KEITHLEY

Model 595 Quasistatic CV Meter
Quick Reference Guide

INTRODUCTION

This reference and programming guide contains condensed specifications, descriptions of the various features and information for using the Model 595. Also, IEEE-488 programming information and several example programs written for commonly used controllers are also included to get the Model 595 "up and running" on the bus.

The Model 595 Quasistatic CV Meter measures capacitance using a unique feedback charge method. This method corrects capacitance readings for background leakage current. A built-in IEEE-488 interface, plotter driver and labeled grid program enable the Model 595 to plot IV or quasistatic CV curves for a variety of semiconductor materials and components.

www.valu

TABLE OF CONTENTS

www.valu

CONDENSED SPECIFICATIONS

CAPACITANCE

Range	Reso- lution	Accuracy* (1 Year) 18-28°C ±(%rdg+counts)	Maximum Allowable Q/t at Half Range C Delay Time=0.07sec Step V=0.1V
200pF	10fF	1.0 + 10	90.000pA
2nF	100fF	0.8 + 2	0.900nA
20nF	1pF	0.6 + 2	9.000nA

*Exclusive of noise, for Step V ≥ 0.05V and
 Delay Time ≤ one second.

CURRENT

Range	Reso- lution	Accuracy* (1 Year) 18-28°C ±(%rdg+counts)	Temperature Coefficient 0-18°C & 28-40°C ±(%rdg+counts)/°C
20pA	1fA	1.5 + 14	0.15 + 3
200pA	10fA	1.5 + 2	0.15 + 0.3
2nA	100fA	0.25 + 6	0.015 + 3
20nA	1pA	0.25 + 1	0.015 + 0.3
200nA	10pA	0.1 + 4	0.01 + 3
2μA	100pA	0.1 + 1	0.01 + 0.3
20μA	1nA	0.1 + 4	0.01 + 3
200μA	10nA	0.1 + 1	0.01 + 0.3

*When properly zeroed.

VOLTAGE SOURCE

OUTPUT: −20.00V to 20.00V in 0.01V increments.

ACCURACY (1 YEAR, 18−28°C): ±(0.2% + 10mV).

MAXIMUM OUTPUT CURRENT: ±2mA; active current limit at <4mA.

ANALOG OUTPUTS

C,I OUTPUT LEVEL: 1V represents 10,000 display counts on X1 gain; 1000 display counts on X10 gain.

VOLTAGE OUTPUT LEVEL: 1V represents 10V on voltage source output.

MAXIMUM OUTPUT VOLTAGE: ±2V.

GENERAL

MAXIMUM INPUT: 30V peak, DC to 60Hz sine wave.

MAXIMUM COMMON MODE VOLTAGE: 30V maximum, DC to 60Hz sine wave.

ENVIRONMENT: Operating: 0° to 40°C, relative humidity 70% non-condensing up to 35°C. **Storage:** −25° to 65°C.

WARM UP: 2 hours to rated accuracy except input bias current (<10fA after 2 hours, <5fA after 8 hours, at 23°C)

POWER: 105-125V or 210-250V (internal switch selected), 50Hz to 60Hz, 15VA max. 90-110V and 180-220V version available upon request.

www.valu

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation

Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If ⏚ or ⏚ is present, connect it to safety earth ground using the wire recommended in the user documentation.

The ⚠ symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The ⚡ symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect

of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

SAFETY PRECAUTIONS

1. Before operation, ground the instrument through a properly earth-grounded power receptacle.

2. Before servicing, disconnect the instrument from the power line and all other equipment. Consult the Model 595 Instruction Manual for service information.

3. Do not touch any terminals while the instrument is turned on or connected to any test equipment.

WARNING
The maximum common mode input voltage (the voltage between input low and chassis ground) is 30V peak. Exceeding this value may create a shock hazard.

CAUTION
The maximum voltage between input high and input low is 30V peak. Exceeding this value may cause damage to the instrument. Current inputs that exceed 3mA may be erroneously displayed as an on-scale reading.

www.valu

DISPLAY MESSAGES

Message	Description
OFF	Voltage source is OFF (0.00V ±0.01V) and Model 595 is set to measure capacitance.
dc	Voltage source is set to DC waveform and Model 595 is set to measure capacitance.
A1	Software revision level; displayed as part of diagnostics.
P.=S P.=O P.=C	Troubleshooting diagnostics: Phases: signal, zero and calibration reference.
OL	Overload (overrange input applied); −OL for negative value.
triG	Instrument is waiting for a trigger (bus, external, or front panel SHIFT, then ±).
bErr	Bus Error: Instrument programmed while not in remote; or illegal command or command option sent.
nErr	Number Error: Calibration, voltage source, waveform parameter, or program value beyond allowable range.
tErr	Trigger Overrun Error: Instrument triggered during a measurement conversion.
r.r.	RAM Test Failure: ON while RAM memory is being tested. If message remains, the test failed.
r.o.	ROM Test Failure: ON while ROM memory is being tested. If message remains, the test failed.
[*].[*].	Flashing Decimal Points in Exponents: Power up calibration constants are not in use (due to nonvolatile memory error on power up or calibration adjustment without storage).
[*].[*].	Decimal Points Turned On in Exponent: Calibration program is in use.

SHIFT
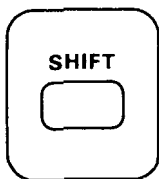
Several of the front panel buttons have a secondary function. These functions are labeled in yellow, as is the SHIFT button. Secondary functions are selected by first pressing the SHIFT button and then pressing the desired feature button. More information on these secondary functions can be found in the following text.

www.valu

METER Block
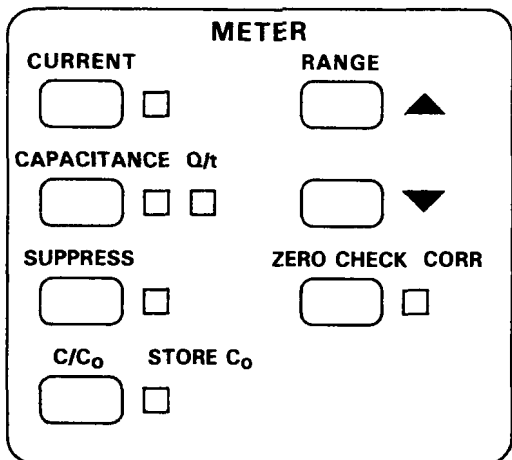
MEASUREMENT FUNCTIONS

CURRENT

The CURRENT button places the Model 595 in the current measurement function. Any one of eight ranges (200pA to 200μA) may be used with this function.

OPERATION

1. Enable ZERO CHECK.
2. Press CURRENT function button.
3. Select the appropriate range.
4. ZERO CORRect the instrument if it is not reading zero (it is best to do this on the 20pA range).
5. Connect the signal to the rear panel and C,I METER INPUT.
6. Turn ZERO CHECK off.

