

## Task

To connect up a simple circuit including a filament lamp and familiarize yourself with how electric voltage is measured.

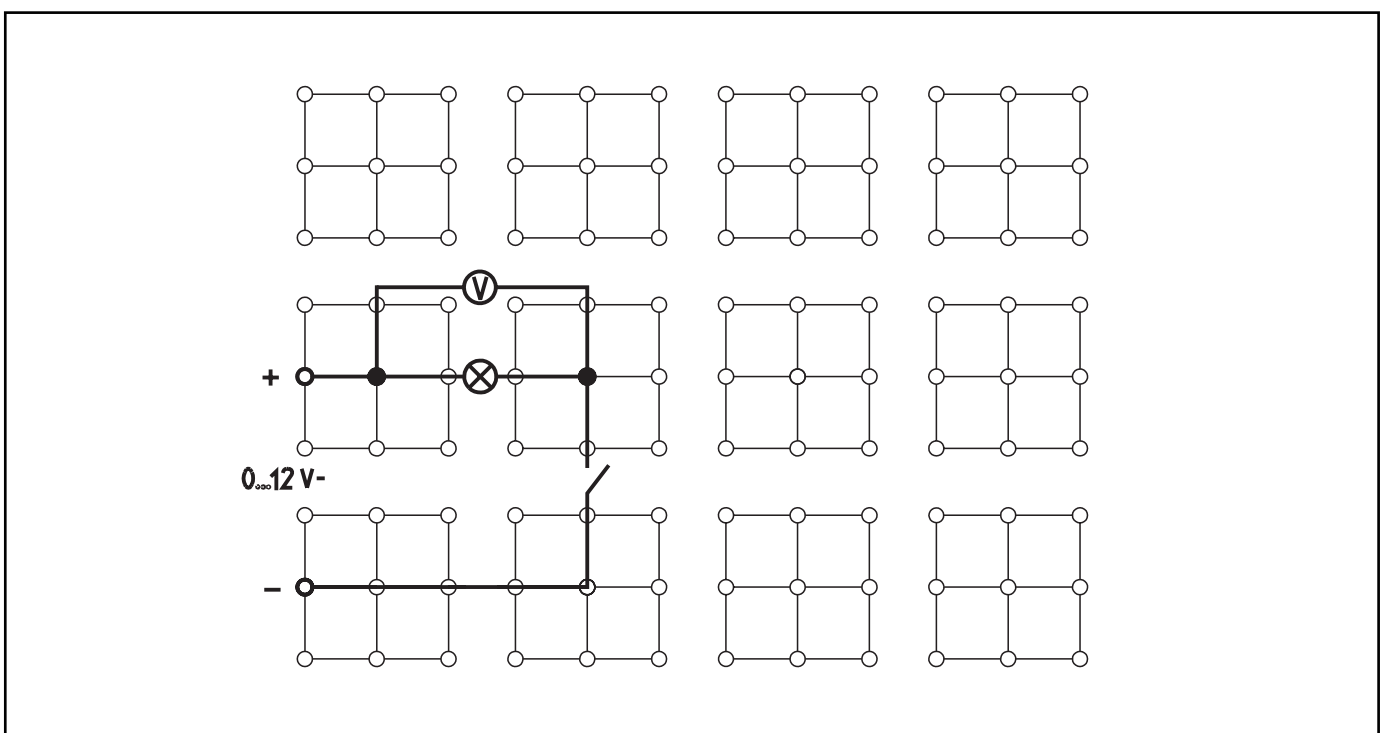
## Equipment

Plug-in board	06033.00	1
On/off switch	39139.00	1
Wire building block	39120.00	1
Lamp holder E10	17049.00	1
Connecting cable, 25 cm, red	07313.01	1
Connecting cable, 25 cm, blue	07313.04	1
Connecting cable, 50 cm, red	07314.01	1
Connecting cable, 50 cm, blue	07314.04	1
Filament lamp, 4V/0.04 A, E10, 1 pc.	06154.03	(1)
Filament lamp, 6V/0.5 A, E10, 1 pc.	35673.03	(1)
Filament lamp, 12V/0.1 A, E10, 1 pc.	07505.03	(1)
Multi-range meter	07028.01	1
Power supply, 0...12 V-, 6 V~, 12 V~	13505.93	1

