



Metrics ICS Driver Manual

KI595

Metrics ICS

Version 4.5

Table of Contents

KI595 Instrument Driver.....	3
Instrument Test Connections	3
Test Jacks	3
Connection Considerations	4
Test Connection Procedure	5
Grounded and Floating Operation	6
IEEE-488 Bus Connections	7
Power-up Procedure.....	7
Setting the Primary Address	9
Getting Started: Creating and Executing a Test Setup.....	10
Connecting a DUT to the Instrument.....	10
Connecting the KI595 Instrument Driver	11
Designating the GPIB Address	12
Creating the Test Setup.....	13
Saving Test Data	22
Project Files	22
The KI Model 595 "OUT" Setup Dialog Box	23
Force Conditions	23
Time Measurement Bias	24
Measure.....	25
Options.....	25

KI595 Instrument Driver

Instrument Test Connections

Use the information below to make Model 595 test connections.

Test Jacks

C, I METER INPUT and VOLTAGE SOURCE OUTPUT are BNC type jacks. The center conductor is high, and the outer ring or shell of each jack is connected to GUARD.

WARNING

The BNC test jacks can be floated up to 30V above chassis ground potential when the ground link is removed. Exceeding 30V will create a shock hazard.

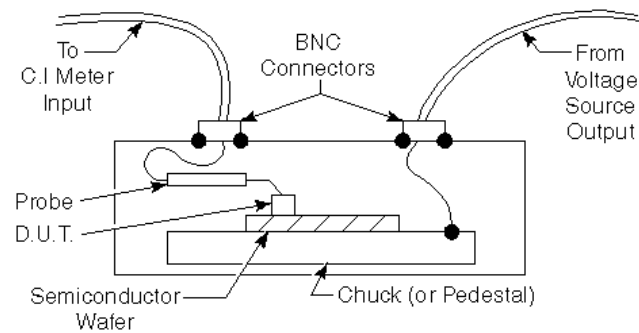
Connection Considerations

When making test connections, keep the following points in mind:

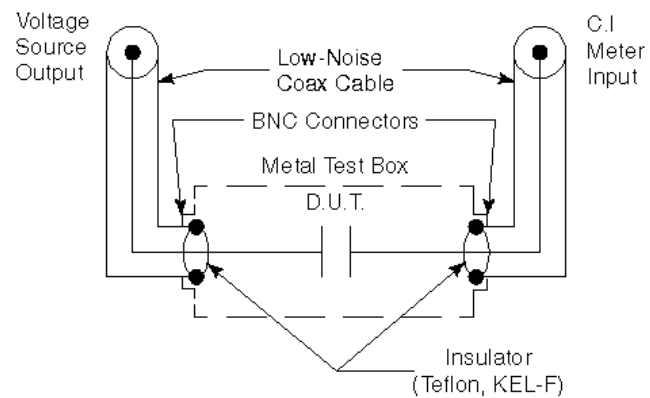
- Use only low-noise coaxial cable for both C, I METER INPUT and VOLTAGE SOURCE OUTPUT test connections. Do *not* use standard 50 Ω cables such as RG-58, and keep cables as short as possible.
- To minimize noise, connect the probe tip to C, I METER INPUT, and connect the substrate to VOLTAGE SOURCE OUTPUT.
- Maximum common-mode voltage for both INPUT and OUTPUT is 30V when the rear panel link between GUARD and chassis ground is removed.
- Excessive shunt capacitance in the cables or probe station may degrade measurement accuracy and increase noise.
- The device under test should be completely enclosed in a light-tight metal box. Connect the box shield to GUARD.
- To minimize noise currents, tie or tape cables to a stable surface to minimize cable flexing, and avoid vibration during testing.

Test Connection Procedure

A. MEASUREMENT SETUP FOR DEVICE ON A SEMICONDUCTOR WAFER.



B. MEASUREMENT SETUP FOR CAPACITOR IN TEST BOX.



C. MEASUREMENT SETUP FOR CAPACITOR AND EXTERNAL VOLTAGE SOURCE.

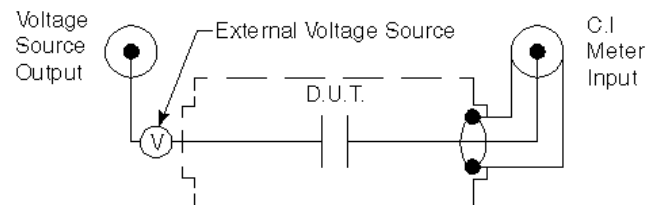


Figure 1: Typical test connections

Figure 1 shows typical test connections. Make connections as follows:

1. Connect one low-noise coaxial cable between the Model 595 C, I METER INPUT jack and the probe tip test jack of the probe station.
2. Connect a second low-noise coaxial cable between the Model 595 VOLTAGE SOURCE OUTPUT jack and the substrate test jack of the probe station.
3. Select either grounded or floating operation with the ground link (see below).

