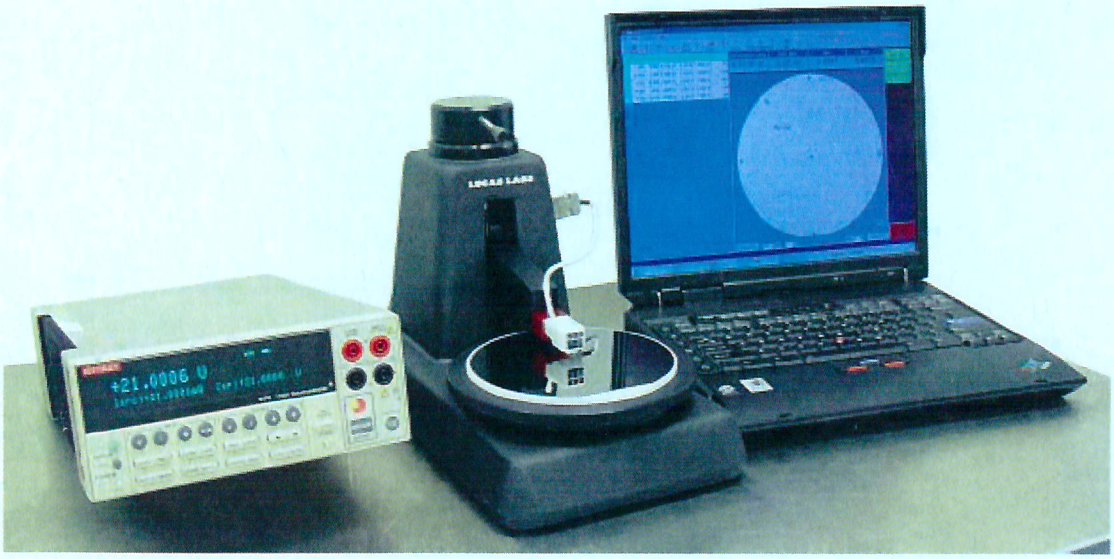
LUCAS LABS

Pro4 M series



Installation and Operation Manual

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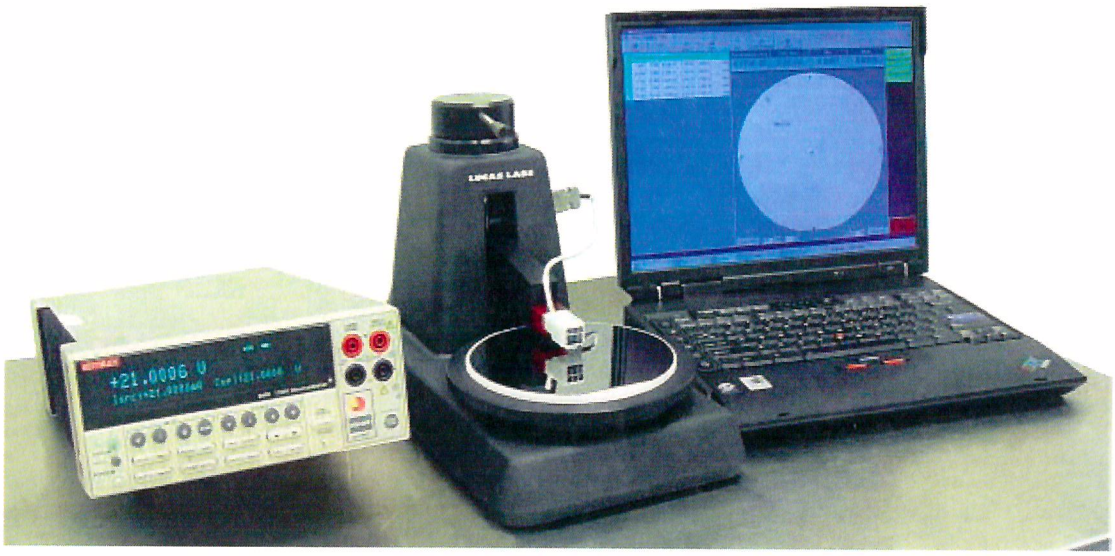
About the Pro4



For over 35 years, Lucas-Signatone has designed and built 4 point probing equipment for measuring the sheet resistivity of semiconductors. More recently, the 4 point probe methodology has been applied to a variety of material research measuring thin films on a variety of substrates. The Pro4 is designed to meet the demands of research on wafers, thin films, solar cells and a variety of applications.

The Pro4 employs the ASTM F84 in line four-point probe configuration. Dual configuration is also used but may be switched off if not desired. The dual configuration method may be found in the NIST publication 260-131. When calibrated with a NIST traceable standard, the accuracy through the standard range ± 1%.

Setting Up the Pro4

Items Included in the Pro4

Before starting with the installation, it is a good idea to take inventory and assure that you have everything needed. The following diagram shows all the pieces included in every configuration of the Pro4.

1) The Pro4 stand assembled and ready for use including the 30" connection cable prewired.

2) The Pro4 software on CD ROM.

3) The Teflon chuck. The size of this chuck will vary based on the model number. Three chucks are available; 100, 150 and 200mm.

4) An international 12 volt D/C power supply along with wall connections.

5) Two each SP4 probe heads. The configuration of these heads should have been specified in the order. If not specified, Lucas Labs includes the two most common probe heads SP4-62085TRY and SP4-620850RY.

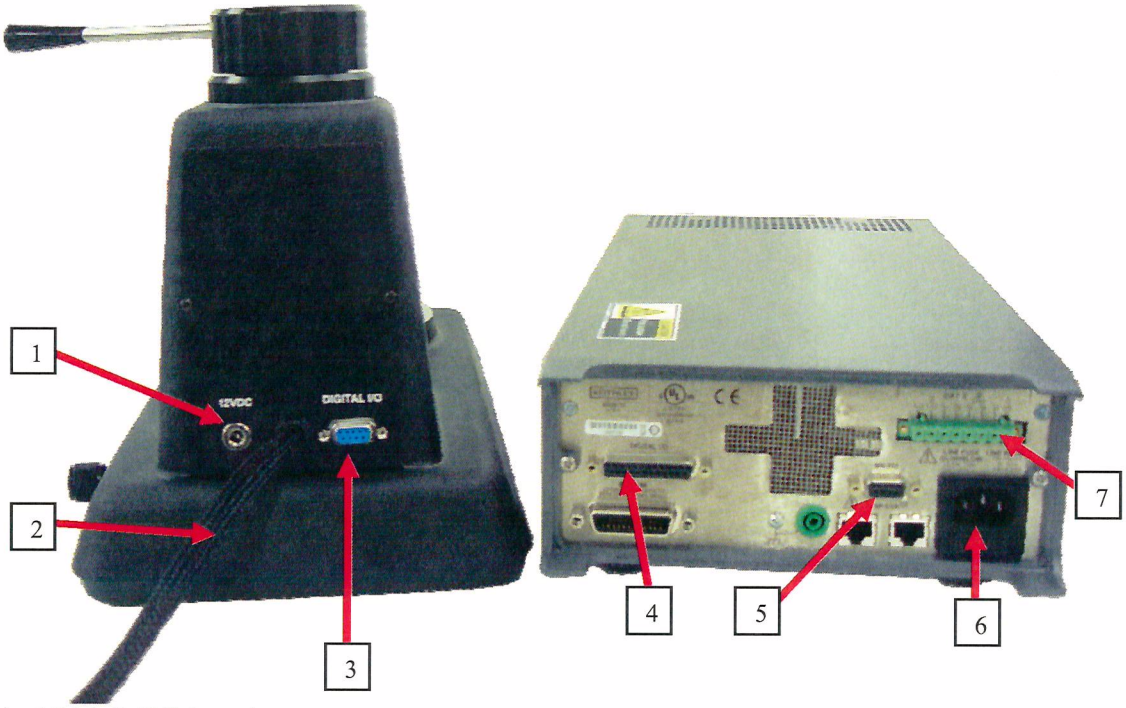
6) Two each of the probe head quick mounting blocks including the stainless steel socket cap screws 7/8" by 6x32.

7) A RS232 cable, 9 pin D sub male to female

8) A custom designed digital I/O cable

These are the items included in all Pro4 configurations. However, the Pro4 is not complete until it has a Keithley 2600 series SourceMeter and a computer running the Pro4 software.

Connecting the Pro4 to the SourceMeter

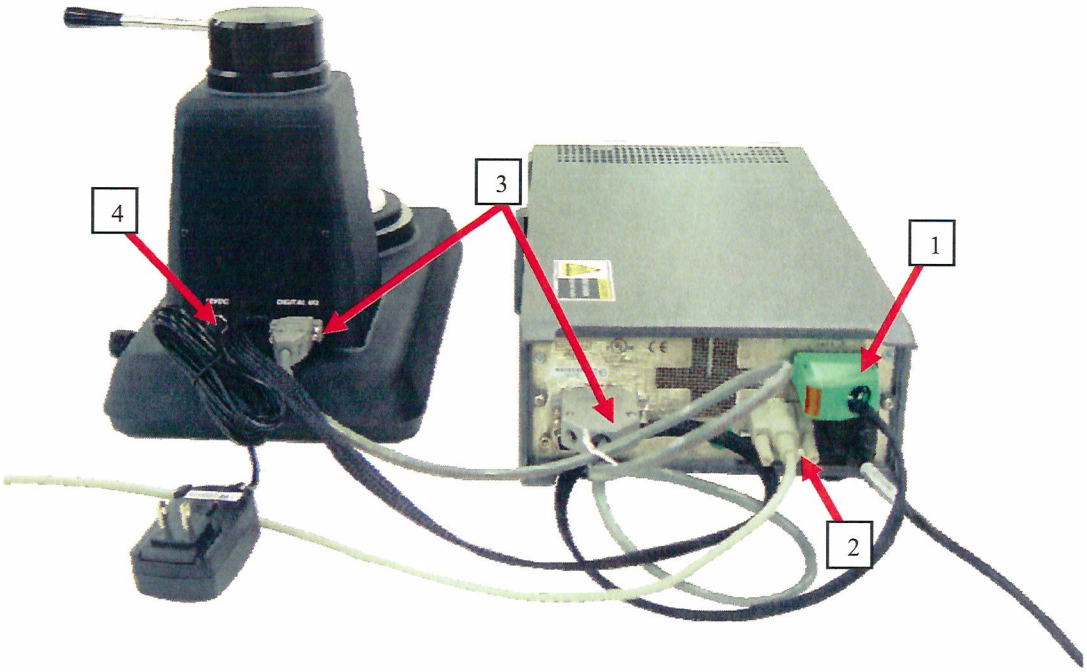


1) 12 Volt DC input
2) Test Lead Bundle
3) Pro4 Digital I/O Connection
4) SourceMeter Digital I/O Connection
5) RS-232 Connection
6) Power Cord Connector
7) Test Lead Connections

Step 1: Connect Pro4 Power
The power adapter is designed for use anywhere in the world. Choose the correct wall adapter for your location and snap it into place. Then connect the power tip end to the Pro4 DC input.

Step 2: Connecting the Test Leads
The test leads are already connected inside the Pro4. The test lead bundle terminates into a single green Phoenix connector. Connect this cable to the **'Channel A'** matching connector on the source meter (see 1 below).

Step 3: Connect digital I/O
The digital I/O acts as the trigger for starting the test and manages the testing modes. It must be connected properly for the Pro4 software features to function properly. The cable connects from the Pro4 to the SourceMeter (3) as shown.



Step 4: Connect the SourceMeter to the Computer
With the 9 pin M/F cable, connect the RS-232 communications line to the SourceMeter (2) and to the computer Com 1 port.

Step 5: Connect A/C power
With all of the other connections complete, it is now safe to connect to the power outlet. There should be a power connection for the Pro4 12V adapter and the Keithley SourceMeter. Of course depending on which computer is being used, it will need to be connected also.

