User Manual

DML Series
Modular Programmable DC Electronic Load

BK PRECISION

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Compliance Information

1.1 EMC

EC Declaration of Conformity - EMC

Compliance was demonstrated to the following specifications listed in the Official Journal of the European Communities: EMC Directive 2014/30/EU.

EN 61000-3-2: 2006 Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)

EN 61000-3-3: 1995+A1: 2001+A2: 2005 Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

EN 61000-4-2 / -3 / -4 / -5 / -6 / -11 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques:

- Electrostatic discharge immunity test
- Radiated, radio-frequency, electromagnetic field immunity test
- Electrical fast transient/burst immunity test
- Surge immunity test
- Immunity to conducted disturbances, induced by radio-frequency fields
- Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase

EN 61326-1: 2006 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

1.2 Safety

EC Declaration of Conformity - Low Voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive: 2006/95/EC .

EN61010-1: 2001 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

1.3 IEC Measurement Category & Pollution Degree Definitions

Measurement Category (CAT) - classification of testing and measuring circuits according to the types of mains circuits to which they are intended to be connected.

Measurement Category other than II, III, or IV : circuits that are not directly connected to the mains supply.

Measurement Category II (CAT II) : test and measuring circuits connected directly to utilization points (socket outlets and similar prints) of the low-voltage mains installation.

Measurement Category III (CAT III) : test and measuring circuits connected to the distribution part of a building's low-voltage mains installation.

Measurement Category IV (CAT IV) : test and measuring circuits connected at the source of the building's low-voltage mains installation.

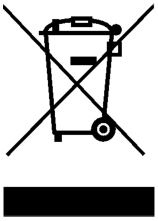
Mains Isolated : is for measurements performed on circuits not directly connected to a mains supply.

Pollution - addition of foreign matter, solid, liquid, or gaseous (ionized gases) that may produce a reduction of dielectric strength or surface resistivity.

Pollution Degree 2 (P2) - only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is expected

1.4 Product End-of-Life Handling

The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product to an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This product is subject to Directive 2012/19/EU of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of this product.

1.5 Terms and Symbols

Terms

CAUTION

A caution statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in damage to or destruction of parts or the entire product.

WARNING

A warning statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in injury or death to personnel.

NOTICE

A note statement calls attention to an operating procedure, practice, or condition, which, should be noted before proceeding.

Symbols

WARNING - HIGH VOLTAGE - possibility of electric shock.

CAUTION – Statements or instructions that must be consulted in order to find out the nature of the potential hazard and any actions which must be taken.

On (Supply). This is the AC mains connect/disconnect switch on the front of the instrument.

Off (Supply). This is the AC mains connect/disconnect switch on the front of the instrument.

Alternating current

Chassis (earth ground) symbol

Earth (ground) TERMINAL - Refer to the instructions accompanying this symbol in this manual.

Safety Notices

The following safety precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this instrument.

Before applying power to this instrument:

- Read and understand the safety and operational information in this manual.
- Apply all the listed safety precautions.
- Verify that the voltage selector at the line power cord input is set to the correct line voltage. Operating the instrument at an incorrect line voltage will void the warranty.
- Make all connections to the instrument before applying power.
- Do not operate the instrument in ways not specified by this manual or by B&K Precision.

Failure to comply with these precautions or with warnings elsewhere in this manual violates the safety standards of design, manufacture, and intended use of the instrument. B&K Precision assumes no liability for a customer's failure to comply with these requirements.

Electrical Power

This instrument is intended to be powered from a CATEGORY II mains power environment. The mains power should be 115 V RMS or 230 V RMS. Use only the power cord supplied with the instrument and ensure it is appropriate for your country of use.

WARNING **Do not use this instrument in an electrical environment with a higher category rating than what is specified in this manual for this instrument.**

WARNING **You must ensure that each accessory you use with this instrument has a category rating equal to or higher than the instrument's category rating to maintain the instrument's category rating. Failure to do so will lower the category rating of the measuring system.**

Ground the Instrument

WARNING

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical safety ground. This instrument is grounded through the ground conductor of the supplied, three-conductor AC line power cable. The power cable must be plugged into an approved three-conductor electrical outlet. The power jack and mating plug of the power cable meet IEC safety standards.

WARNING

Do not alter or defeat the ground connection. Without the safety ground connection, all accessible conductive parts (including control knobs) may provide an electric shock. Failure to use a properly-grounded approved outlet and the recommended three-conductor AC line power cable may result in injury or death.

WARNING

Unless otherwise stated, a ground connection on the instrument's front or rear panel is for a reference of potential only and is not to be used as a safety ground. Do not operate in an explosive or flammable atmosphere.

Environmental Conditions

This instrument is intended to be used in an indoor pollution degree 2 environment. The operating temperature range is 0°C to 40°C and 20% to 80% relative humidity, with no condensation allowed.

Measurements made by this instrument may be outside specifications if the instrument is used in non-office-type environments. Such environments may include rapid temperature or humidity changes, sunlight, vibration and/or mechanical shocks, acoustic noise, electrical noise, strong electric fields, or strong magnetic fields.

⚠WARNING **Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely-divided particulates.**

The instrument is designed to be used in office-type indoor environments. Do not operate the instrument

- **In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.**
- **In relative humidity conditions outside the instrument's specifications.**

⚠WARNING

- **In environments where there is a danger of any liquid being spilled on the instrument or where any liquid can condense on the instrument.**
- **In air temperatures exceeding the specified operating temperatures.**
- **In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.**
- **In environments with restricted cooling air flow, even if the air temperatures are within specifications.**
- **In direct sunlight.**

Do not operate instrument if damaged

WARNING

If the instrument is damaged, appears to be damaged, or if any liquid, chemical, or other material gets on or inside the instrument, remove the instrument's power cord, remove the instrument from service, label it as not to be operated, and return the instrument to B&K Precision for repair. Notify B&K Precision of the nature of any contamination of the instrument.

WARNING

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists.

Clean the instrument only as instructed

WARNING

Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Clean the instrument only with a clean dry lint-free cloth or as instructed in this manual. Not for critical applications.

Do not touch live circuits

WARNING

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified service-trained maintenance personnel who are aware of the hazards involved when the instrument's covers and shields are removed. Under certain conditions, even with the power cord removed, dangerous voltages may exist when the covers are removed.

To avoid injuries, always disconnect the power cord from the instrument, disconnect all other connections (for example, test leads, computer interface cables, etc.), discharge all circuits, and verify there are no hazardous voltages present on any conductors by measurements with a properly-operating voltage-sensing device before touching any internal parts. Verify the voltage-sensing device is working properly before and after making the measurements by testing with known-operating voltage sources and test for both DC and AC voltages.

Do not attempt any service or adjustment unless another person capable of rendering first aid and resuscitation is present.

General Safety

WARNING

Do not insert any object into an instrument's ventilation openings or other openings.

WARNING

This instrument is not authorized for use in contact with the human body or for use as a component in a life-support device or system.

Servicing

WARNING

Do not substitute parts that are not approved by B&K Precision or modify this instrument. Return the instrument to B&K Precision for service and repair to ensure that safety and performance features are maintained.

WARNING

Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Replace fuses only with new fuses of the fuse types, voltage ratings, and current ratings specified in this manual or on the back of the instrument. Failure to do so may damage the instrument, lead to a safety hazard, or cause a fire. Failure to use the specified fuses will void the warranty.

For continued safe use of the instrument

- Do not place heavy objects on the instrument.
- Do not obstruct cooling air flow to the instrument.
- Do not place a hot soldering iron on the instrument.
- Do not pull the instrument with the power cord, connected probe, or connected test lead.
- Do not move the instrument when a probe is connected to a circuit being tested.

Operation Modes

The DML Series offers the following operation modes:

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3.8 Over Current Protection (OCP) Test Mode 34
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3.11 SINE Test Function 41
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3.1 Static Mode

The Static Mode encompasses the four primary operational functions of the DC electronic load: Constant Current (CC), Constant Voltage (CV), Constant Resistance (CR), and Constant Power (CW). Upon entering Static Mode, the desired function is selected by activating its corresponding softkey. Consequently, the parameters presented within the "Load Settings" tab will adjust dynamically to align with the chosen operational mode. (Refer to **Figure 3.1** for a visual representation of Static Mode).

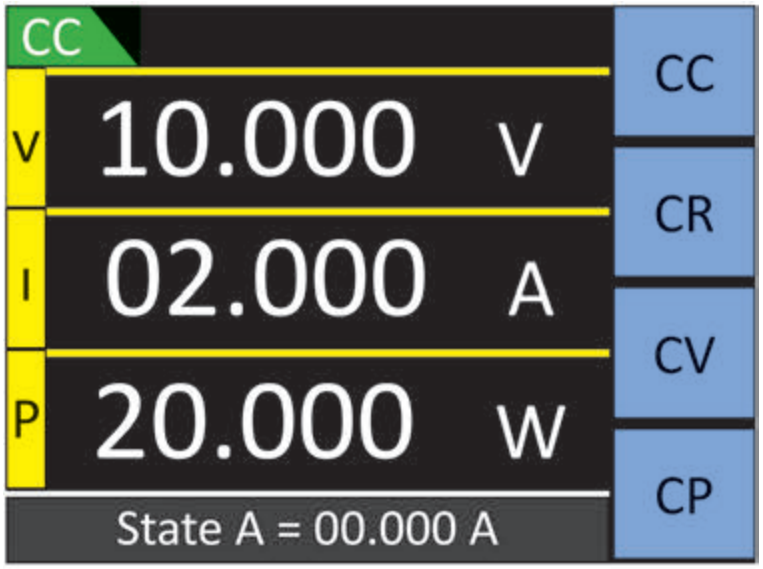


Figure 3.1 Static Mode Menu

Once programmed to a specific mode, the electronic load will persist in that configuration until an alternative mode is selected or the user navigates to a different menu. Therefore, when accessing other menus, such as the "System" menu, the interface for the previously active static mode will not be displayed.

NOTICE

If the selected static function is currently active (load enabled), it must first be deactivated before navigating to any menu outside of the Static Mode structure. Conversely, the initiation of any static function's operation requires the instrument to be situated within the Static Mode interface.

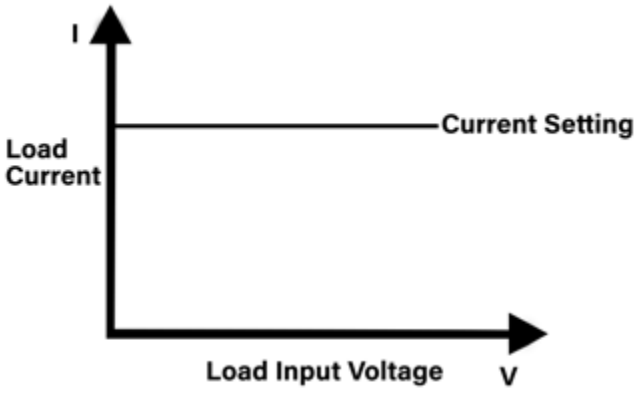
To enter static mode, press the **Mode** button, then select the desired static mode by pressing the corresponding softkey.

F1 := CC | F2 := CR | F3 := CV | F4 := CW

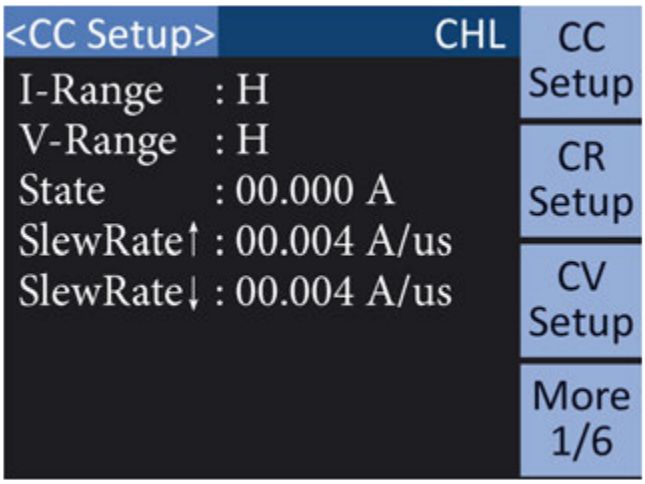
3.1.1 Constant Current Mode

In Constant Current (CC) mode, the electronic load regulates the current it sinks from the connected Device Under Test (DUT), maintaining it precisely at a specific, user-programmed level.

To accomplish this, the instrument dynamically adjusts its internal effective impedance. Should the current drawn from the DUT attempt to rise above the designated setpoint, the electronic load will increase its internal increase impedance to reduce the current back to the target value; conversely, if the current tends to decrease below the setpoint, the load will decrease impedance to maintain the programmed current flow.



CC Mode



CC Setup

Figure 3.2 Constant Current Mode

I-Range

Sets the current range the load will operate at. The ranges can be seen **table 3.1**

Model / Range	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0 to 0.2 A	0 to 0.4 A	0 to 0.1 A	0 to 0.2 A	0 to 0.15 A	0 to 0.6 A	0 to 0.8 A	0 to 0.3 A
Medium	0 to 2 A	0 to 4 A	0 to 1 A	0 to 2 A	0 to 1.5 A	0 to 6 A	0 to 8 A	0 to 3 A
High	0 to 20 A	0 to 40 A	0 to 10 A	0 to 20 A	0 to 15 A	0 to 60 A	0 to 80 A	0 to 30 A

Table 3.1 Constant Current Ranges

V-Range

Sets the voltage range the load will operate at. The ranges can be seen **table 3.2**

Model / Range	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0 to 6 V		0 to 80 V	0 to 6 V	0 to 80 V	0 to 6 V		0 to 80 V
Medium	0 to 16 V		0 to 150 V	0 to 16 V	0 to 150 V	0 to 16 V		0 to 150 V
High	0 to 80 V		0 to 600 V	0 to 80 V	0 to 600 V	0 to 80 V		0 to 600 V

Table 3.2 Constant Voltage Ranges

I-State

Sets the current value the load will sink. The maximum setable value is determined by the set current range. Refer to **table 3.1**

Slew Rate A/µs

Sets the rise/fall slew rate of the load, which determines the rate at which the input current increases to a new programmed value.

