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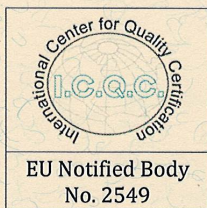


**EARTH RESISTANCE AND SOIL RESISTIVITY METER**

**IS-20 and IS-20/1**

Operation Manual






**International Center for Quality Certification - ICQC Ltd.**  
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## CERTIFICATE OF CONFORMITY


### ATBILSTĪBAS SERTIFIKĀTS

No. 2-158-198/2017

<b>Holder of Certificate:</b> <i>Sertifikāta turētājs:</i>	“RESEARCH AND PRODUCTION COMPANY “RADIO-SERVICE” JSC 268, Pushkinskaya street, Izhevsk, 426000, Russian Federation Web: www.radio-service.ru Phone: +7 3412 439144, fax: +7 3412 439263, e-mail: office@radio-service.ru
<b>Product name, type:</b> <i>Produkta nosaukums, tips:</i>	Earth resistance and soil resistivity meter. Models: IS-20, IS-20/1. <i>Zemējumu pretestības mērītājs. Modeļi: IS-20, IS-20/1.</i>
<b>Essential characteristics:</b> <i>Būtiskie raksturlielumi:</i>	5 AA x 1.5 Vd.c., Class II, IP54, CAT IV (300 V)
<b>Manufacturer, address:</b> <i>Ražotājs, adrese:</i>	“RESEARCH AND PRODUCTION COMPANY “RADIO-SERVICE” JSC 268, Pushkinskaya street, Izhevsk, 426000, Russian Federation Web: www.radio-service.ru Phone: +7 3412 439144, fax: +7 3412 439263, e-mail: office@radio-service.ru
<b>Trademark:</b> <i>Zīmols:</i>	 <b>RADIO-SERVICE</b>
<b>Assessment regulations:</b> <i>Novērtēšanas normatīvi:</i>	Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits. <i>corresponds with LR MK noteikumi Nr. 209 “ Iekārtu elektrodrošības noteikumi”</i>
<b>Used standards:</b> <i>Lietoti standarti:</i>	LVS EN 61010-1:2011 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements (IEC 61010-1:2010) LVS EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2012)
<b>Test report references:</b> <i>Testēšanas pārskati:</i>	No.1311834506/45055/TR/15 dated 12 October 2015 No. LEITC-TR-17-73 dated 19 July 2017
<b>Notes:</b> <i>Piezīmes:</i>	<ul style="list-style-type: none"> <li>• Certificate consists of one page.</li> <li>• The certificate is valid only at presence of the declaration of conformity.</li> <li>• Certificate recipient is responsible for this certificate and the product technical documentation keeping period of 10 years, as well as on the labeling of the CE marking.</li> <li>• The certificate is issued to a particular product with the provision that manufacturer will not make any changes in the product.</li> </ul>

**Director of Certification:**  
*Sertifikācijas direktors:*



 Sergey Kovalev



Date of issue: July 25, 2017  
Certificate is valid until: July 25, 2022

Certificate No. 2-158-198/2017



This Operation Manual describes components and operating principle of earth resistance meters IS-20 and IS-20/1 (hereinafter referred to as instrument) and contains the data relevant for proper operation, safety precautions and calibration.

Operation conditions of the instrument are as follows:

- temperature minus 15 to plus 50 °C;
- upper limit of relative humidity - 90 % at a temperature of plus 30 °C.

Standard conditions:

- ambient air temperature of plus 15 to plus 25 °C;
- relative air humidity of 30 to 80%;
- atmospheric pressure of 84 to 106 kPa (630 to 795 mm Hg).

Protection grade of the casing IP54 in accordance with IEC 60529

Electrical safety as per IEC 61010-1, IEC 61010-2-30:2010.

The instrument satisfy the EMC compatibility requirements complies with EMC directives complies with IEC 61326-1:2012.

*Attention! During device operation in the area of strong electromagnetic fields (about 10V/m with frequency range 80-500 MHz) there is possibility of short-time deviations of voltmeter readings of the instrument (up to 50 V). In such cases, measures should be taken to eliminate the influence on the instrument, change the instrument location or take into account error in readings.*

Due to permanent upgrade of instruments, design changes improving their reliability and operation conditions, the items produced and the design described in this Operation Manual may differ to some extent.

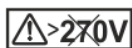


*Attention! Please read this Operation Manual before switching the instrument on.*



*This device is protected by a double insulation or by a reinforced insulation.*

**CAT IV 300 V** Measurement category



*Maximum AC voltage across jacks shall not exceed 270 V.*

## 1 Description and Operation of the Instrument

1.1 The instruments are intended for resistance measurement of earthing elements, metal junctions, continuity of earth connections and equipotential bonding in different modes: using a two-, three-, or four-pole method and measurement with automatic calculation of soil resistivity. Additionally, instrument IS-20/1 measures:

- Selective earth resistance, using a clamp meter, thus avoiding disconnection of a single earth lead from a multi-component earthing system.
- earth lead resistance, using two clamp meters and without use of auxiliary electrodes
- AC, without circuit disconnection.

## 1.2 Specifications

1.2.1 Basic characteristics are given in Table 1.2.1.

Table 1.2.1 – Basic characteristics

<b>1 Earth resistance and continuity of earth connections measurement (2, 3, 4 – pole method)</b>			
Resistance measurement range	Max permissible resistance in connection circuits/ measurement current		Accuracy (for a 4-pole method)
	current circuits E-H	potential circuits ES-S	
1 to 999 mΩ	30 Ω / 250 mA	40 kΩ	± (3% + 3 digits)
0.01 to 9.99 Ω	1 kΩ / 25 mA		
0.1 to 99.9 Ω	10 kΩ/ 2.5 mA		
1 to 999 Ω	40 kΩ / 0.8 mA		
1.00 to 9.99 kΩ			
Maximum interference voltage DC+AC (20-500 Hz)		1 to 999 mΩ	max. 12 V <sub>peak</sub>
		1.00 Ω to 9.99 kΩ	max. 24 V <sub>peak</sub>
Measurement voltage $U \leq 42$ V <sub>rms</sub> , measurement frequency 128 Hz			
<b>2 Selective earth resistance measurement by one current clamp meter (only for IS-20/1)</b>			
Resistance measurement range	Max permissible resistance in connection circuits		Accuracy (for a 4-pole method)
	current circuits E-H	potential circuits ES-S	
1 to 999 mΩ	30 Ω $R_{sel}/R_e \Sigma < 800$	40 kΩ	$\pm(0,05 \times R_{sel} + R_{sel}^2 / (300 \times R_e \Sigma))$ +3 digits)
0.01 to 9.99 Ω	1 kΩ $R_{sel}/R_e \Sigma < 80$		
0.1 to 99.9 Ω			
1 to 999 Ω			
0.01 to 9.99 kΩ			
Minimal admissible measured current in current clamps			0.3 mA
Maximum of interference current			2 A

Table 1.2.1 – Basic characteristics

<b>3 Earth resistance measurement by two current clamp meters (only for IS-20/1)</b>	
Resistance measurement range	Accuracy
0.03 to 9.99 $\Omega$	$\pm$ (10% + 3 digits)
10.0 to 99.9 $\Omega$	$\pm$ (15%+ 3 digits)
Maximum of interference current	2 A
<b>4 Measurement of external voltages (DC+AC 20-500 Hz sine)</b>	
Measurement range	1 to 300 V <sub>peak</sub>
Accuracy	$\pm$ (5% + 3 digits)
<b>5 Measurement of leakage current (AC 50 Hz sine) by current clamp meter (only for IS-20/1)</b>	
Measurement range, mA	1 to 250 mA 0.25 to 2.50 A
Accuracy	$\pm$ (5% + 3 digits)
<b>6 Complementary errors</b>	
Maximum permissible complementary errors of measurements of electrical resistance, AC voltage and rate induced by temperature variation within working range of $\pm$ 3 %.	
Maximum permissible complementary errors of measurements of electrical resistance, AC voltage and rate induced by ambient air relative humidity variation within working range of $\pm$ 3 %.	

Notes

- 1) digits – means least significant digit
- 2) Re  $\Sigma$  – total resistance of the earthing system.
- 3) R<sub>sel</sub> – single earth lead resistance of the earthing system

1.2.2 The instrument ensures automatic switching between measurement ranges and setting of measurement units.

1.2.3 Upon switching off, the instrument saves last measurement settings, and restores them when switched on.

1.2.4 The instrument saves up to 10000 measurement results with an option of data exchange with an external device (a computer).

1.2.5. The supply voltage range is 7.5 to 5.2 V. The power supply is provided with a nickel metal hydride (Ni-Mh) storage battery of 6 V rated voltage and 2000 mA/h capacity, or from five replaceable AA power components placed in a battery compartment. It is allowed to use five AA batteries of 1.2 V rated voltage.

The instrument design allows taking a battery out and putting it in (to replace, for example) without damaging the instrument seal.

1.2.6 The instrument is provided with supply voltage self-check. If the voltage drops from 5.2 to 5.0 V, the instrument switches off.

1.2.7 The instrument has a storage battery charging mode. It is enabled automatically upon connecting a line supply unit from the instrument set and is displayed with an indicator. The instrument protects a storage battery against overcharge.

1.2.8 Continuous work time in a cycle of “measurement – 1 minute, pause – 2 minutes” is not less than 4 hours.

1.2.9 If the instrument is not in use for 2 or 3 minutes, it switches off automatically.

1.2.10 Consumption power is 12 W max.

1.2.11 Weight of the instrument is 0.8 kg max.

1.2.12 Overall dimensions of the instrument are 88 x 105 x 245 mm max.

1.3 Components of the delivery set are given in Table 1.3.

Table 1.3 – Delivery set

Description and designation	Q-ty
1 Earth resistance and soil resistivity meter IS-20 (IS-20/1)	1
2 Operation Manual	1
3 Power unit	1
4 Cramping frame RLPA.301532.001	1
5 Handle RLPA.715311.004	1
6 Crocodile clip	2
7 Instrument bag	1
8 Cable set, including: - instrument cable RLPA.685551.002 – red, 1.5 m long; - instrument cable RLPA.685551.002-03 – blue, 1.5 m long; - spool cable RAPM.685442.003 – red, 40 m long; - spool cable RAPM.685442.003-01 – blue, 40 m long.	1 1 1 1
9 Battery holder 5xAA RAPM.436244.007	1
10 Bluetooth-USB dongle	1
11 Auxiliary earth spikes RLPA.305177.004-01 – 0,2 m long	2
12 Auxiliary earth spikes RLPA.305177.004 – 1 m long	4 <sup>(1)</sup>
13 Current measuring clamp (for IS-20/1) KTI-20/1 (Ø 40 mm) RAPM.418114.005 and/ or KTI-20/2 (Ø 80 mm) RAPM.418114.006	1 <sup>(2)</sup>
14 Transmitting clamp KP-20/1 RAPM.418114.004 (for IS-20/1)	1 <sup>(3)</sup>
Notes	
1 – Set of auxiliary earth spikes is delivered against a separate order.	
2 – Current clamp model is to be agreed at order placement.	
3 – Transmitting clamp KP-20/1 is delivered against a separate order.	

