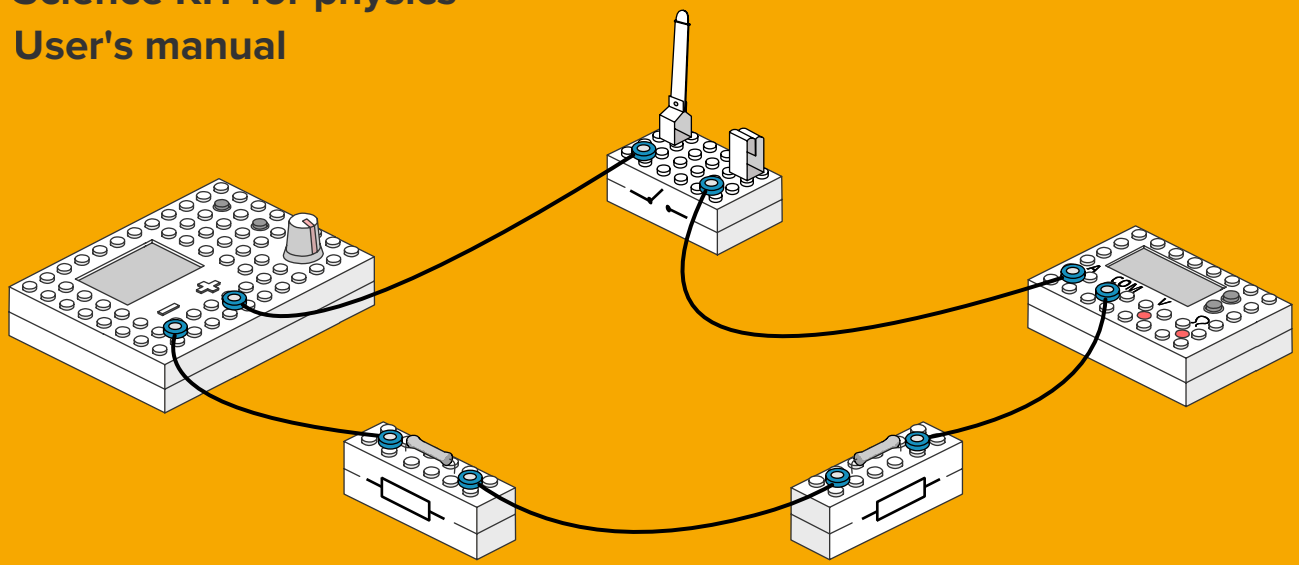
EdPro

#physics #education #experiments #electricity

AMPERIA

Science KIT for physics
User's manual



CONTENT

1. General information **2**
2. Safety instructions **3**
3. Component parts **5**
4. Technical characteristics of elements **7**

Power supply unit 7
Multimeter 8
Non-ideal source 9
Single pole switch 9
Incandescent lamp 10
Fixed-value resistors 10
Direct current motor 10
Capacitors 10
Inductors 10
Light emitting diode 11
Diode 11
Transistors 11
Photoresistor 12
Stabilitron 12
Thermistor 12
Transformers 12
Substrate 12
Set of connecting wires 12
Speaker 13
DC microammeter 13
Coil 13
Electromagnet 13
Slide rheostat 13
High-impedance conductors 13
Magnets 14
Dip-needle (compass) 14
Magnetic shavings 14
Electrochemical cell 14
Charger 14

5. Power supply unit **15**

General information 15
Setting-up procedures 16
DC and AC modes 16
Settings and configuration 18
Working with the device in the network 20
Resolution of common problems 24

6. Multimeter **25**

General information 25
Setting-up procedures 26
Choosing values for measurement 26
Working with external sensors 27
Settings and configuration 28
Working with the device in the network 28
Resolution of common problems 30

7. Warranty **31**

GENERAL INFORMATION

A kit for laboratory classes at school and demonstrations with regard to section «Electricity and Magnetism» in physics classrooms of educational institutions.
This kit allows one to hold the following laboratory classes and perform the following demonstrations:

- Assembling an electrical circuit and measuring the current at different points thereof.
- Determination of electromotive force (EMF) and internal resistance of a current source.
- Measurement of voltage at different sections of the electrical circuit.
- Determination of function and power of the electric current.
- Assembling and testing an electromagnet.
- Study of a direct current motor.
- Determination of electricity consumption using an ammeter, a voltmeter, and a clock.
- Determination of the resistivity of a conductor.
- Observation of the influence of a magnetic field on a current-carrying conductor.
- The study of a series connection of conductors.
- The study of a parallel connection of conductors.
- Regulation of current and voltage in circuits.
- Study of the dependence of electrical resistance on the length of a conductor and its cross-sectional area.
- Determination of the dependence of the resistance of a semiconductor photoresistor and a photodiode on the amount of light.
- Determination of transistor parameters.
- Determination of the resistance of a capacitor in an AC circuit.
- Determination of the energy of a charged capacitor.
- Determination of the inductance of a coil in an AC circuit..
- The study of electric circuits with inductive, capacitive and active elements and determination of the parameters of these elements.
- Determination of the number of turns in transformer windings.
- The study of an electrical circuit with a semiconductor diode.
- Measurement of volt-ampere characteristics of a semiconductor diode.
- The study of an electrical circuit with a semiconductor diode.
- Extension of ammeter measurement range.
- Extension of voltmeter measurement range.
- Study of resonance in an electrical oscillatory circuit.
- Study of Ohm's law for an AC circuit.
- And others. *

** You can see the **full list of laboratory classes** at the following link https://amperia.education*

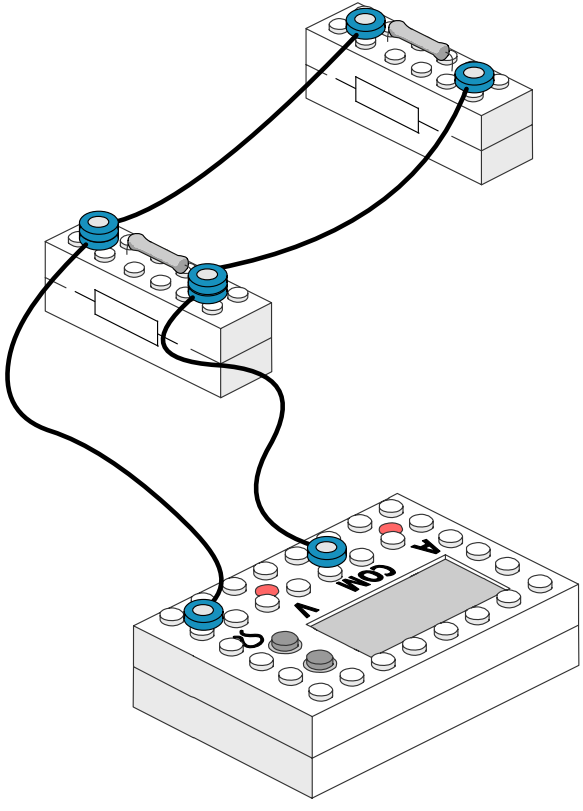
2. SAFETY INSTRUCTIONS

Please read the following safety rules before you begin. There are a number of important things you need to know.