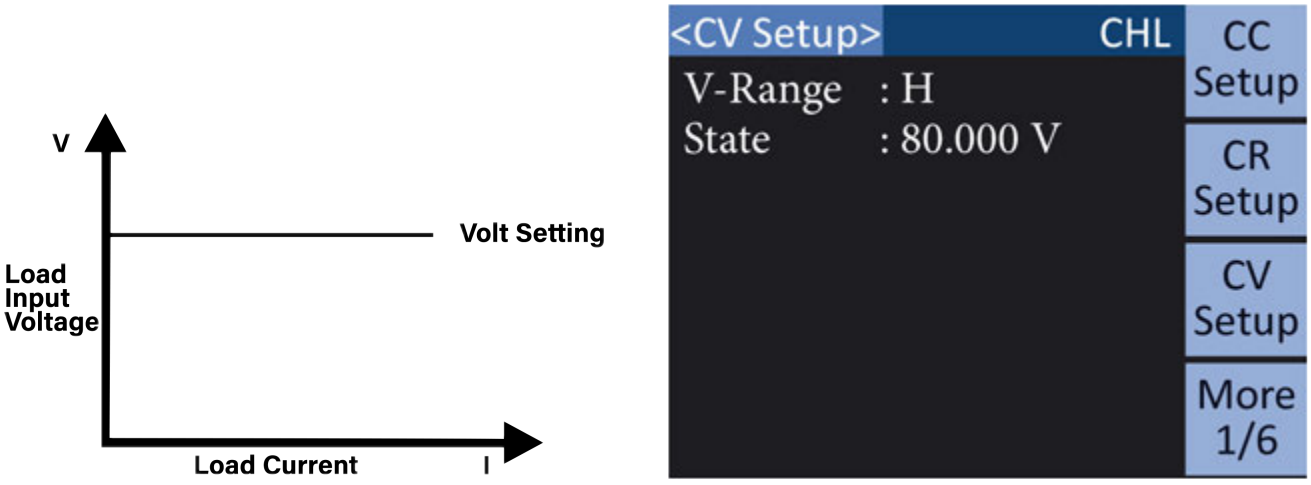
Model / Slope	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0.04mA/ms to 0.02mA/µs	0.08A/ms to 0.04A/µs	0.02A/ms to 0.01A/µs	0.04A/ms to 0.02A/µs	0.03A/ms to 0.015A/ µs	0.12A/ms to 0.06A/ µs	0.16A/ms to 0.08A/ µs	0.06A/ms to 0.03A/ µs
Medium	0.4A/ms to 0.2Aµs	.8A/ms to 0.4A/µs	0.2A/ms to 0.1Aµs	0.4A/ms to 0.2A/µs	0.3A/ms to 0.15Aµs	1.2A/ms to 0.6A/µ	1.6A/ms to 0.8A/µs	0.6A/ms to 0.3A/µs
High	4A/ms to 2A/µs	8A/ms to 4A/µs	2A/ms to 1A/µs	4A/ms to 2A/µs	3A/ms to 1.5A/µs	12A/ms to 6A/µs	16A/ms to 8A/µs	6A/ms to 3A/µs

Table 3.3 Slew Rate Ranges

3.1.2 Constant Voltage

During operation in Constant Voltage (CV) mode, the load regulates the voltage present at the terminals of the connected Device Under Test (DUT) to a specific, user-programmed level.

To accomplish this, the instrument dynamically adjusts the magnitude of current it sinks from the DUT. Should the DUT's voltage attempt to rise above the designated setpoint, the electronic load will increase its current draw; conversely, if the voltage tends to decrease below the setpoint, the load will reduce its current draw accordingly.



CV Mode CV Setup

Figure 3.3 Constant Voltage Mode

V-State

Sets the voltage value the load will maintain.

V-Range

Sets the voltage range the load will operate at. The ranges can be seen **table 3.2**

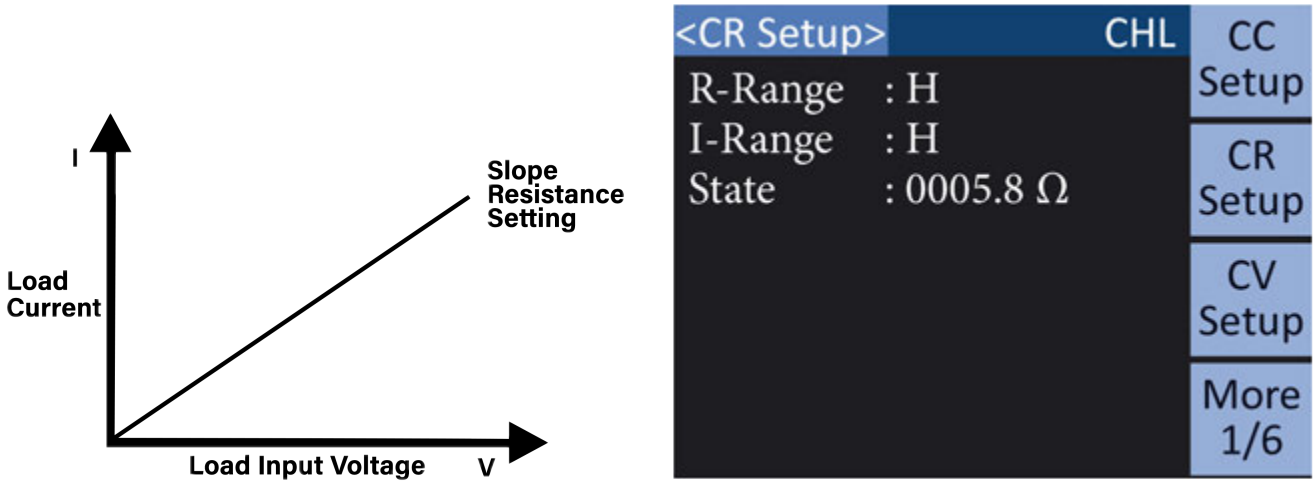
Model / Range	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0 to 6 V		0 to 80 V	0 to 6 V	0 to 80 V	0 to 6 V		0 to 80 V
Medium	0 to 16 V		0 to 150 V	0 to 16 V	0 to 150 V	0 to 16 V		0 to 150 V
High	0 to 80 V		0 to 600 V	0 to 80 V	0 to 600 V	0 to 80 V		0 to 600 V

Table 3.4 Constant Voltage Ranges

3.1.3 Constant Resistance

During operation in Constant Resistance (CR) mode, the electronic load simulates a fixed resistive load by maintaining a constant ratio between the voltage across its input terminals (supplied by the DUT) and the current it sinks, corresponding to a specific, user-programmed resistance value.

To accomplish this emulation, the instrument dynamically adjusts the magnitude of current it sinks in direct proportion to the instantaneous voltage presented by the DUT across the load's input terminals. Should the voltage supplied by the DUT increase, the electronic load will proportionally increase its current draw to maintain the programmed V/I ratio (resistance); conversely, if the DUT voltage decreases, the load will proportionally decrease its current draw accordingly to preserve the same resistance characteristic.



CR Mode CR Setup

Figure 3.4 Constant Resistance Mode

R-Range

Sets the resistance range the load will operate at. The ranges can be seen **table 3.5**

Model	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
CR Low Range	0.04-80Ω (100W/6V)	0.02-40Ω (200W/6V)	0.2-400Ω (200W/80V)	0.04-80Ω (100W/6V)	0.133-270Ω (300W/80V)	0.015-30Ω (300W/6V)	0.01-20Ω (400W/6V)	0.133-270Ω (500W/80V)
CR Medium Range	1.44-2.9kΩ (100W/16V)	0.8-1.5kΩ (200W/16V)	3-6kΩ (200W/150V)	1.44-2.9kΩ (100W/16V)	1.92-4kΩ (300W/10V)	0.3-600Ω (300W/16V)	0.36-720Ω (400W/16V)	1.92-4kΩ (500W/150V)
CR High Range	5.76-12kΩ (100W/80V)	3-6kΩ (200W/80V)	300-300kΩ (200W/600V)	5.76-12kΩ (100W/80V)	208-200kΩ (300W/600V)	1.5-3kΩ (300W/80V)	1.45-2.9kΩ (400W/80V)	208-200kΩ (500W/600V)

Table 3.5 Constant Resistance Ranges

I-Range

Sets the current range the load will operate at. The ranges can be seen **table 3.1**

Model / Range	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0 to 0.2 A	0 to 0.4 A	0 to 0.1 A	0 to 0.2 A	0 to 0.15 A	0 to 0.6 A	0 to 0.8 A	0 to 0.3 A
Medium	0 to 2 A	0 to 4 A	0 to 1 A	0 to 2 A	0 to 1.5 A	0 to 6 A	0 to 8 A	0 to 3 A
High	0 to 20 A	0 to 40 A	0 to 10 A	0 to 20 A	0 to 15 A	0 to 60 A	0 to 80 A	0 to 30 A

Table 3.6 Constant Current Ranges

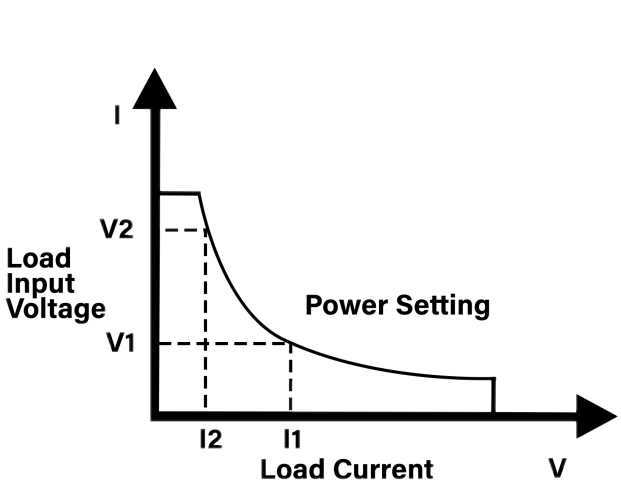
R-State

Sets the resistance value the load will maintain. The maximum setable value is determined by the set resistance range. Refer to **table 3.5**

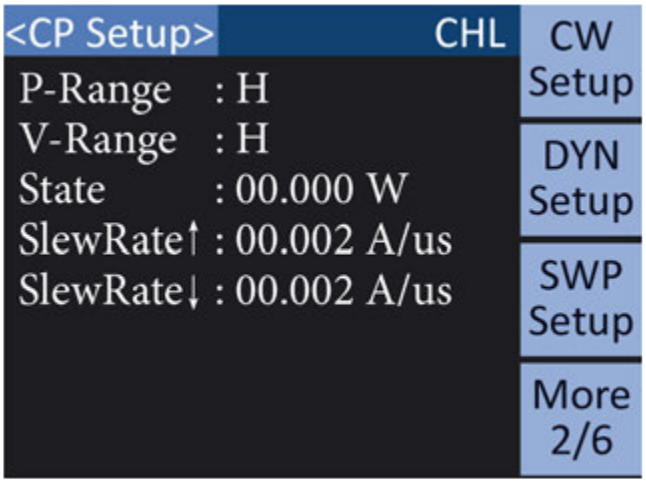
3.1.4 Constant Power

During operation in Constant Power (CW) mode, the load regulates the power drawn from the connected Device Under Test (DUT) to a specific, user-programmed level.

To accomplish this, the instrument dynamically adjusts the magnitude of current it sinks from the DUT based on the measured DUT voltage. Should the DUT's voltage decrease, the load will increase its current draw to maintain the target power (since P = V × I); conversely, if the voltage increases, the load will decrease its current draw accordingly to sustain the programmed power dissipation.



CW Mode



CP Setup

Figure 3.5 Constant Power Mode

R-Range

Sets the power range the load will operate at. The ranges can be seen **table 3.7**

Model	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	2 W	4 W			6 W		8 W	10 W
Medium	10 W	20 W			30 W		40 W	50 W
High	100 W	200 W			300 W		400 W	500 W

Table 3.7 Constant Power Ranges

V-Range

Sets the voltage range the load will operate at. The ranges can be seen **table 3.2**

Model / Range	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0 to 6 V		0 to 80 V	0 to 6 V	0 to 80 V	0 to 6 V		0 to 80 V
Medium	0 to 16 V		0 to 150 V	0 to 16 V	0 to 150 V	0 to 16 V		0 to 150 V
High	0 to 80 V		0 to 600 V	0 to 80 V	0 to 600 V	0 to 80 V		0 to 600 V

Table 3.8 Constant Voltage Ranges

P-State

Sets the power value the load will maintain. The maximum setable value is determined by the set power range. Refer to **table 3.7**

Slew Rate A/µs

Sets the rise/fall slew rate of the load, which determines the rate at which the input current increases to a new programmed value.

