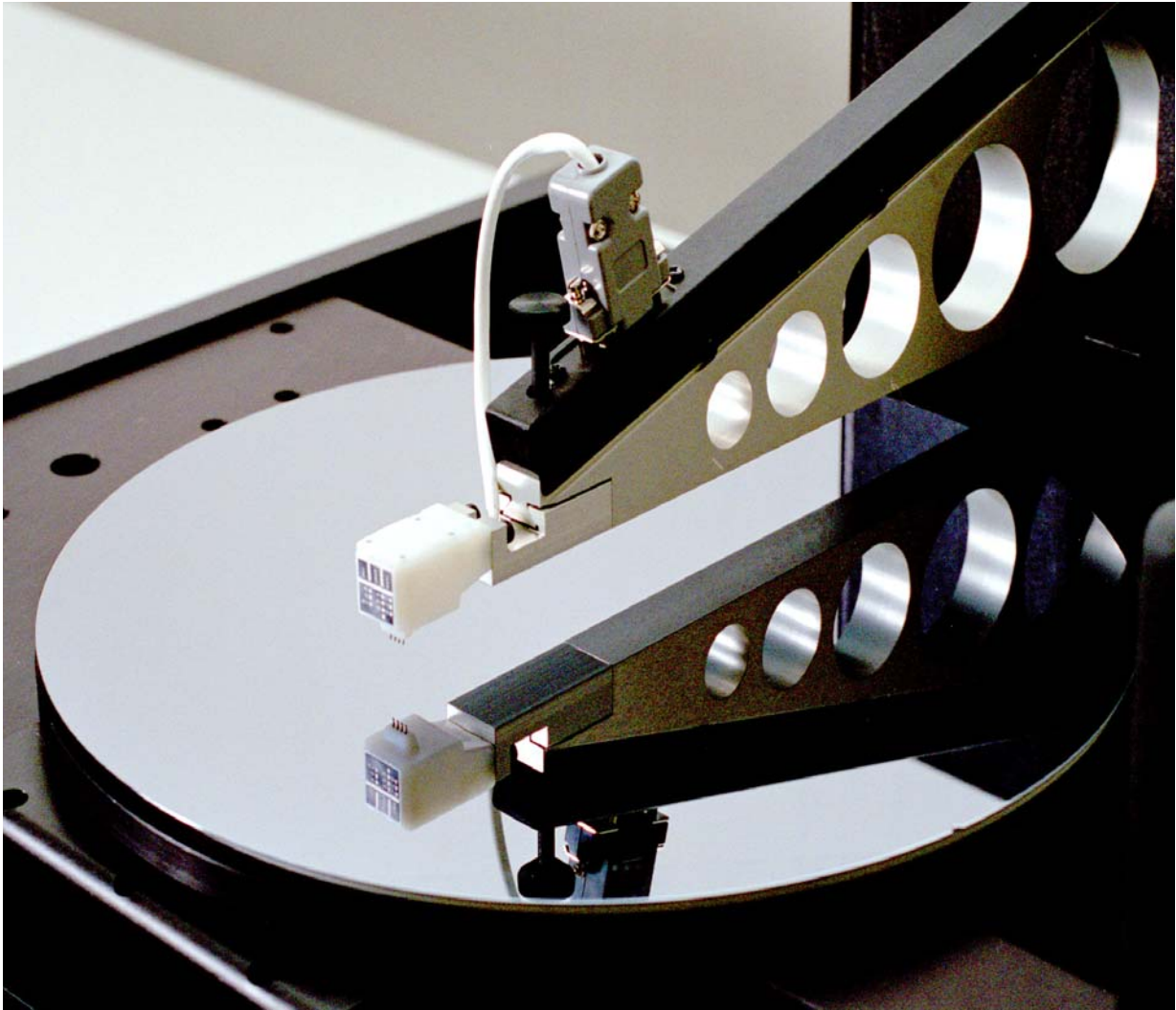




Lucas Signatone Corporation

QuadPro Resistivity System



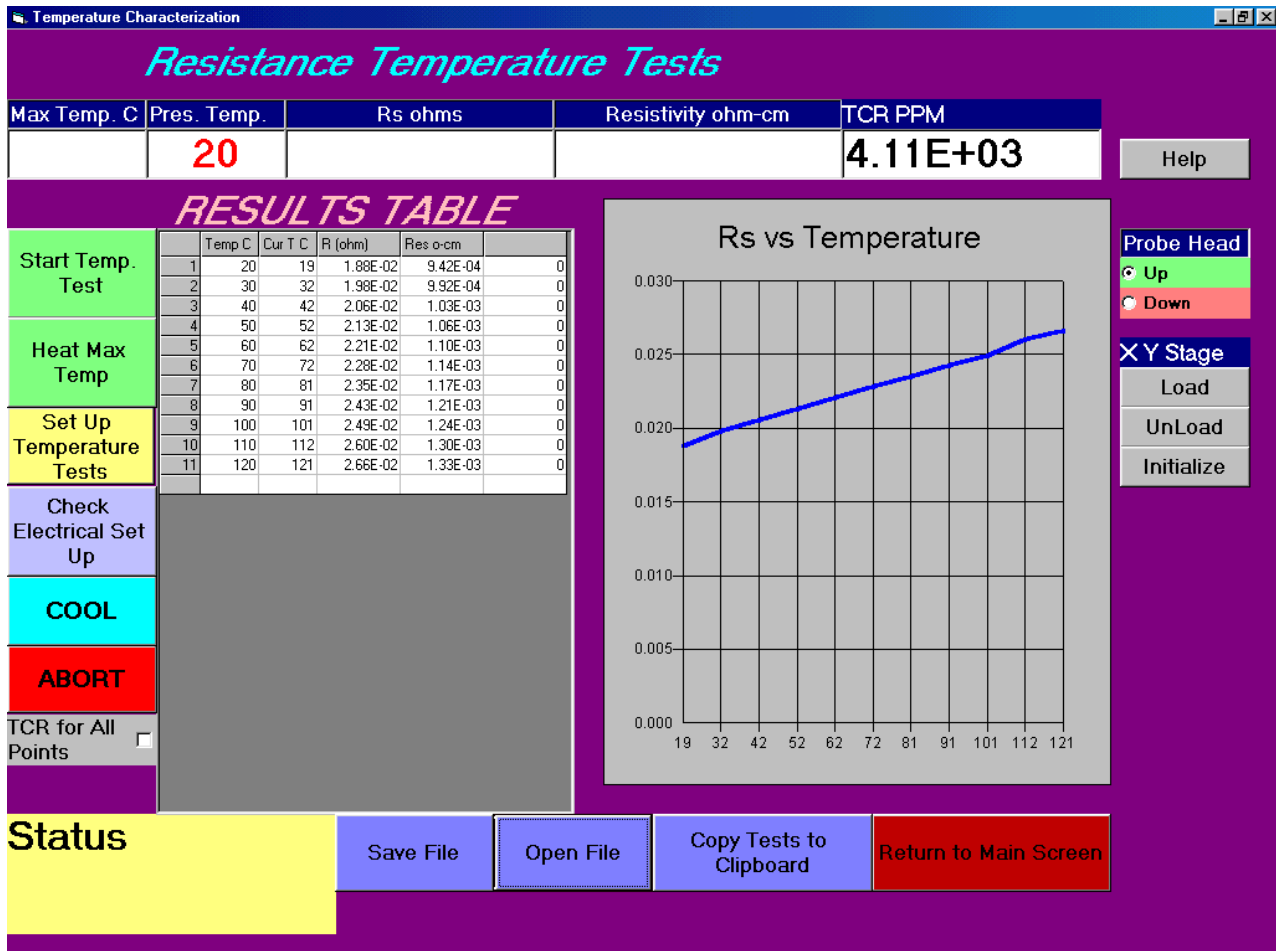
- ✓ Reports Average Resistivity, Resistivity Standard Deviation, Average Sheet Resistance and Sheet Resistance Standard Deviation
- ✓ Temperature Coefficient of Resistance (TCR) measurements integrated with automated temperature chuck and source meter. (Optional)
- ✓ Automated 2D Color Contour mapping, 3D and Crossection mapping
- ✓ Employs the Dual Configuration Testing method for improved accuracy and repeatability
- ✓ For samples 10 to 300mm
- ✓ 1 to 49 NIST traceable automated measurements per sample

QuadPro Automatic System



The QuadPro includes a computer, stepper controller, and base station with either a 200 or 300mm diameter isolated chuck. The software allows for selecting 1, 5, 9, 25 or 49 points for automated testing and mapping of the test sample. Positioning patterns may be set to either round or square configuration.