- There are a number of important things you need to know. Amperia elements must be charged exclusively by adults!
  Improper conduct of an experiment may result in participants getting injured or in damage to equipment. All experiments must be performed under adult supervision only.
- Before you start working with Amperia, you need to carefully read the relevant theoretical information and the procedure for conducting the relevant experiment. Some experiments may have additional safety precautions.
- When conducting experiments with chemical reagents and electrochemical cells, it is necessary to use additional protective equipment, namely goggles, gloves, etc.
- It is strictly forbidden to eat or drink close to experimental equipment and during experiments.
- Under certain conditions, a spark may occur between contacts. Do not conduct experiments close to highly flammable materials.
- If there is a suspicion of overheating of components, in particular when you smell burnt plastic or fused insulation, turn off the power immediately.
  At the same time, it is strongly recommended that you do not touch suspicious components with your fingers or other parts of the body, since this can cause burns.
- Never leave kit components unattended when they are connected to the power supply. Before leaving the place where an experiment is conducted, disconnect magnetic contacts, turn off power supply and multimeters.
- Connect power supply at the last stage of circuit assembly, after the other connections have been checked.
- Do not use additional power supplies. This increases the risk of equipment failure and, accordingly, the risk of participants getting injured as a result of the overheating of components.
- The current source can generate alternating current with frequencies up to 2 MHz. Such frequencies may cause interference with medical equipment and special equipment.
  Avoid using the kit near medical facilities. If you have a pacemaker, talk to your doctor about whether you can conduct experiments with alternating current.

2. SAFETY INSTRUCTIONS

- The power supply and multimeter are powered by lithium batteries. Mechanical damage to such batteries can cause self-ignition. It is **FORBIDDEN** to disassemble these devices on your own!
- Protect kit components from water and do not place them in places with increased humidity. Make sure the air in the room is dry. Normal operating humidity is 10-90% of relative humidity.
- Do not place kit elements close to radiators or heaters. The operating temperature of the kit is 10-35°C. Storage temperature is -20-45°C. Do not use the kit at extremely high or low temperatures.
- The kit contains small parts that can cause suffocation. Keep the kit out of the reach of small children.



Housings of the kit elements are non-assembled.
Damage to the housing of the elements may void the warranty.

3.COMPONENT PARTS

ATTENTION. The manufacturer reserves the right to make design changes that do not lead to deterioration of the declared characteristics of the product, at any time and without prior notice.

EdPro Amperia kit includes the following components:

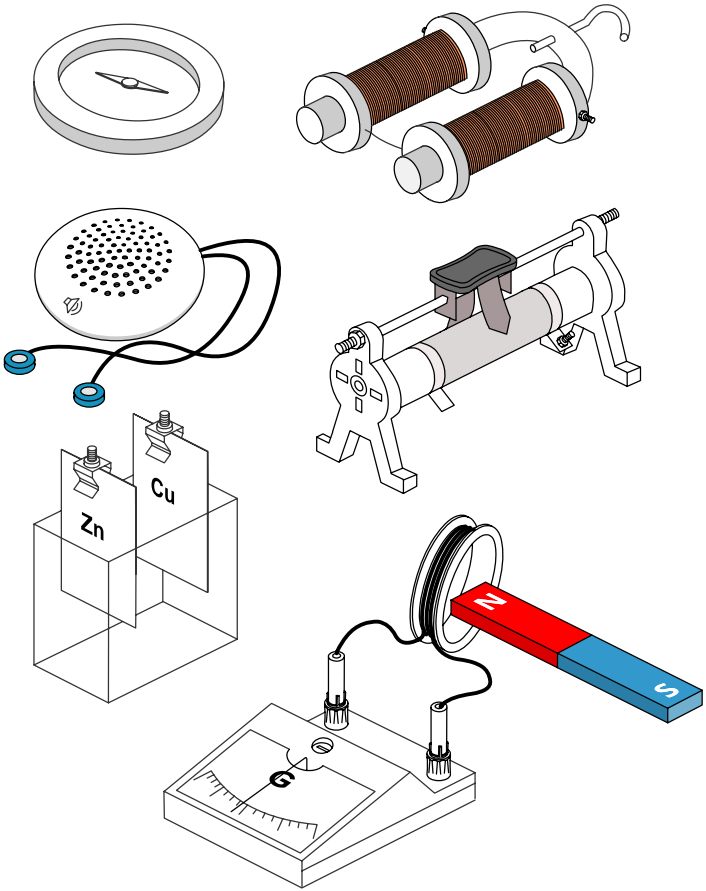
Nº *	name	size	quantity
1	EdPro Amperia power supply unit	6x8	1
2	EdPro Amperia multimeter	6x8	1
3	Non-ideal source	4x6	1
4	Single pole switch	4x6	1
5	6V incandescent lamp	2x6	2
6	Fixed-value resistor, 10 Ohm	2x6	2
7	Fixed-value resistor, 50 Ohm	2x6	2
8	Fixed-value resistor, 100 Ohm	2x6	2
9	Fixed-value resistor, 100 kOhm	2x6	1
10	DC motor	4x6	1
11	Electrolytic capacitor, 10 µF	2x6	2
12	Ceramic capacitor, 100 nF	2x6	1
13	Inductor, 10 mH	2x6	1
14	Inductor, 100 µH	2x6	2
15	Inductor, 56 µH	2x6	1
16	Light-emitting diode	2x6	1
17	Diode	2x6	1
18	PNP transistor	4x6	1
19	NPN transistor	4x6	1
20	Photoresistor, 10 kOhm	2x6	1
21	Zener Diode	2x6	1
22	Thermistor	4x6	1
23	Transformer	4x6	2

** **All the above** elements are made in the form of colored cubes, which are built into the housing with magnetic contacts and can be fixed on the substrate.*

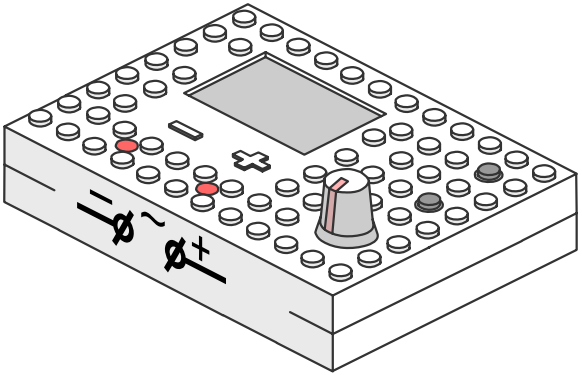
3.COMPONENT PARTS

Additional components of the EdPro Amperia kit:

Nº	name	quantity
24	Substrate	1
25	Set of connecting wires	1
26	Speaker	1
27	DC microammeter	1
28	Coil (Wire frame)	1
29	Electromagnet	1
30	Slide rheostat	1
31	Set of high-impedance conductors	1
32	Magnetic bar	2
33	Horseshoe magnet	1
34	Round magnet	2
35	Dip-needle	1
36	Magnetic shavings	1
37	Electrochemical cell	1
38	Charger	1
39	Spare 6V incandescent lamps	6
40	Instructions	1



4.01 EdPro Amperia power supply unit



EdPro Amperia power supply unit (PSU) is designed to serve as a source of direct and alternating current during laboratory classes and physics experiments in educational institutions.