Model / Slope	DML102	DML200	DML201	DML202	DML300	DML301	DML400	DML500
Low	0.04mA/ms to 0.02mA/µs	0.08A/ms to 0.04A/µs	0.02A/ms to 0.01A/µs	0.04A/ms to 0.02A/µs	0.03A/ms to 0.015A/ µs	0.12A/ms to 0.06A/ µs	0.16A/ms to 0.08A/ µs	0.06A/ms to 0.03A/ µs
Medium	0.4A/ms to 0.2Aµs	.8A/ms to 0.4A/µs	0.2A/ms to 0.1Aµs	0.4A/ms to 0.2A/µs	0.3A/ms to 0.15Aµs	1.2A/ms to 0.6A/µ	1.6A/ms to 0.8A/µs	0.6A/ms to 0.3A/µs
High	4A/ms to 2A/µs	8A/ms to 4A/µs	2A/ms to 1A/µs	4A/ms to 2A/µs	3A/ms to 1.5A/µs	12A/ms to 6A/µs	16A/ms to 8A/µs	6A/ms to 3A/µs

Table 3.9 Slew Rate Ranges

3.2 Dynamic Mode

Transient (or dynamic) load operation involves rapidly and often repeatedly switching the electronic load between two or more defined setpoints, such as distinct high and low current levels. This function simulates sudden changes in demand on a connected DC power source (Device Under Test or DUT), allowing evaluation of its dynamic response.

This testing is crucial for evaluating the DUT's performance under changing conditions, specifically focusing on:

- **Voltage Stability**: Observing how much the output voltage deviates (overshoot/undershoot) during the load transition.
- **Recovery Time**: Measuring how quickly the output voltage returns to its stable, regulated state after the change.

The load's own Slew Rate Capability (A/µs) is a critical factor, as it determines how accurately fast, real-world load steps can be simulated. In essence, transient mode stress-tests the power source's regulation loop and output stage to ensure reliable dynamic performance.

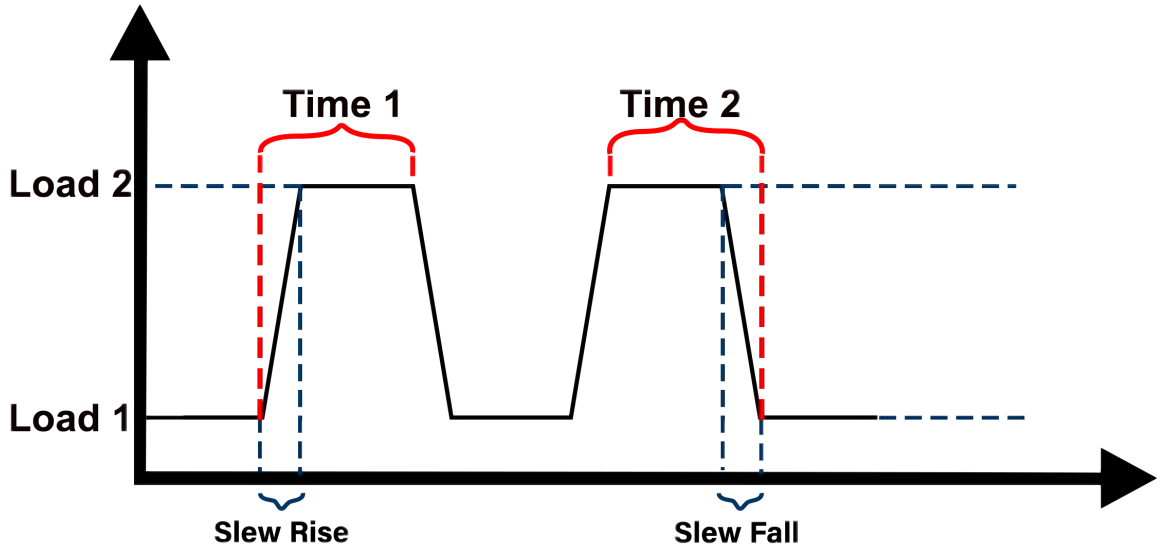
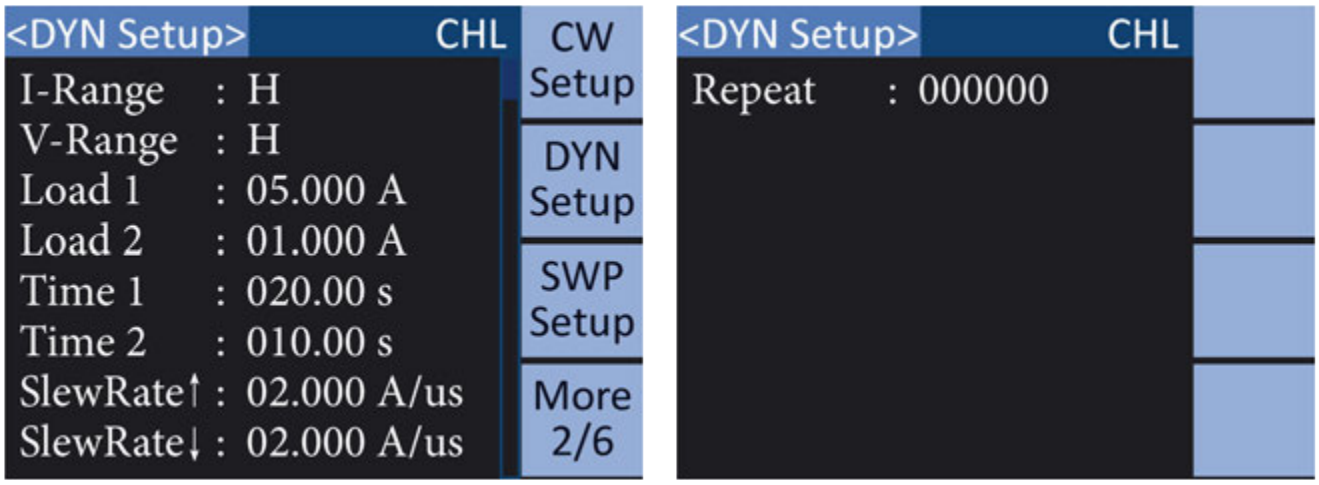


Figure 3.6 Dynamic Load Mode



Dynamic Setup Page1 Dynamic Setup Page 2

Figure 3.7 Dynamic Mode Setup

To enter DYN Setup press the **Setup** key. If already in DYN mode, the settings screen appears. Otherwise, use softkey 4 (**More**) to navigate to and select DYN Setup.

Use the **knob** to navigate and highlight the parameter you want to change.

For most numerical values (Currents, Times, Slopes, Repetitions): Press the **knob** to enter edit mode.

Use the **knob** (up/down) and **left/right keys** to adjust the value. Press **Enter** to confirm.

For Ranges: Use the **knob** to highlight, then press the appropriate **menu key** to select the desired range.

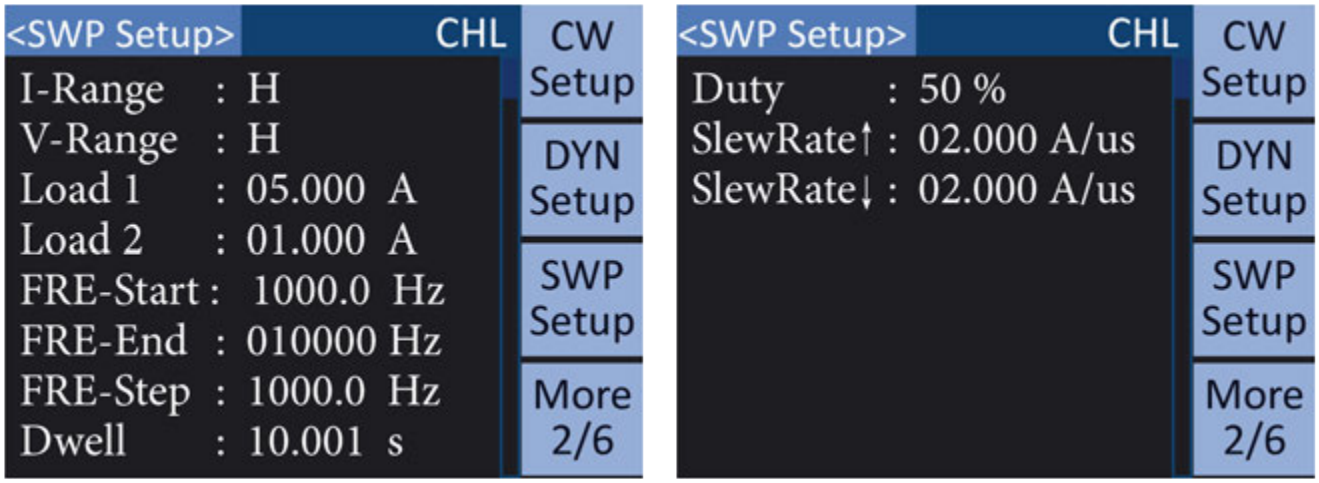
Parameters	Description
I-Range	Set operating range. (***Use softkeys to change value.***)
V-Range	Set operating range. (***Use softkeys to change value.***)
Load 1	The first target current level.
Load 2	The second target current level.
Time 1	Duration to hold Current Level 1.
Time 2	Duration to hold Current Level 2.
Rising Slope	Rate of current increase during transitions (A/µs or mA/µs).
Falling Slope	Rate of current decrease during transitions (A/µs or mA/µs).
Repeat	How many times the cycle between Level 1 and Level 2 repeats.

Table 3.10 Dynamic Mode Parameters

NOTICE Setting repetitions to zero enables continuous cycling.

3.3 Sweep Mode

Sweep (SWP) mode provides a dynamic load frequency sweep capability, operating based on the Constant Current (CC) mode. In this mode, the electronic load switches between two defined current levels (Level 1 and Level 2) while systematically stepping through a specified range of frequencies. This function allows testing the Device Under Test (DUT) behavior across various operating frequencies.



Sweep Setup Page 1 Sweep Setup Page 2

Figure 3.8 Sweep Mode Setup

Parameters	Description
I-Range	Sets the current operating range. (***Use softkeys to change value.***)
V-Range	Sets the voltage operating range. (***Use softkeys to change value.***)
Load 1	The first target current level.
Load 2	The second target current level.
FRE-Start	The initial frequency for the sweep.
FRE-End	The final frequency for the sweep.
Step Frequency	The frequency increment for each step in the sweep.
Duty	Time the load operates at each frequency step.
Rising Slope	Rate of current increase during transitions (A/µs or mA/µs).
Falling Slope	Rate of current decrease during transitions (A/µs or mA/µs).

Table 3.11 Sweep ModeTest Parameters

To enter SWP Setup press the **Setup** key. If already in SWP mode, the settings screen appears. Otherwise, use softkey 4 (**More**) to navigate to and select SWP Setup.

Use the **knob** to navigate and highlight the parameter you want to change.

For most numerical values (Currents, Frequencies, Duration, Slopes): Press the **knob** to enter edit mode.

Use the **knob** (up/down) and **left/right keys** to adjust the value. Press **Enter** to confirm.

For Ranges: Use the **knob** to highlight, then press the appropriate **menu key** to select the desired range.

This testing is crucial for evaluating the DUT's performance under dynamic conditions at different frequencies, specifically focusing on:

- **Frequency Response**: Characterizing how the DUT's output (e.g., impedance, voltage stability) changes as the load switching frequency varies.
- **Voltage Stability**: Observing how much the output voltage deviates (overshoot/undershoot) during the load transitions at each frequency step.
- **Recovery Time**: Measuring how quickly the output voltage returns to its stable state after load changes at different frequencies.

The load's own Slew Rate Capability (A/µs), defined by the Rising and Falling Slope parameters, is critical for accurately simulating fast load transitions during the sweep. In essence, SWP mode stress-tests the power source's dynamic performance and stability across a defined frequency spectrum.

3.4 CR-LED Mode

The CR-LED mode is a specialized function primarily utilized for testing LED power drivers. In this operational mode, the electronic load will only begin to draw current when the input voltage from the LED driver (Vin) surpasses a user-defined voltage, Vd (LED forward voltage). Once V_{in} is greater than Vd, the input impedance of the electronic load (Rin) is designed to conform to the equation: $R_{in} = (V_{in} - Vd)/I_{in} = Rd$, where Rd is the user-defined LED operating resistance. This allows the load to accurately simulate the electrical characteristics of an LED.

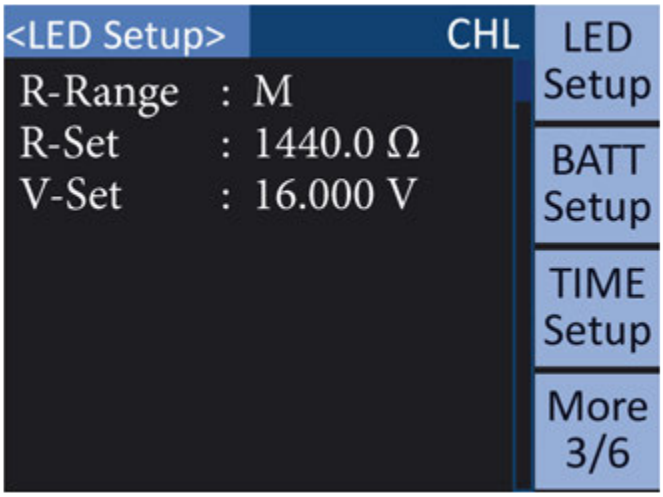


Figure 3.9 CR-LED Mode

Parameters	Description
R-Range	The resistance range is divided into high range, medium range, and low range.
R-Set	This parameter represents the simulated LED resistance value.
V-Set	This parameter represents the simulated LED starting voltage.

