SHEET RESISTANCE SOFTWARE

USER MANUAL

Manual version: 1.0.B
Software version: 2.0

Contents

1. Requirements

Table 1.1 details the minimum computer specifications for the software.

Table 1.1. Ossila Sheet Resistance software requirements.

Operating Systems	Windows 10 (32-bit or 64-bit)
CPU	Dual Core 2 GHz
RAM	2 GB
Available Hard Drive Space	160 MB
Monitor Resolution	1280 x 720

2. Installation

1. Install the Ossila Sheet Resistance software on your PC.
    I. Run the file 'Ossila-Sheet-Resistance-Installer-vX-X-X-X.exe' on the USB memory stick provided.
    II. Follow the on-screen instructions to install the software.

Note: The Ossila Sheet Resistance software can be downloaded from ossila.com/pages/software-drivers

3. Operation

3.1 Taking a Measurement

1. Place your sample in the centre of the vertical stage.
2. Raise the platform until the probes have retracted approximately half-way into their housing.
    I. One full turn of the micrometer (after initial contact is made) is a good way to ensure that there is good electrical contact between the probes and your sample.
    II. Ensure that the probes make contact with the centre of the sample.
    III. For rectangular samples the longest edge should be aligned parallel to the probes.
3. Start the Ossila Sheet Resistance software. The window shown in **Figure 3.1**Error! Reference source not found. will open.
4. Set the appropriate settings in the software (explained in more detail in **Section 3.2**).
5. Click the 'Measure' button.

I. The unit will apply a voltage and measure the current across the sample.
II. The voltage will be increased until either the target current is achieved, or the maximum voltage is reached.
    - If the maximum voltage is reached before the target current is achieved the measurement will cancel.
III. If the target current is achieved, the **sheet resistance** will then be measured.
IV. The measurement will be repeated for the number of times set in the 'Repeats' field, and the average will be displayed on the right.
    - These measurements will use the applied voltage found in the initial sweep to supply the current.
V. If a thickness has been provided, the average **resistivity** and **conductivity** will also be displayed.

6. If automatic saving is turned on, the measurement data and settings will be saved.

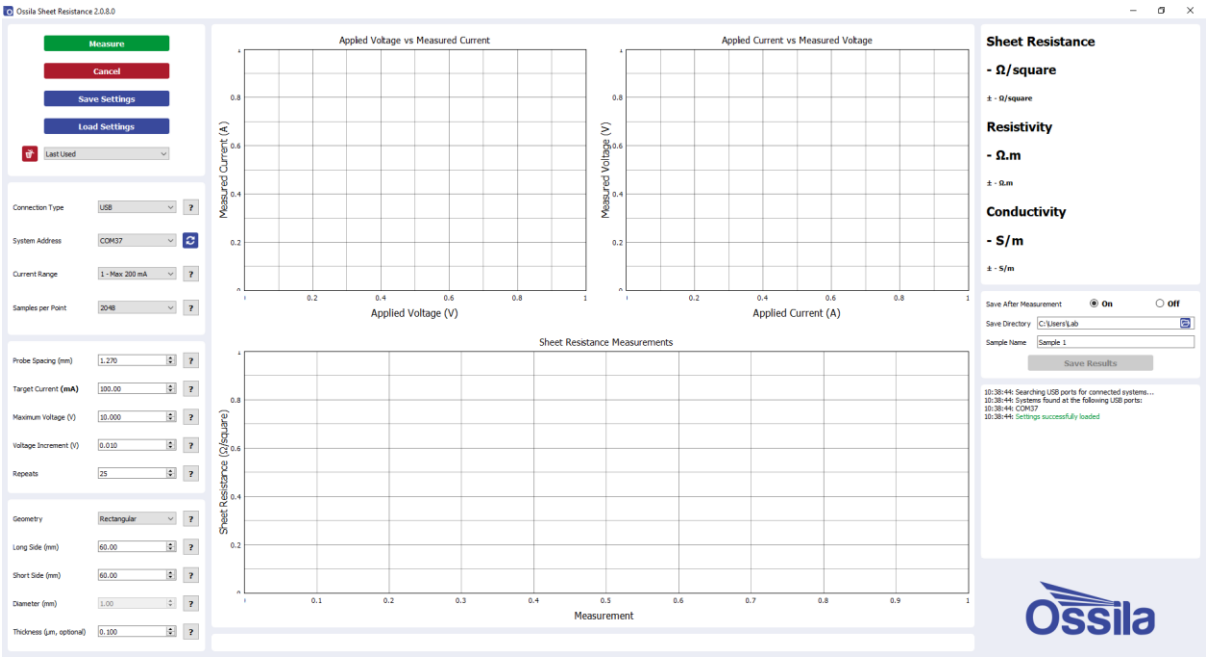

Figure 3.1. Ossila Sheet Resistance software.

