Metrics ICS Driver Manual

KI590

Metrics ICS

Version 4.5

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KI590 Instrument Driver

Instrument Test Connections

Use the information below to make Model 590 test connections.

INPUT and OUTPUT Test Jacks

INPUT and OUTPUT are BNC type jacks. The center conductor is high, and the outer ring or shell of each jack (connected to analog common) is low.

WARNING

The INPUT and OUTPUT jacks can be floated up to 30V RMS (42.4V peak) above chassis ground potential only when the rear panel grounding switch is in floating position. Exceeding 30V RMS will create a shock hazard.

Connection Considerations

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

- Use the correct coaxial cables when making connections. Use only Model 4801 low noise cables for both INPUT and OUTPUT test connections. The maximum recommended cable length is five meters.
- Maximum common-mode voltage for both INPUT and OUTPUT is 30V RMS, 42.4V peak when the rear panel grounding switch is in the floating position.
- Excessive shunt capacitance in the cables or probe station may degrade measurement accuracy and increase noise. Consult Model 590 specifications for accuracy degradation and noise figures.
- Make sure probe shields are carried through as close to the wafer as possible.
- A faraday shield that surrounds the wafer and chuck may be required to minimize noise. This shield must be insulated from the prober chassis and connected to analog common via the BNC cable shields.
- The prober chassis should be connected to earth ground.
- Use cable correction when testing at 1MHz.

Test Connection Procedure

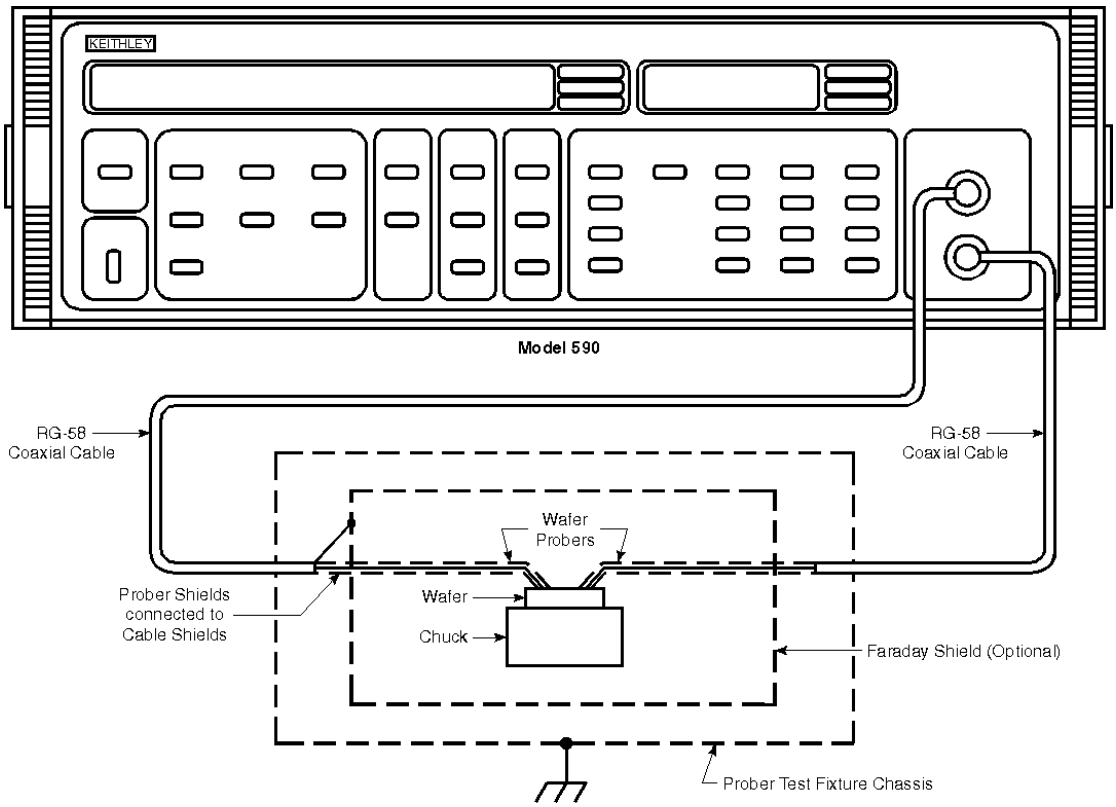


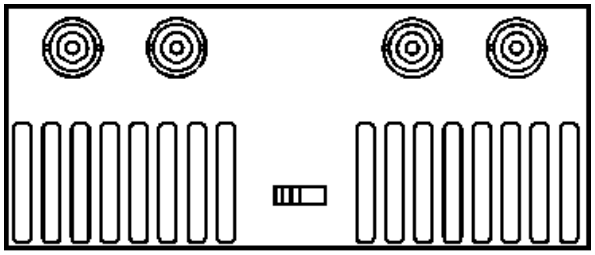
Figure 1: Typical test connections

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

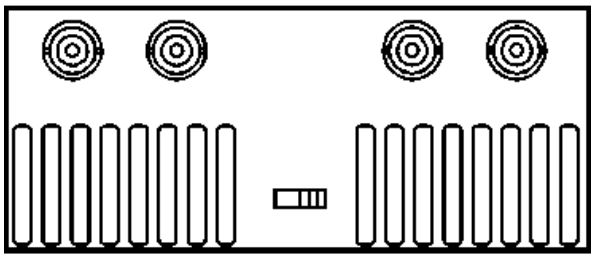
1. Connect one RG-58 BNC cable between the Model 590 test OUTPUT jack and the test input jack of the probe station.
2. Connect a second RG-58 BNC cable between the Model 590 test INPUT jack and the test output jack of the probe station.
3. Select either grounded or floating operation with the rear panel switch. (See the discussion below for further information.)

Grounded and Floating Operation

The outer rings of the TEST INPUT and OUTPUT jacks are connected to analog common, which can either be connected to chassis ground, or floated up to 30V RMS above ground potential. To select grounded or floating operation, simply place the rear panel grounding switch in the appropriate position (Figure 2). Note that the rear panel BIAS and analog outputs will also be affected by the position of this switch.