Table 3.12 LED Simulation Configuration Parameters

NOTICE After configuring the parameters, press the **On/Off** key on the front panel to enable/disable the load input and thereby start or stop the CR-LED test.

To enter LED Setup press the **Setup** key. If already in LED mode, the settings screen appears. Otherwise, use softkey 4 (**More**) to navigate to and select LED Setup.

- Use the **knob** to navigate and highlight the parameter you want to change.
- For most numerical values (R-Set and V-set): Press the **knob** to enter edit mode.
- Use the **knob** and (←, →) arrow keys to adjust the value. Press **Enter** to confirm.
- For Ranges: Use the **knob** to highlight, then press the appropriate **softkey** to select the desired range.

3.5 Battery Test Mode

The Battery Test Mode is designed to evaluate battery performance by measuring characteristics such as battery capacity and discharge time. This mode allows the electronic load to discharge a battery using Constant Current (CC), Constant Power (CP), or Constant Resistance (CR) methods, automatically stopping when predefined cut-off conditions are met.

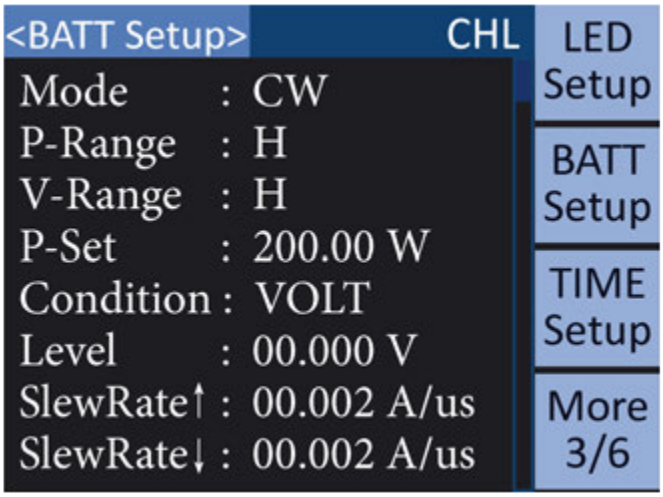


Figure 3.10 Battery Test Mode Setup Screen

Parameters	Description
Mode	Selects the method for discharging the battery during the test. Options typically include Constant Current (CC), Constant Power (CP), or Constant Resistance (CR).
Discharge Value	Sets the specific load value for the selected discharge mode. This would be a current value if in CC mode, a power value for CP mode, or a resistance value for CR mode.
Cut-off Voltage (V)	Defines the battery voltage level at which the discharge test will automatically terminate to prevent over-discharging the battery.
Cut-off Capacity (Ah)	Sets a maximum discharged capacity (in Ampere-hours). The test will stop if the battery's discharged capacity reaches this value.
Cut-off Time	Sets the maximum duration for the discharge test. The test will stop if this predefined time elapses, regardless of other conditions.

Table 3.13 Battery Test Mode Parameters

NOTICE

After configuring all battery test parameters, press the **On/Off** key on the front panel to enable the load input and start the battery discharge test. Press the **On/Off** key again to stop the test or if a cut-off condition is met.

To access and configure the Battery Test Mode parameters, press the **Shift** key and then the **CP** key (which is labeled as **BATT** for its shifted function). This will open the "Battery test parameter setting" interface.

- Use the **knob** to navigate and highlight the parameter you want to change.
- For most numerical values (e.g., Discharge Value, Cut-off Voltage, Cut-off Capacity, Cut-off Time): Press the **knob** to enter edit mode.
- Use the **knob** (for increasing/decreasing values) and (←, →) arrow keys (for selecting digit position) to adjust the value. Press **Enter** to confirm the new value.
- For selections like Discharge Mode (CC, CP, CR): Use the **knob** to highlight the parameter, then press the appropriate **softkey** or menu navigation keys (if applicable, specific interaction for selection might vary based on interface design, though softkeys are not explicitly detailed for the DML front panel in the provided excerpts) to select the desired mode.

3.6 Time Mode

The DML series electronic load incorporates a timing function that allows users to set specific durations for the load to be in an 'On' (active) state and an 'Off' (inactive) state. This capability can be applied when the load is operating in CC (Constant Current), CV (Constant Voltage), CR (Constant Resistance), or CP (Constant Power) modes. This enables automated cyclic loading or timed load application tests. The timing settings range from 1 second to 99999 seconds for both On and Off durations.

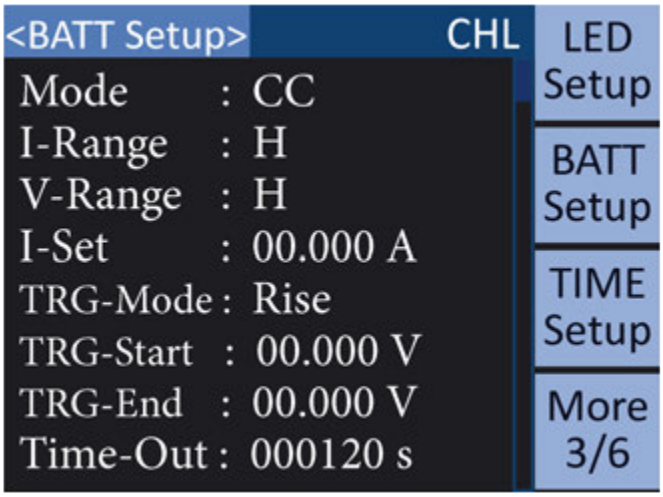


Figure 3.11 Time Setup Screen

Parameters	Description
Timer Mode	Enables or disables the timing function. When set to "TIMER ON", the load will cycle according to the "Load On Time" and "Load Off Time" settings. When set to "TIMER OFF", the timing function is ineffective, and the load operates based on manual On/Off control or other mode settings.
Load On Time	Sets the duration, in seconds, for which the electronic load will be in the 'On' state (actively sinking current/voltage/power/resistance based on the selected base mode) during each cycle. The setting range is 1s to 99999s.
Load Off Time	Sets the duration, in seconds, for which the electronic load will be in the 'Off' state (inactive) during each cycle. The setting range is 1s to 99999s.

Table 3.14 Timing Function Parameters

NOTICE

Once the Timing Function parameters are configured and "Timer Mode" is set to "TIMER ON", pressing the **On/Off** key on the front panel will initiate the timed sequence. The load will then cycle between the 'On' and 'Off' states according to the set durations. Pressing the **On/Off** key again will typically stop the timing sequence and turn the load off.

To access and configure the Timing Function parameters, press the **Shift** key and then the **MODE** key (which is labeled as **TIMER** for its shifted function). This action opens the "Timer parameter setting" interface, where you can set the "Timer Mode" (TIMER ON/OFF), "Load On Time", and "Load Off Time".

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., Load On Time, Load Off Time, or Timer Mode selection).
- For most numerical values (Load On Time, Load Off Time): Press the **knob** to enter edit mode.
- Use the **knob** (for increasing/decreasing values) and (←, →) arrow keys (for selecting digit position) to adjust the value. Press **Enter** to confirm the new value.
- For selections like Timer Mode (TIMER ON/TIMER OFF): Use the **knob** to highlight the parameter, then press the appropriate **softkey** or menu navigation keys (if applicable, specific interaction for selection might vary based on interface design, though softkeys are not explicitly detailed for the DML front panel in the provided excerpts; often this is done by pressing Enter or using the knob to cycle options) to select the desired state.

3.7 Maximum Power Point Tracking (MPPT) Mode

The MPPT test function is utilized for Maximum Power Point Tracking. This mode is primarily designed to test the efficiency and tracking capability of MPPT algorithms, often found in devices like solar panel optimizers or specialized power converters. The settings for this mode include voltage range selection and test speed configuration. A typical setup interface for MPPT is illustrated in Figure 4-12 referenced in the source document.

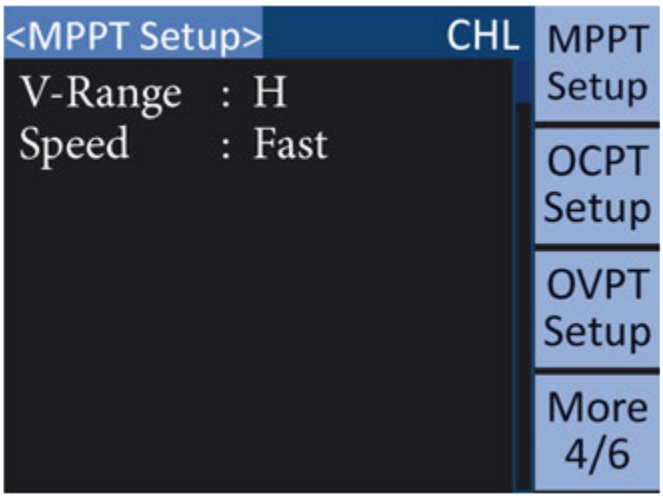


Figure 3.12 MPPT Setup Page

Parameters	Description
Voltage range	This setting defines the operational voltage range for the MPPT test. The voltage range is divided into high range, medium range, and low range. For example, these might be 80V, 16V, and 6V respectively, depending on the specific instrument model.
Test Speed	This setting determines the speed at which the MPPT test or tracking algorithm operates. The test speed can typically be set to fast, medium, or slow.

Table 3.15 MPPT Mode Parameters

NOTICE

After configuring the MPPT parameters, ensure the load input is enabled using the **On/Off** key on the front panel to start the MPPT tracking or test function. The specific method to initiate and observe MPPT operation may require further steps detailed in the instrument's full operational guide for MPPT mode.

To access the MPPT setting interface, press the **SETUP** key. If the instrument is already in MPPT mode, it will automatically jump to the MPPT setting interface. If the current mode is not MPPT mode, you can switch to the MPPT setting interface by toggling the menu key labeled as menu key 4 (More) or its equivalent navigation key to find and select the MPPT settings option.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., Voltage range, Test Speed).
- For most numerical values (if any were applicable here, though these are range/speed selections): Press the **knob** to enter edit mode.
- Use the **knob** (for cycling through options or adjusting values) and potentially (←, →) arrow keys (if applicable for specific value entry) to adjust the setting. Press **Enter** to confirm where applicable.
- For Ranges or enumerated selections (like Voltage range and Test Speed): Use the **knob** to highlight the parameter, then press the appropriate **menu key** (as indicated on the device's interface or "different menu keys" mentioned in the source) to cycle through and select the desired range or speed.

3.8 Over Current Protection (OCP) Test Mode

The Over Current Protection (OCP) test function is utilized to determine and verify the OCP point of a Device Under Test (DUT), such as a power supply. During this test, the electronic load progressively increases the current it draws from the DUT, starting from a defined initial current level. When the DUT's over-current protection mechanism is triggered (causing its output voltage to drop or shut down), the electronic load automatically records the current value at which the protection occurred, as well as the total test time elapsed until that point.

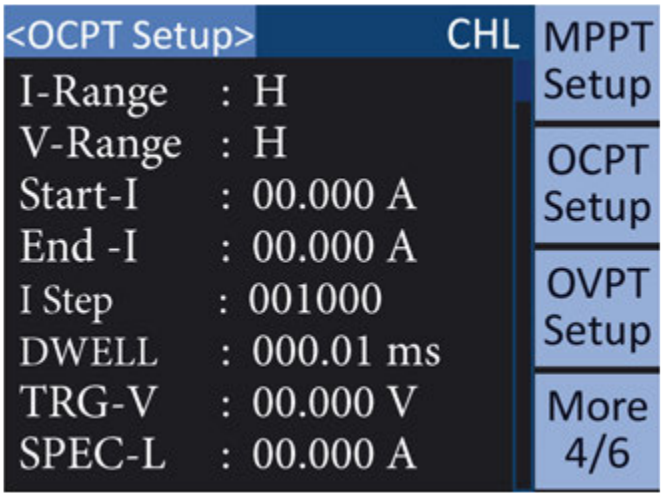


Figure 3.13 OCP Test Mode Setup Screen

Parameters	Description
Start Current	Defines the initial current level from which the OCP test begins its ramp or stepped increase. This value should typically be set below the expected OCP trip point of the DUT.
Step Current	Specifies the incremental amount by which the current is increased during each step of the test, as it progresses from the Start Current.
Step Time / Dwell Time	Determines the duration for which each current step is maintained before the load attempts to increase the current to the next level. This allows the DUT to stabilize at each current level.
Trip Voltage (Detection)	A voltage level that, if the DUT output drops below it, signifies that an OCP event (or other protection) has likely occurred. The load uses this or a similar condition to detect the trip. (This is a common OCP test parameter, specific setting method in DML for this detection criteria is not detailed in the provided function description).

Table 3.16 OCP Test Mode Parameters

NOTICE

After configuring the OCP test parameters, press the **On/Off** key on the front panel to enable the load input and initiate the OCP test sequence. The load will then execute the current ramp/steps until the DUT's protection triggers or the test concludes. The recorded OCP trip current and test time will be displayed or available for recall. Press the **On/Off** key again to stop the test or clear the load state.