## 1.4 Design and Operation

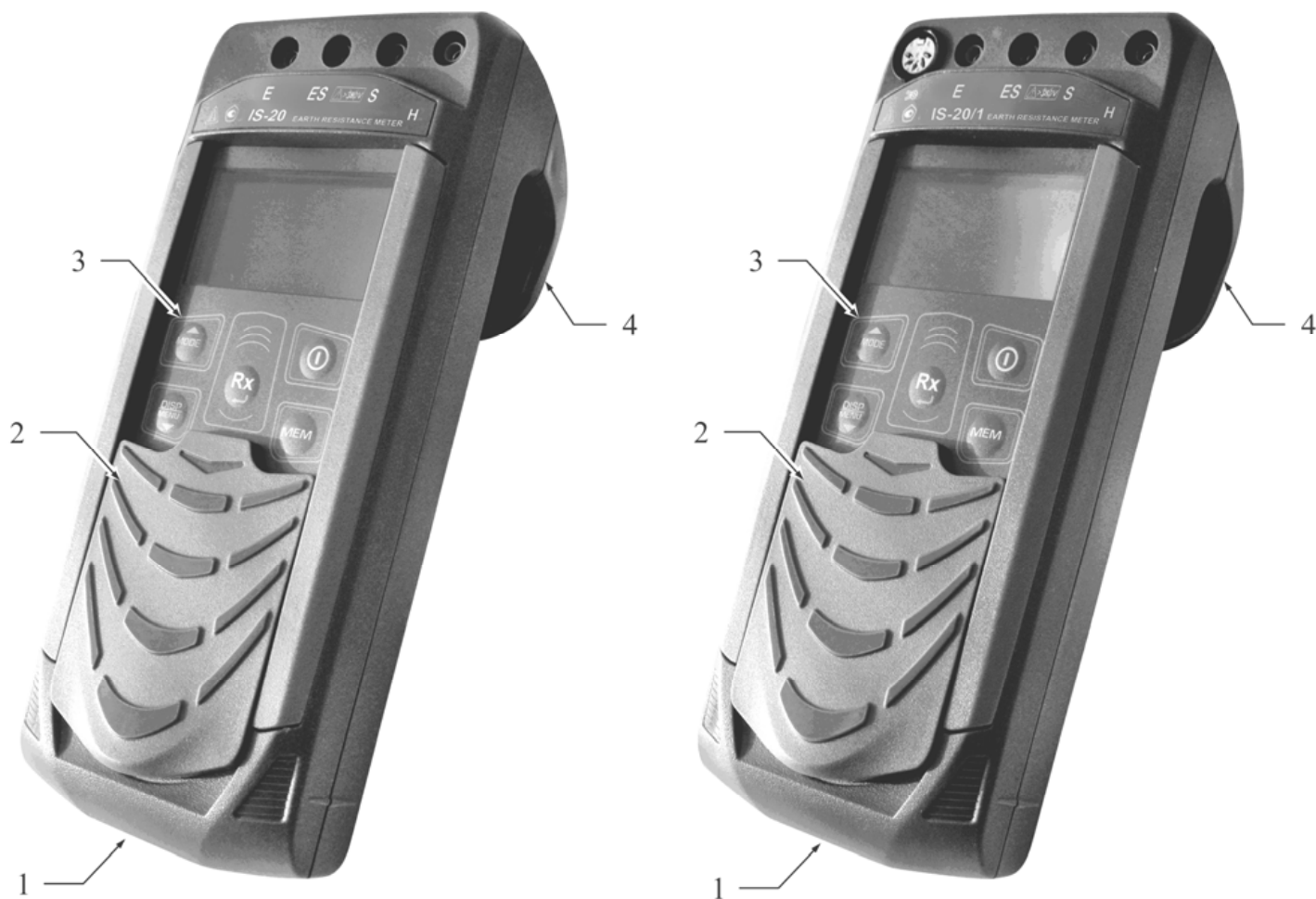


Figure 1.4 – Appearance of instruments IS-20 and IS-20/1, respectively

- 1 – jack “ $\text{—}|\text{—}$ ” for connection of the power unit (central pin – “minus”);
- 2 – protective plate (protective cover);
- 3 – front panel;
- 4 – handle (hook).

Layout of controls and connectors is shown in Figure 1.5.

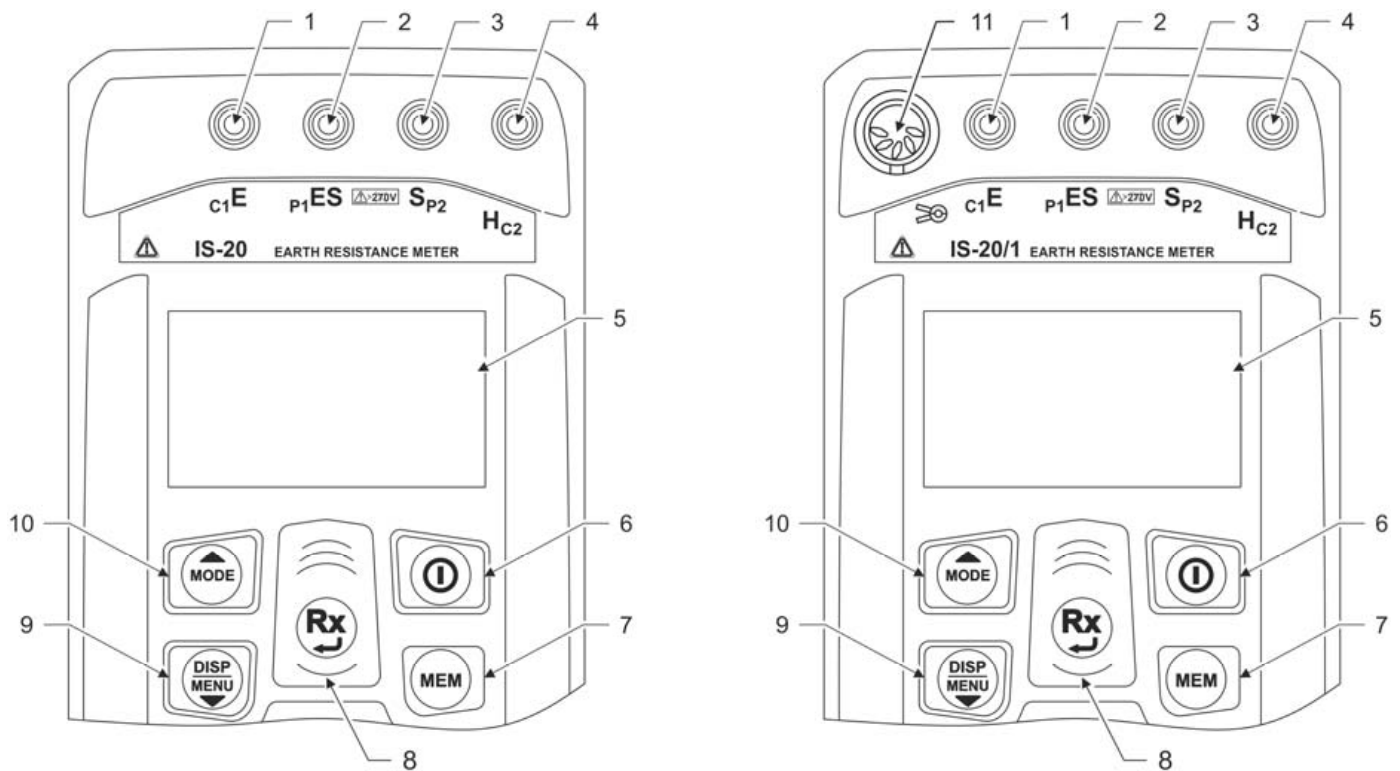




Figure 1.5 – Layout of connectors and controls of instruments IS-20 and IS-20/1


1, 4 – jacks E (C1) and H (C2) for connection of current measurement cables;


2, 3 – jacks ES (P1) and S (P2) for connection of potential measurement cables, in instrument IS-20/1 – also for connection of the conducting clamp meter.


5 – LCD display;


6 – button  switches the instrument on and off;

7 – button  – calls a memory function (writing, reading, deletion, transmission to a computer of measured values);

8 – button  – starts and stops measurements. In the menu mode, the button is used to confirm the selected option or to return to the main mode;

9 – button  – switches between types and scopes of the displayed information. After the active measurement is finished, holding this button pressed longer than 3 seconds returns to the main menu. In the menu mode, the button allows scrolling down the menu. See item 2.3.1 for handling the menu.

10 – button  – switches between measurement modes: two-, three-, and four-wire measurement methods, soil resistivity measurement, and for IS-20/1 – single earth lead resistance measurement, resistance measurement with two clamp meters, current measurement. In the menu mode, the button allows scrolling up the menu.

11 – connector “” in instrument IS-20/1 is used for connection of clamp meters.



## 2 Intended Use

2.1 Operation shall be performed by electrotechnical personnel who have been trained and certified for operating electrical units and who have studied this Operation Manual.

2.2 When operating the instrument, one shall refer to the requirements of "Safety Regulations for Electrical Installations" and use means of protection against electric-shock hazard according to "Instructions on Use and Tests of Protective Means Used in Electrical Installations".



**ATTENTION! *It is prohibited to operate a faulty, damaged and non-tested instrument and to deviate from its operating procedure.***

### 2.2 Preliminary Procedures

2.2.1 If the instrument was exposed to a temperature differing from the operating one, first it shall be held under the operating temperature for two hours. Take the instrument out of its cover and check for mechanical damages and dirt. Ensure operability of protective covers and fasteners, integrity of insulation and cleanness of cables. Check the power unit for mechanical damages and dirt. Check the date of last check. The check validity period shall not have expired.

Prior to operation clean measurement jacks and areas around them.

### 2.2.2 Charging the Storage Battery

The power supply is provided with a nickel metal hydride storage battery "5H-AA2000B-1" of 2000 mA/h rated capacity.