The edge exclusion may also be defined. On the first measurement, the software auto ranges the meter finding the best settings for the sample testing. Dual configuration assures that errors introduced by the probe head manufacturer are eliminated, increasing the repeatability and accuracy of measurements. The Software controller automatically steps to each position and records the X-Y position, Sheet Resistance, Resistivity and V/I measurement in a visible table. Upon completion of the test points, a wafer contour map is displayed. The contour map may be toggled between 2D and 3D viewing. The average and standard deviation of resistivity and sheet resistance display prominently above the contour map.



QuadPro TCR Option

The Temperature Coefficient of Resistance option integrates temperature control of the test sample as well as the automated source meter control and resistance calculations. Integrated with a variety of Signatone thermal chuck systems, the test allows setting of temperature steps in degrees C, dwell time at temperature before reading, starting temperature and ending temperature. Each temperature, and resistance reading is stored in a table and plotted on a graph for analysis.

Signatone offers a variety of thermal chucks and temperature ranges. The standard, most common range is ambient to 350°C. However, different combinations of chucks and controllers could have a low of -55°C to a high of 600°C.



QuadPro Source Meter options

Keithley 2400 Source Meter

The QuadPro standard configuration includes the Keithley 2400 Source Measurement Meter. This meter allows resistance measurements in the range of 1 milliohm to 2 megaohms. Some of the newer high resistance materials require a greater resistance measurement range. For those applications, Signatone implements the Agilent 4156 Parametric Analyzer along with special triaxial shielding. This configuration increases the range from 100 milliohms to 10 gigaohms, *see below*.

Temperature Characterization

High Resistance Temperature Tests

Max Temp. C	Pres. Temp.	Rs ohms	Resistivity ohm-cm	Current Amps	TCR PPM
200	200	4.55E+09	1.47E+08	-1.92E-10	-557

TEMP. TESTS

	Temp C	Cur T C	R (ohm)	Res o-cm	I Amp	
Start Temp. Test	1	20	20	1.02E+11	3.32E+09	-9.37E-12
	2	40	41	1.26E+11	4.11E+09	-1.02E-11
	3	60	61	7.66E+10	2.49E+09	-1.25E-11
	4	80	81	2.89E+10	9.39E+08	-2.23E-11
Heat Max Temp	5	100	100	1.91E+10	6.22E+08	-4.01E-11
	6	120	121	1.89E+10	6.15E+08	-5.68E-11
	7	140	141	1.59E+10	5.17E+08	-6.82E-11
	8	160	161	2.69E+10	8.76E+08	-6.28E-11
COOL	9	180	180	1.10E+10	3.60E+08	-1.20E-10
ABORT	10	200	200	4.55E+09	1.47E+08	-1.92E-10

HP 4156 C

RAvg: 4.552878E+09 Abort Measure Open 4156
 IAvg: -1.92754E-10 Load Setup Copy to Clipboard
 Setup Name: TEST3 Hold Time: 5
 Points: 5 Interval: 2
 SMU1 (V): -5

	V2	V3	I1	R (ohm)
1	-4.6134	-4.4306	-1.8163E-10	4.560183E+09
2	-4.6124	-4.416	-1.9197E-10	4.635564E+09
3	-4.6126	-4.4128	-1.9425E-10	4.660457E+09
4	-4.6126	-4.4178	-1.9796E-10	4.45867E+09
5	-4.6122	-4.4178	-1.9796E-10	4.449513E+09

