LLC “Chelenergopribor”

Small-size portable micro-ohmmeter

IKS–5

User Manual
Certificate

Chelyabinsk
Russia
2015

The manual instructs the user on technical characteristics, list of components, operational principle, and working instructions for the small-size portable micro-ohmmeter IKS–5 (further referred to as IKS–5).

It also offers description of design, operational principle, characteristics of the device, its components and directions necessary for competent use of IKS–5 (functional use, technical maintenance, current repairs, storage and transportation), as well as troubleshooting instructions and reclamation of the device and its components.

Abbreviations list:

CP – current probes;

PP – potential probes;

LCD – liquid crystal display;

ADC – analog digital converter;

REF – reference voltage source.

1. Description and operation

1.1. Application

1.1.1. The device IKS–5 is used for operative measurement of low electrical resistance to continuous current including intermediate resistance of high voltage breakers and disconnectors.

The device IKS–5 also allows measure electrical resistance of low inductance circuits of other devices and mechanisms in the range of 0 – 10,000 microohm.

1.1.2. The device can be used at power engineering enterprises, power plants and substations, as well as at traction substations for electrical transport.

1.1.3. The device operates under the following conditions:

Operating conditions:

- ambient temperature, °C.....–20…55;
- relative humidity, %.....90 at 30°C;
- atmospheric pressure, kPa.....84…106.7;
- electrical field strength with the frequency of 50 Hz up to 5 kV/m.
- magnetic field strength with the frequency of 50 Hz up to 400 A/m.

Standard conditions:

- ambient temperature, °C.....20±5;
- relative humidity, %.....30…80;
- atmospheric pressure, kPa..... 84…106.7;
- voltage of alternating current supply main, V at the frequency of 50 Hz220±20.

1.1.4. The device IKS–5 has a self-contained power supply using the accumulator battery 6 V with nominal capacity not less than 1.2 A·h and alternating current circuit with the voltage of 220 V and frequency of 50 Hz through in-service charging and feeding device.

1.1.5. Measured resistance value is displayed visually using the four-digit system.

1.2. Technical characteristics

1.2.1. The range of measured electrical resistance is 0…10,000 microohm.

1.2.2. Admissible basic relative error of measurements should not exceed: …….. ± (0.2+0.01(10000/*R*–1))%,

where: *R* – measured resistance value, microohm.

1.2.3. Admissible additional relative error of measurements in case of change in ambient temperature from normal to limit values in the temperature operating range should not exceed the limit of admissible basic error (± (0.5+0.01(10000/*R*–1))%, where: *R* – measured resistance value, microohm) for every 10 °C.

1.2.4. Admissible additional relative error of measurements in case of presence of the outer magnetic field with the frequency of 50 Hz and intensity of up to 400 A/m should not exceed the limit of admissible basic error (± (0.5+0.01(10000/*R*–1))%, where: *R* – measured resistance value, microohm).

1.2.5. Device input resistance, not less than: ..... 9 kOhm

1.2.6. Length of long measuring cables: ..... 12 m

1.2.7. Length of short measuring cables: ..... 3 m

1.2.8. Resistance of current measuring cables not more than..... 0.3 Ohm

1.2.9. Device overall dimensions ..... 145x102x55 mm

1.2.10. Mass without measuring cables, not more than ..... 0.9 kg

1.2.11. Time used for a single measurement, not more than .....2 s

1.2.12. Transition time for the operational regime, not less than .....5 s

1.2.13. Time interval between measurements, not less than.....5 s

1.2.14. The device IKS–5 possesses heat resistant, cold resistant and wet strength characteristics; besides, it has increased durability during transportation according to GOST.R 22261-94 for measurement devices of the 4th category.

1.2.15. Unit cost of the minimum control character at measured electrical resistance less than 1000 microohm: .....0.1 microohm

1.2.16. Unit cost of the minimum control character at measured electrical resistance of 1,000 microohm and more:.....1 microohm

1.2.17. Accumulator charge period, not more than..... 15 hours

1.2.18. Average service period of the device, not less than .....10 years

1.2.19. Average error-free running time, not less than ..... 3,000 h

1.3. The device IKS–5 components

1.3.1. The device has a rectangular design and the transportation belt and connectors for connection of connecting wires and charging and feeding device. There is a display window, power supply switch and «Пуск» ("Start") control button at device facial surface. The device consists of the following components:

- Measuring device .....1 piece
- Long measuring cables..... 2 pieces
- Short measuring cables ..... 2 pieces
- Kelvin clamp probes of the "crocodile" type ..... 2 pieces
- Kelvin pin probes .....1 piece
- Power supply - charging device .....1 piece
- User Manual .....1 piece

1.3.2. The device is used for the following purposes:

- To generate steady measuring current.
- To amplify and transform the signal recorded from potential probes into digital code.
- To display measured resistance value.

1.3.3. The accumulator battery is used to supply power to the device and is installed inside the device frame.

1.3.4. The power supply - charging device is used to charge the device accumulator and supply power to the device in case of absence of the accumulator or in case of accumulator discharged state. It is designed as a connector assembly rated for 220 V and is connected to the measuring device by a connecting cord. There is a light-

emitting diode indicator for display of accumulator charge process on the device frame.