A. Analog Common Floating



B. Analog Common Grounded

Figure 2: F*loating/grounded operation of analog common*

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 analog common, or if noise caused by ground loops is not a problem.
- If analog common must be floated above chassis ground potential, or if noise caused by ground loops occurs, the instrument should be operated with analog common floating.

IEEE-488 Bus Connections

Connect the Model 590 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 selecting the line voltage, connecting the instrument to line power, and turning on the instrument.

Line Voltage Selection

The Model 590 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 180-220V ranges). Before connecting the instrument to line power, make sure the rear panel line voltage selection switch is in the correct position for 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 Frequency

The Model 590 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 voltage range 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 590 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

To turn on the power, simply press in on the POWER switch.

NOTE

Do not press and hold the CAL or right arrow keys during the power-up cycle as doing so will cause the instrument to enter the diagnostic or calibration modes.

During the power-up cycle, the instrument will perform the following:

1. A RAM and ROM checksum test. If an error is found as the result of these tests, the instrument will display either all "0"s for a ROM failure, or all "A"s for a RAM failure, and the instrument will lock up. In this case, the unit will require servicing.
2. Assuming the unit successfully passes the self test, it will then briefly display the model number and software revision level, as in this example: REV D14
3. In this instance, the software revision level is D14, but your particular instrument may be different. In any case, you should record the software revision level in case it becomes necessary to replace one of the firmware ROMs in the future.
4. Next, the programmed primary address will be displayed as in the example using the default primary address: IEEE ADDRESS 15
5. Following these display messages, the unit will begin normal operation and assume the operating modes discussed below.

Power-up Configuration

After the self test and power-up display messages, the instrument will assume the operating modes stored in save/recall position 1 as shown in Table 1, which summarizes the factory default configuration. Note that many of these operating modes may be different if you modify save/recall position 1. You can restore these default operating modes with RECALL 0.

Table 1: *Power-up default conditions*

Mode	Condition
Range	2nF
Frequency*	100kHz
Model	Parallel
Filter	On
Rate	10 readings/sec
Zero	Off
Trigger Mode	Sweep
Trigger Source (MANUAL)	Front Panel
Bias Source	Off
Bias Waveform	DC
Start Time	1msec
Stop Time	1msec
Step Time	1msec
First Bias	0V
Last Bias	0V
Bias Step	0
Default Bias	0V

Mode	Condition
Count (# readings DC or external)	450
Plotter Grid Type**	0 (Full Grid)
Plotter Pen Type**	1 (Pen #1)
Plotter Line Type**	7 (Solid Line)
Plotter Label Type**	0 (Full Labels)
Plot Type **	0 (C vs. V)
Buffer to Plot**	0 (Buffer A)
XY Scaling**	Off
IEEE-488 Primary Address**	15
Cable #**	7 (To front panel)

* 590/100k or 590/100k/1M units

** These states cannot be altered with SAVE 1.

NOTE: Use RECALL 0 to restore this configuration.

Warm-up Period

The Model 590 can be used immediately when it is first turned on. However, the instrument must be allowed to warm up for at least one hour to achieve rated accuracy, and you must use the CAL key to obtain rated accuracy if the ambient temperature changes by more than 2°C.

Setting the Primary Address

The primary address of the Model 590 must be the same as the primary address selected from the driver software. The default Model 590 primary address is 15, and the allowable address range is from 0 to 30.

Check or change the primary address as follows:

1. Press SHIFT then IEEE. The instrument will display the present primary address: IEEE ADDRESS 15
2. In this example, the default value (15) is displayed.
3. To exit at this point without changing the primary address, press QUIT.
4. To change the address, key in a new value using the numeric data keys. Keep in mind that the primary address limits are 0-30 inclusive. If you enter address above 30, the unit will set the address to 30.
5. After keying in the desired value, press the ENTER key. The instrument will return to normal operation with the new address in effect.

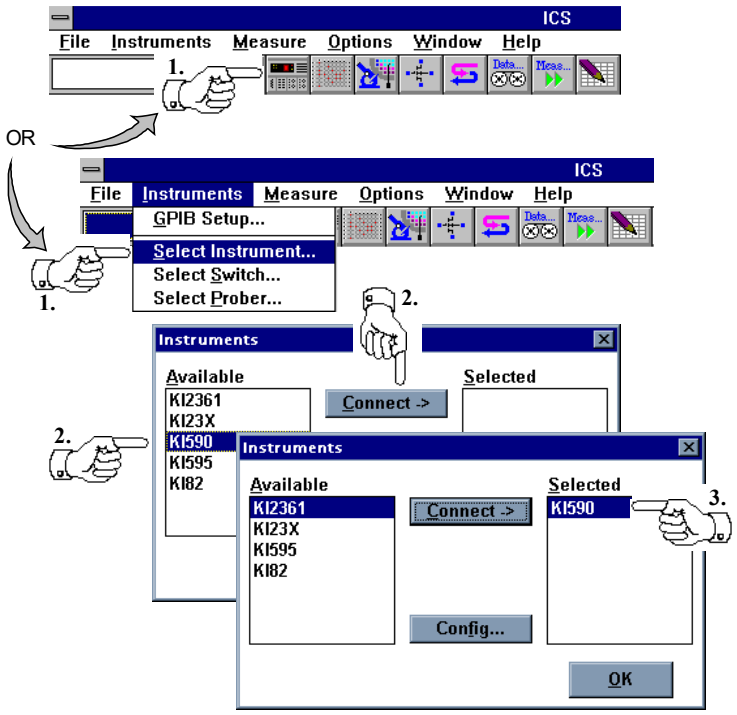
Getting Started: Creating and Executing a Test Setup

This section describes the steps required to create and execute a sample test setup. The sample test setup will be used to measure Drain to Source capacitance of a MOSFET transistor as a function of voltage. The Model 590 CV Analyzer 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 Semi-automatic probe station for measuring on wafer.