Its main properties are as follows:

- Current operating mode, voltage, and frequency are displayed on the built-in high-contrast display, which was made with the use of OLED technology.
- The voltage at the PSU terminals can be controlled using the encoder knob.
- In AC mode, in addition to voltage, you can also control the frequency of the current.
- The device displays direct measurements of current through its contacts and voltages at these contacts.
- It is equipped with multi-level overload protection, which prevents the device from failing in the event of a short circuit.
- It provides access to values of current and voltage at its terminals via Wi-Fi.
- It can automatically construct volt-ampere (VAC) and amplitude-frequency characteristics (AFC) of the connected load.
- The device can work in several modes.

For direct current

Maximum voltage: **5 V**
Maximum current: **1 A**
Maximum current with overload: **2.3 A***
Internal resistance at a current of 1 A or less - close to zero.

For alternating current

Maximum voltage: **3 V**
Maximum current: **0.15 A**
Maximum current with overload: **0.3 A***
Frequency range: **10 Hz - 2 MHz** **

Errors

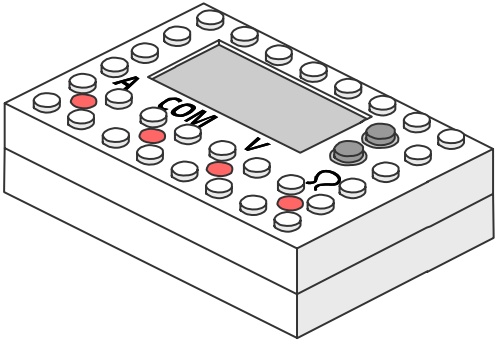
Error when measuring the real direct voltage at the terminals: **2%**
Error when measuring direct current in the circuit: **4%**
Error when measuring the real alternating voltage at the terminals, for frequencies 20 Hz - 200 kHz: **4%**

You can find more information *about the EdPro Amperia power supply unit in section 5.1*

** **Operation in the overload mode is safe.** However, in addition to the accelerated discharge of the battery, in this mode voltage at the terminals of the power supply unit will be lower than the voltage that has been set.*
The power supply unit will display the actual voltage value along with the current in the circuit.

*** **Measured voltage and current readings** at frequencies higher than 50 kHz are inaccurate and can decrease down to zero due to difficulties in measuring voltage in case of high-frequency current.*

4.02 EdPro Amperia multimeter



EdPro Amperia multimeter is designed as a universal measuring device for physics laboratory classes and experiments related to electric current.
Its main properties are as follows:

- Measurements made with the help of the device and its current mode of operation are displayed on the built-in high-contrast display, which was made with the use of OLED technology.
- Measures DC voltage and current.
- Measures AC voltage and current.
- Measures resistance.
- Automatically switches measurement ranges
- Provides access to its measurements via Wi-Fi

- Has protection against excessive currents in the ammeter mode, as well as protection against connection of an external electric current source in the resistance measurement mode.
- Supports the connection of external sensors that work on an open protocol developed by EdPro.

The main operating range

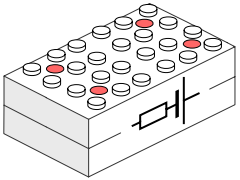
Current: **50 mA - 2A**
Voltage: **100 mV - 12 V**
Resistance: **10 Ohm - 1 MOhm**
Internal resistance in AC modes without loss of accuracy (***): **40 Гц - 5 кГц**
Resistance: **1% ± 0.5 Ohm**
DC voltage measurement error: **1%, ±5 mV**
DC measurement error: **1%, ±5 mA**
AC voltage measurement error: **1%, ±10 mV**
AC measurement error: **5%, ±20 mA**

Maximum allowable range

Current: **2 mA - 5 A**
Voltages: **1 mV - 36 V**
Resistance: **1 Ohm - 2 MOhm**
AC frequency range: **10 Hz - 10 kHz**
Resistance: 4% ± 1 Ohm
DC voltage measurement error: **4%, ±10 мВ**
DC measurement error: **4%, ±10 мА**
AC voltage measurement error: **2%, ±20 мВ**
AC measurement error: **5%, ±30 мА**

*** ***The readings of the measured voltage*** *at frequencies above 50 kHz and the current at frequencies above 10 kHz are inaccurate: they may decrease to zero due to the difficulty of measuring voltage and high-frequency current.*

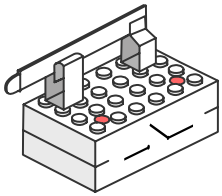
4.03 Non-ideal source



Resistance: **4.6 Ohm**

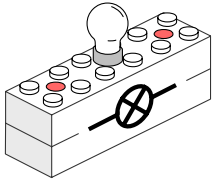
Housing with magnetic contacts, in which the resistor is hidden. Used for the simulation of a non-ideal source.

4.04 Single pole switch



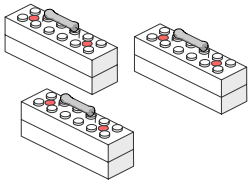
Electric switching device with a movable knife switch.

4.05 Incandescent lamp



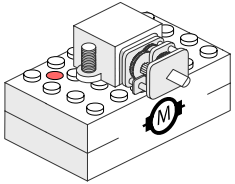
Maximum voltage: **6 V**

4.06, 4.07, 4.08, 4.09 Fixed-value resistors



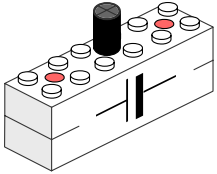
Fixed-value resistors with the following resistances:
10 Ohm, 50 Ohm,
100 Ohm, 100 kOhm.

4.10 Direct current motor



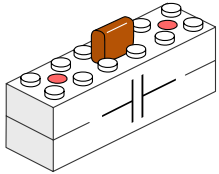
Operating voltage: up to **6 V**
Consumption: up to **120 mA**
Torque: up to **1.5 kg/cm**

4.11 Electrolytic capacitor



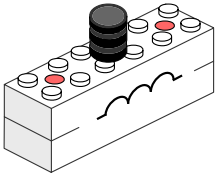
Polarity: non-polar
Capacity: **10 nF**

4.12 Ceramic capacitor

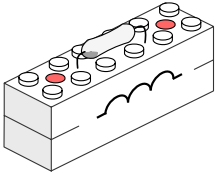


Capacitance: **10 µF**

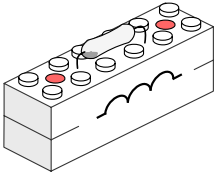
4.13, 4.14, 4.15 Inductors



Inductance: **10 mH**
Active resistance: **15 Ohm**

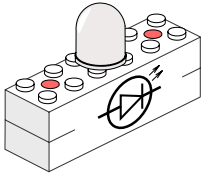


Inductance: **100 µH**
Active resistance:
less than 1 Ohm



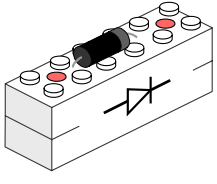
Inductance: **56 μH**
Active resistance:
less than 1 Ohm

4.16 Світлодіод



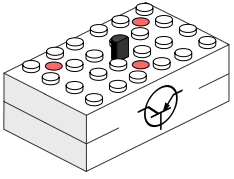
Color: white, **5,500 K**
Maximum brightness: **2 cd**
Typical voltage drop: **2.5 V**
Operating voltage: **3.5 V**
Maximum direct current: **20 mA**

4.17 Випрямний напівпровідниковий діод



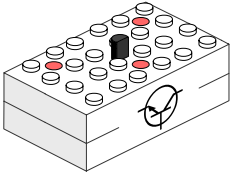
Opening voltage: **1.1 V**
Maximum direct current: **1 A**
Peak reverse voltage: **1,000 V**
Peak reverse current:
less than 50 μA