CAPACITANCE, Q/t

The CAPACITANCE button places the Model 595 in the capacitance measurement function. There are three capacitance ranges: 20nF, 2nF, and 200pF.

OPERATION

1. Enable ZERO CHECK.
2. Press CAPACITANCE button.
3. Select the desired range.
4. Connect the device to be measured between the rear panel VOLTAGE SOURCE OUTPUT and C,I METER INPUT.
5. Turn ZERO CHECK off.

Q/t displays the current flowing through the device at the end of the delay time. Note: the capacitance function must be enabled to select Q/t.

OPERATION

1. Follow steps 1-5 under capacitance.
2. Press SHIFT, then Q/t to display Q/t.

SUPPRESS

The SUPPRESS button allows the user to compensate for external offsets present in the test set up by subtracting the offset value from subsequent readings. Suppress may be used with capacitance or current measurements, but does not apply to Q/t readings. The instrument can be toggled between Q/t and capacitance without losing the stored value.

OPERATION

1. Select desired function and range.
2. Input the offset or baseline level to the Model 595.
3. Press the SUPPRESS button. The SUPPRESS indicator light will turn on and the display will zero.
4. SUPPRESS can be turned off again by pressing the SUPPRESS button.

C/C_O - STORE C_O

C/C_O allows the user to normalize capacitance to a stored capacitance value (C_O). C/C_O applies only to the capacitance reading (even while Q/t is being displayed). Once a value of C_O is stored, it will be retained in memory until a new value is stored or the instrument is turned off.

OPERATION

1. Set up the desired capacitance measurement.
2. Press SHIFT, then STORE C_0. The next reading will be stored as C_0.
3. Press C/C_0 to normalize the capacitance readings to C_0.

RANGE

The Range buttons select the desired range of measurement for the Model 595. Always use the range that allows the greatest amount of resolution.

OPERATION

1. To uprange, press the RANGE ▲ button.
2. To downrange, press the RANGE ▼ button.

ZERO CHECK and CORRect

Zero check is used to protect the input amplifier of the Model 595 from overloads and switching transients when changing instrument functions or connections to the device under test.

Zero check is also used with zero correct to cancel internal offsets in the Model 595. Zero correction is not applicable to capacitance or Q/t but should be performed for the current function on the 20pA range. The zero correct value is stored in permanent memory.

OPERATION

1. Press the CURRENT button and select the 20pA range.

2. Press the ZERO CHECK button and be sure the ZERO CHECK indicator light is on. The Model 595 input amplifier is now configured to read its own internal offset.

3. Press SHIFT, then CORRect to zero correct the instrument. Note that if zero check was not enabled, the zero correct operation will enable zero check first.

4. The proper range may now be selected and ZERO CHECK released to make a measurement.

www.valu◌

VOLTAGE SOURCE Block

```
           VOLTAGE SOURCE
  ▲ LIMIT PRESET    ADJUST
   ▢      ☐        ▢        ▲

  ▼ LIMIT PRESET            FAST
   ▢      ☐        ▢        ▼

  STEP V  ⌐┅↔┅⌐     + / –
   ▢      ☐        ▢

  DELAY TIME       DISPLAY SOURCE
   ▢      ☐        ▢     ☐ FLASHES
                              DURING
                  2mA MAX     I-LIMIT
```
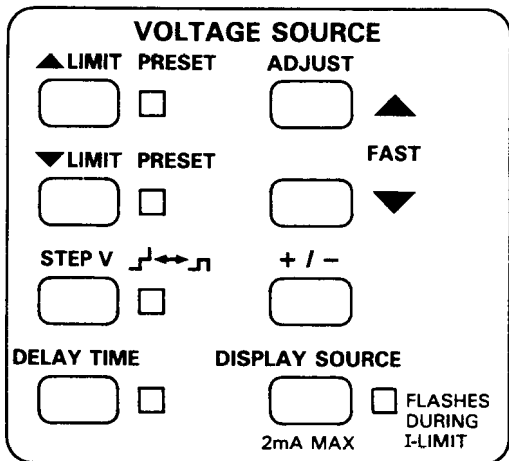
LIMIT, PRESET

The ▲, ▼ LIMIT buttons set the maximum and minimum
voltages that the voltage source will output to protect the
device under test from destructive voltage levels. On power
up, the limits are set to ±20V.

PRESET allows the user to quickly set the output voltage
value to the maximum or minimum limit without using the
ADJUST buttons.

OPERATION

1. Press the LIMIT ▲ or ▼ button to display the upper or lower voltage limit value.
2. Use the voltage source ADJUST buttons to change either limit in 10mV increments.
3. To quickly set the output voltage value to the maximum or minimum limit, press SHIFT, then LIMIT PRESET ▲ or ▼.

STEP V

Step V determines the step size (a small incremental change in voltage) when either the square wave or staircase waveform is selected. The step size may be ±0.01V, ±0.02V, ±0.05V or ±0.10V. When plotting a curve, step V can be set so that the curve contains the desired number of samples (the larger the step size, the fewer number of samples in the curve).

OPERATION

1. Press STEP V to select the step voltage.
2. Select the step size with the ADJUST buttons.
3. To toggle the waveform between square wave and staircase, press SHIFT, then STEP V.

±, Front Panel Trigger

The ± button is used to change the polarity of the voltage step and voltage source. This button can also be used to trigger a single reading from the front panel.

OPERATION

1. Press STEP V to display the step voltage or DISPLAY SOURCE to display the programmed output voltage.
2. Press ± to change the polarity of the displayed value.

Note: Pressing SHIFT, then ± will trigger a measurement from the front panel. This is convenient if an external trigger source is unavailable.

DELAY TIME

The time from the voltage step to the final charge measurement for a capacitance calculation, or from the step to the measurement in current, is the delay time. Delay time, 0.07sec to 199.99sec, is used to allow the device under test to respond to the change in step voltage before the measurement. Delay time is important when performing capacitance and CV measurements on MOS capacitors (Delay Time must be long enough for the device to reach equilibrium). It is not as critical when performing simple capacitance, current, or IV measurements.