*Note. Before changing, make sure that storage batteries rather than batteries are in the battery compartment. Ignoring this rule may lead to damage of a battery compartment and a battery.*

*Note. A storage battery is charged at an ambient air temperature of plus 10 to plus 30 °C. Failure to comply with this rule may reduce the storage battery life.*

A state of storage battery charge is shown on the display with a miniature battery.


To charge the storage battery, connect the output plug of the power unit from the delivery set to the instrument jack. Plug in the power unit to the 220 V mains. Charging progress is shown by filling of a miniature battery on the display. After charging is finished, a miniature battery is full.

Charging a dead storage battery requires 6 to 8 hours.

If the instrument has not been in use for a long time, recharging a storage battery every three months is recommended.

*Note. A standard storage battery is charged with 400 mA to 500 mA current. When charging a storage battery with another rated capacity, check its temperature regularly, for example, by touch. If the temperature grows fast, stop charging.*





## 2.3 Operating the Instrument

To switch the instrument on/off, press button .

After the instrument is switched on and self-tested, its software version is first shown on the display, then the instrument switches over to mode of measurement that preceded switching-off, which is accompanied by measurement of crest voltage across inputs ES and S or by current measurement with clamp meters (for IS-20/1), if the last mode selected was clamp meter mode.

A supply voltage level is shown with a miniature battery at the top right corner with a shaded area being proportional to the supply voltage. If the display shows a caption “Battery is dead. Switching off”, and the instrument switches off (supply voltage is lower than 5.2...5.0 V), charge the storage battery according to item 2.2.2, replace the storage battery or batteries according to item 3.3.

### 2.3.1 Control and Service Options (Menu) of the Instrument

To enter the instrument menu, press and hold pressed button . The menu is context-sensitive, depending on the current measurement mode. To scroll the menu, use buttons  and , to edit the selected option (the option is selected inversely) and to confirm – press button .

Option “**GENERAL SETTINGS**” allows changing the display contrast and to select the interface language. An example of setting is shown in Figure 2.1.

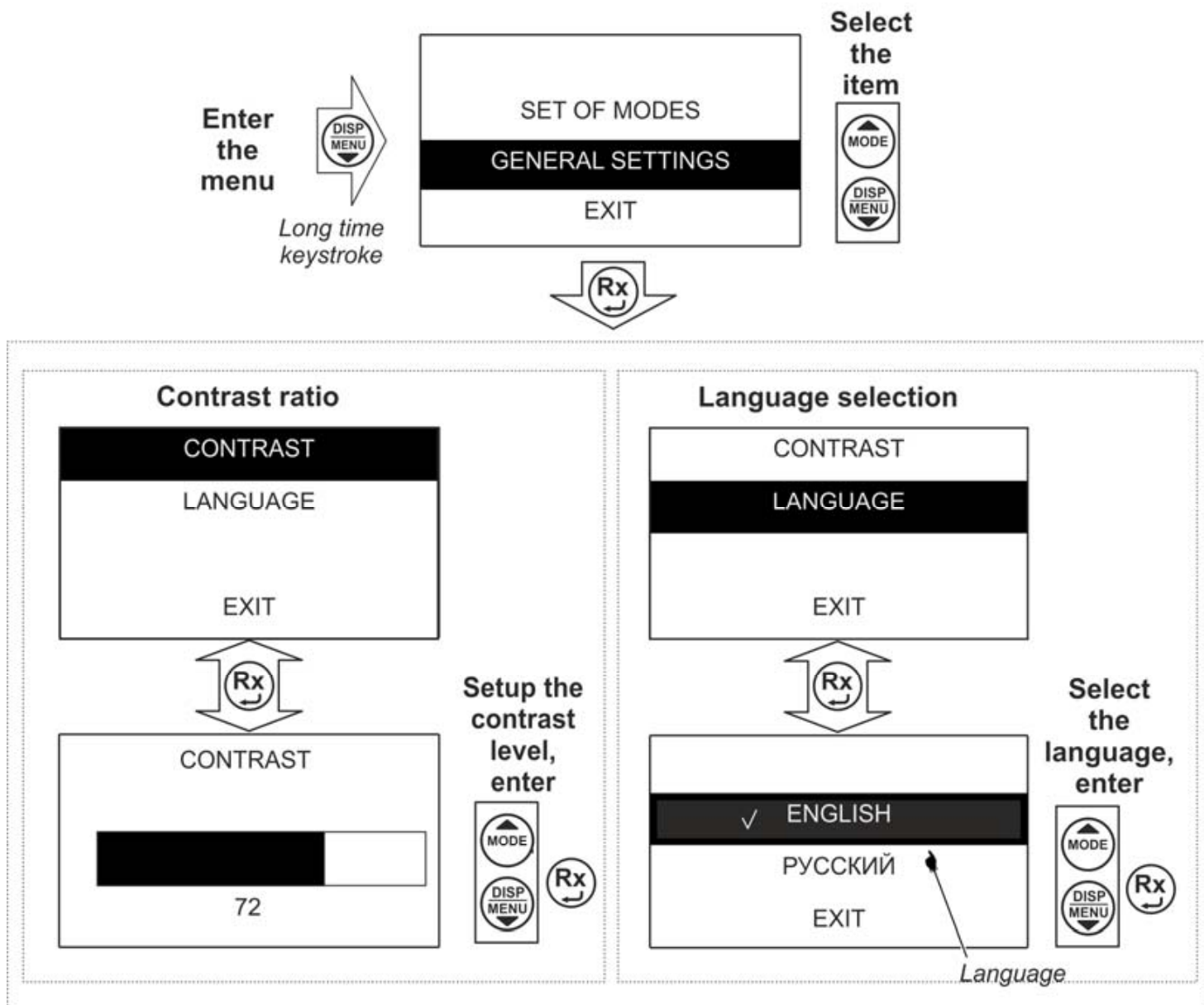




Figure 2.1 – Menu. Instrument setting

Option “**SET OF MODES**” allows deleting or adding to the range of available modes: two (R 2P) –, three (R 3P) –, four (R 4P) – pole measurement methods, soil resistivity measurement ( $\rho$ ), and additionally in instrument IS-20/1 – selective earth resistance measurement (Rsel 3P) or Rsel 4P), resistance measurement with two clamp meters (R 2🔗) and current measurement ( I ).

Enabled modes available for selection with button  are marked with “**V**” (see Figure 2.2). To add or delete the mode, select the relevant option and press button .

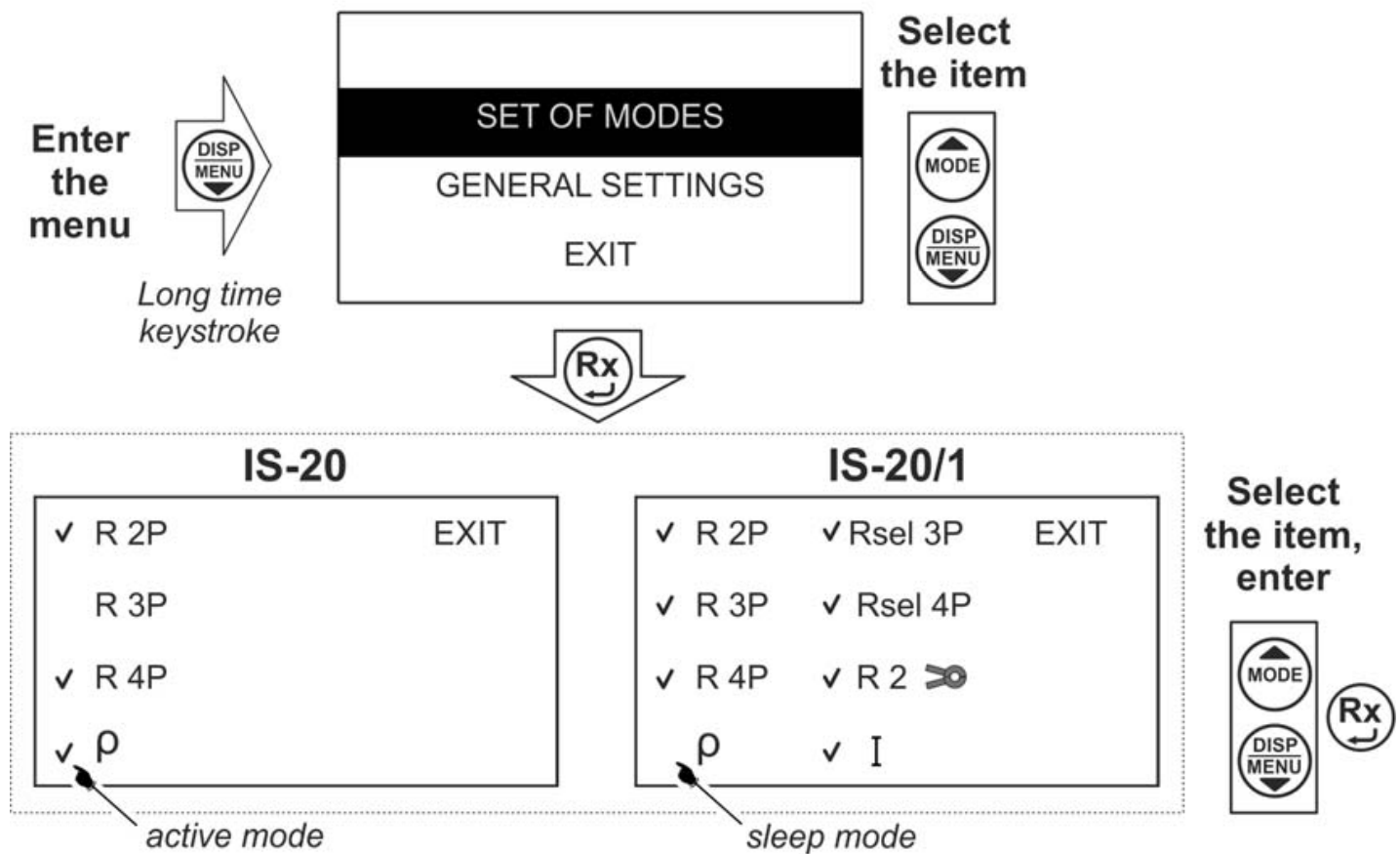


Figure 2.2 – Modes.

The instrument memory is arranged as a set of 100 numbered objects, each consisting of 100 numbered cells. Specific names may be additionally assigned to objects and cells with program RS-terminal (see item 2.3.3).

After the measurement is finished, the display will be showing the last measurement result for 20 seconds. To save the data, press button **MEM**, the result may be written in the selected cell of the selected object, according to Figure 2.3.

If it is more than 20 seconds after the last measurement or the instrument has switched off, to view the last measured value and to save it in the memory,

press button **MEM**, select option "LAST MEASURED RESULT" and save it in the selected cell of the selected object, according to Figure 2.3.