4.18 PNP transistor



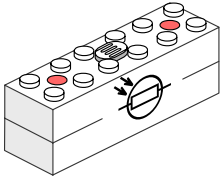
Structure: **p-n-p**
Collector-emitter voltage:
not more than 45 V
Collector-base voltage:
not more than 50 V
Emitter-base voltage:
not more than 5 V
Collector current:
not more than 0.1 A
Dissipated power: **0.5 W**
Maximum frequency: **150 MHz**

4.19 NPN transistor



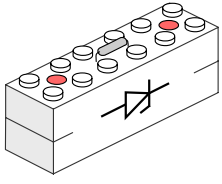
Structure: **n-p-n**
Collector-emitter voltage:
not more than 45 V
Collector-base voltage:
not more than 50 V
Emitter-base voltage:
not more than 6 V
Collector current:
not more than 0.1 A
Dissipated power: **0.5 W**
Maximum frequency: **150 MHz**

4.20 Photoresistor



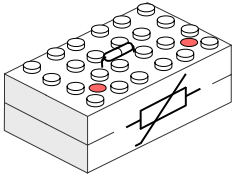
Diameter: **5 mm**
Dark resistance: **0.6 MOhm**
Resistance in daylight:
1-5 kOhm

4.21 Stabilitron



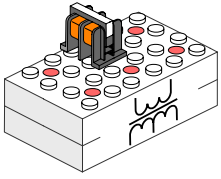
Opening voltage: **0.8 - 0.9 V**
Maximum direct current:
500 mA
Peak reverse current (before breakdown): **100 µA at t = 25°C**
Peak reverse current (after breakdown): **276 mA at t = 25°C**
Permissible short-term jumps up to **1,380 mA**
Breakdown voltage: **3.3 V**

4.22 Thermistor



Resistance at a temperature of 25°C: **4.7 kOhm**
Coefficient B: **3,950**

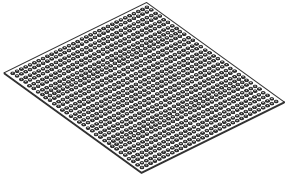
4.23 Transformer



Primary winding: 4**0 turns (copper, 0.2 mm)**
Secondary winding: **60** + **60 turns (copper, 0.2 mm)**, with a tap after the 60th turn

The kit includes 2 transformers with the same parameters. One of them is equipped with a built-in ferrite core, and the other one has no core.

4.24 Substrate

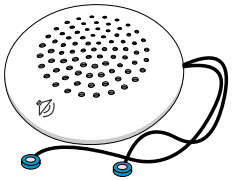


Size: **25 x 25 cm**

4.25 Set of connecting wires

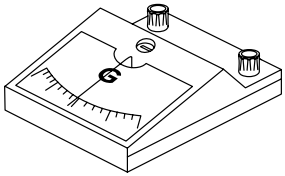
12 pieces of **14 cm-long** wires with magnetic fasteners at the ends.
4 pieces of **20 cm-long** wires and **2** pieces of **40 cm-long** wires with a magnetic fastener on one end and an «alligator» clip on the other end of the wire.

4.26 Speaker



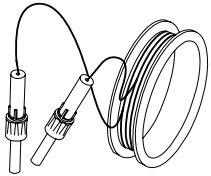
Internal resistance: **7.5 Ohm**
Frequency range:
not less than 60 Hz - 15 kHz

4.27 DC microammeter



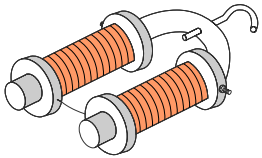
Needle: **central**
Scale: from **-100** microamperes to **+100** microamperes

4.28 Wire frame



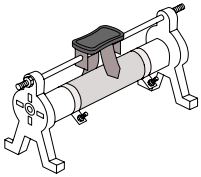
Active resistance: **4 Ohm**
Inductance: **0.8 mH**

4.29 Electromagnet



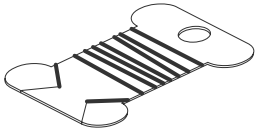
The total resistance of coils: **approximately 3.5 Ohm**
The direct voltage of the electromagnet power supply: **5 V**

4.30 Slide rheostat



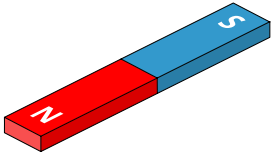
Peak current: **1 A**
Maximum resistance: **50 Ohm**

4.31 High-impedance conductors



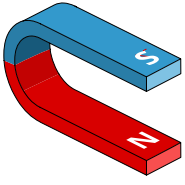
2 m long kanthal conductors with a diameter of **0.1**, **0.2**, and **0.3 mm**
2 m long nichrome conductors with a diameter of **0.1**, **0.2**, and **0.3 mm**

4.32 Magnetic bar



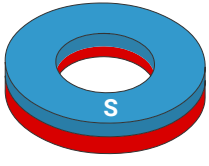
Poles:
northern — **blue**,
southern — **red**

4.33 Horseshoe magnet



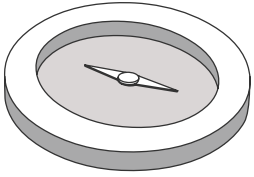
Poles:
northern — **blue**,
southern — **red**

4.34 Round magnet



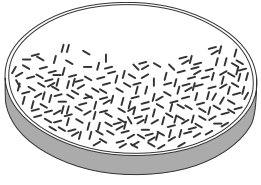
Poles:
northern — **blue**,
southern — **red**

4.35 Dip-needle (compass)



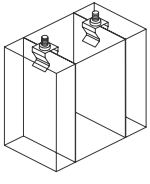
Poles:
northern — **blue**,
southern — **red**

4.36 Magnetic shavings



Magnetic shavings in a transparent plastic case.

4.37 Electrochemical cell



Plastic container. Cover with two holders. Zinc, iron, and copper electrodes.

5.SETTING UP AND USING THE POWER SUPPLY UNIT

5.1 General information

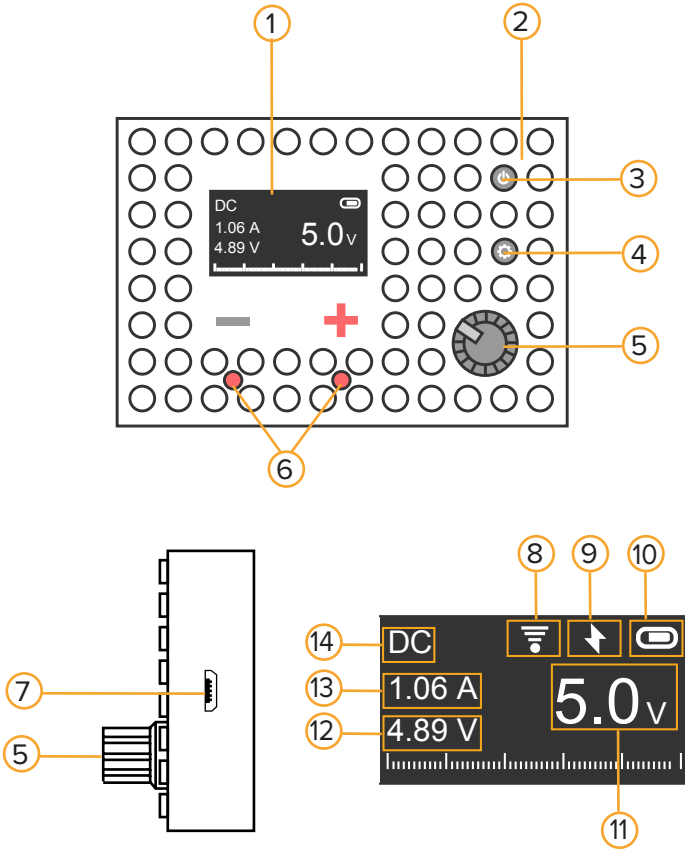


Figure 5.1

The general layout of the power supply unit

1. High-contrast OLED display.
2. Hidden charging LED.
3. Power button.
4. Modes and settings button.
5. Voltage and frequency regulator.
6. Output terminals of the power supply unit.
7. Charging port, micro-USB.

