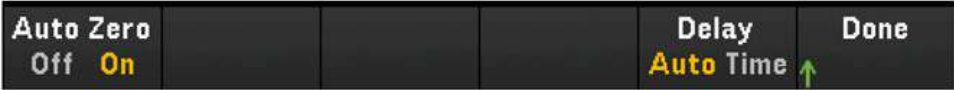
| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                               |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
| Time                | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

Configuración avanzada

NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.

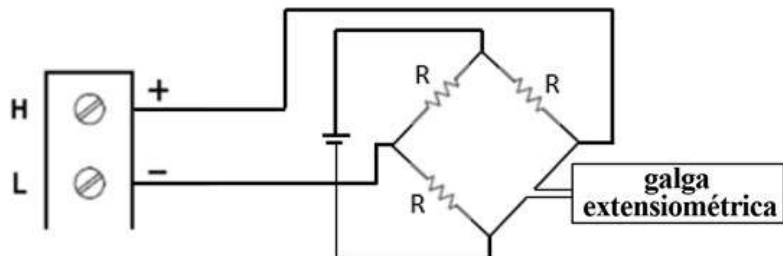


| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

### Distribución de cuarto de puente

En esta sección se describe cómo configurar el canal seleccionado para mediciones de galgas extensométricas de cuarto de puente.

1. Conecte la fuente de configuración del puente a los terminales de tornillo del módulo.



2. Presione [Channel] > Measure y seleccione STRAIN en el menú de selección.



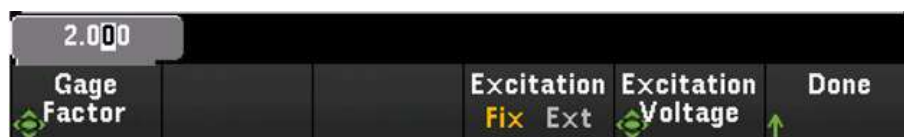
3. Presione Range y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. Auto (autorango) selecciona automáticamente el rango para la medición en función de la entrada. El rango automático es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.



4. Presione Sense Settings > Sense, especifique el método de medición de la deformación como cuarto de puente.



5. Presione **Gage Settings** y use la perilla o las teclas de flecha del panel frontal para especificar varias configuraciones de las galgas extensométricas.



| Tecla de función       | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor            | Gage Factor (factor de galga) es la relación entre el cambio fraccional en la resistencia y el cambio fraccional en la longitud (deformación) a lo largo del eje de las galgas. Cuanto mayor sea el valor, más sensible son las galgas extensométricas. El factor de galga es una cantidad sin dimensión. El valor típico es de aproximadamente 2.                                                                                                                                                                                                                                                                                                                                                                                                         |
| Excitation<br>Fix/ Ext | Las conversiones de puente de deformación requieren el voltaje de la excitación del puente externo. Para este voltaje, usted puede dedicar un canal de multiplexor para medir el voltaje de excitación, o puede especificar un valor de voltaje fijo conocido. Fijo ( <b>Fix</b> ): el valor fijo especificado por la tecla de función Excitation Voltage se utilizará para la conversión de deformación. Externo ( <b>Ext</b> ): las mediciones de DCV en el canal de referencia habilitado se utilizarán para las mediciones de puentes de deformación posteriores que especifiquen una fuente de voltaje de excitación externa. Tome en cuenta que el canal de referencia DCC externo debe ser un canal de número más bajo que el canal de deformación. |
| Excitation Voltage     | Use la perilla o las teclas de flecha del panel frontal para especificar el voltaje de excitación fijo aplicado al puente por una fuente de voltaje externa. Este valor se utilizará para convertir las mediciones de puentes de deformación en el canal seleccionado.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

6. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**) Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

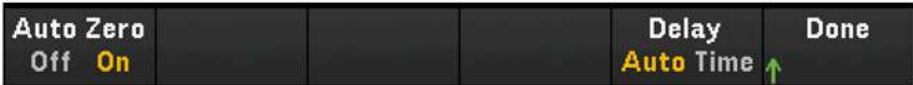
| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC                                                                                                                                                                                                                                                                                                                                      |
|                  | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time                                                                                                                                                                                                                                                                                                                                      |
|                  | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

Configuración avanzada

NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.



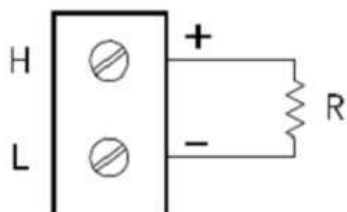
| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

## Método resistivo directo

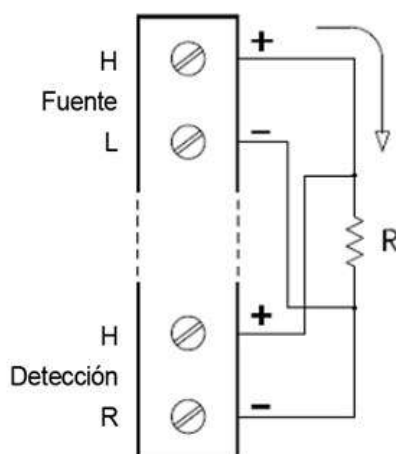
En esta sección se describe cómo configurar el canal seleccionado para mediciones de galgas extensométricas de 2 y 4 alambres desde el panel frontal. Las configuraciones de medición de fuente resistiva directa de 2 y 4 alambres son las mismas. Las descripciones a continuación son ejemplos que explican mediante el uso de mediciones de resistencia de 2 alambres.

1. Conecte la fuente resistiva directa a los terminales de tornillo del módulo.

Deformación directa de 2 alambres:



Deformación directa de 4 alambres:



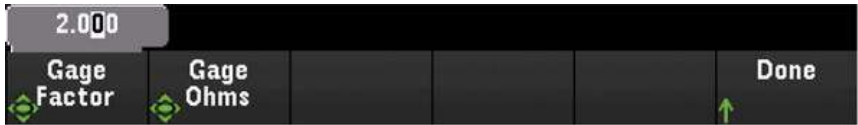
2. Presione **[Channel]** > **Measure** y seleccione **STRAIN** en el menú de selección.



3. Presione **Sense Settings** > **Sense**, especifique el método de medición de la deformación como directa de 2 o 4 alambres. Tome en cuenta que la tecla de función **Range** (como se ve en el paso 2) ya no estará disponible para configuración cuando se seleccione el método de 2 o 4 alambres.



4. Presione **Gage Settings** y use la perilla o las teclas de flecha del panel frontal para especificar varias configuraciones de las galgas extensométricas.



| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                                        |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor      | Gage Factor (factor de galga) es la relación entre el cambio fraccional en la resistencia y el cambio fraccional en la longitud (deformación) a lo largo del eje de las galgas. Cuanto mayor sea el valor, más sensible son las galgas extensométricas. El factor de galga es una cantidad sin dimensión. El valor típico es de aproximadamente 2. |
| Ohms de galga    | Resistencia de galga que se utilizará para convertir las mediciones directas de deformación en el canal seleccionado.                                                                                                                                                                                                                              |

5. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**) Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                               |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate      NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
| Time                | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

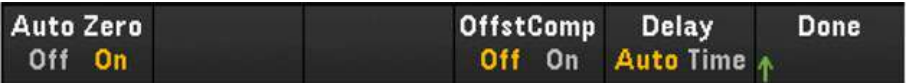


Configuración avanzada

NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.

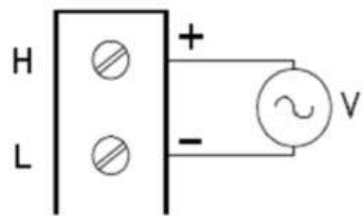


| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| OffstComp<br>Off/ On | La compensación elimina los efectos de los pequeños voltajes de CC en el circuito que se está midiendo. Esta técnica incluye considerar la diferencia entre dos mediciones de resistencia, una con la fuente de corriente configurada con el valor normal, y una con la fuente de corriente configurada con un valor más bajo.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Delay<br>Auto/Time   | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

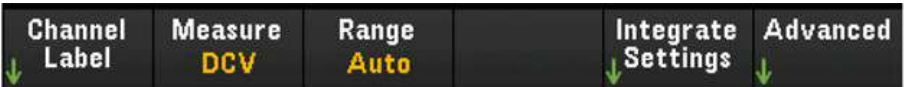
Voltaje de CC

En esta sección se describe cómo configurar el canal seleccionado para mediciones de voltaje de CC desde el panel frontal.

- 1. Conecte la fuente de voltaje a los terminales de tornillo del módulo.



- 2. Presione [Channel] > Measure y seleccione DCV en el menú de selección.



- 3. Presione Range y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. Auto (autorange) selecciona automáticamente el rango para la medición en función de la entrada. El cambio automático de rango es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.

**NOTA** No se admite Autorange en el modo de adquisición de datos DMM Digitize.



- 4. Presione la tecla de función Integrate Settings para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (NPLC) o directamente en segundos (Time) Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

## Configuración avanzada

Presione **Advanced** para configurar los ajustes avanzados para la medición.

|                     |                     |  |  |                      |      |
|---------------------|---------------------|--|--|----------------------|------|
| Auto Zero<br>Off On | Input Z<br>10M Auto |  |  | Delay<br>Auto Time ↑ | Done |
|---------------------|---------------------|--|--|----------------------|------|

| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
|                      | <div>NOTA</div> Esta configuración está disponible cuando se seleccionan <b>Scan</b> o <b>DMM Digitize</b> como modo de adquisición.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Input Z<br>10M/ Auto | Especifica la impedancia de entrada del terminal de medición, que puede ser 10 M $\Omega$ ( <b>10 M</b> ) o alta impedancia ( <b>Auto</b> ). El modo Auto selecciona alta impedancia (10 G $\Omega$ ) para los rangos de 100 mV, 1 V y 10 V, y 10 M $\Omega$ para los rangos de 100 V y 300 V. En la mayoría de las situaciones, 10 M $\Omega$ es lo suficientemente alto para no cargar la mayoría de los circuitos, pero lo suficientemente bajo para hacer lecturas adecuadas para circuitos de alta impedancia. También conduce a lecturas con menos ruido que la opción de alta impedancia, que se incluye para situaciones donde la carga de 10 M $\Omega$ es significativa.                                                                                                                                                      |
|                      | <div>NOTA</div> Esta configuración está disponible cuando se seleccionan <b>Scan</b> o <b>DMM Digitize</b> como modo de adquisición.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |
|                      | <div>NOTA</div> Esta configuración solo está disponible cuando se selecciona <b>Scan</b> como modo de adquisición.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

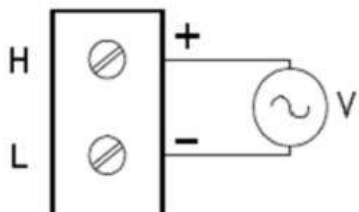
## Voltaje de CA

**NOTA**

La medición de voltaje de CA solo estará disponible cuando se haya seleccionado **Scan** como modo de adquisición.

En esta sección se describe cómo configurar el canal seleccionado para mediciones de voltaje de CA desde el panel frontal.

1. Conecte la fuente de voltaje de CA a los terminales de tornillo del módulo.



2. Presione **[Channel]** > **Measure** y seleccione **ACV** en el menú de selección.



3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (autorango) selecciona automáticamente el rango para la medición en función de la entrada. El cambio automático de rango es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.



Configuración avanzada

Presione **Advanced** para configurar los ajustes avanzados para la medición.



| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter           | Especifica qué filtro de CA se debe utilizar. El instrumento utiliza tres filtros de CA diferentes que le permiten optimizar la precisión de baja frecuencia o lograr una estabilización de CA más rápida después de un cambio en la amplitud de la señal de entrada. Los tres filtros son <b>3 Hz</b> , <b>20 Hz</b> y <b>200 Hz</b> , y generalmente se debe seleccionar el filtro de frecuencia más alta cuya frecuencia sea menor que la de la señal que se está midiendo, ya que los filtros de frecuencia más alta dan como resultado mediciones más rápidas. Por ejemplo, cuando se mide una señal entre 20 y 200 Hz, se debe utilizar el filtro de 20 Hz. Si la velocidad de medición no es un problema, la elección de un filtro de baja frecuencia puede resultar en mediciones más silenciosas, según la señal que se esté midiendo. |
| Delay<br>Auto/ Time | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                                 |

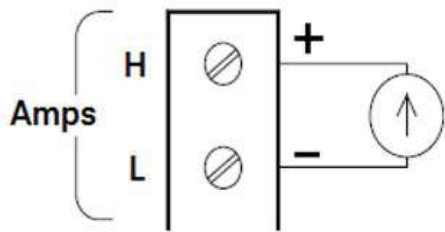
Corriente de CC

NOTA

La medición de Corriente de CC solo se admite en los canales 21 y 22 del DAQM901A.

En esta sección se describe cómo configurar el canal seleccionado para mediciones de corriente de CC desde el panel frontal.

1. Conecte la fuente de corriente de CC a los terminales de tornillo del módulo.



2. Presione [Channel] > Measure y seleccione DCI en el menú de selección.



3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (autorange) selecciona automáticamente el rango para la medición en función de la entrada. El rango automático es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual. La opción **Auto** no está disponible en el modo de adquisición de datos **DMM Digitize**.



4. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**) Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

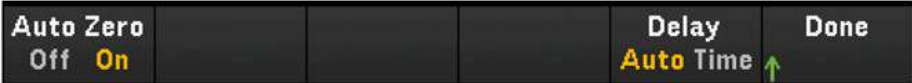
| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

Configuración avanzada

NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.



| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

## Corriente de CA

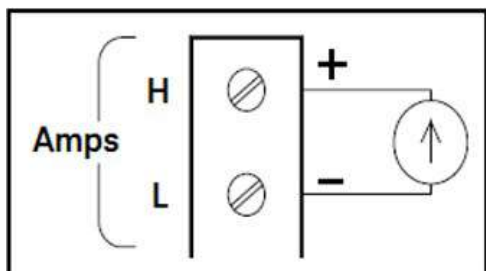
**NOTA**

La opción de medición de Corriente de CA solo estará disponible cuando se haya seleccionado **Scan** como modo de adquisición.

La medición de Corriente de CA solo se admite en los canales 21 y 22 del DAQM901A.

En esta sección se describe cómo configurar el canal seleccionado para mediciones de corriente de CA desde el panel frontal.

1. Conecte la fuente de corriente a los terminales de tornillo del módulo.



2. Presione **[Channel]** > **Measure** y seleccione **ACI** en el menú de selección.



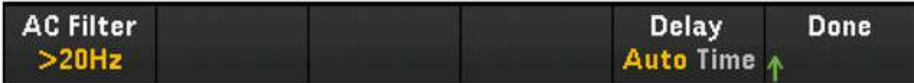
3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (autorange) selecciona automáticamente el rango para la medición en función de la entrada. El rango automático es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.





Configuración avanzada

Presione **Advanced** para configurar los ajustes avanzados para la medición.



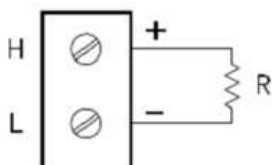
| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter           | Especifica qué filtro de CA se debe utilizar. El instrumento utiliza tres filtros de CA diferentes que le permiten optimizar la precisión de baja frecuencia o lograr una estabilización de CA más rápida después de un cambio en la amplitud de la señal de entrada. Los tres filtros son <b>3 Hz</b> , <b>20 Hz</b> y <b>200 Hz</b> , y generalmente se debe seleccionar el filtro de frecuencia más alta cuya frecuencia sea menor que la de la señal que se está midiendo, ya que los filtros de frecuencia más alta dan como resultado mediciones más rápidas. Por ejemplo, cuando se mide una señal entre 20 y 200 Hz, se debe utilizar el filtro de 20 Hz. Si la velocidad de medición no es un problema, la elección de un filtro de baja frecuencia puede resultar en mediciones más silenciosas, según la señal que se esté midiendo. |
| Delay<br>Auto/ Time | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                                 |

## Resistencia

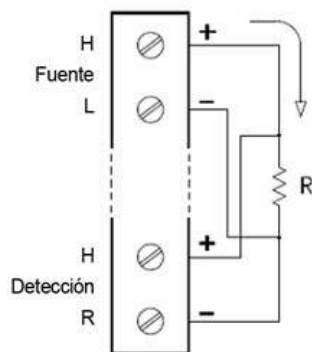
En esta sección se describe cómo configurar el canal seleccionado para mediciones de 2 y 4 alambres desde el panel frontal. Las configuraciones de medición para resistencia de 2 y 4 alambres son las mismas. Las descripciones a continuación son ejemplos que explican mediante el uso de mediciones de resistencia de 2 alambres.

1. Conecte la fuente de resistencia a los terminales de tornillo del módulo.

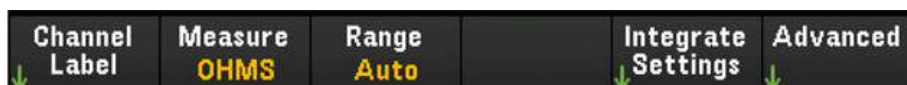
Ohmios de dos alambres:



Ohmios de cuatro alambres:



2. Presione **[Channel] > Measure** y seleccione **OHMS** o **OHMS 4W** en el menú de selección.



3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (disponible solo cuando se ha seleccionado **Scan** como el modo de adquisición de datos) selecciona automáticamente el rango de la medición según la entrada. El cambio automático de rango es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual. La opción **Auto** no está disponible en el modo de adquisición de datos **DMM Digitize**.



4. Presione la tecla de función **Integrate Settings** para seleccionar si el tiempo de integración de la medición se especificará en términos de número de ciclos de línea de alimentación (**NPLC**) o directamente en segundos (**Time**). Solo 1, 2, 10, 20, 100 y 200 PLC proporcionan rechazo en modo normal (ruido de frecuencia de línea). Si selecciona 200 PLC se logra el mejor rechazo y resolución de ruido, pero las mediciones son más lentas.

| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                               |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrate        | NPLC | Configura el tiempo de integración como 0.001, 0.002, 0.006, 0.02, 0.06, 0.2, 1, 2, 10, 20, 100 y 200 ciclos de entrada de alimentación (PLC). Solo 1 PLC y tiempos más prolongados proporcionan rechazo en modo normal (ruido de frecuencia de línea). La selección de 100 o 200 PLC proporciona el mejor rechazo y resolución de ruido. |
|                  | Time | Configura directamente el tiempo de integración en segundos.                                                                                                                                                                                                                                                                              |

### Configuración avanzada

#### NOTA

En el modo de adquisición de datos **DMM Digitize**, solo la configuración **Auto Zero** estará disponible en las configuraciones **Advanced**.

Presione **Advanced** para configurar los ajustes avanzados para la medición.

|                            |                            |                            |                             |             |
|----------------------------|----------------------------|----------------------------|-----------------------------|-------------|
| <b>Auto Zero</b><br>Off On | <b>OffstComp</b><br>Off On | <b>Low Power</b><br>Off On | <b>Delay</b><br>Auto Time ↑ | <b>Done</b> |
|----------------------------|----------------------------|----------------------------|-----------------------------|-------------|

| Tecla de función     | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto Zero<br>Off/ On | Auto Zero proporciona las mediciones más precisas, pero requiere un tiempo de medición adicional para realizar la medición del cero. Con la función de cero automático activada ( <b>On</b> ), el instrumento mide internamente la compensación después de cada medición. Luego resta esa medición de la lectura anterior. Esto evita que los voltajes de compensación presentes en los circuitos de entrada del instrumento afecten la precisión de la medición. Con la función de cero automático desactivada ( <b>Off</b> ), el instrumento mide la compensación una vez y la resta de todas las mediciones posteriores. El instrumento toma una nueva medición de compensación cada vez que se cambia la función, el rango o el tiempo de integración. (No hay configuración de cero automático para las mediciones de 4 alambres). |
| OffstCmp<br>Off/ On  | La compensación elimina los efectos de los pequeños voltajes de CC en el circuito que se está midiendo. Esta técnica incluye considerar la diferencia entre dos mediciones de resistencia, una con la fuente de corriente configurada con el valor normal, y una con la fuente de corriente configurada con un valor más bajo.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Low Power<br>Off/ On | Selecciona la medición de resistencia a baja potencia. Esto suministra menos corriente, lo que da como resultado una menor disipación de energía y un menor nivel de autocalentamiento en la resistencia sometida a pruebas. Normalmente, esto representa cerca de 1/10 de la corriente suministrada para las mediciones de resistencia estándar. El valor aproximado de la corriente suministrada para cada rango de medición se muestra en la parte inferior de las teclas de función de rango de resistencia, por ejemplo: (~ 1 mA).                                                                                                                                                                                                                                                                                                 |
| Delay<br>Auto/ Time  | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                         |

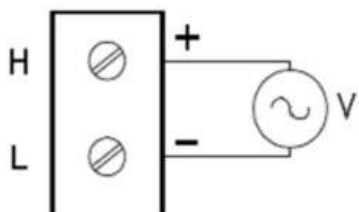
## Frecuencia y periodo

**NOTA**

La opción de medición de frecuencia y periodo solo estará disponible cuando se haya seleccionado **Scan** como el modo de adquisición.

En esta sección se describe cómo configurar el canal seleccionado para mediciones de frecuencia y período desde el panel frontal.

1. Conecte la fuente de CA a los terminales de tornillo del módulo.



2. Presione **[Channel]** > **Measure** y seleccione **FREQ** o **PERIOD** en el menú de selección.

| Channel<br>Label | Measure<br><b>FREQ</b> | Range<br><b>Auto</b> |  | Gate Time<br><b>100ms</b> | Advanced |
|------------------|------------------------|----------------------|--|---------------------------|----------|
| ↓                |                        |                      |  |                           | ↓        |

3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. **Auto** (autorange) selecciona automáticamente el rango para la medición en función de la entrada. El cambio automático de rango es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.

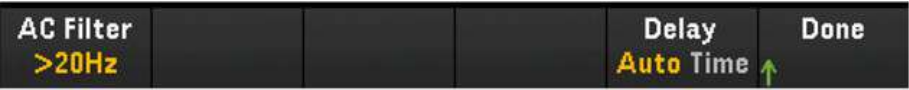
| Select Frequency Voltage Range |       |    |     |      |      |
|--------------------------------|-------|----|-----|------|------|
| <b>Auto</b>                    | 100mV | 1V | 10V | 100V | 300V |

4. Presione **Gate Time** para especificar la apertura de la medición (tiempo de integración) como 1 ms, 10 ms, 100 ms o 1 s.

| Select Gate Time |      |              |    |  |  |
|------------------|------|--------------|----|--|--|
| 1ms              | 10ms | <b>100ms</b> | 1s |  |  |

Configuración avanzada

Presione **Advanced** para configurar los ajustes avanzados para la medición.



| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Filter           | Especifica qué filtro de CA se debe utilizar. El instrumento utiliza tres filtros de CA diferentes que le permiten optimizar la precisión de baja frecuencia o lograr una estabilización de CA más rápida después de un cambio en la amplitud de la señal de entrada. Los tres filtros son <b>3 Hz</b> , <b>20 Hz</b> y <b>200 Hz</b> , y generalmente se debe seleccionar el filtro de frecuencia más alta cuya frecuencia sea menor que la de la señal que se está midiendo, ya que los filtros de frecuencia más alta dan como resultado mediciones más rápidas. Por ejemplo, cuando se mide una señal entre 20 y 200 Hz, se debe utilizar el filtro de 20 Hz. Si la velocidad de medición no es un problema, la elección de un filtro de baja frecuencia puede resultar en mediciones más silenciosas, según la señal que se esté midiendo. |
| Delay<br>Auto/ Time | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé.                                                                                                                                                                                                                                                                 |

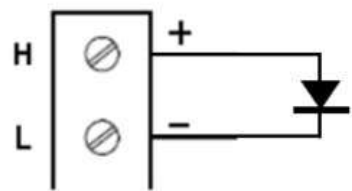
Diodo

NOTA

La opción de medición del diodo solo estará disponible cuando se haya seleccionado **Scan** como el modo de adquisición.

En esta sección se describe cómo configurar el canal seleccionado para la prueba de diodo desde el panel frontal.

- 1. Conecte la fuente de diodo a los terminales de tornillo del módulo.

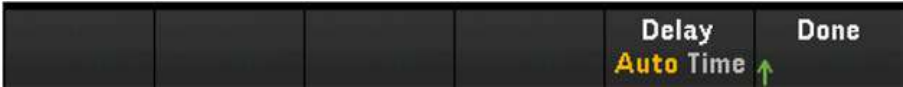


- 2. Presione [Channel] > Measure y seleccione DIODE en el menú de selección.



Configuración avanzada

Presione **Advanced** para configurar los ajustes avanzados para la medición.



| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delay<br>Auto/ Time | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé. |

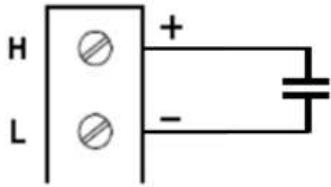
Capacitancia

NOTA

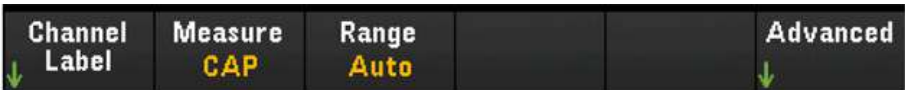
La opción de medición de la capacitancia solo estará disponible cuando se haya seleccionado **Scan** como el modo de adquisición.

En esta sección se describe cómo configurar el canal seleccionado para mediciones de capacitancia desde el panel frontal.

- 1. Conecte la fuente de capacitancia a los terminales de tornillo del módulo.



- 2. Presione **[Channel]** > **Measure** y seleccione **CAP** en el menú de selección.



- 3. Presione **Range** y use la perilla o las teclas de flecha del panel frontal para especificar el rango de medición. Auto (autorange) selecciona automáticamente el rango para la medición en función de la entrada. El cambio automático de rango es conveniente, pero resulta en mediciones más lentas que el uso de un rango manual. El rango automático aumenta un rango al 120 % del rango actual, y reduce un rango a menos de 10 % del rango actual.



Configuración avanzada

Presione **Advanced** para configurar los ajustes avanzados para la medición.

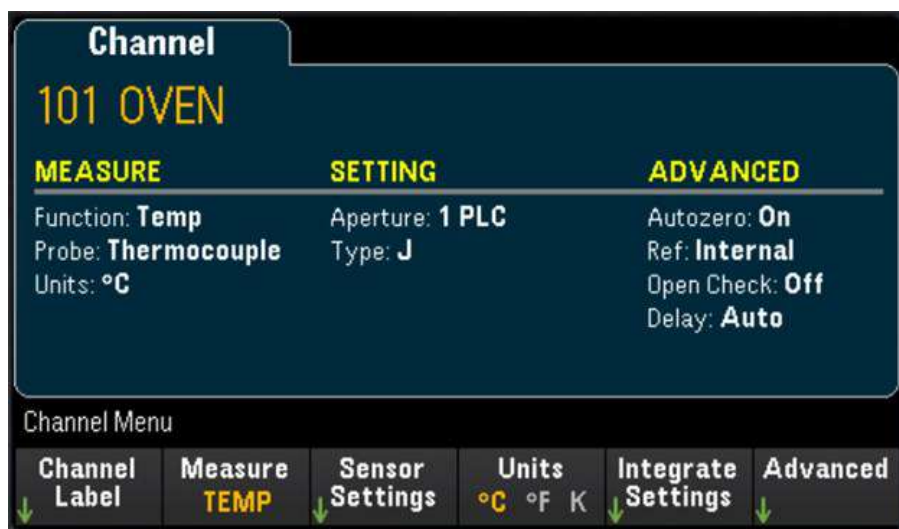


| Tecla de función    | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delay<br>Auto/ Time | Selecciona si el retraso entre los canales de la lista de escaneo se seleccionará de manera automática o manual. Al seleccionar <b>Auto</b> , el instrumento determina automáticamente el retardo del canal con base en la función de medición, el rango, el tiempo de integración y la configuración del filtro de CA. Al seleccionar <b>Time</b> , se inserta el retardo especificado (tiempo en segundos) entre el cierre del relé y la medición real en cada canal, además de cualquier retardo que se produzca implícitamente debido al tiempo de estabilización del relé. |

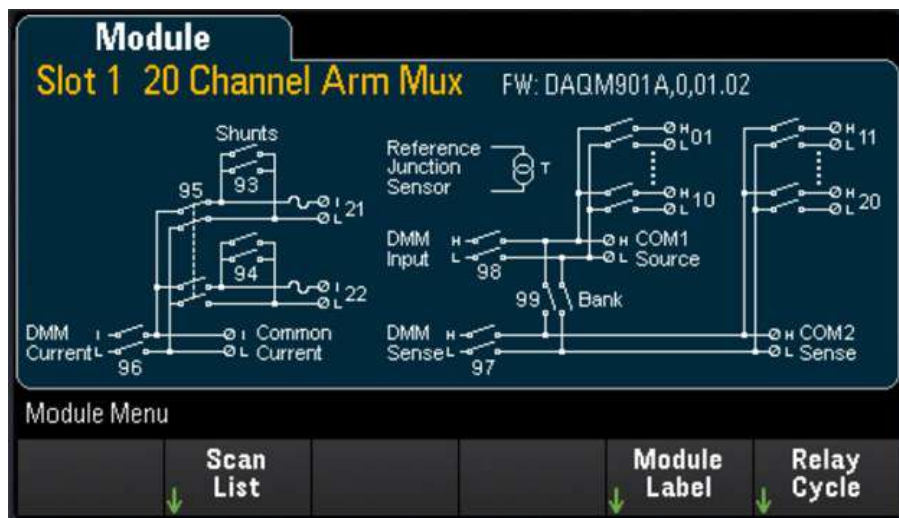
## Módulos de multiplexor: Modo de alternación

Los módulos de multiplexor (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) también pueden operar en modo de alternación que le permite abrir y cerrar los canales de forma independiente. La siguiente sección describe los pasos para habilitar y configurar el modo de alternación.

1. Presione la tecla **[Channel]** para acceder al menú Channel. En el siguiente ejemplo, el Channel 101 de un módulo DAQM901A en la ranura 1, etiquetado como OVEN, está configurado para medir la temperatura en grados °C mediante un termopar de tipo J.

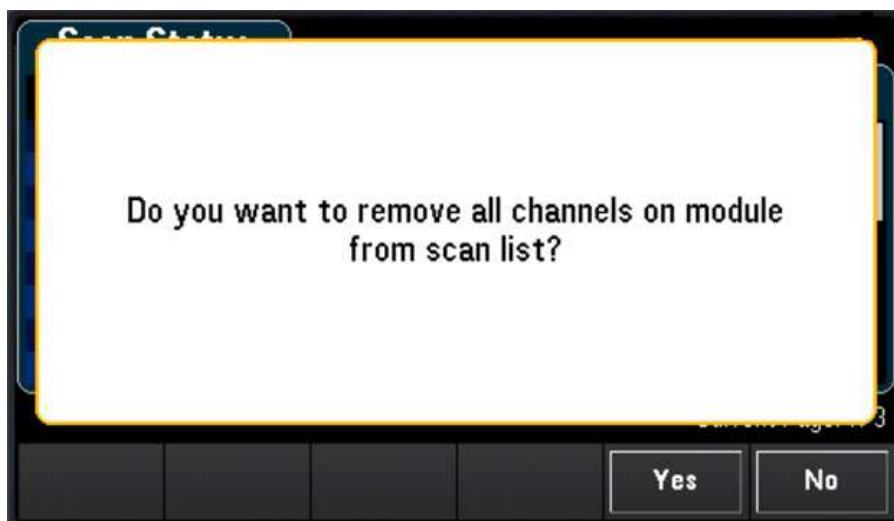


2. Presione la tecla **[Module]** para ir al menú Module. Luego, presione la tecla de función **Scan List**.





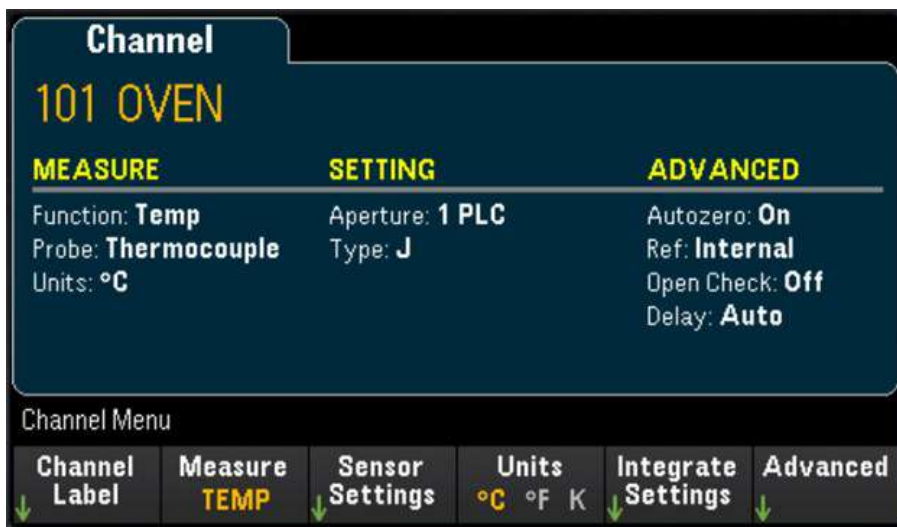
3. Notará que la etiqueta del Channel 101 es OVEN y el Scan Status es ON. Presione la tecla de función **Remove from Scan** y se le pedirá que confirme su acción. Presione la tecla de función **Yes** para confirmar la eliminación de todos los canales del módulo en la lista de escaneo. Esta acción desactiva las mediciones de los canales del módulo y coloca el módulo en modo de alternación.



4. Presione la tecla **[Channel]** para volver al menú Channel. Note que ahora las teclas de función **Open** (abrir) y **Close** (cerrar) están disponibles por que el módulo está en modo de alternación. La etiqueta del canal se mantiene. Puede presionar la tecla de función **Close** para cambiar el estado del canal.



5. Para volver al modo de escaneo, presione la tecla de función **Measure** y seleccione un modo de medición. En el siguiente ejemplo, se ha seleccionado TEMP y el módulo ahora regresó al modo de escaneo. Se ha restaurado la medición de temperatura y las teclas de función **Open** y **Close** ya no están disponibles.



## DAQM907A – Módulo multifunción

La siguiente sección describe cómo puede configurar cada uno de los canales del DAQM907A. Hay un total de 7 canales en el módulo multifunción DAQM907A, como se muestra en la siguiente tabla:

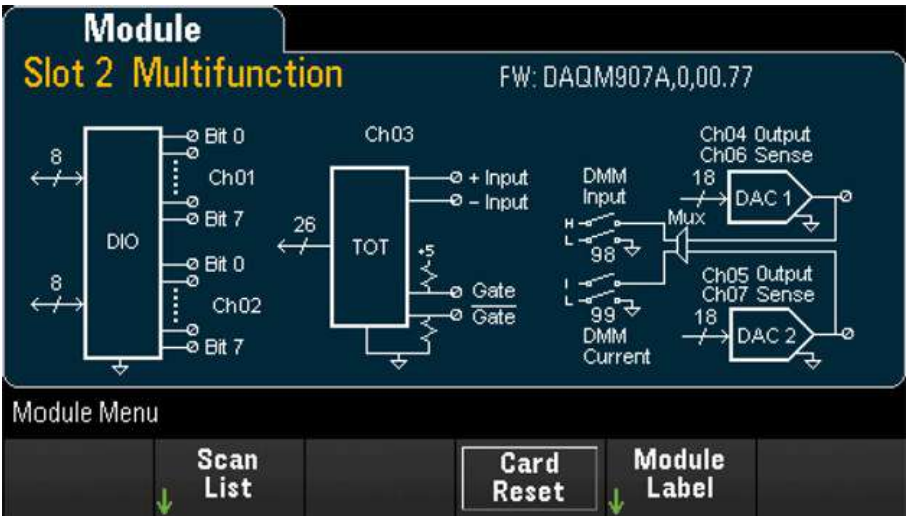
| Número de canal | Etiqueta de canal                |
|-----------------|----------------------------------|
| 01              | Canal de E/S Digital de 8 bits   |
| 02              | Canal de E/S Digital de 8 bits   |
| 03              | Canal totalizador                |
| 04              | Canal de salida DAC              |
| 05              | Canal de salida DAC              |
| 06              | Canal de detección de salida DAC |
| 07              | Canal de detección de salida DAC |

### Canales de E/S Digital (DIO) (Canales 01 y 02)

El módulo multifunción DAQM907A tiene dos puertos de entrada/salida de 8 bits no aislados que puede utilizar para leer patrones digitales. Puede leer el estado en vivo de los bits en el puerto o puede configurar un escaneo para que incluya una lectura digital.

#### Configure el canal DIO

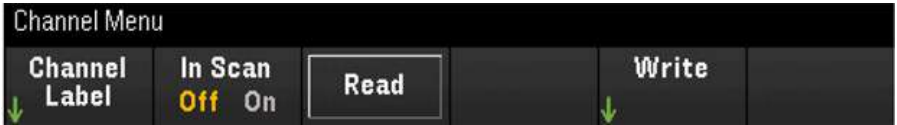
1. Presione **[Module]** y use la perilla o las teclas de flecha del panel frontal para seleccionar la ranura que contiene el módulo multifunción.



2. Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para seleccionar los canales DIO (canales 01 y 02).



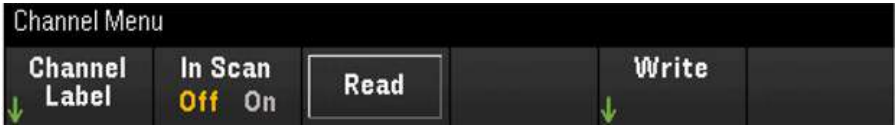
3. Presione **In Scan** para especificar si desea incluir (**On**) o excluir (**Off**) el canal DIO de la lista de escaneo.



| Tecla de función | Descripción                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------|
| Read             | Presione la tecla de función Read para leer los patrones de bits de un puerto de entrada digital.      |
| Write            | Presione la tecla de función Write para especificar y enviar el patrón de bits al puerto especificado. |

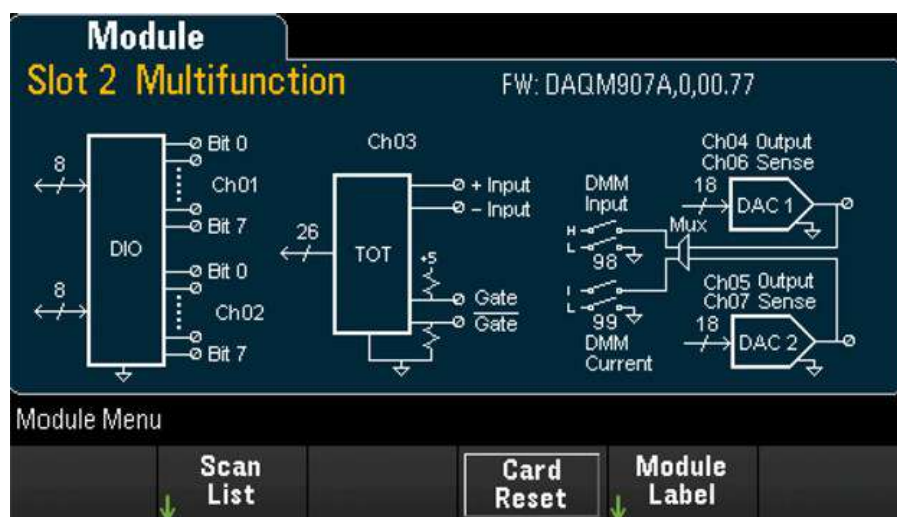
**Leer un puerto de entrada digital**

Presione la tecla de función **Read** para definir la dirección DIO como entrada.



### Escribir una entrada digital

1. Presione **[Module]** y use la perilla o las teclas de flecha del panel frontal para seleccionar la ranura que contiene el módulo multifunción.



2. Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para seleccionar los canales DIO (canales 01 y 02).



- Presione **Write > Base** y use la perilla o las teclas de flecha del panel frontal para seleccionar el número de base utilizado (**Hex**, **Binary**, o **Decimal**) y, a continuación, presione **Pattern** para definir cada patrón de salida de la base seleccionada.



- Presione **Write Pattern** para emitir el patrón de bits en el puerto de salida digital seleccionado. La dirección DIO se configurará como Output (Salida).



- Presione **Clear** para ajustar el patrón de salida a "0".



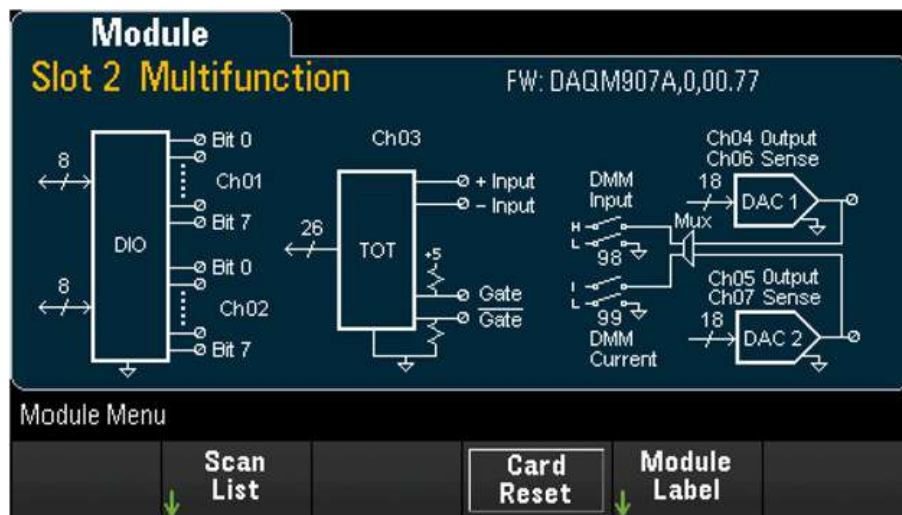
## Canal totalizador

El módulo multifunción DAQM907A tiene un totalizador de 26 bits que puede contar pulsos compatibles con TTL a una velocidad de 100 kHz. El canal totalizador tiene el número “s03”, donde “s” representa el número de ranura. El canal totalizador se etiqueta como canal 03.

Puede leer manualmente el conteo del totalizador o puede configurar un escaneo para que lea el conteo.

Para configurar el canal totalizador con el módulo multifunción:

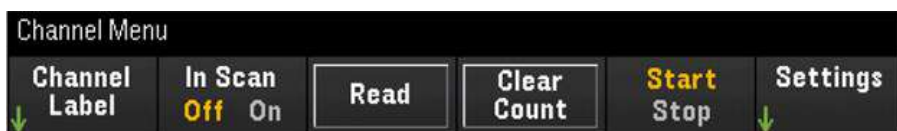
1. Presione **[Module]** y use la perilla o las teclas de flecha del panel frontal para seleccionar la ranura que contiene el módulo multifunción DAQM907A



2. Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para seleccionar el canal totalizador (canal 03).



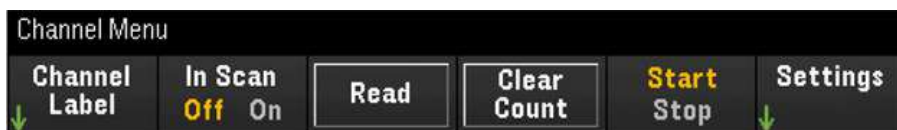
- Presione **In Scan** para especificar si desea incluir (**On**) o excluir (**Off**) el canal totalizador de la lista de escaneo.



- Presione **Settings > Edge** para especificar si el canal totalizador debe contar con el borde ascendente (**Pos**) o el borde descendente (**Neg**) de la señal de entrada y, a continuación, presione **ReadReset** para especificar si el conteo del totalizador debe restablecerse automáticamente (**On**) o no (**Off**) al leerse.



- Presione **Read** para leer el conteo del totalizador. El conteo se lee una vez cuando pulsa Read. El conteo no se actualiza automáticamente en la pantalla.



- Presione **Clear Count** para restablecer el conteo del totalizador a "0".
- Presione la tecla de función Start/Stop para alternar entre **Start** con el fin de iniciar el conteo en el canal totalizador actual o **Stop** para detener el conteo en el canal totalizador actual.



### Canales de detección y salida DAC (canales 04 a 07).

El módulo multifunción DAQM907A tiene dos canales de salida DAC (canal 04 y 05) y dos canales de detección de salida DAC (canal 06 y 07). Se puede realizar el escaneo en cualquiera de estos canales.

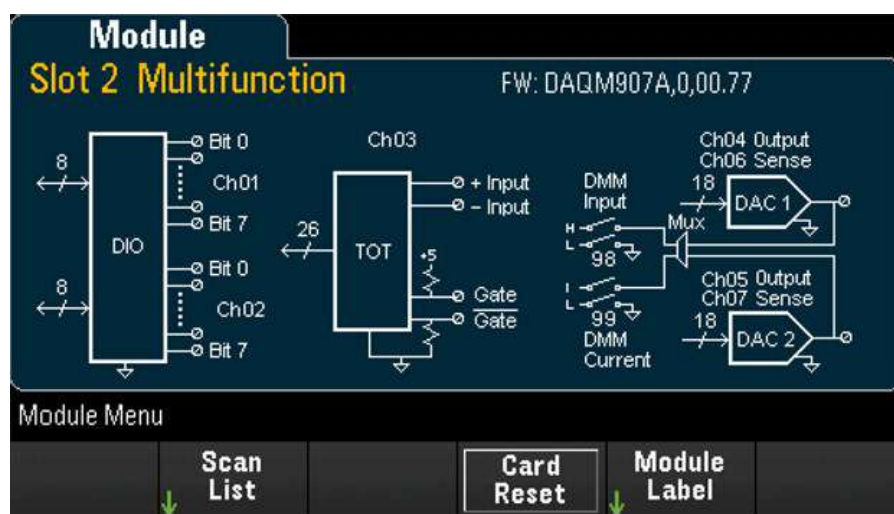
Para los canales de salida DAC, no se realiza ninguna medición de salida real. El valor detectado será el valor de salida programado (voltaje o corriente).