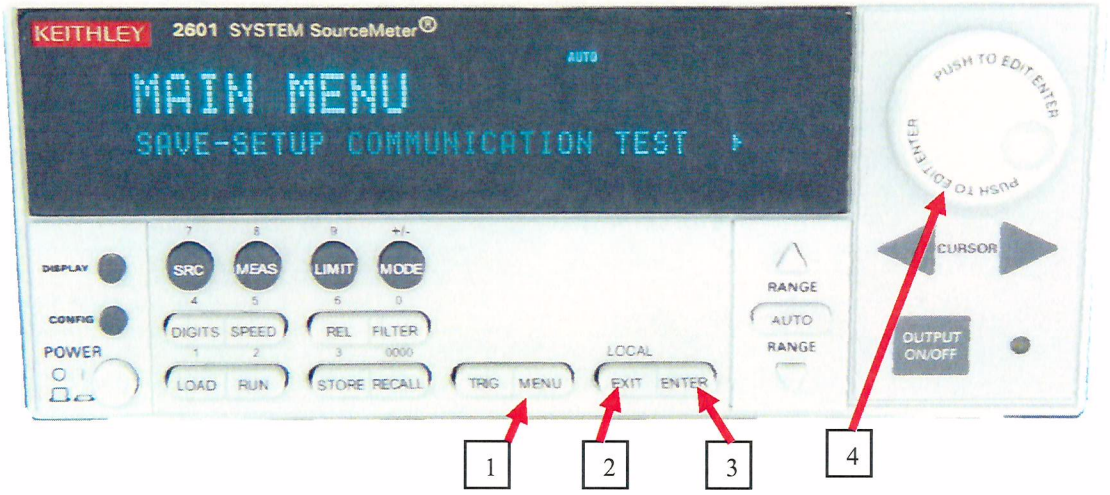
Connecting the Pro4 is now complete.

Configuring the SourceMeter for operation with the Pro4

If your system included the SourceMeter as part of the purchase, these settings have already been set for your system. You may skip this step.

The Pro4 software automatically controls the configuring of the SourceMeter for testing etc. However, the computer and SourceMeter must be set-up to communicate for these automatic settings to take place. The following explains how to set-up the right communication protocol. This only needs to be done during the initial installation. Thereafter, the settings will load automatically upon powering up the SourceMeter.

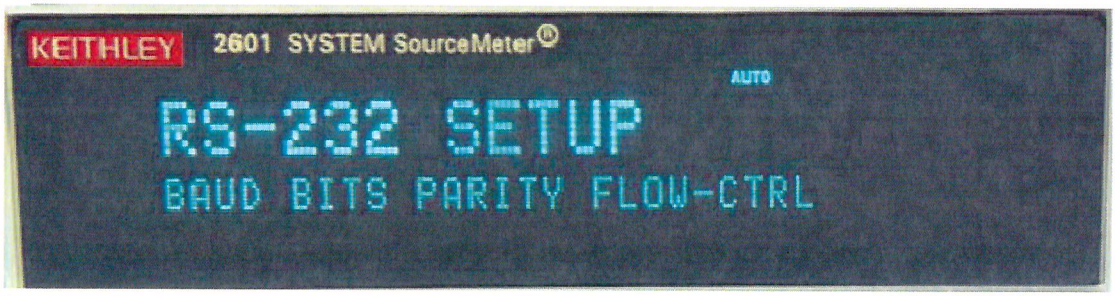
Step 1: With the SourceMeter powered up, select the *MENU* (1) button. This screen appears. The selected option will blink on and off.



Use the roll knob (4) to select the *COMMUNICATION* option. Then press the *ENTER* (3) button.

Step 2: From the Communications Set-up screen, select Interface-SEL and press enter(3). Then choose the RS-232 option. The source meter may power off and on after pressing enter.

Step 3: From the *COMMUNICATIONS SETUP* screen, select *INTERFACE-CFG.* The following screen appears.



Each parameter will need to be set properly by selecting the parameter, scrolling to the target option, and pressing enter. The correct settings are as follows-

Baud	**57,600**
Bits	**8**
Parity	**None**
Flow Control	**None**

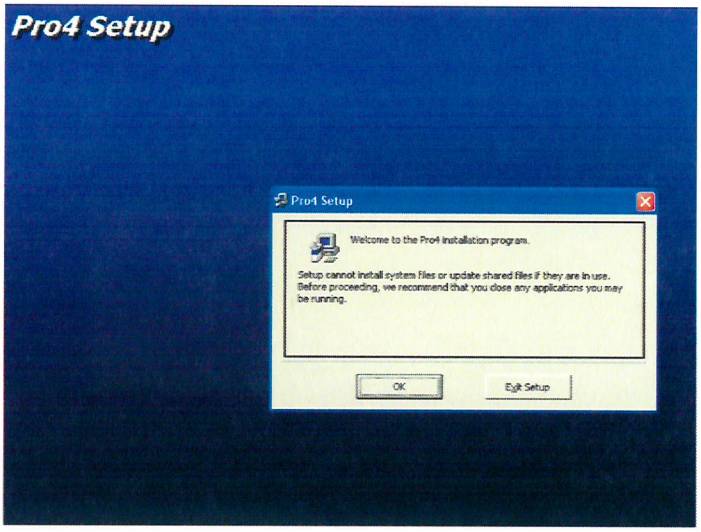
Once these settings are completed, select Exit(2) to return to the main menu. The meter is now set to properly communicate with the Pro4 software running on a computer.

Installing the Pro4 Software on a Computer

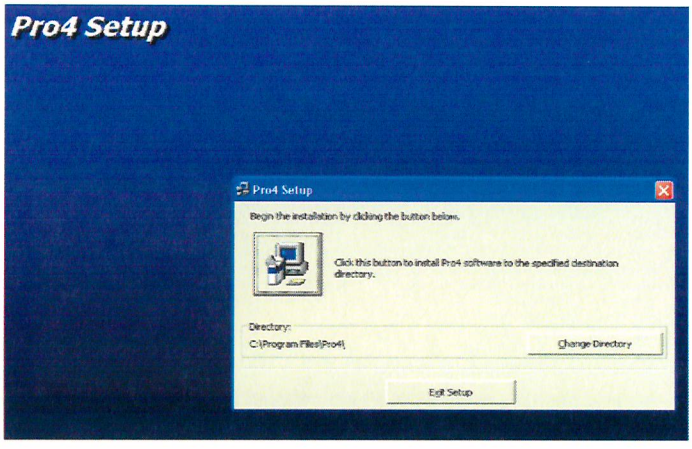
NOTE: If your system included either the industrial computer or notebook computer with the purchase; the software has already been installed and verified on your system.

The Pro4 has been designed to run on computers with the operating systems of MicroSoft Windows 2000 or MicroSoft Windows XP-Pro. We have verified that the software does run properly on these operating systems. Also, the default communication port is the RS-232 port Com1. So, assuming your computer is running either Windows 2000 or XP-Pro and has Com1 available, the following instructions get the software running.

Step 1: Load the Pro4 CD into the CD-Rom drive. If it does not autostart, then click on the *My Computer* icon and locate the CD-Rom drive. High light and double click the CD-rom drive. A list of files appears. Double click on the file called *Set-up.*

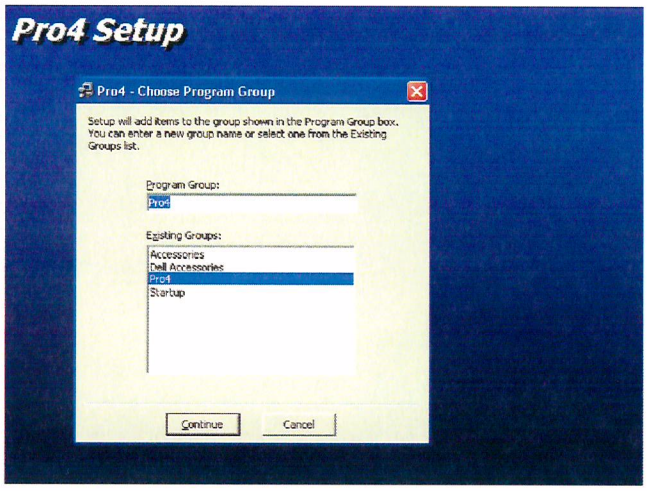


Step 2: If you have other programs running, please close them now. When all programs are closed, select the *OK* button.

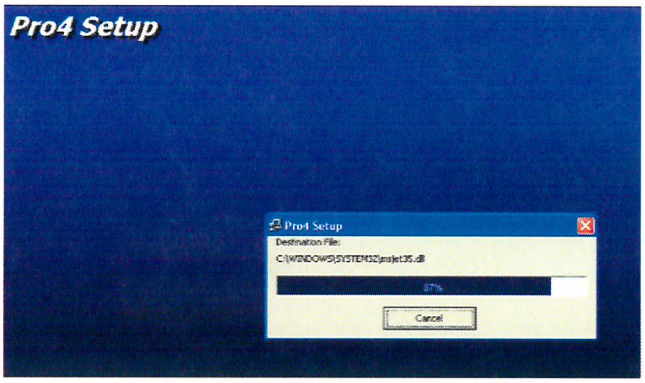


Step 3: If you wish to change the directory where the program is installed, select *Change Directory* and point to the directory you wish.

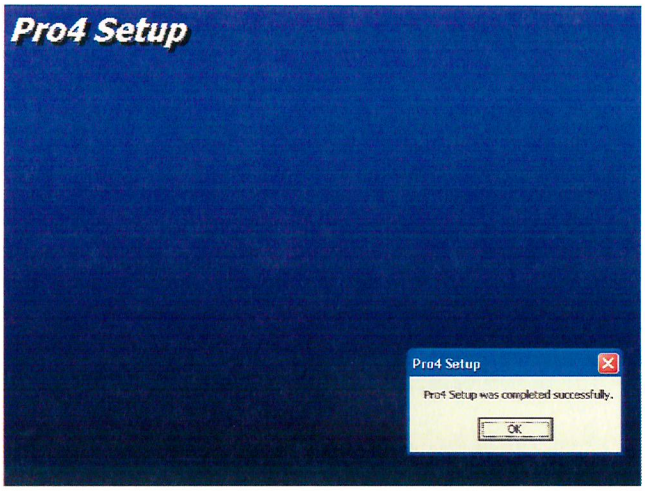
Otherwise, select the large button to begin the installation.



Step 4: Select the Program group for installing the Program. Press *Continue* when ready.

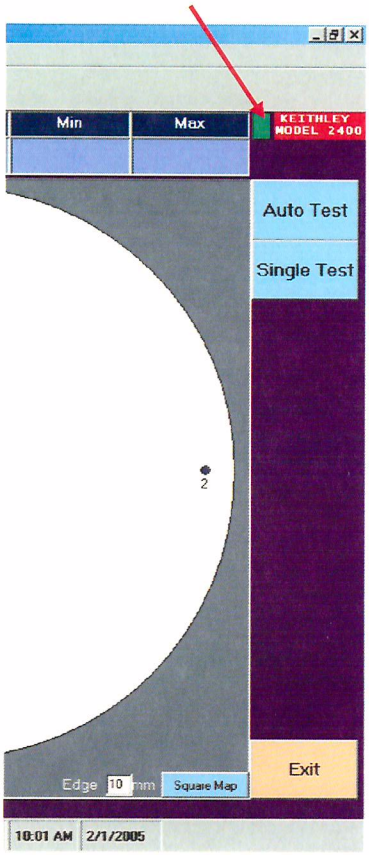


Step 5: The installation program automatically installs all of the necessary files reporting the progress as it goes. The entire program is less than 5 Megabytes and should install quickly.



Step 6: After the files have all loaded, the message *Pro4 Setup was completed successfully* appears. Select the *OK* button. Installation is complete.