Information on the display

When the device works as a power source, the display shows the settings of this power source.

8. Wi-Fi connection status.
9. The sign that shows that the device is charging - forbidden to use as a power source.
10. Battery charge level.
11. Power supply voltage (EMF).
12. Voltage measured directly at the contacts. (*)
13. Current directly measured through the contacts.
14. Mode indicator: **DC** – direct current, **AC** – alternating current.

* *In the normal mode, it is equal to the EMF within the measurement accuracy, whereas in overload mode, it can be lower.*

5.2 Setting-up procedures

- Before first use, the PSU must be charged.
- The device is switched on with the power button ***(4 in Figure 5.1)***. If you press this button again, the device will turn off.
- To charge the PSU, you must connect it with a micro-USB cable to any high-quality USB-compatible source with an admissible current of **0.5-2 A**. A hidden red light-emitting diode ***(2 in Figure 5.1***) will light during charging. The short-term flashing of this light-emitting diode is normal.
  The charging time of the device is 1-2 hours, with a charger that supports a current of **2 A**.

ATTENTION. Do not use the device as a power source while it is charging!

5.3 DC mode

- After the PSU has been switched on, it is in the DC mode. This is shown on the device with the DC symbol in the upper left corner of the display ***(14 in Figure 5.1)***.
- The voltage is set by rotating the regulator ***(2 in Figure 5.1)***. If no overload occurs, then the device is a voltage source.
- If the current exceeds **1 A**, the device will switch to overload mode. In overload mode, the measured voltage and current ***(12 and 13 in Figure 5.1)*** will flash. After the current has been reduced to 1 A, the device will return to normal mode.
- In overload mode, the voltage at the terminals will be lower than the EMF set by the regulator ***(5 in Figure 5.1)***. In this mode the battery is discharged noticeably faster; in particular, the device may switch off, even though there is still enough charge for operation in normal mode. The overload mode is completely safe for the device.
- At low voltage values in the overload mode, protection can be triggered to prevent the device from failing.

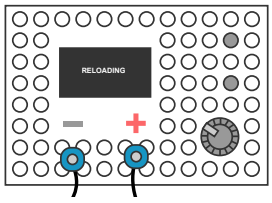


figure 5.2

The protection is activated in response to overheating of the power elements of the device. At the same time, the lower part of the PSU can be heated to 50-60 °C.
In case if the protection is activated the device will display a corresponding message on the screen and will beep ***(figure 5.2)***.

5.4 AC mode

- To switch to AC mode, briefly press the mode button ***(4 in Figure 5.1)***. This mode will be shown on the device with the AC symbol in the upper left corner of the display ***(14 in Figure 5.1)***. If you briefly press the mode button again, the PSU will switch back to DC mode.
- After switching to the AC mode, the regulator ***(4 in Figure 5.1)*** will set the voltage value.

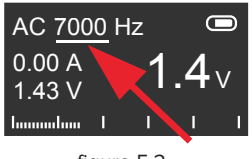


figure 5.3

To regulate frequency, you need to briefly press the regulator. Then its rotation will increase or decrease the frequency at an interval equal to the most significant digit ***(Figure 5.3)***.

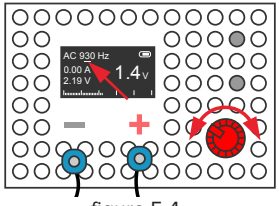


figure 5.4

- If you press and turn the regulator to the right ***(5 in Figure 5.1)***, the PSU will switch to the mode of precise frequency control ***(Figure 5.4)***.
- By turning the regulator ***(5 in Figure 5.1)*** while it is pressed, you can select the number you want to change: after it is released, the regulator will change the selected number. To return to rough editing, you need to press the regulator and turn it to the left.
- If the current exceeds **0.2 A**, the device will switch to overload mode. In overload mode, the measured voltage and current ***(12 and 13 in Figure 5.1)*** will flash.
  After the current has been reduced to **0.2 A**, the device will return to normal mode.
- In overload mode, the voltage at the terminals will be lower than the EMF set by the regulator ***(5 in Figure 5.1)***. In this mode the battery is discharged noticeably faster; in particular, the device may switch off, even though there is still enough charge for operation in normal mode.
  Overload mode is completely safe for the device.

- At low voltage values in the overload mode, protection can be activated to prevent the device from failing. The protection is activated in response to overheating of the power elements of the device. At the same time, the lower part of the PSU can be heated to 50-60 °C. When the protection is activated, the device will display a corresponding message on the screen and will beep ***(figure 5.2)***.

5.5 Setting

- To access the settings menu, press and hold the mode control button ***(4 in Figure 5.1)*** for 3 seconds.

figure 5.5

In the settings mode the options for turning on Wi-Fi, the current network connection status, and the voltage change step are displayed ***(Figure 5.5)***.

- To move around the menu, use the regulator or briefly press the mode control button ***(5 and 4 in Figure 5.1)***. To select a menu item, press the regulator or press and hold the mode control button.

- If Wi-Fi is turned on, the device will try to connect to the network specified in a separate configuration mode.

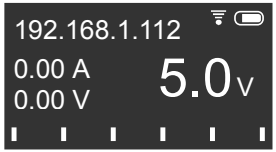


figure 5.6

Immediately after a successful connection to a Wi-Fi network, the device will display the received IP address on the screen ***(Figure 5.6)***.

After the first manipulation of the device – change of voltage or mode, IP address will disappear, but you can always see it in the setting mode

5.6 Configuration

Considering the operating conditions of the PSU, you can change settings related to Wi-Fi access point and device language **only when it is connected to the charger – only during charging**.

- In order to enter the configuration mode, you need to connect the device to the charger, turn it on with the power button ***(3 in Figure 5.1)***, then press the mode control button ***(4 in Figure 5.1)*** and hold it for 3 seconds.

- To move around the menu, use the regulator or briefly press the mode control button. ***(5 and 4 in Figure 5.1)***.

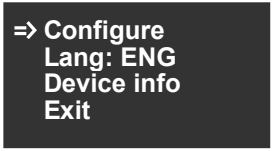


figure 5.7

- To select a menu item, press the regulator or press and hold the mode control button.

Wi-Fi connection settings

When connected to a Wi-Fi network, the PSU must be connected to a charger. ***(For details on the configuration mode, see section 5.6.)***

In the configuration mode, the PSU creates its Wi-Fi access point. You can see its SSID and IP address of the power supply unit by going to the «Settings» section ***(Figure 5.7)***.