3.2 Software Settings

There are several settings in the program which must be filled in before taking a measurement. These are found in the column on the left of the window. Additionally, information about each setting can be found by clicking the '?' buttons next to each field.

3.2.1 Connection

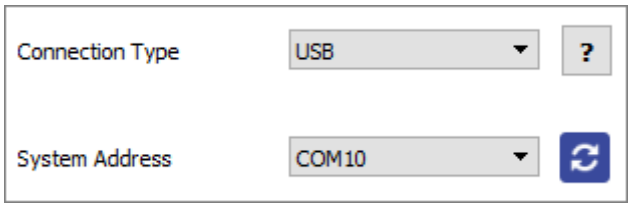

Figure 3.2. Connection settings.

(I) Connection Type

- Select the type of connection you are using, either USB or Ethernet.
- Any connected units will be automatically detected when a selection is made and the 'System Address' box will be populated.
    I. To rescan for connected units (in case the connection is changed) click the refresh icon next to the 'System Address' box.

(II) System Address

- Select the COM port or IP address of the connected unit you intend to use (USB and Ethernet connection respectively).
- This box will be populated automatically with the addresses of any units connected to the computer via the method selected in the 'Connection Type' box.
    I. To rescan for connected units (in case the connection is changed) click the refresh icon next to the 'System Address' box.

3.2.2 System Settings

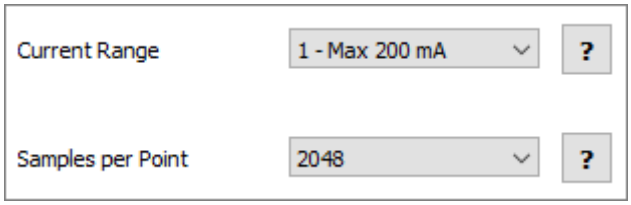

Figure 3.3. System settings.

(I) Current Range

- Select the range of currents to be used for the measurement.
- This defines the upper limit and accuracy of current measurements that can be performed by the unit. The values for each range are given in **Table 3.1**.
    I. The maximum current values for each range are also shown in the range selection box.

Table 3.1. Current specifications for each range of the Four-Point Probe System.

Range	Maximum Current	Accuracy	Precision	Resolution
1	±200 mA	±500 µA	10 µA	1 µA
2	±20 mA	±10 µA	1 µA	100 nA
3	±2 mA	±1 µA	100 nA	10 nA
4	±200 µA	±100 nA	10 nA	1 nA
5	±20 µA	±20 nA	1 nA	0.1 nA

(II) Samples per Point

- Select the number of samples to be taken for each measurement.
- A higher number of samples per point will improve the accuracy and precision of the measurement. However, this will increase the time taken for it to be performed.

3.2.3 Measurement

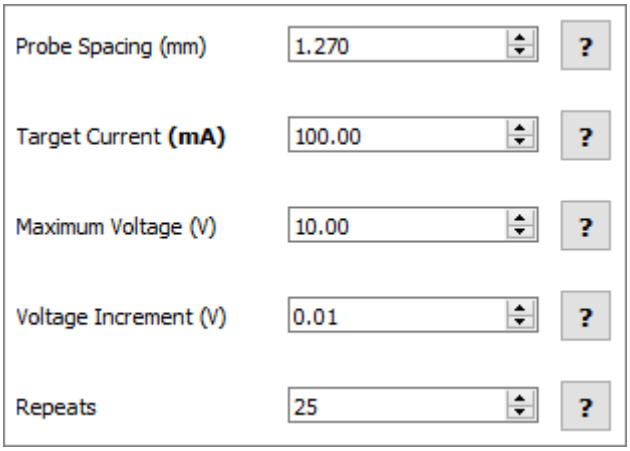

Figure 3.4. Measurement settings.

(I) Probe Spacing

- Sets the spacing between each of the probes in mm.
- This is required to determine the appropriate geometric correction factor for the sample being measured.

