

# User manual for four-probe and Van der Pauw setups

## Four-probe setup:

1. The four-probe setup consists of a probe holder and a stand. The probe holder is basically supporting four linear needles with equal spacing of 3.5 mm between them. The needles are soldered to four twisted copper wires for making electrical connections. The stand serves the purpose of placing sample and fixing probe holder using a screw as depicted in Figure (1b). A K-type thermocouple is also attached to the stand having the other end attached to the temperature controller for temperature measurement. The complete setup is photographed in Figure (1c).

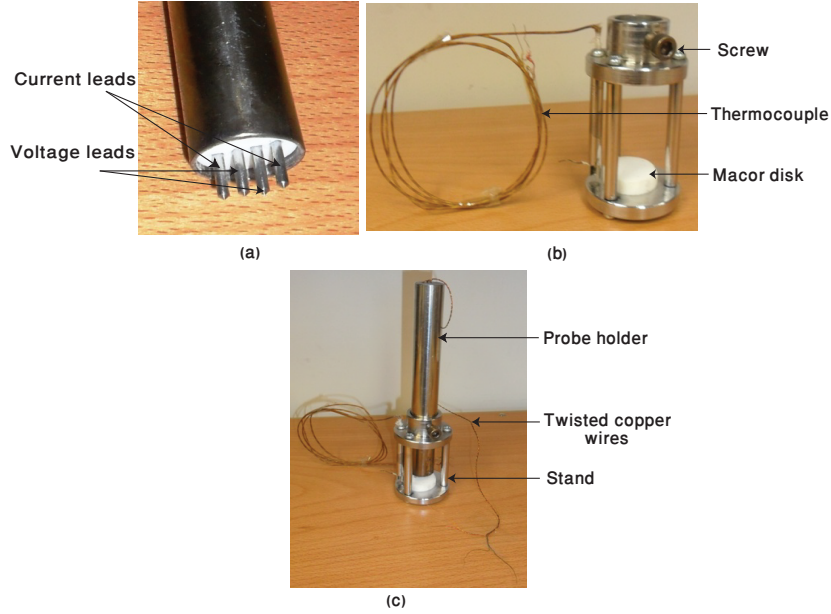


FIG. 1: (a) Probe holder, (b) stand, (c) complete four-probe setup.

2. When the sample is placed on the white macor (electrical and thermal insulator) disk, the user should adjust the position of probe holder such that all needles are in contact with the sample exerting equal pressure on the disk. After this, the user should lock the probe holder using screw.

3. When making electrical connections, care must be taken that red and brown wires are attached to the current source (Keithley 6221) while black and green to the nano-voltmeter (Keithley 2182A). The red and black crocodile clips of current source and nanovoltmeter must be used.
4. The nano-voltmeter and current source is already interfaced to the computer. The user should download the LabView file **Delta\_measurement** from [http://physlab.lums.edu.pk/index.php/Facilities\\_%26\\_Equipment#Variable\\_temperature\\_electrical\\_conductivity\\_measurement](http://physlab.lums.edu.pk/index.php/Facilities_%26_Equipment#Variable_temperature_electrical_conductivity_measurement). Furthermore, go through the supplementary material available at [http://physlab.lums.edu.pk/images/7/75/Conductivity\\_howto.pdf](http://physlab.lums.edu.pk/images/7/75/Conductivity_howto.pdf).
5. For temperature dependent measurements, the user should place the complete setup inside the oven and cover it with ceramic wool to reduce heat losses.

### Van der Pauw setup:

1. The Van der Pauw setup is almost similar to four-probe setup, except that needles are

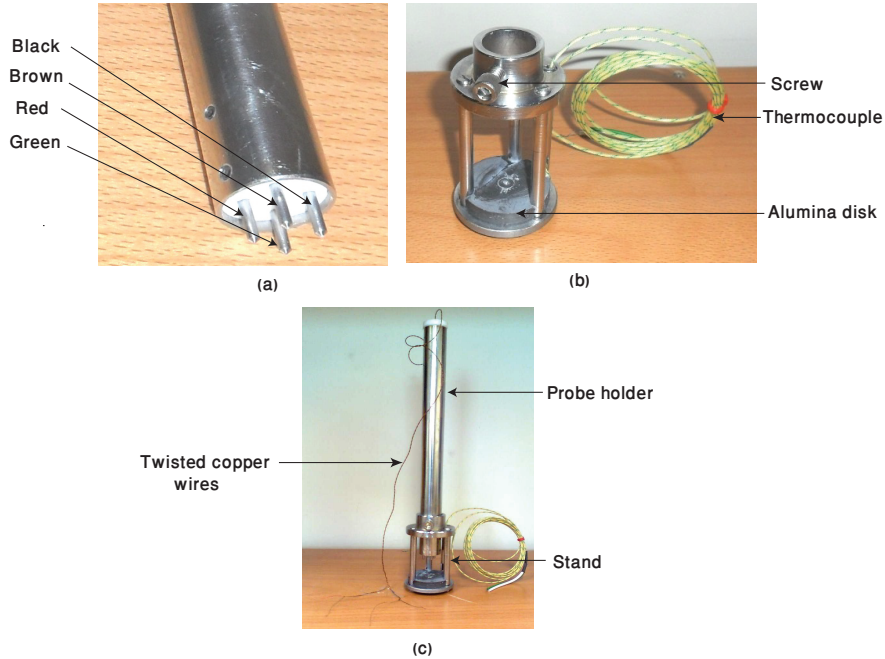


FIG. 2: (a) Probe holder with pins attached, (b) stand, (c) complete setup.

in square configuration with dimensions ( $7.78 \times 7.78$  mm) as shown in Figure (2a). Four different coloured twisted copper wires are also attached to the needles for electrical connections. The complete setup is depicted in Figure (2c).

2. After sample is being placed and current-voltage leads are connected to twisted copper wires, the user needs to interchange current and voltage terminals manually for each set of reading.
3. The data is acquired using the same LabView file.