Figure 1 shows in greater detail where the delay time occurs. The total time of the voltage step is delay time plus T1. (T1 is the period necessary for the Model 595 to finish the measurement, and is typically 0.04sec.) The total time of the voltage step (delay time plus T1 time) is called the step time.

www.value
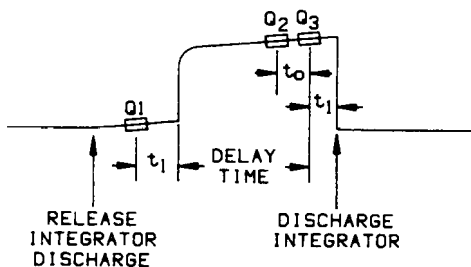
$$C_X = \frac{Q_3 - Q_1}{STEP\,V} \quad Q/t = \frac{Q_3 - Q_2}{t_0}$$

$$C_{X(CORRECTED)} = C_X - \frac{(Q/t)(DELAY\ TIME + t_1)}{STEP\,V}$$

$$READING\ VOLTAGE = V_1 + \frac{1}{2} STEP\,V$$

**Figure 1. Integrator Charge vs Time Curve for a
Capacitance Measurement**

OPERATION

1. Press the DELAY TIME button to view present delay time.
2. Press ADJUST ▲ or ▼ button to increment or decrement the time. On power up delay time is set to 0.07sec.

ADJUST ▲, ▼

www.valu

The voltage source ADJUST buttons are used to increase or decrease the values of ▲ LIMIT, ▼ LIMIT, STEP V, DELAY TIME and the programmed output voltage. The ADJUSTs are also used with the front panel programs.

16

OPERATION

1. Select the parameter to be adjusted (i.e., Press DISPLAY
   SOURCE to select the programmed output voltage).
2. Press either ADJUST button to change the programmed
   output voltage.
3. To quickly adjust these voltage source parameters, press
   SHIFT, then the appropriate ADJUST button.

DISPLAY SOURCE

The DISPLAY SOURCE feature displays the programmed
output voltage. On power up, the Model 595 is programmed
for 0.00V.

The indicator light will flash when the output current ex-
ceeds 2mA. The current limit will prevent the output cur-
rent from exceeding 4mA.

OPERATION

1. Press the DISPLAY SOURCE button to view the pro-
   grammed output voltage.
2. Press the voltage source ADJUST ▲ or ▼ button to in-
   crease or decrease the programmed output voltage.
3. Use ± to change the polarity of the voltage source value
   when displayed. The "nErr" message will appear if a sign
   change conflicts with the voltage source limits.

www.value

WAVEFORM Block
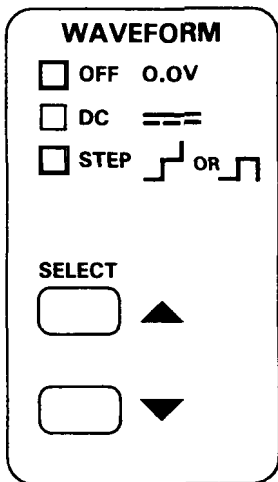
The Model 595 is capable of sourcing either DC or stepped voltage to the device under test. The SELECT ▲, ▼ buttons are used to select the voltage waveform.

OFF 0.0V

OFF sets the voltage source to 0.00V ±0.01V. This can be used to set the voltage source to zero without having to use the ADJUST buttons. If capacitance is selected, an "OFF" message will appear on the display since a step is necessary to measure capacitance.

DC

When DC is selected, the voltage source will output a constant voltage, equal to the voltage source programmed value. The DC waveform may be employed for current measurements. If the capacitance function is selected, the "DC" message will appear on the display since a step is necessary to measure capacitance.

STEP

The STEP waveform is the fundamental signal required for capacitance measurements. Two STEP waveforms are available: square wave and staircase. The instrument powers up with square wave enabled. Select square wave for capacitance and current measurements at specific test voltages, and staircase for CV, IV and Q/t-V measurements. The characteristics of this waveform are tailored using the controls within the VOLTAGE SOURCE block.

www.valu

PROGRAM

```
┌─────────────────────────┐
│       PROGRAM           │
│     MENU  EXIT          │
│     ┌──────────┐        │
│     │          │        │
│     └──────────┘        │
└─────────────────────────┘
```
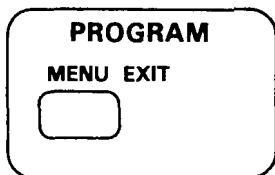
MENU EXIT

The Model 595 has several features available through front panel programs. These programs may be accessed by pressing the MENU button. Every time the MENU button is pressed a different program will be displayed. Program parameters are changed with the voltage source ADJUST buttons.

Exit the program mode and store the parameters by pressing the SHIFT, then EXIT buttons. The instrument will return to the previous display mode.

www.valu

FRONT PANEL PROGRAMS

Frequency

The line frequency program is used to set the Model 595 to the available line frequency. This program is accessed as part of the calibration procedure and does not usually appear in the menu. Refer to Section 8 of the Model 595 Instruction Manual for detailed information about the line frequency program.

Calibration

An advanced feature of the Model 595 is its digital calibration program. This program does not normally appear in the menu. Refer to Section 8 of the Model 595 Instruction Manual for detailed information about the calibration program.

Filter

The Model 595 has three digital filters to minimize the effects of noise on individual measurements and plotted curves. Filter 1 is used when there are 20 or more samples in the fundamental change area of the curve, Filter 2 with 50 or more samples, and Filter 3 with slowly changing DC signals or when there are 200 or more samples in the fundamental change area of the curve.

www.valu

OPERATION

1. Press the MENU button until "Filt" appears.
2. Press either of the voltage source ADJUST buttons until the desired filter number appears (0 = no filter, 1 = Filter 1, 2 = Filter 2, 3 = Filter 3).
3. To exit, press SHIFT, then EXIT. The filter selected will remain enabled until the instrument is powered off.

Trigger

The trigger program allows a stimulus to trigger the Model 595 to take a measurement on either a one-shot or continuous basis.

OPERATION

1. Press the MENU button until the message "triG" appears.
2. Press either voltage source ADJUST button until the display reads "triG 0" to put the instrument in continuous trigger. (When the instrument is in one-shot trigger, the display will read "triG 1").
3. Press SHIFT, then EXIT to exit the trigger program.
4. The Model 595 will now require a trigger to begin measurements (bus, external, or press SHIFT, then ±).

Note that the Model 595 always powers up in continuous trigger.

Analog Output X1/X10

The analog output program allows the user to set the C,I analog output gain to X1 or X10. X1 is used for readings over 10% full range and X10 is used for readings less than 10% of full range.

OPERATION

1. Press MENU until "Aout" is displayed ("Aout 1" means X1 gain, "Aout 10" means X10 gain).
2. Press either of the voltage source ADJUST buttons to toggle gain between X1 and X10.
3. Press SHIFT, then EXIT to leave the analog output program.

Note that the instrument always powers up in X1 gain.

Corrected Capacitance

The corrected capacitance program uses the Q/t measurement to cancel the effects of DC error (leakage) currents on capacitance readings. It must be determined that the device under test has completely responded to the change in voltage used in the measurement and that the Q/t current is only related to DC errors such as leakage current or low oxide resistance. For proper use of this program, refer to the User's Manual application section on Proper Use of Corrected Capacitance Program.

