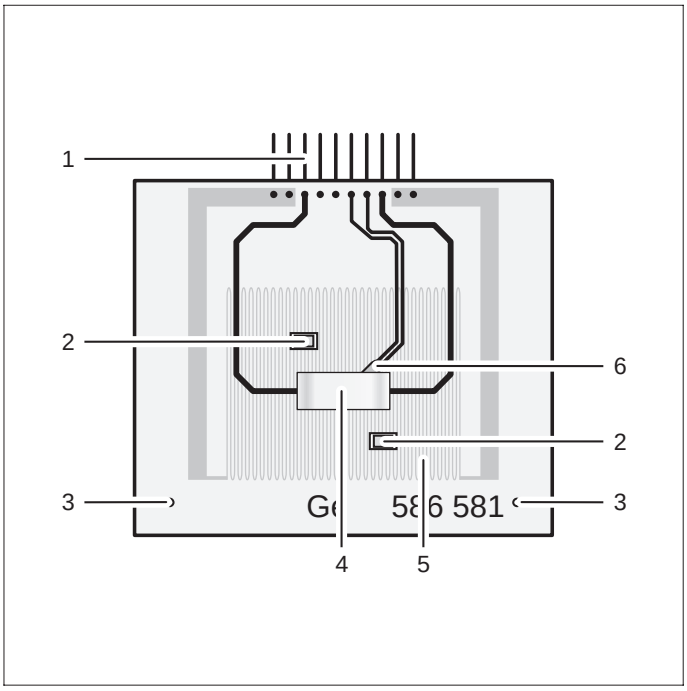
04/99-Pr-



Instruction Sheet 586 851

Ge Undoped on Plug-in Board (586 851)

1 Multi-pin connector
2 Spacers
3 Latch pins
4 Ge crystal, undoped
5 Wave-form heating filament
6 PT100 temperature sensor

1 Description

When used in conjunction with the base unit for Hall effect (586 850), this device enables measurement of the conductivity of undoped germanium as a function of the temperature. The measurement data can then be used to determine the energy interval of germanium.

2 Technical data

Maximum cross-current:	4 mA
Dimensions of crystal:	10 mm × 20 mm × 1 mm
Dimensions of plug-in board including pin connector:	11.5 cm × 11.5 cm × 0.8 cm

Safety notes

The Ge crystal is extremely fragile:

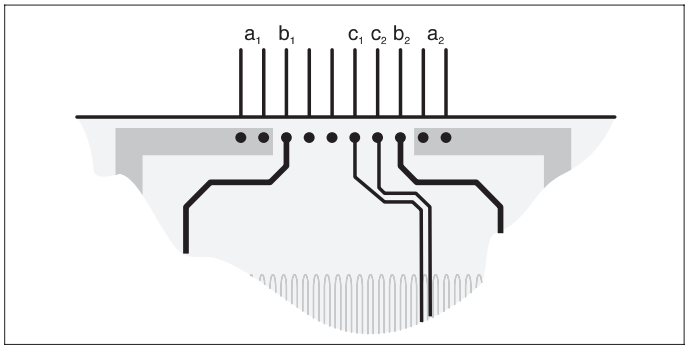
- Handle the plug-in board carefully and do not subject it to mechanical shocks or loads.

Due to its high specific resistance, the Ge crystal warms up even when only the cross-current is applied:

- Do not exceed the maximum cross-current of I = 4 mA.

Turn the control knob for the cross-current on the base unit for Hall effect all the way to the left.

3 Pin assignments



a_1, a_2 Wave-form heating filament
b_1, b_2 Cross-current through Ge crystal
c_1, c_2 PT100 temperature sensor

4 Operation

additionally required:

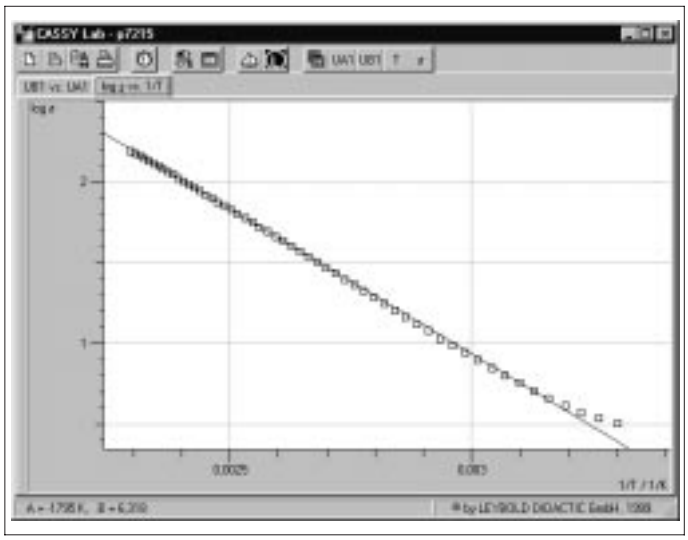
1 Base unit for Hall effect 586 850

Measuring instruments and power supplies as described in the Instruction Sheet of the base unit for Hall effect.

Mount the plug-in board in the base unit for Hall effect and electrically connect all apparatus as described in the Instruction Sheet of the base unit for Hall effect.

5 Experiment example

Measuring the conductivity as a function of the temperature using CASSY-S:



Measurement quantities:

UA1: Voltage at temperature sensor

UB1: Voltage drop across Ge crystal at 2 mA cross-current

Derived quantities:

Conductivity:: $\sigma = \frac{2\text{mA}}{\text{UB1}} \cdot \frac{20\text{mm}}{10\text{mm} \times 1\text{mm}}$

Temperature: $T = 100\text{K} \cdot \frac{\text{UA1}}{\text{V}} + 273{,}15\text{K}$

Display : $\ln\sigma = f\left(\frac{1}{T}\right)$

because at higher temperatures (intrinsic conductivity) we can say:

$$\ln\sigma = \ln\sigma_0 - \frac{E_g}{2 \cdot k} \cdot \frac{1}{T}$$

$E_g = 0{,}67\,\text{eV}$: Band spacing of Ge

$k = 8{,}625 \cdot 10^{-5}\,\frac{\text{eV}}{\text{K}}$ Boltzmann constant