Connecting the KI590 Instrument Driver



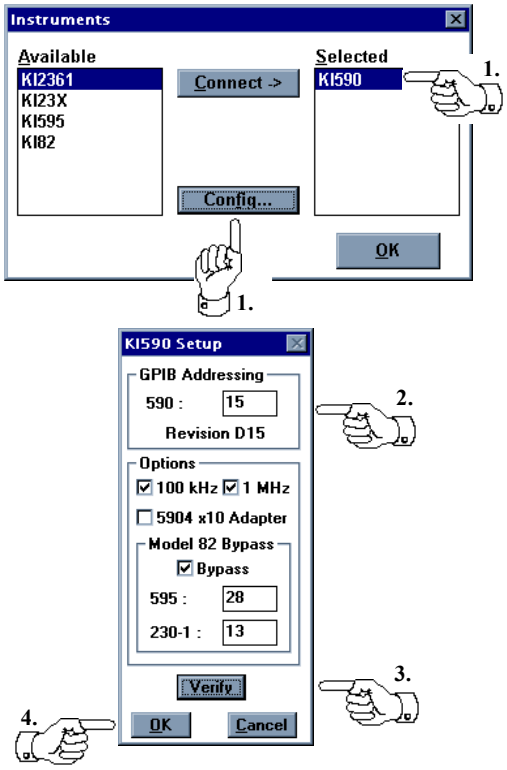
1. Click the **Instruments** button  on the toolbar or select **Instruments/Select Instrument..** from the ICS measurement mode menu.

2. Highlight **KI590** 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 590 CV Analyzer to your computer using a standard IEEE-488 GPIB (General Purpose Interface Bus) as described in the Mode 590 CV Analyzer Instruction Manual.

The Model 590 CV Analyzer Setup dialog box is used to designate the GPIB addresses of the Model 590 CV Analyzer instruments and to verify the instruments are configured correctly.



1. With the **KI590** highlighted in the **Selected** field, click on the **Config...** button.
2. Enter the address of the 590 and the available options. If using a 590 in a Model 82 select **Bypass** and enter the GPIB address of the 595 and the 230

in the appropriate address fields. The GPIB address will be displayed momentarily when the instrument is turned on.

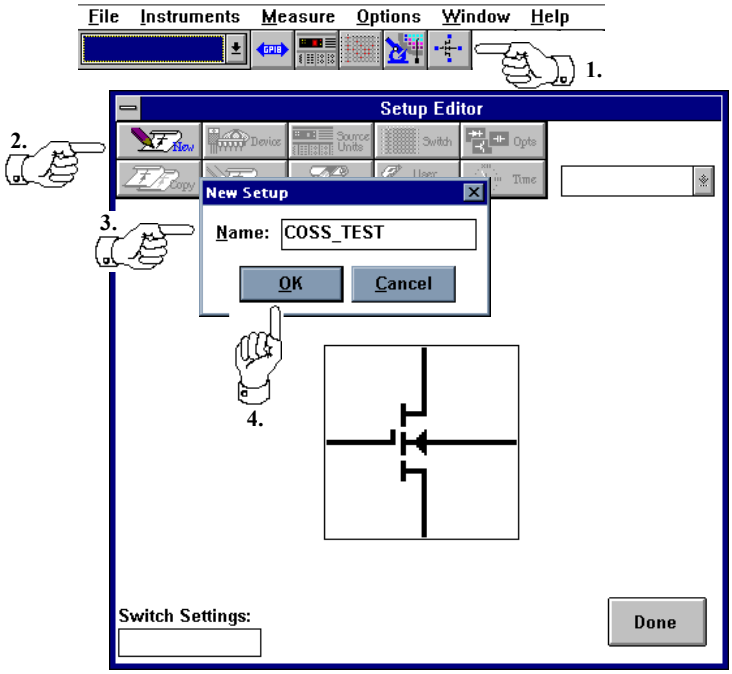
3. Click on the **Verify** button to verify communication with the instruments.
4. Click on the **OK** button.

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.

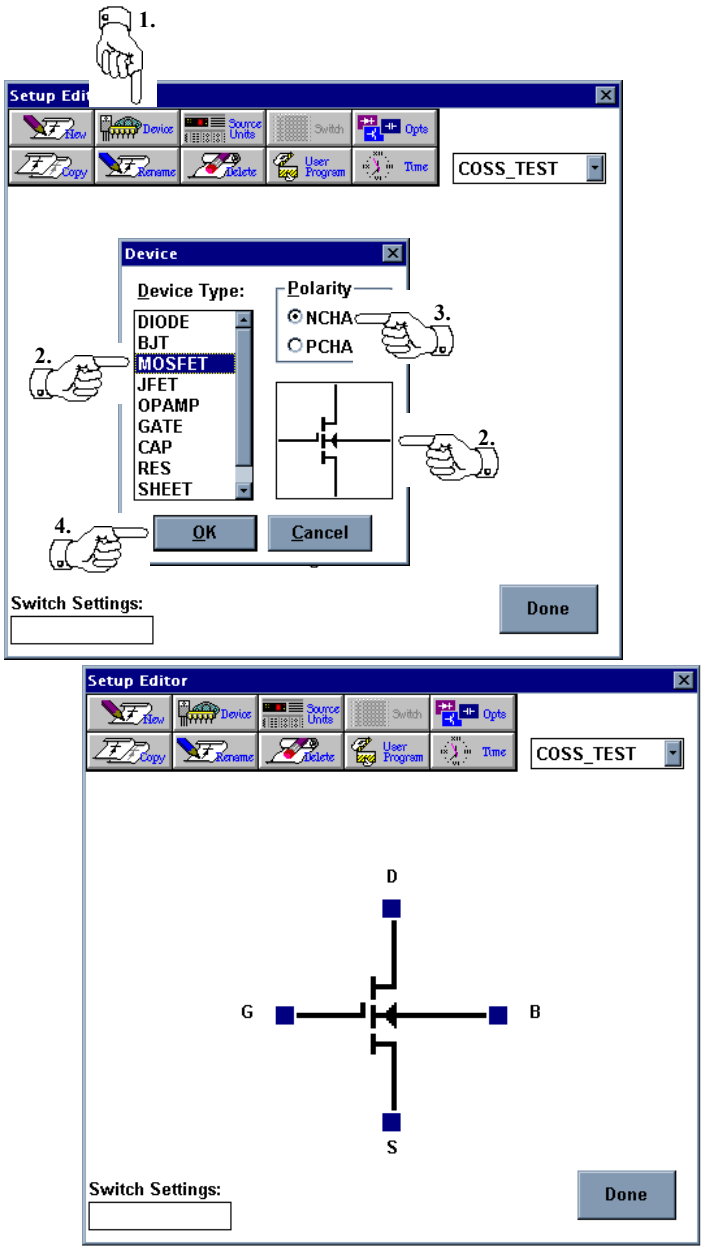
Naming the Setup



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.