To connect the power supply unit to your WI-FI network, follow these steps:

- Find the network generated by the power supply unit ***(Figure 5.8)*** in the list of WI-FI networks on your device *(PC, phone, tablet, etc.)* and connect to it the way you connect to an ordinary WI-FI network.

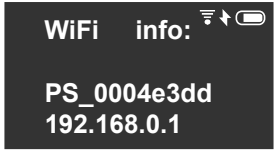


figure 5.8

You do not need to enter a WI-FI password when connecting.

- Open the browser of your device *(PC, phone, tablet, etc.)* and either follow the link http://192.168.0.1 or enter the IP address of the power supply unit in the browser address bar *(by default this is **192.168.0.1**)*.

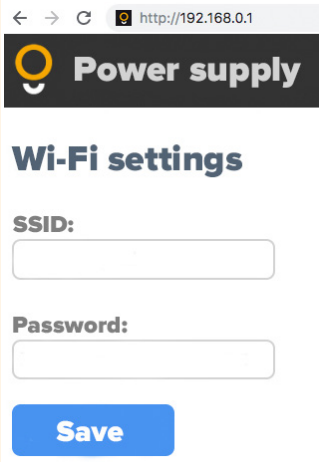


figure 5.9

- In the window that opens, enter the name of YOUR WI-FI network in the «SSID» field, YOUR WI-FI network password in the «Password» field, and click the «Save» button ***(Figure. 5.9)***.
After a successful connection to your WI-FI network, you will see a message asking you to restart the power supply unit.

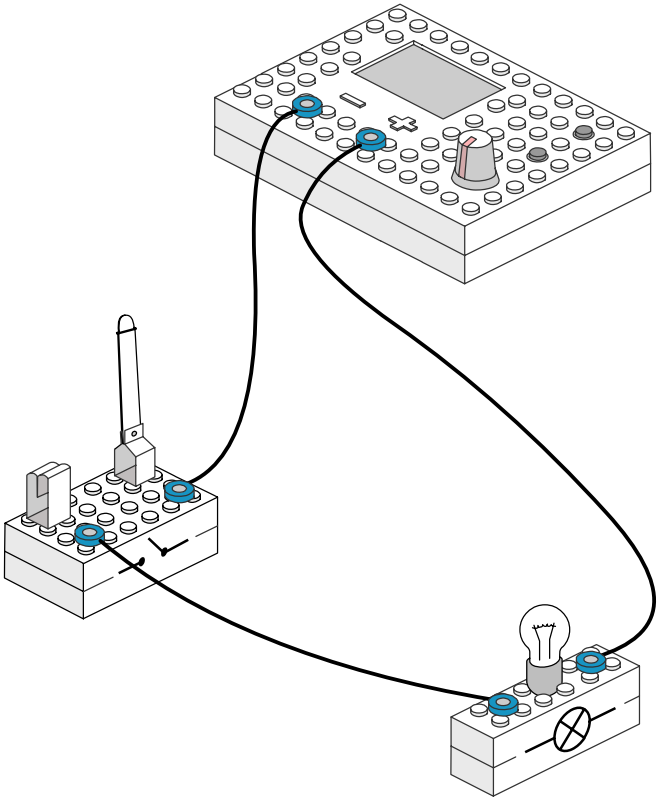
ATTENTION. Only WPA2 networks are supported.

- Disconnect the power supply unit from the charger and restart it. After you do this, the power supply unit will then connect to your WI-FI network and will receive a new IP address. The IP address received by the power supply unit will be displayed on its screen.

5.7 Working with the device on the Internet

- Then the PSU is connected to a Wi-Fi access point, all other devices which are connected to the same access point — computers, tablets, smartphones, etc. - can be used to obtain the results and conduct automated experiments

- You can find out the IP address of the device in the configuration mode, by selecting Wi-Fi info from the menu ***(Figure 5.8)***. The PSU also displays it on the screen after a successful connection ***(Figure 5.6)***.



ATTENTION. Only 1 device can be connected to the power supply unit at a time.

WEB interface

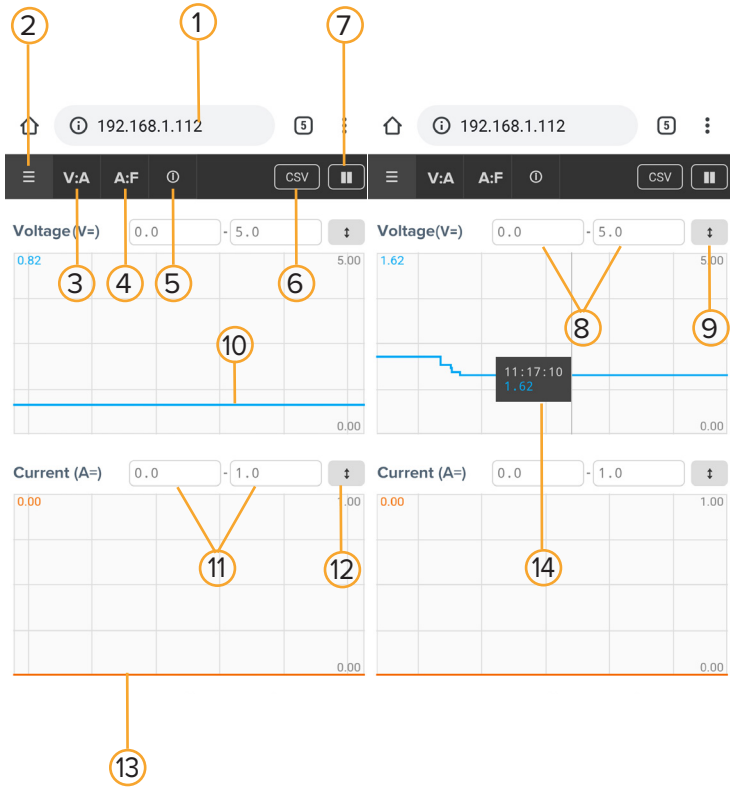


figure 5.10

1. IP address of the device.
2. Refresh button.
3. Volt-ampere characteristics button.
4. Amplitude-frequency characteristics button.
5. Device information.
6. Button for the download of PSU readings in CSV format.
7. Pause button.
8. The range of voltages displayed.
9. Button for the resizing of the graph to the selected **(8)** range..
10. Voltage graph.
11. The range of currents displayed.
12. Button for the resizing of the graph to the selected **(11)** range.
13. Current graph.
14. Voltage value and time of its measurement. *

* ***Appears after you click*** *on it on a computer or touch the screen on a tablet or smartphone. The current can be displayed similarly.*

Volt-Ampere characteristics

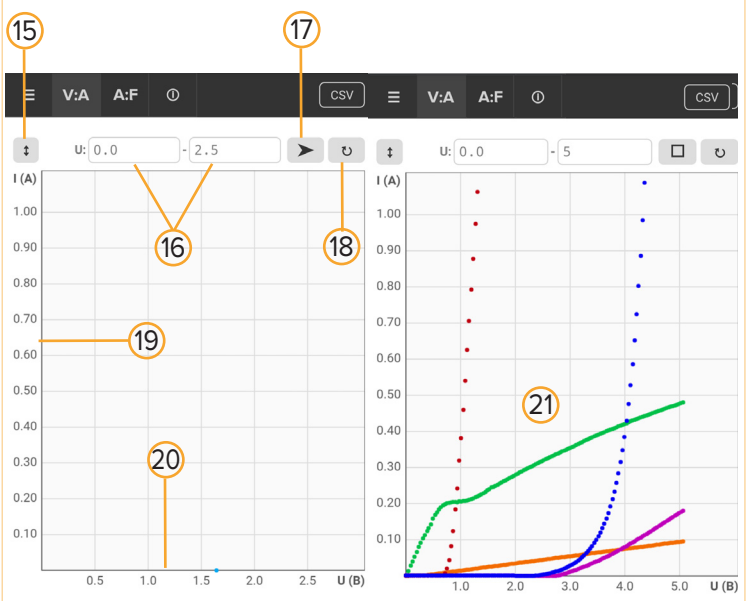


figure 5.11

15. Scaling button.
16. The range of voltage for which the volt-ampere characteristics will be constructed.
17. Button for the start and stop of construction.
18. Refresh button. Clears the screen of previous results.
19. Current axis.
20. Voltage axis.
21. Consistently constructed volt-ampere characteristics.