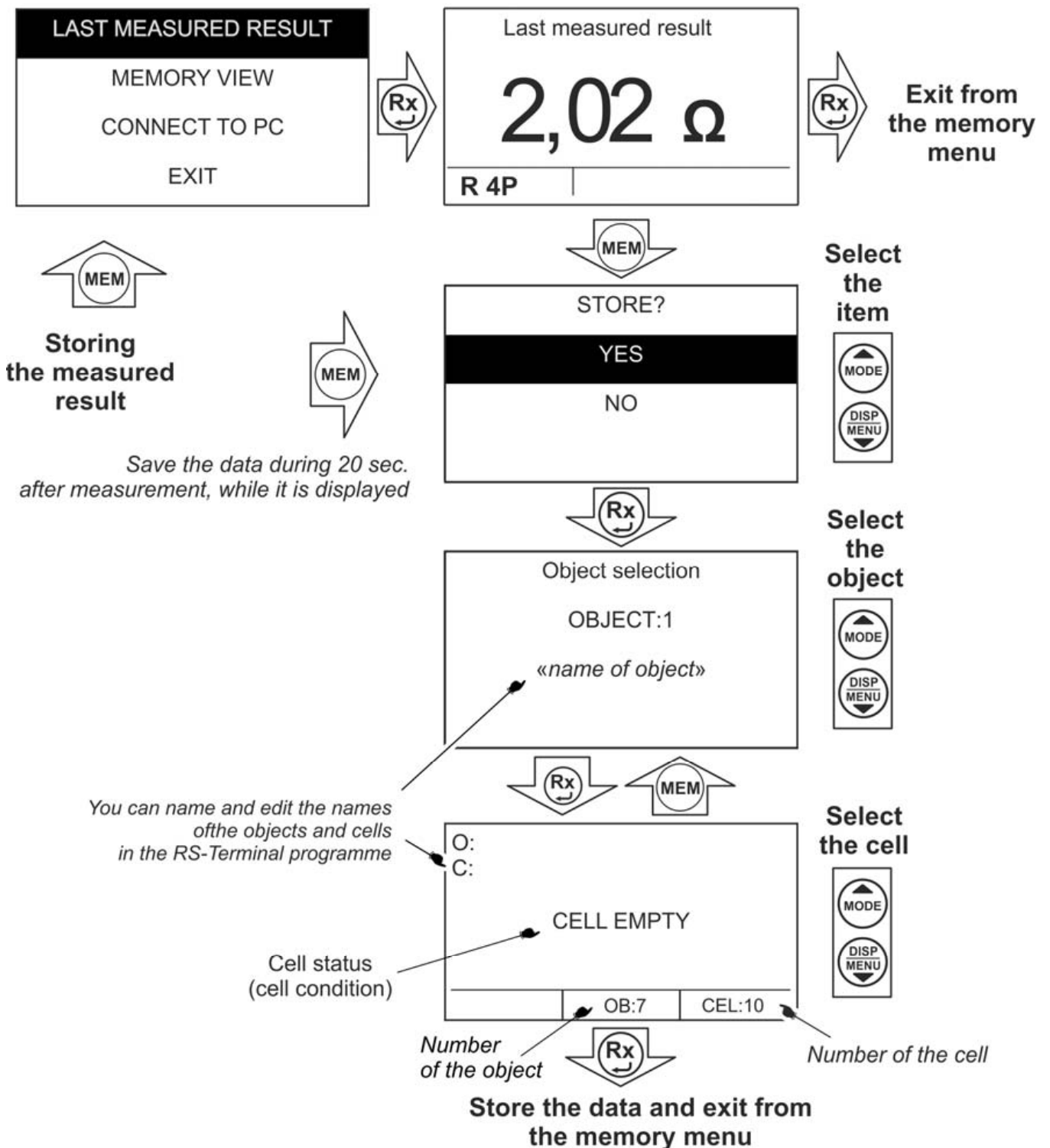


Figure 2.3 – Memory menu. Saving the result.

To view the saved measurement results, select option “MEMORY VIEW” in the instrument menu – the display will show the object selection box. After selection is done, the display will show the information written in the current cell of the current object. If nothing is written in the selected cell, “CELL EMPTY” will be displayed. To scroll between memory cells, use buttons and , to exit the memory menu press button or . To delete the contents of the selected cell or object (all cells in the object), press button and hold it pressed for two seconds.



### 2.3.3 Operating the Computer

The instrument allows wireless data exchange with an external device (a computer). To ensure data transmission to PC, a Bluetooth device is required. When it is not built-in, an external Bluetooth USB adapter is required.

Reception and transmission is performed by operating system tools of a computer. Data are transmitted and saved in PC as text files containing the information stored in the instrument memory. To make data handling easier, a specialized program “RS-terminal” is used, allowing to assign proper names to objects and cells (name lengths is up to ten digits), generate reports, etc. The program and its detailed description can be downloaded from the company's site [www.radio-service.ru](http://www.radio-service.ru).


To do data exchange with a computer:

- turn on PC and run RS-terminal;
- on the instrument, which shall be switched on, enter mode “MENU” and select option “TRANSMISSION TO PC”
- in the RS-terminal window, select all the necessary objects and cells. A file with measurement results may be copied and edited by any text editor.

*Note. The instrument shall be located within the sight at a distance of not more than 8 meters from a computer.*

### 2.3.4 General Recommendations and Notes on Measurement Procedure

An induced interference voltage may occur in some places during measurements, with its value shown on the indicator after plugging the instrument in. If the interference value exceeds the permissible one (see item 1 of Table 1.2.1), during earth resistance measurement, for example, measuring pins shall be positioned in the most appropriate direction where the interference is the lowest. This will allow obtaining the most valid results from the next measurements.

 **ATTENTION! THE VOLTAGE LEVEL ACROSS MEASUREMENT JACKS OF THE INSTRUMENT SHALL NOT EXCEED 240 V OF RMS VALUE (340 V OF CREST VALUE). FAILURE TO COMPLY WITH THIS REQUIREMENT MAY LEAD TO INSTRUMENT FAILURE.**

When the instrument is unable to measure at the maximum possible measurement current, it automatically changes over to measurement at the least possible measurement current with measurement resolution being 1 or 2 digits lower. The digit capacity may decrease in response to storage battery capacity reduction (ageing).

**Attention!** If the item's resistance contains reactive components (inductive or capacitive) in addition to active ones, the total measurement result will consider response of these components to the measurement current nature. **In this regard, it is recommended to use unreeled cables in measurements.**

When the instrument operates at a temperature below minus 10 °C, the update rate of display readings may become slower.

Measurement conditions of various complexity may occur during measurements. Messages on possible problems, causes and remedies are given in Table 2.3.4.

Table 2.3.4 – Messages on possible problems in measurements









Fault		Cause	Remedies
Main field	Message window		
> 10 kΩ		Object resistance is over 10 kΩ	-
<b>NO CIRCUIT E-H</b> (for 4-pole method)  or  <b>NO CIRCUIT ES-H</b> (for 3-pole method)		1. Open-circuit failure 2. Poor contact between E, H (ES, H) pins and earth 3. Resistance in the E-H (ES-H) circuit is over 40 kΩ	Examine connections. Put the H pin deeper or put it on the other place. Moisten the area where the H pin is located
		4. Interference in the E-H (ES-H) circuit exceeds admissible level.	Using the voltmeter of the device (ES-S) select the position of measuring pins to reduce the interference voltage to its minimum.
Measured results are displayed	 <b>ES-S &gt; 40 kΩ</b>	1. Resistance of the ES-S circuit is over 40 kΩ. The measuring error exceeds its admissible value 2. The readings tend to zero. Circuit may be broken.	Examine connections. Put the S pin deeper or put it on other place. Moisten the area where the S pin is located
The result is displayed for Re Σ only and <b>I sel &lt; 0.3 mA</b>		Measuring current intensity in the single grounding conductor is less than 0.3 mA	-


Table 2.3.4 – Messages on possible problems in measurements

The result is displayed for $R_{e\Sigma}$ only and $R_{E-H} > 1\text{ k}\Omega$ (for 4-pole Rsel method) or $R_{ES-H} > 1\text{ k}\Omega$ (for 3-pole Rsel method)		Resistance of the E-H (ES-H) circuit is over 1 kΩ.	Put the H pin deeper or place it on other place. Moisten the area where the H pin is located
The results of measurement are displayed	 $I > 2\text{ A}$	Interference current exceeds 2 A, measuring error exceeds its admissible value in the modes of Rsel resistance measurement or measurement with two clamps	Reduce or eliminate leakage current through the measured grounding conductor
$> 100\ \Omega$		In the mode of measurement with two clamps the object resistance exceeds 100 Ω	–
<b>NO TRANSMITTING CLAMPS</b>		Transmitting clamps are not connected or faulty	–
<b>CHECK TRANSMITTING CLAMPS</b>		Transmitting clamps are not closed or faulty	Clean contact area of half-coil of the clamps
<b>CHECK THE DEVICE</b>		The device may be faulty	Measure the resistance with known rated value (resistor). The error shall not exceed admissible values.
		Constant single-polar pulse voltage of more than 30 V in the ground	Put the pins on other place

### 2.3.5 Four-Pole Earth Resistance Measurement (R 4P)

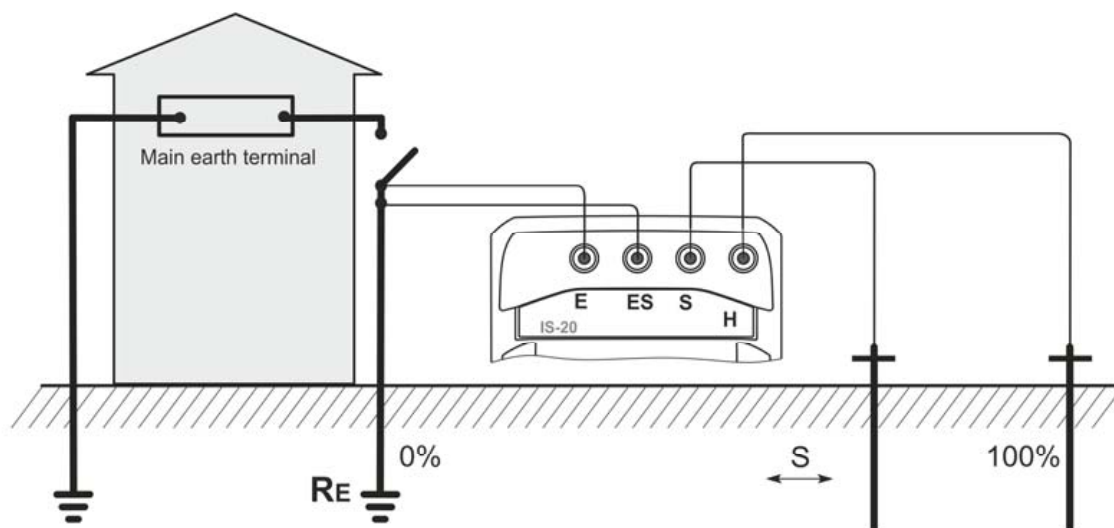


**IF THE FACILITY UNDER CHECK HAS ITS OWN RULES (PROCEDURES) OF EARTH RESISTANCE MEASUREMENT, SUCH RULES SHALL BE FOLLOWED.**

Using button , select the four-pole measurement method (**R 4P**).