OPERATION

1. Press the MENU button until "cCAP" is displayed ("cCAP 0" signifies that correction is off, "cCAP 1" means that corrected capacitance has been enabled).
2. To toggle corrected capacitance on or off, press either one of the voltage source ADJUST buttons.
3. To exit, press SHIFT, then EXIT.

Note that the Model 595 always powers up with corrected capacitance off.

IEEE-488 Address

This program is used to display or change the IEEE-488 address. The Model 595 is set to address 28 at the factory. The following addresses (or codes) may be used with the Model 595:

Address 0 - 30: Normal IEEE-488 address.
40 - 41: Talk only. Data to printer.
42 - 43: Talk only. Data to plotter.

OPERATION

1. Press the MENU button until "IEEE" appears on the display.
2. Press either ADJUST ▲ or ▼ button until the desired value is shown on the display.
3. Press SHIFT, then EXIT to return to normal operation.

Note that the IEEE-488 address is stored in permanent memory.

Display (Alpha or Numeric)

The display program sets the Model 595 to display in either alpha or numeric characters.

OPERATION

1. Press MENU until "dISP" appears on the display. (If "dISP u" appears, then the display is set to alpha characters. If "dISP -6" appears, then the display is set to the numeric function).
2. Press either of the voltage source ADJUST buttons to toggle the display between the alpha and numeric functions.
3. To store the selection and leave the program, press SHIFT, then EXIT.

Note that the display mode selected is stored in permanent memory.

Plotter Parameters

The following front panel programs can only be accessed (from the menu) when the Model 595's IEEE-488 address has been set to code 42 or 43.

Grid

www.valu

The grid program allows the user to plot a grid on an HPGL-compatible plotter (HP7470A or equivalent) with the Model 595 acting as a controller. The plotter must be set to ad-

dress 5. The grid will be plotted according to the function, range and limits that the Model 595 is currently set to at the time the grid is initiated.

OPERATION

1. With the IEEE-488 code set to 42 or 43, press the MENU button until the message "Grid" appears on the display.
2. Press either of the voltage source ADJUST buttons, and the plotter will draw and label the grid. The front panel buttons are inoperable while the grid is being drawn.

Y HI - Y Lo

The Y HI - Y Lo programs are used to set the upper and lower plot limits of the Y axis. The limits range between ±2.0 in 0.1 increments, with 2.0 corresponding to a full 20,000 count display and 0.1 corresponding to 1000 counts.

OPERATION

1   With the IEEE-488 code set to 42 or 43, press the MENU button until the message Y HI or Y Lo appears.
2. Press the ADJUST ▲ or ▼ button until the desired value is displayed.
3. Press SHIFT, then EXIT to store the value and leave the program.

www.valu

Note that the instrument will default to Y HI = 2 and Y Lo = −2 on power up.

REAR PANEL FEATURES

The following features are found on the rear panel of the Model 595.

AC RECEPTACLE—Connects to three-wire line cord.

LINE FUSE—Provides protection on the AC power line cord.

IEEE-488—Connects the instrument to the IEEE-488 bus. IEEE-488 interface functions are marked above the connector.

GUARD—Provides binding post connection for shields or the LO terminal of an external voltage source.

C,I METER INPUT—Teflon-insulated BNC. Inner conductor is input HI, outer conductor is GUARD.

VOLTAGE SOURCE OUTPUT—Isolated BNC connector. Inner conductor is output HI, outer conductor is GUARD. Voltage is sourced from this output to bias devices when making current or capacitance measurements. Referenced to GUARD.

C,I ANALOG OUTPUT—5-way binding posts that correspond to meter display (C, Q/t or I). Referenced to IEEE common.

V ANALOG OUTPUT—5-way binding posts that correspond to voltage at which C, Q/t or I measurement was taken. Referenced to IEEE common.

PEN LIFT—Two 5-way binding posts; pen lift and IEEE common. Normally a TTL high output (pen up), TTL low during a staircase waveform (pen down). Minimizes recorder pen blotting.

METER COMPLETE OUTPUT—Isolated BNC connector provides negative going TTL output pulse after a reading is completed. Referenced to IEEE common.

EXTERNAL TRIGGER INPUT—Isolated BNC connector. Negative edge triggered, TTL level. Referenced to IEEE common.

www.valu

MEASUREMENT CONNECTIONS

The Model 595 is supplied with two Model 4801 Low Noise BNC Cables. Use these cables or similar low noise cables when making measurements with the Model 595.

A typical capacitance measurement can be made with the test set up illustrated in Figure 2, which shows a packaged capacitor in a test box.
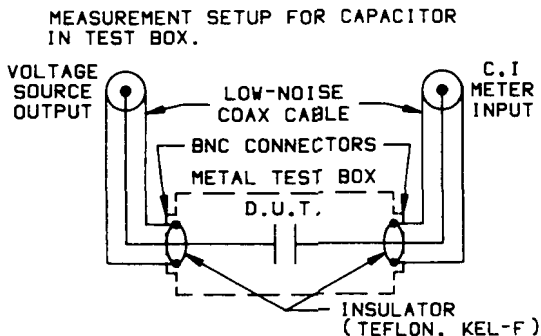
Figure 2. Typical Capacitance Measurement Connections

www.valu

Refer to Figure 3 to see how to make current measurement connections. The set up in Figure 3 shows connections made with the Model 595's voltage source.
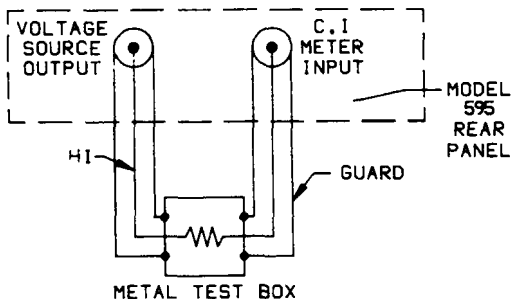
Figure 3. Typical Current Measurement Connections

EXAMPLE MEASUREMENTS

The following examples describe typical capacitance and current measurements. For more information about these measurements (including CV and IV examples), refer to the Model 595 Instruction Manual.

CAPACITANCE MEASUREMENT

Follow the steps outlined below to make a capacitance measurement. The first column indicates what button should be pressed; the second column shows what will be displayed on the Model 595, and the last column describes the results of the action taken.

In this example, the device under test (DUT) has a value of about 500pF. The initial measurement configuration is power OFF, with connections as illustrated in Figure 2. The circuit is broken at the capacitor under test (i.e., the probe is lifted from the wafer).

Button Press	Display		Remarks
1. POWER	r.r.		Memory test (RAM)
	r.o.		Memory test (ROM)
	0.000	nF	20nF capacitance range, ZERO CHECK on, square wave.
2. ZERO CHECK	0.001*	nF	ZERO CHECK off, measuring stray capacitance of fixture.
3. RANGE ▼	.0012*	nF	Go to range of desired resolution (DUT will be about 500pF).