- Connect to the PSU using its IP address and select VA ***(3 in Figure 5.10)***.
- Connect the load to be tested to the PSU terminals.
- Click the start button ***(17 in Figure 5.11)***.

- After completion of construction or forced stop, you can connect another load and construct its volt-ampere characteristics on the same graph. Characteristics constructed in this way will have a different color.
  In order to clear the graph, press the clear button ***(18 in Figure 5.11)***.

Amplitude-frequency characteristics

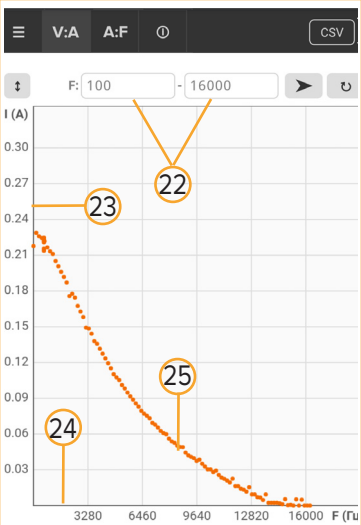


figure 5.12

22. The range of frequencies for which the amplitude-frequency characteristics will be constructed.
23. Current axis, which reflects the value of alternating current.
24. Frequency axis.
25. Amplitude-frequency characteristics.

- Connect to the PSU using its IP address and select AF ***(4 in Figure 5.11)***.
- Connect the load to be tested to the PSU terminals.
- Switch to the AC mode on the PSU and use the regulator to select the voltage for which amplitude-frequency characteristics will be constructed.
- Click the start button. ***(17 in Figure 5.11)***.
- After completion of construction or forced stop ***(17 in Figure 5.11)***, you can connect another load and construct its amplitude-frequency characteristics on the same graph. Characteristics constructed in this way will have a different color.
- To clear the graph, press the clear button ***(18 in Figure 5.11)***.

5.8 Resolution of common problems

The device does not switch on	• Charge the device for 30 minutes and try again.
Voltage is not supplied from the device contacts to the connected devices	• Check whether magnetic contacts of the conductors are connected correctly. They may be shifted or inverted.
The device has switched off after overload and does not switch on	• Connect the device to the power supply for one minute and turn it on again.
The device does not charge	• Check the cable that connects the device to the charger. • Check whether the charger from which the device is charged is working properly.

If the device malfunctions, see the information in the table above. If the problem persists, contact an authorized service center or EdPro manufacturer.
You can find more tips on how to solve problems with the device at: https://amperia.education

6.1 General information

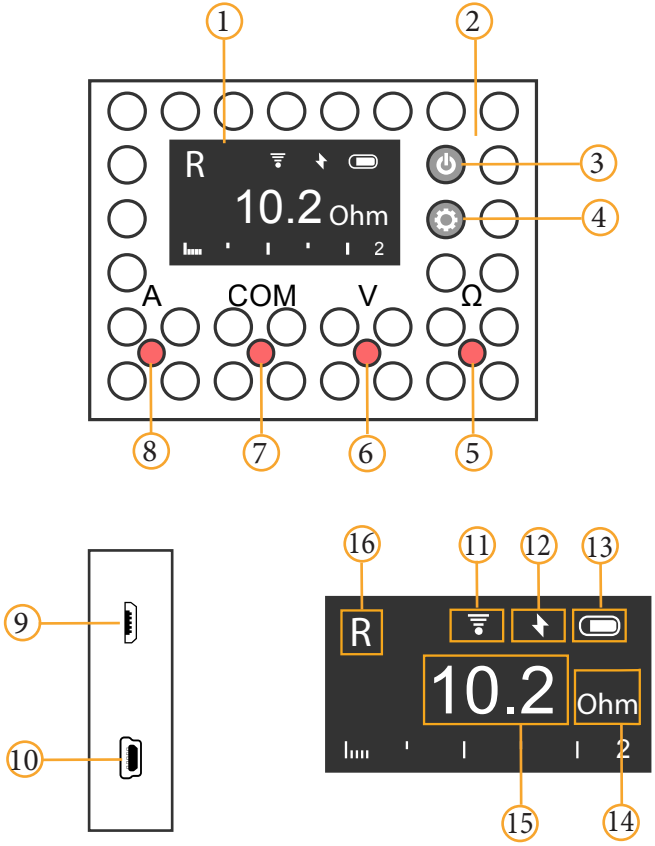


figure 6.1

General layout of the multimeter

1. High-contrast OLED display.
2. Hidden charging LED.
3. Power button.
4. Modes and settings button.
5. Resistance measurement terminal.
6. Voltage measurement terminal.
7. Common terminal for all measurements.
8. Current measurement terminal.
9. Charging port, micro-USB.
10. Port for the connection of external sensors.
    Attention! This is not a mini-USB!

Information on the screen

Operating mode and measurements made with the help of the multimeter are displayed on its display.

11. Wi-Fi connection status.
12. The sign that shows that the device is charging - forbidden to use as a power source.
13. Battery charge level.
14. Unit of measurements.
15. Current multimeter readings.
16. Mode: “**V=**” – DC voltage is being measured, “**A=**” – current is being measured for direct current,

"**V~**" – alternating current voltage is being measured, "**A~**" – current is being measured for alternating current, "**R**" – resistance is being measured.

You can switch between "**V~**" and "**V=**" measurement modes by briefly pressing the settings button ***(4 in Figure 6.1)***. Similarly, you can switch between "**A~**" and "**A=**" modes.

6.2 Setting-up procedures for the multimeter

- The device is switched on with the power button ***(3 in Figure 6.1)***. If you press this button again, the device will turn off.
- In order to charge the PSU, you must connect it with a micro-USB cable to any high-quality USB-compatible source with admissible current of **0.5-2 A**. A hidden red light emitting diode ***(2 in Figure 6.1)*** will light during charging. Short-term flashing of this light emitting diode is a normal process.
  The charging time of the device is about an hour, with a charger that supports a current of **2 A**. The device can become slightly hot during charging.

ATTENTION. While the device is charging, it is forbidden to use it for measurements!

6.3 Choosing values for measurement

- The multimeter automatically determines what is being measured based on terminals of the multimeter which magnetic contacts are connected to. The presence of contacts is determined by the magnetic field, so contacts without magnets will not switch the device to measurement mode.
- In order to start measurement, one magnetic contact shall be connected to the common terminal, and the other one will determine the value that will be measured.