Los canales de detección de salida DAC realizarán una medición complementaria (voltaje o corriente) basada en el modo de salida del canal de salida DAC correspondiente:

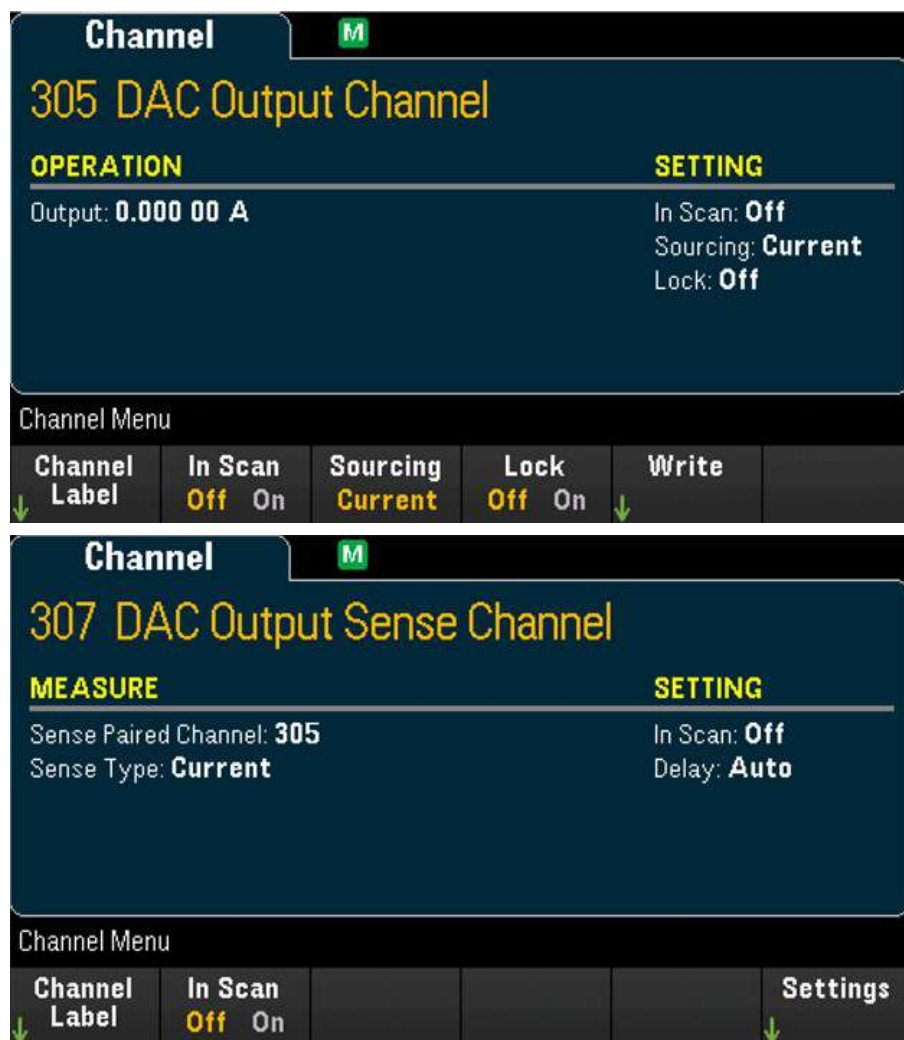
- El canal 06 realizará la medición en función del modo de salida establecido en el canal 04.
- El canal 07 realizará la medición en función del modo de salida establecido en el canal 05.

Si el canal de salida DAC 04 está configurado en modo de voltaje, entonces el canal de detección DAC correspondiente 06 medirá la corriente. Si el canal de salida se establece en el modo corriente, el canal de detección medirá el voltaje.

1. Presione **[Module]** y use la perilla o las teclas de flecha del panel frontal para seleccionar la ranura que contiene el módulo multifunción.



- Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para seleccionar los canales de salida DAC (canal 04 y 05) o los canales de detección DAC (canal 06 y 07).



- Presione **In Scan** para especificar si desea incluir (On) o excluir (Off) el canal DAC de la lista de escaneo.
- Pulse **Sourcing** para configurar el modo de salida en el canal de salida del DAC en **Voltage** o **Current**.
- Alterne entre **Lock (On)** para bloquear el modo de canal de salida del DAC o **Lock (Off)** para deshabilitar el bloqueo en el modo de canal de salida del DAC.
- Presione **Write > Output** para configurar el nivel de voltaje/corriente de salida y, a continuación, presione **Write Output** para emitir el voltaje/corriente desde el canal de salida del DAC seleccionado.

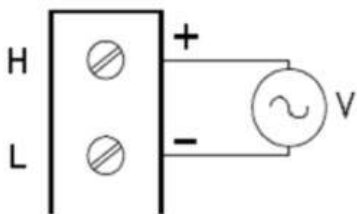
## DAQM909A – Módulo digitalizador de 24 bits y 4 canales

El DAQM909A se puede configurar para digitalizar el voltaje de CC (DCV) y la deformación. La siguiente sección describe cómo puede configurar los canales del DAQM909A.

### Voltaje de CC

En esta sección se describe cómo configurar los canales del DAQM909A para las mediciones de voltaje de CC desde el panel frontal.

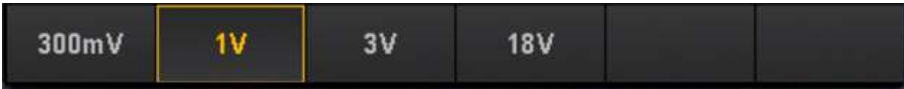
1. Conecte la fuente de voltaje a los terminales de tornillo del módulo.



2. Presione [Channel] > Measure y seleccione DCV en el menú de selección.

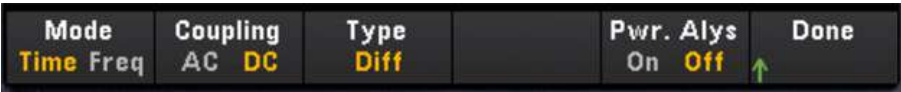


3. Presione la tecla de función **Volt Range** para especificar el rango de medición de voltaje de CC. Puede elegir entre 300mV, 1 V (valor predeterminado), 3 V o 18V.



Configuración avanzada

Presione Advanced para configurar los ajustes avanzados para el digitalizador.



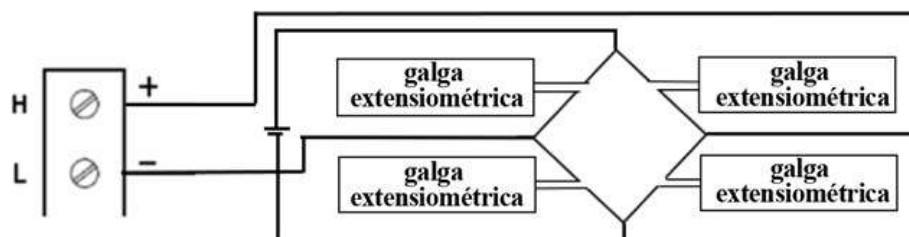
| Tecla de función       |      | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>Time/ Freq     |      | Determina el modo de filtro ADC. Presione la tecla de función <b>Mode</b> para alternar entre la entrada en el modo de dominio de tiempo ( <b>Time</b> ) o la entrada en el modo de dominio de frecuencia ( <b>Freq</b> ). Cuando se ha seleccionado el modo <b>Time</b> , el ADC incorporado se configura para usar el filtro Sinc5. Cuando se ha seleccionado el modo <b>Freq</b> , el ADC incorporado se configura para usar el filtro Wideband. |
| Acoplamiento<br>AC/ DC |      | Presione la tecla de función <b>Coupling</b> para alternar entre la forma en que se muestra el gráfico, en modo CA o CC. En el modo <b>AC</b> , el acoplamiento de CA mostrará la señal de CC normalizada a una media de cero. En el modo <b>DC</b> , el acoplamiento de CC mostrará la señal original en la pantalla.                                                                                                                              |
| Tipo                   | Diff | La entrada diferencial ( <b>Diff</b> ) mide las señales de entrada de terminales de alta y baja entrada.                                                                                                                                                                                                                                                                                                                                            |
|                        | Send | La entrada de Single Ended ( <b>Send</b> ) mide las señales de entrada del terminal de alta entrada y el terminal de baja entrada con conexión a tierra.                                                                                                                                                                                                                                                                                            |
|                        | lepe | El transductor Integrated Electronics Piezo Electric ( <b>lepe</b> , IEPE de 2 alambres con conexión a tierra LO de 100 Ohm) mide las señales de entrada con corriente directa suministrada a los terminales de alta y baja entrada.                                                                                                                                                                                                                |
| Pwr. Alys<br>On/ Off   |      | Presione la tecla de función <b>Pwr. Alys</b> para habilitar ( <b>On</b> ) o deshabilitar ( <b>Off</b> ) el recurso de análisis de potencia en el canal especificado, durante el post procesamiento de datos en el menú View.                                                                                                                                                                                                                       |
|                        |      | <div>NOTA</div> Consulte para conocer más detalles                                                                                                                                                                                                                                                                                                                                                                                                  |

## Deformación

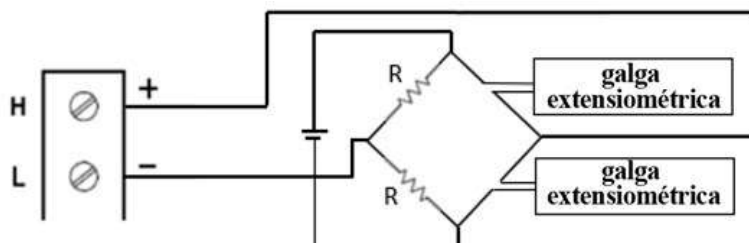
Esta sección describe cómo configurar los canales del DAQM909A para las mediciones de deformación desde el panel frontal.

1. Conecte la fuente de configuración del puente que desea a los terminales de tornillo del módulo.

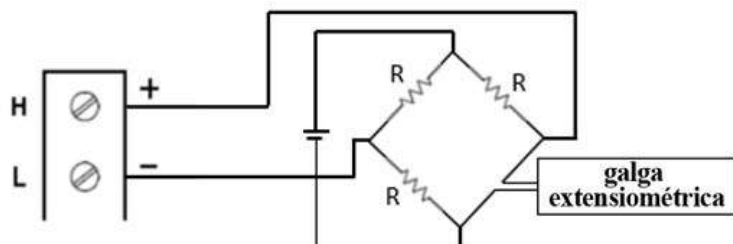
Puente completo de flexión:



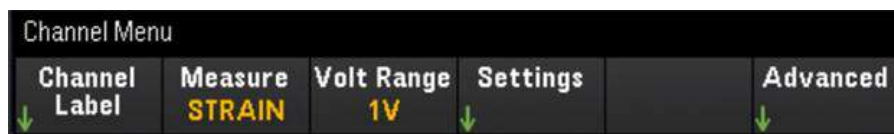
Puente medio de flexión:



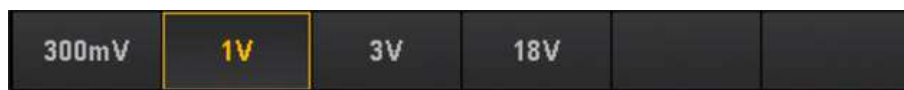
Un cuarto de puente:



2. Presione [Channel] > Measure y seleccione STRAIN en el menú de selección.



3. Presione la tecla de función Volt Range para especificar el rango de medición de voltaje de CC. Puede elegir entre 300mV, 1 V (valor predeterminado), 3 V o 18V.



4. Presione la tecla de función **Settings** > **Sense Settings** para especificar el método de medición de la deformación basado en la configuración del puente que se estableció en el paso 1.



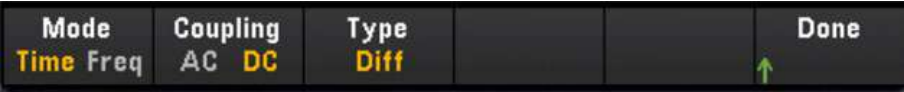
5. Presione la tecla de función **Gage Settings** para especificar las diversas configuraciones de galga extensométrica.



| Tecla de función   |  | Descripción                                                                                                                                                                                                                                                                                                                                        |
|--------------------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gage Factor        |  | Gage Factor (factor de galga) es la relación entre el cambio fraccional en la resistencia y el cambio fraccional en la longitud (deformación) a lo largo del eje de las galgas. Cuanto mayor sea el valor, más sensible son las galgas extensométricas. El factor de galga es una cantidad sin dimensión. El valor típico es de aproximadamente 2. |
| Poisson Ratio      |  | Especifica el coeficiente de Poisson de la galga extensométrica. El coeficiente de Poisson se define como la relación negativa de la deformación en la dirección transversal a la deformación en la dirección longitudinal.                                                                                                                        |
|                    |  | <div>NOTA</div> La tecla de función Poisson Ratio solo estará disponible cuando se especifica Poisson como el tipo del menú <b>Sense</b> .                                                                                                                                                                                                         |
| Excitation Voltage |  | Use la perilla o las teclas de flecha del panel frontal para especificar el voltaje de excitación fijo aplicado al puente por una fuente de voltaje externa. Este valor se utilizará para convertir las mediciones de puentes de deformación en el canal seleccionado.                                                                             |

Configuración avanzada

Presione Advanced para configurar los ajustes avanzados para el digitalizador.



| Tecla de función       |      | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode<br>Time/ Freq     |      | Determina el modo de filtro ADC. Presione la tecla de función <b>Mode</b> para alternar entre la entrada en el modo de dominio de tiempo ( <b>Time</b> ) o la entrada en el modo de dominio de frecuencia ( <b>Freq</b> ). Cuando se ha seleccionado el modo <b>Time</b> , el ADC incorporado se configura para usar el filtro Sinc5. Cuando se ha seleccionado el modo <b>Freq</b> , el ADC incorporado se configura para usar el filtro Wideband. |
| Acoplamiento<br>AC/ DC |      | Presione la tecla de función <b>Coupling</b> para alternar entre la forma en que se muestra el gráfico, en modo CA o CC. En el modo <b>AC</b> , el acoplamiento de CA mostrará la señal de CC normalizada a una media de cero. En el modo <b>DC</b> , el acoplamiento de CC mostrará la señal original en la pantalla.                                                                                                                              |
| Tipo                   | Diff | La entrada diferencial ( <b>Diff</b> ) mide las señales de entrada de terminales de alta y baja entrada.                                                                                                                                                                                                                                                                                                                                            |
|                        | Send | La entrada de Single Ended ( <b>Send</b> ) mide las señales de entrada del terminal de alta entrada y el terminal de baja entrada con conexión a tierra.                                                                                                                                                                                                                                                                                            |
|                        | lepe | El transductor Integrated Electronics Piezo Electric ( <b>lepe</b> , IEPE de 2 alambres con conexión a tierra LO de 100 Ohm) mide las señales de entrada con corriente directa suministrada a los terminales de alta y baja entrada                                                                                                                                                                                                                 |

## Canal calculado

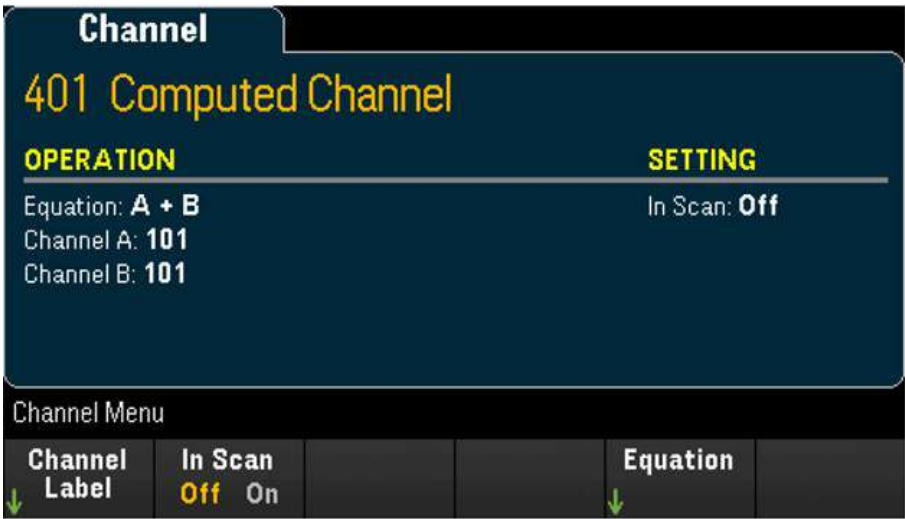
Un canal calculado realiza operaciones matemáticas en las lecturas de los canales de medición u otros canales calculados. Para configurar, presione **Channel** y use la perilla o la tecla de flecha hacia la derecha para seleccionar uno de los canales calculados (canales 401 a 420).

**NOTA**

Debe configurar los canales de medición antes de realizar las operaciones matemáticas en el canal calculado.

La supervisión de los canales computados solo está disponible durante el escaneo y solo mostrará las lecturas del barrido más reciente.

El canal computado no está disponible cuando se ha seleccionado DMM Digitize o Digitizer como el modo de adquisición de datos.



Presione **In Scan** para especificar si el canal computado se incluye en (**On**) o se excluye de (**Off**) la lista de escaneo. Presione **Equation** para especificar la ecuación que se utilizará para el canal calculado. Las opciones de ecuaciones se pueden categorizar en tres grupos principales: matemáticas básicas, quinto orden de polinomios y estadística.



## Matemáticas básicas

La siguiente tabla muestra las operaciones matemáticas básicas admitidas con la etiqueta de tecla de función correspondiente.

| Operación      | Etiqueta de tecla de función Equation |
|----------------|---------------------------------------|
| Suma           | A + B                                 |
| Resta          | A - B                                 |
| Multiplicación | A * B                                 |
| División       | A / B                                 |
| Recíproco      | 1 / A                                 |
| Potencia       | A <sup>2</sup>                        |
| Raíz cuadrada  | Sqrt(A)                               |

Por ejemplo, para realizar la operación de Suma desde los canales de medición (canal 101 y 102) al canal calculado (canal 401):

1. Presione **Equation** > **A+B**, use la perilla o las teclas de flecha del panel frontal para especificar la tecla de función del **Channel A** al canal 101 y la tecla de función del **Channel B** al canal 102.



2. Presione una vez la tecla **[Scan/Start]** para iniciar un escaneo. Puede ver las lecturas de la memoria escaneada si presiona la tecla **[View]**. El resultado de la operación de suma del canal 101 y 102 para el canal 401 aparecerá de la siguiente forma:

*Canal 401 = Canal 101 + Canal 102*

| Date      | Time         | Channel               | Reading           |
|-----------|--------------|-----------------------|-------------------|
| 17/4/2018 | 11:36:51.664 | 101 Armature relay... | -148.32 $\mu$ VDC |
| 17/4/2018 | 11:36:51.816 | 102 Armature relay... | -159.01 $\mu$ VDC |
| 17/4/2018 | 11:36:51.822 | 401 Computed Cha...   | -307.33 $\mu$     |

3. Repita los pasos anteriores para el resto de las operaciones matemáticas básicas (restar, multiplicar, etc.). Si desea calcular desde un único canal operando, ajuste las teclas de función Channel A y Channel B al mismo canal. Las lecturas calculadas serán el resultado de lecturas adicionales del propio canal seleccionado. Por ejemplo:

*Canal 401 = Canal 101 + Canal 101*

| Date      | Time         | Channel               | Reading           |
|-----------|--------------|-----------------------|-------------------|
| 17/4/2018 | 18:21:48.186 | 101 Armature relay... | -50.556 $\mu$ VDC |
| 17/4/2018 | 18:21:48.186 | 401 Computed Cha...   | -101.11 $\mu$     |

Polinomio de quinto orden

Para realizar esta operación desde el canal operando (canal 101) al canal calculado (canal 401):

- 1. Presione **Equation > 5th Order**, use la perilla o las teclas de flecha del panel frontal para especificar la tecla de función **Channel A** para el canal 101.
- 
- 2. Presione **Coef** para recorrer el orden de coeficientes (**Coef #5**, **Coef #4**, **Coef #3**, **Coef #2**, **Coef #1** y **Coef #0**). Especifique los parámetros de coeficiente para cada orden de coeficiente.
  - 3. Presione una vez la tecla **[Scan/Start]** para iniciar un escaneo. Puede ver las lecturas de la memoria escaneada si presiona la tecla **[View]**. El resultado del polinomio de 5º orden se mostrará de la siguiente manera:

| Scan Memory |              |                          |          |
|-------------|--------------|--------------------------|----------|
| Date        | Time         | Channel                  | Reading  |
| 6/19/2019   | 10:37:22.226 | 101 Armature relay MU... | 19 μVDC  |
| 6/19/2019   | 10:37:22.310 | 401 Computed Channel     | 1.000 02 |

Estadísticas

La siguiente tabla muestra las operaciones estadísticas admitidas con la etiqueta de la tecla de función correspondiente. Para estadísticas, (lista) significa un conjunto de canales operandos que en el cálculo.

| Operación           | Tecla de función Statistics | Descripción                                                                                                                                                            |
|---------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Promedio            | Avg(list)                   | Brinda las lecturas promedio de una lista de canales operandos, donde la lectura promedio = suma total de todas las lecturas/número de canales operandos seleccionados |
| Máximo              | Max(list)                   | Devuelve la lectura máxima de una lista de canales operandos.                                                                                                          |
| Mínimo              | Min(list)                   | Devuelve la lectura mínima de una lista de canales operandos.                                                                                                          |
| Desviación estándar | SDev(list)                  | Devuelve las lecturas de desviación estándar de una lista de canales operandos                                                                                         |

Por ejemplo, para realizar la operación de Promedio desde los canales de medición (canales 101 a 103) al canal calculado (canal 401):

- 1. Presione **Equation > Avg(list)**, use la perilla o las teclas de flecha del panel frontal para seleccionar los canales operandos en la tecla de función **Select**, luego presione **Add to List** para agregar el canal operando seleccionado a la lista de canales operandos. Presione esta tecla de función varias veces para agregar el siguiente canal operando a la lista de canales operandos.



2. Cuando se alcanza el número de canales operandos agregados, aparece la tecla de función **Remove from List**. Presione esta tecla para eliminar el canal operando seleccionado anteriormente de la lista de canales operandos.



3. Presione **View List** para ver una lista de los canales de medición disponibles. Los canales operandos seleccionados actualmente están marcados con una "X". Presione **Clear** para eliminar todos los canales operandos seleccionados de la lista de canales operandos.

| Check | Channel                        | In Scan |
|-------|--------------------------------|---------|
| [x]   | 101 Armature relay MUX Channel | Yes     |
| [x]   | 102 Armature relay MUX Channel | Yes     |
| [x]   | 103 Armature relay MUX Channel | Yes     |

4. Presione una vez la tecla **[Scan/Start]** para iniciar un escaneo. Puede ver las lecturas de la memoria escaneada si presiona la tecla **[View]**. El resultado de la operación de Promedio se mostrará a continuación:

$$\text{Canal 401} = (\text{Canal 101} + 102 + 103) / 3$$

| Date      | Time         | Channel               | Reading       |
|-----------|--------------|-----------------------|---------------|
| 17/4/2018 | 12:25:47.944 | 101 Armature relay... | -941,53 μVDC  |
| 17/4/2018 | 12:25:47.996 | 102 Armature relay... | -1,214.8 mVDC |
| 17/4/2018 | 12:25:48.048 | 103 Armature relay... | -1,391.3 mVDC |
| 17/4/2018 | 12:25:48.049 | 401 Computed Cha...   | -1,182.5 m    |

**NOTA**

El formato para los números que se muestran aquí son Coma como separador de punto decimal y separador de mil que está configurado como Activado y el período se inserta entre cada tres dígitos. Consulte [Number Format](#) para ver los detalles.

También puede incluir el canal calculado como un canal operando en la lista de canales calculados. Por ejemplo, para incluir el canal calculado 401 del ejemplo anterior a otro canal calculado (canal 402):

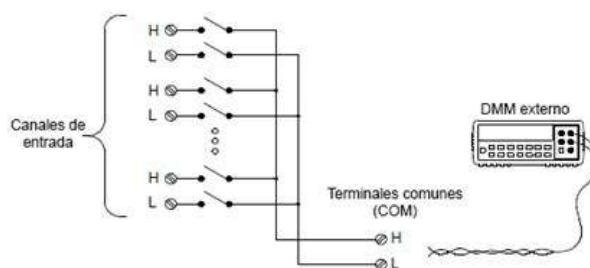
1. Repita los pasos 1-4 como se mencionó anteriormente.
2. Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para definir el canal en el Canal 402. Presione **In Scan** y habilite la tecla de función para incluir el canal 402 en la lista de escaneo. Presione **Equation > Avg(list)**, use la perilla o las teclas de flecha del panel frontal para especificar la tecla de función **Channel A** al canal 101 y la tecla de función **Channel B** al canal computado 401.
3. Presione una vez la tecla **[Scan/Start]** para iniciar un escaneo. Puede ver las lecturas de la memoria escaneada si presiona la tecla **[View]**. El resultado de la operación de Promedio se mostrará a continuación:

$$\text{Canal 402} = (\text{Canal 101} + 102 + 103 + 401) / 4$$

| Date      | Time         | Channel               | Reading  |      |
|-----------|--------------|-----------------------|----------|------|
| 17/4/2018 | 12:43:47.090 | 101 Armature relay... | -1,303.0 | mVDC |
| 17/4/2018 | 12:43:47.142 | 102 Armature relay... | -1,221.3 | mVDC |
| 17/4/2018 | 12:43:47.195 | 103 Armature relay... | -1,146.8 | mVDC |
| 17/4/2018 | 12:43:47.195 | 401 Computed Cha...   | -1,223.7 | m    |
| 17/4/2018 | 12:43:47.195 | 402 Computed Cha...   | -1,223.7 | m    |

## Escaneo con instrumentos externos

En esta configuración, puede usar el DAQ970A/DAQ973A para enrutamiento de señal o aplicaciones de control. Si instala un módulo plug-in multiplexor, puede usar el DAQ970A/DAQ973A para escanear con un instrumento externo. Puede conectar un instrumento externo (como un DMM) a la terminal COM del multiplexor.



Para controlar el escaneo con un instrumento externo, se proporcionan dos líneas de control. Cuando el DAQ970A/DAQ973A y el instrumento externo están configurados correctamente, puede sincronizar una secuencia de exploración entre los dos.

En esta configuración, debe configurar una lista de escaneo para incluir todos los canales multifunción o multiplexores deseados. Los canales que no están en la lista de escaneo se omiten durante el escaneo. El instrumento escanea automáticamente la lista de canales en orden ascendente desde la ranura 100 a la ranura 300.

Para un escaneo controlado externamente, debe deshabilitar el DMM interno. Para ello, presione **[Home] > User Settings > DMM Off**. Dado que el DMM interno está deshabilitado, las lecturas de los canales del multiplexor no se almacenan en la memoria de lectura interna.

Se requieren conexiones externas para sincronizar la secuencia de escaneo entre el DAQ970A/DAQ973A y el instrumento externo. El DAQ970A/DAQ973A debe notificar al instrumento externo cuando se cierra y se establece un relé (incluido el retardo de canal). El DAQ970A/DAQ973A emite un pulso de Canal cerrado desde el pin 5 en el conector del panel posterior. En respuesta, el instrumento externo debe notificar al DAQ970A/DAQ973A cuando haya terminado su medición y esté listo para avanzar al siguiente canal en la lista de escaneo. El DAQ970A/DAQ973A acepta una señal de Avance de canal en la línea de entrada del Disparador externo (pin 6).

Puede configurar el evento o la acción que controla el inicio de cada barrido a través de la lista de escaneo (un barrido es una pasada a través de la lista de escaneo). Cuando el DMM está deshabilitado, la fuente del intervalo de escaneo predeterminado es "Auto" (Inmediato). Para obtener más información, consulte Intervalo de escaneo. Puede configurar el evento o la acción que notifica al DAQ970A/DAQ973A que debe avanzar al siguiente canal en la lista de escaneo. Tome en cuenta que la fuente del Avance de canal comparte las mismas fuentes que el intervalo de exploración. Sin embargo, se genera un error si intenta configurar la fuente de avance de canal en la misma fuente utilizada para el intervalo de escaneo.

Puede especificar la cantidad de veces que el instrumento barrerá la lista de escaneo. Cuando se ha producido el número especificado de barridos, el escaneo se detiene.

Un escaneo controlado externamente también puede incluir una lectura de un puerto digital o una lectura del conteo del totalizador en el módulo multifunción. Cuando el avance del canal alcanza el primer canal digital, el instrumento escanea todos los canales digitales en esa ranura y almacena las lecturas en la memoria de lectura (solo se requiere una señal de avance de canal).

Puede configurar la lista de canales para el escaneo externo de 4 alambres. Cuando está habilitado, el instrumento empareja automáticamente el canal  $n$  con el canal  $n+10$ .

## Etiquetado de canal

Presione la tecla de función **Channel Label** para especificar una etiqueta para el canal seleccionado actualmente. Use la perilla o las teclas de flecha del panel frontal para introducir los caracteres en la pantalla. Tome en cuenta que solo se le permite ingresar un máximo de 10 caracteres para la etiqueta del módulo, incluidas letras, números y caracteres especiales. Para volver a la etiqueta de canal predeterminada, presione **Channel Label > Clear All > Done**. Esta configuración se aplica a todos los módulos instalados, así como a los canales calculados.



## Menú [Interval]

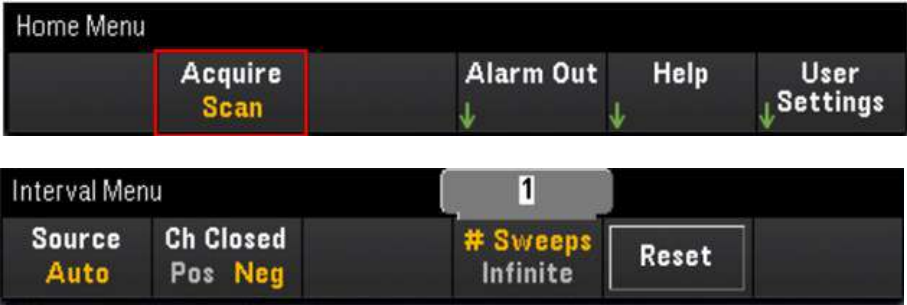
Presione la tecla **[Interval]** en el panel frontal para configurar qué inicia cada barrido y el número de barridos en el escaneo.

**NOTA**

Las opciones dentro del menú **[Interval]** variarán según el modo de adquisición de datos seleccionado en el menú **[Home]** (**[Home]**>**Acquire**>**Scan**, **DMM Digitize** o **Digitizer**).

Al presionar **[Home]** > **Acquire** > **DMM Digitize**, o **Digitizer**, el menú **[Interval]** solo estará disponible una vez que haya configurado los canales.

### Menú [Interval] en el modo Scan



### Selección de la fuente del disparador

Presione la tecla de función **Source** para seleccionar la fuente de disparador para iniciar un barrido. Un barrido es una pasada a través de la lista de escaneo.



| Tecla de función |      | Descripción                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source           | Auto |  <p>Selecciona un disparador inmediato. Cuando se inicia la detección, cada barrido se iniciará automáticamente.</p>                                                                                                                                                                                                          |
|                  | Time |  <p>Configura el temporizador interno del instrumento para que inicie automáticamente los barridos en un intervalo específico. Una vez que lo haya seleccionado como fuente del disparador, presione la tecla de función <b>Time</b> para configurar el intervalo de tiempo entre 0 y 360 000 segundos (100:00:00 horas).</p> |



Manual



Selecciona un disparador manual. Al presionar la tecla **[Scan/Start]** una vez en el panel frontal se inicia manualmente un barrido.

External



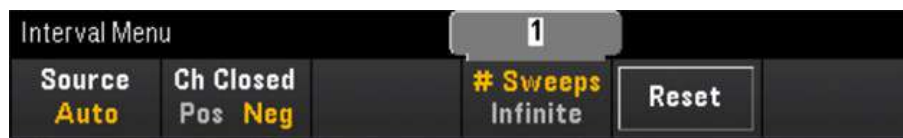
Inicia un barrido cuando se recibe un pulso de disparo externo compatible con TTL desde el conector Ext Trig/Alarms en el panel posterior. Una vez que lo haya seleccionado como fuente del disparador, presione la tecla de función **Ext Trig** para especificar la polaridad de la señal Ext Trig como borde ascendente (**Pos**) o borde descendente (**Neg**).

On Alarm



Inicia un barrido cuando se detecta una condición de alarma durante un escaneo, en el monitor del canal, en una DIO o canal totalizador. Una vez que lo haya seleccionado como fuente del disparador, presione la tecla de función **On Alarm** para seleccionar cuál de las cuatro alarmas se utilizará para informar las condiciones de la alarma en el canal seleccionado.

## Selección de la polaridad del disparador de salida



Presione la tecla de función **Ch Closed** para seleccionar el borde ascendente (**Pos**) o borde descendente (**Neg**) como la señal Chan Closed en el conector Ext Trig/Alarm del panel posterior.

### NOTA

La fuente de salida (señal de cierre de canal) funciona de manera diferente durante el escaneo interno o externo.

- En el caso de detecciones internas (DMM interno habilitado), se genera al FINAL de un barrido, no al comienzo de este.
- En el caso de los escaneos externos (DMM interno desactivado), se genera cuando todos los canales están cerrados, y se puede utilizar para disparar la medición en el DMM externo.



## Especificación del número de barridos en el escaneo

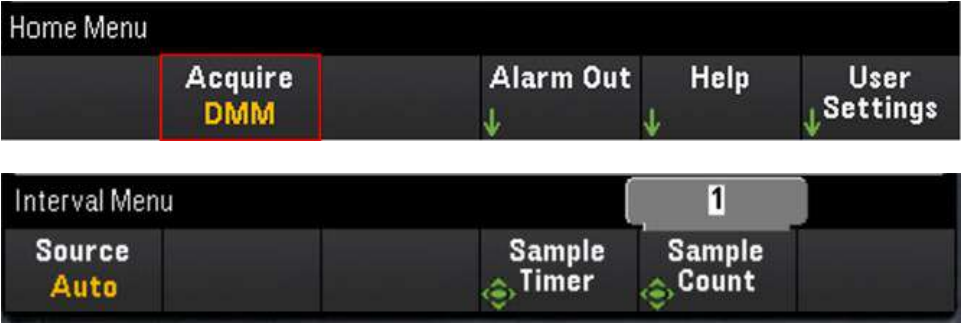


Especifica el número de veces que el instrumento barrerá la lista de escaneo (**# Sweeps**) o los barridos continuos (**Infinite**).

- **# Sweeps**: especifica el número de veces (entre 1 y 1.000.000 barridos) que el instrumento barrerá la lista de escaneo después de que se inicie el escaneo. Presione **Reset** para restablecer el conteo de barrido en 1.
- **Infinite**: configura un barrido para que continúe indefinidamente hasta que se detenga manualmente mediante la tecla **[Scan/Start]** del panel de control, o se envíe el comando SCPI "ABORt" o se envíe un mensaje "Device Clear" desde la interfaz remota.

El instrumento puede almacenar hasta 1 000 000 lecturas en la memoria de lectura, después de lo cual se mostrará el indicador **MEM** que muestra el desbordamiento de la memoria de lectura. Cualquier nueva lectura sobrescribirá la primera lectura guardada (la más antigua). Las lecturas más recientes siempre se conservan.

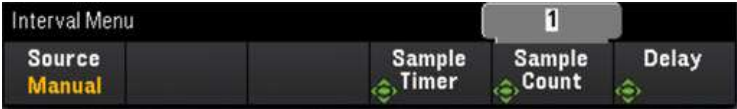
Menú [Interval] en el modo DMM Digitize



Selección de la fuente del disparador

Presione la tecla de función **Source** para seleccionar la fuente del disparador.



| Tecla de función |          | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source           | Auto     | <div></div> <p>Selecciona un disparador inmediato. El instrumento se disparará de forma automática inmediatamente cuando se presione la tecla <b>[Scan/Start]</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                  | Manual   | <div></div> <p>Al presionar la tecla <b>[Scan/Start]</b> dos veces en el panel frontal se dispara el canal especificado. La primera vez que se presiona la tecla <b>[Scan/Start]</b>, se inicia el canal. La segunda vez que se presiona la tecla <b>[Scan/Start]</b>, el canal se dispara manualmente y se iniciará la operación de digitalización.</p>                                                                                                                                                                                                                                                                                   |
|                  | External | <div></div> <p>Selecciona un disparador externo. Se dispara el instrumento cuando se recibe un pulso disparador externo compatible con TTL desde el conector Ext Trig en el panel posterior. Una vez que lo haya seleccionado como fuente del disparador:</p> <ul style="list-style-type: none"><li>– Puede presionar la tecla de función <b>Ext Trig</b> para especificar la polaridad de la señal Ext Trig como borde ascendente (<b>Pos</b>) o borde descendente (<b>Neg</b>).</li><li>– También puede presionar la tecla de función <b>PreTrigger Count</b> para especificar un conteo de predisparadores entre 0 y 999 999.</li></ul> |



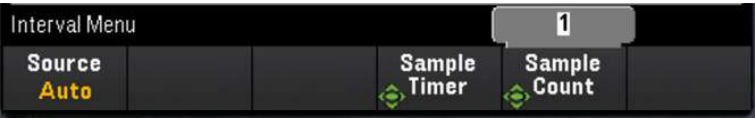
- Selecciona un disparador de nivel. El instrumento se dispara cuando se cumple la condición de umbral de medición especificada.
- Puede presionar la tecla de función **Ext Trig** para especificar la polaridad de la señal Ext Trig como borde ascendente (**Pos**) o borde descendente (**Neg**).
  - También puede presionar la tecla de función **PreTrigger Count** para especificar un conteo de predisparadores entre 0 y 999 999.

**NOTA**

Después de especificar un conteo de predisparadores, las lecturas se toman y mantienen en un búfer, mientras se espera que ocurra el evento disparador. Cuando ocurre el evento disparador, las lecturas en búfer se transfieren a la memoria de lectura y las lecturas restantes se registran como comunes. Si el evento disparador ocurre antes de que se hayan tomado las lecturas del conteo de predisparadores, el evento disparador seguirá vigente y la digitalización se completa sin haber hecho todas las lecturas del predisparador.

El conteo previo al disparador se limita a uno menos que la cantidad total de lecturas que se tomarán, especificadas en la configuración de Sample Count (conteo de muestras). Si Sample Count = 1, la tecla de función **Pretrigger** estará oculta.

Especificar el temporizador de muestra

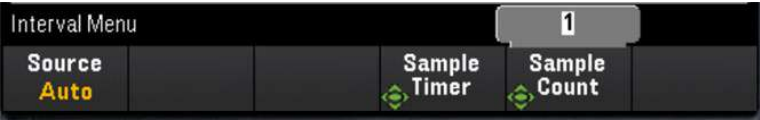


| Tecla de función | Descripción                                                                                                                               |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Sample Timer     | Usa la perilla o la tecla de flecha para especificar el temporizador de muestra (el tiempo entre las muestras) entre 20 $\mu$ s y 3600 s. |

**NOTA**

Este valor configurado para el Sample Timer (temporizador de muestra) se mantendrá aunque haya cambiado la función de medición del canal en el menú **[Channel]**.

Especificar el conteo de muestras



| Tecla de función | Descripción                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sample Count     | Use la perilla o la tecla de flecha para especificar la cantidad total de muestras que se van a digitalizar entre 1 muestra hasta un máximo de 50 331 648 muestras. |

**NOTA**

Este valor configurado para el Sample Count (conteo de muestras) se mantendrá aunque haya cambiado la función de medición del canal en el menú **[Channel]**.

Cuando Pretrigger Count  $\neq$  0, el instrumento limitará el Sample Count (conteo de muestras) a 1 000 000.

## Especificar el tiempo de retraso

Presione la tecla de función **Delay** y use la perilla o las teclas de flecha para establecer un retraso en el tiempo antes de la digitalización.

### NOTA

La opción **Delay** no estará disponible en estas configuraciones:

- Cuando se ha seleccionado **Source > Auto**.
  - Cuando se ha establecido un valor de **PreTrigger Count**.
-

Menú [Interval] en el modo Digitizer.

NOTA

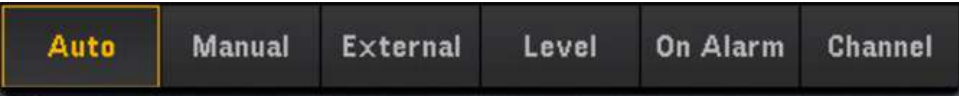
Este menú solo está disponible cuando el módulo DAQM909A se ha conectado.

Las configuraciones de intervalo se restablecerán a los valores predeterminados cuando se ha habilitado **Pwr. Alys** (Power Analysis) en el menú **[Channel]**.



Especificar las configuraciones del disparador

Presione la tecla de función **Trigger Settings > Source** para seleccionar la fuente del disparador.



| Tecla de función |      | Descripción |
|------------------|------|-------------|
| Source           | Auto |             |

El canal digitalizador especificado se disparará automáticamente cuando se presione la tecla **[Scan/Start]**.

|        |  |
|--------|--|
| Manual |  |
|--------|--|

El canal digitalizador especificado se dispara al presionar dos veces la tecla **[Scan/Start]** en el panel frontal. La primera vez que se presiona la tecla **[Scan/Start]**, se inicia el canal digitalizador. La segunda vez que se presiona la tecla **[Scan/Start]**, se dispara manualmente el canal digitalizador y se inicia la operación de digitalización. Puede presionar la tecla de función **Delay** y use la perilla o las teclas de flecha para especificar un tiempo de retraso antes de la digitalización.

|          |  |
|----------|--|
| External |  |
|----------|--|

El canal digitalizador especificado se activa cuando se recibe un pulso del disparador externo, compatible con TTL, del conector Ext Trig en cada módulo plug-in DAQM909A. Una vez que lo haya seleccionado como fuente del disparador, puede presionar la tecla de función **Ext Trig** para especificar la polaridad de la señal Ext Trig como borde ascendente (**Pos**) o borde descendente (**Neg**). Puede presionar la tecla de función **Delay** y use la perilla o las teclas de flecha para especificar un tiempo de retraso antes de la digitalización.

| Tecla de función |       | Descripción     |                  |  |  |       |      |
|------------------|-------|-----------------|------------------|--|--|-------|------|
| Source           | Level | Source<br>Level | Slope<br>Pos Neg |  |  | Delay | Done |

El canal digitalizador especificado se dispara cuando la señal de entrada cruza el nivel de disparador especificado en la pendiente especificada. Una vez que lo haya seleccionado como fuente del disparador, puede presionar la tecla de función Slope (pendiente) para especificar la polaridad de la señal del disparador interno como borde ascendente (Pos) o borde descendente (Neg). Puede presionar la tecla de función Delay y use la perilla o las teclas de flecha para especificar un tiempo de retraso antes de la digitalización.

NOTA

Consulte Disparo de nivel para obtener más información.

|          |                    |  |                |  |  |       |      |
|----------|--------------------|--|----------------|--|--|-------|------|
| On Alarm | Source<br>On Alarm |  | On Alarm<br>#1 |  |  | Delay | Done |
|----------|--------------------|--|----------------|--|--|-------|------|

El canal digitalizador especificado se dispara cuando se detecta una condición de alarma. Presione la tecla de función On Alarm para especificar cuál de las cuatro alarmas se usará para disparar el canal cuando se cumplan las condiciones de alarma. Puede presionar la tecla de función Delay y use la perilla o las teclas de flecha para especificar un tiempo de retraso antes de la digitalización.

|         |                   |  |  |  |  |       |      |
|---------|-------------------|--|--|--|--|-------|------|
| Channel | Source<br>Channel |  |  |  |  | Delay | Done |
|---------|-------------------|--|--|--|--|-------|------|

El canal digitalizador especificado se dispara cuando se dispara su canal maestro. Cualquier canal digitalizador puede configurarse y seleccionarse como canal maestro, incluso si proviene de un módulo diferente. Puede presionar la tecla de función Delay y use la perilla o las teclas de flecha para especificar un tiempo de retraso antes de la digitalización.

NOTA

La opción Channel solo estará disponible una vez que se cumplan las siguientes condiciones:

- Uno de los canales digitalizadores debe configurarse primero como el canal disparador, antes de esté disponible la opción de seleccionar Channel como fuente para el resto de los canales digitalizadores.
- La fuente de disparador del canal disparador no esté establecida en Auto.

Reglas para configurar un canal disparador:

- La fuente de disparador del canal disparador no puede establecerse en Auto.
- Un canal digitalizador no puede seleccionarse a sí mismo como canal disparador.
- Un canal puede ser el maestro disparador de varios canales, pero un canal no puede tener varios canales disparadores.
- Al lidiar con una cadena de canales disparadores, un canal disparador no puede ser un canal hijo de otro canal disparador de la cadena.
- Las configuraciones del canal disparador volverán a los valores predeterminados después de deshabilitar el canal digitalizador.

Especificar las configuraciones de armadura

Presione la tecla de función Arm Settings para especificar las configuraciones de armadura del digitalizador.



NOTA

La tecla de función **Source** no estará disponible para configuración cuando el modo de adquisición de datos **DMM Digitize** esté habilitado en otro canal de módulo plug-in.

| Tecla de función |       | Descripción                                                                                                                                                                                     |
|------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source           | Auto  | El digitalizador se arma al entrar al estado Wait for Arm (armado inmediato).                                                                                                                   |
|                  | Sweep | El digitalizador se arma al inicio de cada barrido durante el escaneo de los módulos multiplexores.                                                                                             |
|                  |       | <div>NOTA</div> La opción <b>Sweep</b> solo estará disponible cuando estos módulos plug-in estén insertados y configurados en el instrumento: DAQM900A, DAQM901A, DAQM902A, DAQM907A, DAQM908A. |
| Arm Count        |       | Presione la tecla de función <b>Arm Count</b> y use la perilla o las teclas de flecha para especificar el número de conteos de armaduras.                                                       |

Especificar las configuraciones de muestras

Presione la tecla de función Sample Settings para especificar las configuraciones del disparador del digitalizador.



| Tecla de función |              | Descripción                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trigger Settings | Samp Rate    | <div>800K 400K 200K 100K 50K More 1 of 2</div> <p>Presione la tecla de función <b>Samp Rate</b> para establecer la frecuencia de muestreo deseada (en Hz). Puede elegir una frecuencia de muestreo entre las opciones que se muestran y varían entre 1,5625 KHz y 800 KHz.</p> <div>NOTA</div> El mismo valor de frecuencia de muestreo se reflejará en todos los canales del módulo DAQM909A con el mismo filtro de ADC. |
|                  | Sample Count | Presione la tecla de función <b>Sample Count</b> y use la perilla o las teclas de flecha para especificar el número de conteos de muestras.                                                                                                                                                                                                                                                                               |
| PreTrigger Count |              | Presione la tecla de función <b>PreTrigger Count</b> y use la perilla o las teclas de flecha para especificar el número del conteo de predisparadores.                                                                                                                                                                                                                                                                    |
|                  |              | <div>NOTA</div> La cantidad de <b>Pretrigger Count</b> está limitada a uno menos del número especificado de <b>Sample Count</b> .<br><br>La configuración <b>PreTrigger Count</b> no estará disponible cuando se haya seleccionado <b>Source&gt;Auto</b> .                                                                                                                                                                |

**NOTA**

El instrumento asigna una cantidad fija de memoria para los módulos plug-in DAQM909A. Esta memoria se divide por partes iguales entre el total de canales digitalizadores disponibles, que se basa en el número del módulo DAQM909A insertado en el instrumento.