4. SUPPRESS	.0000	nF	SUPPRESS on, stray value will be subtracted from all readings.
5. ZERO CHECK	.0000	nF	ZERO CHECK on while connecting device.
6. (Connect capacitance in fixture)	.4562*	nF	Display is value of D.U.T. (minus fixture strays).
7. ZERO CHECK			ZERO CHECK off to resume measurement.
8. SHIFT, then STORE C_O	. .4562*	nF nF	This value is stored as C_O for normalization of capacitance.
9. C/C_O	1.0000*		The measured capacitance is normalized to C_O.
10. SHIFT, then Q/t	.0000*	nA	The magnitude of current through the DUT at the time of each capacitance measurement (i.e., after delay time).
			NOTE: Suppress and C_O apply only to the capacitance measurement, not to Q/t.
11. CAPACITANCE	1.0000*		Return to normalized capacitance display.
12. C/C_O	.4562*	nF	C/C_O off.

*This value depends on the capacitor under test, any strays present, etc.

www.valu

32

CURRENT MEASUREMENT

This example uses a 1MΩ resistor in a test box. The voltage source is set to 1V to cause 1μA input current to flow (I = 1V/MΩ = 1μA).

The initial measurement configuration is POWER off, with input cables attached to the Model 595. The input circuit is temporarily disconnected at the test box, on the voltage source output side.

Button Press	Display		Remarks
1. POWER	r.r.		Memory test (RAM)
	r.o.		Memory test (ROM)
	0.000	nF	20nF capacitance range, ZERO CHECK on, square wave.
2. CURRENT	−.0002*	nA	Place unit in CURRENT function.
3. RANGE ▼ (press twice)	−0.002*	pA	Set unit to 20pA range.
4. SHIFT, then CORR	0.000	pA	Corrects for internal offsets.
5. RANGE ▲	.0000	μA	Go to RANGE of desired resolution (press five times for this example).

(CONNECT RESISTOR)

6. SELECT ▲	.0000	μA	Select DC waveform.
7. DISPLAY SOURCE	00.00	V	Displays voltage sourced.
8. ADJUST ▲	01.00	V	Adjust voltage source to 1V out.
9. DISPLAY SOURCE	.0000	μA	Return unit to meter display.
10. ZERO CHECK	.9835*	μA	Read value from display.

*This value depends on the resistor under test, leakage currents, etc.

Variation: Also try using SUPPRESS on readings and adjust voltage source to 1.5V.

IEEE-488 PROGRAMMING

Execute	
X	Execute device-dependent commands received since last "X"

METER COMMANDS

Display	
D0	Meter
D1	Voltage source
D2	High limit of voltage source
D3	Low limit of voltage source
D4	Step voltage
D5	Delay time

Function	
F0	Capacitance
F1	Current

Range		
	Capacitance(F0)	Current(F1)
R1	200pF	20pA
R2	2nF	200pA
R3	20nF	2nA
R4		20nA
R5		200nA
R6		2 μA
R7		20 μA
R8		200 μA

Zero Check	
Z0	Zero check off
Z1	Zero check on
Z2	Zero check on and zero corrected

Suppress	
N0	Suppress off
N1	Suppress on using new value

Filter	
P0	Filter off
P1	Filter 1
P2	Filter 2
P3	Filter 3 (DC measurements)

VOLTAGE SOURCE COMMANDS

High Limit	
Hnn.nn H20	Set high limit of voltage source; where nn.nn = −20.00V to 20.00V

Low Limit	
Lnn.nn L-20	Set low limit of voltage source; where nn.nn = −20.00V to 20.00V

www.valu

Voltage Source	
Vnn.nn V0	Set voltage source bias level; where nn.nn = LO limit to HI limit

Step Voltage	
S0	10mV step
S1	20mV step
S2	50mV step
S3	100mV step
S4	−10mV step
S5	−20mV step
S6	−50mV step
S7	−100mV step

Delay Time	
Innn.nn I.07	Set delay time for staircase and square wave; where nnn.nn = 000.07sec to 199.99sec

WAVEFORM COMMANDS

Waveform	
W0	Voltage source off (0.0 volts)
W1	DC output (voltage source level)
W2	Square wave output (voltage source + step V)
W3	Staircase output (voltage source + step V)

www.valu

READING/OUTPUT COMMANDS

C/C_0	
C0	Capacitance normalization off
C1	Capacitance normalization on
C2	Take new C_0 value

Capacitance Modifiers	
Q0	Capacitance displayed, not corrected
Q1	Q/t displayed, capacitance not corrected
Q2	Capacitance displayed, capacitance corrected
Q3	Q/t displayed, capacitance corrected

Prefixes	
	TERMINATE ON EACH READING
G0	Reading; prefix
G1	Reading; no prefix
G2	Plotter; prefix
G3	Plotter; no prefix
	TERMINATE ON EACH NON-STAIRCASE READING
G4	Reading; prefix
G5	Reading; no prefix
G6	Plotter; prefix
G7	Plotter; no prefix

Analog Output	
O0	Autopen, X1 gain
O1	Pen up, X1 gain
O2	Pen down, X1 gain
O3	Same as O1
O4	Autopen, X10 gain
O5	Pen up, X10 gain
O6	Pen down, X10 gain
O7	Same as O4

BUS CONTROL COMMANDS

Triggers	
T0	Continuous on Talk
T1	One-shot on Talk
T2	Continuous on GET
T3	One-shot on GET
T4	Continuous on X
T5	One-shot on X
T6	Continuous on External Trigger
T7	One-shot on External Trigger

SRQ Mask	
M0	Clear SRQ mask
M1	Reading overflow
M2	Not used
M4	Staircase done
M8	Reading done
M16	Ready
M32	Error

www.valu

EOI and Bus Hold-off	
K0	Send EOI, hold off on X
K1	Do not send EOI, hold off on X
K2	Send EOI, do not hold off on X
K3	Do not send EOI, do not hold off on X

Terminator	
Y0	CR LF
Y1	LF CR
Y2	CR
Y3	LF
Y4	No terminator

STATUS COMMANDS

Digital Calibration	
Annn.nnE-nn	Calibration value using exponent

Self-Test and NVRAM Storage	
J0	**Perform self-test**
J1-J15	**No operation**
J16	**Charge inject**ion compensation
J17-J18	No operation

www.valu

Status	
U0	Send machine status word
U1	Send error status word
U2	Send data status word
U3	Send delay time
U4	Send high and low limits of voltage source
U5	Send voltage source level

If in staircase, waveform will change to DC (pause). Only changing capacitance correction will cause waveform to change to DC. NOTE: If a measurement is changed to DC, the output voltage is moved to the next level where the effective step is off in order to preserve the direction of the measurement.