To access and configure the OCP Test Mode parameters, press the **Shift** key and then the **I-SET** key (which is labeled as **OCP** for its shifted function). This action opens the "OCP test parameter setting" interface.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., Start Current, Step Current, Step Time).
- For most numerical values (Start Current, Step Current, Step Time): Press the **knob** to enter edit mode.
- Use the **knob** (for increasing/decreasing values) and (←, →) arrow keys (for selecting digit position) to adjust the value. Press **Enter** to confirm the new value.
- For any range selections or specific option choices within the OCP test menu: Use the **knob** to highlight, then press the appropriate **softkey** or menu navigation keys as indicated by the interface to select the desired option.

3.9 Over Voltage Protection Test (OVPT) Mode

The Over Voltage Protection Test (OVPT) function is designed to test the over-voltage protection capabilities of a Device Under Test (DUT). This mode allows the user to configure specific parameters such as the operational voltage range and a trigger voltage to observe the DUT's response when its output voltage reaches or exceeds critical thresholds. The setup for this mode is typically accessed via a dedicated interface, as indicated by "Figure 4-14 OVPT Setup Page" in the source document.

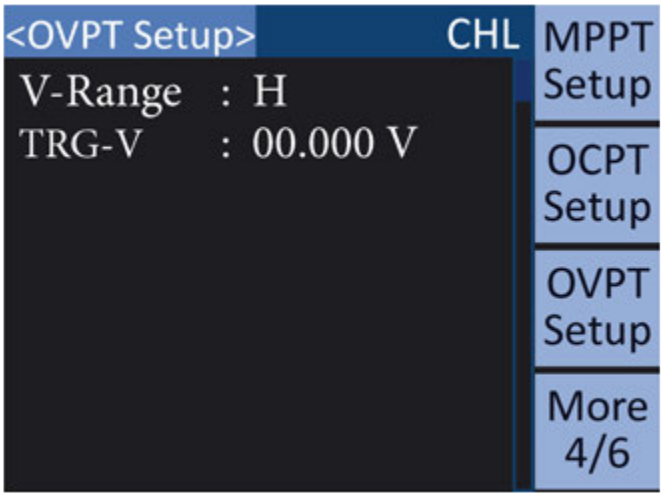


Figure 3.14 OVPT Setup Page

Parameters	Description
Voltage range	This setting defines the operational voltage range for the OVPT test. The voltage range is divided into high range, medium range, and low range. As an example, these might be 80V, 16V, and 6V respectively, depending on the specific instrument model.
Trigger voltage	This parameter represents the specific voltage level that, when reached or exceeded by the DUT's output, is intended to trigger the observation or test of the DUT's over-voltage protection mechanism.

Table 3.17 OVPT Mode Parameters

NOTICE

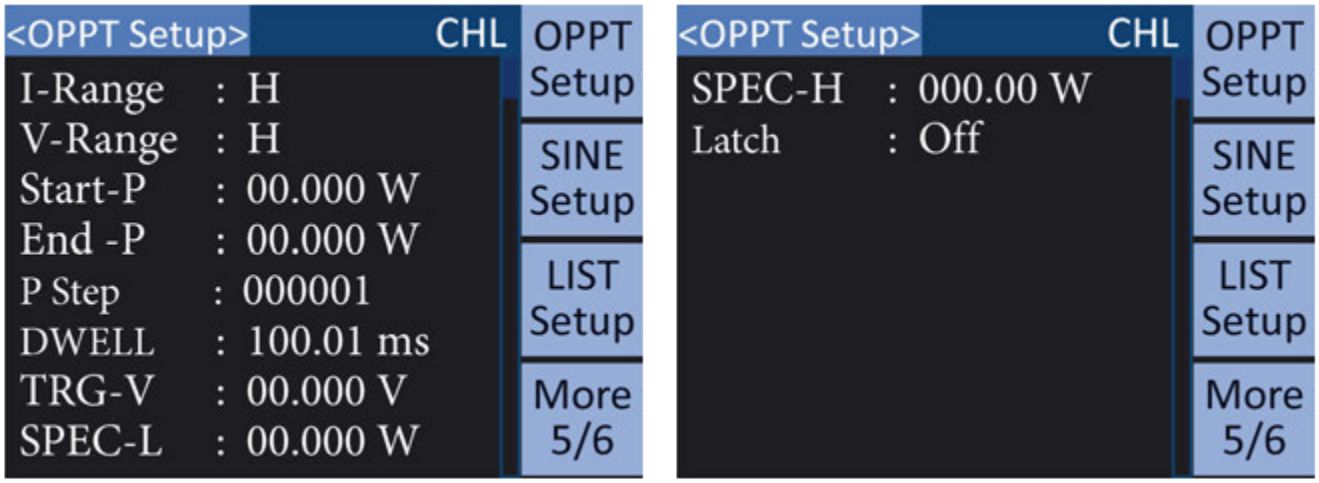
After configuring the OVPT parameters, the electronic load will monitor the input voltage from the DUT. The actual OVP test often involves the DUT's voltage rising (due to an external stimulus or an internal fault/test sequence in the DUT) towards the set trigger voltage. Enable the load input using the **On/Off** key as required by the overall test procedure. The load's role in OVPT mode is typically to provide a specified condition and monitor the voltage.

To access the OVPT setting interface, press the **SETUP** key. If the instrument is already in OVPT mode, it will automatically navigate to the OVPT setting interface. If the current mode is not OVPT mode, you can switch to the OVPT setting interface by toggling the menu key labeled as menu key 4 (More), or its equivalent navigation key, to find and select the OVPT settings option.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., Voltage range, Trigger voltage).
- For most numerical values (e.g., Trigger voltage): Press the **knob** (referred to as the 'knob change key' in the source) to enter edit mode.
- Use the **knob** (rotate up to increase, down to decrease) and (←, →) arrow keys (to change value position) to adjust the value. Alternatively, the value position can be changed by pressing the **knob** continuously. Press **Enter** to confirm and exit the editing state.
- For Ranges (e.g., Voltage range): Use the **knob** to turn the cursor to the voltage range setting, then press the appropriate **menu key** (or "different menu keys" as mentioned in the source) to change the voltage range accordingly.

3.10 Over Power Protection (OPP) Test Mode

The Over Power Protection (OPP) test function is designed to determine and verify the over-power protection point of a Device Under Test (DUT). In this mode, the electronic load typically increases the power it sinks from the DUT, often in defined steps, beginning from a user-defined starting power level. When the DUT's over-power protection mechanism activates, the electronic load automatically records the power value at which this protection event occurred, along with the total duration of the test up to that point.



OPP Test Mode Setup Page 1 OPP Test Mode Setup Page 2

Figure 3.15 OPP Test Mode Setup Screen

To access and configure the OPP Test Mode parameters, press the **Shift** key and then the **P-SET** key (which is labeled as **OPP** for its shifted function). This action opens the "OPP test parameter setting" interface.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., Current Range, Starting Power, Termination Power, Step Number, Duration, Trigger Voltage, Lower Power Limit, Power Limit).
- For most numerical values (Starting Power, Termination Power, Step Number, Duration, Trigger Voltage, Limit values): Press the **knob** to enter edit mode.
- Use the **knob** (for increasing/decreasing values) and (←, →) arrow keys (for selecting digit position) to adjust the value. Press **Enter** to confirm the new value.
- For Ranges (Current Range, Voltage Range): Use the **knob** to highlight the range parameter, then press the appropriate **menu key** or **Range** key (if directly applicable for this setting screen) to select the desired range.

Parameters	Description
Current Range	Selects the appropriate current operating range for the OPP test to ensure measurement accuracy and proper load operation.
Voltage Range	Selects the appropriate voltage operating range for the OPP test, ensuring the load can operate correctly within the DUT's expected voltage output during the power ramp and that measurements are accurate.
Starting Power	Defines the initial power level from which the OPP test begins its power increase. This should generally be set to a value below the DUT's anticipated OPP trip point.
Termination Power	Typically defines the target or maximum power level at which the OPP test will stop if the DUT's protection has not been triggered before this value is reached. (This specific parameter is not explicitly detailed for the DML OPP test mode in the provided manual).
Step Number	Usually specifies the total number of discrete power steps the load will apply between the Starting Power and the Termination Power. (This specific parameter is not explicitly detailed for the DML OPP test mode in the provided manual).
Duration	Often refers to the time duration for each power step (dwell time) in a stepped OPP test, or potentially a total test time if not defined by steps. The DML Series Operation Manual.pdf mentions recording 'test time' upon protection, but a settable 'duration' parameter for OPP test steps is not explicitly detailed.
Trigger Voltage	Generally defines a voltage threshold related to the OPP test. This might be a minimum voltage the DUT must maintain for the test to be considered valid, or the voltage level at which the OPP trip event is qualified. (This specific parameter is not explicitly detailed for the DML OPP test mode in the provided manual).
Lower Power Limit	Sets a minimum power threshold. This may function as a general operational boundary for the load (see general P-Limit Low Set function) or a specific floor for the test parameters. (Its role as a settable parameter within the OPP test setup specifically is not explicitly detailed in the provided manual).
Power Limit	Sets a maximum power threshold. This may function as a general operational boundary for the load (see general P-Limit High Set function) or a specific ceiling for the test parameters. (Its role as a settable parameter within the OPP test setup specifically is not explicitly detailed in the provided manual).
Pull Load Lock	The function or meaning of a parameter termed "Pull Load Lock" is not described in the DML Series Operation Manual.pdf, and its specific role in the context of OPP test mode is unclear from the provided source.

Table 3.18 OPP Test Mode Parameters

NOTICE

After configuring the OPP test parameters, press the **On/Off** key on the front panel to enable the load input and initiate the OPP test sequence. The load will then execute the defined power steps or ramp until the DUT's protection triggers or the test concludes (e.g., by reaching "Termination Power" or completing the specified "Duration"/"Step Number"). The recorded OPP trip power and test time will be displayed or available for recall. Press the **On/Off** key again to stop the test or clear the load state.

3.11 SINE Test Function

The SINE test function allows the electronic load to simulate a load condition where the current drawn has a sinusoidal AC component superimposed on a DC offset. This mode is used for tests requiring a sine wave load characteristic. Key settings for this function include configuring current and voltage operating ranges, the DC current offset, the amplitude of the AC current component, and the frequency of the sine wave. The setup interface for this mode is illustrated in "Figure 4-16 SINE Setup Page" as referenced in the source document.

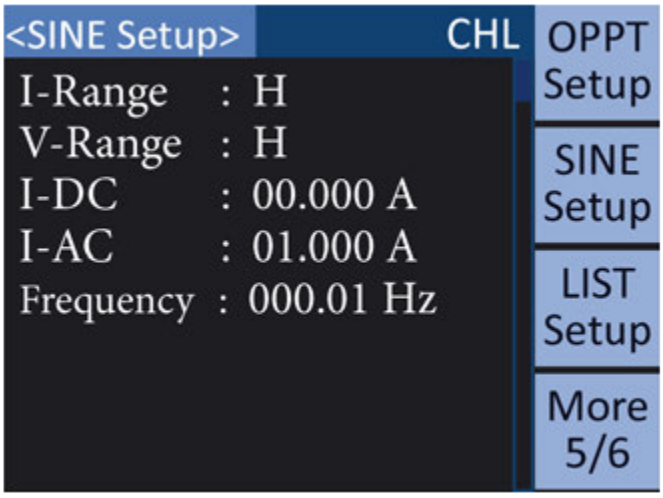


Figure 3.16 SINE Setup Page

Parameters	Description
Current range	This setting defines the operational current range for the SINE test. The current range is divided into high range, medium range, and low range to optimize measurement and control accuracy.
Voltage range	This setting defines the operational voltage range for the SINE test. The voltage range is divided into high range, medium range, and low range. As an example, these might be 80V, 16V, and 6V respectively, depending on the specific instrument model.
DC Current	This parameter represents the DC offset current value around which the AC sine wave will oscillate during the test.
AC Current	This parameter represents the peak amplitude of the AC sinusoidal current component that is superimposed on the DC current. The load current will vary as $I_{DC} + I_{AC}sin(2\pi ft)$.
Frequency	This parameter sets the frequency of the AC sinusoidal current component in the sine wave test.

Table 3.19 SINE Mode Parameters

NOTICE

After configuring all SINE mode parameters, press the **On/Off** key on the front panel to enable the load input and initiate the SINE wave loading function. Pressing the **On/Off** key again will disable the load input.

To access the SINE setting interface, press the **SETUP** key. If the instrument is already in SINE mode, it will automatically navigate to the SINE setting interface. If the current mode is not SINE mode, you can switch to the SINE setting interface by toggling the menu key labeled as menu key 4 (More), or its equivalent navigation key, to find and select the SINE settings option.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., Current range, DC Current, AC Current, Frequency).
- For most numerical values (DC Current, AC Current, Frequency): Press the **knob** (referred to as the 'knob change key' in the source) to enter edit mode.
- Use the **knob** (rotate up to increase, down to decrease) and (←, →) arrow keys (to change value position) to adjust the value. Alternatively, the value position can be changed by pressing the **knob** continuously. Press **Enter** to confirm and exit the editing state.
- For Ranges (Current range, Voltage range): Use the **knob** to turn the cursor to the range setting, then press the appropriate **menu key** (or "different menu keys" as mentioned in the source) to change the range accordingly.

3.12 List Mode

List mode allows the DML series electronic load to execute a pre-programmed sequence of different load steps, enabling complex load profile tests. Each step within a list file can be configured with its own operating mode (CC, CV, CR, CP, short circuit, or load on/off), a specific set value corresponding to that mode, a duration (pulse width), and a transition slope (slew rate). The instrument can store up to 7 regular list files and 1 copy list file, with each list file containing a maximum of 84 steps. This mode is particularly useful for simulating dynamic load changes, battery discharge profiles, and other scenarios requiring varied load conditions over time.