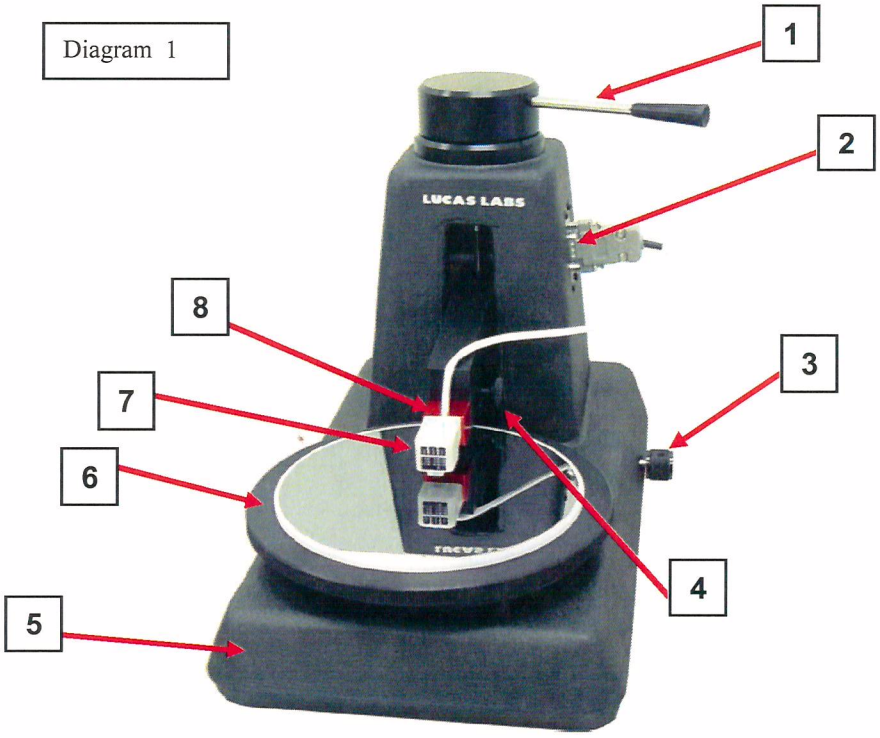
Step 7: To verify the Pro4 software the SourceMeter are communicating, make sure the SourceMeter is powered on. Start the Pro4 software. If the upper right hand corner of the screen reports Keithley Model 2600 series and has a green box, communication has been established.



About the Pro4 Resistivity Probe Stand

The Pro4 resistivity probe stand is designed for measuring sheet resistivity on samples with a flat surface. Making good measurements requires the four point probe to put even pressure on each point and assure the probes move straight up and down. The Pro4 stand is designed with this in mind. The Pro4 consists of three components; the stand (5), the probe head mounting block (8), and the sample chuck (6).

Diagram 1



1. *Contact Lever* Moving this lever clockwise lowers the probe head into contact with the test sample. The full stroke of the Z motion is 0.070 inches (1.78mm). The lever action also trips the micro switch allowing current to flow to probe tip 1 of the probe head.

2. *Probe Head Electrical Connection* The Pro4 has a prewired 9 pin female D sub connection for quick connection of the probe head.

3. *Z adjustment Knob* This knob is used for setting up with the various samples. It slowly raises and lowers the probe head by turning. Clockwise raises the probe head. The full range of motion is 0.700 inches (17.75mm).

4. *Mounting Block Lock* This lock screw tightens the probe head mount in place.

5. *Base Stand* Made of cast aluminum.

6. *Mounting Chuck* This mounting chuck has a thick aluminum base with a Teflon surface. The Teflon surface acts as an electrical insulator between the stand and the device under test. The mounting chuck is not physically connected to the stand allowing the user to slide or rotate the sample into the desired position.

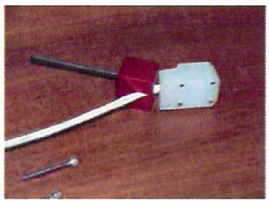
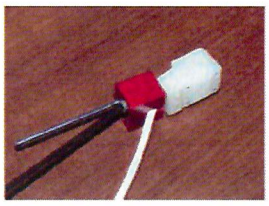
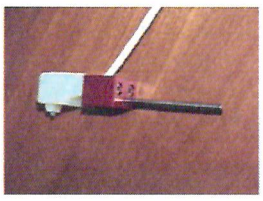
7. *Probe Head* Many choices of probe heads are available. Shown is the popular SP4. Probe heads are mounted to the Mounting block with 2 6-32 machined screws.

8. *Probe Head Mounting Block* The mounting block is designed for easy removal allowing users to quickly change probe heads. Loosening the mounting block lock (4) releases the stinger shaft allowing the user to pull out the block. This presents easy access to the machine screws holding the probe head.

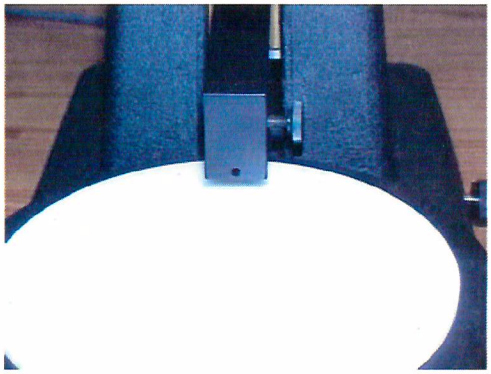
Mounting the Probe Head

Six steps to successfully mounting a probe head. Use extreme caution when handling the probe head. Touching the tips with your hands or bumping the tips on hard surface could damage them and make measurements nearly impossible or inaccurate.

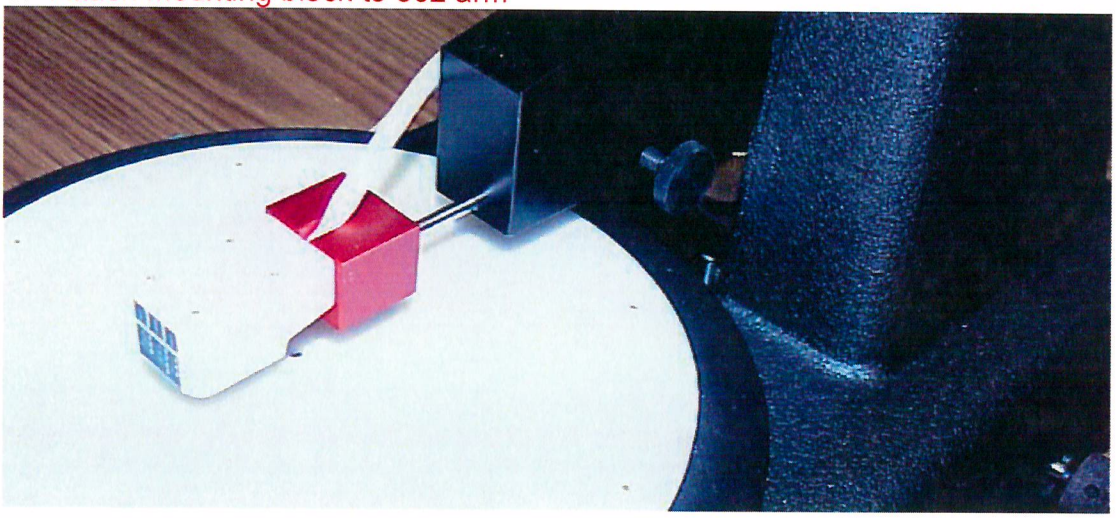
1. Attach the Probe Head to the mounting block.
   The probe head is attached using two 6-32 by 1" socket cap screws. The wire tail is placed in the mounting block center slot. Tighten the screws until the head is snug. Do not over tighten. Be careful to not touch the actual probe tips or bump them on a hard surface.

2. Raise the probe arm
   Raise the mounting receiver arm about 6mm to assure the probe head clears the sample chuck and sample. This is done by rotating the Z adjust knob (diagram 1 #3) counter clockwise.

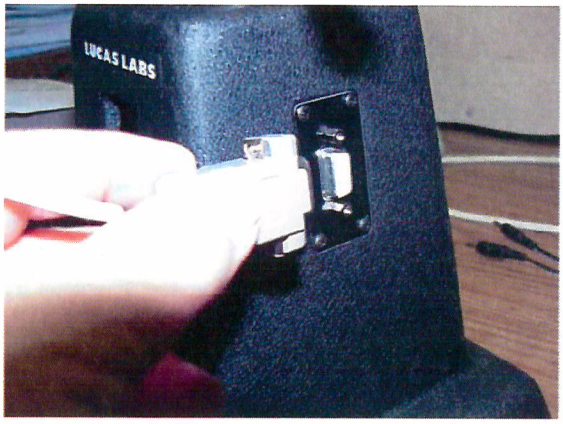


3. Attach mounting block to 302 arm

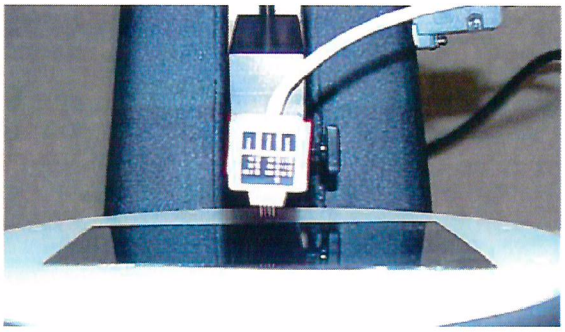


The mounting block stinger slides into the receiver hole. The red block should be snug against the black nose piece when fully inserted. Then, lightly tighten the mounting block lock (diagram 1 #4).

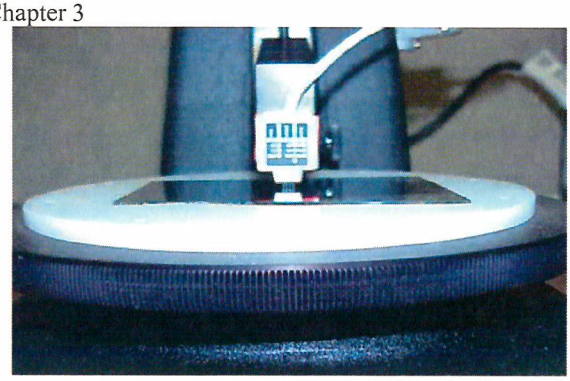
4. Make the electrical connection
Electrically connect the probe head by connecting the 9 pin 'D' sub to the side panel of the stand as shown. Tighten the screws to assure a good connection.



5. Lower Probe Head into contact



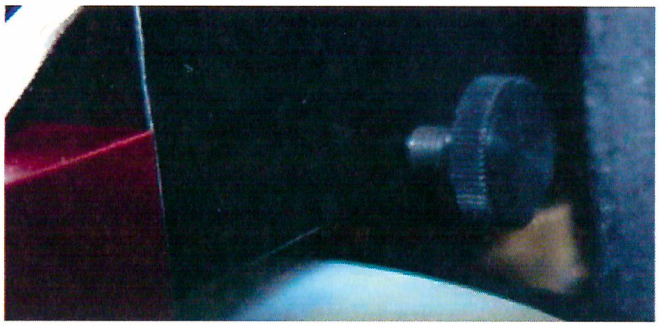
Before starting, check to be sure there is greater than about 6mm clearance between the probe head and the sample to be tested. Then, rotate the contact lever (diagram 1 #1) clockwise as far as possible. Look closely at the probe tips and start lowering the probe head using the 'Z' adjust knob (diagram 1, #3)



As you slowly lower the probe head, check to see that probe tips are perpendicular to the test sample. It may be necessary to rotate the head slightly. When the probes make contact, continue lowering until the tips have compressed between 50 and 70% of their travel.

6. Tighten in place

Finally, tighten the probe head in place with a snug rotation of the mounting block lock screw (diagram 1 #4). Rotate the contact lever counter clockwise assuring the probes pick up off the test sample. The probe head is now mechanically installed and ready for testing.