Debido a que cada canal digitalizador se asigna con una cantidad de memoria fija, en su aplicación, puede elegir usar toda la memoria para un solo registro con una cantidad máxima de muestras o puede elegir tener varios registros con menos muestras.

El número de registro para un canal digitalizador se determina según el número especificado de Arm Count (conteo de armaduras). Por eso, para obtener la cantidad máxima de registros, establezca la cantidad de muestras en el mínimo.

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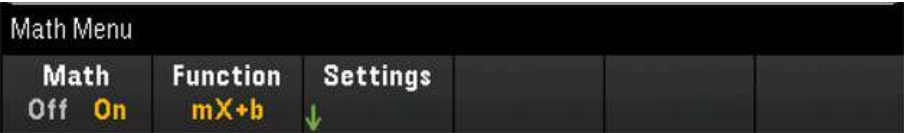
## Menú [Math]

**NOTA**

Los recursos del menú [Math] no estarán disponibles cuando se haya seleccionado **DMM Digitize** o **Digitizer** como modo de adquisición de datos.

Debe configurar el canal antes de aplicar cualquier valor de escala.

En la página del menú Math, presione la tecla de función **Math** para habilitar (**On**) o deshabilitar (**Off**) la escala de medición.



**NOTA**

Math se establece en Off cuando cambia las funciones de medición (por ejemplo, si se cambia de DCV a ACV). Debe volver a habilitar el menú math después de cambiar las funciones de medición.

Presione la tecla de función **Function** para seleccionar una función de escala en el canal seleccionado. Las funciones **dBm** y **dB** solo están disponibles en los canales configurados para medir el voltaje de CC o CA.



Selecciona una función de escala y presiona la tecla de función **Settings** para realizar varias configuraciones de escala. Los valores de escala se guardan en la memoria no volátil para el canal seleccionado.

### mX+b Scaling

La función mX+b scaling le permite realizar una escala lineal con operación de compensación, aplicando los valores de ganancia (m) y compensación (b) a todas las lecturas en un canal seleccionado durante un escaneo. Para configurar esto, seleccione la función **mX+b** y presione **Settings** para abrir el menú de configuración.



| Tecla de función | Descripción                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gain (m)         | Use la perilla o las teclas de flecha del panel frontal para establecer el valor de Gain (ganancia).                                                                   |
| Offset (b)       | Utilice la perilla o las teclas de flecha del panel frontal para establecer el valor de Offset (compensación).                                                         |
| Measure Offset   | Presione la tecla de función <b>Measure Offset</b> para realizar una medición de compensación inmediata y guardar el valor de compensación para la medición posterior. |
| Clear Offset     | Presione <b>Clear Offset</b> para borrar los valores de compensación a 0.                                                                                              |

|            |                       |                                                                                                                                                                                                                                                                                                                                                       |
|------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| User Units | User Units<br>On/ Off | Presione <b>User Units &gt; User Units Off/On</b> para que se muestren ( <b>On</b> ) o apagar ( <b>Off</b> ) las unidades de medición definidas por el usuario. Si selecciona <b>On</b> , se mostrará la unidad como se define en la tecla de función <b>Edit Units</b> . Si selecciona <b>Off</b> , se mostrarán las unidades predeterminadas (VDC). |
|            | Edit Units            | Presione <b>User Units &gt; Edit Units</b> para especificar una cadena que contenga hasta tres caracteres que se mostrarán en lugar de las unidades de medida estándar. Estas unidades se usan posteriormente para la entrada de diversas configuraciones del instrumento, como los límites y la escala de gráficos.                                  |
|            | Default Units         | Presione <b>Default Units</b> para que la unidad regrese a los parámetros predeterminados para el tipo de medición seleccionado. Por ejemplo, si configura el canal seleccionado como medición de temperatura, presione esta tecla de función para que la unidad predeterminada vuelva a °C.                                                          |

% Scaling

% realiza una operación de cambio de porcentaje. El resultado es la diferencia entre la lectura y el valor de referencia expresado en porcentaje:

**Result** =  $\frac{reading - reference}{reference} \times 100$

Para configurar, seleccione la función de escala como % y presione Settings para abrir el menú de configuración.



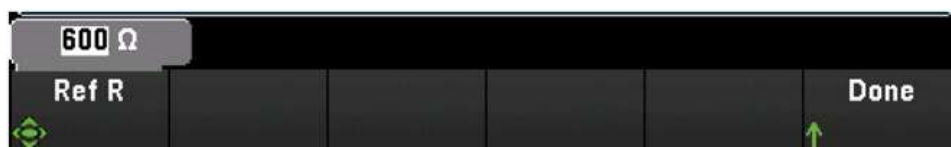
| Tecla de función  | Descripción                                                                                                                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ref Value         | Use la perilla o las teclas de flecha del panel frontal para establecer el valor de Reference (referencia).                                                                                                                                                     |
| Measure Reference | Presione la tecla de función <b>Measure Reference</b> para realizar una medición de referencia inmediata y guardar el valor de referencia para mediciones posteriores, o presione la tecla de función <b>Ref Value</b> para especificar el valor de referencia. |
| Default Reference | Presione la tecla de función <b>Default Reference</b> para establecer el valor de referencia a sus valores predeterminados de fábrica.                                                                                                                          |

## dBm Scaling

Selecciona el ajuste de escala de dBm para la función de medición actual. El resultado es un cálculo de potencia entregada a una resistencia de referencia (que se especifica con la tecla de función Ref R), relativa a 1 milivatio.

$$dBm = 10 \times \log_{10} (reading^2 / reference\ resistance / 1\ mW)$$

Para configurar, seleccione la función de escala como **dBm** y presione **Settings** para abrir el menú de configuración.



El valor de resistencia de referencia (Ref R) puede ser 50, 75, 93, 110, 124, 125, 135, 150, 250, 300, 500, 600 (predeterminado), 800, 900, 1000, 1200, u 8000 Ω. Presione **Ref R** para especificar el valor de resistencia de referencia y convertir las mediciones de voltaje a dBm.

## dB Scaling

Selecciona el ajuste de escala de dB para la función de medición actual. El resultado es la diferencia entre la señal de entrada y un valor de referencia relativo de dB almacenado, con ambos valores convertidos a dBm:

$$dB = measurement\ in\ dBm - reference\ value\ in\ dB$$

Para configurar, seleccione la función de escala como **dB** y presione **Settings** para abrir el menú de configuración.



El valor de referencia puede ser una medida convertida a dBm (tecla de función **Measure Ref Value**), o puede especificar un valor de referencia (tecla de función **dB Ref Value**). Presione **Clear dB Ref** para borrar el valor de referencia para las mediciones de dB.

## Menú [Copy]

### NOTA

El canal de origen (canal para copiar la configuración) debe incluirse en la lista de escaneo antes de realizar esta función.

La operación de copiar/pegar solo está disponible para canales con función de medición similar (por ejemplo, de DCV a DCV); donde el canal de inicio y el canal final pertenecen a una ranura de módulo similar.

Los recursos del menú [Copy] no estarán disponibles cuando se haya seleccionado **DMM Digitize** como modo de adquisición de datos.

Presione la tecla **[Copy]** en el panel frontal para copiar la configuración de medición de los canales seleccionados a otros canales. Esta función facilita la configuración de varios canales para la misma medición. Cuando copia la configuración de un canal a otro, otra información de configuración como la función de medición, la función de escalado, la configuración de la alarma y las configuraciones de medición avanzadas se copian automáticamente a otros canales.

Hay tres opciones disponibles:

### Copiar/pegar desde un solo canal a un solo canal (uno a uno)

Por ejemplo, para copiar/pegar la configuración de medición del canal 01 al canal 02:

1. Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para configurar el canal 01 como DVC (rango automático).



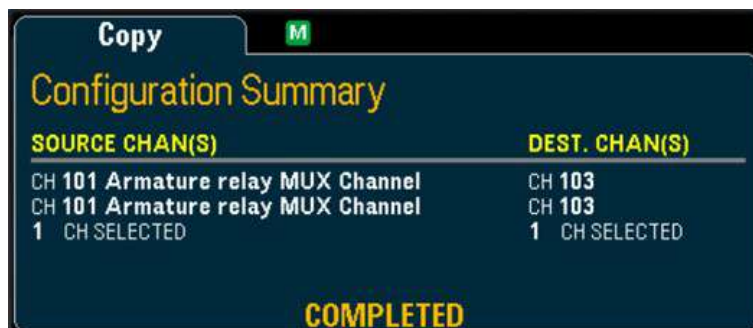
2. Presione **[Copy]** > **Source Chan(s)**. Tanto **Start Channel** como **End Channel** aparecerán con el canal 01 seleccionado en la medida en que no haya ningún otro canal fuente configurado excepto este. Presione **Done** para salir del menú.



3. Presione **Dest. Chan(s)** para seleccionar el canal de destino para la operación de pegado. El instrumento seleccionará automáticamente el canal subsiguiente como opción predeterminada del canal de destino. En este ejemplo, use la perilla o las teclas de flecha del panel frontal para determinar el **Start Channel** y el **End Channel** como canal 02. Presione **Done** para continuar.



- Presione **Copy Now**. La configuración de medición del canal 01 se copiará al canal 02. El mensaje "COMPLETE" aparecerá en la parte inferior de la pantalla cuando la operación haya concluido. Vuelva a presionar **Copy Now** para copiar repetidamente la misma configuración en los nuevos canales seleccionados (canal 03, canal 04, etc.).



## Copiar/pegar desde un solo canal a múltiples canales (uno a varios)

Por ejemplo, para copiar/pegar la configuración de medición del canal 01 al canal 02 y 03:

- Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para configurar el canal 01 como DVC (rango automático).
- Presione **[Copy]** > **Source Chan(s)**. Tanto **Start Channel** como **End Channel** aparecerán con el canal 01 seleccionado en la medida en que no haya ningún otro canal fuente configurado excepto este. Presione **Done** para salir del menú.
- Presione **Dest. Chan(s)** para seleccionar el canal de destino para la operación de pegado. El instrumento seleccionará automáticamente el canal subsiguiente como opción predeterminada de los canales de destino. En este ejemplo, use la perilla o las teclas de flecha del panel frontal para determinar el Start Channel como canal 02 y el End Channel como el canal 03. Presione **Done** para continuar.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 102        |
| CH 101 Armature relay MUX Channel | CH 103        |
| 1 CH SELECTED                     | 2 CH SELECTED |

- Presione **Copy Now**. La configuración de medición del canal 01 se copiará a los canales 02 y 03. Aparece el mensaje "COMPLETE" cuando concluya la operación. Vuelva a presionar **Copy Now** para copiar repetidamente la misma configuración en los nuevos canales seleccionados (canal 04, canal 05, etc.).



## Copiar/pegar desde múltiples canales a múltiples canales (muchos a muchos)

Por ejemplo, para copiar/pegar la configuración de medición de los canal 01 a 04 a los canales 05 a 08:

1. Presione **[Channel]** y use la perilla o las teclas de flecha del panel frontal para seleccionar los canales fuente de la siguiente forma:
  - Canal 01 y 02 (DCV con Autorange)
  - Canal 03 y 04 (resistencia de 2 alambres con el rango de 100  $\Omega$ )
2. Presione **[Copy]** > **Source Chan(s)**. Use la perilla o las teclas de flecha del panel frontal para determinar el **Start Channel** como canal 01 y el **End Channel** como canal 04. Presione **Done** para salir del menú.
3. Presione **Dest. Chan(s)** para seleccionar el canal de destino para la operación de pegado. El instrumento seleccionará automáticamente el canal subsiguiente como opción predeterminada de los canales de destino. En este ejemplo, use la perilla o las teclas de flecha del panel frontal para determinar el **Start Channel** como canal 05.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 105        |
| CH 104 Armature relay MUX Channel | CH 108        |
| 4 CH SELECTED                     | 4 CH SELECTED |

La tecla de función End Channel no está disponible en esta opción, el instrumento realizará automáticamente la operación de copiar/pegar en los siguientes N canales de destino posteriores en función de la N seleccionada de los canales de origen. Por ejemplo, si configura el Start Channel como canal 06, los canales de destino seleccionados serán los canales 06 a 09. Presione Done para continuar.

| SOURCE CHAN(S)                    | DEST. CHAN(S) |
|-----------------------------------|---------------|
| CH 101 Armature relay MUX Channel | CH 106        |
| CH 104 Armature relay MUX Channel | CH 109        |
| 4 CH SELECTED                     | 4 CH SELECTED |

4. Presione **Copy Now**. La configuración de medición de los canales 01 a 04 se copiará a los canales 06 a 09. Aparece el mensaje "COMPLETED" cuando concluya la operación. Vuelva a presionar **Copy Now** para copiar repetidamente la misma configuración en los nuevos canales seleccionados (canales 09 a 11, etc.).

| Copy <span>M</span>               |               |
|-----------------------------------|---------------|
| Configuration Summary             |               |
| SOURCE CHAN(S)                    | DEST. CHAN(S) |
| CH 101 Armature relay MUX Channel | CH 110        |
| CH 104 Armature relay MUX Channel | CH 113        |
| 4 CH SELECTED                     | 4 CH SELECTED |
| COMPLETED                         |               |

## Menú [Alarm]

Presione **[Alarm]** en el panel frontal para configurar la alarma en el canal seleccionado. Puede configurar cuatro alarmas en este instrumento. Debe configurar el canal antes de realizar cualquier ajuste a los límites de alarma. Si cambia la configuración de medición, las alarmas se desactivarán y se borran los valores de límite. Si tiene pensado usar la **scaling function** en un canal que también usa alarmas, asegúrese de configurar los valores de escala en primer lugar.

**NOTA**

Los recursos del menú [Alarm] no estarán disponibles cuando se haya seleccionado **DMM Digitize** o **Digitizer** como modo de adquisición de datos.

### Configuración de límites de alarmas en los módulos multiplexores

1. En la página del menú Alarm, presione la tecla de función **Output** para seleccionar cuál de las cuatro alarmas se utilizará para informar las condiciones de la alarma en el canal seleccionado. Puede asignar varios canales a cualquiera de las cuatro alarmas disponibles (numeradas del 1 al 4).



2. Presione Alarm para desactivar (Off) o especificar un límite de alarma (alto, bajo o ambos), y luego presione **Set Limits** para determinar el valor límite. El instrumento generará una alarma cuando una lectura escaneada o en el monitor exceda el límite especificado.

| Tecla de función Alarm | Tecla de función Set Limits                                                                                                                                                                          |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Off                    | N/A - La alarma está desactivada                                                                                                                                                                     |
| High + Low             | Especifica los límites como valores altos y bajos, o como un valor central con un alcance alrededor de éste. Si se presiona la 1ª o la 2ª tecla de función se alternará entre las dos opciones.<br>  |
| High                   | Especifique el valor de límite superior utilizando la perilla o las teclas de flecha del panel frontal. El valor de límite superior siempre debe ser mayor o igual que el inferior.<br>              |
| Low                    | Especifique el valor límite inferior utilizando la perilla o las teclas de flecha del panel frontal. El valor del límite inferior siempre debe ser menor que el límite superior, o igual a éste.<br> |

3. Presione **Clear** para devolver el valor límite al valor predeterminado, 0.
4. Presione **[Scan/Start]** para iniciar el escaneo y guardar las lecturas en la memoria de lectura. Si se produce una alarma en un canal mientras se está escaneando, entonces el estado de la alarma de ese canal se guarda en la memoria de lectura mientras se realizan las lecturas. Cada vez que inicia un nuevo escaneo, el instrumento borra todas las lecturas (incluso los datos de alarma) almacenadas en la memoria de lectura del escaneo anterior.
5. A medida que se generan las alarmas, éstas también se registran en una cola de alarmas, que está separada de la lectura de la memoria. Presione **[View] > Alarms** para mostrar la cola de alarmas.

## Configuración de los límites de alarma con el módulo multifunción

Puede configurar el módulo multifunción DAQM907A para generar una alarma cuando se detecta un patrón de bits específico o un cambio de patrón de bits en un canal de E/S digital (canal 01 y 02) o cuando se alcanza un conteo específico en un canal totalizador (canal 03).

### Para configurar una alarma en un canal de E/S digital

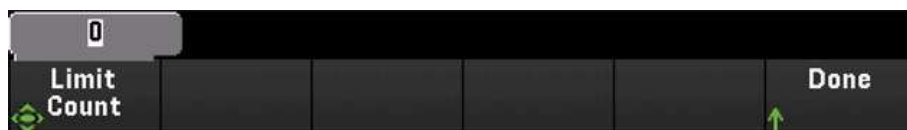
1. En una ranura del módulo multifunción, presione **[Alarm]** y seleccione el canal de E/S digital.
2. Presione **Set Pattern > Pattern**, y use la perilla o las teclas de flecha del panel frontal para configurar los datos de la máscara digital para la comparación de patrones digitales de 8 bits.



3. Configure cada bit en "0", "1" o "X", para ello presione las teclas de función **Set to all 0's**, **Set to all 1's**, o **Set to all X's**. Los bits configurados en "X" se excluyen de la comparación del patrón digital.
4. Presione **Fail On** para configurar el canal seleccionado para generar una alarma cuando una lectura de patrón de 8 bits específica sea igual o diferente a la lectura de datos digitales.

### Para configurar una alarma en un canal totalizador.

1. En una ranura del módulo multifunción, presione **[Alarm]** y seleccione el canal totalizador.
2. Presione **Set Limits > Limit Count** para especificar el límite de conteo. Se generará una alarma cuando se alcance un conteo específico durante el escaneo.





## Indicaciones del límite de alarma

La pantalla utiliza colores para indicar los límites y las violaciones a los límites.

### Número

El color rojo brillante (que se muestra a continuación) indica que la medición que aparece excede los límites.



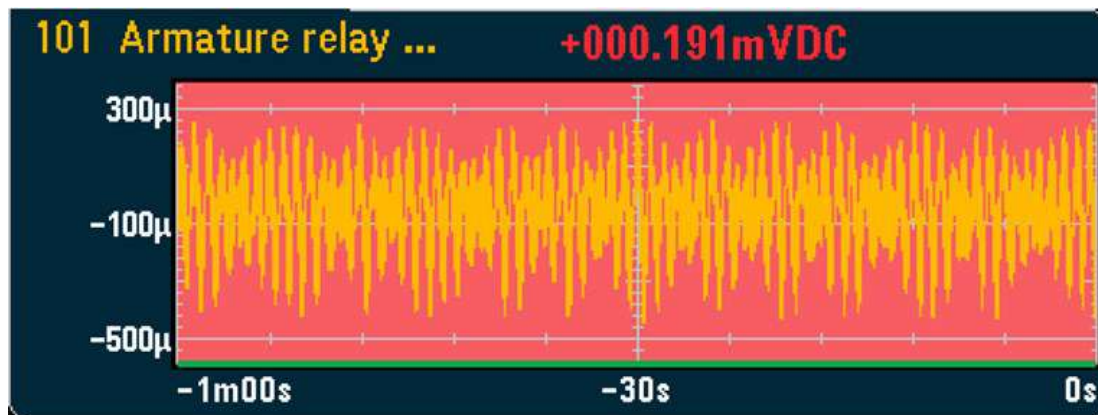
### Multímetro de barras

El multímetro de barras (abajo) utiliza la misma combinación de colores. El siguiente ejemplo muestra una violación de límite. La palabra **FAIL** indica que se ha superado el límite.



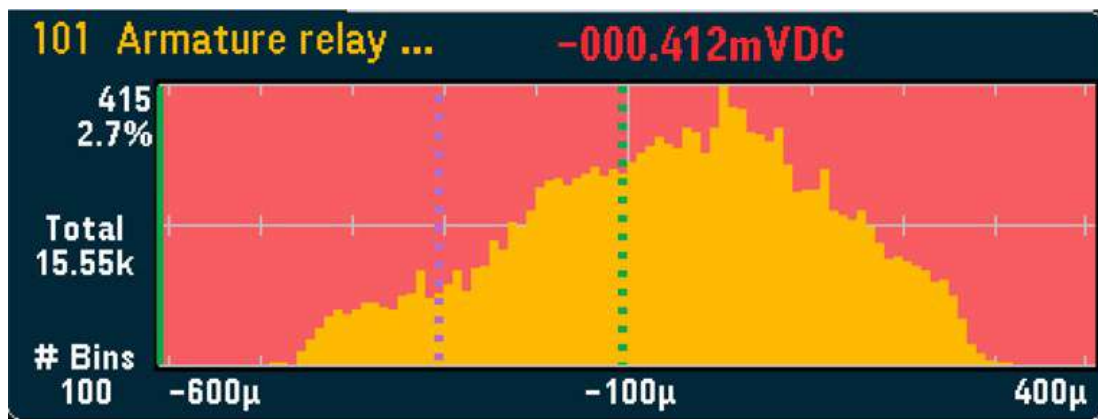
## Gráfico de tendencias

El gráfico de tendencias (abajo) utiliza la misma combinación de colores. El siguiente ejemplo muestra una violación de límite.



## Histograma

El histograma (abajo) utiliza la misma combinación de colores. El siguiente ejemplo muestra una violación de límite.



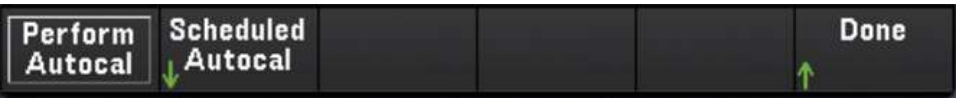
## Menú [Utility]



### Self Test

La prueba automática verifica el funcionamiento correcto del instrumento. Consulte la *Guía de servicio de Keysight DAQ970A/DAQ973A* para obtener detalles sobre los procedimientos de la prueba automática.

### Autocal

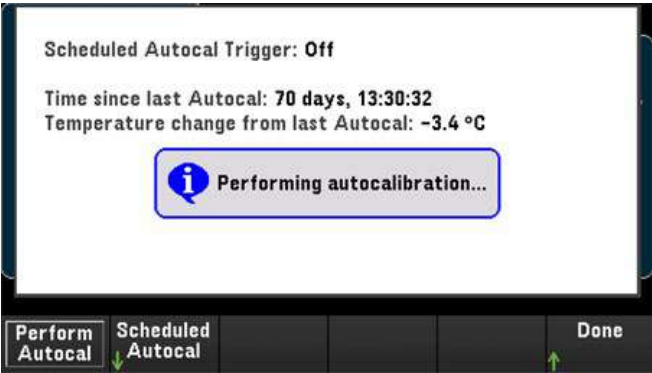


#### Autocalibración

La autocalibración interna compensa las derivaciones en los módulos DAQ970A/DAQ973A o el DMM interno que se producen a causa de cambios de temperatura y tiempo. Esto puede ayudar a eliminar los errores y a lograr un mejor desempeño. En DAQ970A/DAQ973A, la autocalibración se realiza en el DMM interno y en los canales de detección y salida de DAC (canales 04 a 07) del módulo multifunción DAQM907A y el módulo digitalizador DAQM909A.

| Tecla de función | Descripción |
|------------------|-------------|
|------------------|-------------|

Perform Autocal Para realizar la autocalibración, presione la tecla de función **Perform Autocal** y aparecerá la siguiente pantalla.



La duración estimada del proceso de autocalibración con el módulo individual relevante es la siguiente:

| Área        | Tiempo estimado (s) | Ejemplo del cálculo de la duración total                                                                                    |
|-------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------|
| DMM interno | ~15 segundos        | Autocalibración completa con 3 DAQM909A en un sistema principal: DMM interno + (3 x DAQM909A) = ~15 s + (3 x ~20 s) = ~75 s |
| DAQM907A    | ~6 segundos         |                                                                                                                             |
| DAQM909A    | ~20 segundos        |                                                                                                                             |

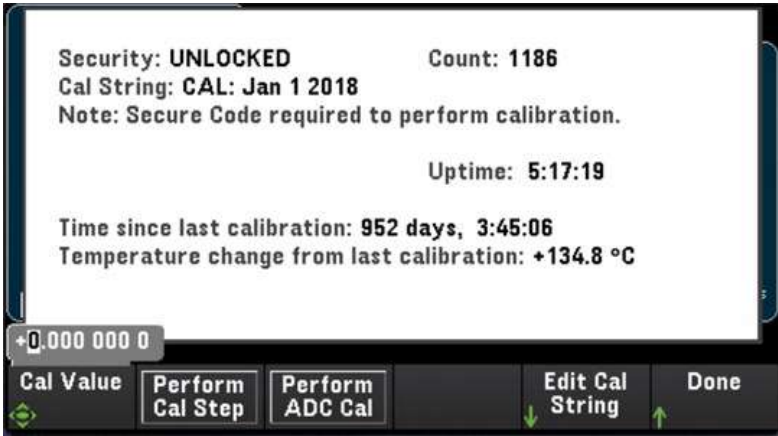
Autocalibración programada

Usted también puede programar el instrumento para que realice una autocalibración según una hora programada. Para usar esta función, presione **Scheduled Autocal > Schedule > On**. Para especificar la frecuencia, presione **Interval > Daily/ Weekly/ Monthly**.

| Tecla de función |         | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interval         | Daily   | <div><div>Schedule<br/>Off On</div><div>Interval<br/>Daily</div><div></div><div>Hour</div><div>Minute</div><div>Done</div></div> <div><div>1. Para programar el instrumento para que realice una autocalibración diaria, presione <b>Interval &gt; Daily</b></div><div>2. Para definir la hora de la autocalibración diaria, presione las teclas de función <b>Hour</b> o <b>Minute</b>, respectivamente, y use la perilla o las teclas de flecha del panel frontal para establecer la hora del día que desea. Una vez que haya terminado, presione <b>Done</b>.</div></div>                                                             |
|                  | Weekly  | <div><div>Schedule<br/>Off On</div><div>Interval<br/>Weekly</div><div>Week Day</div><div>Hour</div><div>Minute</div><div>Done</div></div> <div><div>1. Para programar el instrumento para que realice una autocalibración semanal, presione <b>Interval &gt; Weekly</b></div><div>2. Para definir el día y la hora de la autocalibración semanal, presione las teclas de función <b>Week Day</b>, <b>Hour</b> o <b>Minute</b>, respectivamente, y use la perilla o las teclas de flecha del panel frontal para establecer el día de la semana y la hora del día que desea. Una vez que haya terminado, presione <b>Done</b>.</div></div> |
|                  | Monthly | <div><div>Schedule<br/>Off On</div><div>Interval<br/>Monthly</div><div>Day</div><div>Hour</div><div>Minute</div><div>Done</div></div> <div><div>1. Para definir el día y la hora de la autocalibración mensual, presione las teclas de función <b>Interval &gt; Monthly</b></div><div>2. Para definir el día y la hora de la autocalibración mensual, presione las teclas de función <b>Day</b>, <b>Hour</b> o <b>Minute</b>, respectivamente, y use la perilla o las teclas de flecha del panel frontal para establecer el día del mes y la hora del día que desea. Una vez que haya terminado, presione <b>Done</b>.</div></div>       |

Calibrate

Calibrate accede al procedimiento de calibración del instrumento. Consulte la *Guía de servicio de Keysight DAQ970A/DAQ973A* para obtener más detalles.



## Security

**Security** muestra el estado actual de seguridad del instrumento y le permite bloquear o desbloquear el instrumento o ingresar un nuevo código de seguridad. El instrumento debe estar desbloqueado para realizar la calibración, actualizar el firmware o cambiar el código seguro.

Si el Secure Mode está habilitado, esto muestra una descripción general de las configuraciones de E/S del instrumento y proporciona acceso a la función de saneamiento NISPOM y la configuración de E/S. El instrumento debe estar desbloqueado para realizar un saneamiento NISPOM o para habilitar o deshabilitar las E/S. El conteo seguro aumenta siempre que se realiza una operación que exige el código seguro.



| Tecla de función                                                                     | Descripción                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| New Code                                                                             | Presione la tecla de función <b>New Code</b> para introducir y establecer un nuevo código seguro para desbloquear la seguridad del instrumento. El código debe comenzar con una letra y puede tener hasta 12 letras, dígitos o el carácter de subrayado.                                                                                                                                  |
| BLOQUEO                                                                              | Bloquea la seguridad del instrumento utilizando el código seguro actual. El código seguro está establecido de fábrica como "DAQ970A" para los modelos DAQ970A y DAQ973A.                                                                                                                                                                                                                  |
| Secure                                                                               | La tecla de función <b>Secure</b> activa (On) o desactiva (Off) la seguridad del instrumento. Cuando está activada ( <b>On</b> ), aparecerá la tecla de función <b>NISPOM Sanitize</b> y la seguridad debe estar desbloqueada para realizar cambios en la configuración y habilitaciones de E/S.                                                                                          |
| NISPOM Sanitize                                                                      | Presione la tecla de función <b>NISPOM Sanitize</b> para limpiar toda la memoria del instrumento a la que puede acceder el usuario, excepto las constantes de calibración. Esto cumple con los requisitos del capítulo 8 del Manual de operación de programa de seguridad industrial nacional (NISPON). Cuando está apagado, se pueden hacer cambios de E/S sin desbloquear la seguridad. |
| <div>NOTA</div> El instrumento se reiniciará solo cuando haya concluido la limpieza. |                                                                                                                                                                                                                                                                                                                                                                                           |

PRECAUCIÓN

La tecla de función NISPOM Sanitize y el comando SYSTEM:SECurity:IMMEdiate son equivalentes. Son para clientes, como contratistas militares, que deben cumplir con NISPOM.

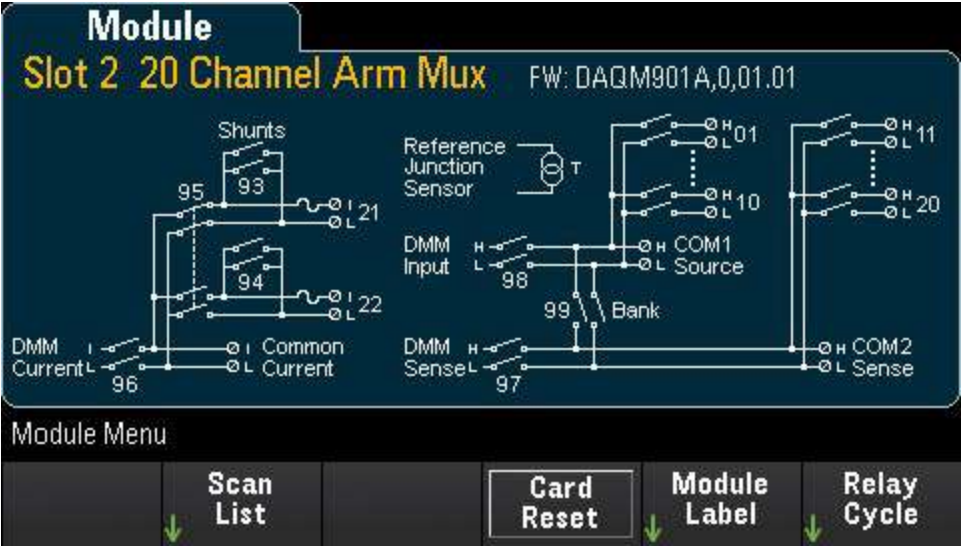
Esta función destruye toda la información de estado definida por el usuario, los datos de medición y la configuración de E/S definida por el usuario, como la dirección IP. Esta función no se recomienda para uso en aplicaciones de rutina debido a la posibilidad de pérdida de datos involuntaria.

## Admin

Presione **Admin > Firmware Update** para actualizar el firmware del instrumento a una nueva versión. Consulte [Actualización de firmware](#) para obtener más información.

# Menú [Module]

Presione la tecla **[Module]** para acceder al menú Module. En la página Module, puede ver la lista de escaneos del instrumento, restablecer los módulos, renombrar la etiqueta de un módulo y verificar los ciclos de relé del DMM interno y los módulos plug-in.



## Scan List

**NOTA** Las opciones solo están disponibles cuando se haya seleccionado **Scan** como modo de adquisición de datos.

Presione la tecla de función **Scan List** para ver los canales disponibles del módulo que están incluidos en la lista de escaneo (Scan Status = ON). Presione la tecla de función **Remove From Scan** para desactivar las mediciones en todos los canales en el módulo, y eliminar los canales de la lista de escaneo. Si la lista de canales tiene más de una página, presione las teclas de flecha arriba/abajo del panel frontal para desplazarse en otras páginas.

The screenshot shows the 'Scan Status' menu with a table of channels and their scan status. The table has two columns: 'Channel' and 'Scan Status'. The channels listed are 201 through 208, all with a status of 'OFF'. Below the table, it says 'Current Page: 1/3'. At the bottom, there are two buttons: 'Remove From Scan' and 'Done'. A green arrow points to the 'Done' button.

| Channel                        | Scan Status |
|--------------------------------|-------------|
| 201 Armature relay MUX Channel | OFF         |
| 202 Armature relay MUX Channel | OFF         |
| 203 Armature relay MUX Channel | OFF         |
| 204 Armature relay MUX Channel | OFF         |
| 205 Armature relay MUX Channel | OFF         |
| 206 Armature relay MUX Channel | OFF         |
| 207 Armature relay MUX Channel | OFF         |
| 208 Armature relay MUX Channel | OFF         |

Current Page: 1/3

Remove From Scan Done



## Card Reset

### NOTA

Las opciones solo están disponibles cuando se haya seleccionado **Scan** como modo de adquisición de datos.

Presione la tecla de función **Card Reset** para restablecer el módulo. Esto abre todos los canales del módulo. En el módulo multifunción, esto también configura los puertos de E/S digitales como entradas, además de configurar las salidas de DAC en el modo de voltaje (si no está bloqueado) y el nivel de salida en 0.

## Module Label

Presione la tecla de función Module Label para especificar una etiqueta para el módulo seleccionado actualmente. Use la perilla o las teclas de flecha del panel frontal para introducir los caracteres en la pantalla. Tome en cuenta que solo se le permite ingresar un máximo de 10 caracteres para la etiqueta del módulo, incluidas letras, números y caracteres especiales. Para restablecer la etiqueta de módulo predeterminada, presione **Module Label > Clear All > Done**.



## Relay Cycle

Presione la tecla de función **Relay Cycle** para ver la cantidad de ciclos de cada relé en el DMM interno y los módulos plug-in. Utilice esta función para rastrear fallas de relé y para predecir los requisitos de mantenimiento del sistema. Para obtener más detalles, consulte [Vida útil del relé y mantenimiento preventivo](#).

Relay Cycles

| Channel                        | User Cycles |
|--------------------------------|-------------|
| 201 Armature relay MUX Channel | 6497        |
| 202 Armature relay MUX Channel | 5609        |
| 203 Armature relay MUX Channel | 1489        |
| 204 Armature relay MUX Channel | 1427        |
| 205 Armature relay MUX Channel | 1079        |
| 206 Armature relay MUX Channel | 1050        |
| 207 Armature relay MUX Channel | 797         |
| 208 Armature relay MUX Channel | 229         |

Current Page: 1 / 4

Done

NOTA

Para acceder a la página Internal DMM en el menú **Module**, gire la perilla en sentido antihorario o presione la tecla de flecha izquierda hasta que aparezca la página del módulo DMM interno. Después, presione la tecla de función para ver el ciclo de relé del DMM interno.

Module

Internal DMM

K201  
ACAL

K202  
Low DCV and ACV

K203  
Ohm Current

K204  
High DCV

K205  
Current

Module Menu

Relay Cycle

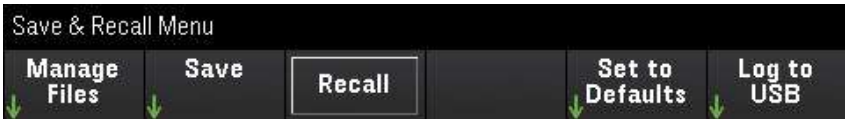
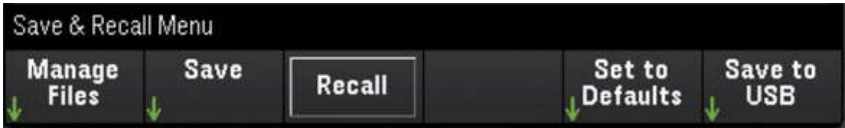
Relay Cycles

| Channel                              | User Cycles |
|--------------------------------------|-------------|
| 001 Non-controllable Internal Switch | 499         |
| 002 Non-controllable Internal Switch | 423         |
| 003 Non-controllable Internal Switch | 487         |
| 004 Non-controllable Internal Switch | 335         |
| 005 Non-controllable Internal Switch | 497         |

Current Page: 1 / 1



## Menú [Save Recall]

| Modo de adquisición de datos | Teclas de función del menú [Save Recall]                                           |
|------------------------------|------------------------------------------------------------------------------------|
| Scan                         |  |
| DMM Digitize, Digitizer      |  |

## Administrar archivos

La tecla de función **Manage Files** le permite crear, copiar, eliminar y renombrar archivos y carpetas en la memoria flash interna del instrumento o en una unidad USB conectada al panel frontal. Tras presionar la tecla de función **Manage Files**, aparecerán las siguientes opciones:



| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action:          | <div>Delete</div> <ol style="list-style-type: none"> <li>1. Para eliminar un archivo o pasta, presione <b>Delete</b> &gt; <b>Browse</b> para navegar en el directorio de archivos con el fin de encontrar el archivo o la carpeta deseados en el directorio.</li> <li>2. Una vez que estén resaltados el archivo o la carpeta deseados, presione <b>Select</b> &gt; <b>Perform Delete</b> &gt; <b>Done</b>.</li> </ol> |
| Folder           | <ol style="list-style-type: none"> <li>1. Para crear una nueva carpeta, presione <b>Folder</b> &gt; <b>Browse</b> para navegar en el directorio de archivo al lugar en el que desea crear la nueva carpeta.</li> <li>2. Presione <b>File Name</b>, introduzca el nombre de carpeta que desea y presione <b>Done</b>. Presione <b>Create Folder</b> &gt; <b>Done</b></li> </ol>                                         |
| Copy             | <ol style="list-style-type: none"> <li>1. Para copiar un archivo o una carpeta, presione <b>Copy</b> &gt; <b>Browse</b> para navegar en el directorio al archivo o carpeta que desea copiar y presione <b>Select</b>.</li> <li>2. Presione <b>Copy Path</b> y seleccione una ruta interna o externa para copiar. Presione <b>Perform Copy</b> &gt; <b>Done</b>.</li> </ol>                                             |
| Rename           | <ol style="list-style-type: none"> <li>1. Para renombrar un archivo o una carpeta, presione <b>Rename</b> &gt; <b>Browse</b> para navegar en el directorio al archivo o la carpeta que desea renombrar y presionar <b>Select</b>.</li> <li>2. Presione <b>New Name</b>, ingrese un nuevo nombre y presione <b>Done</b>. Presione <b>Perform Rename</b> &gt; <b>Done</b>.</li> </ol>                                    |
| Browse           | La tecla de función <b>Browse</b> abre el directorio de archivos donde puede seleccionar el archivo o la carpeta en que se realizará la acción. Use la perilla, las teclas de flecha del panel frontal y <b>[Select]</b> para navegar en el directorio de archivos. Las teclas de flecha izquierda y derecha contraen o expanden una carpeta.                                                                          |
| Copy Path        | La tecla de función <b>Copy Path</b> selecciona una ruta de carpeta interna o externa para la copia. Use la perilla, las teclas de flecha del panel frontal y <b>[Select]</b> para navegar en el directorio de archivos. Las teclas de flecha izquierda y derecha contraen o expanden una carpeta.                                                                                                                     |
| Perform Copy     | La tecla de función <b>Perform Copy</b> copia el archivo o la carpeta seleccionados a su nueva ubicación.                                                                                                                                                                                                                                                                                                              |

Save

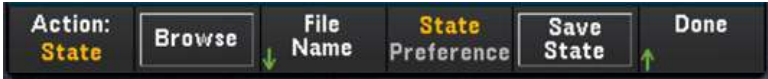
La tecla de función **Save** le permite guardar el estado del instrumento, las preferencias del usuario y las instantáneas de la pantalla.

NOTA

Las opciones de la 4ª tecla de función cambiarán según la opción elegida en la tecla de función [Action:]

| Tecla de función | Descripción |
|------------------|-------------|
|------------------|-------------|

Action: State



Guarda el estado actual del instrumento o la preferencia del usuario. Los archivos pueden tener cualquier nombre, pero termina con la extensión (.sta) para los archivos de State y las extensiones (.prf) para los archivos de Preference, respectivamente. Los estados del instrumento guardados por el SCPI (comando \*SAV) se guardan en los nombres de archivo STATE\_0.sta a través de STATE\_4.sta.

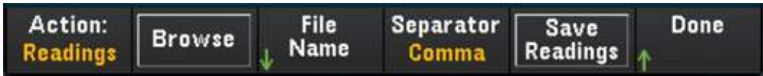
1. Para guardar el estado del instrumento o la preferencia del usuario, presione **State** > **Browse** para navegar por el directorio de archivos hasta el lugar donde desea guardar el archivo y presione **Select**.
2. Presione **File Name**, introduzca un nombre de archivo y presione **Done**.
3. Presione la tecla de función **State/Preference** para alternar entre guardar el estado actual del instrumento (State) o las preferencias del usuario (Preference).
4. Presione la tecla de función **Save State/ Save Preference** para guardar el estado actual del instrumento o las preferencias del usuario en la ubicación designada en el directorio de archivos.

NOTA

**State:** Guarda la configuración de medición, incluyendo la configuración del canal y la configuración de escaneo.

**Preference:** Guarda la configuración no volátil asociada al instrumento, incluyendo las preferencias del usuario y la configuración de E/S.

Readings



1. Para guardar las lecturas de la medición, presione **Readings** > **Browse** para navegar en el directorio de archivos hasta el lugar donde desea guardar el archivo y presione **Select**.
2. Presione **File Name**, introduzca un nombre de archivo y presione **Done**.
3. Presione la tecla de función **Separator** para especificar el carácter (**Comma**, **Tab** o **Semicolon**) que se usará para separar la información de cada fila.
4. Presione la tecla de función **Save Readings** para guardar el archivo en la ubicación designada en el directorio de archivos.

Capture

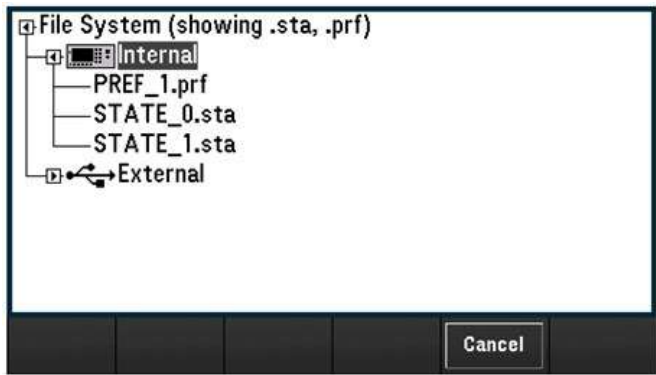


1. Para guardar una instantánea de la pantalla, presione **Capture** > **Browse** para navegar en el directorio de archivos hasta el lugar donde desea guardar el archivo y presione **Select**.
2. Presione **File Name**, introduzca un nombre de archivo y presione **Done**.

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <div>3. Presione la tecla de función <b>Format</b> para especificar el formato de archivo de imagen (.bmp o .png) que se guardará.</div> <div>4. Presione la tecla de función <b>Save Screen</b> para guardar la instantánea en la ubicación designada en el directorio de archivos.</div>                                                                                                                                                                    |
| Browse    | La tecla de función <b>Browse</b> abre el directorio de archivos donde puede seleccionar el archivo o la carpeta en que se realizará la acción. Use la perilla, las teclas de flecha del panel frontal y <b>[Select]</b> para navegar en el directorio de archivos. Las teclas de flecha izquierda y derecha contraen o expanden una carpeta.                                                                                                                 |
| File Name | La tecla de función <b>File Name</b> le permite definir el nombre de la carpeta o archivo para la acción seleccionada. Para especificar un nombre de carpeta o archivo, use la perilla o las teclas de flecha del panel frontal para seleccionar los caracteres deseados y presione <b>[Select]</b> para introducir el carácter seleccionado y pasar al siguiente carácter. Cuando termine de introducir el nombre de archivo deseado, presione <b>Done</b> . |

Recall

La tecla de función **Recall** le permite recuperar un archivo de estado previamente guardado (extensión .sta) o un archivo de preferencia (extensión .prf). Use la perilla o las teclas de flecha del panel frontal para navegar a un archivo en la memoria flash interna (Internal) o la unidad USB (External). Use la tecla de flecha derecha para expandir una carpeta. Presione **Select** para recuperar el archivo seleccionado.



Set to Defaults

La tecla de función **Set to Defaults** le permite devolver los ajustes seleccionados a sus valores predeterminados y tal como vinieron de fábrica. Tras presionar la tecla de función **Set to Defaults**, aparecerán las siguientes opciones:



| Tecla de función            | Descripción                                                                                                                                                                                     |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Restablecimiento de fábrica | Restablece el instrumento a la configuración de fábrica. Esta tecla de función no afectará a ningún estado de instrumento o configuración de E/S guardados anteriormente, como la dirección IP. |
| Default Pref                | Devuelve todas las preferencias al valor predeterminado que incluye las preferencias del usuario y la configuración de E/S que está almacenada en la memoria no volátil                         |
| Preset State                | Preestablece el instrumento. Todas las lecturas se eliminan y se abrirán todos los canales. Las configuraciones de canal no se cambian, a excepción de las del módulo multifunción.             |

## Registro a USB

**NOTA**

La opción solo está disponible cuando se ha seleccionado **Scan** como modo de adquisición de datos.

