What properties of a diode are apparent from its characteristic curve?

EEP 12.3 **S**

Problem

Determine the intensity of a current flowing through a silicone diode as a function of the voltage at the diode.

Equipment

Plug-in board	06033.00	1
On/off switch	39139.00	1
Resistor, 100 Ω	39104.63	1
Potentiometer, 250 Ω	39109.05	1
Silicone diode 1N4007	39106.02	1
Connecting cables, 25 cm, red	07360.01	2
Connecting cables, 25 cm, blue	07360.04	2
Connecting cables, 50 cm, red	07361.01	1
Connecting cables, 50 cm, blue	07361.04	1
Multi-range meter	07028.01	2
Power supply, 0...12 V-, 6 V~, 12 V~	13505.93	1

Set-Up and Procedure

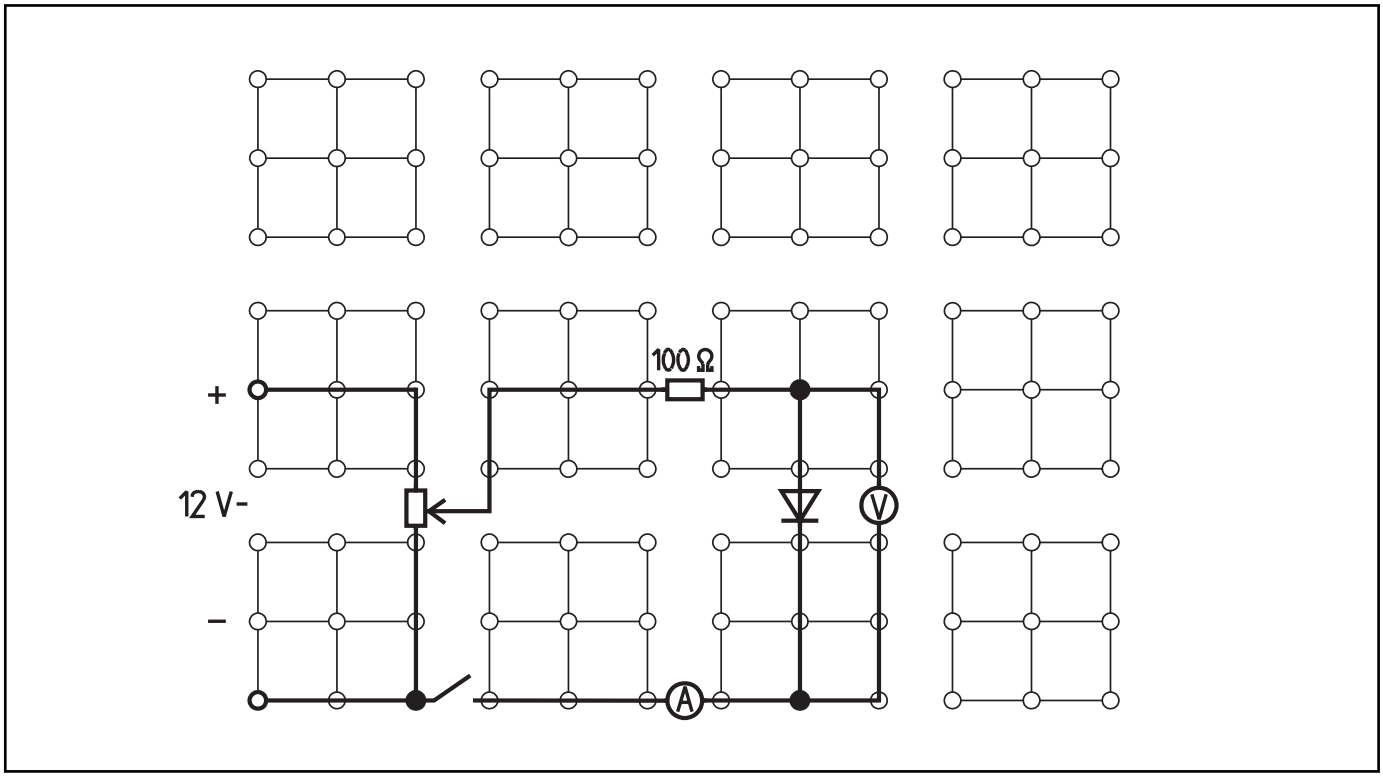
— Set up experiment as shown in Fig. 1. The on/off switch should be off. Plug in the diode in the forward direction. Select measurement range of 1 V- and 30 mA-.
— Set dial on potentiometer to 0, switch on power supply unit, and set direct voltage to 12 V.
— Turn switch on.
— Increase direct voltage from 0 V to 0.7 V in the increments listed in Table 1, measure current for each increment, and enter measurements in Table 1.
— Set measurement range to 300 mA- and increase voltage to more than 0.7 V. Note measurements.
— Finally, set voltage back to 0 V, select measurement range of 3 V-, switch circuit with diode off, and turn diode 180°.
— Switch circuit on, determine current (reverse current) for 1 V and 2 V, and note measurements in Table 1 (values for voltage are negative).
— Switch power supply unit off.