Chapter 4

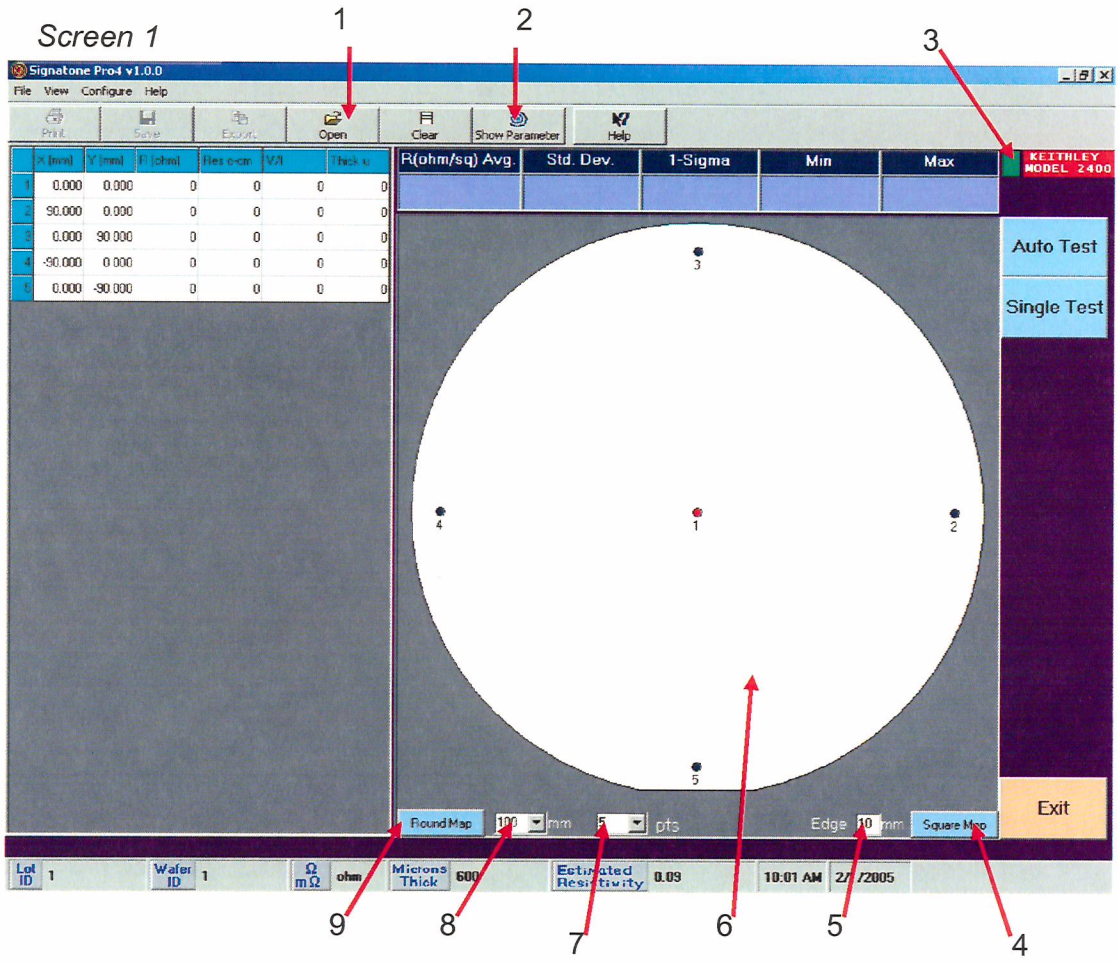
Configuring Your Test with the Pro4 Software

The Pro4 software is designed to allow the maximum versatility, set-up for accurate test, and report the results that you need. Four different parameters may be measured. Following will explain the features and setting up for your desired measurement.

Main Screen

When the software first boots, this screen appears and is the home or default screen.

Screen 1



1 – *Open File*
The box will allow you to find previous test data including the set-up of a previous test.

2- *Show Parameter*
The user may define 1 of four parameters to display in the result boxes.

A) The default is Ohms per Square or Sheet Resistance. Ohms per square is calculated by V/I * constant * correction factors.
B) Resistivity or Ohms per Square CM is calculated as Sheet Resistance * Thickness of the material in microns.

C) V/I is the reading directly from the meters with out corrections; Voltage over Current.
D) Thickness is calculated as Sheet Resistance / Resistivity

3- *Model #*

The Keithley Model # with the green box signifies that the computer and software are communicating to the meter correctly. If there is not a green box or model number showing, communication has not been established.

4- *Square Map*

The sample map (6) is an illustration of your test sample. Pressing this button makes the sample map square instead of round. It also redraws the other changes that you have made to the map such as edge exclusion, number of points and size. You should choose this button if your sample is more square than round.

5- *Edge Exclusion*

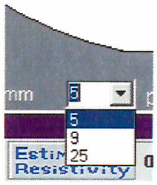
This defines the distance from the edge of the sample when testing on the outside perimeter of the test device. Enter the desired edge exclusion in mm. It is recommended that a number 4X greater than the spacing between probe tips be used. 10mm is the default and recommended.

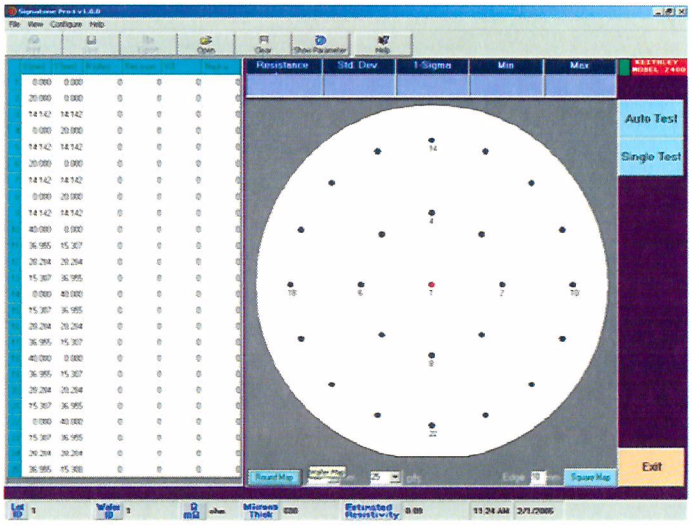
6- *Sample Map*

This area illustrates the sample under test. It is changed from round to square and the number of test points are shown. A red test point is the point at which you should test next.

7- *Test Points*

Selecting this button allows the user to choose to test 5, 9 or 25 points. After the selection you must also select *Round* or *Square* to redraw the sample map. The points are shown on the *sample map* and the data table to the left expands or decreases to fit the number of points selected.



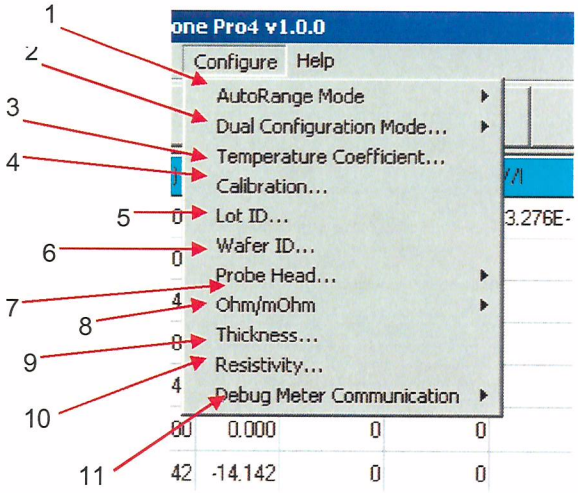


8- *Sample Size*
This menu allows you to choose the size that is closest to your sample. You may choose from 10, 25, 50, 75, 100, 150, or 200mm.

9- Round *Map*
The sample map (6) is an illustration of your test sample. Pressing this button makes the sample map round instead of square. It also redraws the other changes that you have made to the map such as edge exclusion, number of points and size. You should choose this button if your sample is more round than square.

The Configuration Menu

The Configuration menu has a number of additional settings as listed below.



1- *AutoRange Mode*
Autorange mode may be toggled on or off with this switch. The default is on and is recommended. Autorange allows the Pro4 to step through a number of current source settings to find the optimum reading for the sample under test. Turning this mode off requires the user to manually enter a current source setting at the start of each test.

2- *Dual Configuration Mode*
Dual Configuration mode may be toggled off or on with this switch. The default is on and is also recommended. Without going into a long explanation here, dual configuration helps eliminate errors introduced by edge proximity and imperfections in the probe head contact. If dual configuration is off, measurements must be made at least 10X the probe spacing away from the edge of the sample. With Dual configuration on, accurate measurements may still be attained up to 4X the probe spacing from the sample's edge.

3- *Temperature Coefficient*
If you know how much the Sheet Resistance changes per °C on the material you are testing, you can enter that value here. The measurements will be corrected accordingly. Most applications don't include this calculation. Therefore, the default value is 0.

4- *Calibration*
This command starts the calibration procedure. See chapter 7 for details.

5- *Lot ID*
Enter the batch or lot or some other identifier for the group of samples being tested. This name will appear on all of the reports. The default is 1.

6- *Wafer ID*
Enter the serial number or other ID of the sample being tested. This name will also appear on all of the reports. The default is 1.

7- *Probe Head*
Enter the probe head spacing in mm for the probe head you are using. The standard offerings from Lucas-Signatone are listed. For other manufactures, you will need to enter the mm value. This spacing is important in calculating edge and thickness effects. The Pro4 automatically makes the adjustments needed based on the spacing.

8- *Ohm / mOhm*
This toggle simply formats data to reported in Ohms or miliohms.

9- *Thickness*
Enter the thickness of the material being tested if known. The thickness should be entered in microns. If you wish to measure the Resistivity of the material, you must enter the thickness.

10-*Resistivity*
Enter the resistivity of the material being tested. The resistivity should be entered in ohms per cm. If you wish to measure the Thickness of the material, you must enter the resistivity.

11-*DeBug Meter Communication*
This mode has nothing to do with the measurement. The toggle brings up a window to see the communication between the meter and the computer. This allows debugging if there is some sort of an interface failure.

The Main Screen after a Test

After testing, the main screen adds more capabilities and information. In this example, a 4 inch wafer was tested at 9 points. Thickness of the material was set at 600 microns. Refer to the *Screen 2* image on the following page.