Disconnect the earthing device from the earthing system. Determine the maximum diagonal (hereinafter – D) of the earthing device (hereinafter ED). Connect ED to jacks E

and ES by means of 1.5 m measurement cables. Install potential pin S in the soil at a distance of 1.5 D but not less than 20 m from ED being measured (Figure 2.4). Install current pin H in the soil at a distance of more than 3 D but not less than 40 m from ED and attach the connecting cable to instrument connector H. Usually ED, current and potential measurement pins are aligned. Measurement pins shall be driven in the soil as deeply as possible (at least 0.5 meters deep).



Selection the 4-wires earth-resistance measurement method

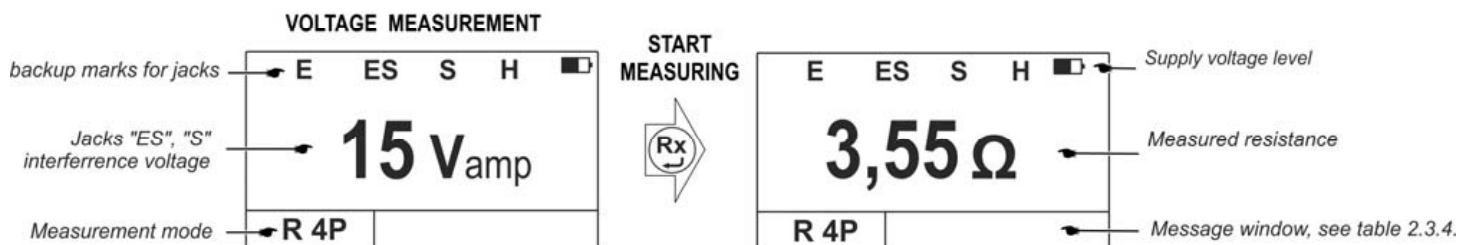
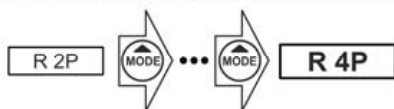


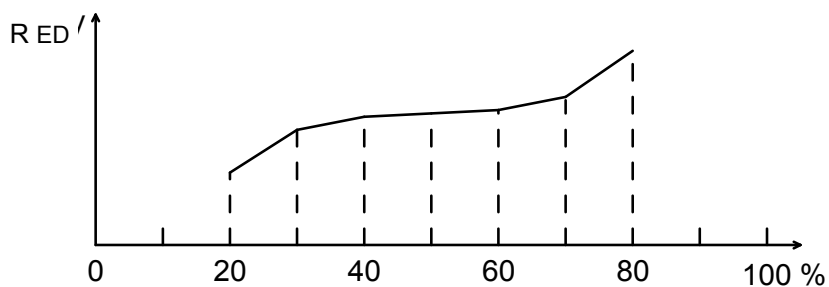


Figure 2.4 – Connecting scheme and display view during four-pole earthing resistance measurement

Ensure that the interference voltage level does not exceed the permissible one (see item 1 of Table 1.2.1). To run the measurement, press button . After the measurement is finished, its results are displayed within 20 seconds, and may be saved in the instrument memory by pressing button  (see item 2.3.2). After that the instrument switches over to voltage measurement mode.

Since the soil is inhomogeneous, a series of earthing resistance measurements shall be made, with potential pin S installed in the soil sequentially at a distance of 20, 30, 40, 50,

60, 70 and 80 % of a distance to current pin H, to enhance reliability of measurements. Then make a curve of resistance vs distance from ED to potential pin S.




If the resistance in the central part of the curve grows quite uniformly, the true value is assumed to be the value between points with minimum resistance difference, and this difference shall not exceed 5%. Otherwise, all distances from ED to pins S and H shall be increased by 1.5-2 times, or the pins shall be positioned in a different direction.

When the resistance of a single earth lead in a multi-component earthing system shall be measured, the earth lead shall be disconnected from the system, or measurements shall be made with instrument IS-20/1 using clamp meters according to item 2.3.9.

### 2.3.6 Three-Pole Earth Resistance Measurement (R 3P)

Connect the 1.5 m measurement cable to jack ES.

Using button , select the three-pole measurement method (**R 3P**) (Figure 2.5).

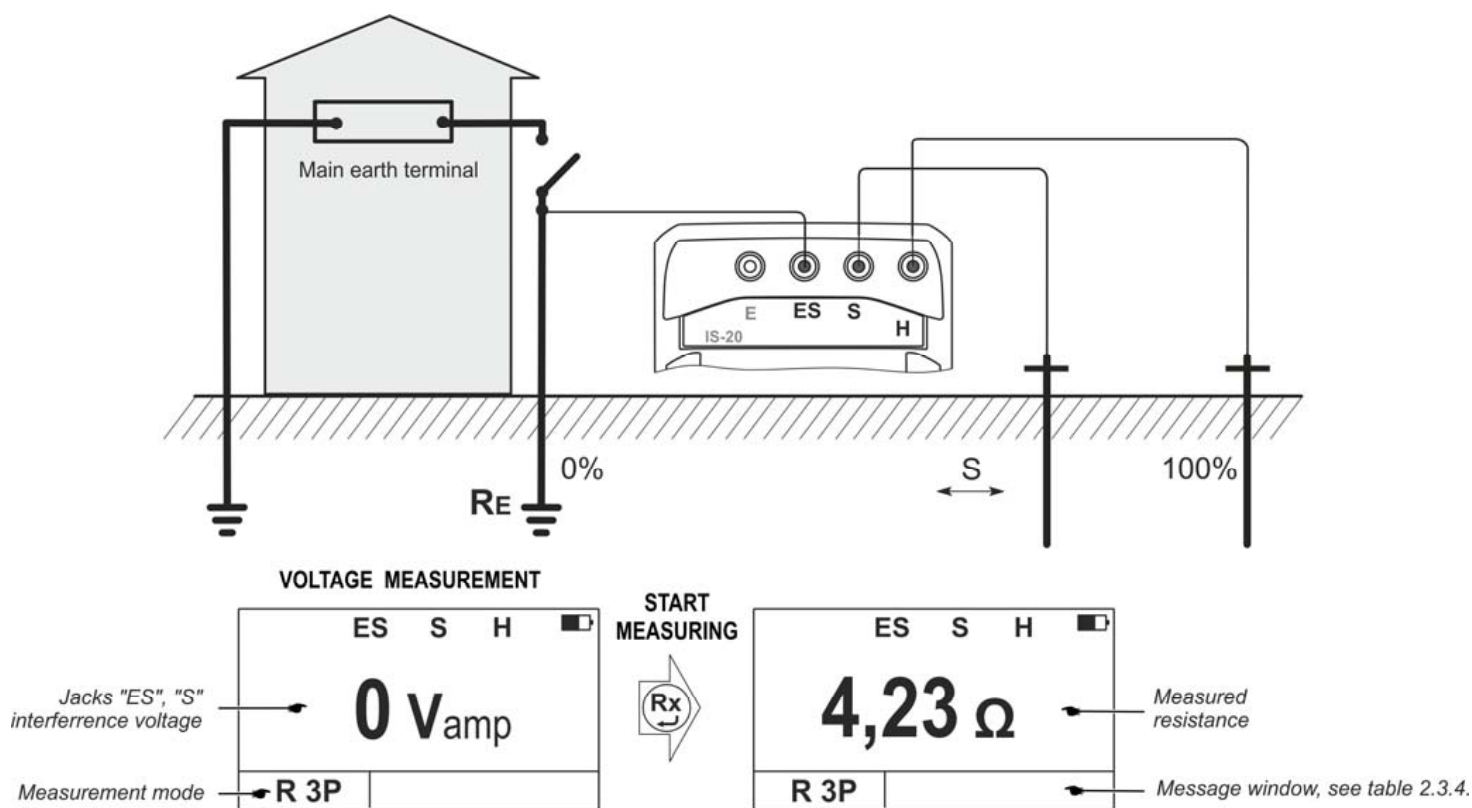


Figure 2.5 – Connecting scheme and display view during three-pole earthing resistance measurement



The measurement procedure is similar to that of item 2.3.6 but the measured value of ED resistance will include the resistance of the measurement cable connected to jack ES and transient resistance at the joint with ED.





### 2.3.7 Measurement of soil resistivity ( $\rho$ )

The soil resistivity value is determined by the Werner measurement procedure. This procedure requires equal distances between electrodes ( $d$ ), and resistivity is calculated by formula:

$$\rho = 2\pi \cdot d \cdot R \quad (6.28 \cdot d \cdot R),$$

where  $R$  – resistance measured with the instrument.

Measurement result will be displayed in “m $\Omega$ \*m”, “ $\Omega$ \*m”, “k $\Omega$ \*m” or “M $\Omega$ \*m”.

Put the measurement pins in the soil along a straight line in equal distances ( $d$ ), which shall be at least 5 times as long as the driving depth. Connect pins to measurement jacks E, ES, S and H (Figure 2.6). Using button , select mode  $\rho$ , after which the display will show the previous distance between the pins. The distance between the pins may be changed, for which purpose select option “DISTANCE” in the instrument menu. Message “DISTANCE XXm” will be displayed. Using buttons  or , set the distance from 1 to 99 m with 1 m increment. To confirm the selected distance, press button . The preset distance is saved in the instrument memory before new values are entered.