Grounded and Floating Operation

The outer rings of the C, I METER INPUT and VOLTAGE SOURCE OUTPUT test jacks are connected to GUARD, which can either be connected to chassis ground, or floated up to 30V RMS above ground potential. To select grounded or floating operation, simply connect or remove the ground link as required.

Keep the following points in mind when selecting an operating mode:

- Grounded operation can be used in cases where it is not necessary to float GUARD, or if noise caused by ground loops is not a problem.
- If GUARD is to be floated above chassis ground potential, or if noise caused by ground loops occurs, the instrument should be operated with GUARD floating.

IEEE-488 Bus Connections

Connect the Model 595 to the bus controller using a shielded IEEE-488 cable. When making connections, be sure to tighten the screws securely, but do not tighten them excessively. Avoid stacking more than three connectors on any one instrument to avoid possible damage.

Power-up Procedure

The steps in the following paragraphs will take you through the basic procedures for connecting the instrument to line power and turning on the power.

Line Power

The Model 595 can be operated on line voltages in the range of 105-125V or 210-250V (a special power transformer can be installed for 90-110V and 195-235V ranges). Before connecting the instrument to line power, make sure the line voltage setting marked on the rear panel agrees with the power line voltage in your area.

CAUTION

Operating the instrument on a line voltage outside the correct range may cause damage, possibly voiding the warranty.

Line Voltage Selection

The operating voltage of the instrument is internally selectable and should be changed only by qualified service personnel.

Line Frequency

The Model 595 may be operated from either 50 or 60Hz power sources. The line frequency must be within this range for the instrument to meet measurement noise specifications.

Line Power Connections

Using the supplied power cord, connect the instrument to an appropriate 50 or 60Hz AC power source within the correct voltage range as described above. Be sure to connect the instrument only to a grounded AC outlet.

WARNING

To maintain continued protection against possible shock hazards, the Model 595 must be connected to a grounded outlet. Failure to do so may result in personal injury or death due to electric shock.

Turning On Instrument Power

1. Press in on the POWER switch.
2. During normal power-up, “r.r” and “r.o” will appear briefly while RAM and ROM are tested.
3. If a memory error occurs, the “r.r” or “r.o” message will remain on the display.
4. If the instrument was not able to read the stored calibration constants and configuration, the decimal points in the two exponent digits will flash.
5. If any of these errors occurs, the instrument may be partially or completely inoperative and will require servicing.

Power-up Configuration

After the self test and power-up display messages, the instrument will assume the following operating modes:

- 20nF CAPACITANCE range
- ZERO CHECK on
- VOLTAGE SOURCE = 0.00V
- WAVEFORM = 0.05V square wave
- DELAY TIME = 0.07sec
- VOLTAGE SOURCE LIMITS = $\pm 20.00V$

Warm-up Period

The Model 595 can be used immediately when it is first turned on. However, the instrument must be allowed to warm up for at least two hours to achieve rated accuracy.

Setting the Primary Address

The primary address of the Model 595 must be the same as the primary address selected from the driver software. The default Model 595 primary address is 28, and the allowable address range is from 0 to 30.

Check or change the primary address as follows:

1. Press the PROGRAM MENU button until the present IEEE-488 primary address is displayed. For example, if the current address is 28, the following message will be displayed: IEEE 28
2. To change the address, use the voltage source ADJUST keys to set the displayed address to the desired value.
3. To exit with the new address in effect, press SHIFT then EXIT.

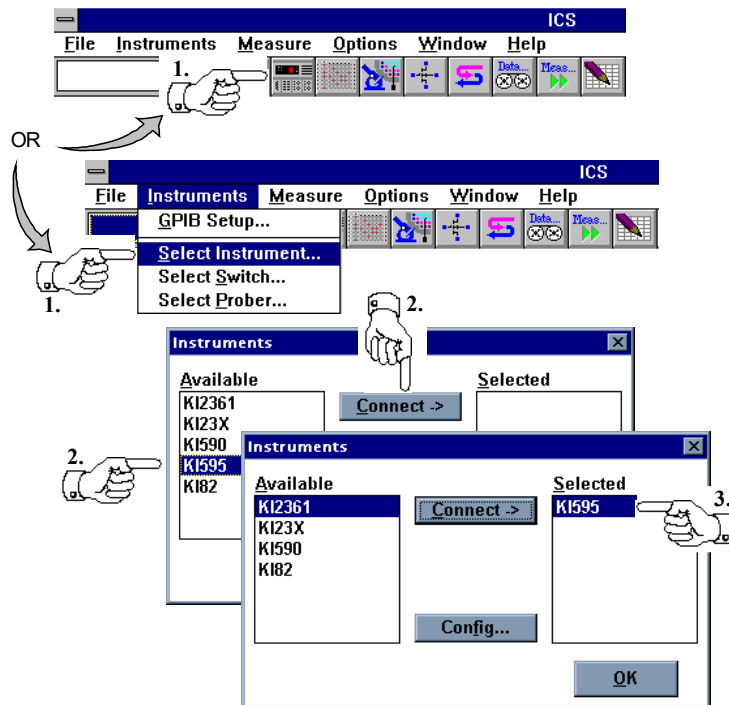
Getting Started: Creating and Executing a Test Setup