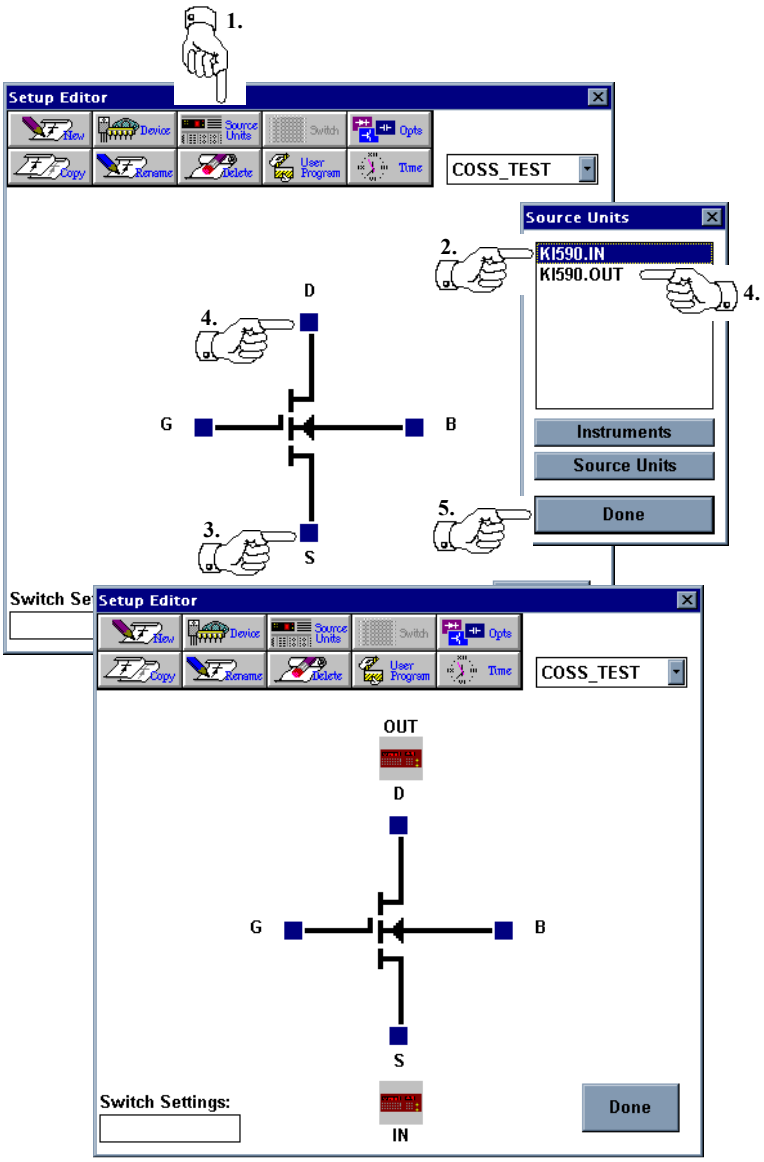
Selecting a Device Type



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. Selecting the MOSFET schematic will display polarity options. Select the **NCHAN** option.

4. 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

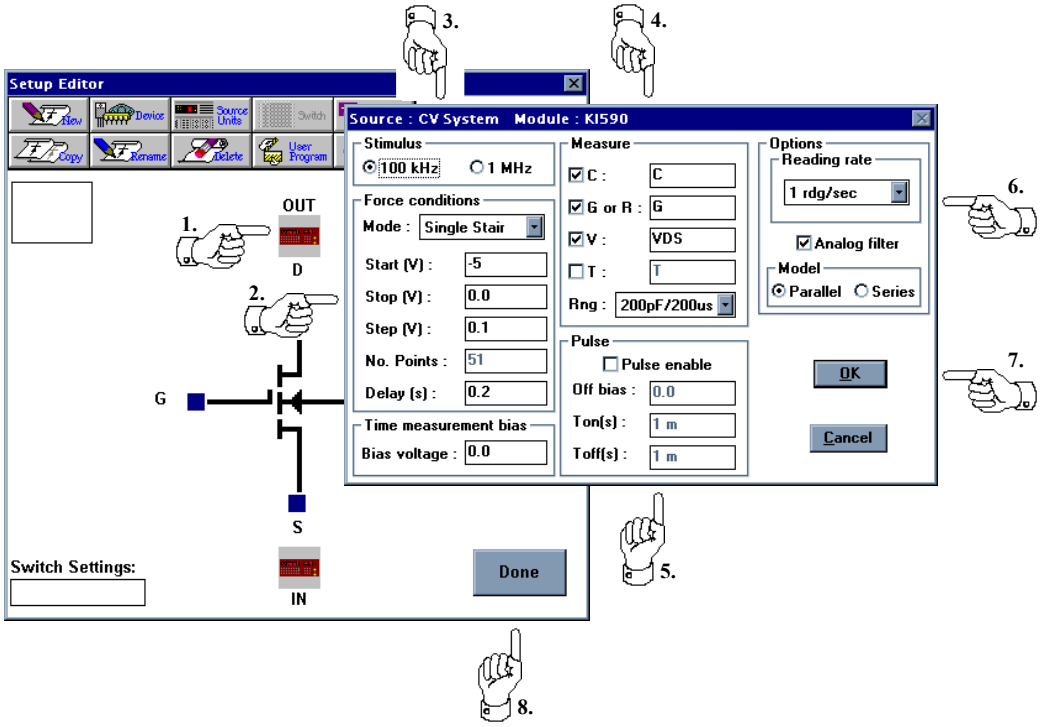


1. Select the Setup Editor **Source Units** button  to open the Source Units dialog box. The Source Units dialog box will list two sources: KI590.IN and KI590.OUT.
2. Click on the **KI590.IN** source.
3. Assign the KI590.IN source to the source by clicking the blue pad next to the letter **S**. An instrument icon will appear next to the connection.

4. Assign the KI590.OUT source to the drain by selecting the **KI590.OUT** source and then clicking the blue pad next to the letter **D**.
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.

