Four-Point Probe System

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Accurate resistivity measurements are critical when characterizing materials, but they are not always easy to make such a measurement on different material types, while they require different instrumentation and techniques.
Electrical resistivity is a basic property that defines how well a material conducts current. Its determined by measuring the resistance of a material sample, then factoring in its geometry. The three basic types of bulk materials: metal, insulator and semiconductors can be defined by their resistivity.

- **Metals** are good conductors of current with typical resistivities of about **10^{-8} Ω.m**
- **Insulators** are poor conductors with typical resistivities of about **10^{7} to 10^{19} Ω.m**
- **Semiconductors** conduct current better than insulator but not as well as metals; they may fall anywhere from about **10^{-5} to 10^{5} Ω.m**

Ossila Four-Point Probe System ia a device to measure resistivity of bulk materials and thin layers (nanometre range) at room temperature.

The system can measure sheet resistances in the range of 100 mΩ/□ to 10 MΩ/□, enabling the characterisation of a wide range of materials. If the sample thickness was provided, then the average resistivity in Ω.m and conductivity S/m will also be displayed.
The four-point probe head utilises gold-plated, gentle spring-loaded contacts with rounded tips. This results in a constant contact force of 60 grams, preventing the probes from piercing fragile thin films, whilst still providing good electrical contact.

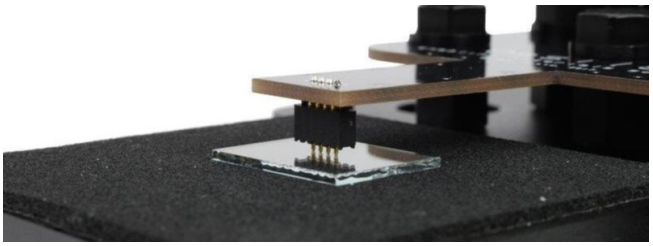
System Specifications

Probe spacing	1.27 mm
Rectangular sample size	minimum 5 mm
Circular sample size ⌀	minimum 5 mm
Maximum sample thickness	10 mm
Voltage range	±100 μV to ±10 V
Current range	±1 nA to ±150 mA
Sheet resistance range	100 mΩ/□ to 10 MΩ/□ (ohms per square)

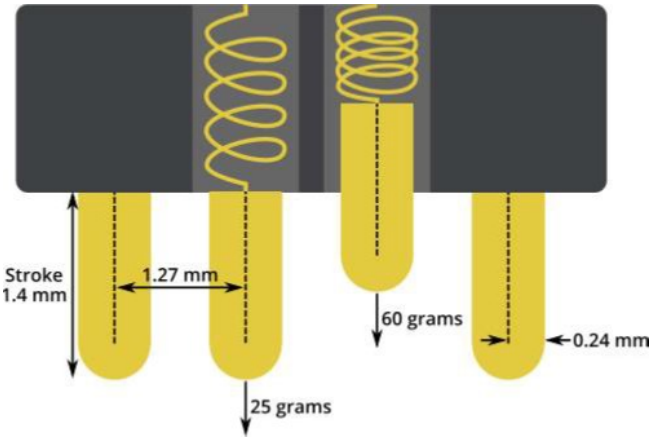
Performing a Measurement

Taking a measurement with the Four-Point Probe System is simple, as it has a built-in source-measure unit included in the system. After plugging the system into the power and PC, start the Ossila Sheet Resistance software, and follow these steps:

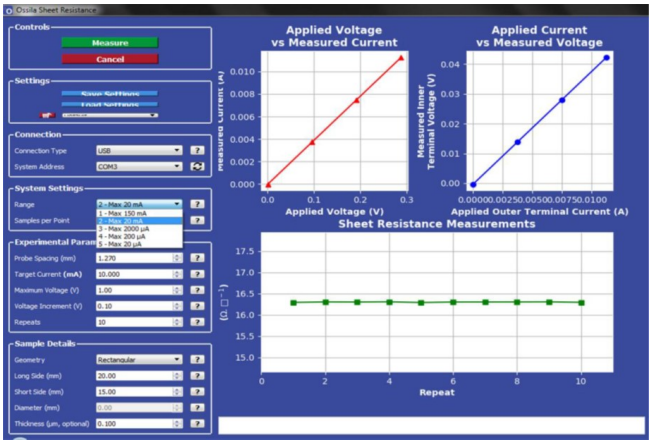
1. Place the sample on the stage, centered under the four-point probe head. The tips should be far from the sample edges (as the probe spacing or higher). Measure in the center of the sample if possible.



2. Use the micrometer to raise the stage until the probes are in good contact with the sample. As the probes are spring-loaded, they will compress as the sample is raised into them - creating a constant contact force. If the sample is notcentered, lower the stage until the probes are not in contact before repositioning it to prevent damaging the sample.

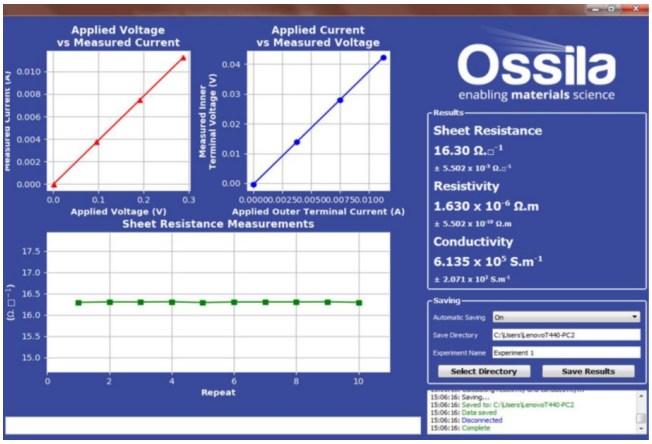


3. Set the appropriate range on the source-measure unit, Chose from **System Settings**. For this you will need to estimate the order of magnitude of the sample. The lower the resistance, the lower the required range number. If you do not know what resistances are likely, start with range 1 (up to 150 mA current) and move down the ranges if the target current cannot be achieved.



4. Click the Measure button. The system will then try to apply the set target current between the outer two probes. Once this has been achieved, the voltage will be measured between the inner two probes and the sheet resistance calculated from these values. Once the measurement has fnished, the average sheet resistance will be displayed in the results box on the right side of the window.

5. The resistivity and conductivity will also be displayed if the sample thickness was provided.



6. Measure at different points on the sample for better accuracy. The precision of the measurement with this system can vary between 0.05% uppto 5% depending on the sample and system setting parameters. Precision is the maximum deviation between identical measurements (useful for comparative measurements).