This section describes the steps required to create and execute a sample test setup. The sample test setup will be used to measure the capacitance characteristics of a 180pf capacitor as a function of voltage. The Keithley Model 595 Quasistatic CV Meter was used to perform the measurements in this manual.

Connecting a DUT to the Instrument

The capacitance example presented in this section was performed using a custom test fixture connected directly to the 5951 Remote Input Coupler of a Model 82 containing the Model 595 Quasistatic CV Meter.

Connecting the KI595 Instrument Driver

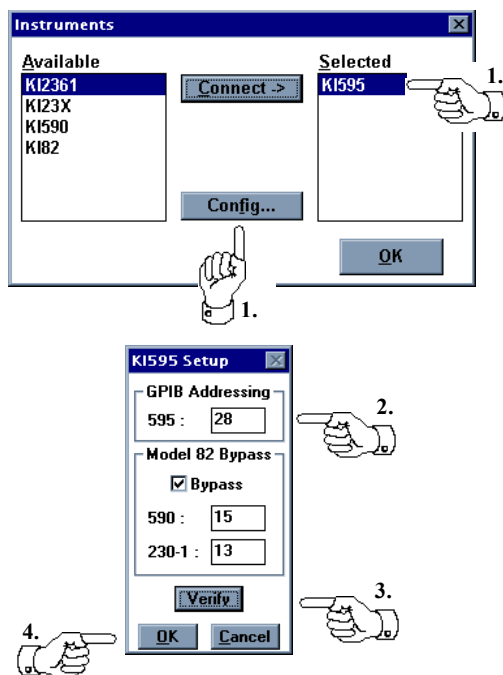


1. Click the Instruments button  on the toolbar or select **Instruments/Select Instrument..** from the ICS measurement mode menu.
2. Highlight **KI595** in the **Available** field and click on the **Connect** button.
3. Your choice will be displayed in the **Selected** field, and removed from the **Available** field.

Designating the GPIB Address

Connect the KI Model 595 to your computer using a standard IEEE-488 GPIB (General Purpose Interface Bus) as described in the Model 595 Instruction Manual.

The Model 595 Setup dialog box is used to designate the GPIB addresses of the Model 595 instruments and to verify the instruments are configured correctly.



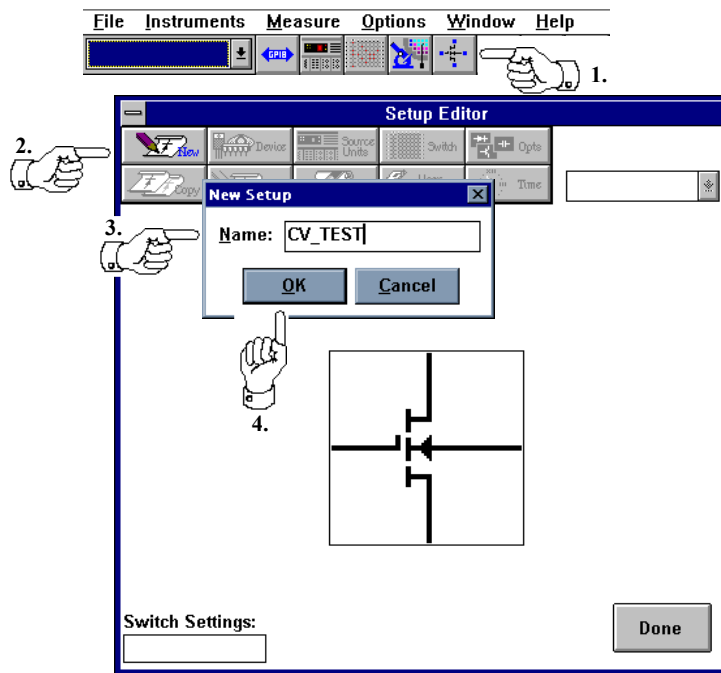
1. With the **KI595** highlighted in the **Selected** field, click on the **Config...** button.
2. Enter the address of the 595. If using a 595 in a Model 82 select **Bypass** and enter the GPIB address of the 590 and the 230 in the appropriate address fields. The GPIB address will be displayed momentarily when the instrument is turned on.
3. Click on the **Verify** button to verify communication with the instruments.
4. Click on the **OK** button.



