1. Scope

1.1 This document provides the procedure for measuring and calculating sheet resistance and resistivity with the 4 point probe.

2. Table of Contents

1. Scope ............................................................................................................................................................. 1
2. Table of Contents .......................................................................................................................................... 1
3. Reference Documents ................................................................................................................................... 2
   3.1 Referenced within this Document .......................................................................................................... 2
   3.2 External Documents ............................................................................................................................... 2
4. Equipment and/or Materials ......................................................................................................................... 2
5. Safety............................................................................................................................................................. 2
6. Measurement Procedures ............................................................................................................................ 2
7. Calculation Procedures ................................................................................................................................. 3
8. Revision History ............................................................................................................................................. 3
3. Reference Documents

3.1 Referenced within this Document
   3.1.1 None

3.2 External Documents
   3.2.1 None

4. Equipment and/or Materials

4.1 4 Point Probe
4.2 Wafer/Sample

5. Safety

5.1 Follow all Nanofab safety procedures.

6. Measurement Procedures

6.1 Turn on the Probe.
   6.1.1 Turn on the power switch. See Figure 1, 4 Point Probe Controls.

6.2 Load the Sample.

6.3 Turn the current down to 1 mA using the knob on the base of the probe station. See Figure 1.
6.4 Turn the contact lever to the left to contact the substrate with the probe tips. See Figure 1.
6.5 Turn the voltage and current knobs until you get a reading that is not 1 or 0. See *Figure 1, 4 Point Probe Controls*.

6.6 Note the measured voltage and the current you are applying.

6.7 Use the equations below to calculate sheet resistance and resistivity.

**7. Calculation Procedures**

7.1 Sheet Resistance (Rs) = resistivity/thickness of conductive layer(s) = 4.53*V/I

7.2 Where V is the voltage measured by the 4 point probe and I is the current applied to the probes.

7.3 For Example:

7.4 0.2 um film of gold on a glass substrate measures 2.05 mV on the 10 mV scale with a current setting of 44.5 mA.

7.5 The sheet resistance would be:

7.6 Rs (Ohm/square) = 4.53*V/I = 4.53*0.00205V/.0445A = 0.209 Ohm/square.

7.7 And the resistivity would be:

7.8 Resistivity (Ohm-cm) = Rs*t = .209 Ohm/sq *0.2 um *.0001 cm/um = .00000418 Ohm-cm = 4.18 uOhm-cm.

7.9 Another Example:

7.10 2” N-type wafer with a specified resistivity of 1-10 Ohm-cm and a thickness of 10-12 mils (250-300 um).

7.11 The voltage measured is 123.4 mV on the 100 mV scale and the current is 4.53 mA.

7.12 Rs = 4.53 * V/I = 4.53 * 0.1234V/.00453A = 123.4 Ohm/sq.

7.13 Resistivity = Rs*t = 123.4 Ohm/sq * 275 um * .0001cm/um = 3.4 Ohm-cm, which is in the specified range of 1-10 Ohm-cm.

**8. Revision History**

<table>
<thead>
<tr>
<th>Rev</th>
<th>Date</th>
<th>Originator</th>
<th>Description of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02 June 2010</td>
<td>Sam Bell</td>
<td></td>
</tr>
</tbody>
</table>