La tecla de función **Log to USB** le permite registrar las lecturas de la memoria escaneada en una unidad USB conectada al puerto host USB del panel frontal. El indicador USB se muestra cada vez que se conecta una unidad USB. Tras presionar la tecla de función **Log to USB**, aparecerán las siguientes opciones:



| Tecla de función | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Logging          | Al presionar la tecla de función <b>Logging</b> habilitará ( <b>On</b> ) o deshabilitará ( <b>Off</b> ) el registro de las lecturas de la memoria detectada en una unidad USB conectada al puerto host USB del panel frontal. Cuando el registro de datos USB está habilitado, las lecturas se guardan en archivos en la unidad USB. Sin embargo, las lecturas no se restaurarán en la memoria de lectura una vez que se apague y se encienda el instrumento.                                                                                                            |
| # Rows           | Al presionar la tecla de función <b># Rows</b> puede especificar el límite de filas (número máximo de filas para datos de barrido) que se escribirán en cada archivo de registro de datos. Puede elegir entre tres opciones: <b>65k</b> (el límite de cada archivo de registro de datos es de 65,536 filas por archivo), <b>1M</b> (el límite de cada archivo de registro de datos es de 1,048,576 filas por archivo), o <b>Infinite</b> (el límite es el número de bytes permitidos por el sistema de archivos, hasta 4 GBytes o espacio de almacenamiento disponible.) |
| Separator        | Presione la tecla de función <b>Separator</b> para especificar el carácter ( <b>Comma</b> , <b>Tab</b> o <b>Semicolon</b> ) que se usará para separar la información de cada fila.                                                                                                                                                                                                                                                                                                                                                                                       |
| Log to New file  | La tecla de función Log to New file aparecerá cuando el registro de datos esté en curso. Cada vez que se presione la tecla de función <b>Log to New file</b> , registrará los datos en un archivo nuevo.                                                                                                                                                                                                                                                                                                                                                                 |

## Estructura de archivos y carpetas

### Descripción de carpeta

Cada escaneo guardado se almacenará en una carpeta de nivel superior llamada:

`/DAQ97xA/[instrument_SN]/[yyyymmdd_hhmmssmmm]`

- Los paréntesis cuadrados ( [ ] ) no son parte del nombre del directorio.
- instrument\_SN es el número de serie del instrumento.
- yyyymmdd\_hhmmssmmm es un sello temporal que indica el inicio aproximado del escaneo. El formato es año (yyyy), mes (mm), día (dd), subrayado ( \_ ), horas (hh), minutos (mm), segundos (ss) y milisegundos (mmm).

Por ejemplo, la carpeta llamada: `/DAQ970A/MY00012345/20191127_134523123` indicaría un escaneo en el número de instrumento MY00012345 que comenzó aproximadamente hace 23.123 segundos después de la 1:45 pm (13:45) del miércoles, 27 de noviembre de 2019.

### Descripciones de archivo

La carpeta de nivel superior descrita anteriormente contendrá dos tipos de archivos.

#### 1. config.csv

Este es un archivo de texto que documenta la configuración del instrumento para este escaneo. La marca de tiempo es tal cual se describió anteriormente. Este archivo enumera la configuración del instrumento en una forma legible para humanos.

#### 2. dat#####.csv

Si usa el comando `MMEMory:FORMat:READing:RLIMit OFF`, todos los datos se almacenarán en un archivo, denominado `dat00001.csv`.

Puede emitir el comando `MMEMory:FORMat:READing:RLIMit ON` para limitar los datos a 64K - 1 (65,535) barridos por archivo, en cuyo caso los barridos se almacenan en varios archivos, denominados `dat00001.csv`, `dat00002.csv`, `dat00003.csv` y así sucesivamente. Esto es útil para importar datos en una hoja de cálculo u otro software de análisis de datos. Tome en cuenta que algunas hojas de cálculo o software de análisis de datos pueden importar los datos más fácilmente si cambia la extensión de `csv` a `txt`. Si su software no importa el archivo correctamente, intente cambiar la extensión en el archivo de datos.

### Contenido de los archivos de datos

El inicio de sesión en archivos de datos solo se permite en los canales que están en la lista de escaneo. Los posibles canales se muestran en la siguiente tabla; tome en cuenta que *s* representa el número de ranura, que es 1, 2 o 3.

Por ejemplo, los soportes del módulo DAQM901A podrían tener los canales 101-120, 201-220 o 301-320.

| Módulo   | Descripción                                      | Canales        |
|----------|--------------------------------------------------|----------------|
| DAQM900A | Multiplexor FET de 20 canales                    | s01 - s20      |
| DAQM901A | Multiplexor armature de 2 alambres de 20 canales | s01 - s20      |
| DAQM902A | Multiplexor reed de 2 alambres de 16 canales     | s01 - s16      |
| DAQM907A | Entrada DIO de 2 canales                         | s01 - s02      |
| DAQM907A | Totalizador de 1 canal, DAC de 4 canales         | s03, s04 - s27 |
| DAQM908A | Multiplexor Armature de 1 alambre de 40 canales  | s01 - s40      |

El formato para todos los archivos de datos USB es similar al que produce el Keysight BenchLink Data Logger de manera predeterminada. El separador de campo predeterminado es una coma, pero puede usar la tecla de función **Seperator** para especificar un separador diferente.

A continuación, se muestra un archivo de ejemplo.

| Sweep # | Time                    | Can 201 (VCC) | Can 202 (VCC) |
|---------|-------------------------|---------------|---------------|
| 1       | 11/27/2019 08:07:12:237 | 0.36823663    | 1.23895216    |
| 2       | 11/27/2019 08:07:13:237 | 0.62819233    | 0.98372939    |
| 3       | 11/27/2019 08:07:13:237 | 0.38238212    | 0.39382906    |
| 4       | 11/27/2019 08:07:13:237 | 0.46773299    | 0.55543345    |
| 6       | 11/27/2019 08:07:13:237 | 1.32323567    | 0.21213335    |

- Los números de canal y las unidades asociadas se muestran en la fila del encabezado.
- Si la función de límite de fila está ENCENDIDA y los datos se reparten en varios archivos, la numeración de escaneo continúa donde se detuvo en el archivo anterior. Por lo tanto, el primer escaneo en el segundo archivo de datos sería el número 65,536, el primer escaneo en el tercer archivo de datos sería el número 131,071, y así sucesivamente.

## Save to USB

**NOTA**

Esta opción solo está disponible cuando se ha seleccionado **DMM Digitize** o **Digitizer** como modo de adquisición de datos.

La tecla de función **Save to USB** le permite guardar los datos digitalizados en una unidad USB conectada al puerto host USB del panel frontal. El indicador USB se muestra cada vez que se conecta una unidad USB. Tras presionar la tecla de función **Save to USB**, aparecerán las siguientes opciones:



| Tecla de función              | Descripción                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Guardar auto-mático<br>On/Off | <p>Al presionar la tecla de función <b>Auto Save</b> se habilitará (<b>On</b>) o deshabilitará (<b>Off</b>) el instrumento para guardar los datos digitalizados en una unidad USB conectada al puerto host USB del panel frontal. Si se habilita <b>Auto Save</b>, el instrumento empezará a guardar el archivo de datos en la unidad USB cuando concluya la operación de digitalización.</p> <div><p><b>NOTA</b> Si el instrumento no detecta una unidad USB, evitará que se inicie el proceso de digitalización hasta que se detecte una unidad USB o se deshabilite la función Auto Save.</p><p>Puede empezar a ver los resultados en el menú <b>[View]</b> mientras se ejecuta la operación Auto Save (guardado automático) en segundo plano.</p></div>                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Separator                     | <p>Al presionar la tecla de función <b>Separator</b> podrá especificar el carácter (<b>Comma</b>, <b>Tab</b> o <b>Semicolon</b>) que se usará para separar la información en cada fila del archivo de datos.</p> <div><p><b>NOTA</b> Esta configuración solo está disponible cuando se haya seleccionado <b>DMM Digitize</b> como modo de adquisición de datos.</p></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Path Name                     | <p>Selecciona una ubicación o carpeta dentro de la unidad USB para guardar los datos digitalizados.</p> <p>Presione la tecla de función <b>Browse</b> y use la perilla o las teclas de flecha para seleccionar la ubicación deseada para guardar. Luego, presione la tecla de función <b>File Name</b> para especificar el nombre de archivo deseado. Presione <b>Done</b> para completar el proceso.</p> <div>A screenshot of a dialog box titled 'Action: Config Digitizer auto save path'. It contains two input fields: 'Path:' with the text 'External\' and 'File:' with the text 'AUTOSAVE.dat'. At the bottom, there are four buttons: 'Action: Auto Save', 'Browse' (with a downward arrow), 'File Name', and 'Done' (with an upward arrow).</div> <div><p><b>NOTA</b> Después de la operación de digitalización, el nuevo conjunto de datos se escribirá en el mismo archivo especificado en la configuración de Path Name y se sobrescribirán los datos antiguos. Por eso, si desea guardar diferentes conjuntos de datos de diferentes operaciones de digitalización, necesita seleccionar cada vez un archivo diferente en la ruta de guardado, antes de iniciar el digitalizador.</p></div> |

## Formato de archivo para guardar en USB

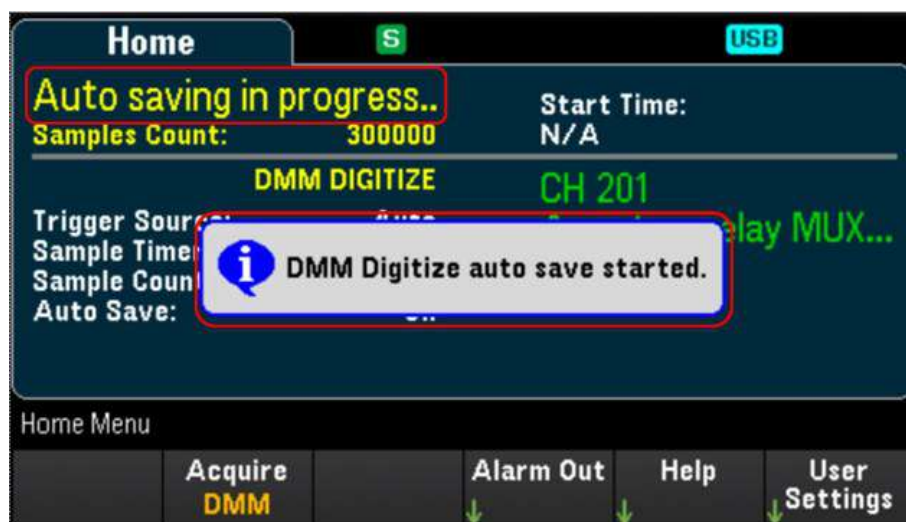
En el modo **Digitizer**, todos los archivos de datos se guardan en formato **.dat** cuando se guardan en la unidad USB. El sufijo de la extensión de archivo **.dat** es fijo y no se puede cambiar.

En el modo **DMM Digitize**, de forma predeterminada, todos los archivos de datos se guardan en formato **.csv**. No obstante, puede elegir guardar el archivo de datos con una extensión de nombre de archivo **.dat**. Para ello, incluya **.dat** al final del nombre de archivo que elija.

## Pantalla del panel frontal para guardar en USB

La pantalla del panel frontal tendrá indicadores para informarle que la operación de guardado automático está en curso. Estos indicadores (resaltados en rojo) se muestran en las siguientes imágenes:

Modo de adquisición de datos **DMM Digitize**:



Modo de adquisición de datos **Digitizer**:





## Interfaz web

El Keysight DAQ970A/DAQ973A Data Acquisition System ofrece una interfaz web incorporada para supervisar y controlar el instrumento a través de un navegador web.

Hay dos opciones disponibles para acceder a la Interfaz Web:

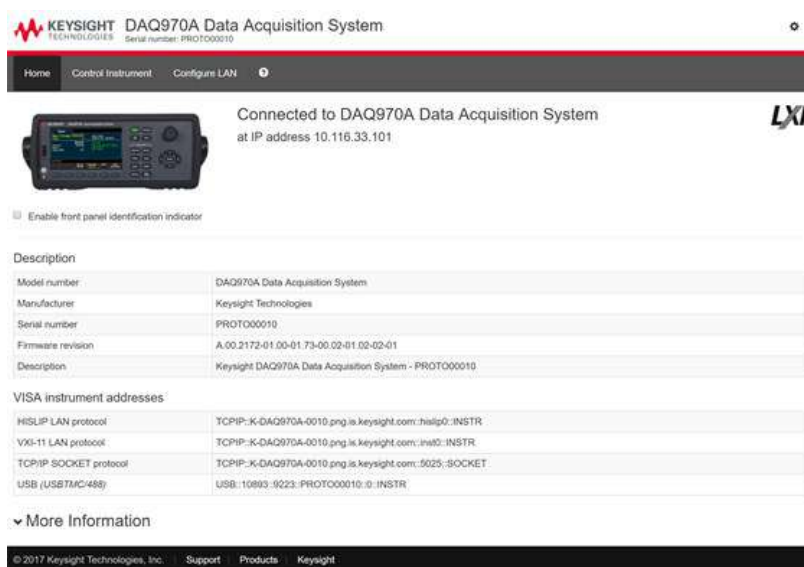
- **Interfaz LAN:** Conecte su instrumento a la interfaz LAN e ingrese la dirección IP del instrumento en la barra de direcciones en la parte superior del navegador web de su PC.
- **Keysight IO Libraries Suite:** Seleccione el instrumento en Connection Expert y haga clic en el botón Web UI. Asegúrese de que Keysight IO Libraries Suite esté instalado antes de continuar con la configuración de la interfaz remota.

### NOTA

La siguiente es una descripción general de alto nivel de las pestañas de la Interfaz Web que se muestra en la parte superior de la ventana de la Interfaz Web. Al utilizar la Interfaz Web, abra una ficha determinada y, a continuación, haga clic en el botón Ayuda (?) para ver el contenido de la ayuda para dicha ficha.

## Página de inicio

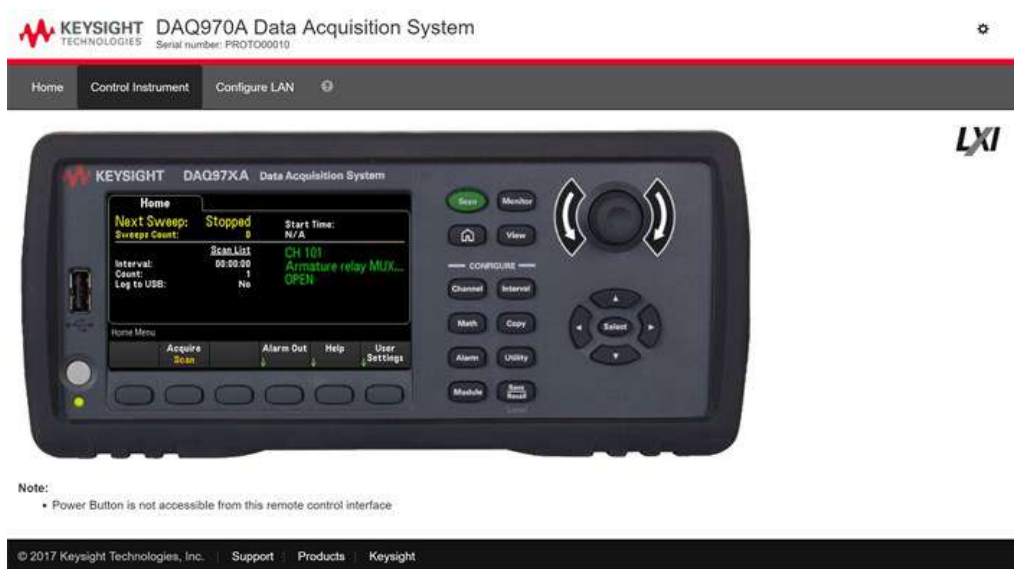
La Página de inicio (Home) muestra información básica del instrumento. Haga clic en More Information (Más información) o Less Information (Menos información) para alternar la visualización de los detalles de LAN y la información de cumplimiento de LXI. Para cambiar cualquier información que se muestra en esta página, use la Página de instrumentos de control.



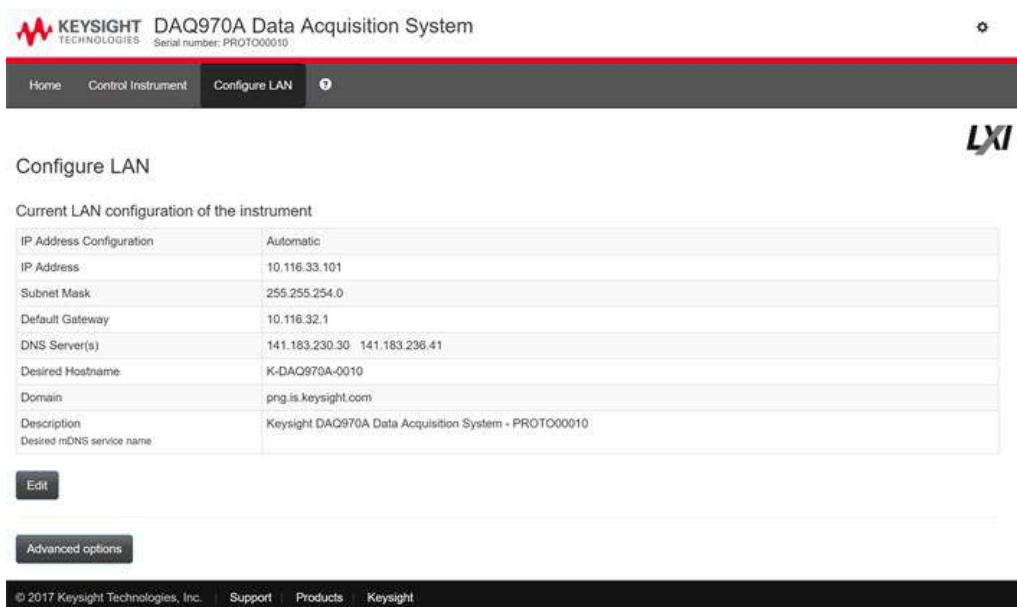
Marque la casilla de verificación "Enable front panel identification indicator" (Activar indicador de identificación del panel frontal) para habilitar un indicador visual que identifique el DAQ970A/DAQ973A. Esto puede ayudarlo a ubicar físicamente el instrumento en un bastidor, por ejemplo.

La posición y el tipo de indicador pueden variar. Los indicadores comunes son luces LED, un mensaje en pantalla o un mensaje que se muestra en un cuadro de diálogo. Desmarque la casilla de verificación para apagar el indicador.

## Página de instrumentos de control



## Página de configuración de LAN



Haga clic en el botón **Edit** para editar la página de configuración de red.

Cuando termine, haga clic en **Apply Changes** para aceptar la nueva configuración o haga clic en **Cancel** para ignorar los cambios.

Haga clic en el botón **Advanced options** para restablecer las opciones de configuración de la red.

## Página de ayuda

La ayuda está disponible para cada una de las fichas descritas anteriormente. Por ejemplo:



**KEYSIGHT**  
TECHNOLOGIES

**DAQ970A Data Acquisition System**  
Help

---

### Home Page Help

The *Keysight Technologies* web pages for the DAQ970A Data Acquisition System will help you get your system up and running as quickly as possible. If you have trouble with the instrument, contact Keysight by clicking on the **Support** link that appears in the footer of the page.

The **Home Page** displays detailed configuration information about the DAQ970A Data Acquisition System.

- The information presented is specified by the LXI Consortium and is consistent across instruments.
- You can use this information to form addresses needed to run SIDL or VISA programs (for example).
- Actions, the navigation bar, and information fields are described below.

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### Actions

- Click **More Information/Less Information** to toggle display of LAN details and LXI compliance information.
- **Enable front panel indicator** checkbox:
  - Select (check) the **Enable front panel indicator** checkbox to enable a visual indicator that identifies the DAQ970A Data Acquisition System. This can help you physically locate the instrument in a rack, for example.
  - The indicator position and type can vary. Common indicators are LEDs, an onscreen message, or a message displayed in a dialog box.
  - Clear (uncheck) the checkbox to turn off the indicator.

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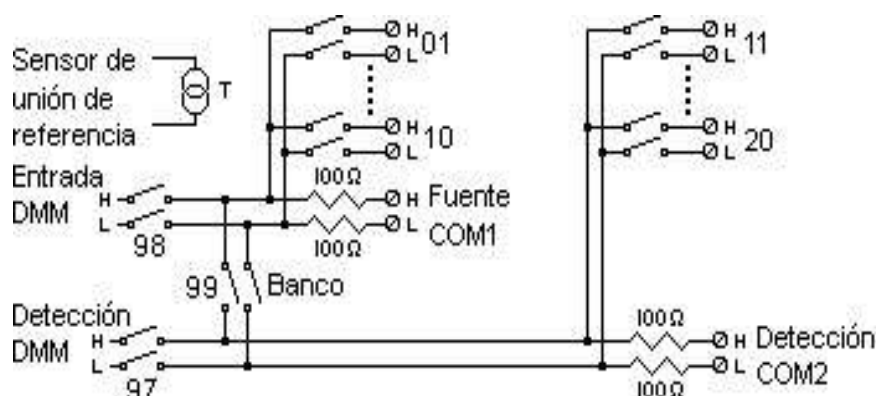
## Descripción general del módulo

Esta sección proporciona una descripción de cada módulo plug-in, incluidos los esquemas simplificados y diagramas de bloques. También se incluye un registro de cableado para facilitar la documentación de su configuración de cableado para cada módulo.

- Módulo Multiplexor FET de 20 canales DAQM900A
- Módulo Multiplexor Armature de 20 canales DAQM901A
- Módulo Multiplexor Reed de 16 canales DAQM902A
- Módulo de conmutación/Accionador de 20 canales DAQM903A
- Interruptor de conmutación Matrix de dos hilos 4x8 DAQM904A
- Módulo Multiplexor (50  $\Omega$ ) RF 1:4 doble DAQM905A
- Módulo multifunción DAQM907A
- Multiplexor de terminación única de 40 canales DAQM908A
- Módulo digitalizador de 24 bits y 4 canales DAQM909A

## Módulo Multiplexor FET de 20 canales DAQM900A

Este módulo está dividido en dos bancos de 10 canales de dos alambres cada uno. Los 20 canales cambian las entradas HI y LO, por lo que proporcionan entradas completamente aisladas para el DMM interno o un instrumento externo. Durante las mediciones de resistencia de 4 alambres, los canales del Banco A (canal n) se emparejan automáticamente con los canales del Banco B (canal n + 10) para proporcionar las conexiones de fuente y detección. El módulo tiene una unión de referencia de termopar incorporada para minimizar los errores debidos a gradientes térmicos al medir los termopares.



### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

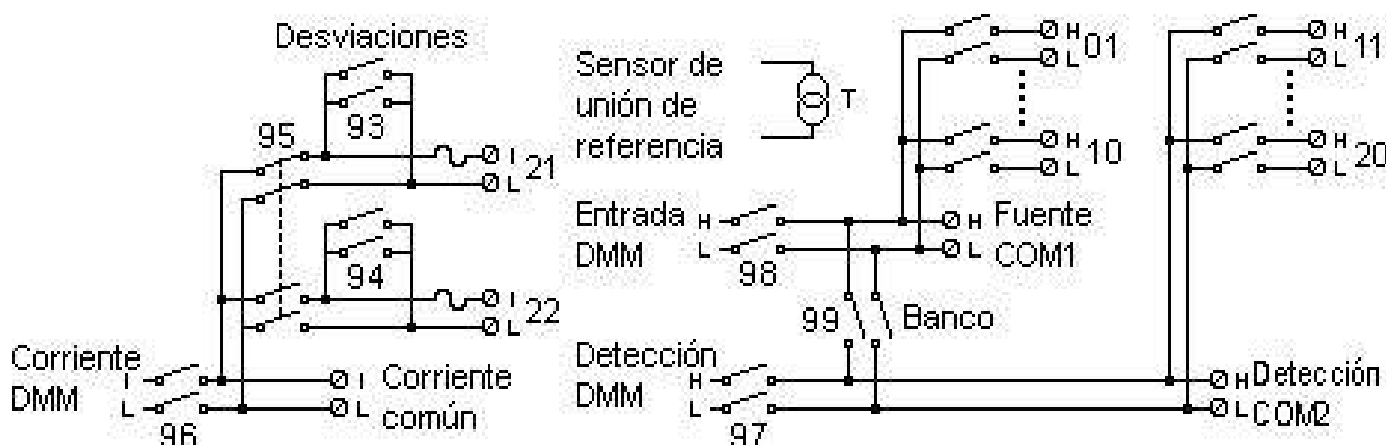
Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.

#### REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

## Módulo Multiplexor Armature de 20 canales DAQM901A

Este módulo está dividido en dos bancos de 10 canales de dos alambres cada uno. Hay dos canales con fusibles adicionales disponibles en el módulo (total en 22 canales) para realizar mediciones de corriente CC o CA calibradas y directas con el DMM interno (no se requieren resistencias de derivación externas). Los 22 canales cambian las entradas HI y LO, por lo que proporcionan entradas completamente aisladas para el DMM interno o un instrumento externo. Durante las mediciones de resistencia de 4 alambres, los canales del Banco A (canal n) se emparejan automáticamente con los canales del Banco B (canal n + 10) para proporcionar las conexiones de fuente y detección. El módulo tiene una unión de referencia de termopar incorporada para minimizar los errores debidos a gradientes térmicos al medir los termopares.



### NOTA

Solo uno de los canales 21 y 22 se puede conectar al DMM interno y/o COM a la vez. La conexión de un canal cerrará el otro (produciendo un cortocircuito en la entrada "I" a "LO").

### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

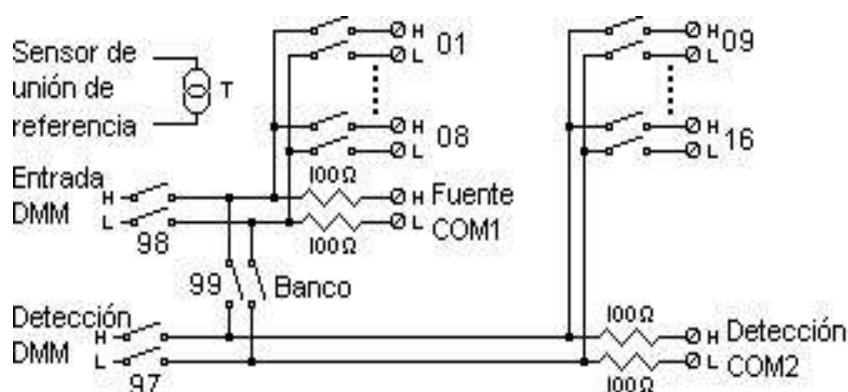
Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.

#### REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

## Módulo Multiplexor Reed de 16 canales DAQM902A

Este módulo está dividido en dos bancos de 8 canales de dos alambres cada uno. Utilice este módulo para aquellas aplicaciones que requieran escaneo de alta velocidad y alto rendimiento en pruebas automatizadas. Los 16 canales cambian las entradas HI y LO, por lo que proporcionan entradas completamente aisladas para el DMM interno o un instrumento externo. Durante las mediciones de resistencia de 4 alambres, los canales del Banco A (canal n) se emparejan automáticamente con los canales del Banco B (canal n +8) para proporcionar las conexiones de fuente y detección. El módulo tiene una unión de referencia de termopar incorporada para minimizar los errores debidos a gradientes térmicos al medir los termopares.



### NOTA

Las mediciones de corriente en este módulo requerirán resistencias de derivación externas.

### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.

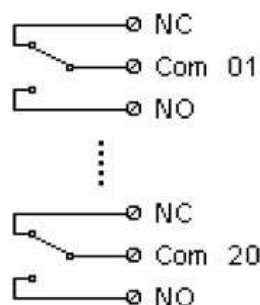
#### REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

## Módulo de conmutación/Accionador de 20 canales DAQM903A

Este módulo contiene 20 relés de enclavamiento independientes y SPDT (Forma C). Este módulo puede conmutar 300 V, 1 A (50 W de potencia de conmutación máxima) a su dispositivo bajo prueba o para activar dispositivos externos. Los terminales de tornillo en el módulo brindan acceso a los contactos normalmente abiertos, normalmente cerrados y comunes para cada uno de los 20 interruptores. Este módulo no se conecta al DMM interno. Utilice este módulo para aquellas aplicaciones que requieren contactos de alta integridad o conexiones de calidad de señales no multiplexadas.

Se proporciona un área de placa de prueba cerca de los terminales de tornillo para implementar circuitos personalizados, como filtros simples, amortiguadores y divisores de voltaje. El área de placa de prueba proporciona el espacio necesario para insertar sus propios componentes, pero aquí no hay rastros de la placa de circuito. Debe agregar sus propios circuitos y enrutamiento de señal.



### NOTA

Puede cerrar varios canales al mismo tiempo en este módulo.

Los comandos CLOSE y OPEN del canal controlan el estado de la conexión normalmente abierta (NO) a COM en cada canal. Por ejemplo, CLOSE 201 conecta el contacto normalmente abierto a COM en el canal 01.

### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.



**REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL**

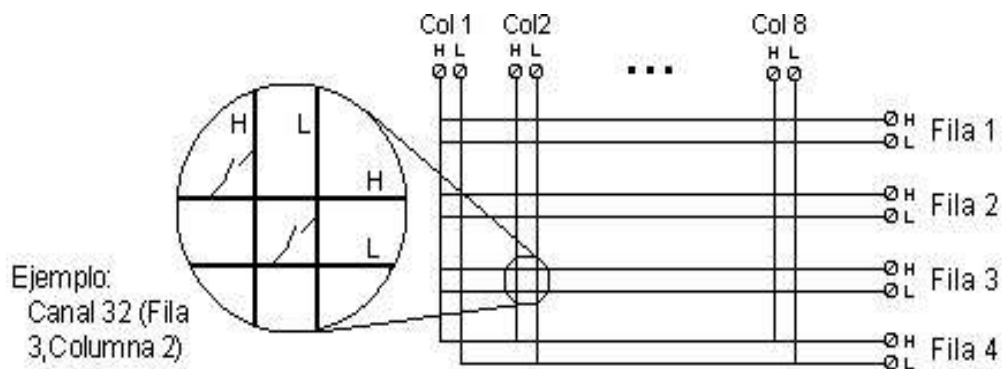
Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

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## Interruptor de conmutación Matrix de dos hilos 4x8 DAQM904A

Este módulo contiene 32 puntos de cruce de dos alambres organizados en una configuración de 4 filas por 8 columnas. Puede conectar filas y columnas entre varios módulos para crear matrices más grandes, como 8x8 y 4x16, con hasta 96 puntos de cruce en una sola unidad principal. Use este módulo para conectar varios instrumentos a diversos puntos, o cualquier combinación de entradas y salidas en su dispositivo bajo prueba al mismo tiempo.

Este módulo no se conecta al DMM interno. Cada relé de punto de cruce tiene su propia etiqueta de canal única que representa la fila y la columna. Por ejemplo, el canal 32 representa la conexión de punto de cruce entre la fila 3 y la columna 2 como se muestra a continuación:



### NOTA

Puede cerrar varios canales al mismo tiempo en este módulo.

### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.

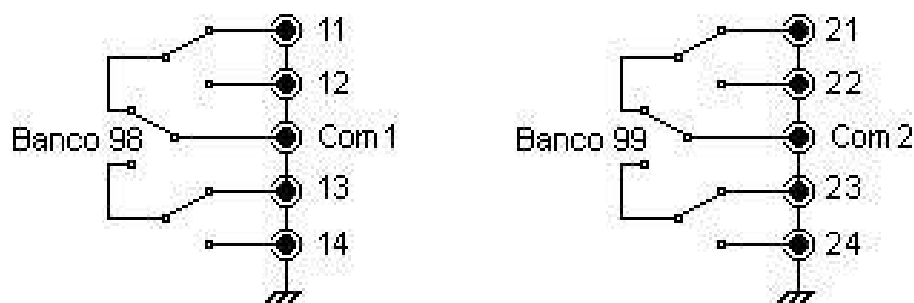
#### REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

## Módulo Multiplexor (50 $\Omega$ ) RF 1:4 doble DAQM905A

Estos módulos constan de dos bancos independientes de 4 a 1 multiplexores, que ofrecen capacidades de conmutación de banda ancha para señales de alta frecuencia y pulsos. Los canales en cada banco están organizados en una estructura de “árbol” para proporcionar alto aislamiento y bajo VSWR. Ambos módulos tienen una conexión a tierra común, ofrecen poca interferencia y un excelente rendimiento de pérdida de inserción. Para crear multiplexores de RF más grandes, puede conectar varios bancos juntos en cascada.

Este módulo no se conecta al DMM interno. Puede conectar sus señales directamente a los conectores SMB incorporados o a los cables SMB a BNC suministrados con el módulo.



### NOTA

Solo puede cerrar un canal por banco a la vez en estos módulos. Cerrar un canal en un banco abrirá el canal previamente cerrado. Un canal en cada banco está siempre conectado a COM.

Este módulo responde solo al comando CLOSE (OPEN no se aplica). Para OPEN (abrir) un canal, envíe el comando CLOSE (cerrar) a otro canal en el mismo banco.

### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

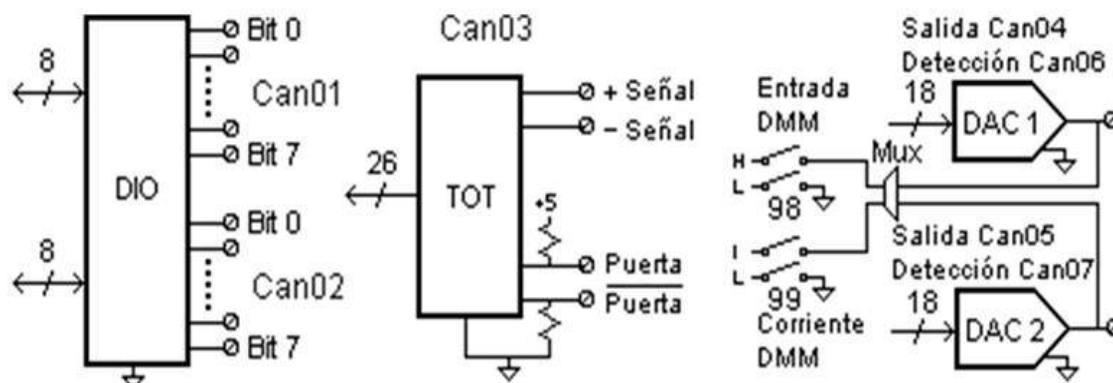
Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.

#### REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

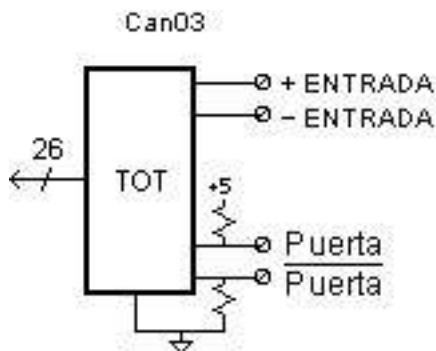
## Módulo multifunción DAQM907A

Este módulo combina dos puertos de entrada/ salida digital de 8 bits, un totalizador de 100 kHz y dos salidas analógicas de  $\pm 12$  V (DAC). Para una mayor flexibilidad, puede leer las entradas digitales y el conteo del totalizador durante un escaneo. Utilice este módulo para detectar el estado y controlar dispositivos externos como solenoides, relés de alimentación y conmutadores de microondas.



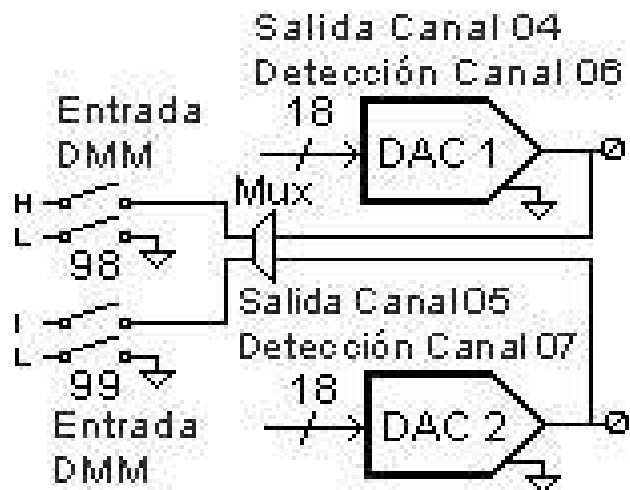
El DIO consta de dos puertos de 8 bits con entradas y salidas compatibles con TTL. Las salidas de colector abierto pueden descender hasta 400 mA. Desde el panel frontal, puede leer datos desde un solo puerto de entrada de 8 bits a la vez. Desde la interfaz remota, puede leer ambos puertos simultáneamente como una palabra de 16 bits únicamente si ninguno de los puertos está en la lista de escaneo.

### Entrada del totalizador



El totalizador de 26 bits puede contar pulsos a una velocidad de 100 kHz. Puede configurar el totalizador para que cuente con el borde ascendente o el borde descendente de la señal de entrada. Aplicar una señal TTL alta al terminal “**G**” activa el conteo y una señal baja deshabilita el conteo. Aplicar una señal compatible con TTL baja al terminal “**G̅**” activa el conteo y una señal alta deshabilita el conteo. El totalizador solo cuenta cuando ambos terminales están habilitados. Mueva el puente del umbral del totalizador a la posición “AC” para detectar cambios a través de 0 V. Mueva el puente a la posición “TTL” (configuración de fábrica) para detectar cambios a través de los niveles de umbral TTL.

Detección y salida del DAC - Salida Analógica



Los dos canales de salidas analógicas (canal 04 y 05) y dos canales de detección de salida (canal 06 y 07) pueden emitir voltajes o corrientes calibrados con 18 bits de resolución. Debe limitar la corriente de salida del DAC a 40 mA en total para cada ranura (dos canales DAC). La siguiente tabla muestra los valores de salida del DAC en modo corriente y modo voltaje:

| Modo           | Corriente | Voltaje |
|----------------|-----------|---------|
| Modo Corriente | ± 24 mA   | ±12 V   |
| Modo Voltaje   | ± 15 mA   | ±12 V   |

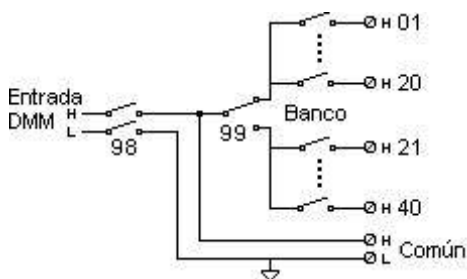
**ADVERTENCIA**

**PARA PREVENIR EL CHOQUE ELÉCTRICO**

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

## Multiplexor de terminación única de 40 canales DAQM908A

El módulo está dividido en dos bancos de 20 canales cada uno. Todos los 40 canales cambian solo a HI, con un LO común para el módulo. Utilice este módulo para aplicaciones de conmutación de alta densidad que requieren entradas de un solo alambre con un LO común.



### NOTA

Solo se puede cerrar un canal a la vez, al cerrar un canal se abrirá el canal previamente cerrado.

Este módulo no se puede utilizar para medir directamente las mediciones de corriente o de 4 alambres.

### ADVERTENCIA

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

#### PRECAUCIÓN CON MÚLTIPLES SEÑALES

Para evitar la posibilidad de que varias fuentes de señales se conecten entre sí, recomendamos que cuando se realice multiplexación de dos o más fuentes, se conecten en módulos separados o en bancos separados del mismo módulo.

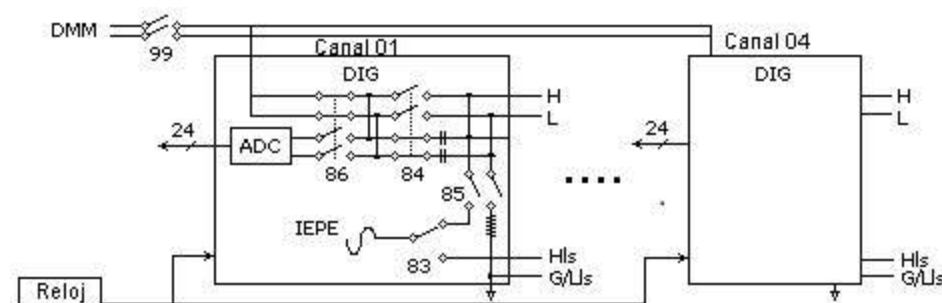
#### PRECAUCIÓN CON VOLTAJES PELIGROSOS

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, todos los canales en el módulo deben tratarse como peligrosos y todo el cableado del canal en el módulo se debe clasificar conforme al voltaje máximo aplicado. Los termopares conectados a cualquier otro canal en el módulo deben tener una clasificación de aislamiento conforme al voltaje máximo, o tener un aislamiento adicional conforme al voltaje máximo, y se aislarán de las partes conductoras con cinta o compuesto térmico apto para el voltaje máximo aplicado. No monte, mueva ni retire ningún termopar cuando el dispositivo bajo prueba esté conectado a una fuente de alimentación.

#### REQUISITOS DE SEGURIDAD Y SALUD MEDIOAMBIENTAL

Cuando cualquier canal está conectado a una fuente de voltaje peligrosa, el instrumento y el dispositivo bajo prueba se deben supervisar. Para ello, se deben seguir las prácticas locales de EHS para restringir el acceso.

## Módulo digitalizador de 24 bits y 4 canales DAQM909A



El DAQM909A es un módulo digitalizador de cuatro canales, capaz de brindar cuatro canales muestreados simultáneamente con una frecuencia de muestreo que puede llegar a 800.000 muestras por segundo con una resolución máxima de 24 bits. Los canales de entrada del DAQM909A se pueden configurar como una entrada diferencial o una entrada con un extremo y cada uno de los canales puede brindar hasta 4 mA de corriente constante para alimentar un transductor IEPE externo. Cuando se insertan tres módulos DAQM909A dentro del mismo instrumento, los 12 canales se pueden sincronizar para brindar muestreo simultáneo.

### ADVERTENCIA

#### NO MIDA MÁS QUE EL VOLTAJE INDICADO

El voltaje de entrada máximo para la medición es  $\pm 18$  Vpk (un extremo) para pines HI y LO.

#### PARA PREVENIR EL CHOQUE ELÉCTRICO

Para evitar descargas eléctricas, use solo alambres que estén clasificados para el voltaje máximo aplicado a cualquier canal. Antes de quitar la cubierta de un módulo, apague la alimentación de los dispositivos externos que estén conectados a este.

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ESTA PÁGINA SE HA DEJADO EN BLANCO DELIBERADAMENTE.



# 4 Tutoriales de medición

Sistema de cableado y conexiones

Fundamentos de medición

Digitalizar las mediciones

Accionadores y conmutación de uso general

Conmutación de matriz

Multiplexores para señal de RF

Módulo multifunción

Vida útil del relé y mantenimiento preventivo

Este capítulo describe los métodos que puede utilizar para reducir los errores que pueden afectar sus mediciones. También encontrará información que puede ayudarlo a comprender mejor cómo el DAQ970A/DAQ973A realiza las mediciones y qué puede hacer para obtener los mejores resultados.

## Sistema de cableado y conexiones

Esta sección describe métodos para reducir los errores de medición a causa del cableado de su sistema. Se pueden reducir o eliminar muchos errores de cableado del sistema si selecciona el esquema de cable y conexión a tierra adecuado para su sistema.

- **Especificaciones de cable**
- **Técnicas de conexión a tierra**
- **Técnicas de blindaje**
- **Separación de señales de alto y bajo nivel**
- **Fuentes de errores de cableado del sistema**

### Especificaciones de cable

Encontrará una amplia variedad de cables de uso general y personalizados disponibles. Los siguientes factores influyen en el tipo de cable que elija.

- Requisito de señal, como voltaje, frecuencia, precisión y velocidad de medición.
- Requisitos de interconexión, como tamaños de cable, longitudes de cable y enrutamiento de cable.
- Requisitos de mantenimiento, como conectores intermedios, terminaciones de cables, anillo pasacables, longitudes de cables y enrutamiento de cables.

Los cables se especifican de varias maneras. Asegúrese de verificar las siguientes especificaciones para el tipo de cable que desea usar:

- Impedancia nominal (resistencia de aislamiento): varía con la frecuencia de la señal de entrada. Compruebe si es HI-to-LO, channel-to-channel, and HI-to-LO-to-shield. Las aplicaciones de RF de alta frecuencia tienen requisitos exactos para la impedancia del cable.
- Voltaje de resistencia dieléctrica: debe ser lo suficientemente alta para su aplicación.

**ADVERTENCIA**

Para evitar descargas eléctricas o daños al equipo, aisle todos los canales al máximo potencial del sistema. Se recomienda utilizar un cable con al menos 600 V de aislamiento nominal.

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- Resistencia del cable: varía con el calibre del cable y la longitud del cable. Use el cable del calibre más grande posible e intente mantener las longitudes de cable lo más cortas posible para minimizar la resistencia del cable. La siguiente tabla enumera la resistencia del cable más comunes para cable de cobre de varios calibres (el coeficiente de temperatura para cable de cobre es de 0,35 % por °C).

| AWG               | $\Omega$ / pies (2 conductores) a 25 °C |
|-------------------|-----------------------------------------|
| 14                | 5 m $\Omega$                            |
| 16                | 10 m $\Omega$                           |
| 18                | 15 m $\Omega$                           |
| 20 <sup>[1]</sup> | 20 m $\Omega$                           |
| 22                | 30 m $\Omega$                           |
| 24                | 50 m $\Omega$                           |

- Capacitancia del cable: varía según el tipo de aislamiento, la longitud del cable y el blindaje del cable. El cable debe ser lo más corto posible para reducir al mínimo la capacitancia del cable. En algunos casos, se puede usar un cable de baja capacitancia.