Creating the Test Setup

Test setups in ICS are created using the Setup Editor. A device schematic is located at the center of the Setup Editor to provide the user with a method of documenting the terminal connections required for the corresponding test setup. The device schematic does not have to match the pin layout of the Device Under Test.

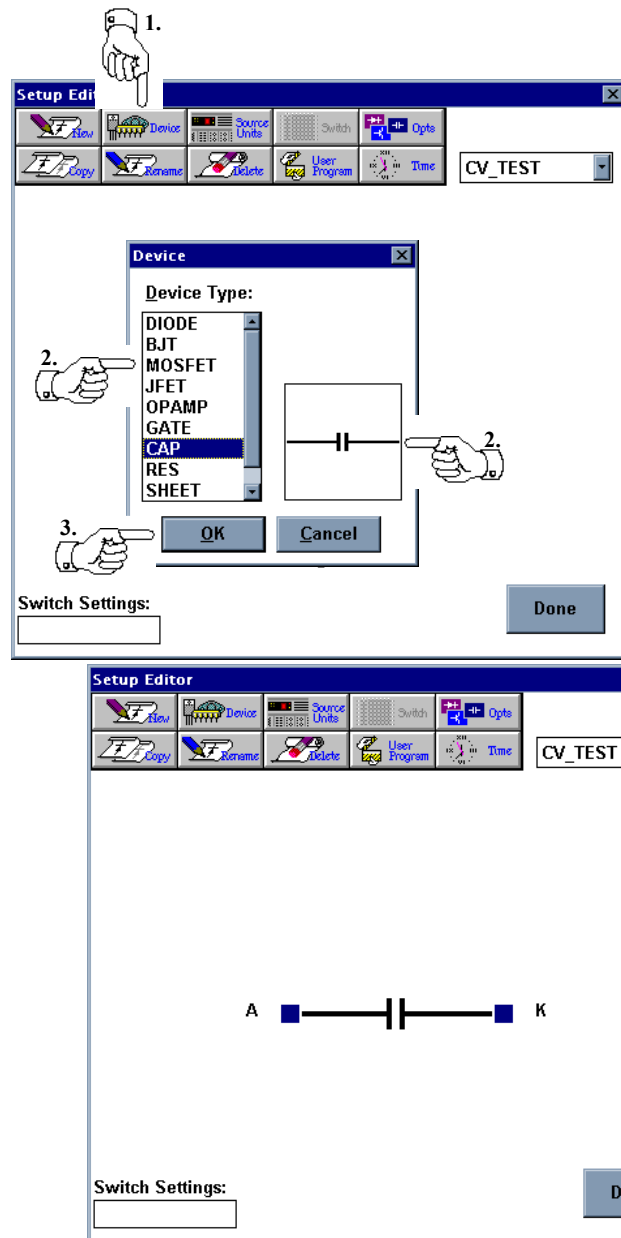
A library of different device schematics is provided in ICS. A MOSFET is the default device type and a MOSFET schematic will appear at the center of the Setup Editor when the Setup Editor is first opened.


Naming the Setup



1. Click on the **SETUP EDITOR** button  on the toolbar.
2. Click on the **New** button  in the Setup Editor window.
3. Enter a **Name** for the test setup. Setup names should not contain spaces.
4. Click on the **OK** button. Note that the setup name appears in the pull-down menu in the Setup Editor window and a data spreadsheet icon with the setup name appears at the bottom of the ICS workspace.