## Set-Up and Procedure

- Connect up the circuit as shown in Fig. 1; hereby connect the red connecting cable to the socket of the power supply marked +, and the blue cable to the one marked -; use the sockets +V and - of the multi-range meter.
- Screw the lamp whose rated voltage is 4 V in position.
- Set the voltage measuring instrument to measurement range 10 V- (type of voltage: direct voltage; V  $\overline{\text{---}}$ ) and open the switch.
- Set the power supply to 0 V and switch it on.
- Close the switch in the circuit and turn the rotary knob on the power supply to slowly increase the voltage U (shown on the power supply scale) to 4 V; read off the voltage  $U_L$  across the filament lamp and note it in Table 1.
- Note: Use the black scale up to 10!
- Screw out the 4 V lamp and replace it with the lamp rated for 6 V; observe the brightness of the lamp and note it under Observation (1).
- Adjust the power supply voltage U to 6 V; measure voltage  $U_L$  and note this value in Table 1.
- Screw in the lamp rated for 12 V; observe the brightness of the lamp and note it under (1).
- Set the measurement range of the voltmeter to 30 V. Note: Before a measuring instrument is to be used to carry out a measurement, it is always necessary to consider if the measurement range is sufficiently high. When the height of the value to be measured cannot be estimated in advance, always therefore select the highest possible measurement range and then switch progressively down to a smaller, more appropriate one.
- Adjust the power supply voltage U to 12 V; again measure  $U_L$  (read it off from the black scale up to 30) and note the measured value in Table 1.
- Connect the voltmeter parallel to the wire building block; note your observation under (2).
- Remove the wire building block; measure voltage U and observe the lamp; note the measured value and your observation under (3).
- Set the power supply to 0 V and switch it off.

Fig. 1



**Observations and Measurement Results**

Table 1

U/V	$U_L/V$
4	
6	
12	

(1) Brightness of the 6 V lamp at  $U = 4\text{ V}$ :

.....

Brightness of the 12 V lamp at  $U = 6\text{ V}$ :

.....

(2)

.....

(3)

.....

**Evaluation**

1. Which knowledge on how to properly operate electrical appliances can you derive from the observations noted under (1)?

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2. Which knowledge follows from (2)?

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3. A rule on how a voltmeter must be connected can be derived from Fig. 1 and the observations noted under (3). How can this be formulated?

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4. Summarize everything which must be considered when one is to measure voltage.

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(How is electric voltage measured?)

After the students have become acquainted with the term electric voltage and its unit, they should learn how a voltmeter must be connected and what must be taken into consideration when making a measurement. In addition, they should come to understand that an electrical instrument or appliance must be supplied with its rated voltage for proper operation.

## Notes on Set-Up and Procedure

Before the students switch the power supply on, the teacher should check that the voltmeter is correctly connected and adjusted, and should also ensure that the red and blue cables are connected to + and - respectively, according to convention.

## Observations and Measurement Results

Table 1

U/V	$U_L/V$
4	3.8
6	5.5
12	11.9

- (1) Brightness of the 6 V lamp at  $U = 4$  V: weak  
Brightness of the 12 V lamp at  $U = 6$  V: weak
- (2) The measuring instrument indicates 0 V.
- (3) The measuring instrument indicates 12 V, but the lamp does not light up.

## Evaluation

1. When electrical appliances are to operate properly, they must be connected to the voltage intended for them, their rated voltage.
2. No voltage can be measured across connecting cables.
3. A voltmeter must **not** be connected **in** a circuit. It must be connected **parallel** to the appliance at which the voltage is to be measured.
4. When measuring voltage, the following must be taken into consideration:
  - The voltmeter must be connected in parallel,
  - its connections must be correctly selected, with correct polarity,
  - the actual type of voltage is to be set with the selection of the measurement range, and
  - the correct measurement range must be selected (if appropriate, first select a high measurement range, then switch down to a smaller, more suitable one, with which the swing is large, but not too large).

## Remarks

The term operating voltage can also be introduced here. The students can then use this term in their answer to the first question in the Evaluation (the operating voltage must be equal to the rated voltage).

When working with the multi-range meter, the students must be repeatedly helped to determine the measured value with the help of the scale value read, the measurement range and the scale end value. Measured value = (scale value read · measurement range/scale end value).

**T****EEP  
1.2****Measuring voltage**

(How is electric voltage measured?)

Room for notes