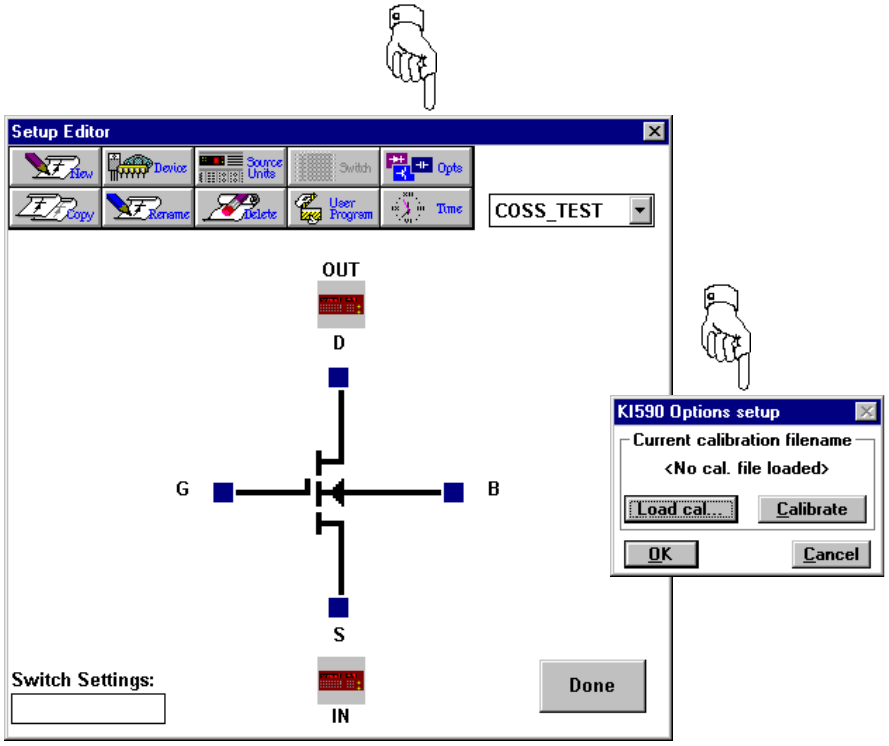
Specifying the Instrument Configuration



1. Click once on the **OUT** instrument icon to open the Model 590 CV Analyzer setup dialog box.
2. Specify the Model 590 CV Analyzer **Force Conditions** for the Coss measurement.
3. Select the **Stimulus** frequency.
4. Select the Parameters to be measured from the **Measure** group. The names of the parameters may be changed by typing the desired name into the corresponding name field.
5. Specify the pulse mode configuration for the 590 in the **Pulse** group.

6. Specify the desired options in the **Options** group.
7. Click on the **OK** button to the Model 590 CV Analyzer setup dialog.
8. Click on the **Done** button to close the Setup Editor.

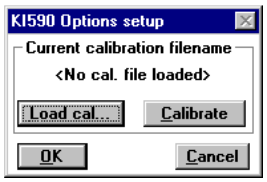
Accessing KI590 Options and Cable Calibration

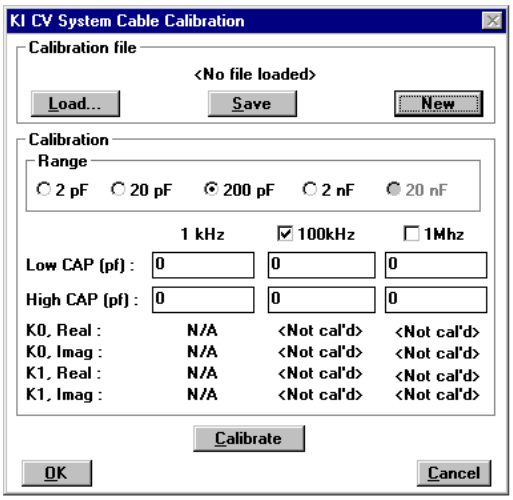


1. From the Setup Editor, click Options button to display the KI590 Options Setup dialog box.

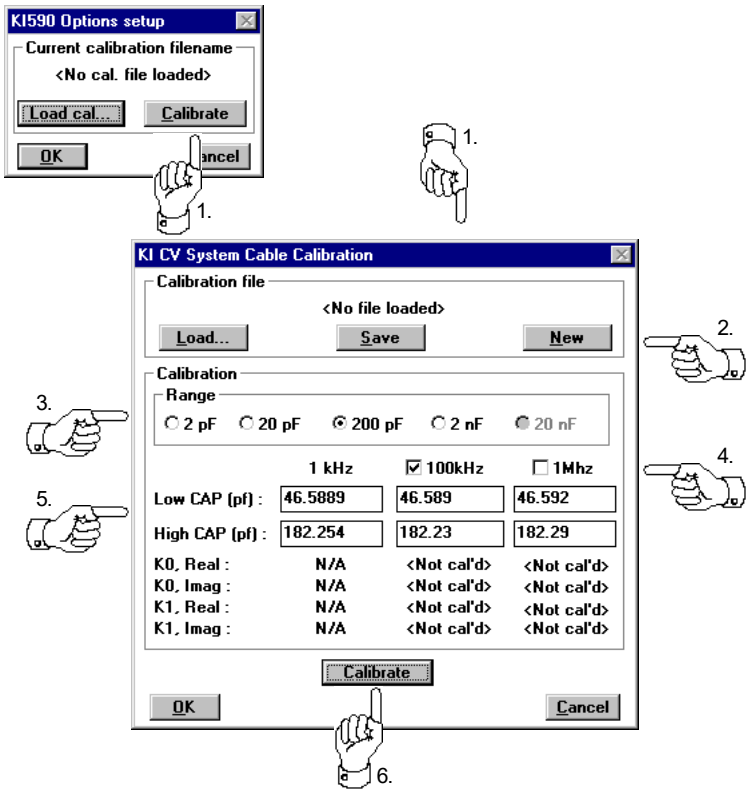
KI590 Cable Calibration

KI590 Cable Calibration is performed through the KI590 Options Setup dialog box.