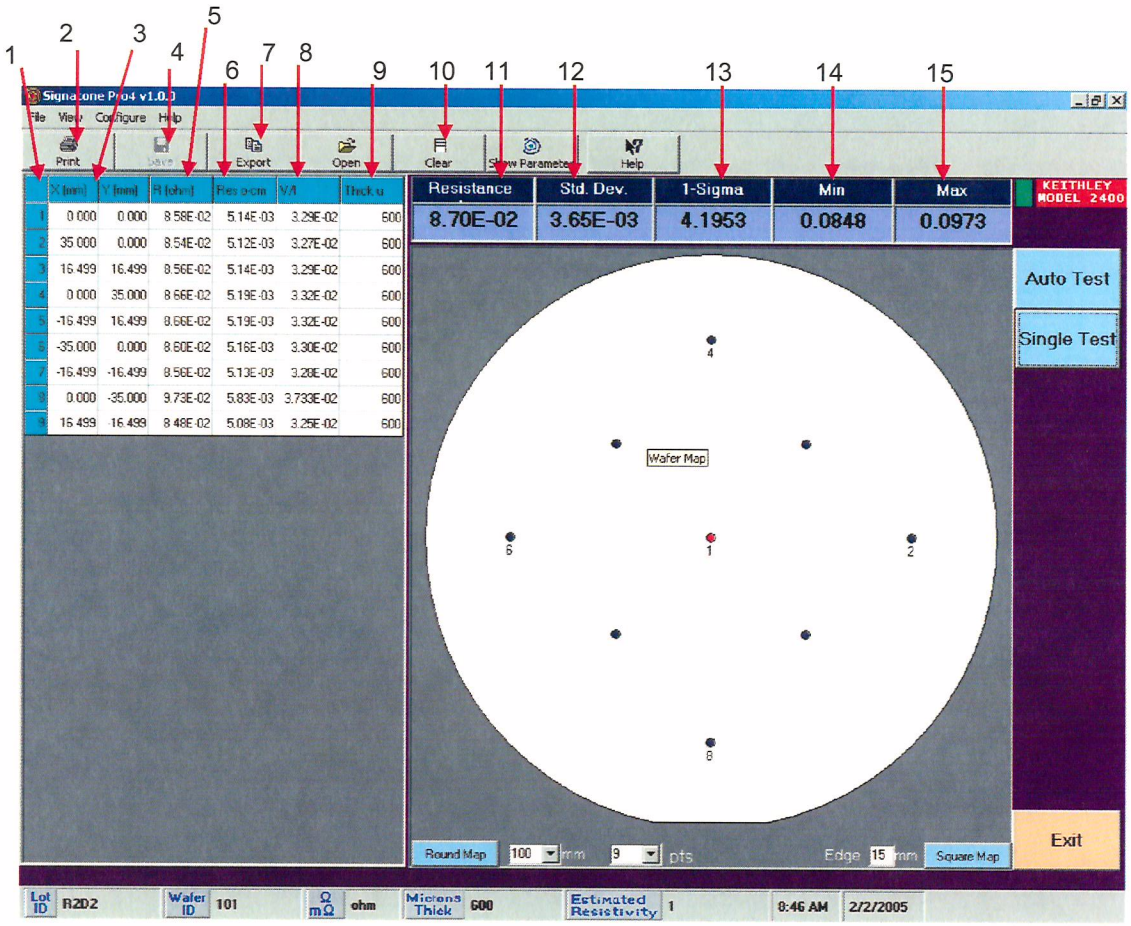
1 *Probe Test Number*
The sequential order of the test points tested.

2 *Print*
This button sends the data to the printer, printing a summary report.

3 *X-Y Position*

These columns show the X-Y position in mm where the sample should be placed for making the test.

Screen 2



4 *Save*

Saves data and configuration to a file for future recall.

5 *Sheet Resistance or Ohms per Square*

This column reports the measured Sheet Resistance of each test location.

6 *Resistivity or Ohms per Square centimeter*

This column reports the Resistivity of the sample based on the given thickness. If the resistivity was given in order to measure thickness, the Resistivity will be the same for each measurement.

7 *Export*

This button allows exporting the data to an Excel spreadsheet format. See Chapter 6 for more detail.

8 *V/I Voltage / Current*

This is the reading from the meters.

9 *Thickness in Micrometers*

This column reports the Thickness of the material based on the given resistivity. If the thickness was given in order to measure resistivity, the thickness will be the same for each measurement.

10 *Clear*

This button erases all of the test results but keeps the set-up information in preparation for testing the next sample.

11 *Average*

This box displays the average of the data. The show button determines which parameter is displayed here. In screen 2, the sample shows the average Sheet Resistance for 9 point sample.

12 *Standard Deviation*

This box displays the standard deviation of the collected data.

13 *1-Sigma*

This box displays 1-Sigma of the collected data.

14 *Minimum*

This box displays the lowest value of the test points collected.

15 *Maximum*

This box displays the highest value of the test points collected.

Testing a Sample

Following are a few quick steps for making measurements on your sample.

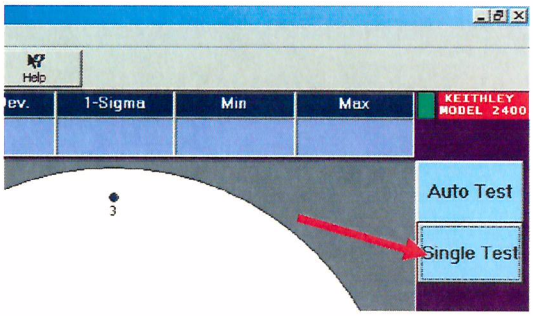
A Single Measurement on a Sample

Step 1: Mounting your test sample

Your sample should be placed on the Teflon chuck and centered directly under the probe head. Verify that turning the lever clockwise lowers the probe head into contact with the sample. The lever should be turned all the way to its limit stop. The probe needles should compress about 50-70% of their range to assure the proper pressure and contact with the sample. For more information about setting up the probe head, see Chapter 3. Once this is verified, raise the probe head.

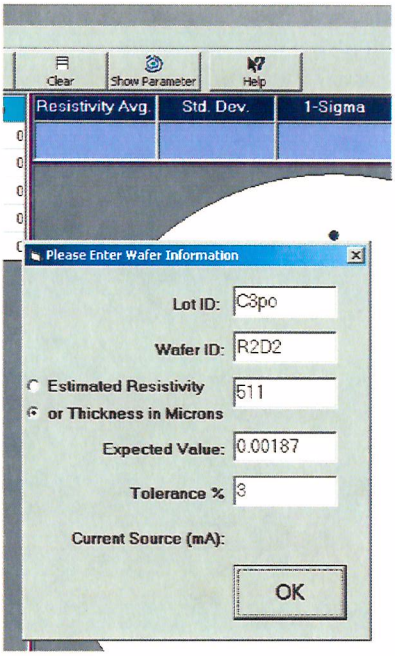
Step 2: Select the Single Test Button

Select the *Single Test* button in the software.



Step 3: Review the Verification Window

After pressing the Test button, verification window appears. Most of the data is already entered from the defaults or the configuration screen. However, the information may be changed at this point as desired.



Lot ID and Wafer ID are identifiers that will appear on the printed report and data exported to identify this particular sample and test.

Estimated Resistivity or Thickness

You must enter either the estimated thickness or resistivity of the sample. If you enter a thickness, check *Thickness* and enter the number in microns. This will allow the system to measure resistivity. If you choose *Estimated Resistivity*, enter the number in ohms. This will allow the system to measure thickness.

Expected Value

The *Expected Value* is believed to be the average of this sample. By setting a target allows setting a pass/ fail criteria for the sample. If you do not know nor care for pass/fail on the report, enter zero. Otherwise, enter the desired target data.

Tolerance %

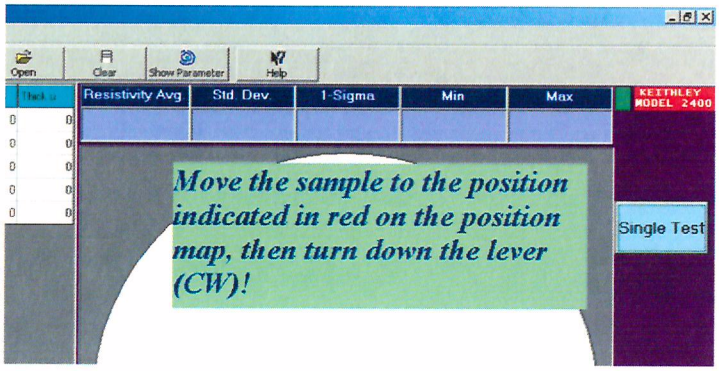
This sets the pass/fail criteria to be ± x% of the Target set above where x is the value you enter.

Current Source (mA)

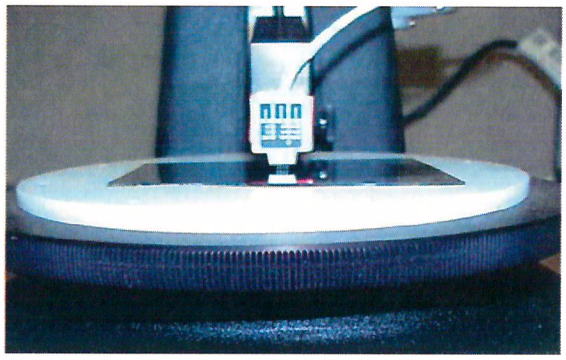
If this box does not appear, the system is in autorange mode which is recommended. However, if autorange mode is off, you will need to enter the desired current to force for the measurement. Current settings must be between 5E-08 to 1000 mA.

Step 4: Press OK and prepare the meter

Selecting the OK button from the verification window will prepare the Keithley meter for testing. When the meter is ready, this message window will appear on the screen. The 1st position is always the center of the sample.

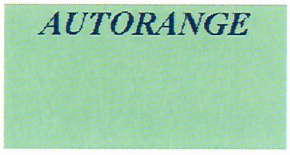


Step 5: Lower the probe head into contact



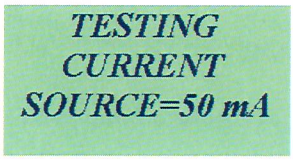
Turn the lever clockwise all the way to the stop. This lowers the probe head and triggers the meters to start testing.

If the autorange mode is on, the meter will start stepping through a number of current settings. The following message appears on the screen.

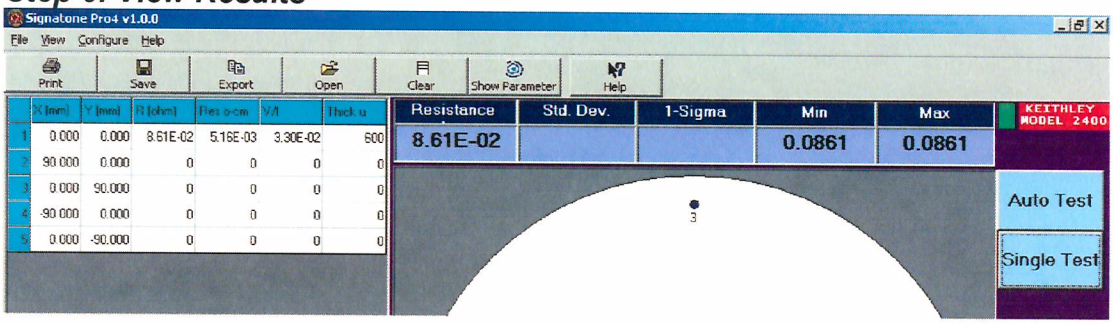


It will take several seconds for the meters to go through all of the settings to find the optimum current setting for the measurement.

Once, it has found the appropriate setting, the following message will appear stating the current that has been selected for this test.



Step 6: View Results



At this point the test is complete. Results are shown in the table position 1. Since there is only 1 measurement, the average, minimum and maximum are all the same.

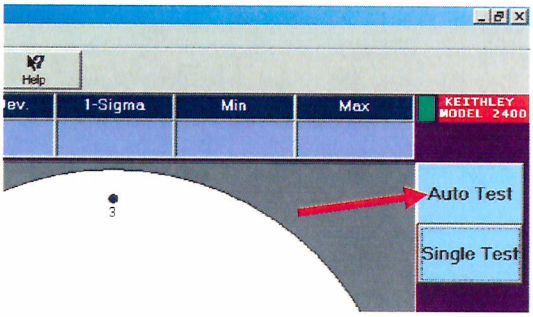
Multiple Measurements on a Sample

Step 1: Mounting your test sample

Your sample should be placed on the Teflon chuck and centered directly under the probe head. Verify that turning the lever clockwise lowers the probe head into contact with the sample. The lever should be turned all the way to its limit stop. The probe needles should compress about 50-60% of their range to assure the proper pressure and contact with the sample. For more information about setting up the probe head, see Chapter 3. Once verified, raise the probe head to the up position.

Step 2: Select the Auto Test Button

Select the *Auto Test* button in the software.



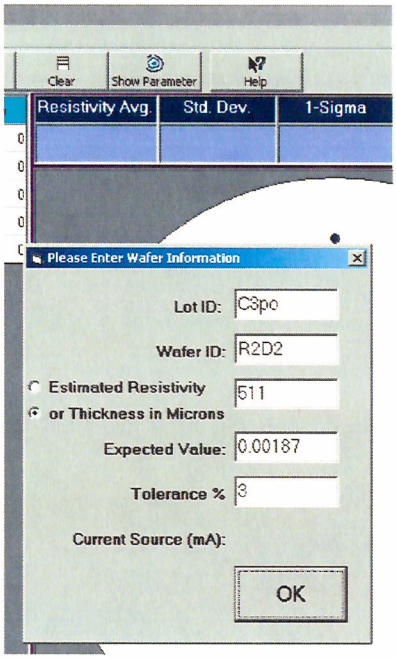
Step 3: Review the Verification Window

After pressing the Test button, verification window appears. Most of the data is already entered from the defaults or the configuration screen. However, the information may be changed at this point if desired.