www.valu

POWER UP DEFAULT CONDITIONS

Mode	Default Value	Status
Display	DO	Meter
Function	FO	Capacitance
Range	R3	20nF, 2nA
Zero Check	Z1	Zero check on
Suppress	NO	Suppress off
Filter	PO	Filter off
High Limit	H20	High limit = 20V
Low Limit	L-20	Low limit = −20V
Voltage Source	VO	Zero voltage progammed
Step Voltage	S2	50mV step
Delay Time	I.07	000.07sec
Waveform	W2	Square wave output (voltage source + step V)
C/C_o	CO	Capacitance normalization off
Modifiers Capacitance	QO	Capacitance displayed, not corrected
Prefixes	GO	Reading, prefix
Analog Output	OO	Autopen, X1 gain
Triggers	T6	Continuous, triggered by external trigger
SRQ Mask	MO	Clear SRQ mask
EOI	KO	Send EOI, hold off on X
Terminator	YO	CR LF

A. CAPACITANCE DATA STRING

PREFIX: NCVI

CAPACITANCE: +0.59500 E-12 . -01.825 . +1.23400 E-12

Q/i

N=NORMAL
O=OVERRANGE
Z=ZERO CHECK
CVI=CAPACITANCE, VOLTAGE, Q/i

MANTISSA + EXPONENT

READING VOLTAGE

MANTISSA EXPONENT

B. CURRENT DATA STRING

PREFIX: NIVX

CURRENT: +0.59500 E-12 . -12.230

N=NORMAL
O=OVERRANGE
Z=ZERO CHECK
IVX=CURRENT, VOLTAGE

MANTISSA EXPONENT

READING VOLTAGE

C. PLOTTER FORMAT

MEASUREMENT

PD-01825 . -12345

PU=PEN UP
PD=PEN DOWN

READING VOLTAGE=1.825V

D. G5(F1) DURING A STAIRCASE

+0.59500E-12,-12.230,+0.59502,-12.230...

www.valuetronics.com

IF WAVEFORM IS DC OR OFF, CAPACITANCE READING IS 999999999999.

SERIAL POLL STATUS BYTE

BIT POSITION	B7	B6	B5	B4	B3	B2	B1	B0
VALUE	0	1/0	1/0	1/0	1/0	1/0	0	1
DECIMAL WEIGHTING	128	64	32	16	8	4	2	1

1=READING OVERFLOW

1=STAIRCASE DONE

1=READING DONE

1=READY

1=ERROR

1=SRQ BY 595 (SERIAL POLL BYTE ONLY)

www.valu

44

STATUS WORDS

MACHINE STATUS (U0)

    595F0R3Z1N0C0W252Q0P0T6G0D000M00K0Y0

 DEFAULT CONDITIONS SHOWN

ERROR STATUS (U1)

MODEL NO. (PREFIX)	1DDC	1DDCO	NO REMOTE	CONFLICT	TRIGGER OVERRUN	NUMBER	SELF-TEST		
595	1/0	1/0	1/0	1/0	1/0	1/0	1/0	0 0	\<TERM\>

DATA STATUS (U2)

MODEL NO.	TEMPORARY CAL	VOLTAGE SOURCE I-LIMIT	STORAGE ENABLED	50Hz		
595	1/0	1/0	1/0	1/0	0 0 0 0 0	\<TERM\>

IEEE-488 ADDRESS SELECTION

A front panel program is used to display and change the IEEE-488 primary address of the Model 595. The instrument may be set to primary addresses 0 to 30 and IEEE-488 codes 40 to 43 (as long as no other instrument on the bus is set to the same value). To select an IEEE-488 address or code, simply press the MENU button until "IEEE" appears. Then press either voltage source ADJUST button until the desired value appears. Press SHIFT, then EXIT to store the value.

www.valu

TALK ONLY OPERATION

In Talk Only operation, the instrument will control the bus and output data to a listening device. No controller may be on the bus. The listening device may be a listen-only printer or an addressable printer with its address set to 3. When the instrument is in Talk Only, the front panel TALK indicator light will turn on.

To place the instrument in Talk Only, perform the following steps:

1. Using the front panel PROGRAM MENU button, display the present IEEE-488 address value.
2. Using the voltage source ADJUST buttons, select one of the following Talk Only parameters:
    A. 40 Talk Only with prefix on data string (i.e., NCVI+1.23456E-12, -01.820, +1.23400E-12).
    B. 41 Talk Only without prefix on data string (i.e., +1.23456E-12, -01.820, +1.23400E-12).
3. Press the SHIFT button and then the program EXIT button. The instrument will start talking when the measurement sequence is started.
4. Change the IEEE-488 code or go to one-shot to stop talking.

www.valu

IEEE-Plot

In IEEE-Plot, the instrument will output voltage and capacitance, Q/t or current data to an IEEE-488 plotter for the purpose of plotting the CV, IV, or Q/t-V curves of staircase measurements.

A grid can also be drawn with the labels corresponding to the selected function, range, voltage source limit, and Y HI - Y Lo values of the Model 595.

To use IEEE-Plot, connect an IEEE-488 plotter to the bus connector of the Model 595 (set plotter address to 5 before power up) and perform the following steps:

1. From the front panel, set up the Model 595 to make staircase measurements (capacitance or current). First complete the configuration of the voltage source and meter block for the measurement. Do not start the staircase at this time.
2. Use the program MENU button to display the present IEEE address of the instrument.
3. Using the voltage source ADJUST buttons, set the address to 42 (or to 43 to reverse the direction of the X axis). Install plotter pen #1.
4. Press the SHIFT button and then the program EXIT button.
5. Plot a grid as follows:
   A. Press the program MENU button until the "Grid" message is displayed.

www.valu

B. To start the grid plot, press one of the voltage source ADJUST buttons. A grid will be plotted and labels will be placed on the X and Y axes. The labels on the X axis correspond to the programmed high and low voltage limits. The labels on the Y axis correspond to the Y HI and Y Lo program settings. "Y HI = 2" corresponds to a full 20,000 count display, while "Y HI = .1" corresponds to a 1000 count display. Adjust Y HI and Y Lo to "crop" the plot.

6. Press the SHIFT button, then program EXIT. The measurement plot will begin when the staircase is started.

7. To pause and restart the plot, press SELECT ▲ to pause and SELECT ▼ to continue.

NOTES:

1. The display can be toggled between capacitance and Q/t while plotting without affecting the plot.

2. Changing functions, ranges, zero check or voltage source settings will cause the staircase and plot to stop. When the staircase is restarted, keep in mind that the labels on the plot correspond to the original function/range and voltage limits but the new plot parameters correspond to the new Model 595 settings.

www.valu

PROGRAMS

The following programs are designed to be a simple aid to the user. They are not intended to suit specific needs. Each program is designed to send a device-dependent command string to the instrument and obtain and display an instrument reading string. Detailed programming information can be found in the instruction manual.

www.valu

IBM PC or XT
(KEITHLEY MODEL 8573A INTERFACE)

The following program sends a command string to the Model 595 from an IBM PC or XT computer and displays the instrument reading string on the CRT. The computer must be equipped with the Keithley Model 8573A IEEE-488 Interface and the DOS 2.00 operating system. Model 8573A software must be installed and configured as described in the Model 8573A instruction manual.

