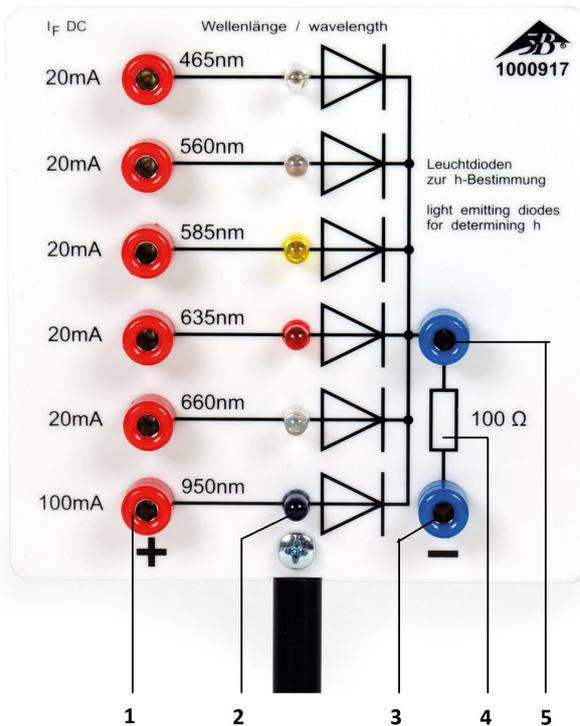


Light emitting diodes for determining Planck's constant (h) 1000917

Instruction sheet

09/15 SP



- 1 Sockets for LED's (anode)
- 2 LEDs, blue to infrared
- 3 Socket for 100 Ω series resistor
- 4 Series resistor on (rear of) circuit board 100 Ω
- 5 Socket for common cathode

1. Safety instructions

- When the diodes are brightly illuminated, avoid looking directly at the radiating surface.
- Do not exceed the maximum current.
- Do not operate the diodes without the series resistor.
- Do not allow any liquid to enter the equipment.

2. Description

The equipment is used to determine Planck's constant h by measuring the diffusion voltage of multicoloured LEDs as a function of wavelength or frequency. It is also possible to determine wavelengths by means of lattice diffraction, as well as the relation between luminous intensity and current. In addition, the equipment can also be used to determine the current/voltage characteristic curves for the LEDs. The circuit board is equipped with six LEDs in the colours blue, green, yellow, and three different wavelengths of red. The cathodes are all connected to a common rail. The resistor serves as a protection and should always be connected in series when operating the diodes.

3. Technical data

| | |
|------------------------------|--|
| Operating voltage: | 6 V DC |
| Maximum permissible current: | 20 mA, LED (infra-red) 100 mA |
| Diodes: | 6 LEDs (blue, green, yellow, and 3 different wavelengths of red) |
| Series resistor: | 100 Ohm, 1 W |
| Connections: | 4-mm safety connectors |
| Dimensions: | 115 mm x 115 mm |
| Weight: | 120 g approx. |

4. Sample experiments

In order to conduct the experiments, the following apparatus is additionally required:

| | |
|----------------------------------|---------|
| 1 DC Power Supply 20 V@230 V | 1003312 |
| or | |
| 1 DC Power Supply 20 V @115 V | 1003311 |
| 1 Analogue Multimeter ESCOLA 100 | 1013527 |
| 1 Stand base | 1001046 |
| Experiment leads | |

4.1 Determining Planck's constant (h)

- Connect the diodes individually via the resistance to the voltage source. Make sure they are forward biased.
- Switch on the power supply unit after setting it to the minimum voltage.
- Gradually increase the voltage.

The diodes light up when the bias voltage U_D (between connections 1 and 4) has been reached.

For a wavelength of 950 nm, the light emission can be observed through the viewfinder of a digital camera.

4.2 Evaluation

- Calculate the frequency values from the wavelengths.

$$f = c/\lambda$$

- Calculate the values for energy.

$$E = e \cdot 10^{-19} \cdot U_D$$

- Based on the energy values in the E/f curve, calculate the gradient of the curve.
- Derive the constant (Planck's constant h) from the gradient.

$$e \cdot U_D = h \cdot f$$

| λ (nm) | Colour | f in 10^{14} Hz $f = c/\lambda$ | U_D in V Measurements | $E = e \cdot U_D$ in $J \cdot 10^{-19}$ ($e = 1.602 \cdot 10^{-19}$ As) |
|----------------|-----------|--|----------------------------|---|
| 465 | Blue | 6.45 | 2.26 | 3.62 |
| 560 | Green | 5.36 | 1.72 | 2.76 |
| 585 | Yellow | 5.12 | 1.67 | 2.67 |
| 635 | Light red | 4.72 | 1.51 | 2.419 |
| 660 | Dark red | 4.54 | 1.44 | 2.307 |
| 950 | Infra-red | 3.15 | 1.0 | 1.6 |