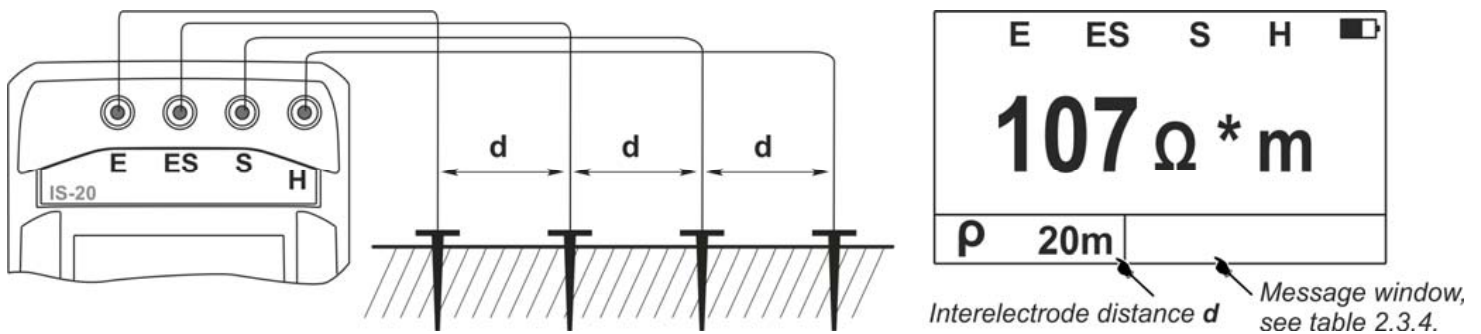




Figure 2.6 – Connecting scheme and display view during soil resistivity measurement


To run the measurement, press button . After the measurement is finished, its results are displayed within 20 seconds, and may be saved in the instrument memory by pressing button  (see item 2.3.2). After that the instrument switches over to voltage measurement mode.

### 2.3.8 Resistance measurement of the continuity of earth connections and equipotential bonding

According to the requirements resistance of earthing conductors, earthing PE conductors and equipotential bonding conductors, including their connecting elements and clamps, shall be measured with the measurement current of not less than 0.2 A. Instruments IS-20 and IS-20/1 ensure the measurement alternating current of 0.25 A on resistors within the range from 0 to 30  $\Omega$ .

#### 2.3.8.1 Four-Pole Resistance Measurement (R 4P)

The four-pole measurement method excludes the resistance of measurement cables and transient resistances at their connection points from measurement results, which is important for a low resistance being measured.

Using button , select the four-pole measurement method (**R 4P**). Connect cables from jacks E and ES from one end of the resistor (R) being measured and cables from jacks S and H from the other end (Figure. 2.7). Ensure that the interference voltage level does not exceed the permissible one.

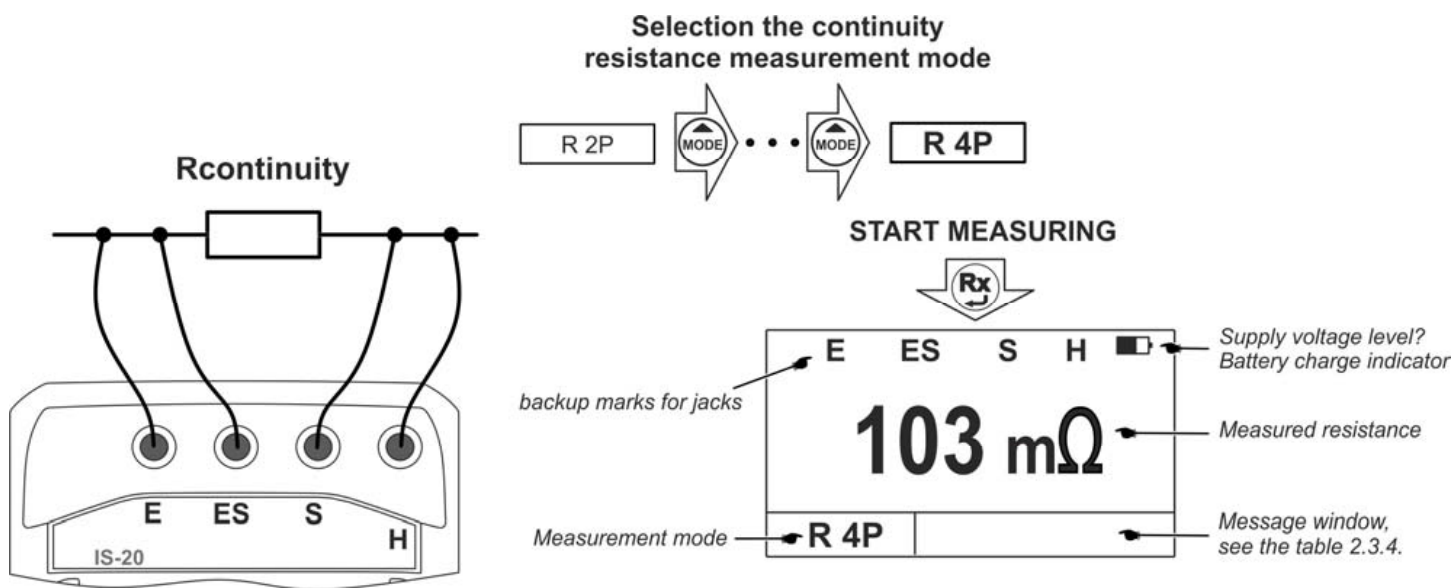




Figure 2.7 – Connecting scheme and display view during four-pole resistance measurement

To run the measurement, press button . Measurement result is displayed within 20 seconds and may be saved in the instrument memory (see item 2.3.2). After that the instrument switches over to voltage measurement mode.

### 2.3.8.2 Two-pole resistance measurement method (R 2P)

Using button , select the two-pole measurement method (**R 2P**). Connect measurement cables to jacks ES, S (Figures 2.8). Ensure that the interference voltage level does not exceed the permissible one.

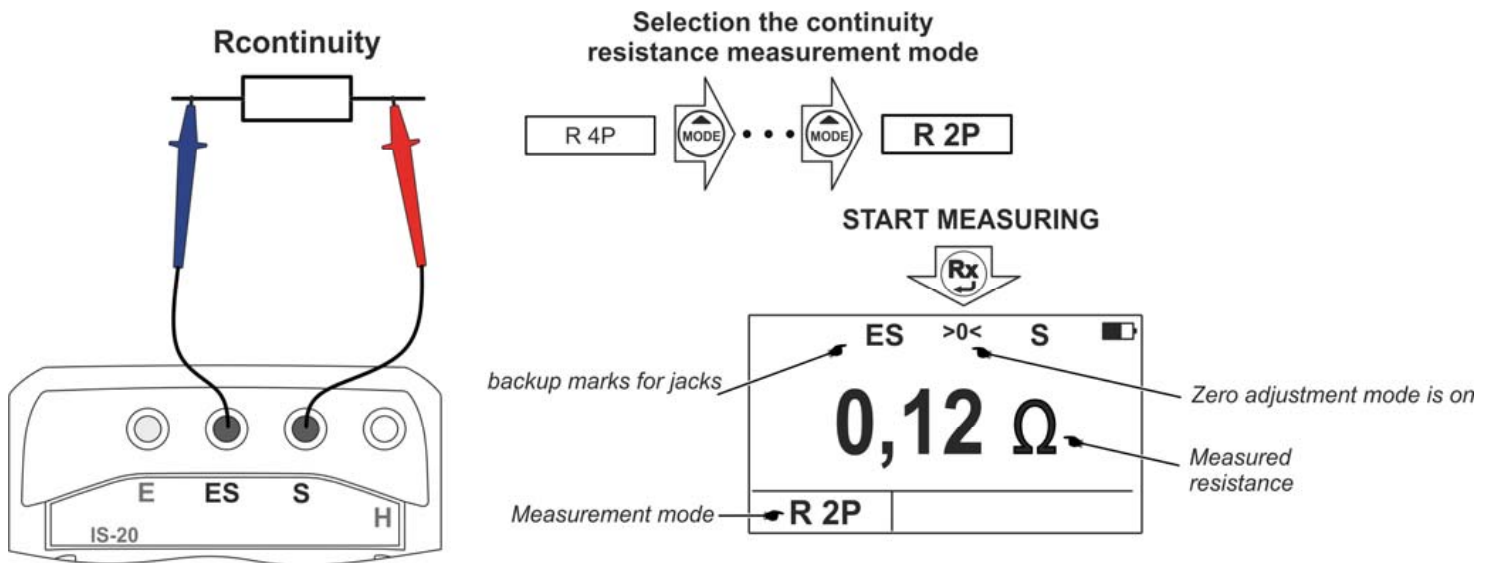





Figure 2.8 – Connecting scheme and display view during two-pole resistance measurement

To run the measurement, press button . After the measurement is finished, its results are displayed within 20 seconds, and may be saved in the instrument memory by pressing button (see item 2.3.2). After that the instrument switches over to voltage measurement mode.

One should keep in mind that the true resistance of the item being measured is lower than instrument readings by a value equalling to resistance of measurement cables and transient resistances at their connection points.

Influence from resistance of measurement cables not higher than 1  $\Omega$  on the measurement result may be corrected by deducting their resistance value from an overall result. However such correction is not substitute for the four-pole measurement method as far as accuracy of low-resistance measurement is concerned, because transient resistances at the contact with an item are not taken into account.

When necessary, the instrument allows enabling the zero-point correction mode “>0<”. To do it, enter the menu (see Fig. 2.9), select the option “Correction >0<” and press button . To go to the correction menu, select the option “Correcting”, close both ends of measurement cables and press button . The instrument will measure resistances of

measurement cables, save the result in the memory and enable the zero-point correction mode. After that the display will show “>0<”, and difference between the measured resistance and that of measurement cables will be shown as a result. It is recommended to run the zero-point correction procedure regularly, as well as in case of replacement of measurement cables.

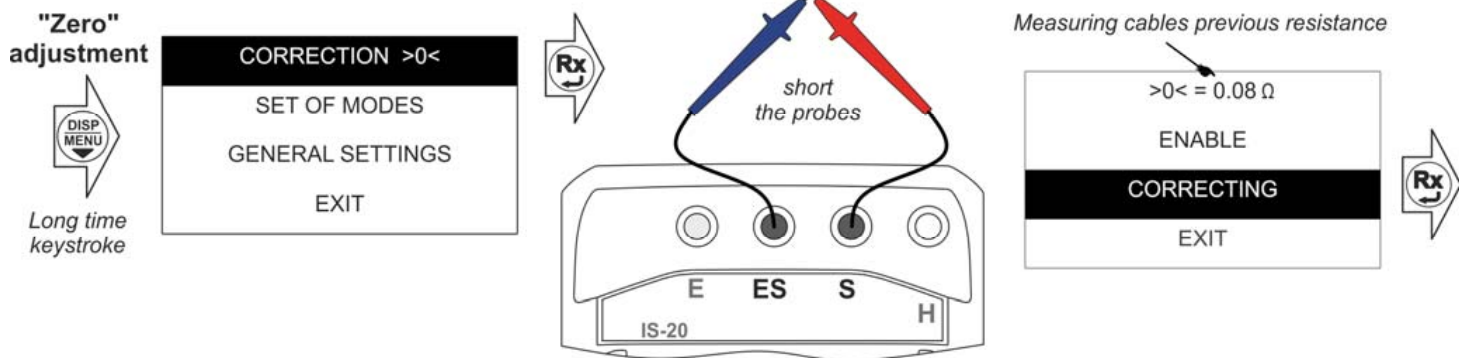





Figure 2.9 – Resistance correction of measurement wires

To disable the zero-point correction mode, enter the correction menu, select the option “Disable” and press the button .