La siguiente tabla enumera las especificaciones más comunes de los cables.

| Tipo de cable         | Impedancia nominal                  | Capacitancia  | Atenuación                  |
|-----------------------|-------------------------------------|---------------|-----------------------------|
| Par trenzado          | 100 $\Omega$ a 1 MHz                | 10 a 20 pF/ft | Hasta 1 dB/100 ft a 1 MHz   |
| Par trenzado blindado | 100 $\Omega$ a 1 MHz                | 10 a 20 pF/ft | Hasta 1 dB/100 ft a 1 MHz   |
| Coaxial               | 50 $\Omega$ o 75 $\Omega$ a 100 MHz | 15 a 25 pF/ft | Hasta 6 dB/100 ft a 100 MHz |
| Cinta de par trenzado | 100 $\Omega$ a 1 MHz                | 15 a 20 pF/ft | Hasta 1 dB/100 ft a 1 MHz   |

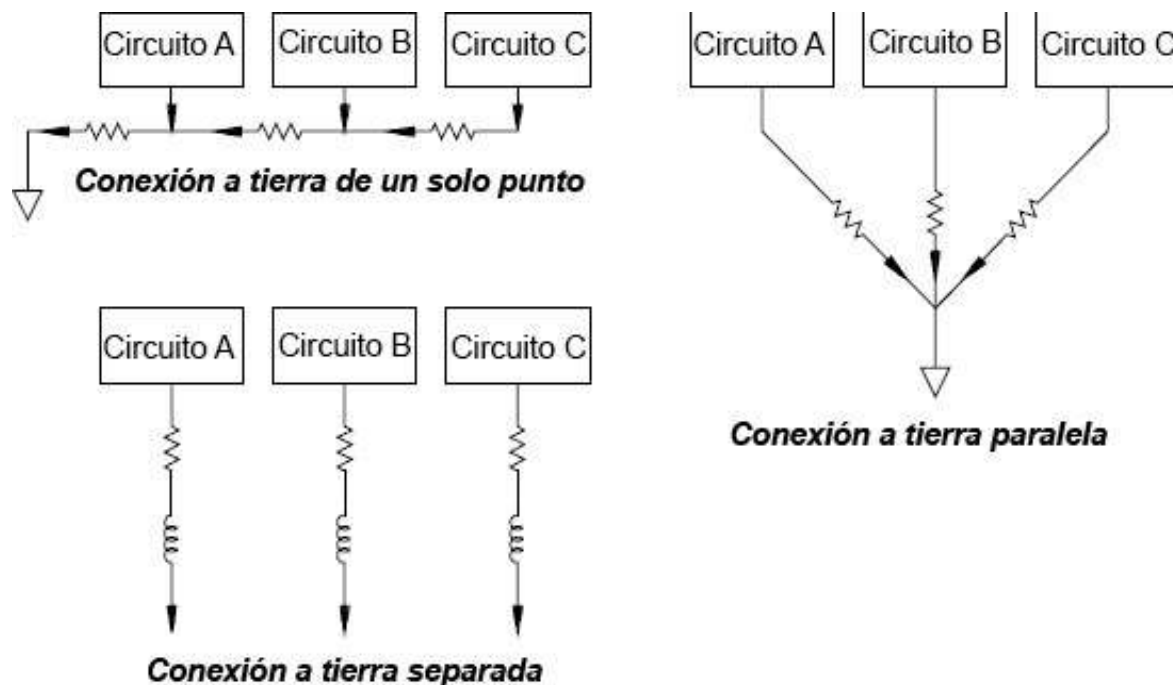
<sup>[1]</sup>Tamaño de cable recomendado para los terminales de tornillo en los módulos plug-in de DAQ970A/DAQ973A.

## Técnicas de conexión a tierra

El propósito de la conexión a tierra es evitar los bucles de tierra y minimizar el ruido. La mayoría de los sistemas deben tener al menos tres retornos por tierra separados.

1. Una puesta a tierra para señales. También es posible que desee proporcionar conexiones a tierra separadas entre señales de alto nivel, señales de bajo nivel y señales digitales.
2. Una segunda conexión a tierra se usa para hardware ruidoso, como relés, motores y equipos de alta potencia.
3. Una tercera conexión a tierra se usa para el chasis, los bastidores y los gabinetes. La conexión a tierra de la alimentación de CA generalmente se debe conectar a esta tercera conexión a tierra.

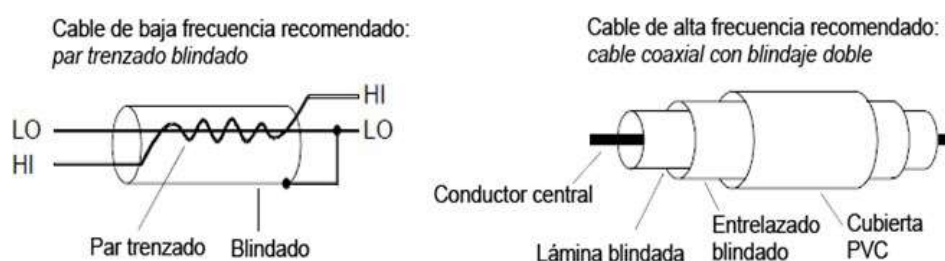
En general, para frecuencias inferiores a 1 MHz o para señales de bajo nivel, use una conexión a tierra de un solo punto (vea la imagen a continuación). La conexión a tierra paralela es superior, pero también es más costosa y más difícil de cablear. Si la conexión a tierra de un solo punto es adecuada, los puntos más críticos (aquellos con los niveles más bajos y/o los requisitos de medición más precisos) deben colocarse cerca del punto de tierra principal. Para frecuencias superiores a 10 MHz, use el sistema de puesta a tierra separado. Para señales entre 1 MHz y 10 MHz, puede usar un sistema de un solo punto si la ruta de retorno a tierra más larga se mantiene a menos de  $1/20$  de una longitud de onda. En todos los casos, la resistencia de la ruta de retorno y la inductancia deben minimizarse.



## Técnicas de blindaje

El blindaje contra el ruido debe tener en cuenta el acoplamiento capacitivo (eléctrico) y el inductivo (magnético). Agregar una protección a tierra alrededor del conductor es altamente eficaz contra el acoplamiento capacitivo. En redes de conmutación, este blindaje a menudo toma la forma de cables y conectores coaxiales. Para frecuencias superiores a 100 MHz, se recomienda un cable coaxial con blindaje doble para lograr la máxima efectividad de blindaje.

La reducción del área de bucle es el método más eficaz para protegerse contra el acoplamiento magnético. Por debajo de unos pocos cientos de kilohercios, se pueden usar pares trenzados contra el acoplamiento magnético. Use par trenzado blindado para lograr inmunidad frente a la captación magnética y capacitiva. Para lograr una protección máxima por debajo de 1 MHz, asegúrese de que el blindaje no sea uno de los conductores de señal.



## Separación de señales de alto y bajo nivel

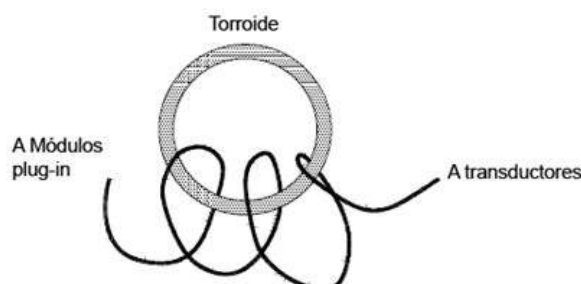
Las señales cuyos niveles excedan una proporción de 20 a 1 deben estar físicamente separadas lo más posible. Se debe examinar la ruta de la señal completa, incluido el cableado y las conexiones adyacentes. Todas las líneas no utilizadas deben estar conectadas a tierra (o unidas a LO) y ubicadas entre rutas de señales sensibles. Cuando realice las conexiones de cableado a los terminales de tornillo del módulo, asegúrese de cablear funciones similares en los canales adyacentes.

## Fuentes de errores de cableado del sistema

### Interferencia de radio frecuencia

La mayoría de los instrumentos de medición de voltaje pueden generar lecturas falsas en presencia de señales de alta frecuencia grandes. Las posibles fuentes de señales de alta frecuencia incluyen transmisores de radio y televisión cercanos, monitores de computadora y teléfonos celulares. La energía de alta frecuencia también se puede acoplar al DMM interno en el cableado del sistema. Para reducir la interferencia, intente minimizar la exposición del cableado del sistema a fuentes de RF de alta frecuencia.

Si su aplicación es extremadamente sensible al RF1 emitido desde el instrumento, use un obturador de modo común en el cableado del sistema como se muestra a continuación para atenuar las emisiones del instrumento.



## Errores de EMF térmicos

Los voltajes termoeléctricos son una de las fuentes más comunes de errores en mediciones de voltaje de CC a bajo nivel. Los voltajes termoeléctricos se generan cuando realiza conexiones de circuitos con diferentes metales y temperaturas. Cada unión de metal con metal forma un termopar, que genera un voltaje proporcional a la diferencia de temperatura de la unión. Debe tomar las precauciones necesarias a fin de minimizar los voltajes del termopar y las variaciones de temperatura en las mediciones de voltaje de bajo nivel. Las mejores conexiones se forman utilizando conexiones prensadas de cobre a cobre. La tabla a continuación muestra los voltajes termoeléctricos más comunes para las conexiones entre metales diferentes.

| Cobre-a-                  | Aprox. $\mu\text{V}/^{\circ}\text{C}$ |
|---------------------------|---------------------------------------|
| Cobre                     | < 0,3                                 |
| Oro                       | 0,5                                   |
| Plata                     | 0,5                                   |
| Bronce                    | 3                                     |
| Cobre berilio             | 5                                     |
| Aluminio                  | 5                                     |
| Kovar o aleación 42       | 40                                    |
| Silicona                  | 500                                   |
| Cobre-Óxido               | 1000                                  |
| Soldadura cadmio-estaño   | 0,2                                   |
| Soldadura de estaño-plomo | 5                                     |

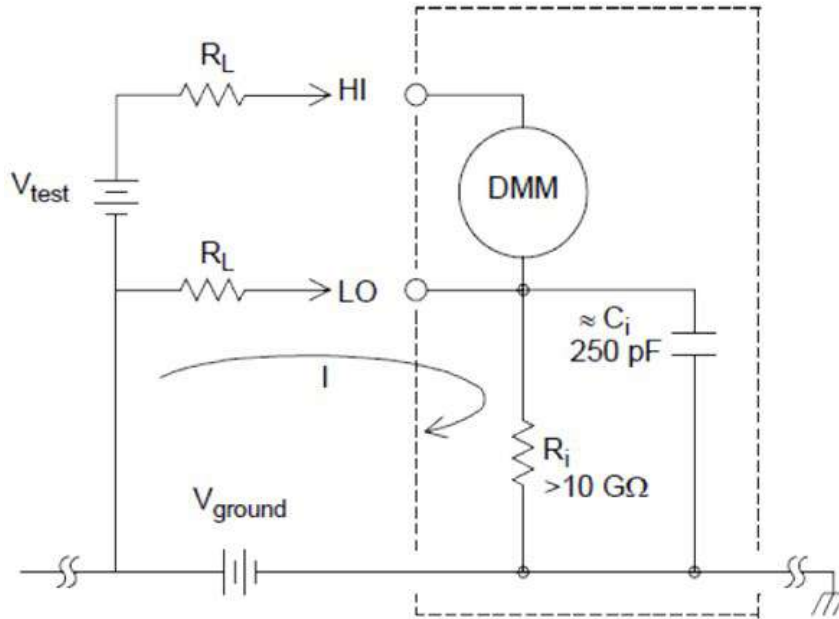
## Ruido causado por los campos magnéticos.

Si realiza mediciones cerca de campos magnéticos, debe tomar precauciones para evitar la inducción de voltajes en las conexiones de medición. El voltaje puede ser inducido ya sea por el movimiento del cableado de conexión de entrada en un campo magnético fijo o por un campo magnético variable. Un cable de entrada sin blindar y mal revestido que se mueve en el campo magnético de la tierra puede generar varios milivoltios. El campo magnético variable alrededor de la línea de alimentación de CA también puede inducir voltajes de hasta varios cientos de milivoltios. Debe tener especial cuidado cuando trabaje cerca de conductores que transportan grandes corrientes.

Siempre que sea posible, debe enrutar el cableado lejos de los campos magnéticos. Generalmente, los campos magnéticos están presentes alrededor de motores eléctricos, generadores, televisores y monitores de computadora. También asegúrese de que el cableado de entrada tenga los anillos pasacables adecuado y esté bien sujeto cuando se trabaja cerca de campos magnéticos. Use conexiones de par trenzado al instrumento para reducir el área de bucle de captación de ruido, o revista los cables lo más juntos posible.

## Ruido causado por bucles de tierra

Cuando se miden voltajes en circuitos en los que el DMM interno y el dispositivo bajo prueba tienen la misma referencia a tierra, se forma un bucle de tierra. Como se muestra a continuación, cualquier diferencia de voltaje entre los dos puntos de referencia a tierra ( $V_{\text{ground}}$ ) hace que una corriente fluya a través del cable de medición LO. Esto provoca voltaje de error ( $V_L$ ) que se agrega al voltaje medido.



$$I = \text{Current flow caused by } V_{\text{ground}} = \frac{V_{\text{ground}}}{R_L + Z}$$

$$Z \approx Z_{ci} = \frac{1}{2\pi fC} \approx 10\text{M}\Omega \text{ or } 60\text{Hz}$$

$$V_L = I \times R_L$$

Donde:

$R_L$  = resistencia del cable

$R_i$  = resistencia de aislamiento DMM

$C_i$  = capacitancia de aislamiento DMM

$V_{\text{ground}}$  = Voltaje de ruido a tierra

Para minimizar los errores de bucle de tierra:

- Si  $V_{\text{ground}}$  es un voltaje de CC, mantenga  $R_L$  bajo en comparación con  $R_i$ .
- Si  $V_{\text{ground}}$  es un voltaje de CA, mantenga  $R_L$  bajo en comparación con  $Z$  y configure el tiempo de integración del DMM en 1 PLC o superior.

## Errores de medición de CA de bajo nivel

Al medir voltajes en CA inferiores a 100 mV, tome en cuenta que dichas mediciones son especialmente susceptibles a errores introducidos por fuentes de ruidos extrañas. Un cable de prueba expuesto actuará como una antena y el DMM interno medirá las señales recibidas. Toda la ruta de medición, incluida la línea de alimentación, actúa como una antena de bucle. Las corrientes circulantes en el bucle crearán voltajes de error en cualquier impedancia en serie con la entrada del instrumento. Por este motivo, debe aplicar voltajes de CA de bajo nivel al instrumento a través de cables blindados. También debe conectar el blindaje al terminal de entrada LO.

Asegúrese de minimizar el área de cualquier bucle de tierra que no pueda evitarse. Una fuente de impedancia alta es más susceptible a recibir ruido que una fuente de impedancia baja. Puede reducir la impedancia de alta frecuencia de una fuente si coloca un capacitor en paralelo con los terminales de entrada del instrumento. Es posible que tenga que experimentar para determinar el valor de capacitancia correcto para su aplicación.

El ruido más extraño no se correlaciona con la señal de entrada. Puede determinar el error como se muestra a continuación:

$$\textit{Voltage Measured} = \sqrt{V_{in}^2 + \textit{Noise}^2}$$

El ruido correlacionado, aunque no es común, es especialmente perjudicial. El ruido correlacionado siempre se agregará directamente a la señal de entrada. Medir una señal de nivel bajo con la misma frecuencia que la entrada de alimentación local es una situación común que puede producir este error.

Debe tener cuidado al cambiar señales de alto y bajo nivel en el mismo módulo. Es posible que los voltajes cargados de alto nivel se descarguen en un canal de bajo nivel. Se recomienda utilizar dos módulos diferentes o separar las señales de alto nivel de las señales de bajo nivel con un canal no utilizado conectado a tierra.



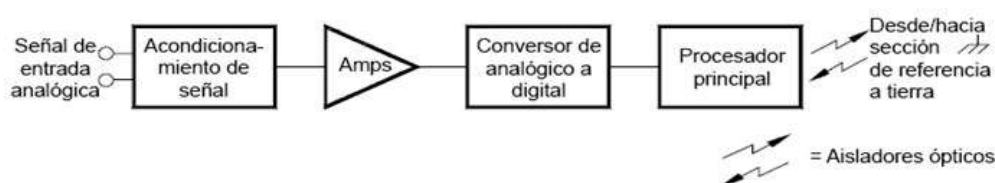
# Fundamentos de medición

Esta sección explica cómo el DAQ970A/DAQ973A realiza mediciones y analiza las fuentes de error más comunes relacionadas con estas mediciones.

- El DMM interno
- Mediciones de temperatura
- Mediciones de voltaje CC
- Mediciones de voltaje de CA
- Mediciones de corriente
- Medición de resistencia
- Mediciones de galgas extensométricas
- Mediciones de frecuencia y período
- Mediciones de capacitancia
- Digitalizar las mediciones
- Disparo de nivel

## El DMM interno

El DMM interno proporciona un front-end de entrada universal para medir una variedad de tipos de transductores sin la necesidad de un acondicionamiento de señal externo adicional. El DMM interno incluye acondicionamiento de señal, amplificación (o atenuación) y un convertidor analógico a digital de alta resolución (hasta 22 bits). A continuación, se muestra un diagrama simplificado del DMM interno:



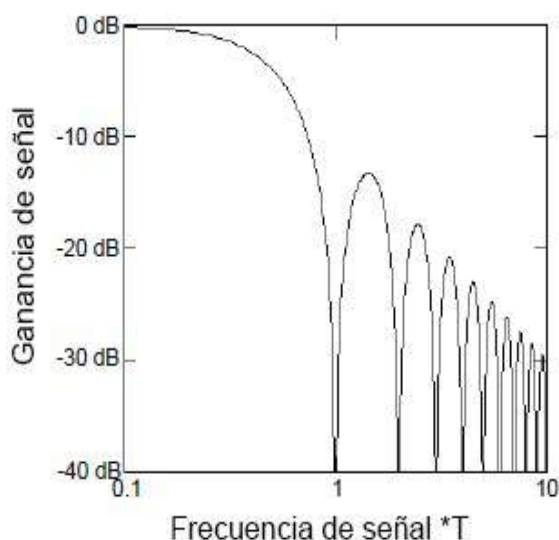
El DMM interno puede realizar directamente los siguientes tipos de mediciones. Cada una de estas medidas se describe en las siguientes secciones de este capítulo:

- Temperatura (termopar, RTD de 2 y 4 alambres y termistor de 2 y 4 alambres)
- Voltaje (CC y CA hasta 300 V)
- Resistencia (2 y 4 alambres hasta 1 G $\Omega$ )
- Corriente (CC y CA hasta 1 A)
- Frecuencia y período (hasta 300 kHz)
- Deformación (puente y métodos directos)

## Rechazo de voltajes de ruido de línea eléctrica

Una característica deseable de un conversor analógico a digital (A/D) integrador es su capacidad para rechazar señales espurias. Las técnicas de integración rechazan el ruido relacionado con la línea eléctrica presente con las señales de CC en la entrada. Esto se llama rechazo de modo normal o RMN. El rechazo de ruido en modo normal se logra cuando el DMM interno mide el promedio de la entrada “integrándolo” durante un período fijo. Si configura el tiempo de integración en un número entero de ciclos de línea de alimentación (PLC) de la entrada no esencial, estos errores (y sus armónicos) promediarán aproximadamente a cero.

Cuando aplica energía al DMM interno, mide la frecuencia de la línea de alimentación (50 Hz o 60 Hz) y utiliza esta medición para determinar el tiempo de integración. El siguiente gráfico muestra la atenuación de las señales de CA medida en la función de voltaje de CC para varias configuraciones de tiempo de integración A/D. Tome en cuenta que las frecuencias de señal en múltiplos de  $1/T$  muestran una atenuación alta.



## Mediciones de temperatura

Una medición de transductor de temperatura suele ser una medición de resistencia o voltaje convertida a una temperatura equivalente mediante rutinas de conversión de software dentro del instrumento. La conversión matemática se basa en las propiedades específicas de los diversos transductores. La precisión de conversión matemática (sin incluir la precisión del transductor) para cada tipo de transductor se muestra a continuación:

| Transductor | Exactitud de conversión |
|-------------|-------------------------|
| Termopar    | 0,05 °C                 |
| RTD         | 0,02 °C                 |
| Termistor   | 0,05 °C                 |

Los errores asociados con las mediciones de temperatura incluyen todos los enumerados para las mediciones de voltaje y resistencia de CC en este capítulo. La mayor fuente de error en las mediciones de temperatura es generalmente el propio transductor.

Sus requisitos de medición lo ayudarán a determinar qué tipo de transductor de temperatura debe usar. Cada tipo de transductor tiene un rango particular de temperatura, precisión y costo. La siguiente tabla resume algunas especificaciones típicas para cada tipo de transductor. Utilice esta información para que lo ayude a seleccionar el transductor para su aplicación. Los fabricantes de transductores pueden proporcionarle las especificaciones exactas para un transductor en particular.

| Parámetro                          | Termopar                                                         | RTD                                               | Termistor                                    |
|------------------------------------|------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------|
| Rango de temperatura               | -210 °C a 1820 °C                                                | -200 °C a 850 °C                                  | -80 °C a 150 °C                              |
| Tipo de medición                   | Voltaje                                                          | Ohmios de 2 y 4 alambres                          | Ohmios de 2 y 4 alambres                     |
| Sensibilidad del transductor       | 6 $\mu\text{V}/^\circ\text{C}$ a 60 $\mu\text{V}/^\circ\text{C}$ | $\approx R_0 \times 0,004 \text{ }^\circ\text{C}$ | $\approx 400 \text{ } \Omega/^\circ\text{C}$ |
| Precisión de la sonda              | 0,5 °C a 5 °C                                                    | 0,01 °C a 0,1 °C                                  | 0,1 °C a 1 °C                                |
| Costo (en dólares estadounidenses) | \$1/pie                                                          | \$20 a \$100 cada uno                             | \$10 a \$100 cada uno                        |
| Durabilidad                        | Resistente                                                       | Frágil                                            | Frágil                                       |

## Mediciones de RTD

Un RTD está construido de un metal (generalmente platino) que cambia la resistencia con un cambio en la temperatura de una manera precisamente conocida. El DMM interno mide la resistencia del RTD y luego calcula la temperatura equivalente.

Un RTD tiene la mayor estabilidad de los transductores de temperatura. La salida de un RTD también es muy lineal. Esto hace que un RTD sea una buena opción para mediciones de alta precisión y a largo plazo. El DAQ970A/DAQ973A admite RTD con  $\alpha = 0,00385$  (DIN / IEC 751) con conversiones de software ITS-90. "PT100" es una etiqueta especial que a veces se usa para referirse a un RTD con  $\alpha = 0.00385$  y  $R_0 = 100 \text{ } \Omega$

La resistencia de un RTD es nominal a 0 °C y se conoce como  $R_0$ . El DAQ970A/DAQ973A puede medir RTD con valores  $R_0$  de  $100 \text{ } \Omega \pm 1 \text{ } \%$  o  $1000 \text{ } \Omega \pm 1 \text{ } \%$ .

Puede medir los RTD utilizando un método de medición de 2 o 4 alambres. El método de cuatro alambres ofrece la manera más precisa de medir pequeñas resistencias. La resistencia del cable de conexión se elimina automáticamente mediante el método de 4 alambres.

## Mediciones de termistores

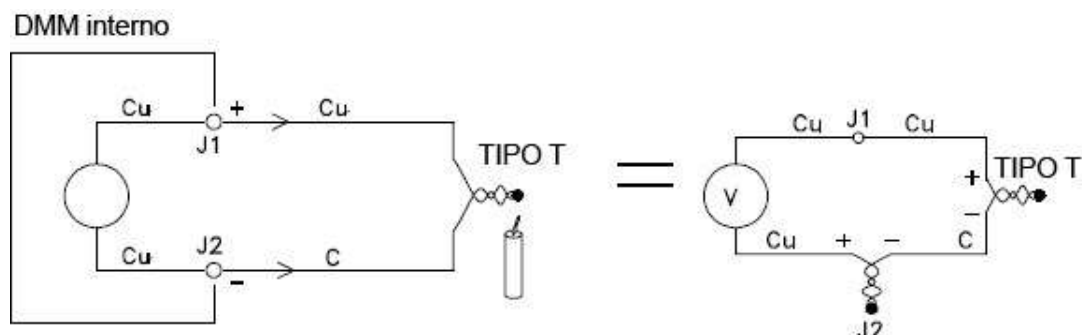
Un termistor está construido con materiales que cambian la resistencia de forma no lineal con los cambios de temperatura. El DMM interno mide la resistencia del termistor y luego calcula la temperatura equivalente.

Los termistores tienen una sensibilidad más alta que los termopares o RTD. Esto hace que un termistor sea una buena opción cuando se miden cambios muy pequeños en la temperatura. Sin embargo, los termistores son ampliamente no lineales, especialmente a altas temperaturas y funcionan mejor por debajo de 100 °C.

Debido a su alta resistencia, los termistores se pueden medir utilizando un método de medición de 2 alambres. El DMM interno admite termistores de 2,2 k $\Omega$  (44004), 5 k $\Omega$  (44007) y 10 k $\Omega$  (44006). Las rutinas de conversión del termistor utilizadas por el DAQ970A/DAQ973A son compatibles con la Escala Internacional de Temperatura de 1990 (ITS-90).

## Mediciones de termopares

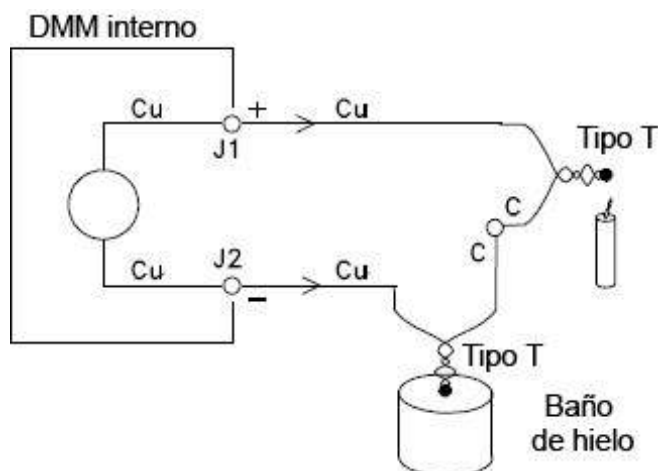
Un termopar convierte la temperatura a voltaje. Cuando se unen dos alambres compuestos de metales diferentes, se genera un voltaje. El voltaje es una función de la temperatura de unión y los tipos de metales en el cable del termopar. Dado que las características de temperatura de muchos metales diferentes son bien conocidas, se puede realizar una conversión del voltaje generado a la temperatura de la unión. Por ejemplo, una medición de voltaje de un termopar tipo T (hecho de cobre y cable de constantan) podría tener este aspecto



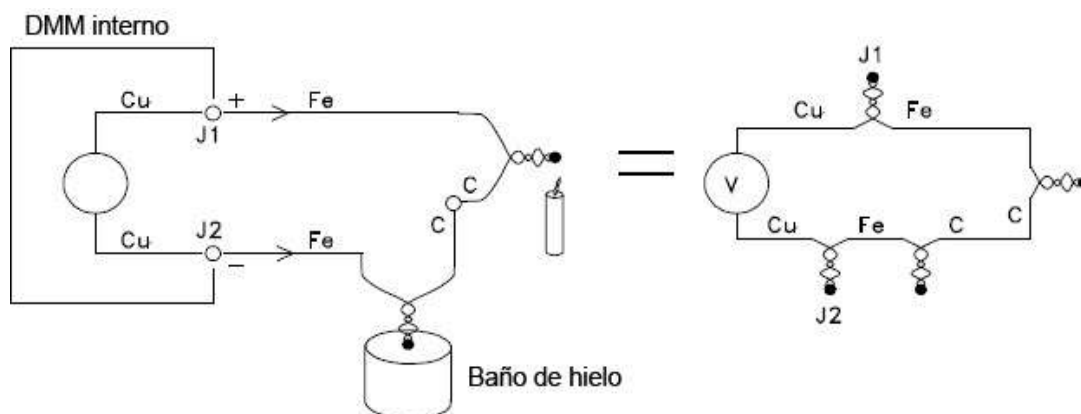
Sin embargo, tome en cuenta que las conexiones realizadas entre el cable del termopar y el DMM interno forman un segundo termopar no deseado donde el cable de constantan (C) se conecta al terminal de entrada de cobre (Cu) del DMM interno. El voltaje generado por este segundo termopar afecta la medición de voltaje del termopar tipo T.

Si se conoce la temperatura del termopar creado en J2 (el terminal de entrada LO), se puede calcular la temperatura del termopar tipo T. Una forma de hacer esto es conectar dos termopares tipo T juntos para crear solo conexiones de cobre a cobre en los terminales de entrada del DMM interno, y mantener el segundo termopar a una temperatura conocida.

Se utiliza un *baño de hielo* para crear una temperatura de referencia conocida (0 °C). Una vez que se conocen la temperatura de referencia y el tipo de termopar, se puede calcular la temperatura del termopar de medición.

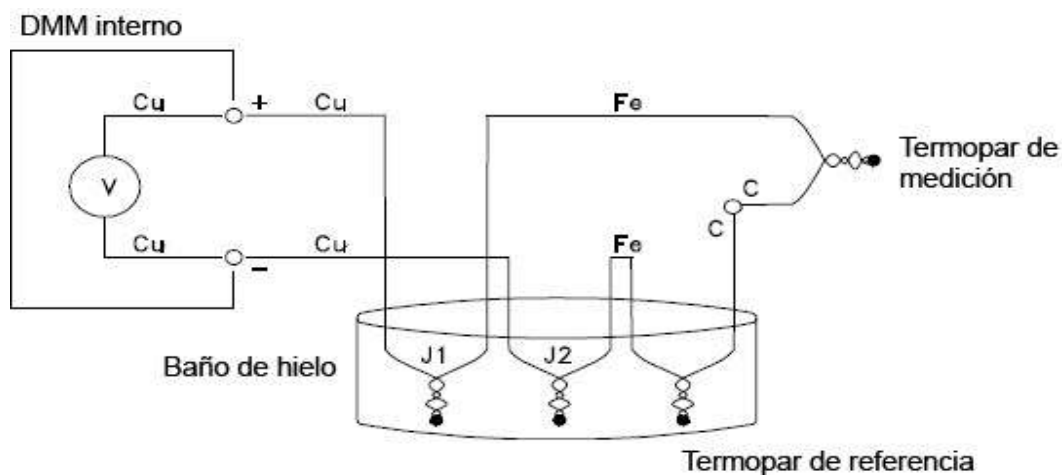


El termopar tipo T es un caso único ya que uno de los conductores (cobre) es el mismo metal que los terminales de entrada del DMM interno. Si se usa otro tipo de termopar, se crean dos termopares adicionales. Por ejemplo, eche un vistazo a las conexiones con un termopar de tipo J (hierro y constante):

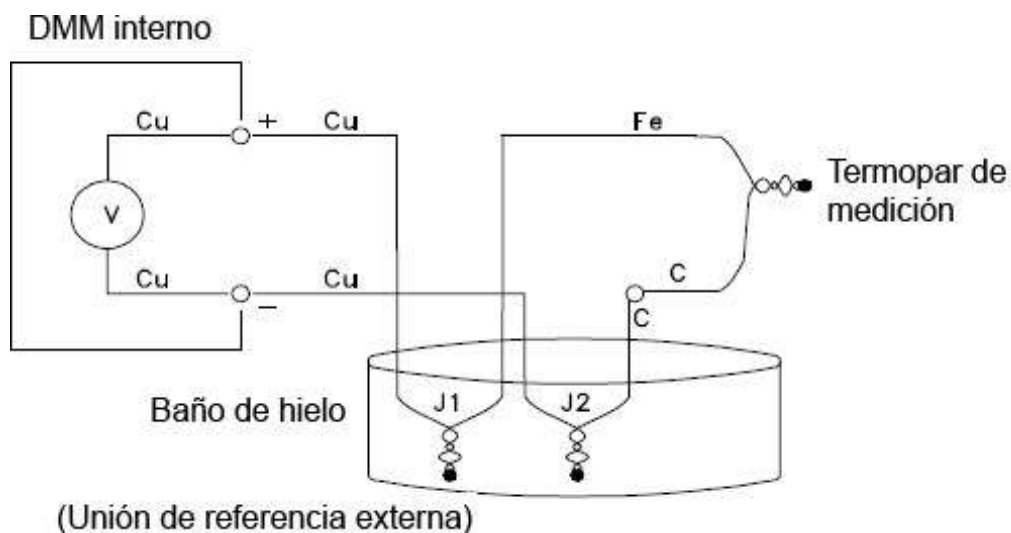


Se han creado dos termopares adicionales donde el cable de hierro (Fe) se conecta a los terminales de entrada de cobre (Cu) del DMM interno. Dado que estas dos uniones generarán voltajes opuestos, su efecto será cancelarse entre sí. Sin embargo, si los terminales de entrada no están a la misma temperatura, se creará un error en la medición.

Para realizar una medición más precisa, debe extender los cables de prueba de cobre del DMM interno más cerca de la medición y mantener las conexiones al termopar a la misma temperatura.



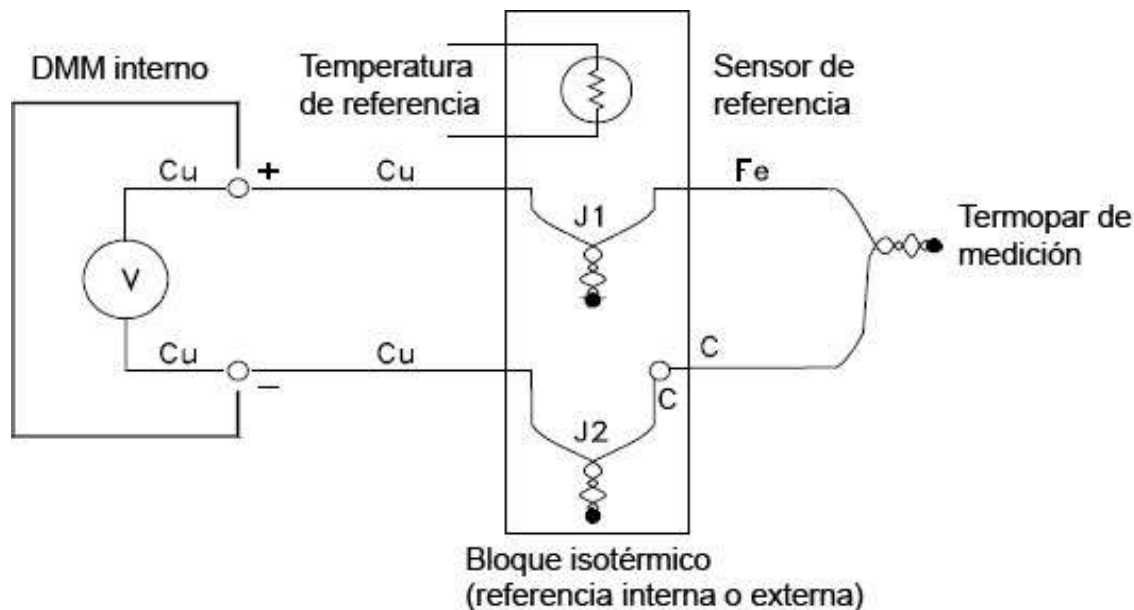
Este circuito dará mediciones precisas de la temperatura. Sin embargo, no es muy conveniente hacer dos conexiones de termopar y mantener todas las conexiones a una temperatura conocida. La Ley de Metales Intermedios elimina la necesidad de una conexión adicional. Esta ley empírica establece que un tercer metal (hierro (Fe) en este ejemplo) insertado entre dos metales diferentes no tendrá ningún efecto sobre el voltaje de salida, siempre que las uniones formadas estén a la misma temperatura. La eliminación del termopar de referencia facilita mucho las conexiones.



*Este circuito es la mejor solución para conexiones de termopares precisas.*

Sin embargo, en algunas situaciones de medición, sería bueno eliminar la necesidad de un baño de hielo (o cualquier otra referencia externa fija). Para hacer esto, se usa un bloque isotérmico para hacer las conexiones. Un bloque isotérmico es un aislante eléctrico, pero un buen conductor de calor. Los termopares adicionales creados en J1 y J2 ahora se mantienen a la misma temperatura mediante el bloque isotérmico.

Una vez que se conoce la temperatura del bloque isotérmico, se pueden realizar mediciones de temperatura precisas. Se monta un sensor de temperatura en el bloque isotérmico para medir su temperatura.



Existen diversos tipos de termopares. El tipo está especificado por una sola letra. La siguiente tabla muestra los tipos de termopares más utilizados y algunas de las características clave de cada uno.

#### NOTA

Las rutinas de conversión del termopar utilizadas por el DAQ970A/DAQ973A son compatibles con la Escala Internacional de Temperatura de 1990 (ITS-90).

## Tipos de termopar:

| Tipo T/C | Cable Post (+)     | Cable Neg (-)      | Rango de temperatura | Precisión de la sonda | Comentarios                                              |
|----------|--------------------|--------------------|----------------------|-----------------------|----------------------------------------------------------|
| B        | Platino-30 % Rodio | Platino-60 % Rodio | 250 °C - 1820 °C     | ±0.5 °C               | Alta temperatura.                                        |
| EE. UU.  | Gris               | Rojo               |                      |                       | Cuidado con la contaminación.                            |
| Inglés   | No disponible      | No disponible      |                      |                       | No insertar en tubos de metal.                           |
| DIN      | Rojo               | Gris               |                      |                       |                                                          |
| Japonés  | Rojo               | Gris               |                      |                       |                                                          |
| Francés  | No disponible      | No disponible      |                      |                       |                                                          |
| E        | Níquel-cromo       | Constantan         | -200 °C - 1000 °C    | ±1 °C - 1.7 °C        | Voltaje de salida más alto.                              |
| EE. UU.  | Púrpura            | Rojo               |                      |                       | Resolución más alta.                                     |
| Inglés   | Marrón             | Azul               |                      |                       |                                                          |
| DIN      | Rojo               | Negro              |                      |                       |                                                          |
| Japonés  | Rojo               | Blanco             |                      |                       |                                                          |
| Francés  | Amarillo           | Azul               |                      |                       |                                                          |
| J        | Hierro             | Constantan         | -210 °C - 1200 °C    | ±1,1 °C - 2,2 °C      | Para ambientes inertes y vacíos.                         |
| EE. UU.  | Blanco             | Rojo               |                      |                       | Menos caro.                                              |
| Inglés   | Amarillo           | Azul               |                      |                       | No recomendado para baja temperatura.                    |
| DIN      | Rojo               | Azul               |                      |                       |                                                          |
| Japonés  | Rojo               | Blanco             |                      |                       |                                                          |
| Francés  | Amarillo           | Negro              |                      |                       |                                                          |
| K        | Níquel-cromo       | Níquel-aluminio    | -200 °C - 1370 °C    | ±1,1 °C - 2,2 °C      | Para ambientes oxidantes.                                |
| EE. UU.  | Amarillo           | Rojo               |                      |                       | Buena linealidad por encima de 8 °C.                     |
| Inglés   | Marrón             | Azul               |                      |                       |                                                          |
| DIN      | Rojo               | Verde              |                      |                       |                                                          |
| Japonés  | Rojo               | Blanco             |                      |                       |                                                          |
| Francés  | Amarillo           | Púrpura            |                      |                       |                                                          |
| N        | Nicrosil           | Nisil              | -200 °C - 1300 °C    | ±1,1 °C - 2,2 °C      | Estabilidad superior al tipo K a temperaturas más altas. |
| EE. UU.  | Naranja            | Rojo               |                      |                       |                                                          |
| Inglés   | No disponible      | No disponible      |                      |                       |                                                          |
| DIN      | No disponible      | No disponible      |                      |                       |                                                          |
| Japonés  | No disponible      | No disponible      |                      |                       |                                                          |
| Francés  | No disponible      | No disponible      |                      |                       |                                                          |
| R        | Platino -13% Rodio | Rodio              | -50 °C - 1760 °C     | ±0,6 °C - 1,5 °C      | Temperatura más alta.                                    |
| EE. UU.  | Negro              | Rojo               |                      |                       | Cuidado con la contaminación.                            |
| Inglés   | Blanco             | Azul               |                      |                       | No insertar en tubos de metal.                           |
| DIN      | Rojo               | Blanco             |                      |                       |                                                          |
| Japonés  | Rojo               | Blanco             |                      |                       |                                                          |
| Francés  | Amarillo           | Verde              |                      |                       |                                                          |
| S        | Platino -10% Rodio | Platino            | -50 °C - 1760 °C     | ±0,6 °C - 1,5 °C      | Bajo error, buena estabilidad.                           |
| EE. UU.  | Negro              | Rojo               |                      |                       | Alta temperatura.                                        |
| Inglés   | Blanco             | Azul               |                      |                       | Cuidado con la contaminación.                            |
| DIN      | Rojo               | Blanco             |                      |                       | No insertar en tubos de metal                            |
| Japonés  | Rojo               | Blanco             |                      |                       |                                                          |
| Francés  | Amarillo           | Verde              |                      |                       |                                                          |

| Tipo T/C | Cable Post (+) | Cable Neg (-) | Rango de temperatura | Precisión de la sonda | Comentarios                       |
|----------|----------------|---------------|----------------------|-----------------------|-----------------------------------|
| T        | Cobre          | Constantan    | -200 °C - 400 °C     | ±0,5 °C - 1 °C        | Resiste la humedad.               |
| EE. UU.  | Azul           | Rojo          |                      |                       | Tiene un cable de cobre.          |
| Inglés   | Blanco         | Azul          |                      |                       |                                   |
| DIN      | Rojo           | Marrón        |                      |                       | Aplicaciones de baja temperatura. |
| Japonés  | Rojo           | Blanco        |                      |                       |                                   |
| Francés  | Amarillo       | Azul          |                      |                       |                                   |

**NOTA**

Constantán = Cobre-Níquel; Nicrosil = Níquel-Cromo-Silicio; Nisil = Níquel-Silicona-Magnesio;  
N/D= No disponible

## Fuentes de error en las mediciones de termopares

### Error de unión de referencia

Generalmente, un termopar se forma al soldar dos alambres juntos para hacer la unión. La soldadura introduce un tercer metal en la unión. Siempre que ambos lados del termopar estén a la misma temperatura, el tercer metal tiene poco efecto.

Los termopares comerciales se sueldan con una técnica de descarga capacitiva. Esta técnica se utiliza para evitar el sobrecalentamiento del cable del termopar cerca de la unión y para evitar la difusión del gas de soldadura y la atmósfera en el cable del termopar.

Una mala soldadura o una mala conexión de soldadura también pueden causar errores en la medición de un termopar. Las uniones de termopar abiertas se pueden detectar al verificar la resistencia del termopar. Una medida de resistencia de más de 5 k $\Omega$ , generalmente indica un termopar defectuoso. El DAQ970A/DAQ973A contiene una función de comprobación integrada automática de termopares. Si habilita esta función, el instrumento mide la resistencia del canal después de cada medición de termopar para asegurar una conexión adecuada.

### Error de difusión

La difusión en un cable de termopar es el proceso de cambiar el tipo de aleación a lo largo del cable. Las partículas atmosféricas pueden realmente difundirse en el metal. Estos cambios en la aleación del cable introducen pequeños cambios de voltaje en la medición. La difusión es causada por la exposición a altas temperaturas a lo largo del cable o por el estrés físico del cable, como el estiramiento o la vibración.

Los errores de temperatura debidos a la difusión son difíciles de detectar ya que el termopar todavía responderá a los cambios de temperatura y dará resultados casi correctos. Los efectos de difusión generalmente se detectan como una desviación en las mediciones de temperatura.

Es posible que reemplazar un termopar que presenta un error de difusión no corrija el problema. El cable de extensión y las conexiones están todas sujetas a difusión. Examine toda la ruta de medición para detectar signos de temperaturas extremas o estrés físico. Si es posible, mantenga el gradiente de temperatura en el cable de extensión al mínimo.

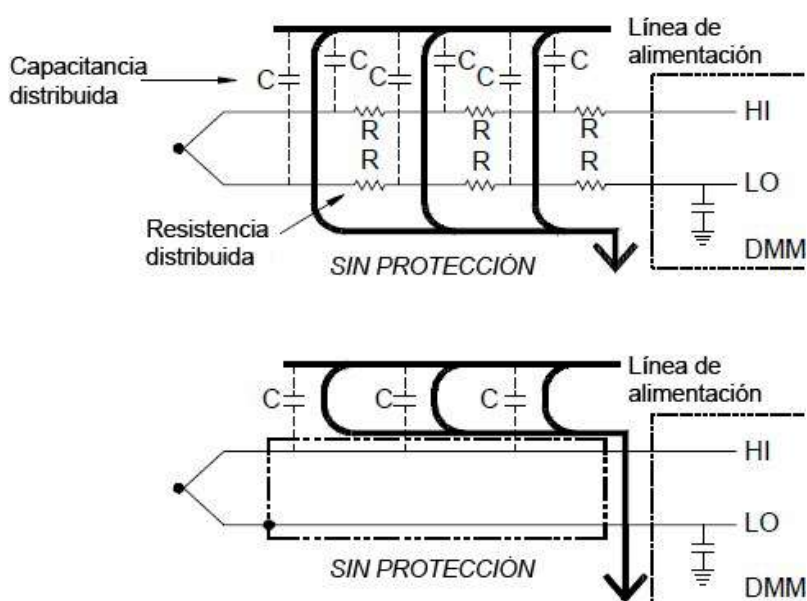


## Impedancia de derivación

El aislamiento utilizado para el cable del termopar y el cable de extensión se puede degradar a altas temperaturas o en atmósferas corrosivas. Estas fallas aparecen como una resistencia en paralelo con la unión del termopar. Esto es especialmente evidente en sistemas que utilizan un cable de calibre pequeño donde la resistencia en serie del cable es alta.

## Blindaje

El blindaje reduce el efecto del ruido de modo común en una medición de termopar. El ruido en modo común es generado por fuentes tales como líneas eléctricas y motores eléctricos. El ruido se acopla a los alambres de termopar sin blindaje a través de la capacitancia distribuida. A medida que la corriente inducida fluye a tierra a través del DMM interno, se generan errores de voltaje a lo largo de la resistencia distribuida del cable del termopar. Agregar blindaje al cable del termopar desviará el ruido del modo común a tierra y preservará la medición.