DIRECTIONS

1. With the power off, connect the Model 595 to the IEEE-488 interface installed in the IBM computer.
2. Using the front panel program feature, set the primary address of the Model 595 to 28.
3. Type in BASICA on the computer keyboard to get into the IBM interpretive BASIC language.
4. Place the interface software disk in the default drive, type LOAD"DECL", and press the return key.
5. Add the lines below to lines 1-6 which are now in memory. Modify the address in lines 1 and 2, as described in the Model 8573A Instruction Manual.
6. Run the program and type in the desired command string. For example, to place the instrument in the current function and 200μA range, type in F1R8X and press the return key.
7. The instrument reading string will then appear on the display. For example, the display might show NIVX+0.59500E-4, +00.000.
8. To exit the program, type in EXIT at the command prompt and press the return key.

PROGRAM	COMMENTS
`10 CLS`	Clear screen.
`20 NA$=''GPIB0'':CALL IBFIND` `(NA$, BRD0%)`	Find board descriptor.
`30 NA$=''DEV1'':CALL IBFIND` `(NA$,M595%)`	Find instrument descriptor.
`40 V%=28:CALL IBPAD` `(M595%,V%)`	Set primary address to 28.
`50 V%=&H102:CALL IBPOKE` `(BRD0%,V%)`	Set timeouts.
`60 V%=1:CALL IBSRE(BRD0%,V%)`	Set REN true.
`70 INPUT''COMMAND STRING'';` `CMD$`	Prompt for command.
`80 IF CMD$=''EXIT'' THEN 150`	See if program is to be halted.
`90 IF CMD$='' THEN 70`	Check for null input.
`100 CALL IBWRT(M595%,CMD$)`	Address 595 to listen, send string.
`110 RD$=SPACE$(100)`	Define reading input buffer.
`120 CALL IBRD(M595%,RD$)`	Address 595 to talk, get reading.
`130 PRINT RD$`	Display the string.
`140 GOTO 70`	Repeat.
`150 V%=0:CALL IBONL(M595%,V%)`	Close the instrument file.
`160 CALL IBONL(BRD0%,V%)`	Close the board file.
`170 END`	

NOTE: For conversion to numeric variable, make the following changes:

```
130 RD=VAL(MID$(RD$,5,14))
135 PRINT RD
```

www.valu

APPLE II
(APPLE II IEEE-488 INTERFACE)

The following program sends a command string to the Model 595 from an Apple II computer and displays the instrument reading string on the computer CRT.

The computer must be equipped with the Apple II IEEE-488 Interface installed in slot 3.

DIRECTIONS:

1. With the power off, connect the Model 595 to the IEEE-488 interface installed in the Apple II computer.
2. Using the front panel program feature, set the primary address of the Model 595 to 28.
3. Enter the lines in the program below, using the RETURN key after each line.
4. Run the program and type in the desired command string at the command prompt. For example, to place the instrument in the current function and 200µA range, type in F1R8X and press the return key.
5. The instrument reading string will then appear on the CRT. A typical display is: NIVX+0.59500E-4, +00.000.

www.value

PROGRAM	COMMENTS
`10 Z$=CHR$(26)`	Terminator.
`20 INPUT''COMMAND STRING'';` `   B$`	Prompt for and enter string.
`30 PR#3`	Set output to IEEE bus.
`40 IN#3`	Define input from IEEE bus.
`50 PRINT''RA''`	Remote on.
`60 PRINT ''WT<'';Z$;B$`	Address 595 to listen, send string.
`70 PRINT''LF1''`	Line feed on.
`80 PRINT''RD'';CHR$(92);B$`	
`81 A$='':C$=''`	Strings initially empty.
`82 GET A$`	Read a character.
`83 PRINT A$`	Echo the character.
`84 IF ASC (A$)=13 THEN GOTO 90`	End of input if CR.
`85 C$=C$+A$`	Add characters to string.
`86 GOTO 82`	
`90 PRINT ''UT''`	Untalk the 595.
`100 PR#0`	Define output to CRT.
`110 IN#0`	Define input from keyboard.
`120 PRINT C$`	Display reading string.
`130 GOTO 20`	Repeat

NOTES:

1. If conversion to numeric variable is required, make the following changes.

```
120 C=VAL(MID$(C$,5,14))
125 PRINT C
```

2. The Apple II INPUT statement terminates on commas.

54

HP 85

The following program sends a command string to the Model 595 from an HP-85 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HP82937 GPIB Interface and an I/O ROM.

DIRECTIONS

1. With the power off, connect the Model 595 to the HP82937A GPIB interface installed in the HP-85 computer.
2. Using the front panel program feature, set the primary address of the Model 595 to 28.
3. Enter the lines in the program below, using the END LINE key after each line.
4. Press the HP-85 RUN key and type in the desired command string at the command prompt. For example, to place the instrument in the current function and $200\mu A$ range, type in F1R8X and press the END LINE key.
5. The instrument reading string will then appear on the CRT. A typical display is: NIVX+0.59500E-4, +00.000.

www.valu

PROGRAM	COMMENTS
10 DIM A$[40],B$[40]	Dimension strings.
20 REMOTE 728	Place 595 in remote.
30 DISP''COMMAND STRING'';	Prompt for command.
40 INPUT A$	Input command string.
50 OUTPUT 728; A$	Address 595 to listen, send string.
60 ENTER 728; B$	Address 595 to talk, input reading.
70 DISP B$	Display reading string.
80 GOTO 30	Repeat.
90 END	

NOTE: For conversion to numeric variable, change line 70 as follows:

```
70 DISP VAL (B$[5])
```

www.valu

HP 9816

The following program sends a command string to the Model 595 from a Hewlett-Packard Model 9816 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HP82937 GPIB Interface and BASICA 2.0.