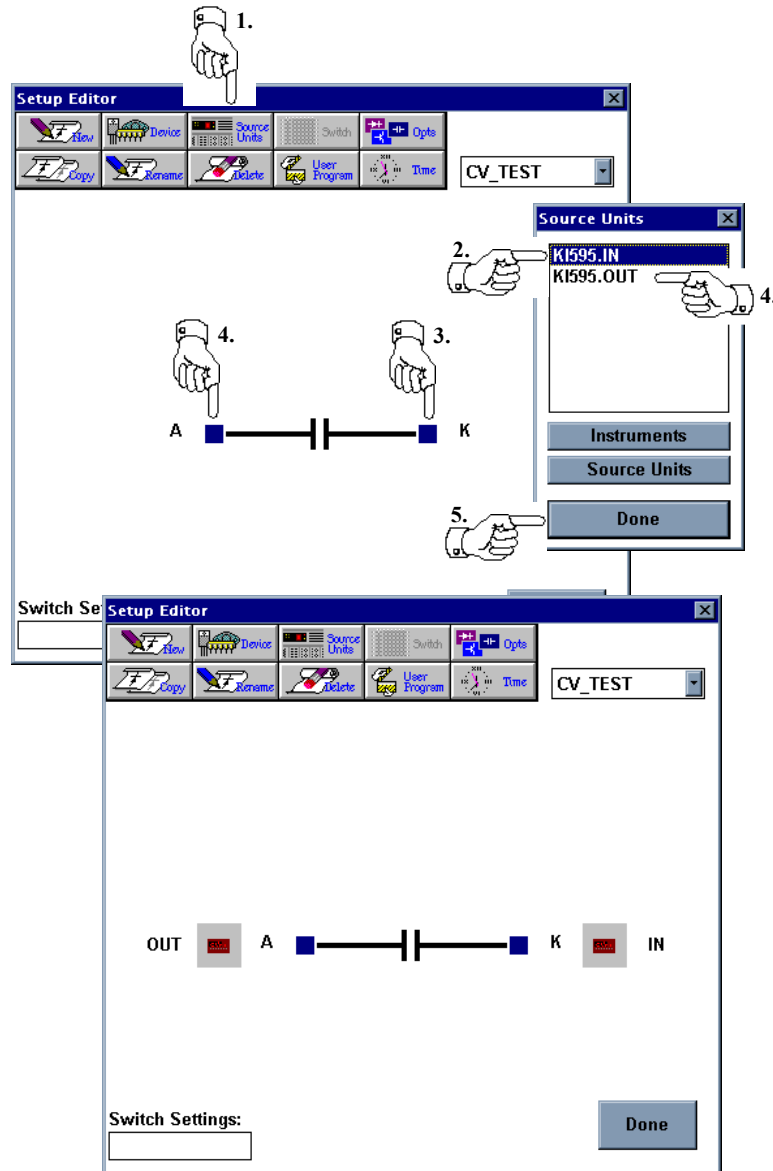
Selecting a Device Type




1. Click the **Device** button  in the Setup Editor window.
2. The Device Type window will display a list of available device schematics. Select **MOSFET** from this list. Notice that a preview of the schematic is shown to the right of the list of devices.

3. Click **OK**. This will close the Device dialog box and display the selected schematic at the center of the Setup Editor window.

Designating the Instrument/DUT Connections

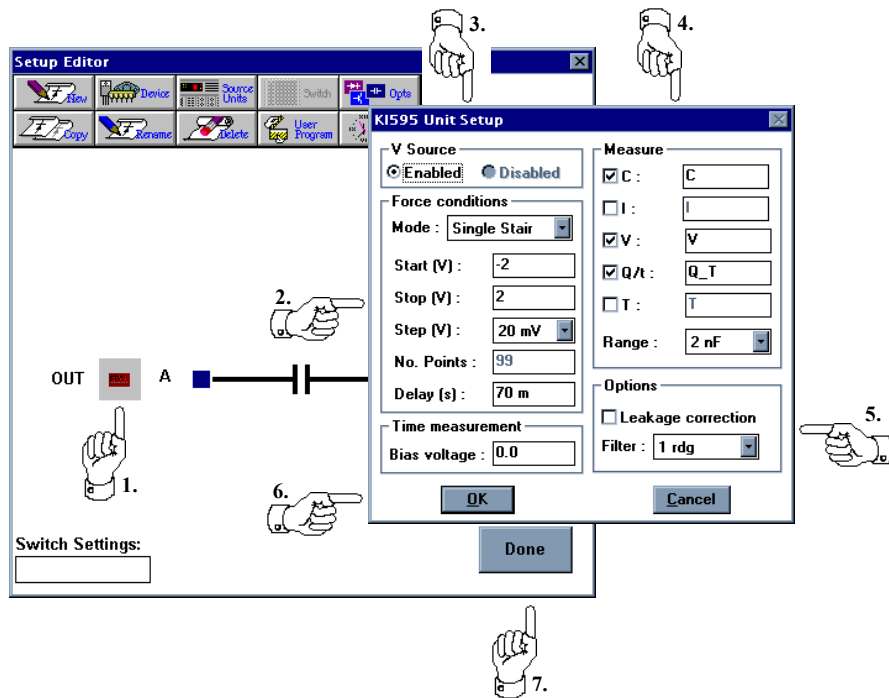


1. Select the Setup Editor **Source Units** button  to open the Source Units dialog box. The Source Units dialog box will list two sources: KI595.IN and KI595.OUT.
2. Click on the **KI595.IN** source.