El ruido de modo común puede afectar notablemente el DMM interno. Una salida de termopar típica es de unos pocos milivoltios y esos pocos milivoltios de ruido de modo común pueden sobrecargar la entrada al DMM interno.

## Error de cálculo

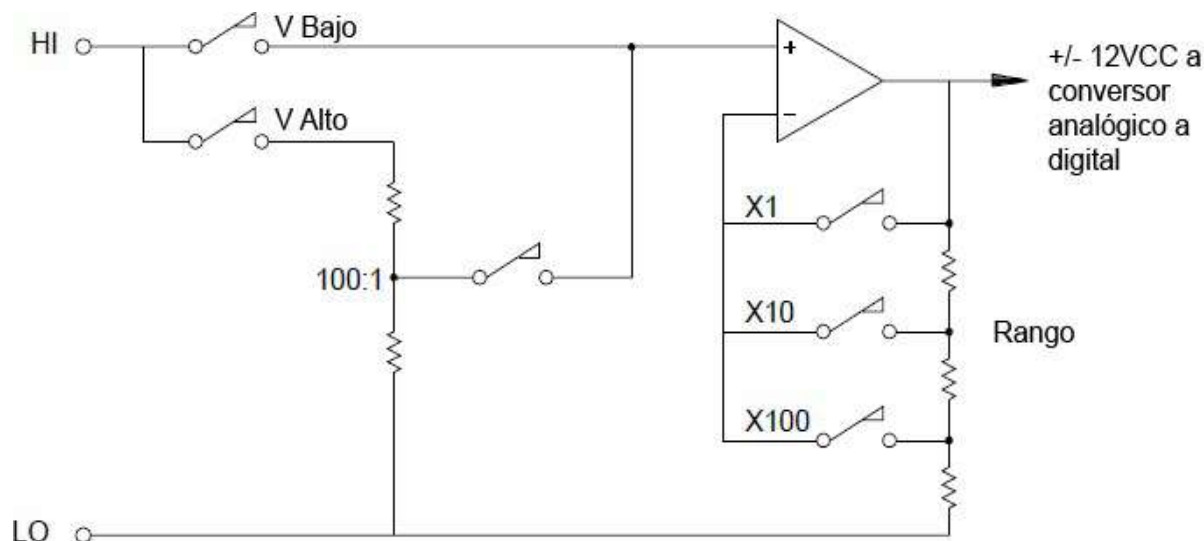
Un error es inherente a la forma en que un voltaje del termopar se convierte en temperatura. Estos errores de cálculo suelen ser muy pequeños en comparación con los errores del termopar, las conexiones de cableado y la unión de referencia.

## Mediciones de voltaje CC

Para que el multímetro de CC sea útil, se requiere un “front-end” para acondicionar la entrada antes de la conversión de analógico a digital. El acondicionamiento de la señal aumenta la resistencia de entrada, amplifica las señales pequeñas y atenúa las señales grandes para producir una selección de rangos de medición.

### Acondicionamiento de señal para mediciones de CC

El acondicionamiento de la señal de entrada para las mediciones de voltaje de CC incluye tanto la atenuación como la amplificación. A continuación, se muestra una entrada simplificada al DMM interno:



Para voltajes de entrada inferiores a 12 VCC, el interruptor Low V se cierra y aplica la señal de entrada directamente al amplificador de entrada. Para voltajes más altos, el interruptor High V se cierra y la señal se atenúa 100:1 antes de aplicarse al amplificador de entrada. La ganancia del amplificador de entrada se establece en uno de los tres valores (x1, x10 o x100) para producir una señal en el rango de  $\pm 12$  VCC para el convertor analógico a digital.

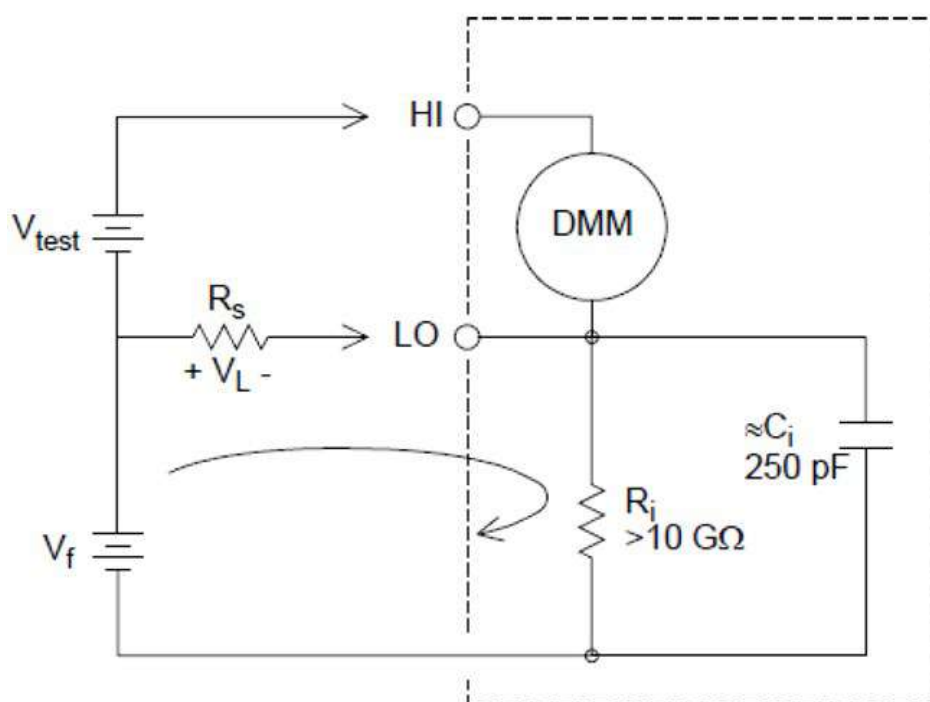
Para los rangos de voltaje más bajos, la resistencia de entrada del DMM interno es esencialmente la del amplificador de entrada. El amplificador de entrada utiliza una etapa de entrada FET de corriente de baja polarización (menos de 50 pA) que produce una resistencia de entrada superior a 10 G $\Omega$ . En los rangos de entrada de 100 V y 300 V, la resistencia de entrada está determinada por la resistencia total del divisor 100:1. También puede configurar la resistencia de entrada a 10 M $\Omega$  cerrando continuamente el interruptor High V.

## Fuentes de error en las mediciones de voltaje de CC

### Rechazo en modo común

Lo ideal sería que el DMM interno esté completamente aislado de los circuitos con referencia a tierra. Sin embargo, existe una capacitancia y resistencia finita entre el terminal de entrada LO y la conexión a tierra. Si los terminales de entrada están controlados por una señal de referencia a tierra ( $V_f$ ), entonces una corriente fluirá a través de  $R_s$  y creará una caída de voltaje  $V_L$  como se muestra a continuación:

Cualquier voltaje resultante ( $V_L$ ) aparecerá como una entrada al DMM interno. A medida que el valor de  $R_s$  se acerca a cero, también lo hace el error. Además, si  $V_f$  está en la frecuencia de la línea de alimentación (50 Hz o 60 Hz), el ruido puede reducirse considerablemente al configurar el tiempo de integración del DMM interno en 1 PLC o superior.



$$\text{Error } (V_L) = \frac{V_f \times R_s}{R_s + Z}$$

Donde:

$V_f$  = voltaje de flotación en modo común

$R_s$  = resistencia del cable LO

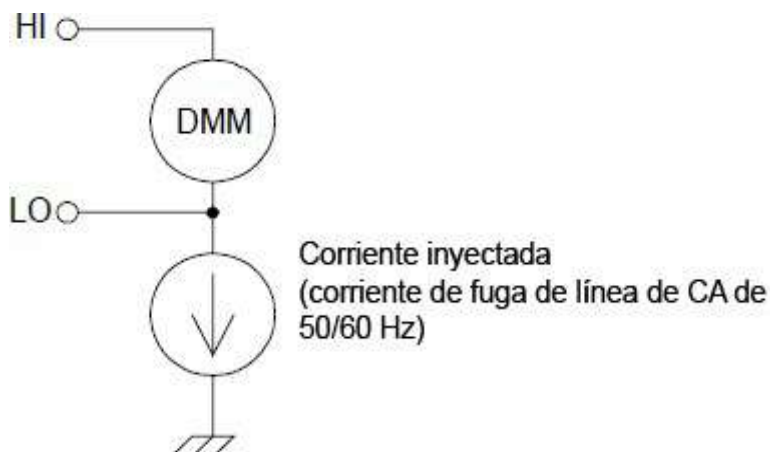
$R_i$  = resistencia de aislamiento

$C_i$  = capacitancia de aislamiento

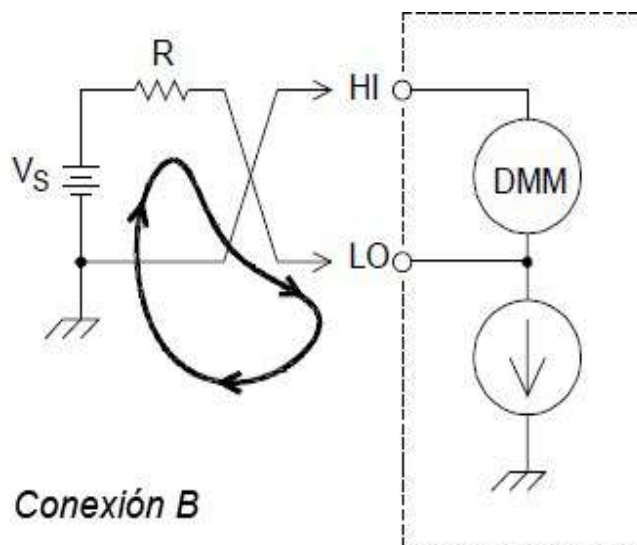
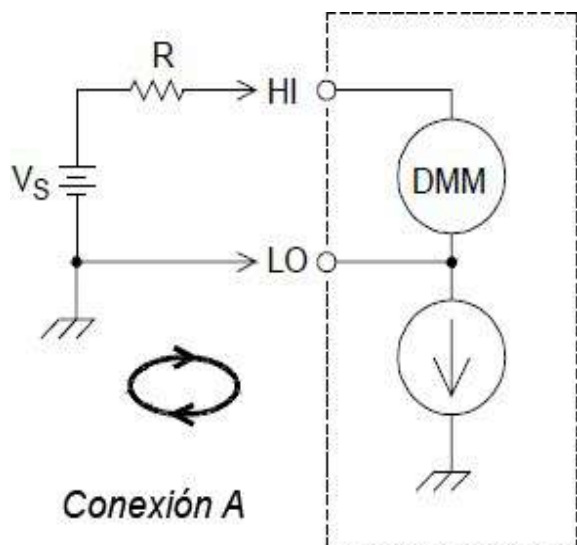
$Z_i$  = impedancia paralela de  $+R_iC_i$

### Ruido causado por la corriente inyectada

La capacitancia residual en el transformador de potencia del instrumento hace que pequeñas corrientes fluyan desde el terminal LO del DMM interno a la conexión a tierra. La frecuencia de la “corriente inyectada” es la frecuencia de la línea de alimentación o posiblemente los armónicos de la frecuencia de la línea de alimentación. La corriente inyectada depende de la configuración y la frecuencia de la línea eléctrica. A continuación, se muestra un circuito simplificado:



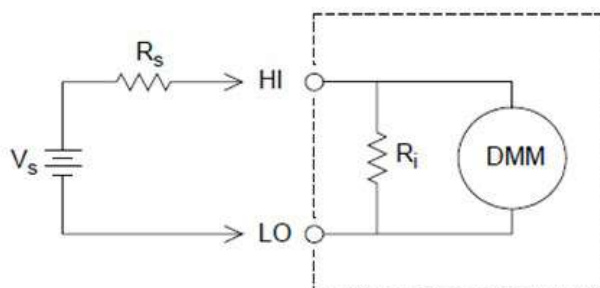
Con la Conexión A (ver más abajo), la corriente inyectada fluye desde la conexión a tierra proporcionada por el circuito al terminal LO del DMM interno. Esta configuración no añade ruido a la medición. Sin embargo, con la Conexión B, la corriente inyectada fluye a través de la resistencia  $R$ , lo que agrega ruido a la medición. Con la Conexión B, los valores mayores de  $R$  empeorarán el problema.



El ruido de medición causado por la corriente inyectada se puede reducir significativamente al configurar el tiempo de integración del DMM interno a 1 PLC o superior.

### Errores de carga debidos a la resistencia de entrada

Los errores de carga de medición ocurren cuando la resistencia del dispositivo bajo prueba (DUT) es un porcentaje apreciable de la propia resistencia de entrada del instrumento. El siguiente diagrama muestra esta fuente de error:



$$\text{Error (\%)} = \frac{-100 \times R_s}{R_s + R_i}$$

Donde:

$V_s$  = voltaje ideal del DUT

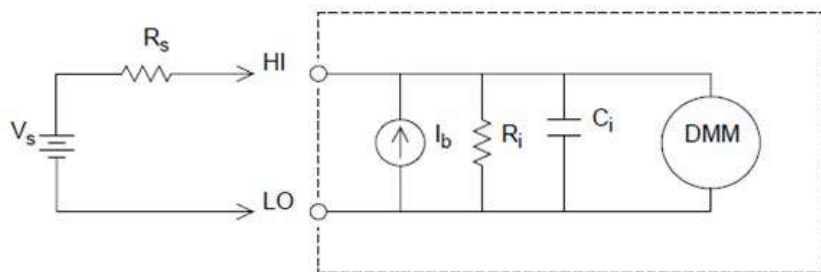
$R_s$  = resistencia de fuente del DUT

$R_i$  = Resistencia de entrada (10 M $\Omega$  o >10 G $\Omega$ )

Para minimizar los errores de carga, configure la resistencia de entrada de CC del DMM a más de 10 G $\Omega$  cuando sea necesario.

### Errores de carga debidos a la corriente de polarización de entrada

Los dispositivos semiconductores utilizados en los circuitos de entrada del DMM interno tienen corrientes de fuga leves llamadas corrientes de polarización. El efecto de la corriente de polarización de entrada es un error de carga en los terminales de entrada del DMM interno. La corriente de fuga se duplicará aproximadamente por cada 10 °C que aumente la temperatura. Esto hará que el problema sea mucho más evidente a temperaturas más altas.



$$\text{Error (V)} = I_b \times R_s$$

Donde:

$I_b$  = Corriente de polarización de DMM

$R_s$  = resistencia de fuente del DUT

$R_i$  = Resistencia de entrada ( $10\text{ M}\Omega$  o  $>10\text{ G}\Omega$ )

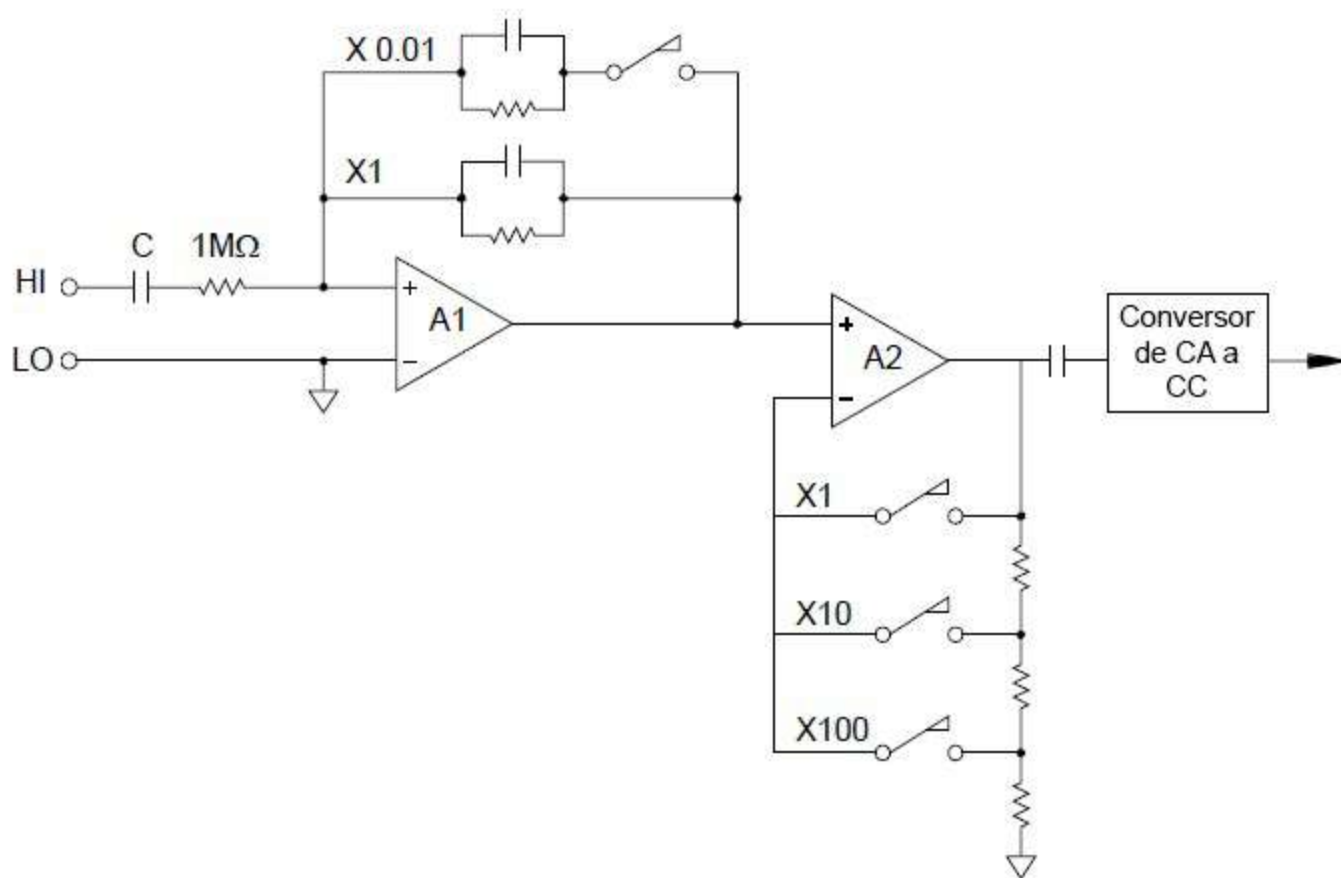
$C_i$  = capacitancia de entrada del DMM

## Mediciones de voltaje de CA

El propósito principal de un “front end” de CA es cambiar una entrada de voltaje de CA a un voltaje de CC que el AD pueda medir.

### Acondicionamiento de señal para mediciones de CA

El acondicionamiento de la señal de entrada para las mediciones de voltaje de CA incluye tanto la atenuación como la amplificación. Un capacitor de acoplamiento de entrada (C) bloquea la parte de CC de la señal de entrada de manera que solo se mide el componente de CA. El rango se logra combinando la atenuación de la señal del amplificador de la primera etapa y la ganancia del amplificador de la segunda etapa.

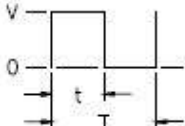


La primera etapa implementa un atenuador compensado que puede conmutarse de impedancia de entrada alta ( $1\text{ M}\Omega$ ). La segunda etapa proporciona amplificación de señal de ganancia variable para escalar la entrada al convertidor de CA al nivel de escala completa. Cualquier compensación de CC residual de las etapas de atenuador y amplificador está bloqueada por un capacitor.

También se utiliza un front end de voltaje de CA similar al descrito anteriormente para medir la corriente de CA. Las resistencias de derivación convierten la corriente de CA en un voltaje de CA que luego se puede medir. Las derivaciones de corriente se conmutan para proporcionar rangos de corriente CA seleccionables.

## Mediciones de RMS reales en CA

Los multímetros con respuesta RMS verdadera miden el potencial de “calentamiento” de un voltaje aplicado. A diferencia de una medición de “respuesta promedio”, se usa una medición RMS verdadero para determinar la potencia disipada en una resistencia. La potencia es proporcional al cuadrado del voltaje RMS verdadero medido, independientemente de la forma de onda. Un multímetro de CA de respuesta promedio se calibra para leer lo mismo que un multímetro RMS verdadero solo para entradas de onda sinusoidal. Para otras formas de forma de onda, un multímetro de respuesta promedio exhibirá errores sustanciales como se muestra a continuación:

| Forma de onda                                                                     | Factor de cresta (C.F.) | RMS CA                                                           | RMS CA+CC         | Error de respuesta promedio |
|-----------------------------------------------------------------------------------|-------------------------|------------------------------------------------------------------|-------------------|-----------------------------|
|  | 1.414                   | $\frac{V}{1.414}$                                                | $\frac{V}{1.414}$ | Calibrado para 0 error      |
|  | 1.732                   | $\frac{V}{1.732}$                                                | $\frac{V}{1.732}$ | -3.9%                       |
|  | $\sqrt{\frac{T}{t}}$    | $\frac{V}{C.F.} \times \sqrt{1 - \left(\frac{1}{C.F.}\right)^2}$ | $\frac{V}{C.F.}$  | -46% para C.F. = 4          |

Las funciones de voltaje de CA y corriente de CA del DMM interno miden el valor RMS verdadero acoplado a CA. Esto contrasta con el valor RMS verdadero de ca + cc que se muestra arriba. Solo se mide el “valor de calentamiento” del componente de CA de la forma de onda de entrada (CC se rechaza). Para las ondas sinusoidales, las ondas triangulares y las ondas cuadradas, los valores de CA y CA+CC son iguales, ya que estas formas de onda no contienen compensación de CC. Las formas de onda no simétricas, como los trenes de impulsos, contienen voltajes de CC que son rechazados por mediciones RMS verdaderas acopladas a CA.

Es preferible una medición de RMS verdadera acoplada a CA en situaciones en las que se miden señales de CA pequeñas en presencia de grandes compensaciones de CC. Por ejemplo, esta situación es común al medir ondulación de CA presente en fuentes de alimentación de CC. Sin embargo, hay situaciones en las que es posible querer conocer el valor de RMS verdadero de ca+cc. Puede determinar este valor si combina los resultados de las mediciones de CC y CA como se muestra a continuación. Debe realizar la medición de CC con al menos 10 ciclos de integración de la línea de alimentación para obtener el mejor rechazo de CA.

$$AC + DC = \sqrt{AC^2 + DC^2}$$

## Realización de mediciones de CA de alta velocidad

Las funciones de voltaje CA y corriente CA del DMM interno implementan tres filtros de baja frecuencia. Estos filtros le permiten intercambiar precisión de baja frecuencia para logra una velocidad de escaneo más rápida. El filtro rápido se estabiliza en 0,12 segundos y es útil para mediciones por encima de 200 Hz. El filtro de medio se estabiliza en 1 segundo y es útil para mediciones por encima de 20 Hz. El filtro lento se instala en 7 segundos y es útil para mediciones por encima de 3 Hz.

Con algunas precauciones, puede realizar mediciones de CA a velocidades de hasta 100 lecturas por segundo (use el rango manual para eliminar los retrasos de rango automático). Al establecer los retardos de ajuste del canal preprogramado en cero, cada filtro permitirá hasta 100 canales por segundo. Sin embargo, es posible que la medición sea muy precisa ya que el filtro no está completamente asentado. En las aplicaciones de escaneo donde los niveles de muestra a muestra varían ampliamente, el filtro de medio (20 Hz) se estabilizará a 1 lectura por segundo, y el filtro rápido (200 Hz) se estabilizará a 10 lecturas por segundo.

Si los niveles de muestra a muestra son similares, se requiere poco tiempo de estabilización para cada nueva lectura. Bajo esta condición especializada, el filtro medio (20 Hz) proporcionará resultados de precisión reducidos a 5 lecturas por segundo, y el filtro rápido (200 Hz) proporcionará resultados de precisión reducidos a 50 lecturas por segundo. Es posible que se requiera un tiempo de estabilización adicional cuando el nivel de CC varía de una muestra a otra.

El circuito de bloqueo de CC del DMM interno tiene un tiempo de estabilización constante de 0,2 segundos. Este tiempo de estabilización solo afecta a la precisión de la medición cuando los niveles de compensación de CC varían de una muestra a otra. Si se desea una velocidad de medición máxima en un sistema de escaneo, es posible que desee agregar un circuito de bloqueo de CC externo a los canales con voltajes de CC importantes. Este circuito puede ser tan simple como una resistencia y un capacitor.

| Filtro de CA    | Retardo de canal | Tiempo de estabilización |
|-----------------|------------------|--------------------------|
| 200 Hz (Rápido) | AUTO             | 0,12 segundos            |
| 20 Hz (Medio)   | AUTO             | 1 segundo                |
| 3 Hz (Lento)    | AUTO             | 7 segundos               |
| 200 Hz (Rápido) | 0                | 0,02 segundos            |
| 20 Hz (Medio)   | 0                | 0,2 segundos             |
| 3 Hz (Lento)    | 0                | 1,5 segundos             |

*Tiempo de estabilización de bloqueo de CC (1 constante de tiempo) = 0,2 segundos.*



## Fuentes de error en las mediciones de voltaje de CA

Muchos de los errores asociados con las mediciones de voltaje de CC también se aplican a las mediciones de voltaje de CA. Los errores adicionales exclusivos de las mediciones de voltaje de CA se describen en esta sección.

### Errores de factor de cresta (entradas no sinusoidales)

Un error común es que “dado que el DMM interno es RMS verdadero, sus especificaciones de precisión de onda sinusoidal se aplican a todas las formas de onda”. En realidad, la forma de la señal de entrada puede afectar notablemente la precisión de la medición. Una forma común de describir formas de ondas de señal es el factor de cresta. El factor de cresta es la relación entre el valor pico y el valor RMS de una forma de onda.

En general, cuanto mayor es el factor de cresta, mayor es la energía contenida en los armónicos de alta frecuencia. Todos los multímetros muestran errores de medición que dependen del factor de cresta. Tome en cuenta que los errores de factor de cresta no se aplican a señales de entrada por debajo de 100 Hz cuando se usa el filtro de CA lento.

Puede estimar el error de medición debido al factor de cresta de la señal como se muestra a continuación:

$$\textbf{Total Error} = \textbf{Error}_{\textit{sine}} + \textbf{Error}_{\textit{crest factor}} + \textbf{Error}_{\textit{bandwidth}}$$

Donde:

$\text{Error}_{\textit{sine}}$  = precisión de onda sinusoidal de DMM

$\text{Error}_{\textit{crest factor}}$  = factor de cresta de DMM

$$\text{Error}_{\textit{bandwidth}} = \frac{-C.F.^2 \times F}{4\pi \times BW}$$

Donde:

C.F = factor de cresta de la señal

F = frecuencia de la señal de entrada fundamentales

BW = ancho de banda -3 dB del DMM (1 MHz para el DAQ970A/DAQ973A)

### Ejemplo: Cálculo del error de medición

Calcule el error de medición aproximado para una entrada de tren de pulsos con un factor de cresta de 3 y una frecuencia fundamental de 20 kHz. El DMM interno se establece en el rango de 1 V. Para este ejemplo, use las especificaciones de precisión de 90 días de  $\pm (0,05 \% \text{ de lectura} + 0,04 \% \text{ del rango})$ .

$$\text{Error}_{\textit{sine}} = \pm(0,05 \% + 0,04 \%) = \pm 0,09 \%$$

$$\text{Error}_{\textit{crest factor}} = 0,15 \%$$

$$\text{Error}_{\textit{bandwidth}} = \frac{-3^2 \times 20000}{4\pi \times 1000000} \times 100 = 1.4\%$$

$$\text{Error total} = 0,09 \% + 0,15 \% + 1,4 \% = 1,6 \%$$

## Errores de carga de CA

En la función de voltaje de CA, la entrada del DMM interno aparece como una resistencia de 1 M $\Omega$  en paralelo con 150 pF de capacitancia. El cableado que utiliza para conectar las señales al instrumento también agregará capacidad y carga adicionales. La siguiente tabla muestra la resistencia de entrada aproximada en varias frecuencias.

| Frecuencia de entrada | Resistencia de entrada |
|-----------------------|------------------------|
| 100 Hz                | 700 k $\Omega$         |
| 1 kHz                 | 600 k $\Omega$         |
| 10 kHz                | 100 k $\Omega$         |
| 100 kHz               | 10 k $\Omega$          |

Para frecuencias bajas:

$$\text{Error}(\%) = \frac{-100 \times R_s}{R_s + M\Omega}$$

Error adicional para altas frecuencias:

$$\text{Error}(\%) = 100 \times \left[ \frac{1}{1 + (2\pi \times F \times R_s \times C_{in})^2} - 1 \right]$$

Donde:

F = frecuencia de entrada

R<sub>S</sub> = resistencia de fuente

C<sub>in</sub> = capacitancia de entrada (150 pF) + capacitancia del cable

Use un cable de baja capacitancia cuando mida señales de CA de alta frecuencia.

### Errores de medición de CA de bajo nivel

Al medir voltajes de CA inferiores a 100 mV, tome en cuenta que dichas mediciones son especialmente susceptibles a errores introducidos por fuentes de ruidos extrañas. Un cable de prueba expuesto actuará como una antena y el DMM interno medirá las señales recibidas. Toda la ruta de medición, incluida la línea de alimentación, actúa como una antena de bucle. Las corrientes circulantes en el bucle crearán voltajes de error en cualquier impedancia en serie con la entrada del instrumento. Por este motivo, debe aplicar voltajes de CA de bajo nivel al instrumento a través de cables blindados. También debe conectar el blindaje al terminal de entrada LO.

Asegúrese de minimizar el área de cualquier bucle de tierra que no pueda evitarse. Una fuente de impedancia alta es más susceptible a recibir ruido que una fuente de impedancia baja. Puede reducir la impedancia de alta frecuencia de una fuente si coloca un capacitor en paralelo con los terminales de entrada del instrumento. Es posible que tenga que experimentar para determinar el valor de capacitancia correcto para su aplicación.

El ruido más extraño no se correlaciona con la señal de entrada. Puede determinar el error como se muestra a continuación:

$$\text{Voltage Measured} = \sqrt{V_{in}^2 + \text{Noise}^2}$$

El ruido correlacionado, aunque no es común, es especialmente perjudicial. El ruido correlacionado siempre se agregará directamente a la señal de entrada. Medir una señal de nivel bajo con la misma frecuencia que la entrada de alimentación local es una situación común que puede producir este error. Debe tener cuidado al cambiar señales de alto y bajo nivel en el mismo módulo. Es posible que los voltajes cargados de alto nivel se descarguen en un canal de bajo nivel. Se recomienda utilizar dos módulos diferentes o separar las señales de alto nivel de las señales de bajo nivel con un canal no utilizado conectado a tierra.

### Mediciones por debajo de la escala completa

Puede realizar las mediciones de CA más precisas cuando el DMM interno esté a escala completa del rango seleccionado. El rango automático se produce al 10 % y 120 % de la escala completa. Esto le permite medir algunas entradas en escala completa en un rango y el 10% de la escala completa en el próximo rango más alto. Tome en cuenta que la precisión de la medición será significativamente diferente para los dos casos. Para una mayor precisión, debe usar el rango manual para seleccionar el rango más bajo posible para la medición.

### Coefficiente de temperatura y errores de sobrecarga

El DMM interno utiliza una técnica de medición de CA que mide y elimina periódicamente los voltajes de compensación internos cuando selecciona una función o rango diferente. Cuando el rango manual alcanza un nuevo rango en una condición de sobrecarga, la medición de compensación interna puede degradarse para el rango seleccionado. Generalmente, se puede introducir un 0.01 % adicional de error de rango. Este error adicional permanecerá hasta la próxima eliminación periódica (normalmente 15 minutos).

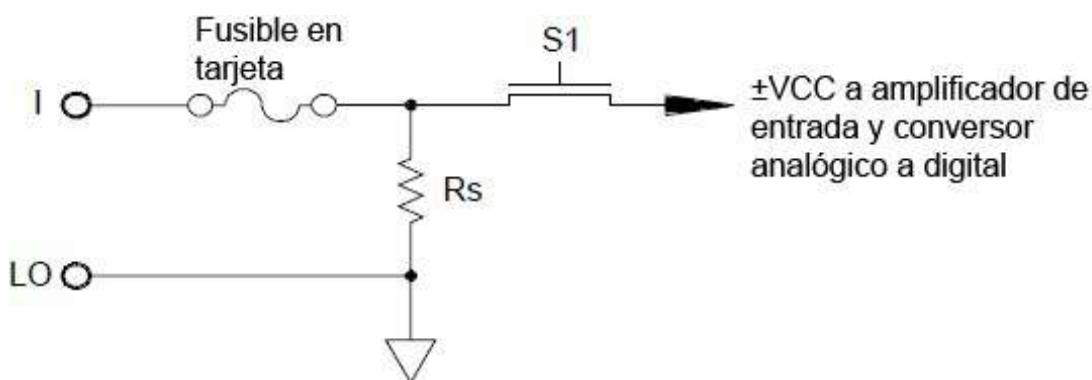
## Mediciones de corriente

**NOTA**

Solo se admite en el módulo multiplexor DAQM901A.

Un amperímetro detecta la corriente que fluye a través de sus conexiones de entrada, aproximándose a un cortocircuito entre sus terminales de entrada. Un amperímetro debe conectarse en serie con el circuito o dispositivo medido de manera que la corriente fluya a través del multímetro y el circuito de prueba.

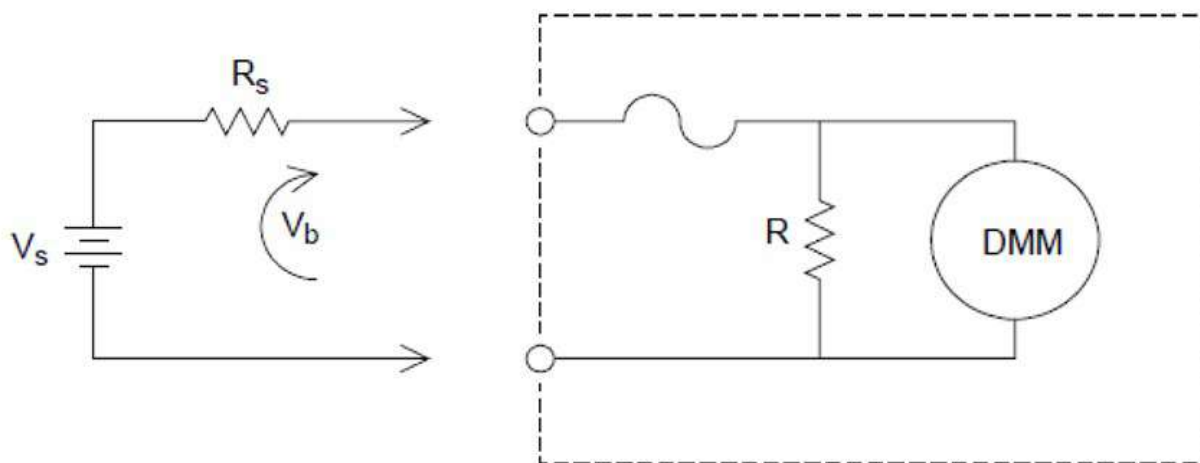
Una resistencia,  $R_s$  en el diagrama a continuación, está conectada a través de los terminales de entrada, de manera que se genera una caída de voltaje proporcional a la corriente de entrada. El valor de  $R_s$  se selecciona lo más bajo posible para minimizar el voltaje de carga del instrumento o la caída de  $IR$ . Esta caída de voltaje es detectada por el DMM interno y se escala al valor de corriente adecuado para completar la medición (consulte la discusión en la página siguiente).



Las mediciones de corriente CA son muy similares a las mediciones de corriente CC. La salida del sensor de corriente a voltaje se mide con un voltímetro de CA. Los terminales de entrada están acoplados directamente (ca+cc acoplados) a la derivación, de modo que el DMM interno mantiene la continuidad de CC en el circuito de prueba. La realización de mediciones de corriente CA requiere un cuidado adicional. El voltaje de carga (carga) varía con la frecuencia y la inductancia de entrada, causando a menudo un comportamiento inesperado en el circuito de prueba.

### Fuentes de error en las mediciones de corriente CC

Cuando conecta el DMM interno en serie con un circuito de prueba para medir la corriente, se introduce un error de medición. El error lo causa el voltaje de carga en serie del DMM. Se desarrolla un voltaje a través de la resistencia del cableado y la resistencia de la derivación de corriente del DMM interno, como se muestra a continuación:



$$\text{Error (\%)} = \frac{-100\% \times V_b}{V_s}$$

Donde:

$V_s$  = voltaje de fuente

$R_s$  = resistencia de fuente

$V_b$  = resistencia de derivación de corriente

### Fuentes de error en las mediciones de corriente CA

Los errores de voltaje de carga, que se aplican a la corriente en CC, también pueden aplicarse a las mediciones de corriente en CA. Sin embargo, el voltaje de carga para la corriente CA es mayor debido a la inductancia interna en serie del DMM y las conexiones de medición. El voltaje de carga aumenta a medida que la frecuencia de entrada aumenta. Algunos circuitos pueden oscilar cuando se realizan mediciones de corriente debido a la inductancia en serie del DMM interno y las conexiones de medición.

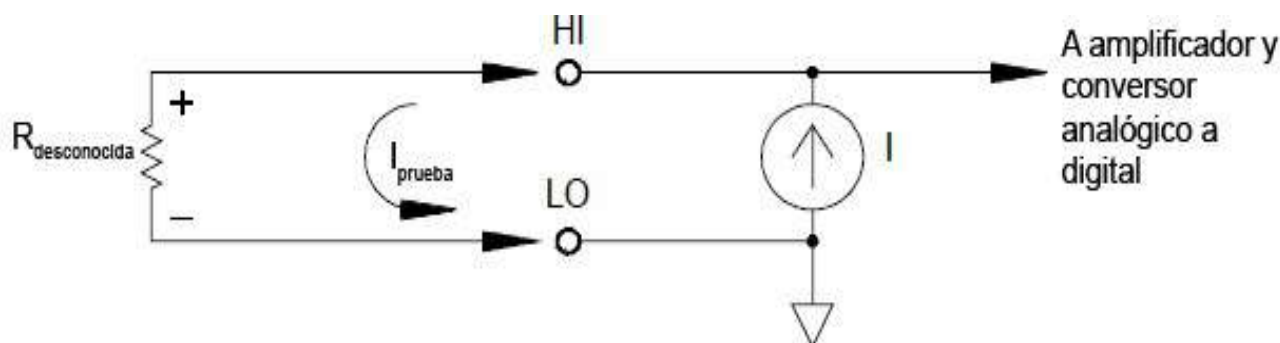
## Medición de resistencia

### NOTA

Las mediciones de resistencia de 2 alambres solo son compatibles con los módulos de multiplexor DAQM900A, DAQM901A, DAQM902A y DAQM908A.

Las mediciones de resistencia de 4 alambres solo son compatibles con los módulos de multiplexor DAQM900A, DAQM901A y DAQM902A

Un óhmetro mide la resistencia de CC de un dispositivo o circuito conectado a su entrada. Las mediciones de resistencia se realizan suministrando una corriente de CC conocida a una resistencia desconocida y midiendo la caída de voltaje de CC.



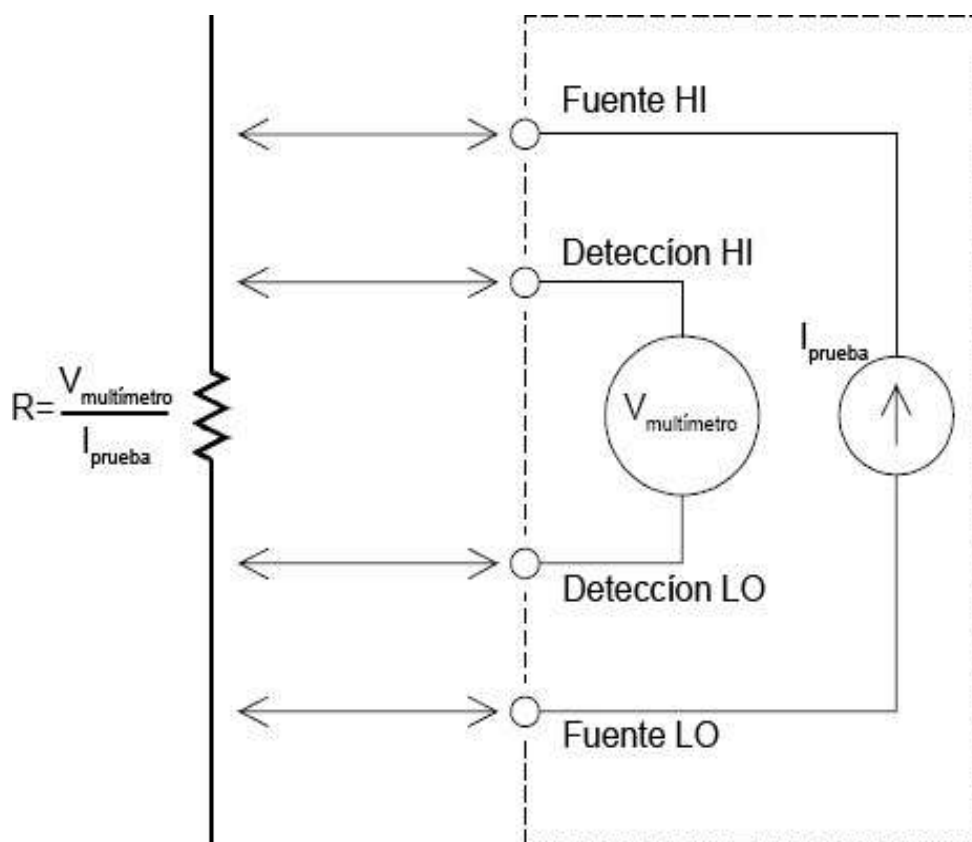
El DMM interno ofrece dos métodos para medir la resistencia: Ohmios de 2 y 4 alambres. Para ambos métodos, la corriente de prueba fluye desde el terminal de entrada HI a través de la resistencia que se está midiendo. Para los ohmios de dos alambres, el DMM detecta de manera interna la caída de voltaje en la resistencia que se está midiendo. Por lo tanto, también se mide la resistencia del cable de prueba. Para los ohmios de cuatro alambres, se requieren conexiones “de detección” separadas. Debido a que no fluye corriente en los cables de detección, la resistencia en dichos cables no ofrece un error en la medición.

### Mediciones de ohmios de cuatro alambres

El método de ohmios de cuatro alambres ofrece la manera más precisa de medir pequeñas resistencias. El cable de prueba, el multiplexor y las resistencias de contacto se reducen automáticamente con este método. El método de ohmios de 4 alambres se usa a menudo en aplicaciones de prueba automatizadas donde los cables son largos, hay conexiones de entrada y un multiplexor entre el DMM interno y el dispositivo bajo prueba.

Las conexiones recomendadas para mediciones de ohmios de 4 alambres se muestran en el diagrama de la página siguiente. Una fuente de corriente constante, que fuerza la corriente  $I$  a través de una resistencia desconocida  $R$ , desarrolla un voltaje medido por un front-end de voltaje CC. La resistencia desconocida se calcula utilizando la Ley de Ohmios.

El método de ohmios de 4 alambres se usa en sistemas donde las resistencias de los cables pueden ser bastante grandes y variables, y en aplicaciones de prueba automatizadas donde los cables pueden ser bastante largos. El método de ohmios de 4 alambres tiene la desventaja obvia de que requiere el doble de interruptores y el doble de alambres que el método de 2 alambres. El método de ohmios de 4 alambres se usa casi exclusivamente para medir valores de resistencia más bajos en cualquier aplicación, especialmente para valores menores a  $10\ \Omega$  y para requisitos de alta precisión, como transductores de temperatura RTD.



## Compensación

La mayoría de las conexiones en un sistema utilizan materiales que producen pequeños voltajes de CC debido a un contacto metal a metal diferente (efecto termopar) o baterías electroquímicas. Estos voltajes de CC también agregan errores a las mediciones de resistencia. La medición de compensación está diseñada para permitir mediciones de resistencia en presencia de pequeños voltajes de CC.

La compensación realiza dos mediciones en el circuito conectado al canal de entrada. La primera es una medición de resistencia convencional. La segunda es igual, excepto que la fuente de corriente de prueba del DMM interno está apagada (esencialmente una medición de voltaje de CC normal). La segunda medición se resta de la primera antes de escalar el resultado. Así se obtiene una medición de resistencia más precisa.

La compensación se puede utilizar para mediciones de ohmios de 2 o 4 alambres (pero no para mediciones de RTD o termistor). El DAQ970A/DAQ973A desactiva la compensación cuando se cambia la función de medición o después de un restablecimiento de fábrica (comando \*RST). Un ajuste preestablecido de instrumento (SYSTEM:PRESet ) o reinicio de tarjeta (comando SYSTEM:CPON) no cambia la configuración.

Si la resistencia que se está midiendo no responde rápidamente a los cambios en la corriente, la compensación no producirá una medición precisa. Dentro de esta categoría podemos encontrar a las resistencias con inductancias o con capacitancia paralela muy grandes. En estos casos, el parámetro de retardo del canal se puede aumentar para permitir un mayor tiempo de establecimiento después de que la fuente de corriente se encienda o apague, o se puede desactivar la compensación.

## Fuentes de error en las mediciones de resistencia

### Voltajes externos

Cualquier voltaje presente en el cableado o las conexiones del sistema afectará una medición de resistencia. Los efectos de algunos de estos voltajes se pueden superar utilizando la compensación (como se describe en la sección anterior).

### Efectos del tiempo de estabilización

El DMM interno tiene la capacidad de insertar retardos de estabilización de medición automáticos. Estos retrasos son adecuados para las mediciones de resistencia con menos de 200 pF de capacitancia combinada del dispositivo y el cable. Esto es particularmente importante si está midiendo resistencias por encima de 100 k $\Omega$ . La estabilización debido a los efectos de la constante de tiempo RC puede tardar bastante. Algunas resistencias de precisión y calibradores multifunción utilizan grandes capacitancias paralelas (1000 pF a 0,1  $\mu$ F) con valores resistencia alto para filtrar las corrientes de ruido inyectadas por sus circuitos internos. Las capacitancias no ideales debido a los efectos de absorción dieléctrica en cables y otros dispositivos pueden tener tiempos de estabilización mucho más largos de lo esperado solo por las constantes de tiempo RC. Los errores se medirán luego de la estabilización después de la conexión inicial, después de un cambio de rango o al usar la compensación. Es posible que deba aumentar el tiempo de retardo del canal antes de realizar una medición en estas situaciones.