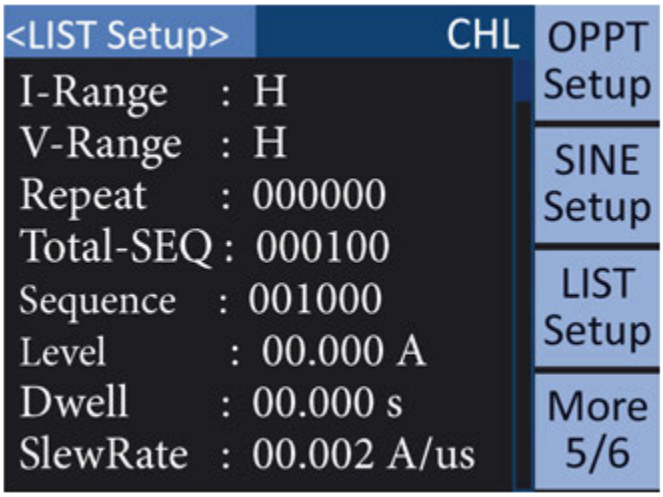


Figure 3.17 List Mode Setup Screen

To access and configure the List Mode parameters, press the **Shift** key and then the **AUTO TEST** key (which is labeled as **LIST** for its shifted function). This action opens the "List test parameter setting" interface. To manage list files (save, recall, delete), use the **File** key and navigate to the list file management options.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., File Number, Step Number, Operating Mode, Set Value, Pulse Width, Slope, Number of Repeat Times).
- For most numerical values (Set Value, Pulse Width, Slope, Number of Repeat Times): Press the **knob** to enter edit mode.
- Use the **knob** (for increasing/decreasing values) and (←, →) arrow keys (for selecting digit position or navigating fields) to adjust the value. Press **Enter** to confirm the new value.
- For selections like Operating Mode (per step) or File Number: Use the **knob** to highlight, then press the appropriate **softkey** or menu navigation keys (as indicated by the interface, potentially using **Enter** or knob rotation to cycle through options) to select the desired option.

Parameters	Description
File Number/Name	Selects the specific list file (from the 7 regular and 1 copy file slots) to be edited, executed, saved, or recalled.
Step Number	Identifies the particular step (1 to 84) within the selected list file that is currently being configured or viewed.
Operating Mode (per step)	Defines the load's behavior for the current step. Available modes include Constant Current (CC), Constant Voltage (CV), Constant Resistance (CR), Constant Power (CP), Short Circuit simulation, and simple Load On/Off states.
Set Value (per step)	Specifies the target numerical value for the chosen Operating Mode in the current step (e.g., current in Amps for CC mode, voltage in Volts for CV mode, resistance in Ohms for CR mode, or power in Watts for CP mode). This is not applicable if the mode is Short Circuit or Load Off.
Pulse Width (Duration per step)	Sets the duration for which the load maintains the conditions defined for the current step before proceeding to the next step in the list.
Slope (Slew Rate per step)	Defines the rate of change (slew rate) for the load to transition to the 'Set Value' of the current step. This is applicable for CC, CV, CR, and CP modes to control how quickly the new setpoint is reached. For current slew rate settings, refer to general current slew rate parameters.
Number of Repeat Times	Sets the number of times the entire sequence of steps within the selected list file will be repeated during execution.

Table 3.20 List Mode Parameters

NOTICE

After configuring the list file and its steps, select the desired list file for execution. Press the **On/Off** key on the front panel to enable the load input and start the List Mode sequence. The load will then proceed through the programmed steps. Pressing the **On/Off** key again will stop the sequence and disable the load input.

3.13 Auto Mode

Auto mode enables the DML series electronic load to automatically switch between different basic operating modes—Constant Current (CC), Constant Resistance (CR), Constant Voltage (CV), and Constant Power (CP)—in a programmed sequence. This function is designed for comprehensive testing of a Device Under Test (DUT) under a variety of load conditions without requiring manual intervention for each change. Each auto test file can contain up to 84 steps, and the instrument can store 7 regular auto files plus 1 copy auto file. For each step in an auto test sequence, parameters such as the operating mode, the set value for that mode, a delay time, GO/NG (Pass/Fail) judgment criteria, and upper/lower limits for judgment can be configured.

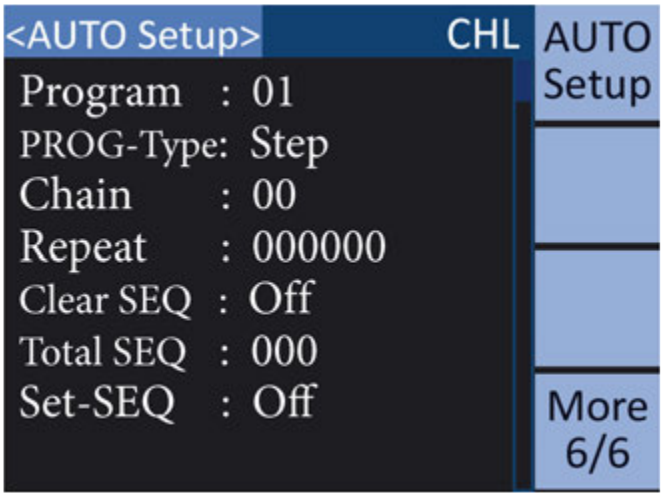


Figure 3.18 Auto Mode Setup Screen

To select Auto Mode, press the **Mode** key repeatedly until "AUTO" is displayed, then press **Enter**. To access and configure the Auto Mode parameters for the steps within a file, press the **Shift** key and then the **LIST** key (which is labeled as **AUTO TEST** for its shifted function). This action opens the "Auto test parameter setting" interface. To manage auto test files (save, recall, delete), use the **File** key and navigate to the auto file management options.

- Use the **knob** to navigate and highlight the parameter you want to change (e.g., File Number, Step Number, Operating Mode, Set Value, Delay Time, GO/NG Judgment, Upper Limit, Lower Limit).
- For most numerical values (Set Value, Delay Time, Upper Limit, Lower Limit): Press the **knob** to enter edit mode.
- Use the **knob** (for increasing/decreasing values) and (←, →) arrow keys (for selecting digit position or navigating fields) to adjust the value. Press **Enter** to confirm the new value.
- For selections like Operating Mode (per step), GO/NG Judgment (Enable/Disable), or File Number: Use the **knob** to highlight, then press the appropriate **softkey** or menu navigation keys (as indicated by the interface, potentially using **Enter** or knob rotation to cycle through options) to select the desired option.

Parameters	Description
File Number/Name	Selects the specific auto test file (from the 7 regular and 1 copy file slots) to be edited, executed, saved, or recalled.
Step Number	Identifies the particular step (1 to 84) within the selected auto test file that is currently being configured or viewed.
Operating Mode (per step)	Defines the load's behavior for the current step. Available modes are Constant Current (CC), Constant Resistance (CR), Constant Voltage (CV), or Constant Power (CP).
Set Value (per step)	Specifies the target numerical value for the chosen Operating Mode in the current step (e.g., current for CC, resistance for CR, voltage for CV, or power for CP).
Delay Time (per step)	Sets the duration for which the load maintains the conditions defined for the current step before proceeding to the next step or performing a GO/NG judgment.
GO/NG Judgment (per step)	Enables or disables the Pass/Fail judgment for the current step. If enabled, the load will compare a measured value against the set upper and lower limits to determine a GO (Pass) or NG (Fail) status.
Upper Limit (for GO/NG)	If GO/NG judgment is enabled for the step, this parameter sets the upper boundary for the measured value (e.g., measured voltage, current) to qualify as a Pass (GO) condition.
Lower Limit (for GO/NG)	If GO/NG judgment is enabled for the step, this parameter sets the lower boundary for the measured value to qualify as a Pass (GO) condition.

Table 3.21 Auto Mode Parameters

NOTICE

After configuring the auto test file and its steps, select the desired file for execution. Press the **On/Off** key on the front panel to enable the load input and start the Auto Mode sequence. The load will then proceed through the programmed steps, switching modes and applying set values as defined. Pressing the **On/Off** key again will stop the sequence and disable the load input.

System

4.1 System Setup

The system settings menu allows for the configuration of the instrument's fundamental operational parameters, including power-on state, display and sound preferences, and system reset functions.

4.1.1 Instructions and operation

To access the system settings menu, press the **System** key. The interface will display the parameters available for modification.

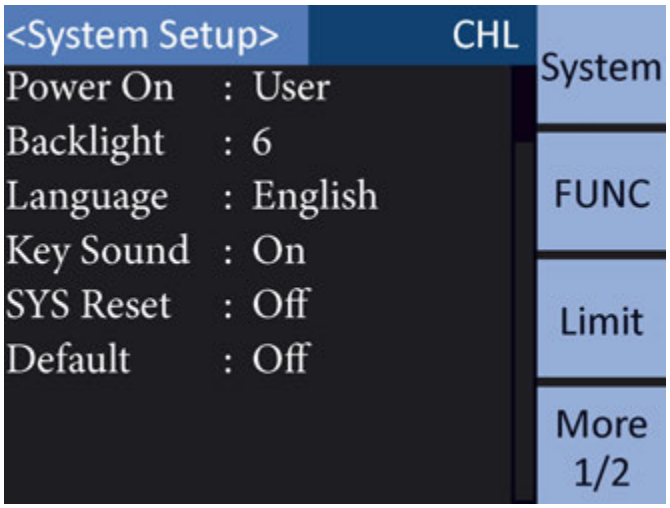


Figure 4.1 System Setup Screen

4.1.2 Setting parameter description and operation

The following table details the parameters available in the System Setup menu.

Parameters	Description
Power On	Determines the instrument's state upon startup. Options are `Default` (factory settings) and user-defined parameters.
Backlight	Adjusts the brightness of the LCD screen on a scale from 1 to 10. (***Use the knob to highlight, then press the '+' or '-' buttons to change the value.***)
Language	Sets the user interface language. Options are Chinese and English.
Key Sound	Enables or disables the audible tone that sounds upon a key press.
SYS Reset	Initiates a system reboot. (***Use the corresponding softkey to activate.***)
Default	Restores all instrument settings to their original factory defaults. (***Use the corresponding softkey to activate.***)

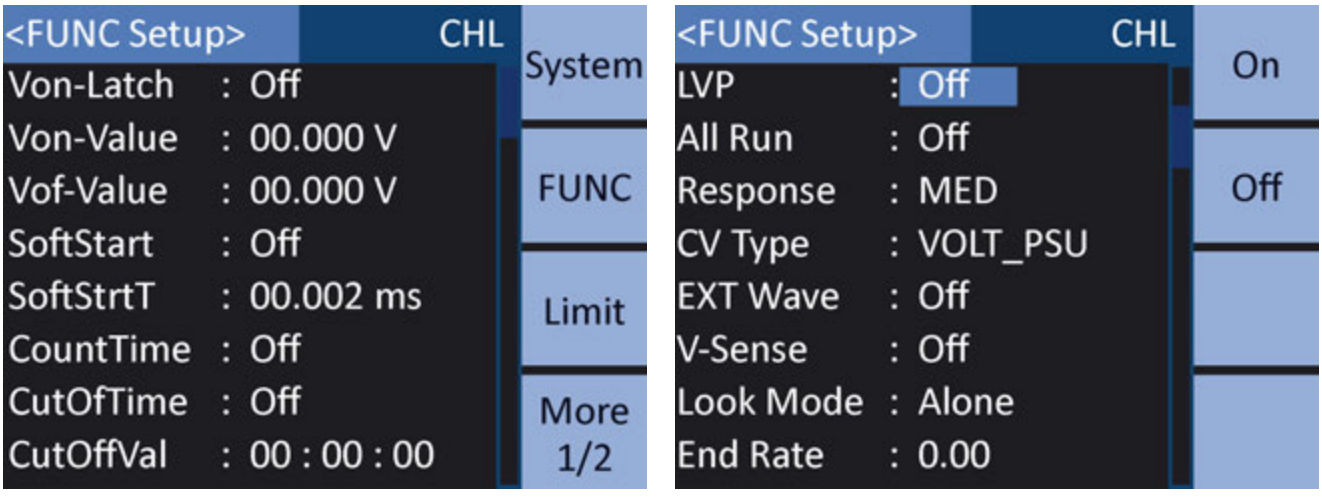
Table 4.1 System Setup Parameters

4.2 Function Setting

Function settings provide detailed control over the load's operational behaviors, including voltage-triggered actions, soft start, timing functions, protection features, and other advanced configurations.

4.2.1 Description and operation

To access the function settings, press the **System** key to enter the system menu, then press the softkey corresponding to **FUNC**. The interface will display two pages of parameters for modification.



Function Setup Page 1 Function Setup Page 2

Figure 4.2 Function Setting Screens

4.2.2 Setting parameter description and operation

The following table details the parameters available in the Function Setting menu.