Lot ID and Wafer ID are identifiers that will appear on the printed report and data exported to identify this particular sample and test.

Estimated Resistivity or Thickness

You must enter either the estimated thickness or resistivity of the sample. If you enter a thickness, check *Thickness* and enter the number in microns. This will allow the system to measure resistivity. If you choose *Estimated Resistivity*, enter the number in ohms. This will allow the system to measure thickness.



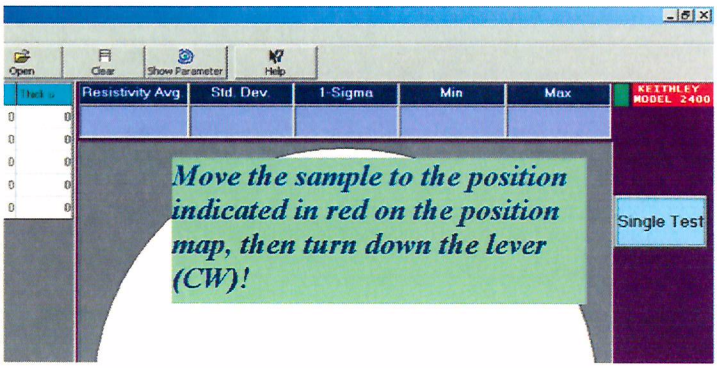
Expected Value
The *Expected Value* is believed to be the average of this sample. By setting a target allows setting a pass/ fail criteria for the sample. If you do not know the expected value nor care for pass/fail on the report, enter zero. Otherwise, enter the desired target data.

Tolerance %
This sets the pass/fail criteria to be ± x% of the Target set above where x is the value you enter.

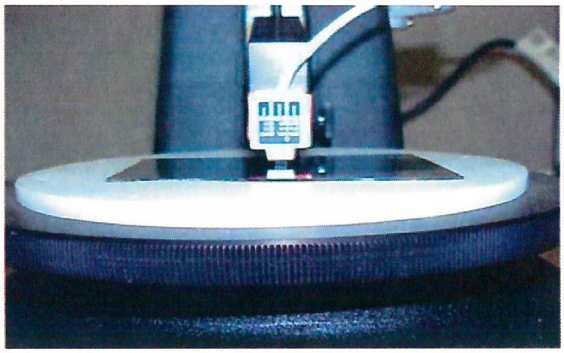
Current Source (mA)
If this box does not appear, system is in autorange mode which is recommended. However, if autorange mode is off, you will need to enter the desired current to force for the measurement. Current settings must be between 5E-08 to 1000 mA.

Step 4: Press OK and prepare the meter

Selecting the OK button from the verification window will prepare the Keithley meter for testing. When the meter is ready, this message window will appear on the screen. The 1st position is always the center of the sample.



Step 5: Lower the probe head into contact



Turn the lever clockwise all the way to the stop. This lowers the probe head and triggers the meters to start testing.

If the autorange mode is on, the meter will start stepping through a number of current settings. The following message appears on the screen.

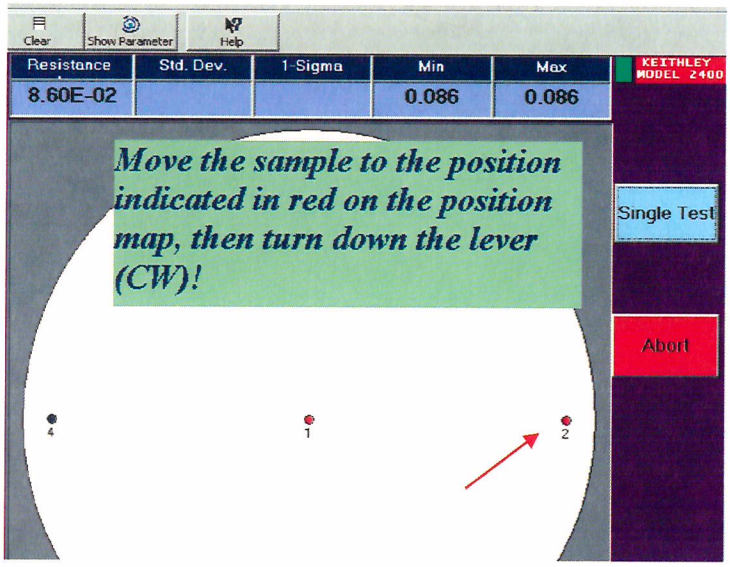
It will take several seconds for the meters to go through all of the settings to find the optimum current setting for the measurement.

AUTORANGE

Once, it has found the appropriate setting, the following message will appear stating the current that has been selected for this test.

TESTING CURRENT SOURCE=50 mA

Step 6: Move to next position



Once the test for this position has completed, the data for the last position is displayed. Also, the following message appears and the wafer map indicator highlights the next desired position in red.

At this point, turn the lever counter clockwise raising the probe head. Then move the sample to indicated position by sliding and / or rotating the Teflon chuck.

Step 7: Test the next position

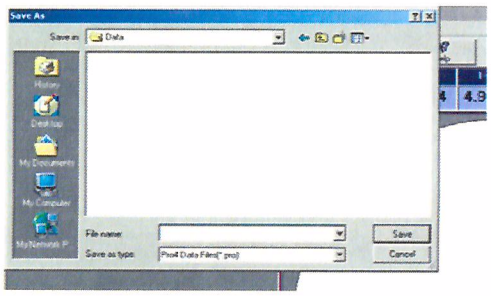
Lowering the probe head into contact will automatically start the test. Unlike the first point, autorange is not performed. The value found in the first autorange is used through out the rest of the test sites. Also, the message screen does not display the current source setting.

TESTING

Steps 6 & 7 are repeated until all points in the list have been tested.

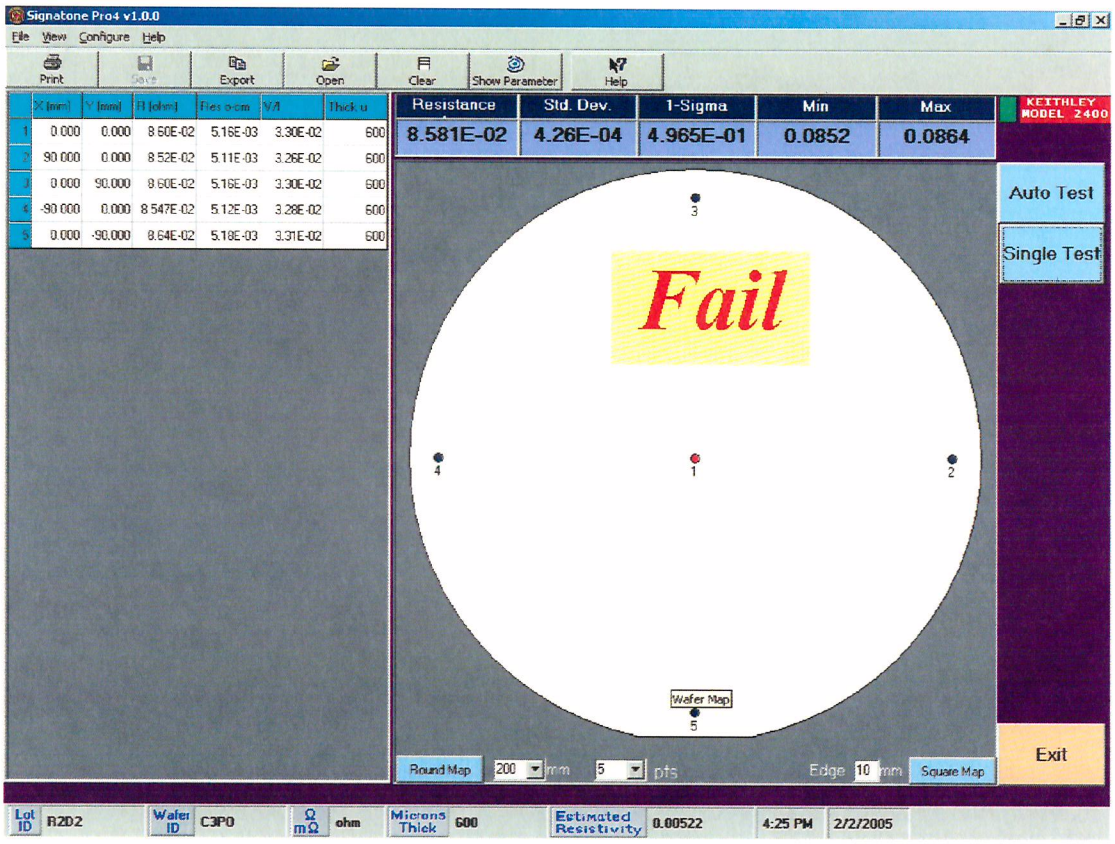
Step 8: Save Data

After the last point has been tested, a save menu pops up for you to save the data in a file. Saving the data also saves the configuration settings for future testing.



Step 9: Review Results

After saving, all of the data is displayed. If a Pass/Fail criteria was set, then ***Pass*** is displayed if all points passed, ***Fail*** is displayed if any points failed. The statistical data is calculated and shown. Also, the table is complete.

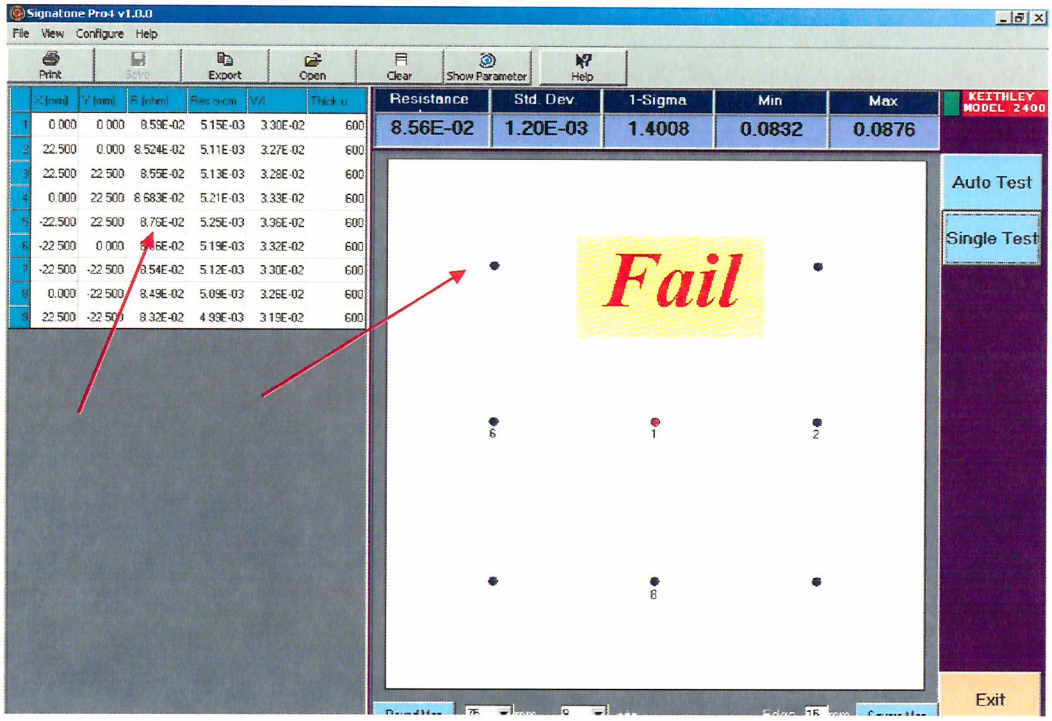


Retest a Point

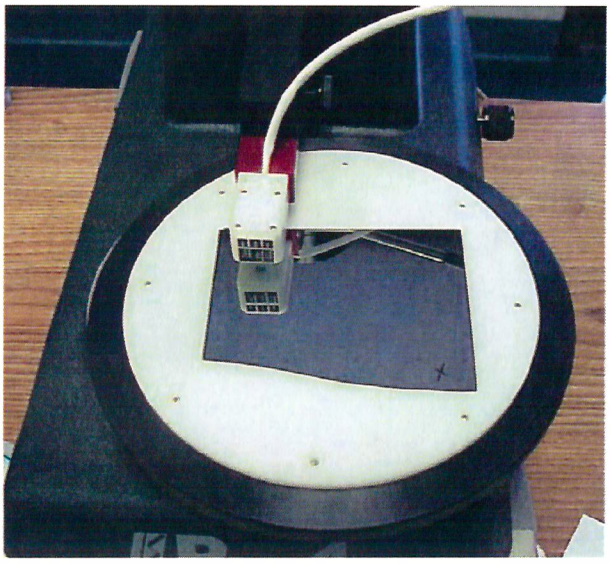
After completing the series of test and filling the data table, it may appear that a particular test site is out of range with the others. The Pro4 will allow you to retest this site by doing the following:

Step 1: Locate the Position in the Table

Find the data position in the results table. With the mouse, pointing in the *R (ohm)* column, select the position that you wish to retest. A Message appears asking if you wish to retest this position. Answer yes.