### Errores de medición de resistencia alta

Cuando mide grandes resistencias, es posible que ocurran errores importantes debido a la resistencia de aislación y la limpieza de la superficie. Debe tomar las medidas necesarias para mantener “limpio” el sistema de alta resistencia. Los cables y aparatos de prueba son susceptibles a la fuga de energía debido a la absorción de humedad en los materiales aislantes y la película de “suciedad” en la superficie. El nailon y el PVC son aislantes de baja calidad ( $10^9$  ohmios) si se los compara con aislantes de PTFE ( $10^{13}$  ohmios). Las fugas de los aislantes de nailon o PVC fácilmente pueden agregar un error del 0,1 % cuando se mide una resistencia de 1 M $\Omega$  en condiciones de humedad. La siguiente tabla muestra varios materiales aislantes comunes y sus resistencias típicas.

| Material aislante            | Rango de resistencia          | Absorción de humedad |
|------------------------------|-------------------------------|----------------------|
| PTFE                         | 1 T $\Omega$ a 1 P $\Omega$   | No                   |
| Nailon                       | 1 G $\Omega$ a 10 T $\Omega$  | Sí                   |
| PVC                          | 10 G $\Omega$ a 10 T $\Omega$ | Sí                   |
| Poliestireno                 | 100 G $\Omega$ a 1 P $\Omega$ | No                   |
| Cerámica                     | 1 G $\Omega$ a 1 P $\Omega$   | No                   |
| Epoxi de vidrio (FR-4, G-10) | 1 G $\Omega$ a 10 T $\Omega$  | Sí                   |
| Fenolico, papel              | 10 M $\Omega$ a 10 G $\Omega$ | Sí                   |



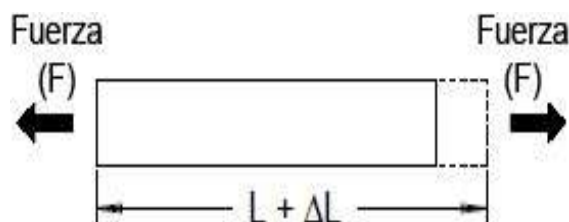
## Mediciones de galgas extensométricas

Puede medir galgas extensométricas utilizando una medición de resistencia de 4 alambres con escalado.

Cuando se aplica una fuerza a un cuerpo, el cuerpo se deforma. La deformación por unidad de longitud se llama deformación ( $\epsilon$ ). La deformación puede ser de tracción (+) o de compresión (-). Los valores de deformación práctica suelen ser bastante pequeños (por lo general, menos de 0,005 pulgada/pulgada para la mayoría de los metales) y, a menudo, se expresan en microdeformación ( $\mu\epsilon$ ). Hay tres tipos comunes de mediciones de deformación como se muestra a continuación:

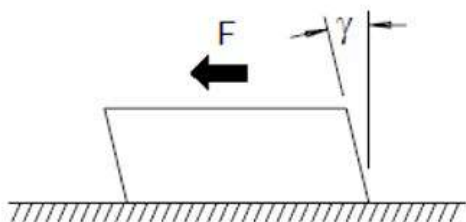
### 1. Deformación normal ( $\epsilon$ )

Es una medición de la deformación a lo largo del eje de la fuerza aplicada, donde  $\epsilon = \Delta L / L$



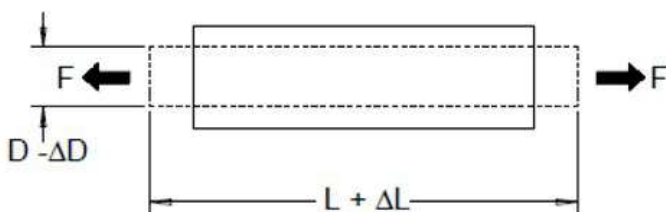
### 2. Deformación por cizallamiento ( $\gamma$ )

Es una medición de la distorsión angular de un cuerpo. Es aproximado por la tangente del ángulo que se forma por el cambio angular entre dos segmentos de línea que se realizaron paralelamente en el estado sin deformar.



### 3. Deformación de Poisson ( $\nu$ )

Mide una propiedad de materiales conocidos como la proporción de Poisson. Es la relación negativa de deformación normal transversal y longitudinal cuando un cuerpo tiene una fuerza de tracción longitudinal aplicada, donde  $\nu = -\epsilon_t / \epsilon$ , donde  $\epsilon_t = \Delta D / D$  y  $\epsilon = \Delta L / L$



## Estrés

El estrés es un término utilizado para comparar la carga aplicada a un material con su capacidad para transportar la carga. El estrés ( $\sigma$ ) en un material no se puede medir directamente, debe calcularse a partir de las propiedades del material y las cantidades medibles, como la deformación y la fuerza.

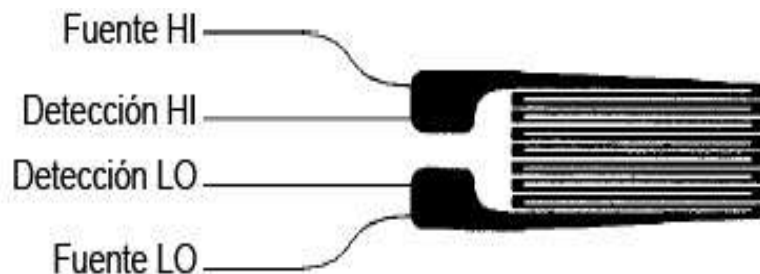
## Sensores de deformación

La galga extensométrica de resistencia de lámina metálica es el sensor de medición de deformación más utilizado. Consiste en una rejilla de lámina metálica delgada unida a un aislante adhesivo fino. La resistencia de la lámina varía linealmente con la deformación. La deformación en el cuerpo de prueba es simplemente la relación entre la resistencia de la lámina y la resistencia sin deformar:  $\epsilon = \Delta R / R$ .

## Factor de galga (GF)

El Factor de galga (GF) indica la sensibilidad de la galga extensométrica y es una medición del cambio de resistencia fraccional por deformación:  $GF = (\Delta R / R) / \epsilon$ . Los dispositivos con un factor de galga más alto mostrarán un mayor cambio de resistencia por deformación aplicada.

Las galgas extensiométricas están disponibles en varios números y configuraciones de elementos. El elemento más común es la forma única de la galga que se muestra a continuación. Las galgas extensométricas con varios elementos, también llamados rosetas, se usan para medir los componentes de la deformación en diferentes direcciones. Las configuraciones de dos elementos (90°) y tres elementos (45° o 60°) son las más comunes.



## Usos comunes de las galgas extensiométricas

Las galgas extensométricas se utilizan para detectar muchos tipos de parámetros físicos. Las galgas extensométricas son principalmente un dispositivo de detección de fuerza. La fuerza se mide indirectamente midiendo la deformación de un cuerpo de prueba con una fuerza aplicada conocida, lo que produce un cambio de resistencia proporcional a la fuerza aplicada. Se pueden medir muchas otras cantidades físicas a través de mediciones de fuerza. Las aplicaciones comunes de las galgas extensométricas incluyen mediciones de peso, presión, flujo y nivel.

## Realización de mediciones con galgas extensométricas

Un puente de Wheatstone se usa comúnmente para habilitar instrumentos con capacidades de medición de baja sensibilidad para medir pequeños cambios de resistencia comunes en las mediciones de deformación. Los instrumentos con capacidades de medición de resistencia de alta resolución, como el DMD interno del DAQ970A/DAQ973A, pueden medir directamente pequeños cambios de resistencia con gran precisión y linealidad. También debe usar el método de resistencia de 4 alambres para medir galgas extensométricas para eliminar los errores de cableado del sistema.

Se utiliza una medición de resistencia de la galga inicial, sin restricciones, como la medida de referencia ( $R_0$ ) a partir de la cual se mide la deformación ( $\Delta R / R_0$ ). Para obtener los mejores resultados, debe realizar esta medición de referencia después de que la galga extensométrica se haya montado en el cuerpo de prueba. La siguiente tabla muestra los cambios de resistencia correspondientes a la deformación  $1 \mu\epsilon$  para el factor de galga común y los valores de resistencia de la galga sin restricciones.

| Deformación     | GF  | $R_0$         | $\Delta R$             | Sensibilidad de DMM                         |
|-----------------|-----|---------------|------------------------|---------------------------------------------|
| $1 \mu\epsilon$ | 2,0 | $120 \Omega$  | $0,24 \text{ m}\Omega$ | $0,1 \text{ m}\Omega$ ( $0,4 \mu\epsilon$ ) |
| $1 \mu\epsilon$ | 2,0 | $350 \Omega$  | $0,70 \text{ m}\Omega$ | $1,0 \text{ m}\Omega$ ( $1,4 \mu\epsilon$ ) |
| $1 \mu\epsilon$ | 2,0 | $1000 \Omega$ | $2,0 \text{ m}\Omega$  | $1,0 \text{ m}\Omega$ ( $0,5 \mu\epsilon$ ) |

El uso de la función de escala de medición ( $mX+b$ ) con las ecuaciones que se muestran a continuación le permitirá mostrar los resultados directamente en deformación en la pantalla del panel frontal del DAQ970A/DAQ973A. Puede usar una unidad de medida personalizada para mostrar las lecturas en " $\mu\epsilon$ " (microdeformación) directamente. El instrumento agregará automáticamente el prefijo micro (" $\mu$ ") basado en los valores calculados reales.

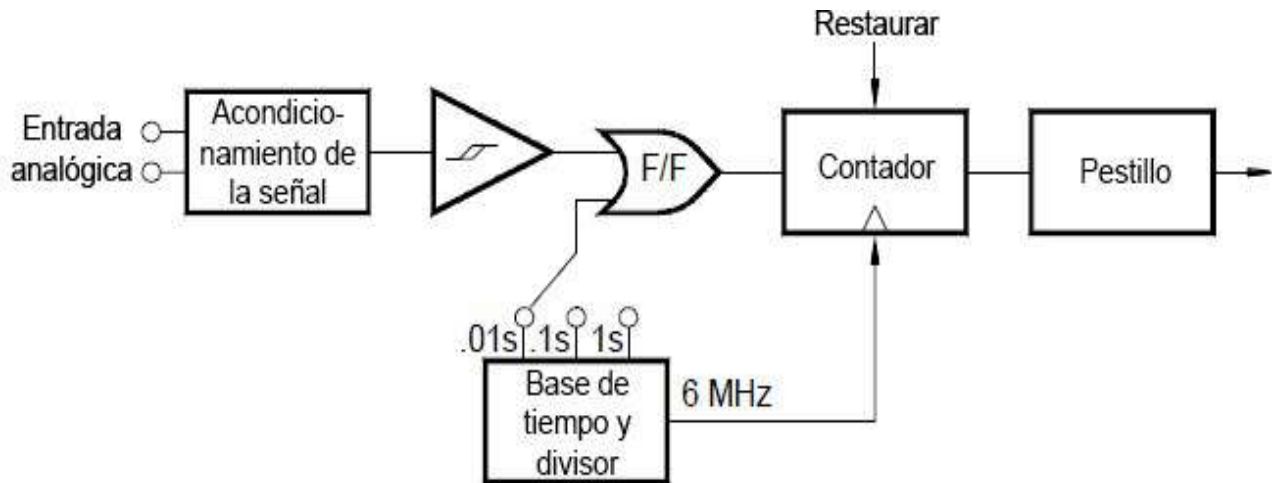
$$m = \frac{1}{GF \times R_0} \quad b = -\frac{1}{GF}$$

## Efectos de temperatura

El elemento resistivo de una galga extensométrica producirá un cambio de resistencia  $\Delta R$  debido a la deformación medida, así como a los cambios en la temperatura de la galga. Esto creará un cambio de deformación "aparente" que es indeseable. Se puede usar una segunda galga, de tipo similar, para detectar cambios de temperatura y así eliminar esta fuente de error. Debe montar la segunda galga cerca y a  $90^\circ$  de la primera. Así puede responder a los cambios de temperatura locales pero rechazar los cambios de deformación. Si resta las mediciones de la segunda galga eliminará cualquier error de deformación no deseado.

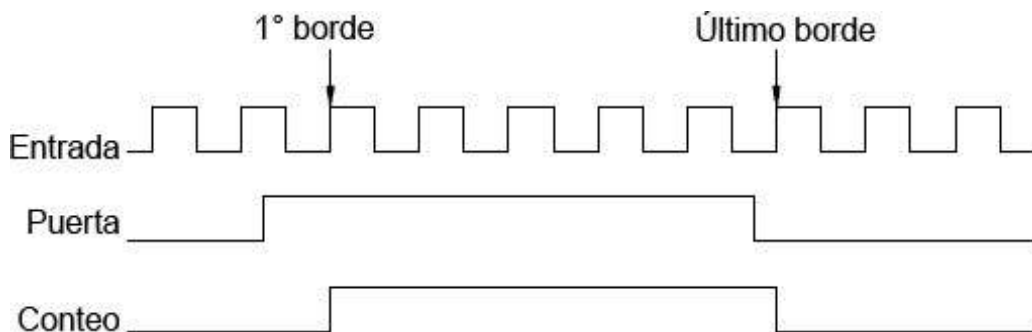
## Mediciones de frecuencia y período

El DMM interno utiliza una técnica de conteo recíproco para medir la frecuencia y el período. Este método genera una resolución de medición constante para cualquier señal de entrada. La sección de medición de voltaje de CA del DMM interno realiza el acondicionamiento de la señal de entrada para las mediciones de frecuencia y período.



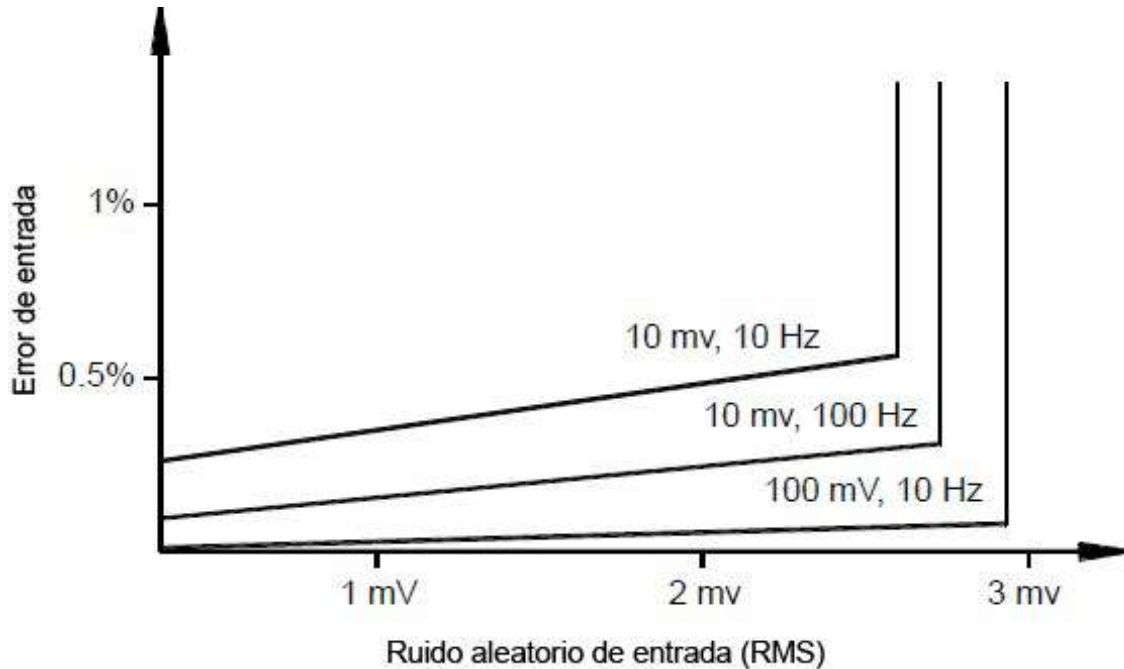
La base de tiempo se divide para proporcionar una señal de puerta. La señal de puerta y la señal de entrada se combinan para habilitar el contador. Durante el tiempo de “encendido”, el contador cuenta la señal de base de tiempo de 6 MHz. Al final de cada período de puerta, el conteo total se bloquea y el resultado se divide por la frecuencia de base de tiempo conocida para determinar la frecuencia de entrada. El contador se restablece antes del siguiente período de puerta. La resolución de la medición está vinculada a la base de tiempo, y no a la frecuencia de entrada. Esto aumenta la velocidad de medición especialmente a bajas frecuencias.

El contador recíproco tiene la ventaja de un número constante de dígitos de la pantalla, independientemente de la frecuencia de entrada. Con un contador recíproco, el número de dígitos de resolución se escala con el tiempo de puerta. Si es una puerta de 1 segundo serán seis dígitos de resolución, con una puerta de 0.1 segundos serán cinco dígitos, y así sucesivamente.



## Fuentes de error en las mediciones de frecuencia y periodo

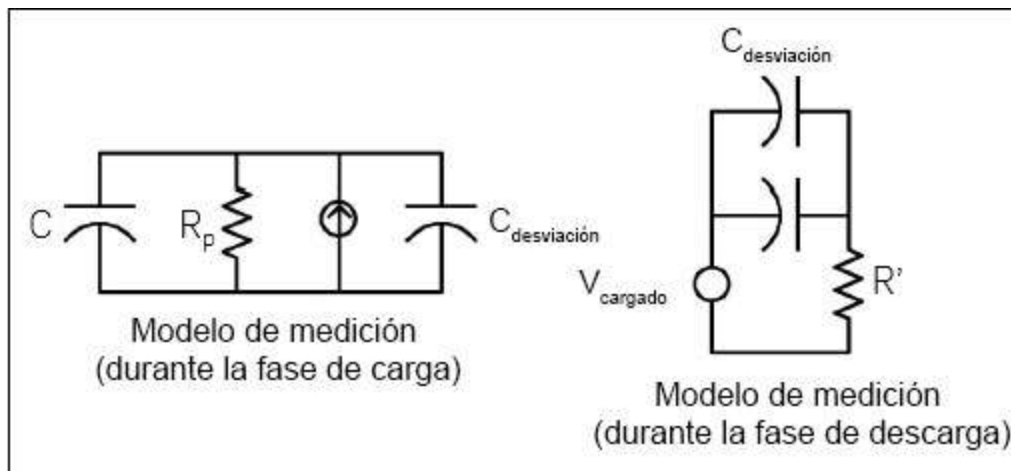
La sección de medición de voltaje de CA del DMM interno realiza el acondicionamiento de la señal de entrada. Todos los contadores de frecuencia son propensos a error al medir las señales de frecuencia y voltaje bajos. Los efectos, tanto de la entrada de ruido interno como externo, son crítico al medir señales “lentas”. El error es inversamente proporcional a la frecuencia. También se producirán errores de medición si intenta medir la frecuencia (o período) de una entrada después de un cambio de voltaje de compensación de CC. Debe permitir que el capacitor de bloqueo de CC de entrada del DMM se estabilice completamente antes de realizar mediciones de frecuencia.



Si la captación de ruido externo es lo suficientemente grande como para exceder la histéresis de los circuitos de medición, la función de frecuencia puede tornarse inutilizable. El blindaje externo y el filtrado de paso bajo pueden ayudar.

## Mediciones de capacitancia

El DAQ970A/DAQ973A realiza mediciones de capacitancia aplicando una corriente conocida para cargar la capacitancia y luego una resistencia para descargar como se muestra a continuación:



La capacitancia se calcula al medir el cambio en el voltaje (DV) que se produce en un tiempo de “apertura corta”, (Dt). Esta medición se repite en dos momentos diferentes durante el aumento exponencial que se produce. Un algoritmo toma los datos de estos cuatro puntos, y al linealizar ese aumento exponencial sobre estas “aperturas cortas”, calcula con precisión el valor de la capacitancia.

El ciclo de medición consta de dos partes: una fase de carga (que se muestra en el gráfico) y una fase de descarga. La constante de tiempo durante la fase de descarga es más larga, debido a una resistencia protectora de  $100\text{ k}\Omega$  en la ruta de medición. Esta constante de tiempo juega un papel importante en la velocidad de lectura resultante (tiempo de medición). Los tiempos incrementales (o “tiempos de muestra”), así como el ancho de las “aperturas cortas”, varían según el rango, para minimizar el ruido y aumentar la precisión de lectura. Para mayor precisión, realice una medición nula a cero con sondas abiertas, para anular la capacitancia del cable de prueba, antes de conectar las sondas a través del capacitor a medir.

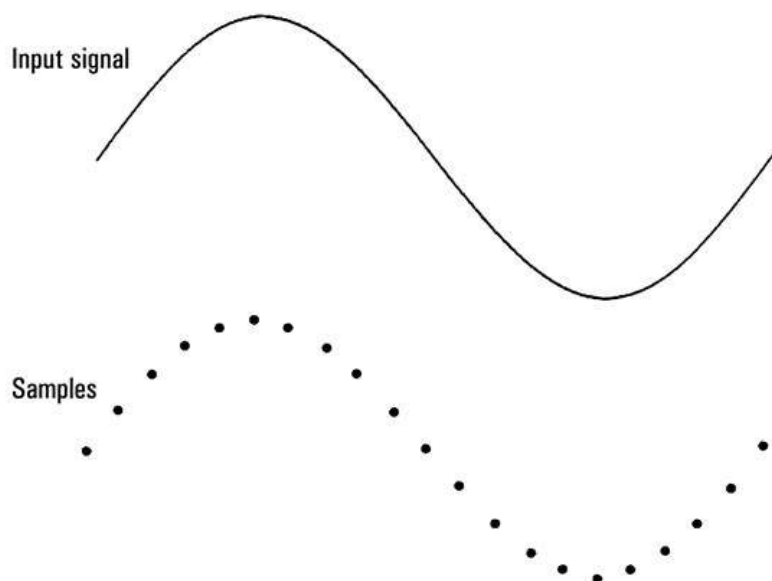
## Consideraciones de la medición de capacitancia

Los capacitores que tienen un alto factor de disipación u otras características no ideales afectarán las mediciones de capacitancia. Los capacitores con altos factores de disipación pueden mostrar una variación entre el valor medido usando el multímetro en comparación con el método de frecuencia única de algunos otros multímetros LCR. El método de una sola frecuencia también verá más variaciones en diferentes frecuencias. Por ejemplo, algunas cajas de sustitución de capacitancia económicas, cuando se miden con el multímetro, son casi un 5 % diferentes en comparación con la misma capacitancia medida con el método de frecuencia única de un multímetro LCR. El multímetro LCR también mostrará diferentes valores en diferentes frecuencias.

Los capacitores con constantes de tiempo prolongado (absorción dieléctrica) darán como resultado un tiempo de estabilización de medición lento, y tardarán varios segundos en estabilizarse. Puede ver esto cuando se conecta por primera vez un capacitor o cuando varía el tiempo de retardo para hacer una medición. Un capacitor de película de alta calidad generalmente casi no lo muestra, pero un condensador electrolítico sí, generalmente con los condensadores de cerámica en medio.

## Digitalizar las mediciones

El modo de digitalización está disponible en DAQ970A/DAQ973A con el modo de adquisición de datos **DMM Digitize**. La digitalización es el proceso de convertir una señal analógica continua, como una onda sinoidal, en una serie de muestras discretas (lecturas). La siguiente figura muestra el resultado de digitalizar una onda sinoidal. Este capítulo analiza las diversas formas de digitalizar las señales. La importancia de la frecuencia de muestreo y cómo usar el disparo de nivel.

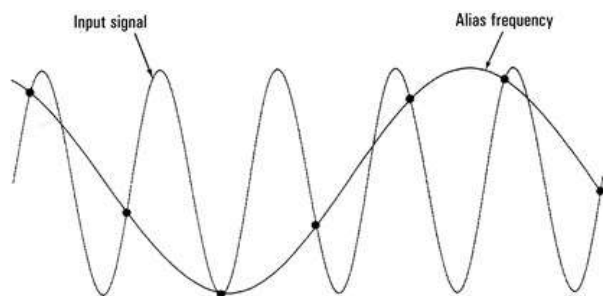


### Frecuencia de muestreo

El Teorema de Nyquist o de muestreo establece que: si una señal continua con ancho de banda limitado no contiene componentes de frecuencia superiores a  $F$ , la señal original se puede recuperar sin distorsión (aliasing) si se muestrea a una frecuencia superior a  $2F$  muestras por segundo.

En la práctica, la frecuencia de muestreo del multímetro debe ser superior al doble del componente de frecuencia más alto de la señal que se está midiendo. Desde el panel frontal, puede seleccionar una frecuencia de muestreo en muestras por segundo, o seleccionar un intervalo de muestra (tiempo entre muestras) al presionar la tecla de función **Sample**.

La siguiente figura ilustra el muestreo de una onda sinoidal a una frecuencia ligeramente inferior a  $2F$ . Como muestra la línea de puntos, el resultado es una frecuencia de alias muy diferente de la frecuencia de la señal que se está midiendo. Algunos digitalizadores tienen incorporado un filtro de paso bajo anti-aliasing con un corte profundo en una frecuencia equivalente a la mitad de la frecuencia de muestreo del digitalizador. Esto limita el ancho de banda de la señal de entrada, de forma que no pueda ocurrir el aliasing. Debido a que el multímetro tiene una frecuencia de muestreo variable para la digitalización de DCV y, con el fin de preservar el ancho de banda superior para las mediciones de alta frecuencia, no se brinda un filtro anti-aliasing en el multímetro. Si le preocupa el aliasing, debe agregar un filtro anti-aliasing externo.



Algunos digitalizadores tienen incorporado un filtro de paso bajo anti-aliasing con un corte profundo en una frecuencia equivalente a la mitad de la frecuencia de muestreo del digitalizador. Esto limita el ancho de banda de la señal de entrada, de forma que no pueda ocurrir el aliasing. Debido a que el multímetro tiene una frecuencia de muestreo variable para la digitalización de DCV y, con el fin de preservar el ancho de banda superior para las mediciones de alta frecuencia, no se brinda un filtro anti-aliasing en el multímetro. Si le preocupa el aliasing, debe agregar un filtro anti-aliasing externo.

## Disparo de nivel

Al digitalizar, es importante empezar a muestrear en un punto definido de la señal de entrada, por ejemplo, cuando la señal cruza los cero voltios o cuando alcanza el punto medio de su amplitud pico positiva o negativa. El disparo de nivel le permite especificar cuándo (con respecto al voltaje y la pendiente) empezar a muestrear. Consulte [Disparo de nivel](#) para obtener más información.

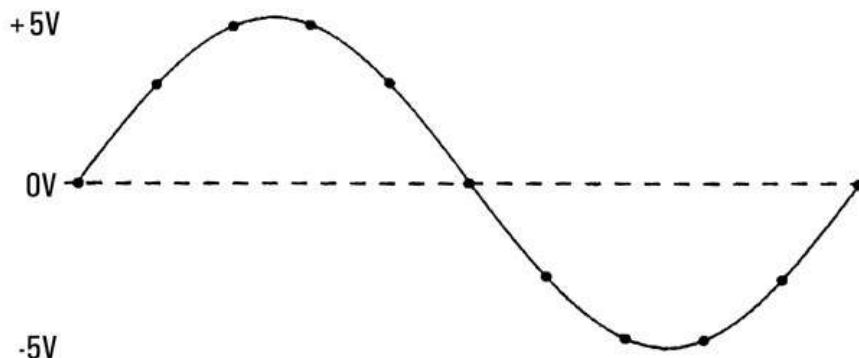
## Acerca del modo DMM Digitize

- El modo DMM Digitize está disponible para DAQ970A/DAQ973A.
- DMM Digitize le permite tomar muestras de la señal de entrada, a una **Frecuencia de muestreo (Sample Rate)** especificada, por ejemplo 50 kHz, o un **Intervalo de muestreo (Sample Interval)**, por ejemplo 20  $\mu$ S. Puede especificar la **Duración (Duration)** como una cantidad de **Tiempo (Time)** o una cantidad de **Lecturas (Readings, muestras)**. Puede usar el disparo automático, externo o de nivel. Después de presionar **[Home]**, presione **Acquire > DMM Digitize**. Luego, puede seleccionar los parámetros de digitalización/disparo. Después de configurar los parámetros de digitalización, presione **[Scan/Start]**. La digitalización empezará cuando ocurra el evento disparador especificado.
- La opción DMM Digitize habilita el predisparo, el disparo de nivel y el recurso de retardo del disparador.
- En el caso del predisparador, si un disparador llega antes de que se reciban todos los predisparadores, se ejecuta el disparador para iniciar las lecturas.
- Todas las muestras tomadas durante la digitalización se guardan en la memoria volátil. Después de completar una operación de digitalización, presione la tecla de función **[Save Recall] > Save > Readings** y especifique un archivo para guardar las lecturas digitalizadas.
- La cantidad máxima de lecturas que se pueden capturar se basa en el espacio disponible en la memoria volátil.
- La lectura guardada se borra al inicio de una nueva adquisición.



## Disparo de nivel

El disparo de nivel le permite disparar las mediciones en un punto definido de la señal de entrada, por ejemplo, cuando la señal cruza los cero voltios o cuando alcanza el punto intermedio de su amplitud pico positiva o negativa. En este caso, el gráfico ilustra el muestreo cuando la señal de entrada cruza los 0 V con una pendiente positiva:



### Acerca del disparador de nivel

El disparo de nivel está disponible para estas funciones de medición:

- voltaje de CC y corriente de CC
- Deformación
- Resistencia con 2 y 4 alambres, con la compensación desactivada y el bajo consumo de energía desactivado
- Temperatura (solo sensor de RTD)

El disparador de nivel es sensible al perímetro. Esto significa que el instrumento debe detectar un cambio en la cantidad que se está midiendo de un lado al otro de la configuración de nivel (dirección controlada por la configuración de Slope o pendiente). Por ejemplo, si la pendiente es positiva, la cantidad que se está midiendo primero debe alcanzar un valor inferior al nivel establecido antes de que se pueda detectar un evento de disparador. El rendimiento del disparador de nivel no es uniforme. Su precisión, latencia y sensibilidad dependen de otras funciones de DMM.

## Conmutación y multiplexor para señal de bajo nivel

Los multiplexores de bajo nivel están disponibles en los siguientes tipos: uno, dos y cuatro alambres. Las siguientes secciones de este capítulo describen cada tipo de multiplexor. Los siguientes módulos de multiplexor de bajo nivel están disponibles con el DAQ970A/DAQ973A.

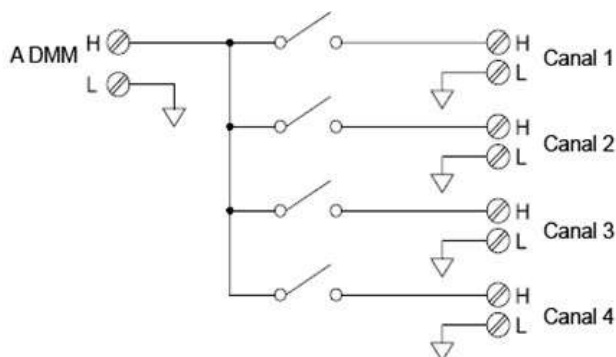
- Multiplexor FET de 20 canales DAQM900A
- Multiplexor Armature de 20 canales DAQM901A
- Multiplexor Reed de 16 canales DAQM902A
- Multiplexor de terminación única de 40 canales DAQM908A

Una característica importante de un multiplexor utilizado como canal de entrada DMM es que solo se conecta un canal a la vez. Por ejemplo, si utiliza un módulo multiplexor y el DMM interno, puede configurar una medición de voltaje en el canal 1 y una medición de temperatura en el canal 2. Primero, el instrumento cierra el relé del canal 1, realiza la medición de voltaje y luego abre el relé antes de pasar al canal 2 (denominado conmutación de desconexión antes de conexión).

- Accionador de 20 canales DAQM903A
- Matriz de dos alambres 4x8 DAQM904A

### Multiplexores de un cable (un extremo)

En el multiplexor DAQM908A, todos los 40 canales cambian solo la entrada HI, con un LO común para el módulo. El módulo también proporciona una unión de referencia de termopar para realizar mediciones de termopares.

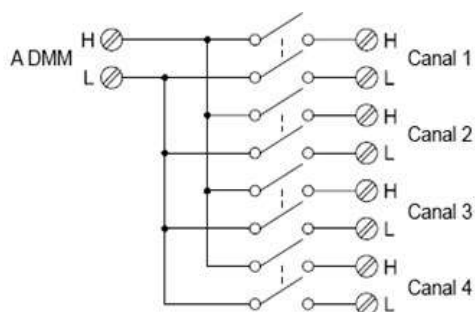


#### NOTA

Solo se puede cerrar un canal a la vez. Al cerrar un canal se abrirá el canal previamente cerrado.

## Multiplexores de dos alambres

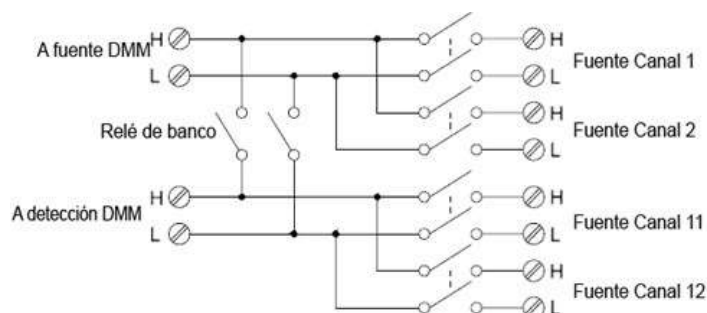
Los multiplexores DAQM900A, DAQM901A y DAQM902A cambian las entradas HI y LO, por lo que proporcionan entradas completamente aisladas para el DMM interno o un instrumento externo. Estos módulos también proporcionan una unión de referencia de termopar para realizar mediciones de termopares.



## Multiplexores de cuatro alambres

Puede realizar mediciones en ohmios de 4 alambres utilizando los multiplexores DAQM900A, DAQM901A y DAQM902A. Para una medición de 4 alambres en ohmios, los canales se dividen en dos bancos independientes al abrir el relé del banco.

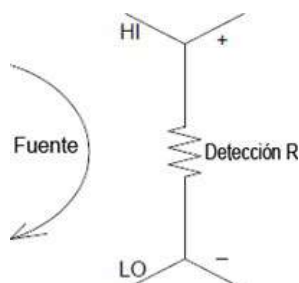
Para mediciones a 4 alambres, el instrumento empareja automáticamente el canal  $n$  con el canal  $n + 10$  (DAQM901A) o  $n + 8$  (DAQM902A) para proporcionar las conexiones de fuente y detección. Por ejemplo, realice las conexiones de origen a los terminales HI y LO en el canal 2 y las conexiones de detección a los terminales HI y LO en el canal 12.



### NOTA

Si alguno de los canales está configurado para formar parte de la lista de escaneo, no puede cerrar varios canales. Al cerrar un canal se abrirá el canal previamente cerrado.

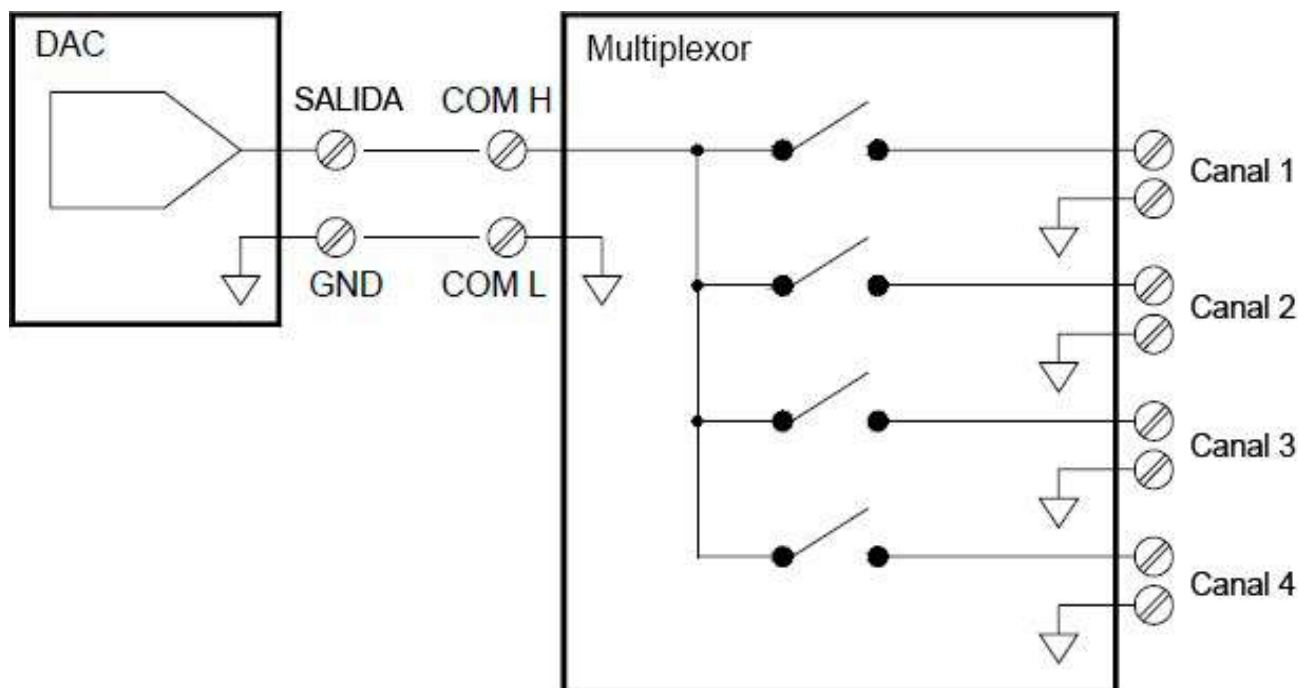
Al realizar una medición a 4 alambres, la corriente de prueba fluye a través de las conexiones de la fuente desde el terminal HI a través de la resistencia que se está midiendo. Para eliminar la resistencia del cable de prueba, se utiliza un conjunto separado de conexiones de detección como se muestra a continuación:



## Uso del multiplexor y enrutamiento de la señal

Cuando se utiliza de forma independiente para el enrutamiento de la señal (sin escanear o conectado al DMM interno), se pueden cerrar al mismo tiempo varios canales en los multiplexores DAQM901A y DAQM902A. Debe tener cuidado de que esto no cree una condición peligrosa (por ejemplo, conectar dos fuentes de alimentación).

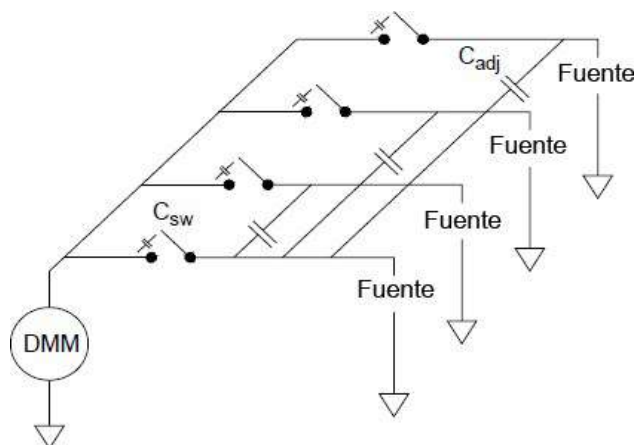
Tome en cuenta que un multiplexor no es direccional. Por ejemplo, puede usar un multiplexor con una fuente (como un DAC) para conectar una sola fuente a múltiples puntos de prueba como se muestra a continuación:



## Fuentes de error en el uso del multiplexor y la conmutación

El circuito de accionamiento, los EMF térmicos del interruptor o el acoplamiento entre rutas de señal pueden acoplar el ruido dentro de un interruptor. El ruido también puede generarse fuera de la red y conducirse o acoplarse al conmutador. Aunque los problemas de ruido se aplican a todo el sistema, pueden llegar a ser especialmente graves en la conmutación. Las redes de conmutación contienen una alta concentración de señales, que incrementan los errores. La mayoría de los problemas con el ruido eléctrico se pueden atribuir a una conexión a tierra y un blindaje incorrectos.

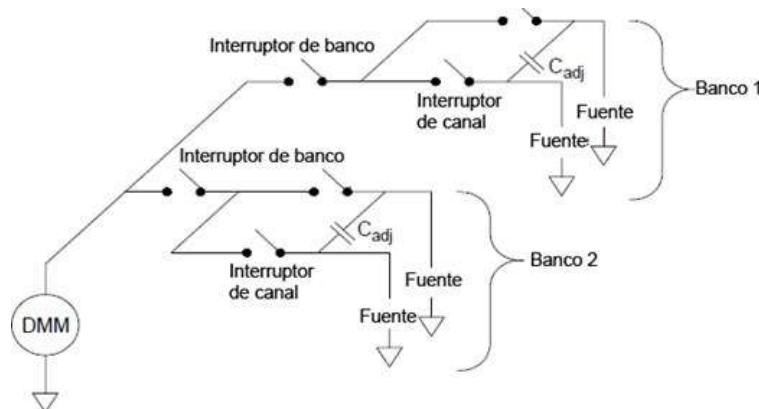
El ruido se puede acoplar capacitivamente entre canales físicamente adyacentes en un sistema de conmutación. El ruido se puede acoplar entre los contactos del interruptor ( $C_{sw}$ ) o entre cables adyacentes ( $C_{adj}$ ).



El acoplamiento capacitivo de ruido es una función de área y proximidad. Un método simple para reducir el acoplamiento de ruido es separar físicamente los interruptores y los cables entre sí. Sin embargo, es posible que esto no sea práctico para todas las aplicaciones.

Otra solución es mantener alejadas las señales de gran amplitud y las señales de pequeña amplitud. Agrupe señales similares (voltajes altos, voltajes bajos, analógica y digital). Si es posible, use dos módulos de interruptores separados; uno para señales de alto nivel y otro para señales de bajo nivel. Si está utilizando un solo módulo para conmutación de señales mixtas, deje un canal que no se use con conexión a tierra entre los grupos. También, conecte a tierra cualquier canal no utilizado en el módulo.

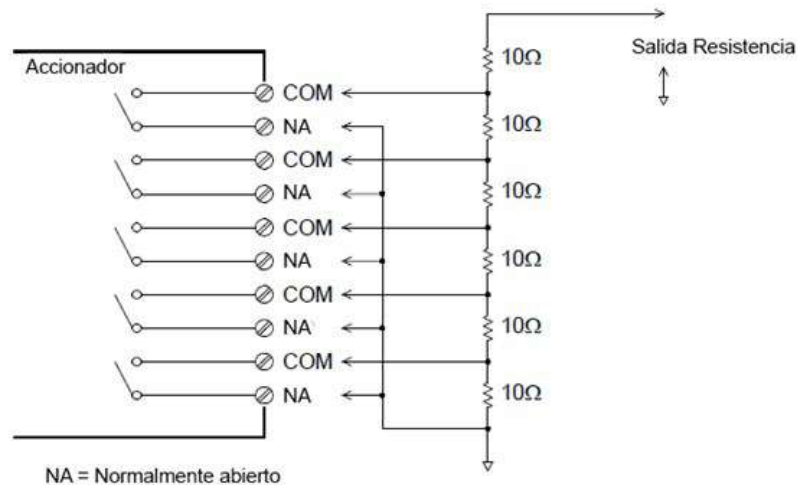
Los multiplexores DAQM901A y DAQM902A tienen un relé adicional, llamado conmutador de banco o conmutador de árbol, que ayuda a reducir el ruido de canal a canal ( $C_{adj}$ ). Los canales del multiplexor se dividen en dos bancos. El interruptor de banco aísla un banco de canales del otro, eliminando efectivamente cualquier capacitancia paralela cercana del banco aislado. Durante un escaneo, el instrumento controla automáticamente los conmutadores de banco.



| Módulo   | Banco 1        | Bancos 2        |
|----------|----------------|-----------------|
| DAQM900A | Canales 1 y 10 | Canales 11 y 20 |
| DAQM901A | Canales 1 y 10 | Canales 11 y 20 |
| DAQM902A | Canales 1 y 8  | Canales 9 y 16  |
| DAQM908A | Canales 1 y 20 | Canales 21 y 40 |

## Accionadores y conmutación de uso general

El accionador DAQM903A proporciona 20 interruptores independientes, SPDT (polo único, doble tiro) o Forma C. Este módulo ofrece una conmutación de encendido y apagado simple que puede utilizar para controlar dispositivos de potencia o para aplicaciones de conmutación personalizadas. Por ejemplo, puede usar un accionador para construir una escalera de resistencia simple como se muestra a continuación:

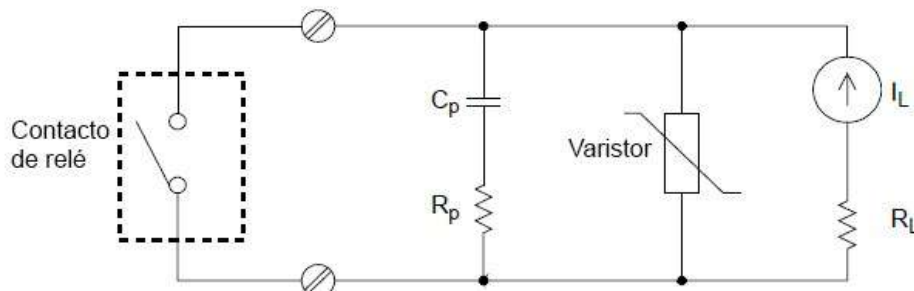


En el diagrama anterior, la resistencia es de  $60\ \Omega$  cuando todos los canales del accionador están abiertos (no conectados a COM). Tome en cuenta que cuando los canales del accionador están abiertos, como se muestra arriba, los contactos normalmente cerrados (que no se muestran arriba) están conectados a COM. Los valores de  $10\ \Omega$  a  $50\ \Omega$  se seleccionan cerrando los canales apropiados en el módulo.

## Circuitos amortiguadores

Cada vez que un contacto de relé se abre o se cierra, puede ocurrir una falla eléctrica o un arco entre los contactos. Esto puede causar radiación de ruido de alta frecuencia, sobretensiones de voltaje y corriente, y daños físicos a los contactos del relé.