DIRECTIONS

1. With the power off, connect the Model 595 to the HP82937A GPIB interface installed in the 9816 computer.
2. Using the front panel program feature, set the primary address of the Model 595 to 28.
3. Type EDIT and press the EXEC key.
4. Enter the lines in the program below, using the ENTER key after each line.
5. Press the 9816 RUN key and type in the desired command string at the command prompt. For example, to place the instrument in the current function and 200µA range, type in F1R8X and press the ENTER key.
6. The instrument reading string will then appear on the CRT. A typical display is: NIVX+0.59500E-4, +00.000.

www.valu

PROGRAM	COMMENTS
`5 DIM B$[50]`	
`10 REMOTE 728`	Place 595 in remote.
`20 INPUT ''COMMAND STRING'', A$`	Prompt for and input command.
`30 OUTPUT 728; A$`	Address 595 to listen, send string.
`40 ENTER 728; B$`	Address 595 to talk, input reading.
`50 PRINT B$`	Display reading string.
`60 GOTO 20`	Repeat.
`70 END`	

NOTE: For conversion to a numeric variable, change the program as follows:

```
40 ENTER 728; B
50 PRINT B
```

www.valu<

HP 9825A

Use the following program to send a command string to the Model 595 from a Hewlett-Packard Model 9825A and display the instrument reading string on the computer printer. The computer must be equipped with the HP98034A HPIB Interface and a 9872A extended I/O ROM.

DIRECTIONS:

1. With the power off, connect the Model 595 to the 98034A HPIB interface installed in the 9825A.
2. From the front panel, set the primary address of the Model 595 to 28.
3. Enter the lines in the program below, using the STORE key after each line. Line numbers are automatically assigned by the 9825A.
4. Press the 9825A RUN key and type in the desired command string at the command prompt. For example, to place the instrument in the current function and $200\mu A$ range, type in F1R8X and press the CONT key.
5. The instrument reading string will then appear on the computer print out. A typical display is: NIVX+0.59500E−4, +00.000.

www.valu

PROGRAM	COMMENTS
0 DIM A$[25],B$[20]	Dimension data strings.
1 DEV "595",728	Define 595 at address 28.
2 REM "595"	Place 595 in remote.
3 ENT "COMMAND STRING",B$	Prompt for command string.
4 WRT "595",B$	Address 595 to listen, send string.
5 RED "595",A$	Address 595 to talk, input data.
6 PRT A$	Print data string on printer.
7 GTO 3	Repeat.

NOTE: For conversion to numeric variable, modify the program as follows:

```
6 PRT VAL(A$[5])
```

www.valu

60

DEC LSI 11

The following program sends a command string to the
Model 595 from a DEC LSI 11 minicomputer and displays
the instrument reading string on the DEC CRT terminal. The
LSI 11 must be configured with 16K words of RAM and an
IBV 11 IEEE-488 interface. The software must be configured
with the IB software as well as FORTRAN and the RT 11
operating system.

DIRECTIONS

1. Using the front panel program feature, set the primary
   address of the Model 595 to 28.
2. With the power off, connect the Model 595 to the IBV
   11 IEEE-488 interface cable.
3. Enter the program below, using the editor under RT 11
   and the name IEEE.FOR.
4. Compile using the FORTRAN compiler as follows: FOR-
   TRAN IEEE.
5. Link with the system and IB libraries as follows: LINK
   IEEE,IBLIB.
6. Type RUN IEEE and press the RETURN key.
7. The display will read "ENTER ADDRESS".
8. Type in 9 and press the RETURN key.
9. The display will read "TEST SETUP".
10. Type in the desired command string and press the
    RETURN key. For example, to program the instrument
    for the current function and 200μA range, type in F1R8X
    and press RETURN.
11. The instrument data string will appear on the computer
    display. A typical display is: NIVX+0.59500E-12,
    +00.000.

PROGRAM	COMMENTS
`PROGRAM IEEE`	
`INTEGER*2 PRIADR`	
`LOGICAL*1 MSG(80),`	
`INPUT(80) DO 2 I = 1,10`	
`CALL IBSTER`	Turn off IB errors.
`2 CONTINUE`	
`CALL IBSTER(15,5)`	Allow 5 error 15's.
`CALL IBTIMO(120)`	Allow 1 second bus timeout.
`CALL IBTERM(10)`	Set line feed as terminator.
`CALL IBREN`	Turn on remote.
`4 TYPE 5`	
`5 FORMAT (1X,''ENTER ADDRESS:'',$)`	Input primary address.
`ACCEPT 10,PRIADR`	
`10 FORMAT (I2)`	
`12 TYPE 15`	
`15 FORMAT (1X,''TEST SETUP: '',$)`	Prompt for command string.
`CALL GETSTR (5,MSG,72)`	Program instrument.
`CALL IBSEOI (MSG,-1, PRIADR)`	Address 595 to listen, send string.
`18 I=IBRECV (INPUT,80, PRIADR)`	Get data from instrument.
`INPUT (I+1)=0`	
`CALL PUTSTR (7,INPUT, ''0'')`	
`CALL IBUNT`	Untalk the 595.
`GOTO 12`	Repeat.
`END`	

www.valu

PET/CBM 2001

The following program sends a command string to the Model 595 from a PET/CBM 2001 computer and displays the instrument reading string on the computer CRT. As the PET/CBM computer has a standard IEEE-488 interface, no additional equipment is necessary.

DIRECTIONS

1. With the power off, connect the Model 595 to the PET/CBM IEEE-488 interface.
2. Using the front panel program feature, set the primary address of the Model 595 to 28.
3. Enter the lines of the program below, using the RETURN key after each line is typed.
4. Type RUN and press the RETURN key. Type in the desired command string at the command prompt. For example, to place the instrument in the current function and 200µA range, type in F1R8X and press the RETURN key.
5. The instrument reading string will then appear on the CRT. A typical display is: NIVX+0.59500E-12, +00.000.

www.valu

PROGRAM	COMMENTS
10 OPEN 1,28	Open file 1, primary address 28.
20 INPUT''COMMAND STRING''; B$	Prompt for, input command string.
30 PRINT#1,B$	Address 595 to listen, send string.
40 INPUT#1,A$	Address 595 to talk, input data.
50 IF ST = 2 THEN 40	If bus timeout, input again.
60 PRINT A$	Display reading string.
70 GOTO 20	Repeat.

NOTES:

1. If conversion to numeric variable is required, modify the program as follows:

```
60 A=VAL(MID$(A$,5,14))
70 PRINT A
80 GOTO 20
```

2. The PET INPUT# statement terminates on a comma. Thus, when reading Model 595 command strings which include commas, you should input each portion of the string into a separate string variable. For example, in the G2 (default) mode, to obtain and display the channel number, the program above can be modified as follows:

```
40 INPUT#1, A$,C$
60 PRINT A$',' C$
```

www.valu

64

Specifications are subject to change without notice.

All Keithley trademarks and trade names are the property of Keithley Instruments, Inc. All other trademarks and trade names are the property of their respective companies.

KEITHLEY

Keithley Instruments, Inc.

28775 Aurora Road • Cleveland, Ohio 44139

440-248-0400 • Fax: 440-248-6168

1-888-KEITHLEY (534-8453) www.keithley.com