*Note. If the resistance of the item under measurement is much lower than that of measurement cables, results with a negative sign may be displayed because of measurement errors.*

### 2.3.9 Measurement Procedure Using Clamp Meters

Clamp meters KTI-20/1 with inner diameter 40 mm or KTI-20/2 with inner diameter 80 mm are used in measurements.

**ATTENTION!** Before proceeding to measurements, set the relevant clamp meter model in the instrument model (Figure 2.10). After that a clamp meter sign in the top left corner of the display will be shown as  for KTI-20/1 or  for KTI-20/2.

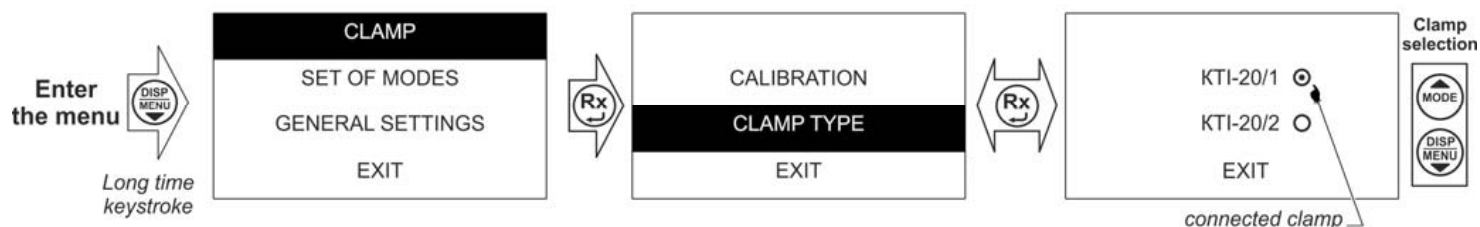



Figure 2.10 – Selection of clamp meter type

**ATTENTION!** Before proceeding to measurements with a clamp meter, make sure that their number coincides with the number given in acceptance and primary calibration certificates of this Operation Manual.

2.3.9.1 Selective earth resistance measurement in a multi-component earthing system without disconnecting a single earth lead using a clamp meter according to three- (**Rsel 3P**) or four-pole (**Rsel 4P**) method. (only for IS-20/1)

*Note. The clamp verification according to item 2.3.10 is recommended before each measurement.*

Connecting the instrument to the earthing system and arranging auxiliary electrodes are similar for four- or three-pole systems, as is described in items 2.3.6 and 2.3.7. Embrace the earth conductor with a clamp meter below the place of connection of potential pin ES (Figure 2.11).

For the selected connection scheme, select the mode of single earth lead resistance measurement with the use of a clamp meter “Rsel 3P” or “Rsel 4P”, by pressing the button . Make sure that the interference voltage across jacks ES S and 50 Hz background current flowing via the earth lead do not exceed the permissible levels of 24 V and 2 A, respectively.

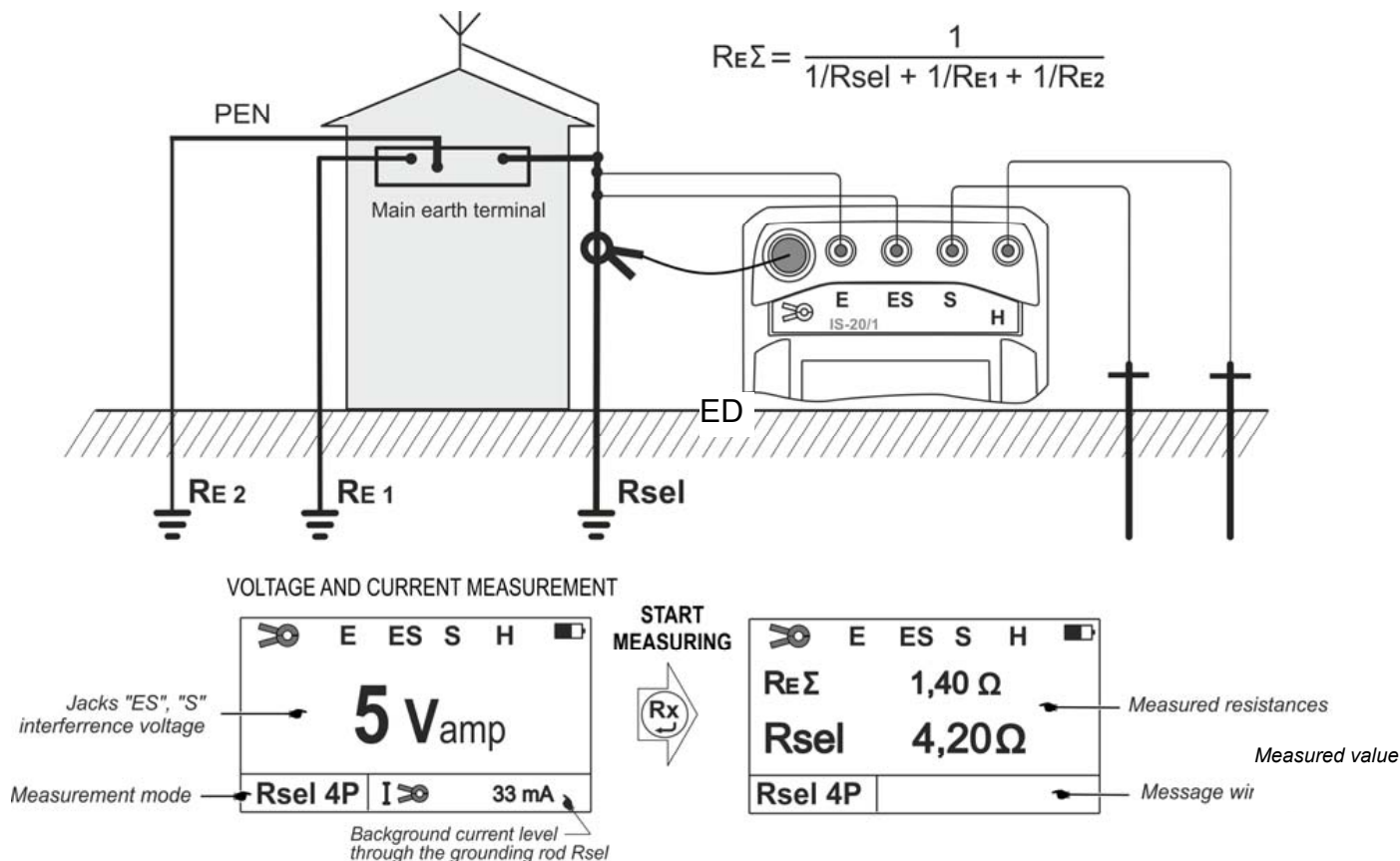



Figure 2.11 – Connecting scheme and display view during single earth lead resistance measurement according to four-wire method

To run the measurement, press button . The instrument will measure the total resistance of the earthing system (**REΣ**) and selective earth resistance (**Rsel**). After the




measurement is finished, its results are displayed within 20 seconds, and may be saved in the instrument memory by pressing button  (see item 2.3.2). After that the instrument switches over to the mode of voltage measurement across jacks ES S and 50 Hz current flowing via an earth lead.

If the measured value of the measurement current in a single earth lead is less than 0.3 mA (for example, its resistance is more than 100 times higher than the total resistance of the earthing system), the message “**I sel < 0.3 mA**” will be displayed, and measurement of the single earth lead resistance is not made.

#### 2.3.9.2 Resistance measurement with two clamp meters ( **R 2** ) (only IS-20/1)

In some cases when using auxiliary external electrodes is not possible (for example, in city conditions, on asphalt area), it is allowed to use two clamp meters to measure the earth resistance in a multi-component system where several parallel earth leads are connected to each other. In this case the resistance is measured relative to other earth leads of the earthing system. So it should be kept in mind that the measurement result ( $R_{E\Sigma}$  in the formula below) will be slightly in excess because it incorporates resistances of all circuits from an earth “loop”, including those of equipotential bonding and PEN conductor wires.

Select the mode of resistance with two clamp meters “**R 2** ”. Connect the clamp meter and conducting clamp meter KP-20/1 to the instrument, embrace the earthing device with clamps (Figure 2.12). The clamps shall be at least 30 cm spaced. Make sure that the 50 Hz background current flowing via the earth lead does not exceed 2 A.