3. Assign the KI595.IN source to the cathode by clicking the blue pad next to the letter **K**. An instrument icon will appear next to the connection.
4. Assign the KI595.OUT source to the anode by selecting the **KI595.OUT** source and then clicking the blue pad next to the letter **A**.
5. Click on the **Done** button to close the Source Units dialog box.

Note: Source assignments can be changed by selecting a source in the Source Units dialog box and then clicking on the blue pad indicating the terminal where it is to be removed.

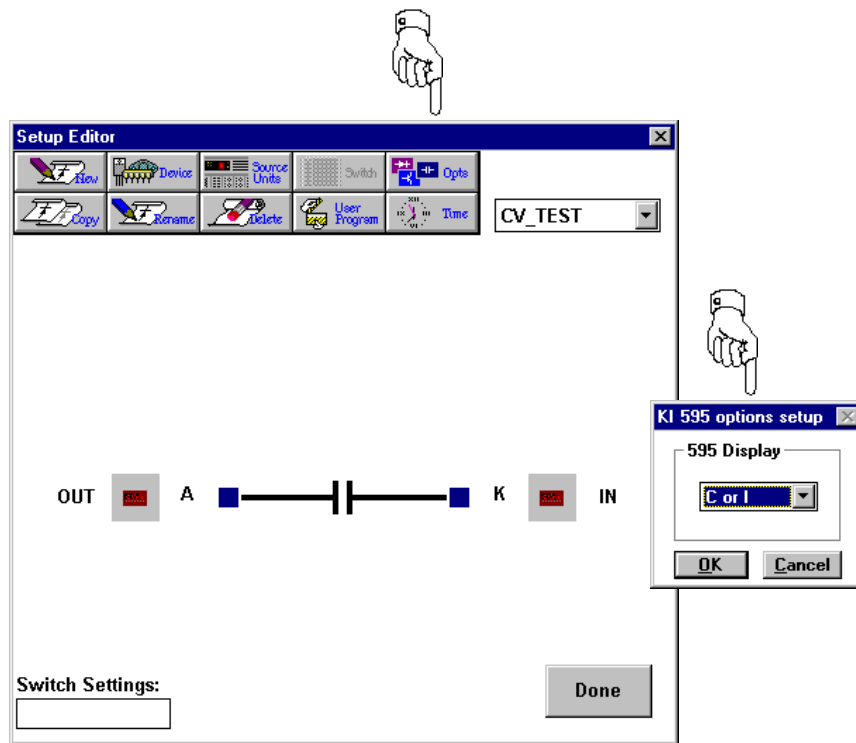
Specifying the Instrument Configuration



1. Click once on the **OUT** instrument icon to open the Model 595 setup dialog box.
2. Specify the Model 595 **Force Conditions** for the C-V measurement.
3. Select the **V source** mode.
4. Select the Parameters to be measured from the **Measure** group and select the 595's measurement range from the **Range** field. The names of the parameters may be changed by typing the desired name into the corresponding name field.
5. Specify the desired options in the **Options** group.
6. Click on the **OK** button to the Model 595 setup dialog.

7. Click on the **Done** button to close the Setup Editor.

Accessing KI595 Options

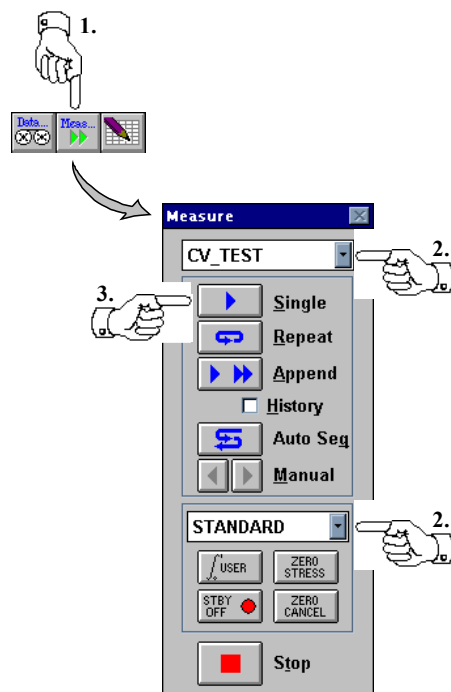



1. From the Setup Editor, click Options button to display the KI595 Options Setup dialog box.

KI595 Option 595 Display

The 595 Display option allows the user to select what is displayed on the front panel of the 595. Selectable values are C or I, V Src, and Q/t.