(II) Target Current

- Sets the current to apply to the sample for the measurement.
- The units and maximum values of this field will be dependent upon the selected Range.
- This value can be positive or negative.
- The value that should be used for this field is dependent upon the resistance of the sample being tested (see **Section 3.3**Error! Reference source not found.):

I. Higher values for less resistive samples.
II. Lower values for more resistive samples.

(III) Maximum Voltage

- Sets the maximum voltage in volts that can be applied to the sample to achieve the target current.
- The polarity of the voltage will be determined automatically, based upon the target current.

(IV) Voltage Increment

- Sets the step size for changing the voltage when trying to achieve the target current.

(V) Repeats

- Sets the number of measurements that will be taken to generate an average for the results.

3.2.4 Sample Details

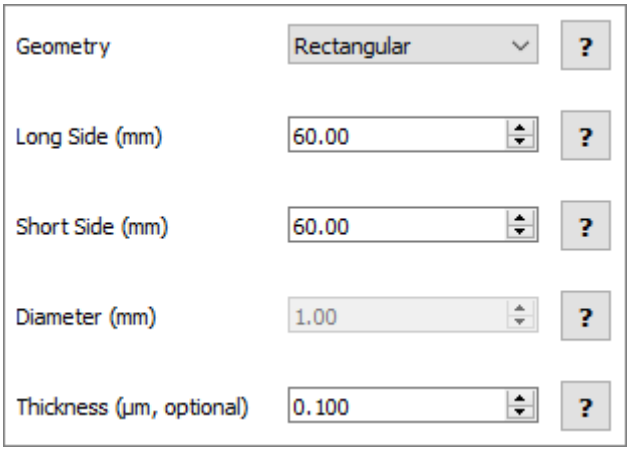

Figure 3.5. Sample detail settings.

(I) Geometry

- Select the geometry of the sample being measured.
- This is required to calculate the geometrical correction factor for the current sample.
- If the shape of the sample is irregular, consider whether it is closer to rectangular or circular and then estimate what size of that shape could fit within the sample.

(II) Long Side (Rectangular Sample)

- Sets the length of the long side of the sample in mm for rectangular samples.
- This is required for calculating the appropriate geometrical correction factor.

(III) Short Side (Rectangular Sample)

- Sets the length of the short side of the sample in mm for rectangular samples.
- This is required for calculating the appropriate geometrical correction factor.

(IV) Diameter

- Sets the diameter of the sample in mm for circular samples.
- This is required for calculating the appropriate geometrical correction factor.

(V) Thickness (Optional)

- Sets the thickness of the sample in µm.
- This enables the calculation of the resistivity and conductivity of the sample.
- It is not needed for sheet resistance measurements and can be set to 0 if not known.

3.2.5 Settings Profiles

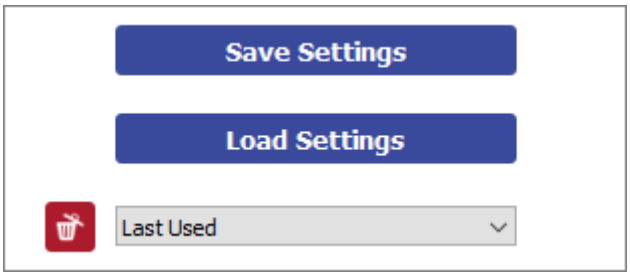

Figure 3.6. Controls for saving and loading settings profiles.

(I) Save Settings

- Saves the current settings as a profile that can be loaded quickly for use at another time.
- When clicked, you will be prompted to name the settings profile.
    I. If the name is already in use, you will be asked if you wish to overwrite the previous profile.
    II. The name cannot contain the characters: \ / : * ? " < > |
- The settings profile will be added to the drop-down box using the given name.
- The settings used in the most recent measurement are automatically saved to the 'Last Used' profile.

(II) Load Settings

- Opens a dialog box to navigate to a settings file that has been created as part of a previous measurement.
- The settings fields will be populated with the values in the settings file.

(III) Settings Profiles

- Select a saved settings profile from the drop-down box.
    I. The settings fields will be populated with the saved values.
- Settings profiles can be deleted by selecting the profile and then clicking the red 'delete' icon next to the drop-down box.
- The settings used in the most recent measurement are automatically saved to the 'Last Used' profile.

