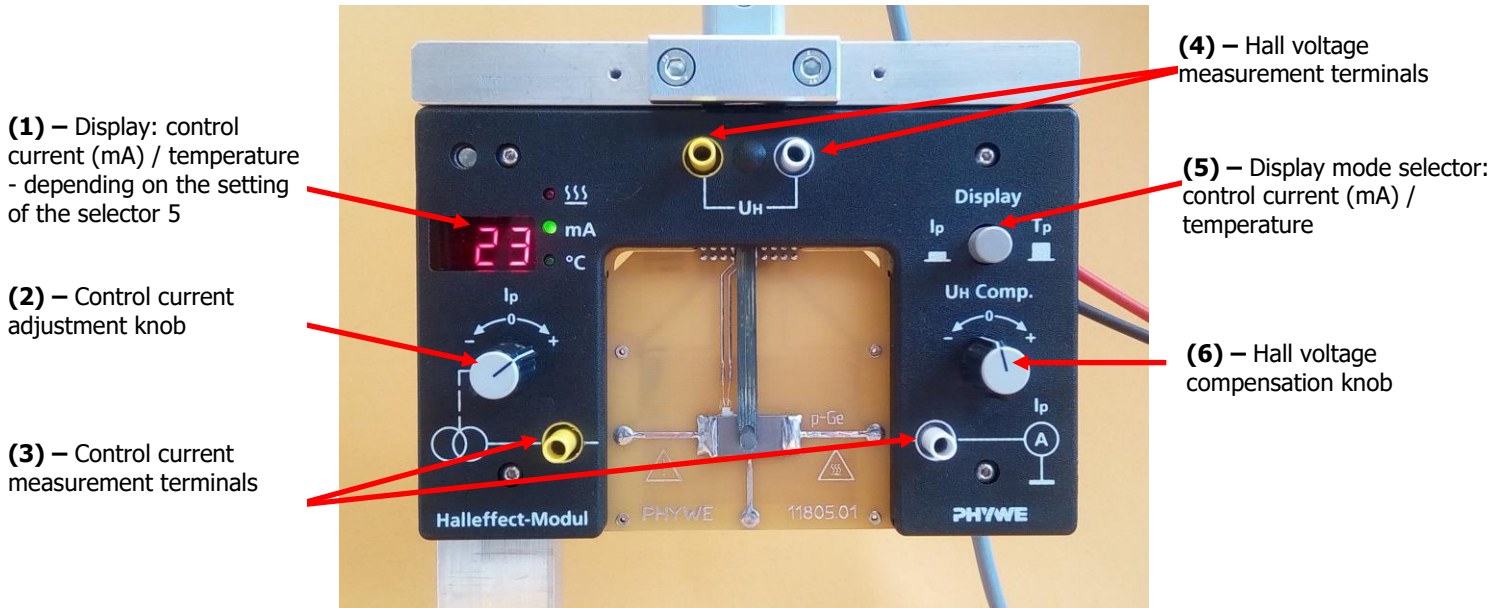


30 – HALL EFFECT IN SEMICONDUCTORS



MEASUREMENT MODULE

Experimental procedure

1. Connect the setup according to the description below. Please compare the diagram in the manual to the experiment.
The power supply of the coils creating the magnetic field: connect wires to + (red) and - (blue) terminals labeled as „ZASILANIE CEWEK DC” and marked „0...12V- / 0...2A” on the Phywe power supply and to terminals on the coils (the polarity does not matter).
The power supply of the measurement module: connect wires to black 0 and 12V~ terminals labeled as “ZASILANIE MODUŁU AC” marked „max. 5A” on the Phywe power supply and black terminals on the back panel of the measurement module (the polarity does not matter). **The power buttons of both power supplies are located on their back panels.**
 The millivoltmeter has to be connected to (4) terminals to measure Hall voltage or to (3) terminals to measure the voltage on the sample in the direction of the control current (to measure the sample resistance). **Make sure that the selector (5) is in the sample current measurement mode** (shown in the display (1)).
2. Connect the millivoltmeter to (4) terminals to measure the Hall voltage.
 Once the supervisor has checked all the connections, turn all the devices on, starting from the power supply of the measurement module.
3. Ensure that the teslameter shows magnetic field induction equal to zero (2000 mT range). Otherwise, adjust it with the knob (2). Make sure the teslameter shows 0 mT.
4. Use the knob (2) to set the control current flow (I_c) on 30 mA. Measure the Hall voltage (U_H) against the magnetic field induction (B) (changed by the adjustment of **the coil current**)—the measurement range -320 to +320 mT with an increment of 40 mT. To change the direction of the field, change the polarity of terminals. The tutor will define the number and conditions of measurement series (for various current values).
5. Set the induction on 250 mT. Measure the Hall voltage against **the control current** in the range from -30 to +30 mA with step 5 mA. The control current can be changed with the knob (2). The tutor will define the number and conditions of the measurement series (for various induction values).
6. Disconnect the wires powering the coil to make sure that the magnetic field is off. Connect the millivoltmeter to (3) terminals to measure the voltage in accordance with the control current flow.
7. Measure the sample voltage against the current flowing through the sample in the range from 5 to 30 mA with the step 5 mA. The control current can be changed with the knob (2).
8. Based on the measurements done in points 4 and 5, draw the $(U_H \cdot T_h)$ vs. $(B \cdot I_c)$ using the least-squares method (t is the sample thickness – please see below), find the Hall constant R_H and its uncertainty, taking into consideration the uncertainty type A and B. Is the χ^2 test confirming the dependence?
9. Based on the measurements done in point 7, using the least-squares method, find the sample resistance and its uncertainty, considering the uncertainty type A and B. Is the χ^2 test confirming the dependence?
10. Find the remaining microscopic parameters of the semiconductor sample according to the description given in the exercise manual.

CAUTION: MULTIMETER ACCURACY: RD700: $c_1 = 0,5\%$; $c_2 = 0,1\%$ (for all the DC voltages)

Sample:

Doped Germanium, p-type

Sample dimensions: length (l) 20.0 ± 0.1 mm; width (w) 10.0 ± 0.1 mm; thickness (t) $1.0 \pm 0,1$ mm