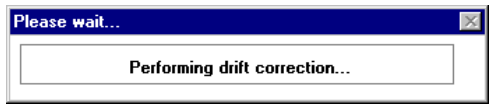




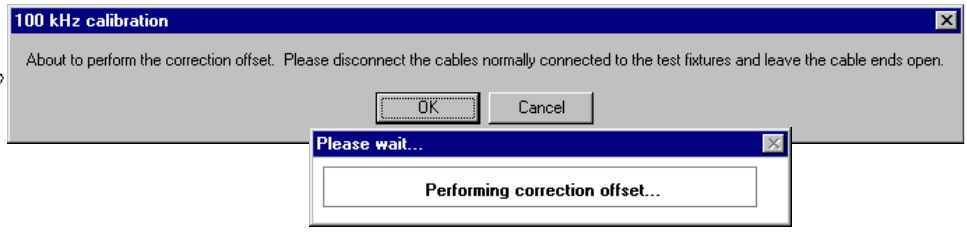
Create A New Cable Calibration Settings



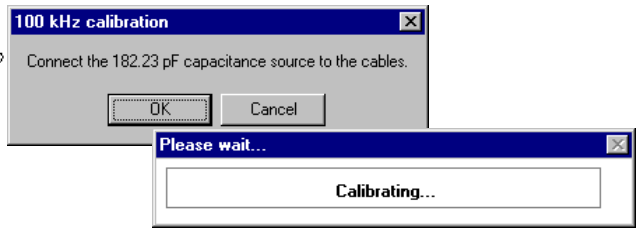
6.


Please wait...
Performing drift correction...

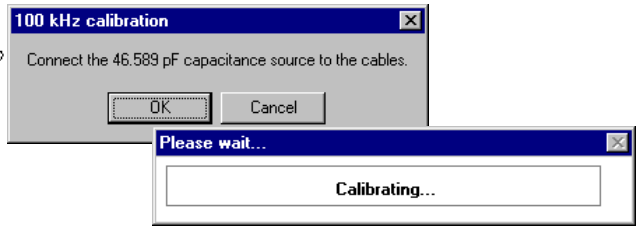
7.


100 kHz calibration
About to perform the correction offset. Please disconnect the cables normally connected to the test fixtures and leave the cable ends open.
OK
Cancel
Please wait...
Performing correction offset...

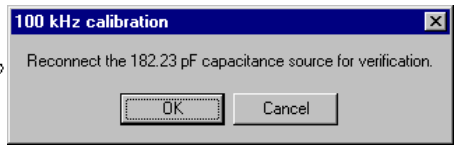
8.


100 kHz calibration
Connect the 182.23 pF capacitance source to the cables.
OK
Cancel
Please wait...
Calibrating...

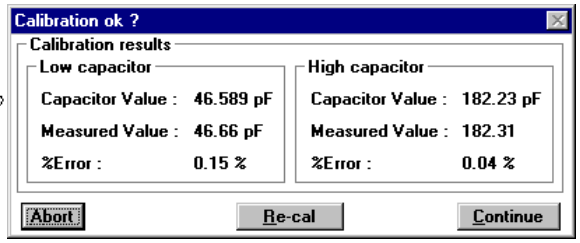
9.


100 kHz calibration
Connect the 46.589 pF capacitance source to the cables.
OK
Cancel
Please wait...
Calibrating...

10.


100 kHz calibration
Reconnect the 182.23 pF capacitance source for verification.
OK
Cancel

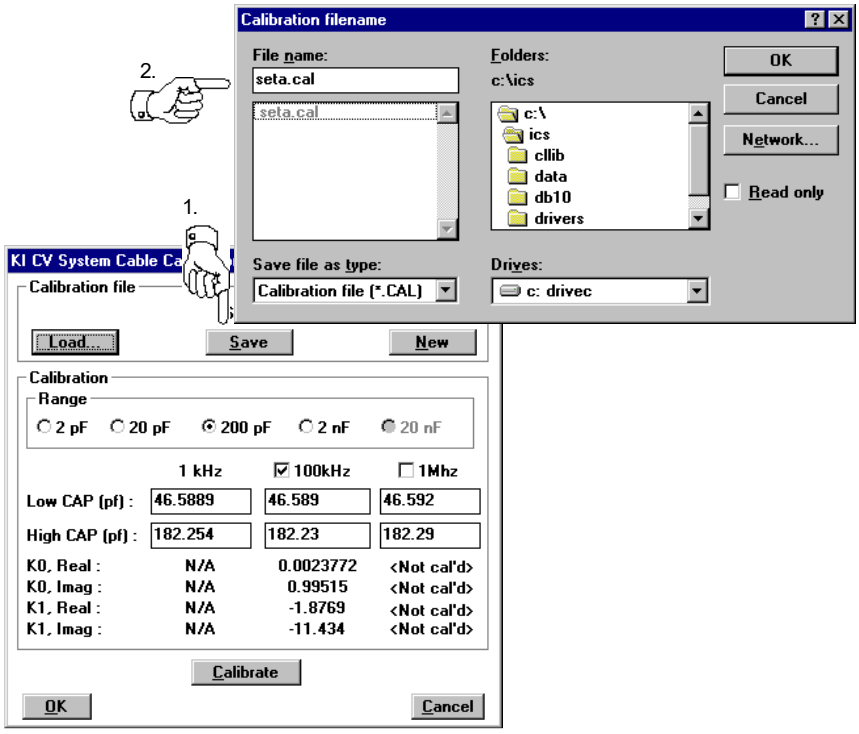
11.


Calibration ok ?
Calibration results
Low capacitor
Capacitor Value : 46.589 pF
Measured Value : 46.66 pF
%Error : 0.15 %
High capacitor
Capacitor Value : 182.23 pF
Measured Value : 182.31
%Error : 0.04 %
Abort
Re-cal
Continue

1. Click on the Calibrate button to open the KI CV System Cable Calibration dialog box.
2. Click on the New button to start a New Calibration file.
3. Select the Range to be calibrated from the Range controls. This range should match the measurement range and the calibrated capacitors to be used for calibration.
4. Select the frequencies at which calibration is to be performed.
5. Enter the capacitor values for the calibrated capacitors to be used during calibration. The calibrated capacitors must have values in the range being calibrated.
6. Click on the Calibrate button to begin the calibration process with Drift Correction.
7. Remove all cable connections and press OK to the prompt to perform the Correction Offset feature.
8. Connect the High CAP calibrated capacitor and press OK to perform calibration on the High CAP.
9. Connect the Low CAP calibrated capacitor and press OK to perform calibration on the Low CAP.
10. Re-connect the High CAP calibrated capacitor and press OK to perform verification on the High CAP.
11. Calibration status is displayed after the completion of calibration at frequency. If too much error exists check the system configuration press the Re-cal button to re-perform the calibration. If more than one frequency was selected for calibration the calibration procedure would begin again with Step 6 for the next frequency.