3.2.6 Saving Results

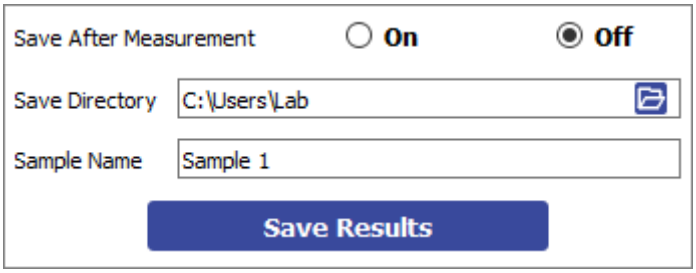

Figure 3.7. Settings for saving results.

(I) Save After Measurement

- When turned on the measurement data will be saved automatically when a measurement completes.
    I. Data will not be saved if the measurement is cancelled.
- The data will be saved to the location specified in 'Save Directory' using the name specified in 'Sample Name'.

(II) Save Directory

- Sets the location in which to save the results.
- This can be set either by:
    I. Manually typing the directory into the field.
    II. Copying and pasting it from your file explorer.
    III. Clicking the folder icon, which will open a dialog box to allow the selection of a folder to save to.

(III) Sample Name

- Sets the name to append to the saved data files.
    I. The name cannot contain the following characters: \ / : * ? " < > |

(IV) Save Results

- Clicking this button will manually save the measurement results.

(V) Saved Data Format

- Add data is saved to .csv (comma separated value) files.
- Sheet resistance measurement data is saved in the specified directory with the name 'SAMPLE NAME Sheet-resistance'. It has columns for:
    I. Applied outer current (A)
    II. Measured inner voltage (V)
    III. Sheet resistance (Ohms/square)
    IV. Resistivity (Ohm.m)
    V. Conductivity (S/m)
- Current-voltage sweep data is saved into a folder named 'I-V' in the specified directory with the name 'SAMPLE NAME Current-voltage-sweep'. It has columns for:
    I. Applied outer voltage (V)
    II. Measured outer current (A)
    III. Measured inner voltage (V)
- Measurement settings are saved into a folder named 'Settings' in the specified directory with the name 'SAMPLE NAME Settings'.
    I. This file can be loaded by the software.

Note: If files already exist with the specified sample name, an incrementing number will be appended to the file names, i.e., 'SAMPLE NAME Sheet-resistance (2)'.

3.2.7 Controls

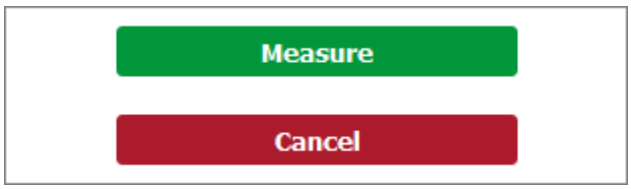

Figure 3.8. Controls for starting and stopping a measurement.

(I) Measure

- Clicking this button will start the measurement using the chosen settings.
- This button cannot be clicked if the software has not detected a unit.

(II) Cancel

- Stops a measurement that is currently in progress.
- If the measurement is stopped before it completes, any measured data cannot be saved.

3.3 Choosing a Target Current

The choice of target current will depend upon how resistive the sample is. Lower target currents should be set for samples with higher resistivity and vice versa.

3.3.1 Examples

1. For the 100 nm indium tin oxide (ITO) sample provided:
    I. A target current between **1 and 10 mA (Range 2)** should be used because the sample is fairly conductive.
    II. The sample should have a sheet resistance between **10 and 16 Ω/square** (see **Figure 3.9**).
2. A less resistive material, such as a 100 nm aluminium film (sheet resistance of **~265 mΩ/square**):
    I. A target current of **greater than 10 mA (Range 1)** is required to be able to measure a decrease in voltage between the inner probes.
3. More resistive materials (sheet resistance **≈kΩ/square**):
    I. A target current of **100 – 1000 µA (Range 3)** is needed as the resistance of the material prevents higher currents from being reached.
4. If the resistances are higher than that, even lower target currents **(Range 4 or 5)** will be required.

