

## Measurement of Magnetoresistance of Semiconductors

### Introduction

It is noticed that the resistance of the sample changes when the magnetic field is turned on. The phenomenon, called magnetoresistance, is due to the fact that the drift velocity of all carriers is not same. With the magnetic field on; the Hall voltage  $V$  is given as:

$$V = Eyt = |v \times H|$$



which compensates exactly the Lorentz force for carriers with the average velocity; slower carriers will be over compensated and faster one undercompensated, resulting in trajectories that are not along the applied field. This results in an effective decrease of the mean free path and hence an increase in resistivity.

Here the above referred symbols are defines as:  $v$  = drift velocity;  $E$  = applied electric field;  $t$  = thickness of the crystal;  $H$  = Magnetic field

### Description of the experimental setup

The set-up consists of the following:

- Four probe arrangement
- Sample: (Ge: p-type)
- Magnetoresistance set-up, Model: DMR-11
- Electromagnet, Model : EMU-50V
- Constant Current Power Supply, Model : DPS-50
- Digital Gaussmeter, Model DGM-102



### Four Probe arrangement

It consists of 4 collinear, equally spaced (2mm) and individually spring loaded probes mounted on a PCB strip. Two outer probes for supplying the constant current to the sample and two inner probes for measuring the voltage developed across these probes. This eliminate the error due to contact resistance which is particularly serious in semiconductors. A platform is also provided for placing the sample and mounting the Four Probes on it.

### Sample

Ge Crystal (n-type) dimensions : 10 x 10 x 0.5 mm.

### Magnetoresistance Set-up, Model DMR-11

This unit consists of a digital millivoltmeter and constant current power supply. The voltage and probe current can be read on the same digital panel meter through a selector switch.

**(a) Digital Millivoltmeter**

Intersil 3½ digit single chip ICL 7107 been used. Since the use of internal reference causes the degradation in performance internal heating an external reference been used. Digital voltmeter is much convenient to use, because the input voltage of either polarity can be measured.

**Specifications**

Range: 0-200mV (100mV minimum)

Accuracy:  $\pm 0.1\%$  of reading  $\pm 1$  digit

**(b) Constant Current Power Supply**

This power supply, specially designed for Hall Probe, provides 100% protection against crystal burn-out due to excessive current. The supply is a highly regulated and practically ripple free dc source.

**Specifications**

Current: 0-20mA Resolution : 10mA

Accuracy:  $\pm 0.2\%$  of the reading  $\pm 1$  digit

Load regulated: 0.03% for 0 to full load

Line regulation: 0.05% for 10% variation

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