Save the Current Calibration Settings to File

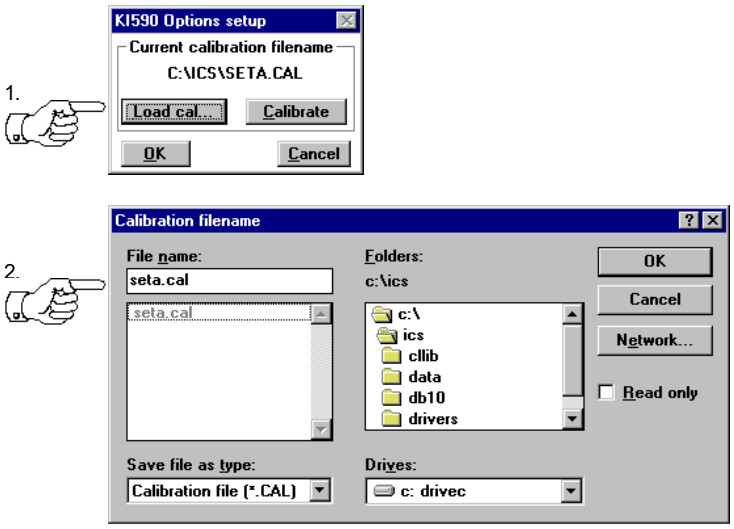
In order to allow calibration settings to be re-used at a later time the settings must be saved to a file which may be loaded and used with multiple measurement setups.



1. Click on the Save button to open the Calibration Filename dialog box.
2. Enter a name for the file which will contain the current calibration settings.

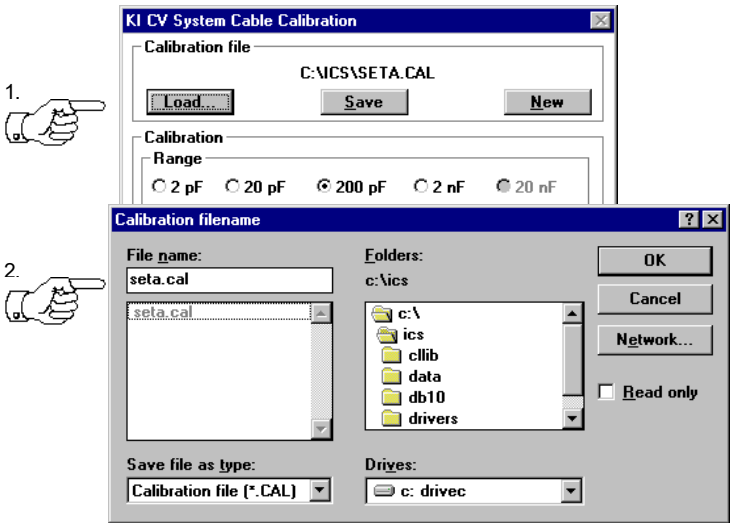
Load an Existing Calibration Settings from File

In order to allow calibration settings to be edited or re-used at a later time the settings must be saved to a file which may be loaded and used with multiple measurement setups. Calibration files may be loaded either from the KI590 Options Setup dialog or the KI CV System Cable Calibration dialog box.



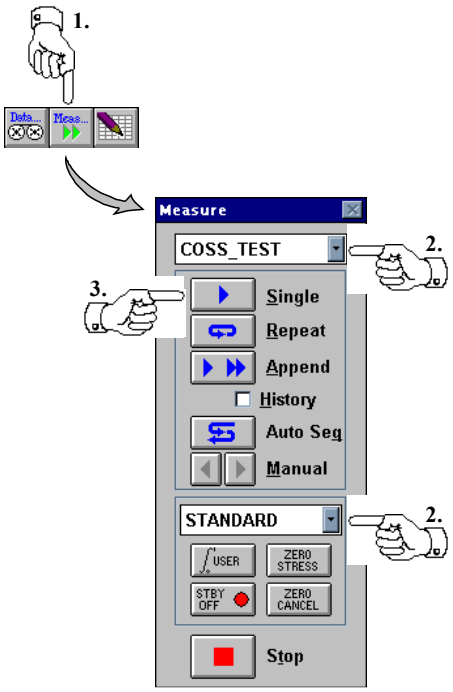
1. From the KI590 Options Setup dialog box click on the Load Cal... button to open the Calibration Filename dialog box.
2. Locate the select the desired calibration file to be loaded and used with the current measurement setup.

OR



1. From the KI CV System Cable Calibration dialog box click on the Load... button to open the Calibration Filename dialog box.
2. Locate the select the desired calibration file to be loaded and used with the current measurement setup.

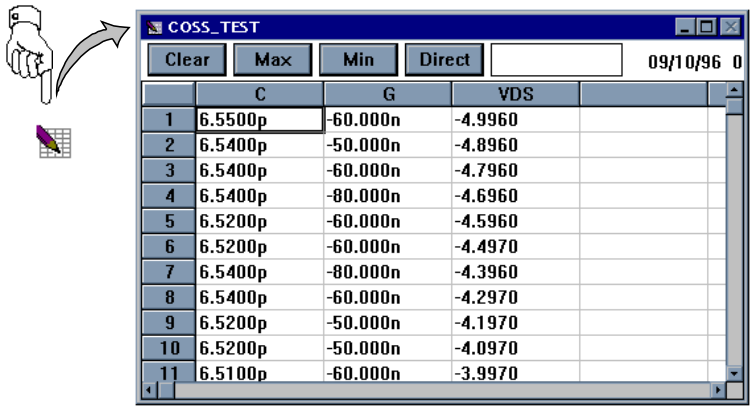
Executing the Measurement



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.