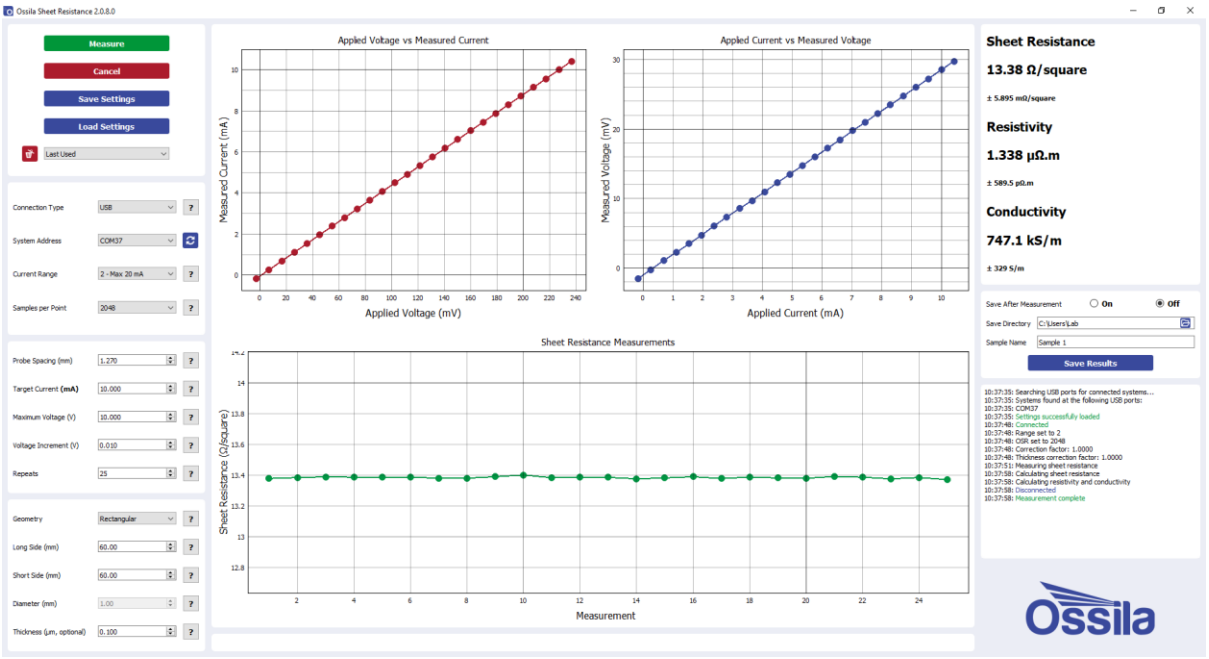

Figure 3.9. Typical output plots and measurement results for a 100 nm layer of ITO on a 60 x 60 mm glass substrate.

3.3.2 Best Practice

If you are unsure how resistive your sample is, the best technique for measuring sheet resistance is as follows:

1. Start with **Range 1** currents (10 – 200 mA).
2. If these currents cannot be reached, attempt to use **Range 2** currents (1 – 20 mA).
3. Keep decreasing the target current and switching to lower current ranges until the target current can be achieved.

4. Troubleshooting

Most of the issues that may arise will be detailed here. However, if you encounter any issues that are not detailed here, then contact us by email at info@ossila.com. We will respond as soon as possible.

Problem	Possible Cause	Action
No power/display	The power supply may not be connected properly.	Ensure the system is firmly plugged into the power supply, and that the plug is connected to both the adaptor and a working power socket.
	The power supply adaptor has a fault.	Contact Ossila for a replacement power supply adaptor.
Software does not start	The wrong version of Windows is installed on the computer.	Install the software on a computer with Windows Vista or newer.
	The software has not installed properly.	Try reinstalling the software.
Cannot connect to the system via USB	The USB cable may not be connected properly.	Ensure the USB cable is firmly plugged in at both ends.
	The USB cable may not be connected to a working USB port.	Try connecting the unit to a different USB port on the computer.
	The USB drivers may not be installed or may not have installed properly.	Try installing or reinstalling the USB drivers. If the drivers on the USB provided are not working, try following the Windows 7 installation instructions found in the Installation Guide.
	The USB cable is defective.	Try using a different USB-B cable, and contact Ossila if necessary.
Cannot connect to the system via network	The MAC address of the unit is not registered with the internal network.	Register the system on the network using the MAC address obtained via a USB connection (see Source Measure Unit manual).
	The Ethernet cable may not be connected properly.	Ensure the Ethernet cable is firmly plugged in at both ends.
	The Ethernet cable is defective.	Try using a different Ethernet cable.