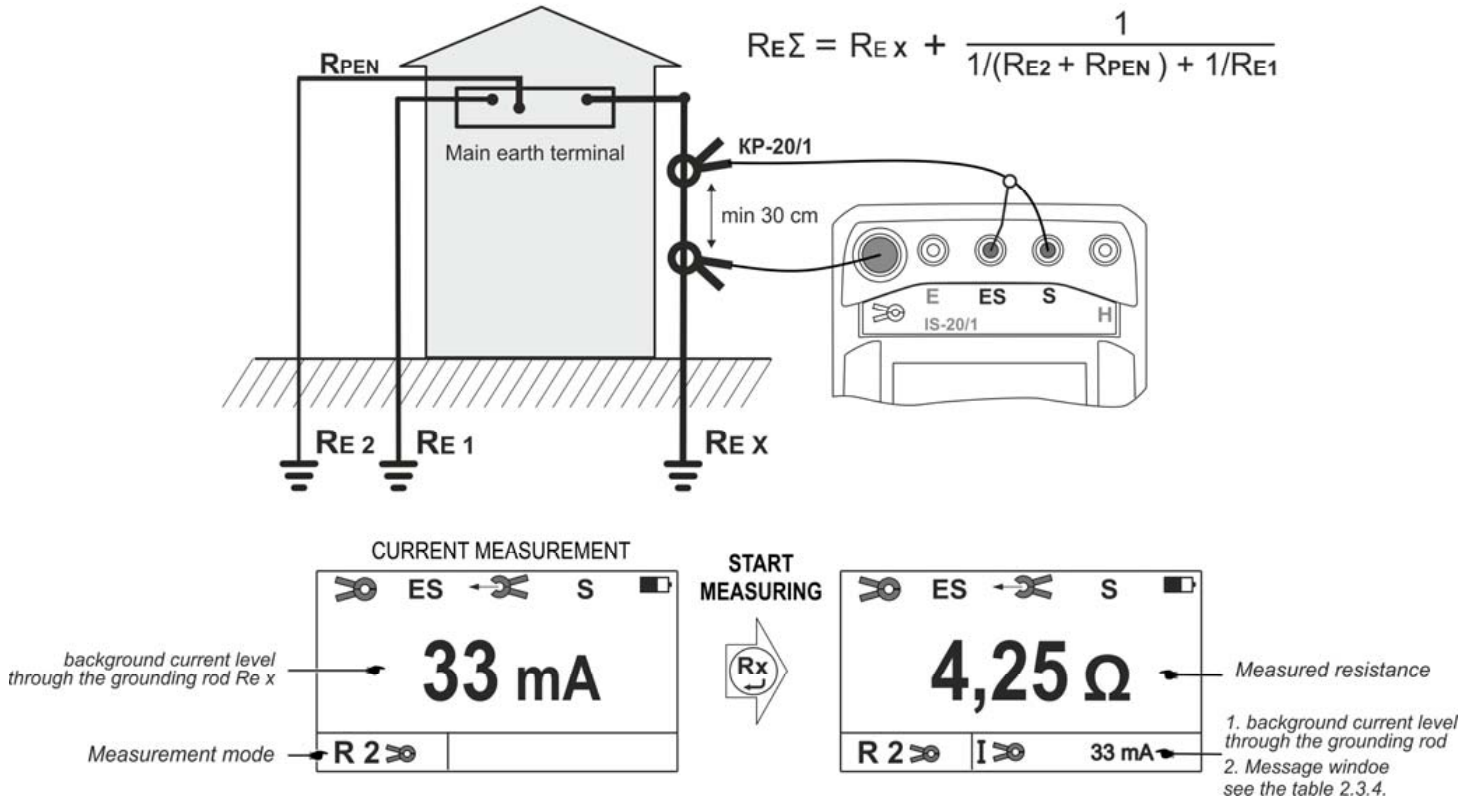


Figure 2.12 – Connecting scheme and display view during resistance measurement with two clamps

To run the measurement, press button . After the measurement is finished, its results are displayed within 20 seconds, and may be saved in the instrument memory by pressing button (see item 2.3.2). After that the instrument switches over to current measurement mode.

### 2.3.9.3 AC measurement without circuit breaking. (I) (only IS-20/1)

Connect the clamp meter to connector . Using button , select the mode of AC measurement with clamp meter “I”.

Embrace the circuit being measured with the clamp meter. The 50 Hz current value will be shown on the display.



Figure 2.13 view – Display view during AC measurement

### 2.3.10 Calibration of Clamp Meters KTI-20/1 and KTI-20/2.

Periodic calibration of clamp meters before measurement of single earth lead resistance is recommended. For this purpose, close the circuit between jacks E and H with a 1.5 m cable and embrace it with the clamp meter (Figure 2.14).

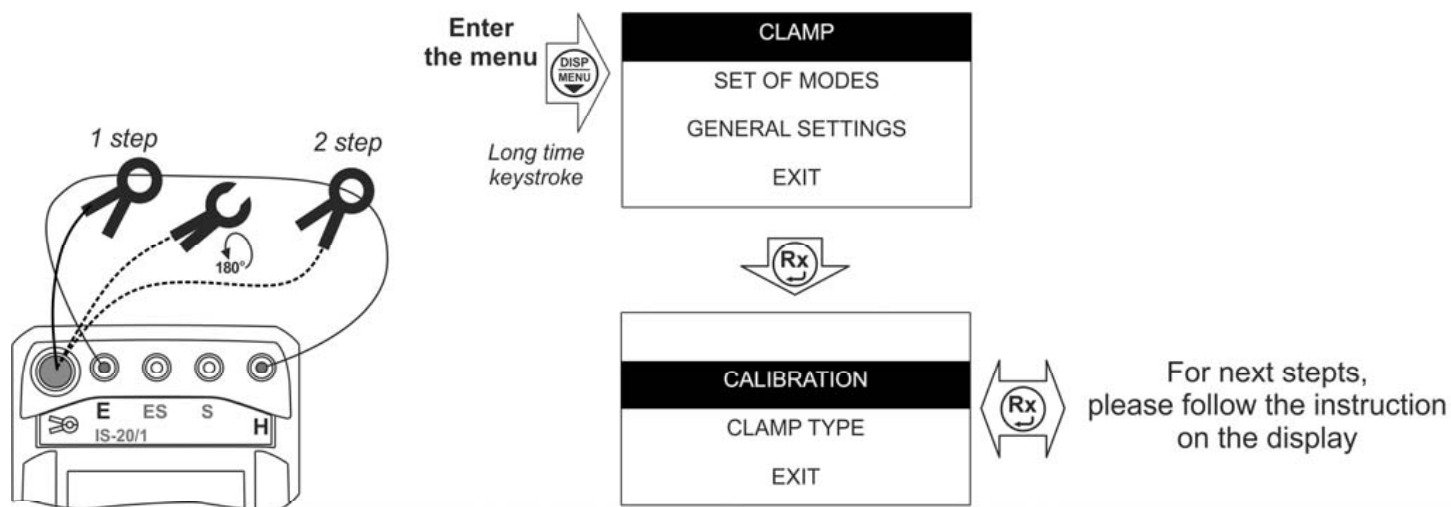




Figure 2.14 – Calibration of clamp meters

Set the operation mode “Rsel 3P” or “Rsel 4P”, make sure that a proper clamp meter type is selected. Then selection the option “CALIBRATION” in the menu, press button . The instrument will run the first calibration phase, the instruction “TURN OVER THE CLAMP”, release the clamp meter, turn it over 180° and embrace the cable again. Wait till the second calibration phase is completed and press button .

If there is no contact in circuit E-H or no signal from the clamp meter, for example, the clamp meter is not connected or has failed, the instrument will show the message “NO CIRCUIT E H !!!” or “NO CLAMPS !!!” respectively. Also the message “NO CIRCUIT E H !!!” may be displayed when the storage battery has been extremely discharged.

### 3 Maintenance and Troubleshooting





#### 3.1 General Instructions

Maintenance means observation of operation and storage rules.

Repair of the instrument is only allowed at the manufacturer's site or in special repair agencies. Possible failures and troubleshooting procedure are provided in Table 3.

Table 3 – Possible failures and troubleshooting procedures

Failure symptoms	Possible cause	Troubleshooting procedure
The instrument won't switch on	The storage battery (battery) has been discharged.	Check the storage battery (battery) voltage, charge (see item 2.2.2) or replace (see item 3.3) if necessary.
No image is displayed while the backlight is on	Error of display contrast settings for this temperature	Set the required display contrast (see item 3.2)
The storage battery cannot be charged	Either power unit or storage battery is faulty	Check the charger, replace the storage battery if necessary (see item 3.3).
The instrument does not respond to buttons pressing	Microprocessor failure	Switch off the instrument for 5 seconds and switch it on again. Disconnect and then connect the storage battery if necessary (see item 3.3).

3.2 The instrument allows changing contrast of the display image without entering the menu. For this purpose, while the instrument is off, press the button , hold it pressed and switch the instrument on. Using buttons  and  increase or decrease contrast, respectively. To stop setting contrast, press the button .

#### 3.3 Replacement of a Storage Battery or Power Components

Proceed as follows to replace power components:

- take out storage battery cover screws;
- remove the cover and take the storage battery (battery compartment) out;
- decouple the connector running to the storage battery (battery compartment);
- replace to storage battery or power components, restore the connection;
- assemble an instrument in a reverse order;
- charge the storage battery.

#### **4 Transportation and Storage**

The instrument packed in a standard package allows transportation by all transport means without any distance limitation. When transported by an aircraft, the instrument may be arranged in a pressurized compartment.

Climatic conditions of transportation and storage shall within the ambient air temperature range from minus 40 to plus 70 °C at the relative air humidity of not more than 90% at a temperature of plus 30 °C. Exposure to atmospheric precipitations is not allowed.

#### **5 Disposal**

Follow up local regulations regarding disposal of packages, used batteries and accumulators.

Worn electrical and electronic equipment should be collected separately from the other waste, it can not be placed together with the other waste.

Worn electronic equipment should be delivered to the collection point according to the law of electrical and electronic equipment disposal.

Do not dismantle electrical and electronic equipment before sending to the collection point.



## 6 Acceptance Certificate

Earth resistance meter IS-20 IS-20/1 No. \_\_\_\_\_  
delete as applicable Reg. No.

is fitted with clamp meters

KTI-20/1 No. \_\_\_\_\_  
Reg. No. (to be filled in only for IS-20/1)

KTI-20/2 No. \_\_\_\_\_  
Reg. No. (to be filled in only for IS-20/1)

and corresponds to specifications RAPM.411212.002TU, and has been found fit for operation.

QCD Head

Stamp here \_\_\_\_\_  
personal signature print full name  
\_\_\_\_\_  
day, month, year

## 7 Data on Primary Calibration

Measuring means

earth resistance meter IS-20 IS-20/1 No. \_\_\_\_\_  
delete as applicable Reg. No.

with clamp meters

KTI-20/1 No. \_\_\_\_\_  
Reg. No. (to be filled in only for IS-20/1)

KTI-20/2 No. \_\_\_\_\_  
Reg. No. (to be filled in only for IS-20/1)

on the basis of primary calibration results, has been found compliant with the metrological requirements established in the type specification and fit for application in the field of measurement assurance state control.

Date of primary calibration \_\_\_\_\_  
day, month, year

Stamp here Calibration operator \_\_\_\_\_  
signature of a metrological service representative

## 8 Manufacturer's Warranty

The manufacturer guarantees that the instrument meets the specification requirements provided that operation, transportation and storage rules are observed.

The guaranteed service life of the instrument is 18 months from the date of manufacture or date of sale (if a note on sale is available), but not more than 24 months from the date of manufacture.

The guaranteed service life is prolonged through the period from claim presentation till elimination of failures.

The guaranteed service life does cover the storage battery.

To be filled in by the seller:

Date of sale \_\_\_\_\_

Seller \_\_\_\_\_

Seller's address \_\_\_\_\_

Seller's phone \_\_\_\_\_

Stamp here

Manufacturer's name and address:

Radio-Service, JSC

Pushkinskaya street, 268, Izhevsk, Russia.

Post code: 426000, P.B. 10047.

Phone: +7-3412- 43-91-44. Fax: +7-3412- 43-92-63.

E-mail: [office@radio-service.ru](mailto:office@radio-service.ru) Internet: [www.radio-service.ru](http://www.radio-service.ru)