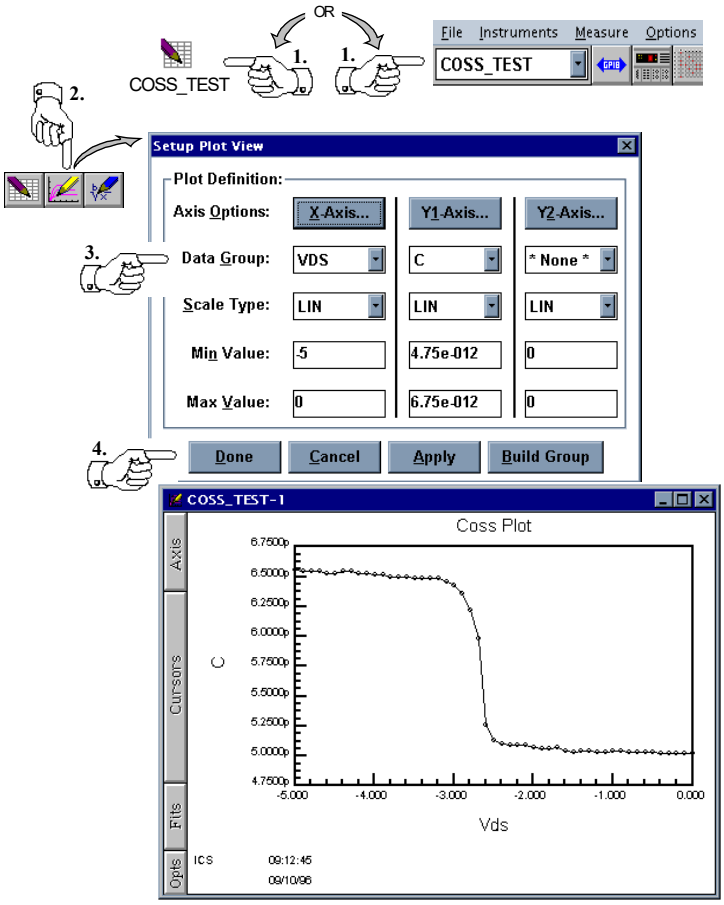


	C	G	VDS
1	6.5500p	-60.000n	-4.9960
2	6.5400p	-50.000n	-4.8960
3	6.5400p	-60.000n	-4.7960
4	6.5400p	-80.000n	-4.6960
5	6.5200p	-60.000n	-4.5960
6	6.5200p	-60.000n	-4.4970
7	6.5400p	-80.000n	-4.3960
8	6.5400p	-60.000n	-4.2970
9	6.5200p	-50.000n	-4.1970
10	6.5200p	-50.000n	-4.0970
11	6.5100p	-60.000n	-3.9970

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. Clicking once on a data window spreadsheet icon will display a system menu; ignore this display.
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

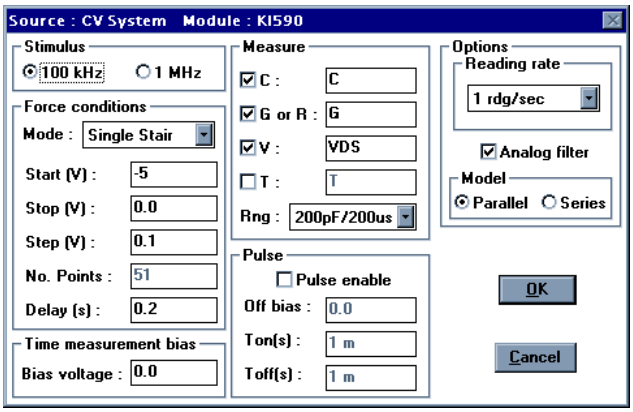
A project file includes all of the information necessary to execute a test setup or group of test setups. A single project file includes: 1) the instrument driver selection, 2) any defined test setups, and 3) all of the data and plot windows associated with the test setups.

Saving the Results to a Project File

1. Open the File Manager 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 590 CV Analyzer "OUT" Setup Dialog Box

Options for configuring the OUT source unit of the Model 590 CV Analyzer can be found in the Model 590 CV Analyzer setup dialog box. This dialog box is accessed by clicking on the OUT source icon in the Setup Editor schematic.



Stimulus

The stimulus controls are used to setup the frequency stimulus for the Model 590 CV Analyzer.

100KHz

The 100KHz option is used to place the 5951 Remote Input Coupler in 100KHz mode and the Model 590's source frequency value to 100KHz.

1MHz

The 1MHz option is used to place the 5951 Remote Input Coupler in 1MHz mode and the Model 590's source frequency value to 1MHz. 1MHz will be disabled if the optional Model 5904 adapter is active.

Force Conditions

The Force Conditions controls are used to specify the form of the voltage source output for the 590.

Mode

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 **DC/C vs Time** mode a constant voltage source is applied and all values selected for measurement are measured versus accumulate delay time. For this mode the No. Points parameter designates the number of samples to be taken and the delay time designates the sample interval.

Start

The Start parameter specifies the starting voltage for the staircase modes and the constant voltage value for the DC/C vs. T mode. Start is not used for either of the External modes.

Stop

The Stop parameter controls the stopping voltage for the staircase modes. This parameter is not used when the Force Conditions are in DC/C vs. T mode or either External mode.

Step

The Step parameter specifies the voltage increments between Start and Stop for the staircase modes. This parameter is not used when the Force Conditions are in DC/C vs. T mode or either External mode.

No. Points

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

Delay

The Delay parameter is used to specify the time before a measurement is made after each voltage change for the staircase modes and is the sample interval when in DC/C vs. T mode or either External mode.

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 590 CV Analyzer.

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.

Pulse

The pulse functions allows the user to pulse the 590's voltage source.

Pulse Enable

Pulse Enable enables the pulse feature set of the 590.

Off Bias

Off Bias specifies voltage value when the pulse is in the off portion of the pulse wave.

Ton(s)

Ton specifies the amount of time the Start source voltage is applied during each pulse.

Toff(s)

Toff specifies the amount of time the Off Bias source voltage is applied during each pulse.

Options

Reading Rate

The Reading Rate specifies the rate at which the 590 samples during a measurement.

Analog Filter

The Analog Filter parameter is used to enable the Analog Filter feature of the 590.

Model

The Model parameter is used to specify either a Parallel or Series the circuit mode on the 590.