Step 2: Position the Sample to the Location

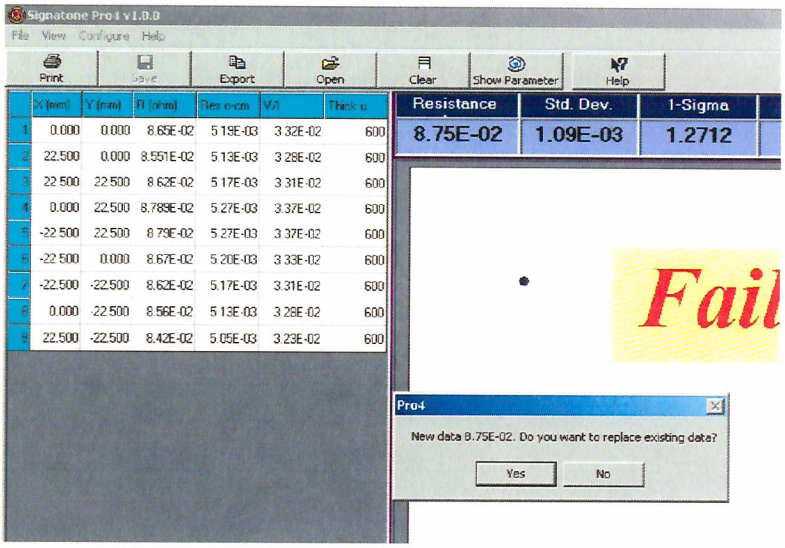


Another message appears asking you to move to the position and lower the probe head.

Find the position in the wafer map. In this case, position 5 is being retested.

Physically move the sample to the position indicated on the wafer map for retesting. Then turn the lever clockwise, lowering the probe head into contact and testing will begin.

Step 3: Accepting or Rejecting the Data



After the testing has completed for that point, a screen appears showing the new data. You are asked, 'Do you want to replace existing data?'

If you answer yes, the new data will be filled into the table and the statistical information will be recalculated.

If you answer no, the present table and calculations remain unchanged.

Printing and Exporting Results

Printing the Data

After the testing is complete, the data may be tested by simply pressing the print button. Assuming your computer is connected to a printer, the results will be printed out.

Here is a sample report:

Lucas Labs Pro4

Summary Report

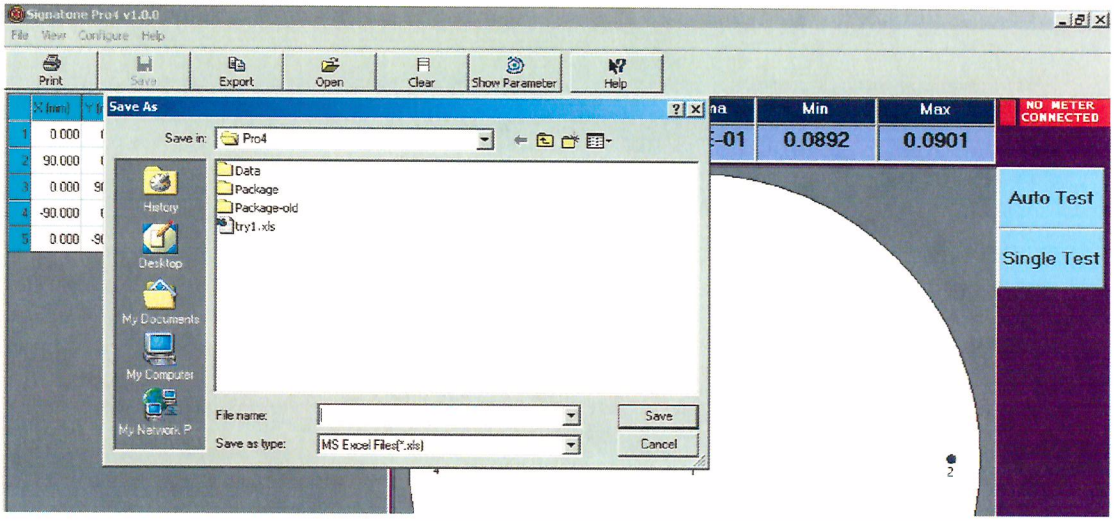
1/27/2005 1:53:48PM

Lot ID:	R2D2	
Sample ID:	C3po	
Number of Test Points:	5	
Target Tolerance Ohms Square:	.09 ohms ± 10%	
Test Results		
Average Resistance Ohms Square:	0.09456	Pass
Standard Deviation:	3.78079E-03	Pass
Maximum:	0.102	Fail
Minimum:	0.092	Pass

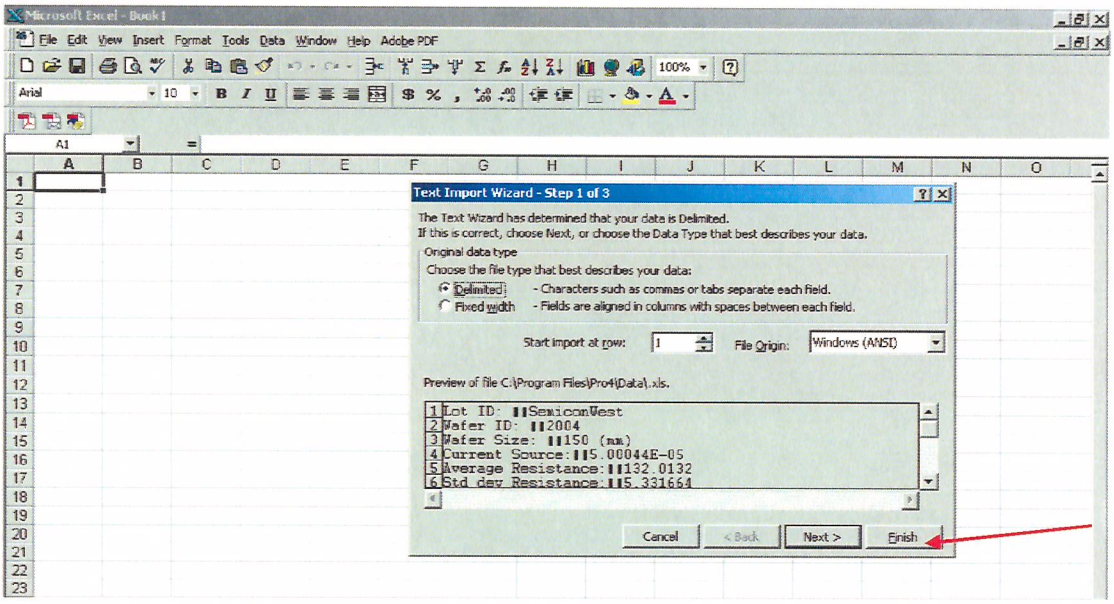
#	Resistance	Resistivity	V/I
1	9.30E-02	5.58E-03	3.57E-02
2	9.38E-02	5.63E-03	3.61E-02
3	1.020E-01	6.12E-03	3.91E-02
4	9.20E-02	5.52E-03	3.53E-02
5	9.20E-02	5.52E-03	3.52E-02

Exporting Data to an Excel Spread Sheet

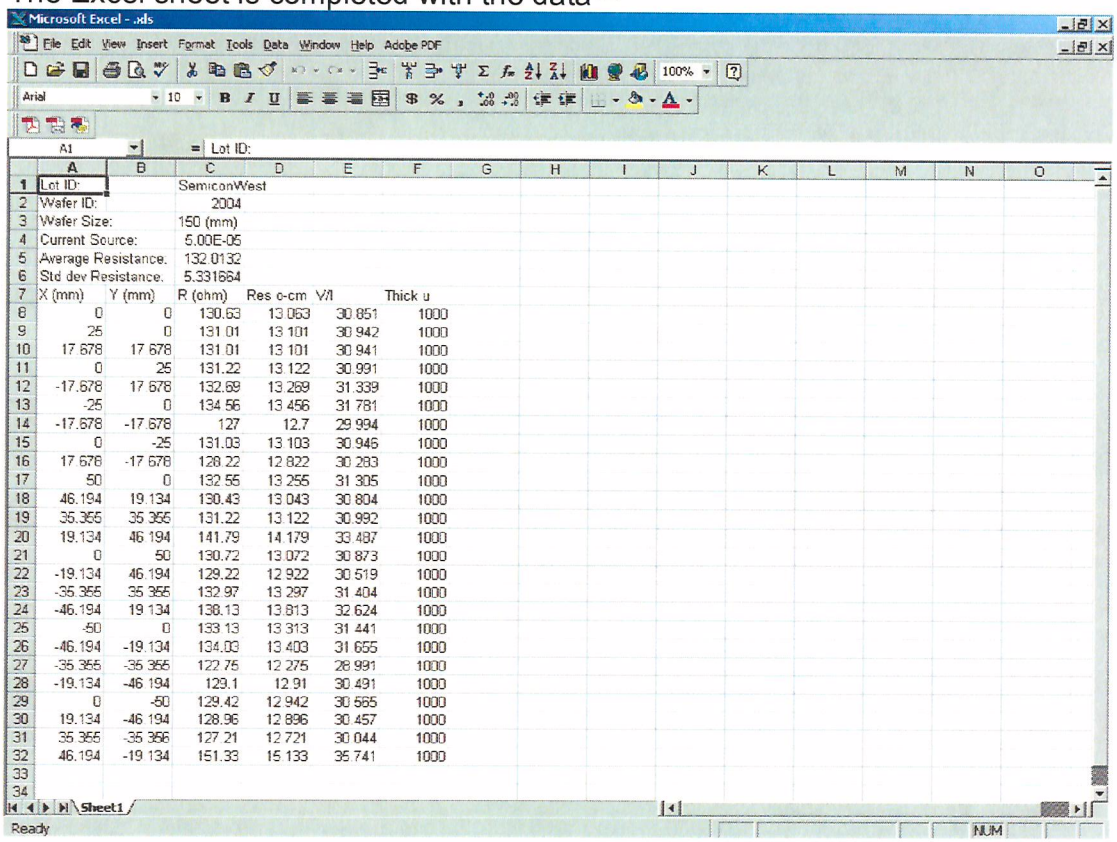
Exporting the data is a simple task. Simply select the export button. You are requested to save the file where you wish. When save the file is gen an .xls extension recognized by Excel.