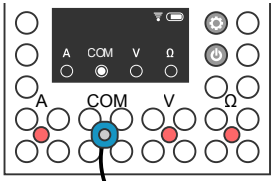


figure 6.2

- A common magnetic contact is connected, the device is waiting for the second one, which will select the measurement mode.

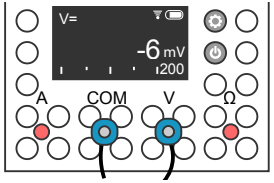


figure 6.3

- Voltage is being measured.

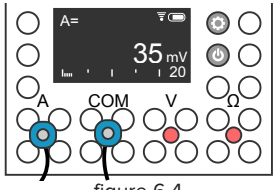


figure 6.4

- Current is being measured.

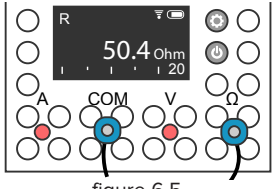


figure 6.5

- Resistance is being measured.

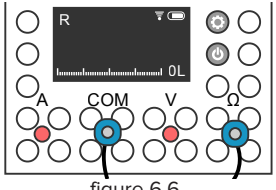


figure 6.6

- The screen in case of a infinite resistance break .

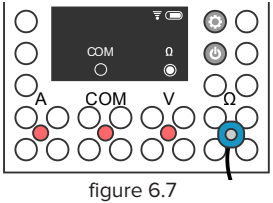


figure 6.7

- If only one terminal is connected, the device will tell you to connect a common terminal as well.

- The current is being measured.
  After the device has been switched on, it will be in the DC measurement mode.
  In order to switch to the AC measurement mode, briefly press the modes and settings button ***(3 in Figure 6.1).***
  If you briefly press this button again, the multimeter will switch back to the DC measurement mode.
- The current mode is displayed in the upper left corner of the screen ***(16 in Figure 6.1)***.

6.4 Working with external sensors

- If a compatible external sensor is connected to the device via a special connector (16 in Figure 6.1), the device will automatically switch to the mode of receiving data from this sensor.

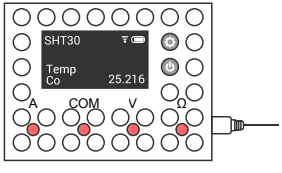


figure 6.8

The sensor tells the multimeter what values it is measuring, its accuracy, sensitivity, possible measurement frequency, etc.

The protocol of operation of the device with sensors is open, its description, reference implementation and instructions can be viewed on the website at: *https://amperia.education*

This allows you to independently develop a variety of sensors using Arduino and similar platforms and to conduct experiments with them in other areas of physics, biology, chemistry, etc.

6.5 Setting up the multimeter

- In order to access the settings menu, press and hold the mode control button ***(3 in Figure 6.1)*** for 3 seconds. In the settings mode you can find the options of turning on Wi-Fi and the current network connection status. The procedure for setting up the multimeter is similar to the procedure for setting up the power supply unit. *(see section 5.5)*

6.6 Configuration

Considering the operating conditions of the PSU, you can change settings related to Wi-Fi access point and device language only when it is connected to the charger - only during charging.

- In order to enter the configuration mode, connect the device to the charger, turn it on with the power button ***(4 in Figure 6.1)***, then press the mode control button ***(3 in Figure 6.1)*** and hold it for 3 seconds.

In other cases, the configuration of the multimeter is similar to the configuration of the power supply unit. ***(see section 5.6)***.

6.7 Working with the device on the Internet

- When the multimeter is connected to a Wi-Fi access point, all other devices which are connected to the same access point — computers, tablets, smartphones, etc. - can be used to obtain the results and conduct automated experiments.
- You can find out the IP address of the device in the configuration mode, by selecting Wi-Fi info from the menu. The device also displays it on the screen after a successful connection.

WEB interface

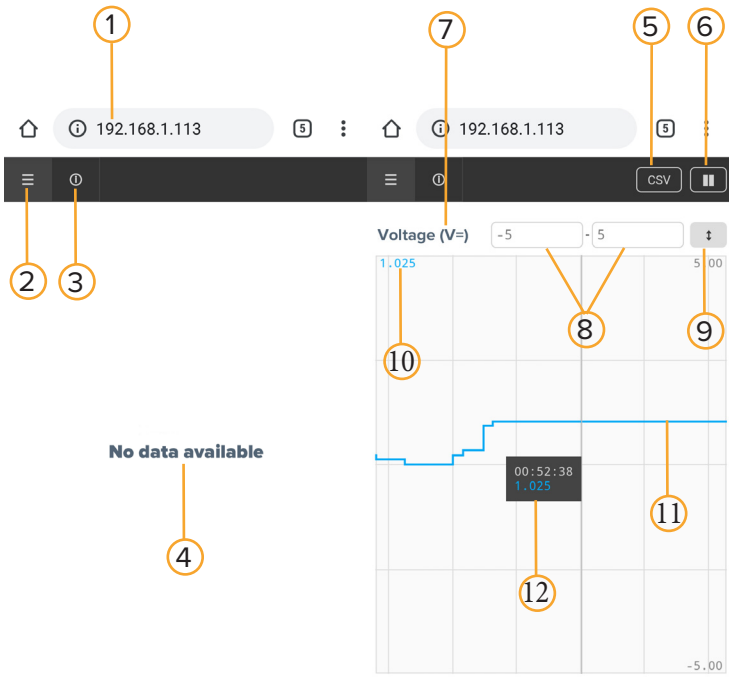


figure 6.9

1. IP address of the multimeter.
2. Refresh button.
3. Device information.
4. The text tells us that the device is not making measurements.
5. Button for the download of multimeter readings in CSV format.
6. Pause button.
7. Value that is being measured and its units of measurement.
8. The range for the graph below.
9. Button for the resizing of the graph to the selected **(8)** range.
10. Current measurement.
11. Graph of changes in the measured value over time **(*)**.
12. Graph of changes in the measured value over time.
    Appears after you click on it on a computer or touch the screen on a tablet or smartphone.

** **For technical reasons**, the time scale is heterogeneous - the graph is for illustration only. For construction, please use data in CSV format.*

6.8 Resolution of common problems

The device does not switch on	• Charge the device for 30 minutes and try again.
I cannot connect to the multimeter from my device's browser	• Check whether the IP address is correct. • Make sure the device and the multimeter are on the same network.
Device does not measure voltage	• Check whether magnetic contacts of the conductors are connected correctly. They may be shifted or inverted
The device does not charge	• Check the cable that connects the device to the charger. • Check whether the charger from which the device is charged is working properly.

If the device malfunctions, see the information in the table above. If the problem persists, contact an authorized service center or EdPro manufacturer.
You can find more tips on how to solve problems with the device at: https://amperia.education

7.WARRANTY CARD

SN of the multimeter _____

SN of the PSU _____

Date of sale _____

SELLER _____

Name of organization _____

Organization's phone number _____

Address and e-mail _____

P.S.

Attention! A blank warranty card is not valid!
The warranty period is 12 months from the date of sale.

NOTES

WARNING

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

?

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

?

Warning: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

?

The devices has been evaluated to meet general RF exposure requirement，?the device can be used in portable exposure condition without estriction

NOTES

NOTES

EdPro

+3 80 (32) 249 20 29

amperia@edpro.ua

https://amperia.educations

edpro.ua