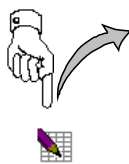
Executing the Measurement



1. Click on the **Measure** button  on the toolbar to access the Measurement Remote Control.
2. Verify that the test setup to be executed is selected and that **Standard** mode is selected.
3. Click on the **Single** button to execute the measurement.

Viewing the Results

Data values are written to the corresponding data window spreadsheet each time the measurement is executed. To display the numerical data, double click on the white spreadsheet icon corresponding to the test setup.

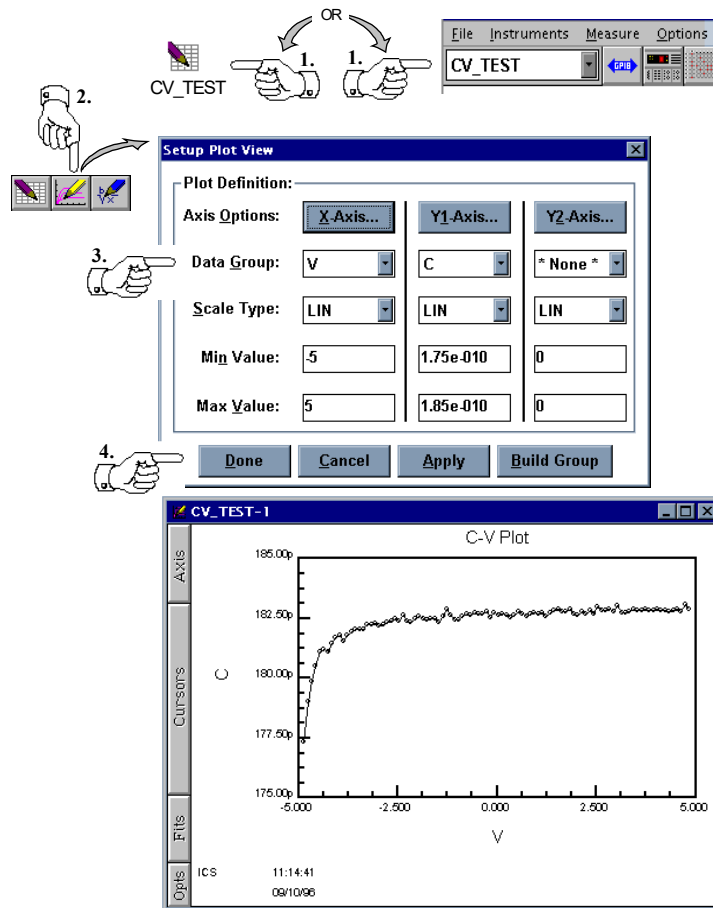



	C	V	Q T
1	177.32p	-4.8750	-980.00f
2	179.01p	-4.7750	-240.00f
3	179.88p	-4.6750	-500.00f
4	180.50p	-4.5750	-250.00f
5	181.08p	-4.4750	-180.00f
6	181.20p	-4.3750	-70.000f
7	181.10p	-4.2750	-140.00f
8	181.41p	-4.1750	-190.00f
9	181.69p	-4.0750	-90.000f
10	181.80p	-3.9750	-30.000f
11	181.56p	-3.8750	-350.00f

Data window spreadsheets are linked dynamically to the test setup. Each time the corresponding test setup is executed, the spreadsheet data is replaced with the most recently measured data. Each spreadsheet has the same name as the setup that was executed to measure the data.

Creating a Plot of the Results

Plot windows are linked dynamically to a corresponding data window spreadsheet. Just as the spreadsheets are updated after each measurement, the plots are regenerated anytime there is a change to the corresponding spreadsheet data. If the test setup is executed more than once, the plot window is regenerated after each measurement. Up to ten plots can be created from a single data window spreadsheet; each plot can be formatted independent of the others.