Next, run MS-Excel and open the file. The import wizard automatically pops up. Select the finish button.



The Excel sheet is completed with the data –



	A	B	C	D	E	F
1	Lot ID:		SemiconWest			
2	Wafer ID:		2004			
3	Wafer Size:		150 (mm)			
4	Current Source:		5.00E-05			
5	Average Resistance:		132.0132			
6	Std dev Resistance:		5.331664			
7	X (mm)	Y (mm)	R (ohm)	Res o-cm	V/I	Thick u
8	0	0	130.63	13.063	30.851	1000
9	25	0	131.01	13.101	30.942	1000
10	17.678	17.678	131.01	13.101	30.941	1000
11	0	25	131.22	13.122	30.991	1000
12	-17.678	17.678	132.69	13.269	31.339	1000
13	-25	0	134.56	13.456	31.781	1000
14	-17.678	-17.678	127	12.7	29.994	1000
15	0	-25	131.03	13.103	30.946	1000
16	17.678	-17.678	128.22	12.822	30.283	1000
17	50	0	132.55	13.255	31.305	1000
18	46.194	19.134	130.43	13.043	30.804	1000
19	35.355	35.355	131.22	13.122	30.992	1000
20	19.134	46.194	141.79	14.179	33.487	1000
21	0	50	130.72	13.072	30.873	1000
22	-19.134	46.194	129.22	12.922	30.519	1000
23	-35.355	35.355	132.97	13.297	31.404	1000
24	-46.194	19.134	138.13	13.813	32.624	1000
25	-50	0	133.13	13.313	31.441	1000
26	-46.194	-19.134	134.03	13.403	31.655	1000
27	-35.355	-35.355	122.75	12.275	28.991	1000
28	-19.134	-46.194	129.1	12.91	30.491	1000
29	0	-50	129.42	12.942	30.565	1000
30	19.134	-46.194	128.96	12.896	30.457	1000
31	35.355	-35.355	127.21	12.721	30.044	1000
32	46.194	-19.134	151.33	15.133	35.741	1000
33						
34						

Calibrating for NIST Traceable Measurements

The Pro4 is very repeatable and uses quality materials to assure reliable testing. When a NIST traceable standard is used, the measurements may be set to correlate with the standard. Of course, this requires that a NIST traceable resistivity standard is used. Appendix A has a list of standards available from Lucas-Signatone. Calibration should be done weekly or after changing probe heads.

The following describes the calibration procedure for the Pro4. If you have several calibration standards, select one that is closest to the value of the samples you wish to test. Each calibration standard has a certificate that accompanies it. Here is an example of the certificate-

CERTIFICATE OF CALIBRATION

RESISTIVITY STANDARD

Model Number:	**SRS – 0.002**	Serial Number:	**9211-1002**
Substrate Material:	**Silicon**	Certification Program:	**rssrs00**
Wafer Mfg.:	**Virginia Semiconductor**	Lot No.:	**5000-11/01**
Orientation:	**<100>**	Type:	**P**
Diameter:	**76.2 mm**		

Measuring Current: **100 mA**
Voltage-Current Ratio: **0.00811 Ω**
(as measured with an ideally spaced 1.59 mm probe)
Temperature Coeffecient of Resistivity: **0.00148 1/°C**

CALIBRATED VALUES:

	Mean		Expanded Uncertainty[1]
Thickness	**(0.511**	±	**0.003) mm**
Sheet Resistance	**(0.0366**	±	**0.0005) Ω**
Resistivity	**(0.00187**	±	**0.00003) Ω cm**

All measurements were made at the center of the standard.
All measurements were corrected to 23 °C.

Resistivity Reference Standard: **NIST SRM – 1523 Slice 0.01-500**

Enviromental conditions at the time of measurement:

Temperature:	**(20.8**	±	**0.1) °C**
Humidity:	**(56**	±	**2) %**

This standard is calibrated in accordance with ASTM F-84
This standard is calibrated in compliance with ISO 10012-1 and ANSI/NCSL Z540-1-1994.

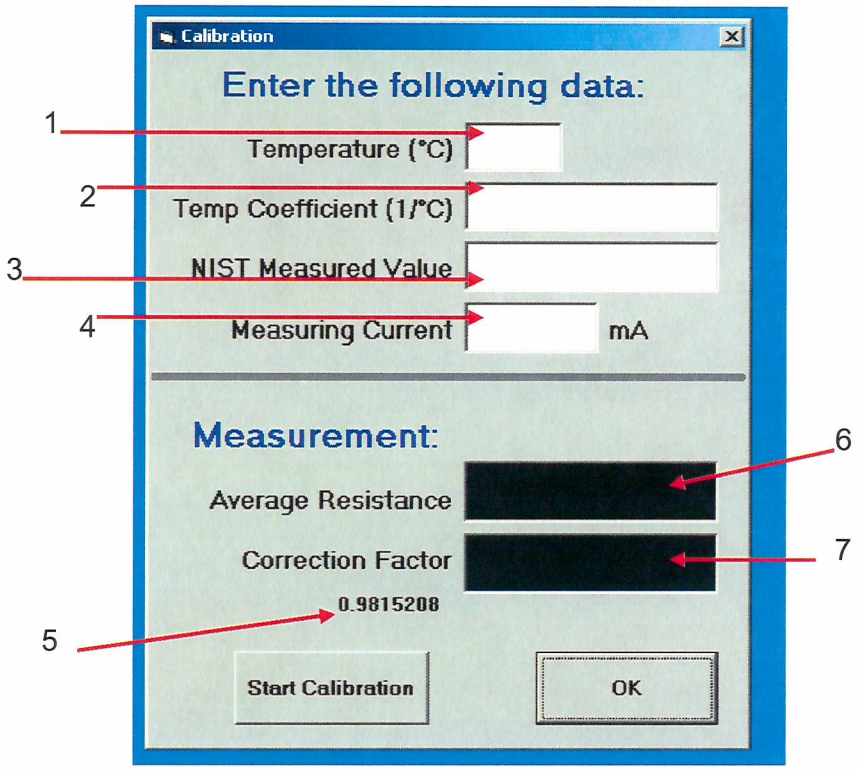
Certification Date: March 30, 2003

To calibrate the Pro4, do the following steps-

1. Set-up the calibration wafer standard on the 302 probe stand. Center the probe head over the standard. Besure the probe compress 50-70% when the probe is lowered into contact.

2. In the software, select the *Configure* menu. High light and choose the *Calibration* option.

3. The following screen pops up. The value shown (#5) is the calibration factor calculated last time. To accept this value, simply press OK.



4. Enter the present temperature of the sample in °C in box #1. If you do not know, enter 23°C.

5. Enter the *Temperature Coefficient of Resistivity* in °C, found on the certificate, (see previous page, 2nd yellow highlight) in box #2.

6. Enter the *Sheet Resistance* value (see previous page, 3rd yellow highlight) in box #3.

7. Enter the *Measuring Current* value in mA. (see previous page, 1st yellow highlight in box #4)

8. Once these values are entered, lower the probe head into contact and press the *Start Calibration* button.

The Pro4 will automatically set the current to the defined measuring current, then measure the calibration sample. It will make 5 measurements then report the average in box #6. This will take about 1 minute to complete. The recommended new correction factor is reported in box #7.

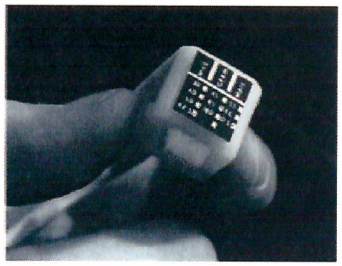
At the conclusion of the 5 measurements, a message screen will appear with the question, "*The calculated correction factor is ########. Do you accept this value?*"
If the test went well and the system is in good order, a valid correction factor should be in the range of 0.88 to 1.12. Selecting the *Yes* button will apply the calibration to all future measurements. The data is stored and the calibration window closes returning to the main program.

If you select *No* the message window closes. Verify that all of the entered data is correct, then move the sample about a mm and try the test again. If the correction is always greater than 12%, there may be a bad probe head or connection introducing too much resistance to the measurement.

Ordering Probe Heads and Parts

Four Point Probe Heads

A variety of choices of four point probe heads are available from Lucas Labs. The part number ordering information is listed below. The model 302 requires the 9 pin connector option which is designated by the letter 'Y' in the last position of the part number.



SP4- [ ][ ] [ ][ ][ ] [ ] [ ] Y

Tip Radius (inches)
R = 0.0016
F = 0.005
B = 0.010

Material
0 = Osmium
T = Tungsten Carbide

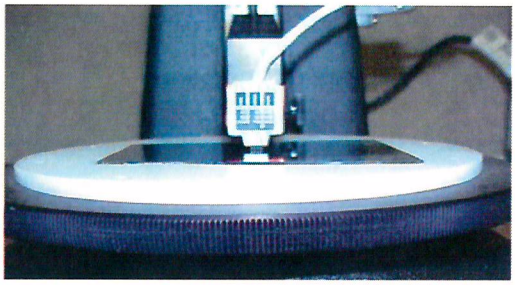
Spring Pressure (grams)
045 = 45
085 = 85
180 = 180

Spacing between tips (inches)
40 = 0.040
50 = 0.050
62 = 0.0625

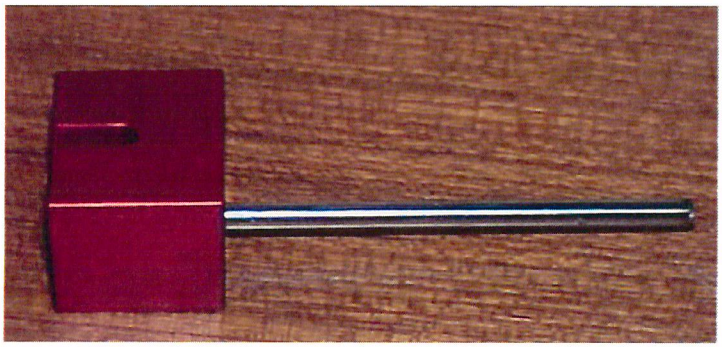
Isolation Chucks

The 302 includes one isolation chuck. However, you may order additional chucks if desired. They are available in 100mm, 150mm and 200mm sizes. The 302-8 is the only model that accepts the 200mm chuck.

100mm – S-3TD-4
150mm – S-3TD-6
200mm – S-3TD-8



Probe Head Quick Mounting Block



Part number = L-4PQM

Resistivity NIST Traceable Calibration Standards

A number of calibration standards are available as listed below. Normal lead time is about 6 weeks on these items. Users should choose the standard that is closest to the values being tested.

Part #	***Description***
SRS3-0.002	3 inch p-Type Silicon < 100 > 0.002 ohms-cm 0.04 ohms
SRS3-0.01	3 inch p-Type Silicon < 100 > 0.01 ohms-cm 0.2 ohms
SRS3-0.03	3 inch p-Type Silicon < 100 > 0.03 ohms-cm 0.6 ohms
SRS3-0.1	3 inch p-Type silicon <111> 0.1 ohm-cm 2 ohms
SRS3-0.3	3 inch p-Type Silicon < 111 > 0.3 ohms-cm 6 ohms
SRS3-0.9	3 inch p-Type Silicon < 111 > 0.9 ohms-cm 18 ohms
SRS3-3.0	3 inch p-Type Silicon <111> 3 ohms-cm 60 ohms
SRS3-10	3 inch p-Type Silicon <111> 10 ohms-cm 200 ohms
SRS3-30	3 inch n-Type Silicon < 111 > 30 ohms-cm 600 ohms
SRS3-57	3 inch n-Type Silicon < 111 > 57 ohms-cm 1100 ohms
SRS3-75	3 inch n-Type Silicon < 111 > 75 ohms-cm 1500 ohms
SRS3-90	3 inch n-Type Silicon < 111 > 90 ohms-cm 1700 ohms