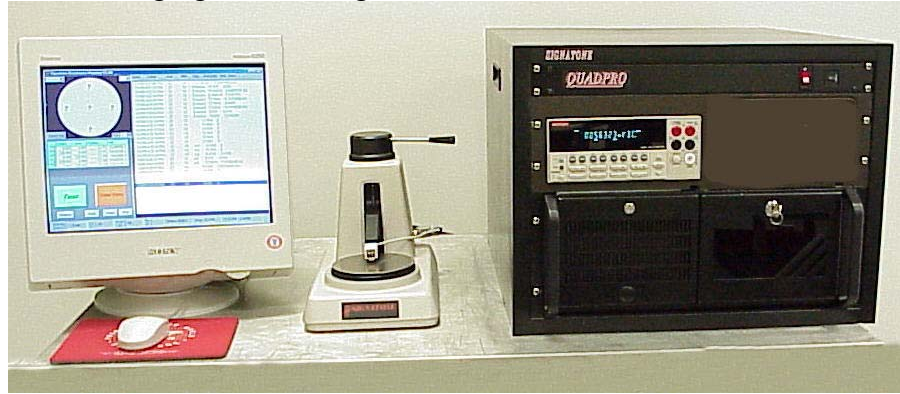
Probe Head: Up

Main Screen Set Up Temperature Tests Set Up 4156 Copy Tests to Clipboard Open File Save File

Temp. Testing Complete

QuadPro and Manual systems

Since 1968, Signatone has offered a simple manual resistivity measurement stand. This simple stand may be incorporated with QuadPro computer and source meter for easy accurate measurements. Of course, the sample is positioned by hand. A lever lowers the probe head into contact with the sample. The auto ranging, dual configuration and data collection features do the calculations accounting for edge error and probe head error assuring repeatable NIST traceable accurate results.



QuadPro-301-6

Four Point Probe heads

Signatone offers two probe heads to choose from; the SP4 and the HT4. The SP4 is an inline probe made of delrin and used in most applications. Several choices are available for configuration to your specific application. The three spacings are .040, .050 and .0625 inches. The three pressures available are 45, 85, and 180 grams. Tips are made of Tungsten Carbide or Osmium and a choice of .0016, .005, .010 inches radius.



The HT4 inline four point probe head is made of ceramic and designed for high temperature and high resistance measurements. The HT4 accurately collects data at temperatures up to 650°C. The coaxial high temperature wiring also allows resistance measurements up to 10 Gigohms. The HT4 features spacing of .050 and .0625 inches and pressure is fixed at 180 grams. Tips are made of Tungsten Carbide or Osmium and a choice of .0016, .005, .010 inches radius.

QuadPro Test & Calibration

The system uses the Dual Configuration test method of ASTM Standard F84-99 to compensate for errors in probe spacing and errors caused by proximity to the edge of the conducting layer. NIST traceable calibration standards are available for purchase with the system. Proper use of the standards and the calibration procedure insures the specified system accuracy of better than 1%.

QuadPro Specifications

Measurements	<u>Manual</u>	<u>Auto</u>	<u>High R</u>
Range Rs (ohms)	10 ⁻³ to 10 ⁶	10 ⁻³ to 10 ⁶	10 ⁻¹ to 10 ¹⁰
Accuracy	<1%	<1%	5X @ > 10 ⁸
Test Time / Point	10 sec	2 sec	Varies
Dual Configuration Method	Yes	Yes	No
Display Resistivity or Thickness	Yes	Yes	Yes
General			
Sample Size	300mm	50-300 mm	50-300 mm
Shape Round or Square	Yes	Yes	Yes
Number of Points Measured	5 – 25	5 – 49	5 – 49
Open Frame or Enclosure	Open Frame	Enclosure	Enclosure
TCR Option	150 mm	200 mm	300 mm
Temperature Range 5°C to	500°C	400°C	200°C

Automation: Select Min Temp, Max Temp, Interval & Dwell Time Then Auto Run

Display: Temp, Rs, Resistivity or Thickness

Calculate TCR or Map Rs @ Temperature

Output: 2D and 3D Contour Maps, Save & Get Results, Print Results including contour maps, Copy to Clip Board, etc., Retest function

Probe heads

Type	<u>Material</u>	<u>PinSpacing</u>	<u>Spring Pressure</u>	<u>Tip</u>	<u>Diameter</u>
SP4	Delrin	40, 50, or 62.5 mils	45, 85, or 180 grams,	TC or OSM,	1.6, 5, or 10 mils
HT4	Ceramic	50, 62.5	180 grams	Same	Same

:Calibration Substrate wafers available