Parameters	Description
Von-Latch	Enables or disables the start voltage latch. When enabled, the load continues to draw current if the voltage reaches Von.
Von-Value	Sets the minimum starting voltage threshold for the electronic load to begin drawing current.
Vof-Value	Sets the shutdown voltage. The load will stop drawing current when the DUT voltage drops below this value. To avoid logic errors, Voff should generally be less than or equal to Von.
SoftStart	Enables or disables the soft start function.
SoftStrtT	Sets the soft start time duration for the electronic load.
CountTime	Enables or disables the positive timing (count-up timer) function.
CutOffTime	Enables or disables the countdown timer function.
CutOffVal	Sets the time for the countdown operation.
LVP	Enables or disables the low voltage protection switch.
All Run	When enabled, pressing the **LOAD** key for any module with this function on will cause all such modules to draw current simultaneously.
Response	Sets the speed of the electronic load's voltage response.
CV Type	Distinguishes the voltage types for different power supplies, including Current PSU and Voltage PSU.
EXT Wave	Enables the use of an external waveform generator to drive the current in CC mode.
V-Sense	Enables the remote voltage Sense terminal to avoid errors from voltage drops on the test line, especially useful for precise CR or CV tests.
Lock Mode	Determines if pressing the **Lock** key locks a single module or all modules.

Table 4.2 Function Setting Parameters

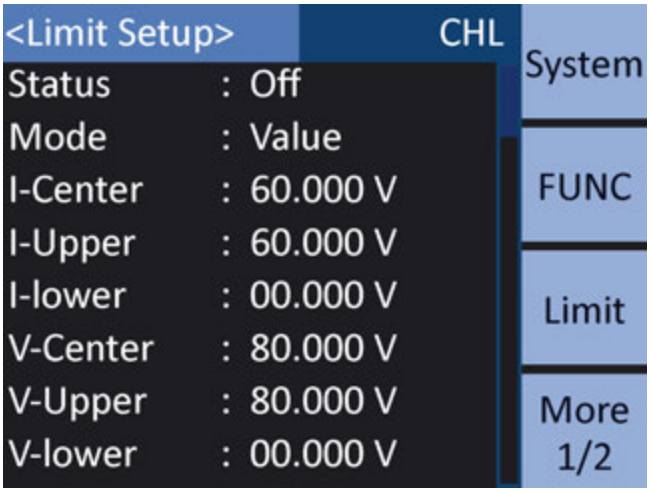
4.3 Limit Settings

The limit setting menu allows for the configuration of upper and lower boundaries for current, voltage, and power measurements, enabling Pass/Fail judgment of the DUT's performance.

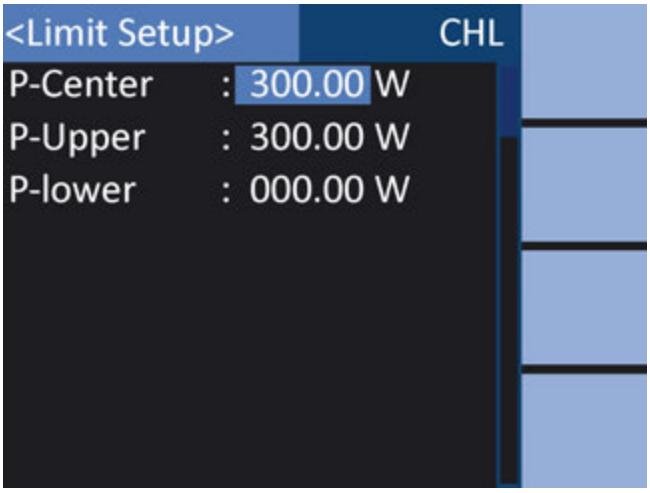
4.3.1 Instructions and operation

The limit settings include configuring the limit judgment status (On/Off), the judgment mode (absolute value or percentage), and the reference, upper, and lower values for current, voltage, and power. The configuration interface is shown in Figure ?? and Figure ??.

Press the **System** key to access the system menu, then press the softkey corresponding to **Limit** to enter the limit setting interface.



Limit Settings Page 1



Limit Settings Page 2

Figure 4.3 Limit Settings Screens

4.3.2 Setting parameter description and operation

The following table details the parameters available in the Limit Settings menu. For numerical values, use the **knob** to select the parameter, press the **knob** to enter edit mode, adjust the value with the **knob** and arrow keys, and press **Enter** to confirm.

4.4 Online Settings

The online settings menu is used to configure modules for parallel operation, allowing multiple modules to function together as a single, higher-power load. This section details the configuration of parallel modes and connection types.

4.4.1 Instructions and operation

Online settings include online mode setting, online status setting, and online type setting. The configuration interface is shown in Figure ??.

Parameters	Description
Status	Enables or disables the limit judgment function. (***Use softkeys to change value.***)
Mode	Sets the limit mode to either absolute numeric values or percentage-based values.
I-Center	Sets the reference current for limit calculations.
I-Upper	Sets the upper current limit for judgment.
I-lower	Sets the lower current limit for judgment.
V-Center	Sets the reference voltage for limit calculations.
V-Upper	Sets the upper voltage limit for judgment.
V-lower	Sets the lower voltage limit for judgment.
P-Center	Sets the reference power for limit calculations.
P-Upper	Sets the upper power limit for judgment.
P-lower	Sets the lower power limit for judgment.

Table 4.3 Limit Settings Parameters

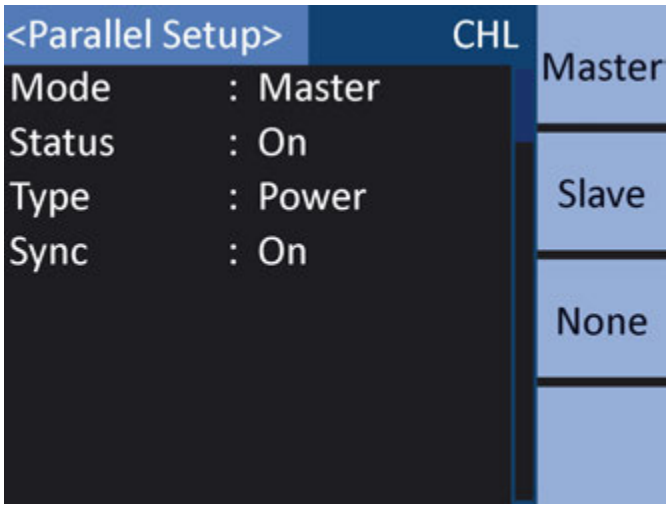


Figure 4.4 Online Setup Screen

Press the **System** key to access the system menu. Use the **More** softkey (menu key 4) to navigate to the second page of options, then press the softkey corresponding to **PARAL** (online setting) to enter the online setting interface.

4.4.2 Setting parameter description and operation

The following table details the parameters available in the Online Settings menu.

Parameters	Description
Online mode	Sets the module's role in the parallel configuration. Options are `Standalone`, `Slave`, and `Master`. (***Use softkeys to change value.***)
Online Status	Enables or disables the parallel connection. This can only be turned on for a module set as the Master. An online failure will be indicated if more than one Master is detected. (***Use softkeys to change value.***)
Online Type	Displayed on the Master module after a successful connection. `Power` mode assigns current to each module proportional to its power level. `Copy` mode makes each slave module pull the same current value as the Master. (***Use softkeys to change value.***)

Table 4.4 Online Settings Parameters

4.5 Digital Setup

The digital setup menu provides access to the instrument's waveform digitization functions. This allows for the capture of transient voltage and current events by configuring sampling parameters and trigger conditions.

4.5.1 Instructions and operation

The digitization settings include sample time, sample points, trigger source, and trigger point. The configuration interface is shown in Figure ??.

Press the **System** key to access the system menu. Use the **More** softkey (menu key 4) to navigate to the second page of options, then press the softkey corresponding to **DIGIT** (digital setting) to enter the digitization setup interface.

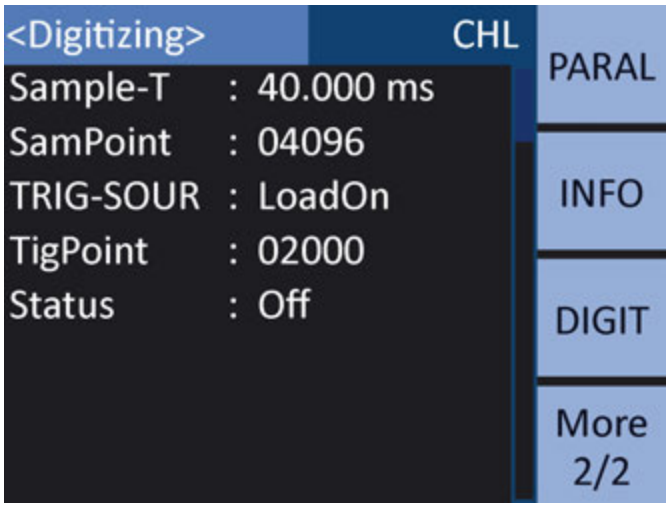


Figure 4.5 Digitization Setup Screen

4.5.2 Setting parameter description and operation

The following table details the parameters available in the Digital Setup menu. For numerical values, use the **knob** to select the parameter, press the **knob** to enter edit mode, adjust the value with the **knob** and arrow keys, and press **Enter** to confirm.

Parameters	Description
Sample-T	Sets the sampling time interval. The configurable range is from 10µs to 40ms.
SampPoint	Sets the number of sampling points to be captured. The configurable range is from 1 to 4096.
TRIG-SOUR	Sets the event that will trigger the start of the digitization capture. Options include `LoadOn`, `LoadOff`, `TTL`, `BUS`, and `MANUAL`. (***Use softkeys to change value.***)
TrigPoint	Sets the position of the trigger event within the captured data record.
Status	Enables or disables the digitization function. (***Use softkeys to change value.***)

Table 4.5 Digital Setup Parameters

4.6 Machine Information and Upgrades

This menu displays the current software and firmware versions for the instrument's main components and provides the interface for performing firmware upgrades.

4.6.1 Instructions and operation

The machine information page displays the software versions for the main frame (baseboard), the front panel of the module, and the module's DSP. From this page, the user can initiate upgrades for each of these components. The interface is shown in Figure ??.

Press the **System** key to access the system menu. Use the **More** softkey (menu key 4) to navigate to the second page of options, then press the softkey corresponding to **INFO** to enter the machine information and upgrade interface.

4.6.2 Setting parameter description and operation

The following table details the parameters and functions available in the Machine Information menu.

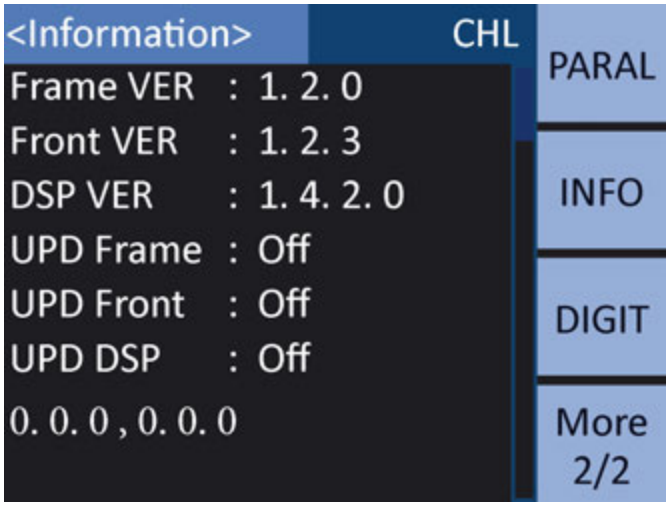


Figure 4.6 Machine Information Screen

Parameters	Description
Frame VER	Displays the current software version of the instrument's mainframe (baseboard).
Front VER	Displays the current software version of the module's front panel controller.
DSP VER	Displays the current software version of the module's Digital Signal Processor (DSP).
UPD Frame	Initiates an upgrade for the mainframe (baseboard) software. (***Use the knob to select, then press menu key 1 to start the upgrade.***)
UPD Front	Initiates an upgrade for the module's front panel software. (***Use the knob to select, then press menu key 1 to start the upgrade.***)
UPD DSP	Initiates an upgrade for the module's DSP software. (***Use the knob to select, then press menu key 1 to start the upgrade.***)

Table 4.6 Machine Information and Upgrade Parameters

4.7 Baseboard Setup

The baseboard setup menu is dedicated to configuring the communication between the instrument's mainframe (baseboard) and external devices. This includes the setup for the System I/O interface and the CAN bus address.

4.7.1 Instructions and operation

The parameters available in this menu allow for the functional configuration of digital I/O ports (DIO) and the setup of the CAN interface address, state, and mode. The configuration interface is shown in Figure ??.

Press the **Frame** key to switch directly to the baseboard settings page.

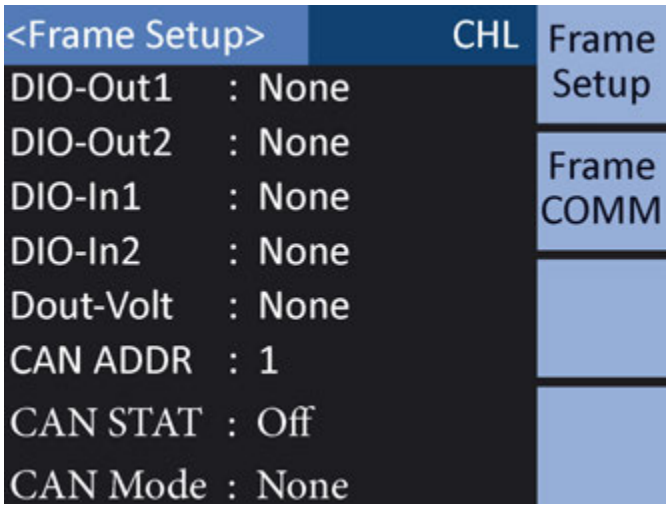


Figure 4.7 Baseboard Settings Screen

4.7.2 Setting parameter description and operation

The following table details the parameters available in the Baseboard Setup menu.