Measurement Results

Table 1

U_D/V	I_D/mA
0.00	
0.20	
0.40	
0.60	
0.65	
0.70	
0.75	
0.77	
-1.00	
-2.00	

Fig. 1

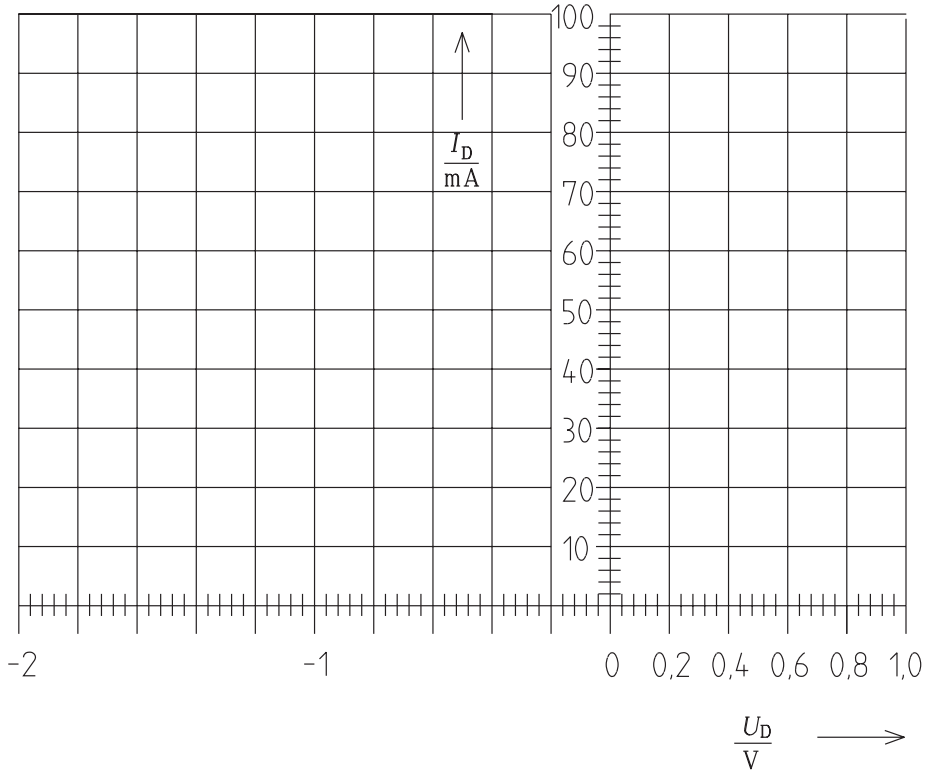


Evaluation

1. Draw a graph in Fig. 2 based on the measurements in Table 1.
   This graph is the characteristic curve of the silicone diode.
2. Why are graphs like the one in Fig. 2 referred to as characteristic curves?
   List the properties of diodes apparent from the characteristic curve.

3. Why is there a 100 Ω resistor in the circuit?

Fig. 2



(What properties of a diode are apparent from ist characteristic curve?)

Characteristic curves provide professionals with information on how electrical components function. Each electrical component has its own characteristic curve.
This experiment should demonstrate this fact to students. Furthermore, they should record and evaluate the characteristic curve of a silicone diode themselves.

Notes on Set-Up and Procedure
The measurement range of 300 mA- is too large to determine the values for forward current at voltages of up to about 0.65 V. Therefore, it is recommended that a measurement range of 30 mA- be selected initially. The students will have to switch to the higher range while taking measurements.
Instead of reversing the polarity of the operating voltage and of both meters to measure the reverse current, the procedure calls for the students to turn the diode 180°. Make sure the students see the difference so they understand why the voltage values in the lower part of Table 1 are negative.

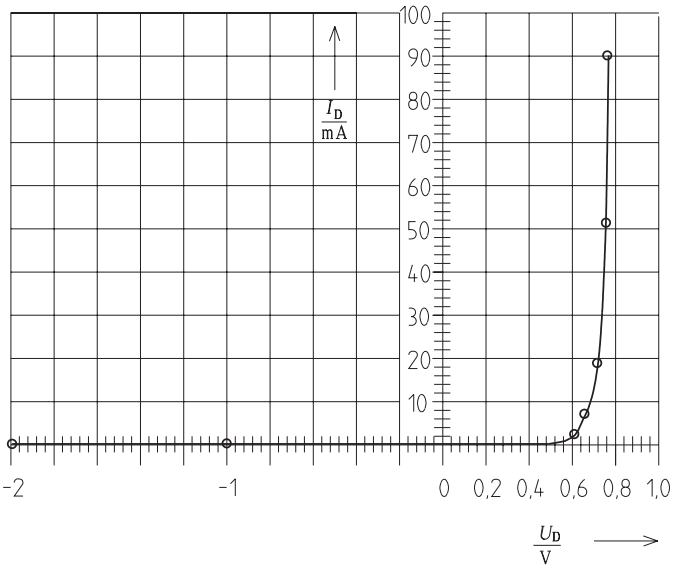
Measurement Results
Table 1

U_D/V	I_D/mA
0.00	0
0.20	0
0.40	0
0.60	2
0.65	6
0.70	19
0.75	51
0.77	90
-1.00	0
-2.00	0

Evaluation
1. See Fig. 2.
2. The graph is called a characteristic curve because it shows the characteristic behavior of the diode at various voltages.
   The characteristic curve in Fig. 2 shows that:
   — no current flows through the diode in reverse direction.
   — (almost) no current flows in forward direction up to a voltage of almost 0.6 V.
   — the forward current increases gradually at first and then rapidly in the range 0.65...0.77 V.
3. The resistor is included in the circuit to limit the diode current (forward current), thereby protecting the diode from damage.

Notes
Silicone diodes conduct electricity at a voltage of approx. 0.7 V. This voltage is called threshold voltage. It is necessary to compensate for the diffusion voltage formed in the barrier layer between the p-conducting and the n-conducting silicone due to the diffusion of electron in the p-conducting area and electron holes in the n-conducting area.
The reverse current of the silicone diode used in this experiment is so minimal that normal meters can not register it. Therefore, it is not necessary to try and measure the current in the measurement range of 50 μA. If you try doing this for the type of circuit selected specifically for the forward direction (i.e. circuit for measuring the correct voltage) in spite of this, then the current meter would basically just display the current flowing through the voltmeter.

Fig. 2



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Room for notes