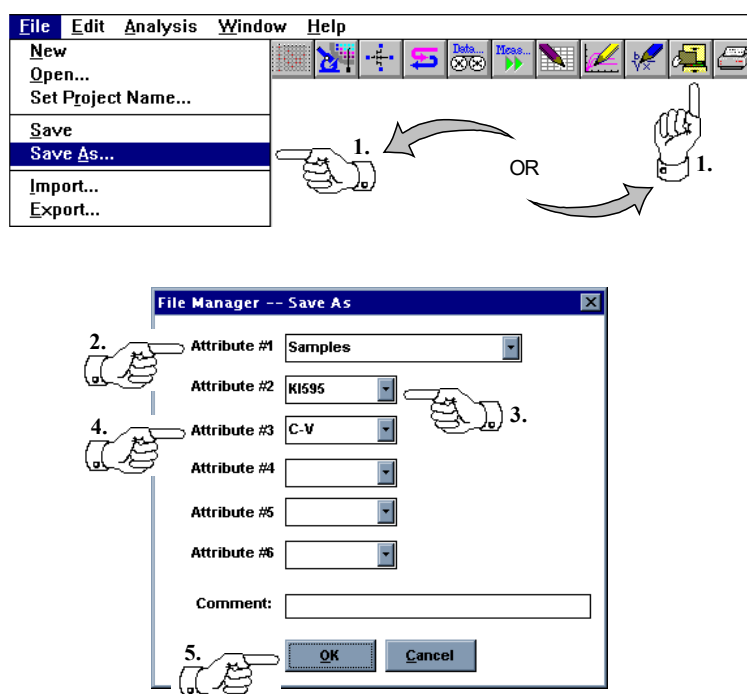
1. If there is more than one defined test setup, designate the active test setup by using the pull-down menu at the left end of the toolbar. A setup can also be made active by clicking once on the corresponding data window spreadsheet icon.
2. Click the **Create Plot** button  on the toolbar. This will open an empty plot window and the Plot Data dialog box.
3. Using the **Data Group** pull-down lists, select the vectors to be plotted on the x- and y-axes.
4. Click the **Done** button.


Saving Test Data

Project Files

A project file includes all of the information necessary to execute a test setup or group of test setups. A single project file includes: 1) the instrument driver selection, 2) any defined test setups, and 3) all of the data and plot windows associated with the test setups.

Saving the Results to a Project File



1. Save the test by clicking the **Save As** button  on the toolbar or by selecting **File/Save As...** from the menu bar.
2. Select a directory and enter a filename.
3. Click the **OK** button, or hit the keyboard **ENTER** key.

The KI Model 595 "OUT" Setup Dialog Box

Options for configuring the OUT source unit of the Model 595 can be found in the Model 595 setup dialog box. This dialog box is accessed by clicking on the OUT source icon in the Setup Editor schematic.

KI595 Unit Setup

V Source
☒ Enabled ☐ Disabled

Force conditions
Mode : **Single Stair**
Start (V) : **-5**
Stop (V) : **5**
Step (V) : **50 mV**
No. Points : **99**
Delay (s) : **0.2**

Time measurement
Bias voltage : **0.0**

Measure
☒ C : **C**
☐ I : **I**
☒ V : **V**
☒ Q/t : **Q_T**
☐ T : **T**
Range : **200 pF**

Options
☐ Leakage correction
Filter : **1 rdg**

OK **Cancel**

Force Conditions

The Force Conditions controls are used to specify the form of the voltage source output for the 595.

Mode

In **DC** mode the output voltage remains constant throughout the measurement. In DC mode only I, V, and T may be measured.

In **Single Stair** mode the output voltage is changed from the start value to the stop value in increments of the step value.

In **Double Stair** mode the output voltage is changed from the start value to the stop value in increments of the step value and then returns the output voltage to the start value in the same step increments.

In **Squarewave** mode the base voltage remains constant throughout the measurement, while pulsing at the Step voltage for quasistatic C measurements.

Start

The Start parameter specifies the starting voltage for the staircase modes and the base voltage for the DC and Squarewave modes.

Stop

The Stop parameter controls the stopping voltage for the staircase modes. This parameter is not used when in DC or Squarewave mode.

Step

The Step parameter specifies the voltage increments between Start and Stop for the staircase modes and is the voltage offset from the start voltage value for DC and Squarewave modes.

No. Points

No. Points displays the number of samples to be included in the measurement.

Delay

The Delay parameter is used to specify the time before a measurement for all modes.

Time Measurement Bias

The Time Measurement Bias controls are used to specify the bias values used during ICS Time, Bias Delay, Sequence Stress, and Sequence Bias mode measurements.

Bias Voltage

The Bias Voltage parameter specifies the voltage to be used for all ICS Time Measurements.

Measure

The Measure controls are used to specify parameter names and what parameters are to be measured on the Model 595 Quasistatic CV Meter.

Parameter Check Boxes

The Parameter Check boxes allow the user to specify the parameters which are to be measured by checking the associated check box.

Parameter Names

The Parameter Name fields are used to specify a user defined name for the associated parameter.

Range

The Range parameter specifies the value for a fixed range measurement. Values can be selected from a pull-down menu, and vary from 200pF to 20nF.

Options

Leakage Correction

The Leakage Correction parameter is used to enable or disable the Leakage Correction feature of the 595.

Filter

The Filter parameter is used to specify the number of readings to be integrated into a single sample. Values can be selected from a pull-down menu, and vary from 1 to 24. See the Model 595 Operators Manual for full details on all filter modes.