Parameters	Description
DIO-Out1	Configures the function of the digital output port 1. (***Use softkeys to change value.***)
DIO-Out2	Configures the function of the digital output port 2. (***Use softkeys to change value.***)
DIO-In1	Configures the function of the digital input port 1. (***Use softkeys to change value.***)
DIO-In2	Configures the function of the digital input port 2. (***Use softkeys to change value.***)
Dout-VOLT	Configures the voltage level of the digital output port. (***Use softkeys to change value.***)
CAN ADDR	Sets the CAN address, configurable in the range of 1 to 10. (***Use the '+' or '-' keys to change the value.***)
CAN STAT	Sets the switching state (On/Off) of the CAN interface. (***Use softkeys to change value.***)
CAN Mode	Sets the online mode (e.g., Master/Slave) of the current frame for CAN communication. (***Use softkeys to change value.***)

Table 4.7 Baseboard Setup Parameters

4.8 Baseboard Communication

This menu is used to configure the communication parameters for the various interfaces on the mainframe (baseboard), enabling remote control and data exchange with a host computer.

4.8.1 Description and operation

Baseboard communication settings allow the user to select and configure the active communication interface, including RS232, LAN, USBTMC, USBCDC, and GPIB. Depending on the selected mode, parameters such as IP address, baud rate, and GPIB address can be set. The configuration interface is shown in Figure ??.

Press the **Frame** key to enter the baseboard menu, then press the softkey corresponding to **Frame COMM** to switch to the baseboard communication setting interface.

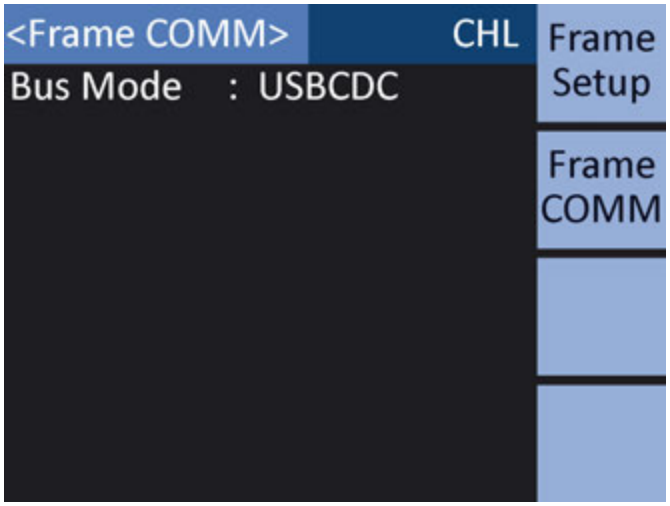


Figure 4.8 Baseboard Communication Screen

4.8.2 Setting parameter description and operation

The following table details the parameters available in the Baseboard Communication menu. To edit a numerical value, use the **knob** to select the parameter, press the **knob** to enter edit mode, adjust the value with the **knob** and arrow keys, and press **Enter** to confirm.

Parameters	Description
Bus Mode	Selects the active communication interface. Options include RS232, LAN, USBTMC, USBCDC, and GPIB. (***Use softkeys to change value.***)
LAN PROTO	Sets the communication protocol for the LAN interface (e.g., TCP/IP).
DHCP	Enables or disables the Dynamic Host Configuration Protocol for automatic IP address assignment.
TCP Port	Sets the TCP port number for network communication.
IP ADDR	Sets the static IP address for the instrument.
Gateway	Sets the network gateway address.
Net Mask	Sets the subnet mask for the network.
Baud Rate	(Visible in RS232 Mode) Sets the data transmission rate for the serial interface.
GPIB Address	(Visible in GPIB Mode) Sets the GPIB address for the instrument.

Table 4.8 Baseboard Communication Parameters

File Management

This chapter describes the instrument's file management capabilities, which allow for saving and recalling instrument settings.

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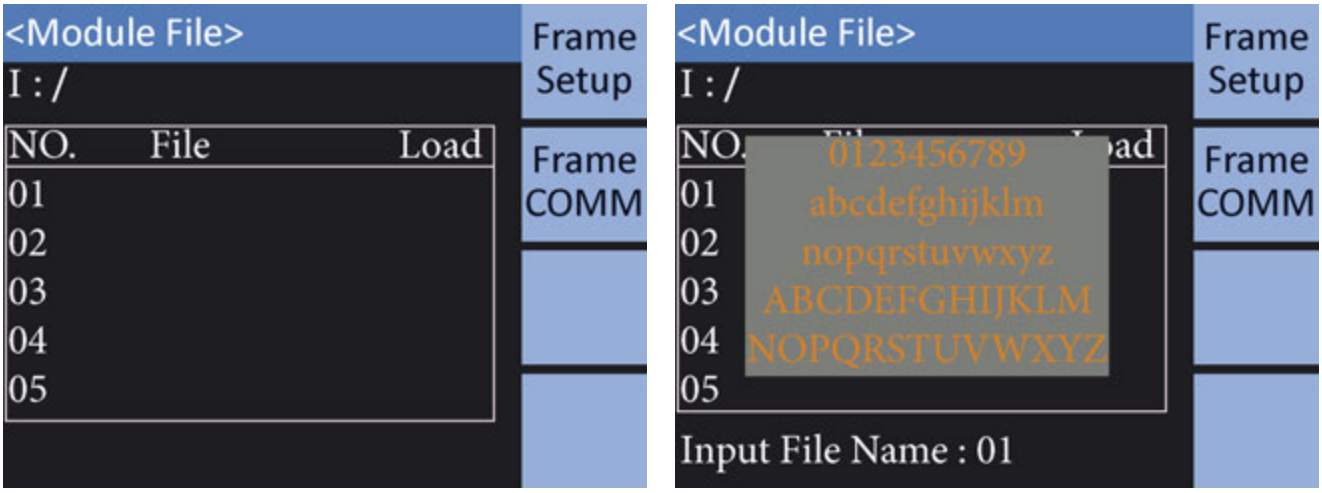
5.1 Module File

5.1.1 Description

The DML series electronic load can store all user-configured parameters as a file in the internal non-volatile memory. When the same settings are required for a future test, the user can simply load the corresponding file without needing to reconfigure the parameters. The instrument can store up to 40 internal files. The file management interface is shown in Figure ?? and Figure ??.



Module file page File save page

Figure 5.1 File Management Screens

5.1.2 Operation

Press the **File** module key to enter the '<Module File>' page.

5.1.2.1 Save

- Use the **knob** to navigate to an empty file number.
- Press the softkey corresponding to **Save**. A confirmation prompt will appear at the bottom of the page.
- Press the softkey corresponding to 'Yes'. A character selection panel will appear.
- Use the **knob** to select characters and press the **knob** to add them to the filename. Use the **Delete** and **Clear** softkeys to edit the name.
- Once the filename is entered, press the softkey corresponding to 'OK' to save the file.

5.1.2.2 Load

- Use the **knob** to navigate to the desired file number.
- Press the softkey corresponding to **Load** to recall the settings from the selected file.

5.1.2.3 Unload

- Use the **knob** to navigate to a currently loaded file (indicated by a checkmark).
- Press the softkey corresponding to **Unload** to deactivate the settings from that file.

5.1.2.4 Delete

- Use the **knob** to navigate to the file number you wish to delete.
- Press the softkey corresponding to **Delete** to permanently remove the selected file.

Communication Interface

This chapter provides detailed information on the various communication interfaces available on the DML series, including RS232, USBTMC, USBCDC, and GPIB, for remote control and data communication.

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6.1 RS232 Interface

6.1.1 Description

The RS-232 standard is a widely used serial communication protocol for data exchange between computers and peripheral devices. The DML series provides a minimal subset of the RS-232 standard, utilizing a 9-pin DB-type socket for connectivity.

Signal	Symbol	25-pin	9-pin
Request to send	RTS	4	7
Clear send	CTS	5	8
Data setup preparation	DSR	6	6
Data carrier detection	DCD	8	1
Data terminal preparation	DTR	20	4
Sending data	TXD	2	3
Receiving data	RXD	3	2
Grounding	GND	7	5

Table 6.1 Standard RS-232 Signals (9-pin)

Signal	Symbol	Pin Number
Sending data	TXD	3
Receiving data	RXD	2
Grounding	GND	5

Table 6.2 DML RS-232 Pinout

NOTICE

To avoid electrical shock, turn off the power before plugging or unplugging the connector. Do not short the output terminal to the case to avoid damaging the device.

6.1.2 Operation

6.1.2.1 RS232 connection to computer

A three-wire connection cable (less than 1.5m) is required. When creating a custom cable, pins 4 and 6 should be shorted on the computer connector, and pins 7 and 8 should also be shorted.

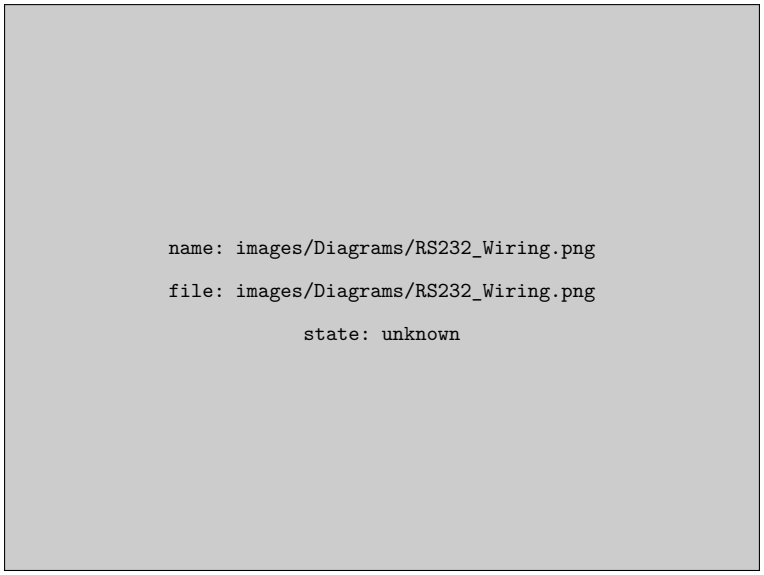

Figure 6.1 RS-232 Wiring Diagram

6.1.2.2 Format of data sent and received

The instrument uses a full-duplex asynchronous communication method with a data format of 8 data bits, 1 stop bit, and no parity. The ending character is a line feed <LF> (ASCII 10).

6.1.2.3 Select Baud Rate

The available baud rates are 9600, 19200, 28800, 38400, 57600, and 115200. The factory default is 9600.

6.2 USBTMC Remote Control System

The USB Test and Measurement Class (USBTMC) system allows for device control via the USB interface, compliant with USBTMC-USB488 and USB2.0 protocols.

6.2.1 System Configuration

Connect the USB port on the rear panel of the instrument to a USB port on the host computer using a standard USB cable.

6.2.2 Installing the driver

The first time the instrument is connected to a computer via USB, a "New Hardware" prompt will appear, followed by a driver installation wizard. Follow the on-screen prompts, selecting "Automatically install software". After installation, the "usb test and measurement device" will appear in the computer's Device Manager.

6.3 USBCDC

6.3.1 Description

The USBCDC (Communications Device Class) function allows the instrument's USB port to be used as a virtual serial port (VCOM). This provides the familiar functionality of an RS232 interface over a USB connection. All settings applicable to the RS232 interface are suitable for the USBCDC virtual serial interface.

6.3.2 Installing the driver

The driver can be downloaded from the official Tonghui Electronics website. The installation method is the same as for USBTMC. After installation, "DML USB Vcom Port" will appear in the computer's Device Manager.

6.4 GPIB Interface

The IEEE 488 (GPIB) General Purpose Parallel Bus Interface is an international standard for intelligent instrument control, allowing multiple instruments (up to 15) to be connected on the same bus for automated testing.

NOTICE

The total cable length of a GPIB system should not exceed 2 meters multiplied by the number of connected instruments, with an absolute maximum length of 20 meters.

6.4.1 GPIB interface function

The instrument supports most standard GPIB functions as detailed in the table below.

Code Name	Function
SH1	Support all data source contact functions
AH1	Support all fiduciary contact functions
T5	Basic speak function; serial roll call not supported
L4	Basic listen function; no listen-only function
RL1	Remote control / local function
DC1	Device Clear Function
DT1	Device trigger function
CO	No controller function
E1	Open collector drive

Table 6.3 GPIB Interface Functions

6.4.2 GPIB Address

The instrument uses a single GPIB address, which can be set from 1 to 31. The factory default address is 1.

Service Information

Warranty Service: Please go to the support and service section on our website to obtain an RMA #. Return the product in the original packaging with proof of purchase to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device.

Non-Warranty Service: Please go to the support and service section on our website to obtain an RMA #. Return the product in the original packaging to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device. Customers not on an open account must include payment in the form of a money order or credit card. For the most current repair charges please refer to the service and support section on our website.
Return all merchandise to B&K Precision Corp. with prepaid shipping. The flat-rate repair charge for Non-Warranty Service does not include return shipping. Return shipping to locations in North America is included for Warranty Service. For overnight shipments and non-North American shipping fees please contact B&K Precision Corp.

Include with the returned instrument your complete return shipping address, contact name, phone number and description of problem.

LIMITED THREE-YEAR WARRANTY

B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of **13years** from date of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

To help us better serve you, please complete the warranty registration for your new instrument via our website.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. The warranty is void if the serial number is altered, defaced or removed.

B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages. So the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

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