

Product Name : Four Probe Setup Research Model Experiments for Physics Lab for High School Science Kits Lab	Product Code : HS-LAB0010
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Description :

Four Probe Setup Research Model Experiments for Physics Lab for High School Science Kits Lab

Technical Specification :

Four Probe Setup Research Model Experiments for Physics Lab - The Four Probe Method is one of the standard and most widely used method for the measurement of resistivity. In its useful form, the four probes are collinear. The error due to contact resistance, which is significant in the electrical measurement on semiconductors, is avoided by the use of two extra contacts (probes) between the current contacts. In this arrangement the contact resistance may all be high compare to the sample resistance, but as long as the resistance of the sample and contact resistance's are small compared with the effective resistance of the voltage measuring device (potentiometer, electrometer or electronic voltmeter), the measured value will remain unaffected. Because of pressure contacts, the arrangement is also specially useful for quick measurement on different samples or sampling different parts of the sample.

Description of the experimental setup

1. Probes Arrangement

It has four individually spring loaded probes. The probes are collinear and equally spaced. The probes are mounted in a teflon bush, which ensure a good electrical insulation between the probes. A teflon spacer

near the tips is also provided to keep the probes at equal distance. The probe arrangement is mounted in a suitable stand, which also hold the sample plate and RTD sensor. This stand also serves as the lid of PID Controlled Oven. Proper leads are provided for the current and voltage measurement.

2. PID Controlled Oven

This is high quality temperature controlled oven suitable for Four Probe Set-up. The oven has been designed for fast heating and cooling rates, which enhances the effectiveness of the controller. While the basic design of the controller is around the PID configuration for its obvious advantages, wastage of power is avoided by using a Pulse Width Modulated (PWM) switch. This combination has the advantages of both on-off controller and linear PID controller. The result is a good stable and accurate temperature control.

Platinum RTD has been used for sensing the temperature. A wheatstone bridge and an instrumentation amplifier are used for signal conditioning. Feedback circuit ensures offset and linearity trimming to a great degree of accuracy. The set and measured temperature are displayed on 3½ digit DPM through selector switch.

Specifications

Temperature Range Ambient to 200° C

Resolution 0.1° C

Short Range Stability $\pm 0.2^\circ$ C

Long Range Stability $\pm 0.5^\circ$ C

Measurement Accuracy $\pm 0.5^\circ$ C (typical)

Oven Specially designed for Four Probe Set-Up

Sensor RTD (A class)

Display 3½ digit, 7 segment LED with autopolarity and decimal indication

Power 150W

3. Constant Current Source

a) Constant Current Source, Model : CCS-01 (for low resistivity to medium resistivity samples)

It is an IC regulated current generator to provide a constant current to the outer probes irrespective of the changing resistance of the sample due to change in temperatures. The basic scheme is to use the feedback principle to limit the load current of the supply to preset maximum value. Variations in the current are achieved by a potentiometer included for that purpose. The supply is a highly regulated and practically ripples free d.c. source. The constant current source is suitable for the resistivity measurement of thin films of metals/ alloys and semiconductors like germanium.

Specifications

Open Circuit Voltage 12 V

Current Range 0-20mA & 0-200mA continuously variable

Resolution 10 μ A at 0-20mA range

Accuracy $\pm 0.25\%$ of the reading ± 1 digit

Display 3½ digit, 7 segment LED with autopolarity and decimal indication

Load Regulation 0.03% for 0 to full load

Line Regulation 0.05% for 10% changes

b) Low Current Source, Model : LCS-02 (for high resistivity samples)

Low Constant Current Sources are needed when the sample resistance,

either inherently or due to contact resistances, is large. These include the resistivity measurement of silicon wafers or high resistivity film deposits. Large values of the sample resistance make the measurement prone to noise pick-up from the mains and elsewhere. This is one of the most significant problems of high resistance measurement.

In the present unit the problem of pick-up has been reduced to very low levels by having a battery operated source. Since the current requirement is small and the circuit being specially designed for this purpose, the batteries should have a reasonably long life. Further, a transistor circuit has been preferred over an Op-Amp based circuit as it offers a reduction of the battery count and is also simpler. An internal voltage reference of 2.5 volt ensures reliable operation even when the battery voltage falls and a ten turn potentiometer makes the current adjustment very easy. The actual current is read on a 3½ digit LCD display. There are four current ranges which may be selected with the help of a bandswitch on the panel.

Specifications

Open Circuit Voltage 15V (min.)

Current Range 0-2µA, 0-20µA, 0-200µA, 0-2µA

Resolution 100nA at 0-100µA range

Accuracy ± 0.25% of the reading ± 1 digit

Display 3½ digit, 7 segment LCD with autopolarity and decimal indication

Load Regulation 0.05% for 0 to full load

Power 9V batteries

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