Se proporciona un área de placa de prueba en el DAQM903A para implementar circuitos personalizados, como filtros simples, amortiguadores y divisores de voltaje. El área de placa de prueba proporciona el espacio necesario para insertar sus propios componentes, pero aquí no hay rastros de la placa de circuito. Puede construir estas redes para proporcionar protección de contacto al activar la línea de alimentación de CA para cargas reactivas. Si bien se pueden usar muchos tipos de redes de protección de contactos, en esta sección solo se describen las redes RC y los varistores.



## Red de protección RC

Al diseñar redes de protección RC, la resistencia de protección  $R_p$  se selecciona como un compromiso entre dos valores de resistencia. El valor mínimo de  $R_p$  está determinado por la corriente de contacto de relé máxima aceptable ( $I_{max}$ ). Para el DAQM903A, la corriente de relé máxima permitida ( $I_{max}$ ) es 1 A CC o CA rms. Por lo tanto, el valor mínimo para  $R_p$  es  $V/I_o$ , donde  $V$  es el valor máximo del voltaje de alimentación.

$$R_p = \frac{V}{I_{max}} = \frac{V}{2}$$

El valor máximo para  $R_p$  es generalmente igual a la resistencia de carga  $R_L$ . Por lo tanto, los límites de  $R_p$  se pueden establecer como:

$$\frac{V}{I_{max}} < R_p < R_L$$

Tome en cuenta que el valor real de la corriente ( $I_o$ ) en un circuito está determinado por la ecuación:

$$I_o = \frac{V}{R_L}$$

donde  $V$  es el valor máximo de la fuente de voltaje y  $R_L$  es la resistencia de la carga. El valor de  $I_o$  se utilizará para determinar el valor del capacitor de protección ( $C_p$ ).

Al determinar el valor del capacitor de la red de protección ( $C_p$ ), hay varias cosas que deberá considerar. Primero, la capacitancia total del circuito ( $C_{tot}$ ) debe ser tal que el voltaje pico en los contactos de relé abiertos no exceda los 300 Vrms. La ecuación para determinar la capacitancia mínima permitida del circuito es:

$$C_{tot} \geq (I_o/300)^2 \times L$$

donde  $L$  es la inductancia de la carga e  $I_o$  es el valor actual calculado anteriormente.

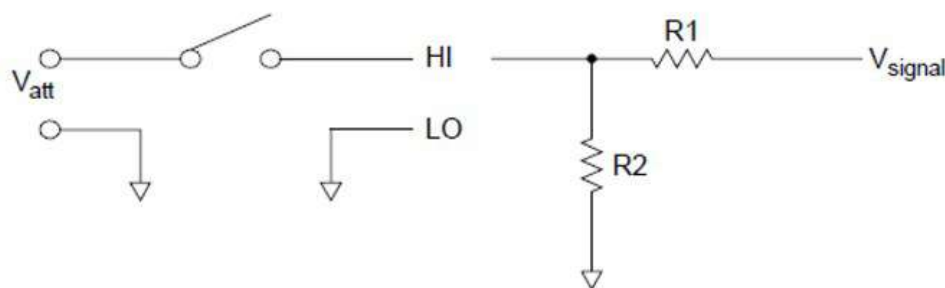
La capacitancia total del circuito ( $C$ ) se compone realmente de la capacitancia del cableado más el valor del capacitor de la red de protección ( $C_p$ ). Por lo tanto, el valor mínimo para  $C_p$  debe ser el valor obtenido para la capacitancia total del circuito ( $C$ ). Tome en cuenta que el valor real utilizado para  $C_p$  debe ser sustancialmente mayor que el valor calculado para  $C$ .

## Utilización de varistores

Use un varistor para agregar un límite de voltaje absoluto a través de los contactos del relé. Los varistores están disponibles para una amplia gama de voltajes y valores de energía de la abrazadera. Una vez que el circuito alcanza el voltaje nominal del varistor, la resistencia del varistor disminuye rápidamente. Un varistor puede complementar una red RC y es especialmente útil cuando la capacitancia requerida ( $C_p$ ) es demasiado grande.

## Utilización de atenuadores

Se han hecho provisiones en la placa de circuitos DAQM903A para instalar atenuadores simples o redes de filtro. Un atenuador está compuesto por dos resistencias que actúan como divisor de voltaje. A continuación, se muestra un circuito típico de atenuador:



Para seleccionar los componentes del atenuador, use la siguiente ecuación:

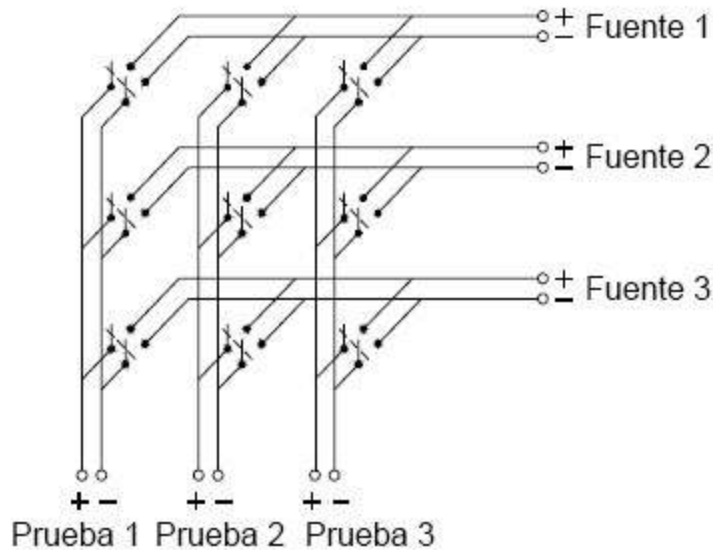
$$V_{att} = V_{signal} \times \frac{R_2}{R_1 + R_2}$$

Un uso típico para el componente de derivación es con transductores de 4 a 20 mA. Se puede instalar una resistencia de  $50 \, \Omega$ ,  $\pm 1 \, \%$ , 0,5 vatios en la ubicación R2. El DMM interno puede medir la caída de voltaje resultante (corriente del transductor a través de la resistencia). Por lo tanto, la resistencia de  $50 \, \Omega$  convierte la corriente de 4 a 20 mA en una señal de 0,2 a 1 voltio.



## Conmutación de matriz

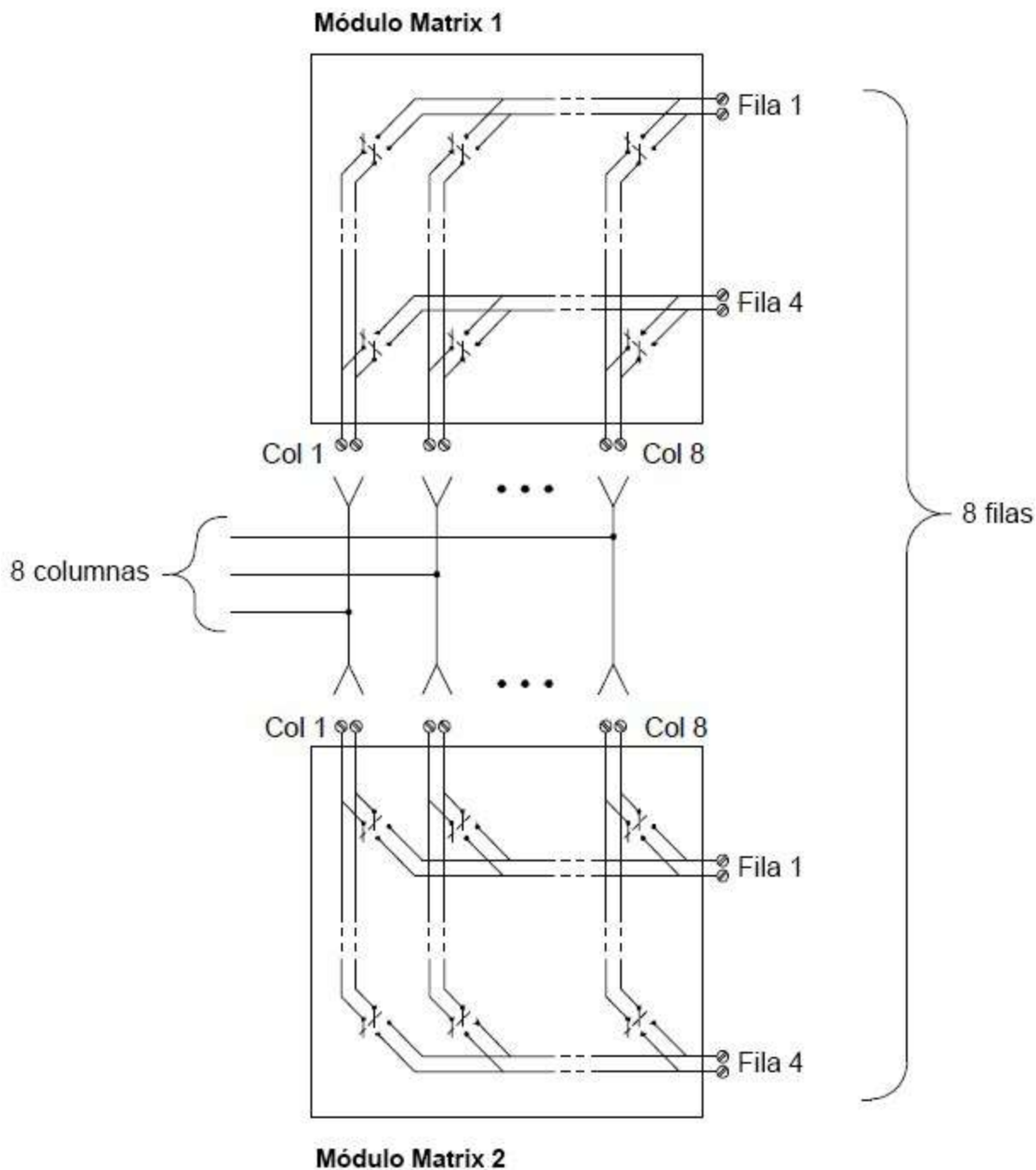
Un conmutador de matriz conecta múltiples entradas a múltiples salidas y, por lo tanto, ofrece más flexibilidad de conmutación que un multiplexor. Use una matriz para conmutar señales de baja frecuencia (menos de 10 MHz) solamente. Una matriz está dispuesta en filas y columnas. Por ejemplo, una matriz simple de 3x3 podría usarse para conectar tres fuentes a tres puntos de prueba, como se muestra a continuación:



Cualquiera de las fuentes de señal se puede conectar a cualquiera de las entradas de prueba. Tome en cuenta que con una matriz, es posible conectar más de una fuente al mismo tiempo. Es importante asegurarse de que estas conexiones no creen condiciones peligrosas o no deseadas.

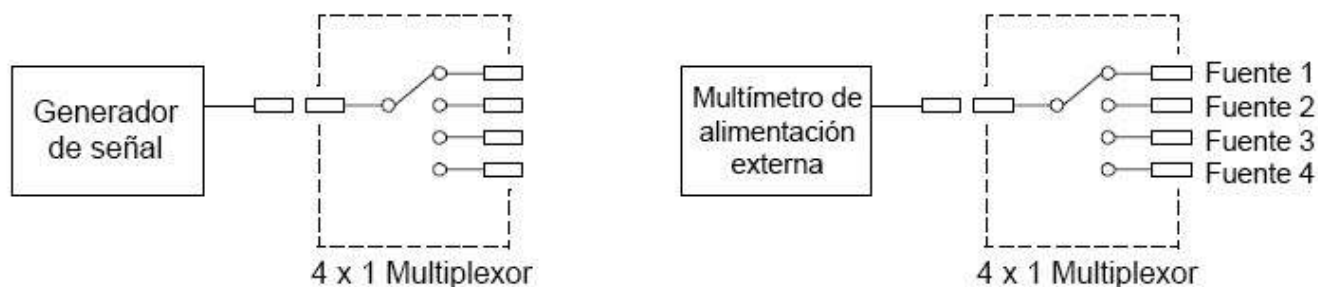
## Combinación de matrices

Puede combinar dos o más conmutadores de matriz para proporcionar una conmutación más compleja. Por ejemplo, el DAQM904A proporciona una matriz de 4 filas por 8 columnas. Puede combinar dos de estos módulos como una matriz de 4 filas por 16 columnas o una matriz de 8 filas por 8 columnas. A continuación, se muestra una matriz de 8x8:

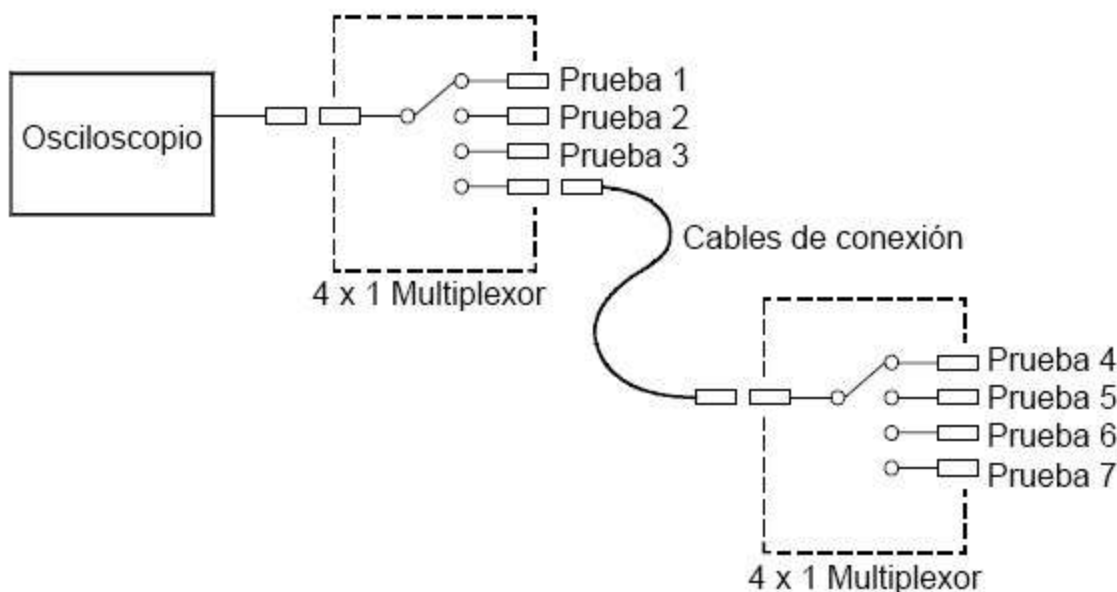


## Multiplexores para señal de RF

El multiplexor de RF es un tipo especial de multiplexor. Este tipo de multiplexor utiliza componentes especiales para mantener una impedancia de  $50\ \Omega$  en la línea de señal conmutada. En un sistema de prueba, a menudo, estos interruptores se usan para enrutar una señal de prueba desde una fuente de señal al dispositivo bajo prueba. Los interruptores son bidireccionales. El siguiente diagrama muestra dos ejemplos de un multiplexor de RF de 4 a 1 canales en un sistema de prueba.



Al usar cables de conexión, puede expandir los multiplexores de RF para proporcionar entradas o salidas de prueba adicionales. Por ejemplo, puede combinar dos multiplexores 4 a 1 para crear un multiplexor 7 a 1 como se muestra a continuación:



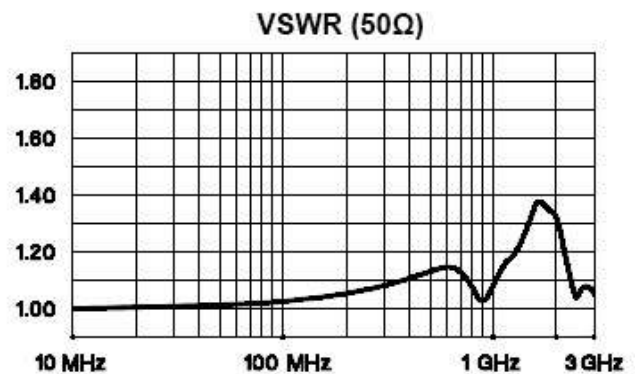
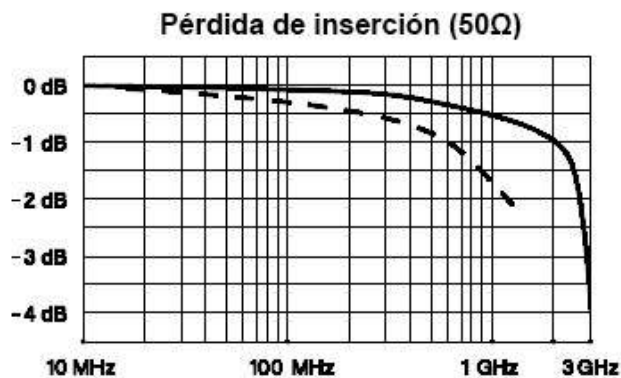
En los multiplexores de RF DAQM905A ( $50\ \Omega$ ), solo puede cerrar un canal por banco a la vez en estos módulos. Cerrar un canal en un banco abrirá el canal previamente cerrado. Estos módulos responden solo al comando CLOSE (OPEN no se aplica). Para abrir un canal, envíe el comando CLOSE a otro canal en el mismo banco. Tome en cuenta que el módulo DAQM905A no cierra automáticamente el canal abierto.

## Fuentes de error en la conmutación de RF

Los desajustes de impedancia pueden causar una variedad de errores en un sistema de multiplexores de RF. Estos errores pueden causar formas de onda distorsionadas, sobrevoltaje o subvoltaje.

Para disminuir el desajuste de impedancia de RF:

- Utilice el cable y el conector correctos para la impedancia del circuito (50  $\Omega$ ).
- Asegúrese de que todas las rutas de señal y los cables estén cerrados correctamente. Las secciones de línea sin cerrar pueden aparecer como cortos en las frecuencias de RF.



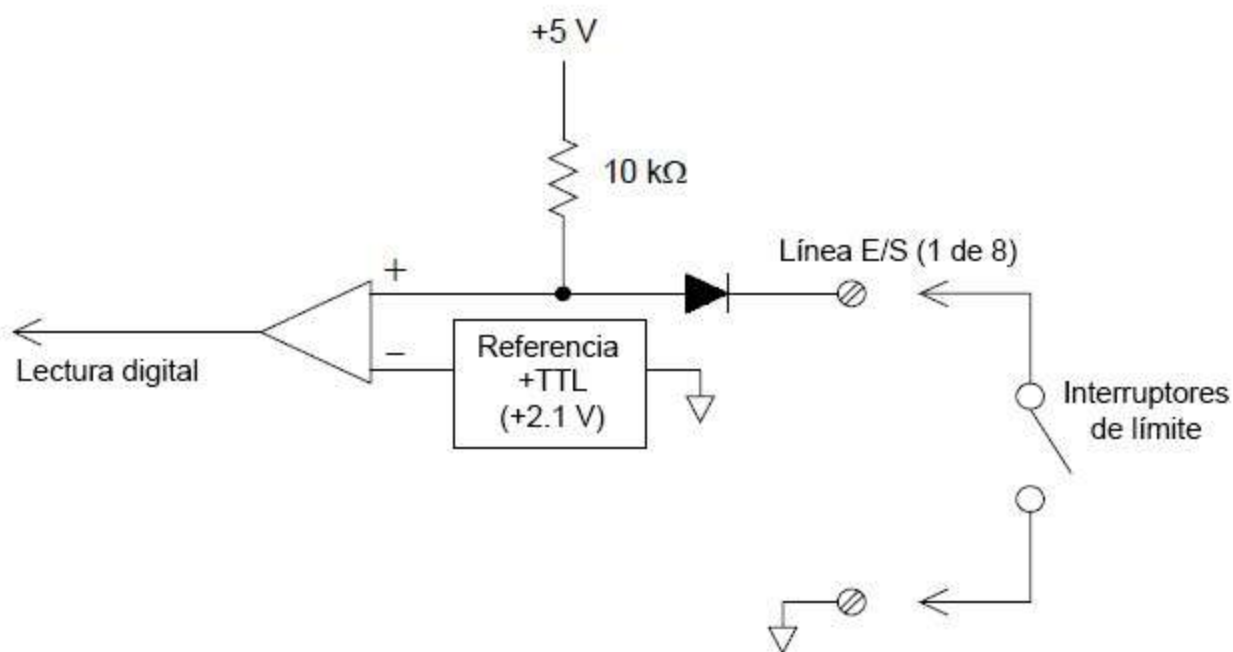
————— Directo al módulo  
 - - - - - Usar cables adaptadores provistos

## Módulo multifunción

### Entrada digital

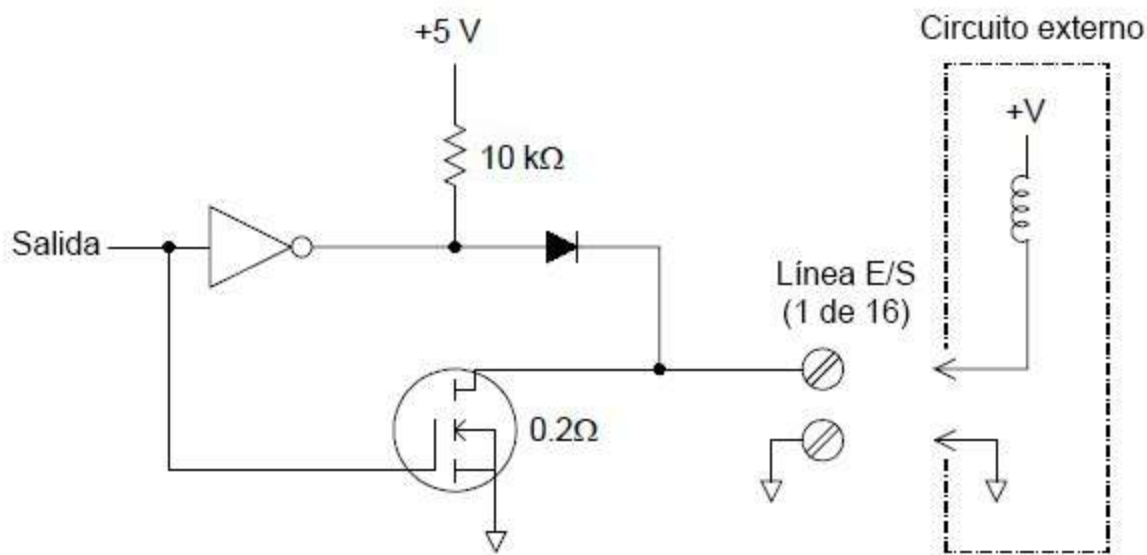
El módulo DAQM907A tiene dos puertos de entrada/salida de 8 bits no aislados que puede utilizar para leer patrones digitales.

- Puede leer el estado en vivo de los bits en el puerto o puede configurar un escaneo para que incluya una lectura digital.
- Puede generar una alarma cuando se detecta un patrón de bits específico o un cambio de patrón de bits en un canal de entrada. Los canales no tienen que formar parte de la lista de escaneo para generar una alarma.
- El circuito interno de extracción de +5 V le permite utilizar la entrada digital para detectar cierres de contactos como microinterruptores o interruptores de límite. Una entrada abierta flota a +5 V y se lee como “1”. Una entrada en cortocircuito a tierra se lee como “0”. A continuación, se muestra un ejemplo de un canal de detección de cierre de contacto:



## Salida digital

El módulo DAQM907A tiene dos puertos de entrada/salida de 8 bits no aislados que puede utilizar para emitir patrones digitales. Puede combinar los dos puertos para generar una palabra de 16 bits. A continuación, se muestra un diagrama simplificado de un solo bit de salida:



- Cada bit de salida puede conducir directamente hasta 10 cargas TTL (menos de 1 mA). El búfer para cada puerto se usa para impulsar una salida alta desde el suministro interno de  $+5\text{ V}$  a través del diodo. La unidad tiene una capacidad nominal de  $+2,4\text{ V}$  como mínimo a 1 mA.
- Cada bit de salida también puede absorber de forma activa, puede absorber hasta 400 mA desde la fuente de alimentación externa. El FET se usa para absorber corrientes y tiene una resistencia nominal "on" de  $0,2\Omega$ .
- Para la lógica no TTL, debe proporcionar un pull-up externo. En la siguiente sección, se ofrece una descripción del cálculo de pull-up.
- Si se usa con una fuente de alimentación externa y un pull-up, la fuente externa debe ser mayor que  $+5\text{ VDC}$  y menor que  $+42\text{ VDC}$ .

## Utilización de un pull-up externo

En general, solo se requiere un pull-up externo cuando se desea establecer el valor de salida “alto” que es mayor que los niveles TTL. Por ejemplo, para usar una fuente de alimentación externa de +12V, el valor de la resistencia de pull-up externa se calcula de la siguiente manera:

$$V_{cc} = 12 \text{ VDC}$$

$$I_{max} = I_{out\ low} \times \text{safety factor} = 1 \text{ mA} \times 0.5 + 0.5 \text{ mA}$$

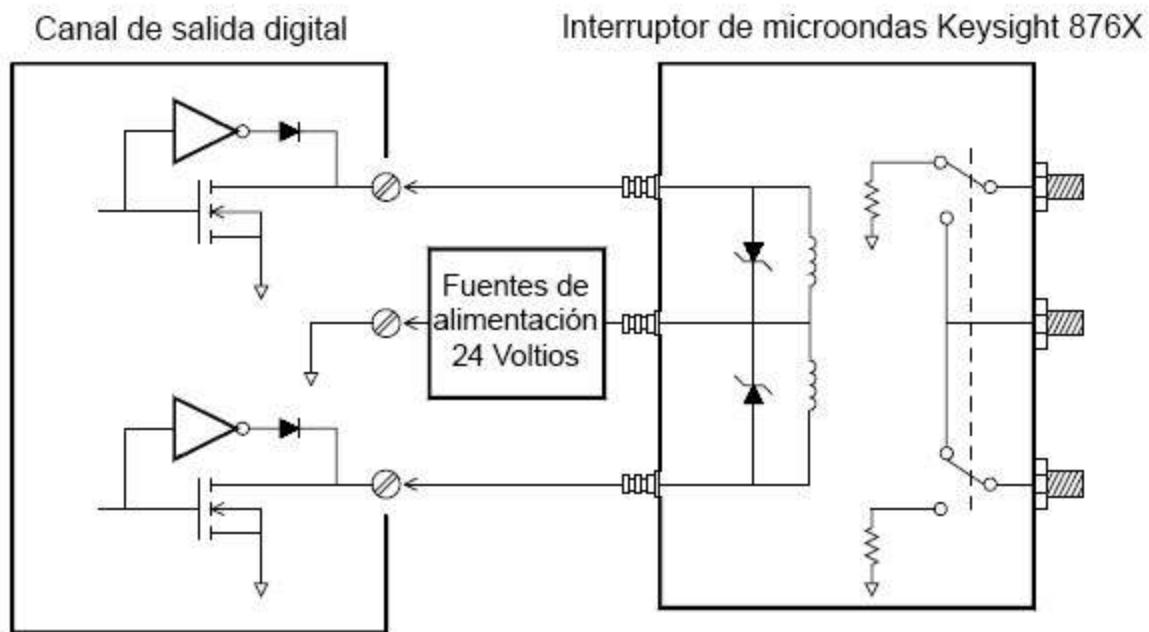
$$R = \frac{V_{cc}}{I_{max}} = \frac{12}{0.0005} = 24 \text{ k}\Omega$$

El valor del nivel lógico “alto” con la resistencia de pull-up externa de 24 k $\Omega$  se calcula de la siguiente manera:

$$V_{high} = V_{cc} \times \frac{R_{external}}{R_{external} + R_{internal}} = 12 \times \frac{24 \text{ k}\Omega}{24 \text{ k}\Omega + 10 \text{ k}\Omega} = 8.47 \text{ VDC}$$

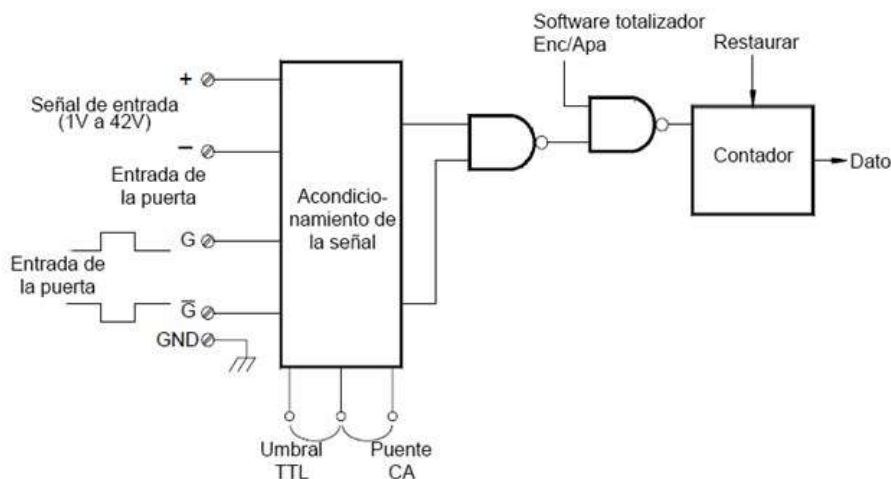
## Conducción de interruptores externos

Puede utilizar dos canales de salida digital para controlar un interruptor externo. Por ejemplo, puede conducir la serie de interruptores de microondas Keysight 876X utilizando una fuente de alimentación externa y dos canales de salida digital. El estado del multiplexor 2 a 1 se cambia estableciendo el bit de salida apropiado bajo (0).



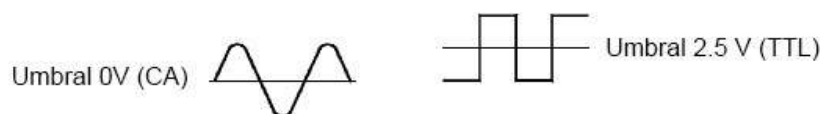
## Totalizador

El módulo DAQM907A tiene un totalizador de 26 bits que puede contar pulsos compatibles a una velocidad de 100 kHz. Puede leer manualmente el conteo del totalizador o puede configurar un escaneo para que lea el conteo.



Puede configurar el totalizador para que cuente con el borde ascendente o el borde descendente de la señal de entrada.

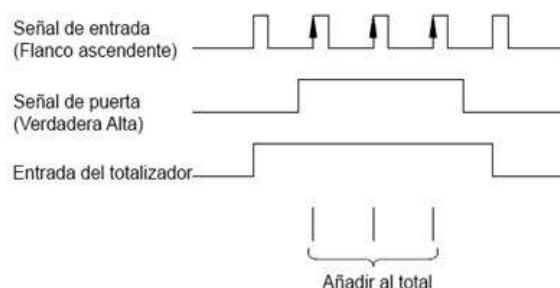
Si utiliza el puente de hardware etiquetado como “Totalize Threshold” (umbral del totalizador) en el módulo, puede controlar el umbral en el que se detecta un borde. Mueva el puente a la posición “AC” para detectar cambios a través de 0 voltios. Mueva el puente a la posición “TTL” (configuración de fábrica) para detectar cambios a través de los niveles de umbral TTL.



El conteo máximo es 67 108 863 (226-1). El conteo se desplaza a “0” después de alcanzar el valor máximo permitido.

Puede controlar cuándo el totalizador registra realmente los conteos mediante una señal de puerta ( $G$  y terminales  $\bar{G}$  en el módulo). Una señal alta TTL aplicada al terminal “G” activa el conteo y una señal baja desactiva el conteo. Aplicar una señal TTL baja al terminal  $\bar{G}$  activa el conteo y una señal alta desactiva el conteo. El totalizador solo cuenta cuando ambos terminales están habilitados. Puede utilizar el terminal G, el terminal  $\bar{G}$  o ambos. Cuando una puerta no está conectada, el terminal de la puerta flota al estado habilitado, creando efectivamente una condición de “gate always”.

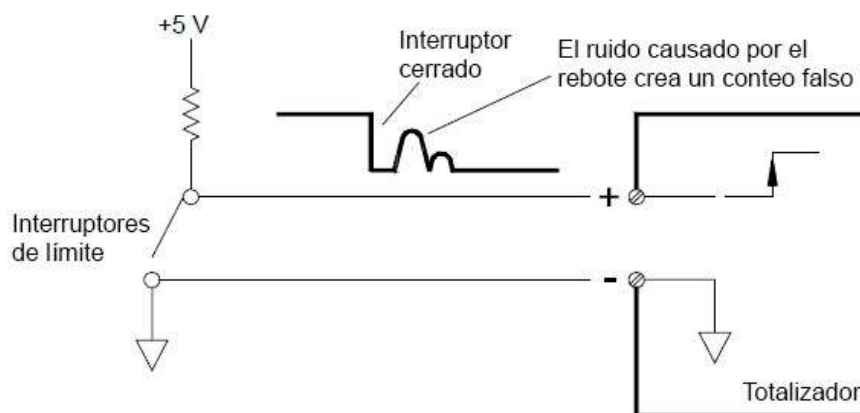




## Errores de totalizador

El ruido en la entrada del totalizador puede ser un problema, especialmente en señales con un tiempo de elevación lento. Este ruido puede crear una indicación falsa de que se ha cruzado un umbral. Consulte [Sistema de cableado y conexiones](#) para obtener más información.

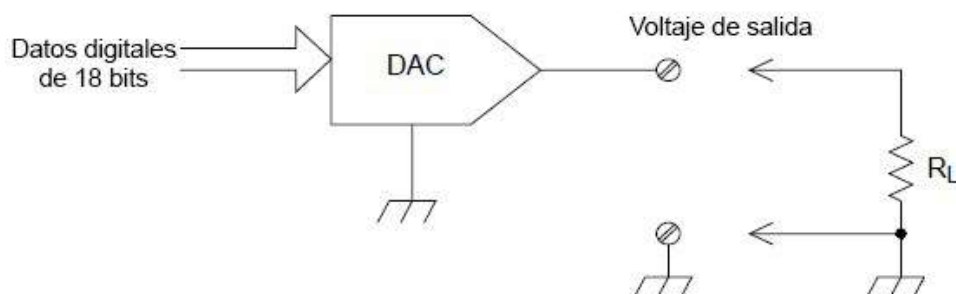
El contacto de rebote en los interruptores externos puede crear conteos falsos. Todos los interruptores mecánicos rebotan cuando se abren y se cierran. Utilice un capacitor externo para filtrar el rebote de contacto.



## Salida analógica (DAC)

El módulo DAQM907A tiene dos salidas analógicas y sensores que pueden emitir voltajes o corrientes calibrados con 18 bits de resolución.

Cada canal DAC (Convertidor digital a analógico) se puede usar como una fuente de voltaje o corriente programable para el control de la entrada analógica de otros dispositivos.



Puede configurar el voltaje de salida en cualquier valor entre +12 VDC y -12 VDC, en pasos de 0.1 mV. Cada DAC está conectado a tierra, no puede flotar.

Cada canal DAC puede suministrar una corriente máxima de 15 mA.

NOTA

Debe limitar la corriente de salida del DAC a 40 mA en total para cada ranura (dos canales DAC).

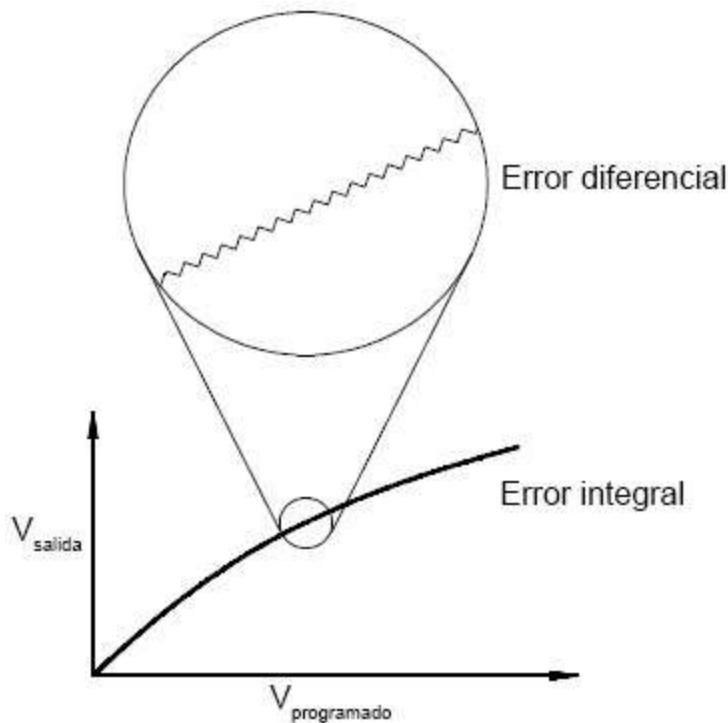
Para mantener la precisión de salida nominal, la carga ( $R_L$  en el diagrama que se muestra arriba) debe ser mayor que 1 k $\Omega$ .

Errores del DAC

La salida de un DAC varía con la temperatura. Si es posible, debe operar el instrumento a una temperatura estable y lo más cerca posible de la temperatura de calibración del DAC para obtener una mayor precisión, o realizar una autocalibración para recalibrar el DAC si la temperatura ha cambiado mucho con respecto a la temperatura de calibración.

La salida de un DAC también muestra otros dos tipos de errores: error diferencial y error integral.

| Tipos de errores  | Descripción                                                                                                                                                                                          |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Error diferencial | Se refiere al menor cambio posible en el voltaje.<br>La salida DAC no es lineal, pero se escalona a medida que se programan voltajes progresivamente mayores (o menores). El paso es en 100 $\mu$ V. |
| Error integral    | Se refiere a la diferencia entre el voltaje programado y el voltaje de salida real del DAC.                                                                                                          |





## Vida útil del relé y mantenimiento preventivo

El sistema de mantenimiento de relés DAQ970A/DAQ973A cuenta automáticamente los ciclos de cada relé en el instrumento y almacena el conteo total en la memoria no volátil en cada módulo de conmutación. Utilice esta función para rastrear fallas de relé y para predecir los requisitos de mantenimiento del sistema.

Los relés son dispositivos electromecánicos que están sujetos a modos de falla por desgaste. La vida útil de un relé, o el número de operaciones reales antes del fallo, depende de cómo se use: carga aplicada, frecuencia de conmutación y entorno.

Puede usar los gráficos que se muestran en esta sección para estimar la duración de los relés para su aplicación. También se proporciona información de referencia adicional para brindarle una mejor comprensión de los mecanismos de desgaste del relé. En general, la vida útil de los relés depende en gran medida de las señales que se conmutan y de los tipos de mediciones que se realizan.

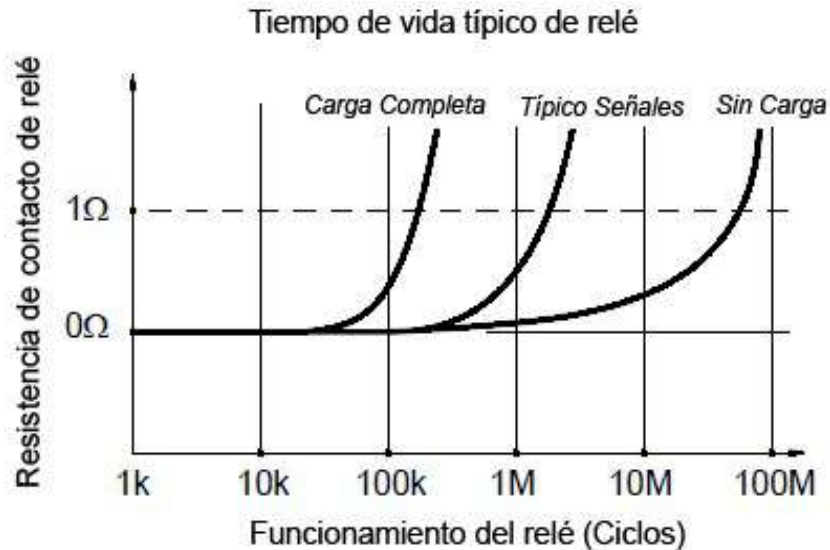
- Los niveles de señal de conmutación típicos dará como resultado una vida útil del relé de 1,000,000 a 10,000,000 operaciones.
- Las aplicaciones de conmutación de alta potencia (> 25 %) o de conmutación de alto voltaje (> 100 V) darán una vida útil de relé de 100 000 a 1 000 000 operaciones.
- Las aplicaciones de conmutación de bajo voltaje (<25 %) y conmutación de baja corriente (<10 mA) darán como resultado la vida útil del relé a 10 000 000 operaciones.
- Las aplicaciones de conmutación de RF rara vez muestran una vida útil del relé que exceda las 1 000 000 operaciones debido a los requisitos de resistencia constante más estrictos (por lo general menos de 0,2  $\Omega$ )

La siguiente tabla muestra el tiempo requerido para alcanzar el número especificado de operaciones de conmutación para varias velocidades de conmutación.

| Velocidad de conmutación continua | Operaciones de conmutación |               |               |
|-----------------------------------|----------------------------|---------------|---------------|
|                                   | 100 000                    | 1 000 000     | 10 000 000    |
| 1 / hora                          | 12 años                    | No disponible | No disponible |
| 1/ minuto                         | 10 semanas                 | 2 años        | No disponible |
| 1 / segundo                       | 1 día                      | 12 días       | 4 meses       |
| 10 / segundo                      | 3 horas                    | 1 día         | 12 días       |

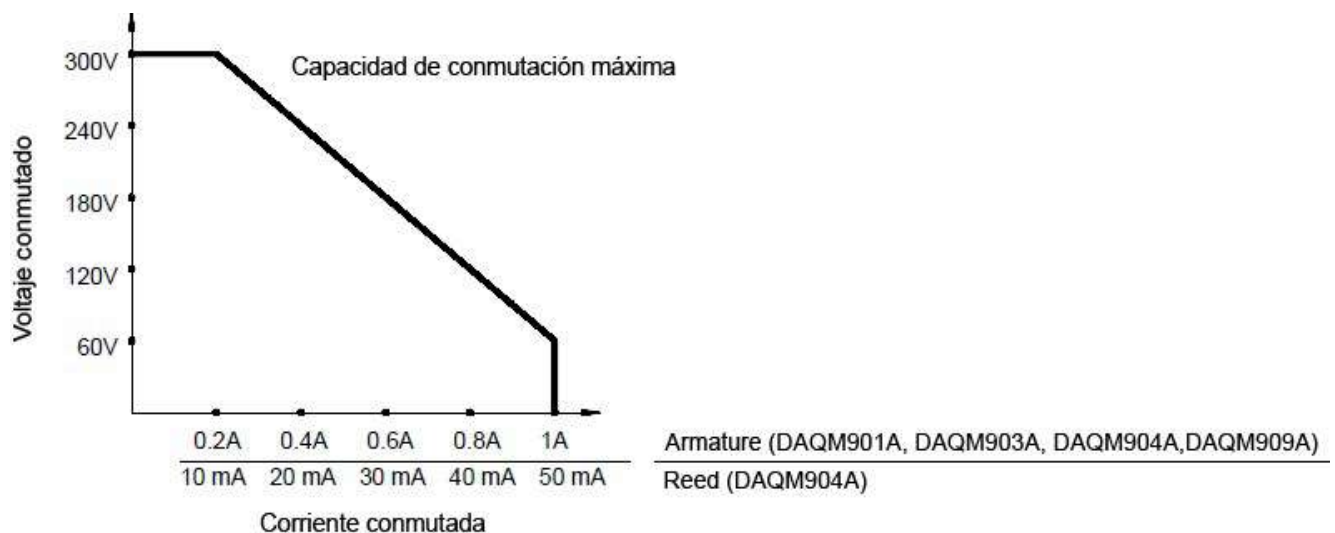
## Duración del relé

Cuando se usa un relé, los contactos comienzan a desgastarse y la resistencia de los contactos cerrados aumenta. Generalmente la resistencia de contacto inicial de un relé es de  $50\text{ m}\Omega$  (más la resistencia del cable). Cuando la resistencia de contacto excede de 20 a 50 veces su valor inicial, la resistencia de contacto se vuelve muy errática y, probablemente, deba reemplazar el relé. Para la mayoría de las aplicaciones, se debe reemplazar un relé con una resistencia de contacto mayor que  $1\ \Omega$ . El gráfico siguiente muestra las características típicas de resistencia de contacto de los relés utilizados en los módulos de conmutación DAQ970A/DAQ973A.



## Carga de relé

Para la mayoría de las aplicaciones, la carga conmutada por el relé es el factor más importante que afecta la vida útil del relé. Como se muestra en el gráfico a continuación, la vida del relé aumenta si la potencia de conmutación es baja. A medida que aumenta la potencia conmutada, la vida del relé se deteriora.



## Frecuencia de conmutación

Los contactos de relé se calientan cuando hay conmutación de potencia significativa. El calor se disipa a través de los cables y el cuerpo del relé. A medida que aumenta la frecuencia de conmutación y se acerca de su pico máximo, el calor no puede disiparse antes del siguiente ciclo. La temperatura de contacto aumenta y se reduce la vida útil del relé.

## Estrategia de reemplazo

Básicamente, existen dos estrategias que puede utilizar para el mantenimiento preventivo de los relés en los módulos de conmutación. La estrategia que elija dependerá de su aplicación, las consecuencias de una falla de relé en su sistema y la cantidad de ciclos de relé durante una sesión de medición.

La primera estrategia es reemplazar cada relé según sea necesario después de que falle o se vuelva errático. Esto es adecuado si conmuta cargas más altas en solo algunos relés en el módulo. La desventaja de esta estrategia es el inconveniente de reemplazar continuamente los relés a medida que se acercan al final de su vida en diferentes momentos.

La segunda estrategia es reemplazar todos los relés en el módulo o simplemente comprar un nuevo módulo cuando los relés cumplen su vida útil. Esta estrategia es más adecuada para aquellas aplicaciones en las que todos los relés en el módulo conmutan cargas similares. La falla de varios relés durante un período de tiempo relativamente corto puede indicar fallas inminentes en otros relés que conmutan cargas similares. Esta estrategia reduce el riesgo de falla durante el uso real a costa de reemplazar algunos relés que aún tienen suficiente vida útil.

**NOTA**

Para cambiar la frecuencia y la estrategia de reemplazo como se describe anteriormente, puede usar el sistema de mantenimiento de relés DAQ970A/DAQ973A para rastrear e incluso predecir fallas de relés.

Esta información está sujeta a cambios  
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