1.4. Design and operation

1.4.1. Fig. 1 shows the flow chart of the device.

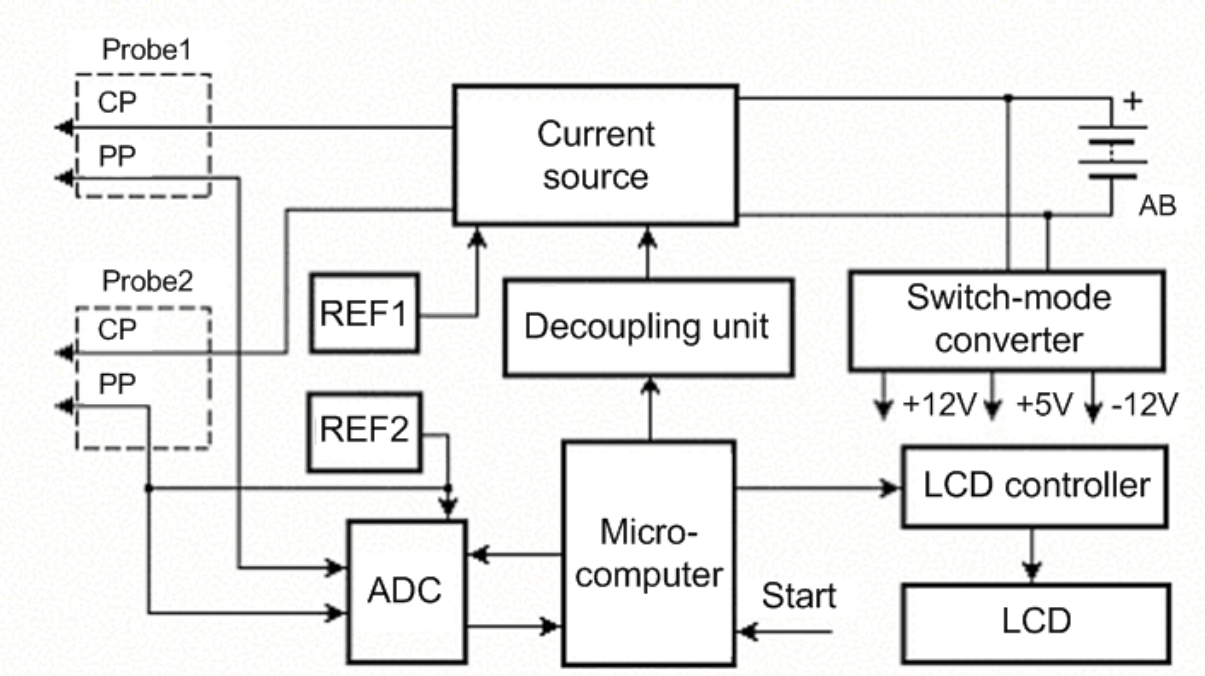

Fig.1

1.4.2. Single functional schematic blocks are used for the following. ADC amplifies voltage at potential probes (PP), converts a signal into digital additional code and transmits it to the microcomputer on demand for further processing. ADC has a built-in digital filter used to dejam noises caused by commercial nets with the frequency of 50 Hz. Steady continuous current generator is used to generate current equal to about 2 A through current probes (CP) during measurement. A single-chip microcomputer is used to control the device, control button and ADC, it switches on the steady current generator and displays indicated values. The microcomputer has nonvolatile data memory with calibration factors calculated during device adjustment. (see 3.2).

The circuit of measuring current rise is separated from the circuit of potential drop measurement by electrical isolation at transistor optocoupler. The device is lo-

cated in the welded frame made from aluminum alloy. Fig. 3 gives the image of the clamp.

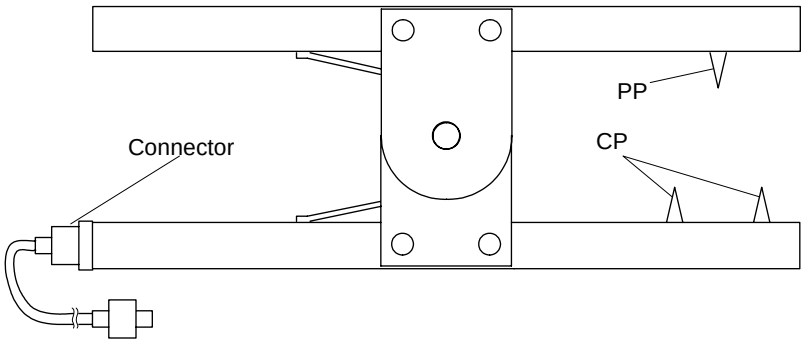

Fig. 3

1.4.3. The device measures resistance using standard four-point method. Steady current with known intensity passes through current probes (CP) along the controlled area during the measurements. Voltage generated in the circuit controlled area by the above-mentioned current using potential probes (PP) is supplied to the device input.

1.4.4. The operating algorithm of the device at the moment of measurements is given below. After having installed the probes at the device current-carrying parts, the operator presses the "Start" button. The microcomputer measures schematic zero shift and starts the ADC. After the zero shift code is supplied from the ADC, the microcomputer starts the steady continuous current generator and transmits the command to start the ADC after ten milliseconds. After ADC operational regime is over, the microcomputer receives the code proportional to the input signal and switches off the current generator. Using the code proportional to the signal at potential probes and zero shift code of the measurement schematic, the microcomputer does the correction and displays the measurement results.

1.4.5. Device circuit technique allows exclude the additive component of systematic inaccuracy according to the reference standard method and measure schematic zero shift before each measurement.

Non-linearity of the device scale is mainly determined by ADC non-linearity and is equal to not more than ±0.015% from the full scale.

The above-mentioned features of mathematical treatment increase measurement accuracy, simplify use of the device under industrial conditions and reduce requirements to professional skills of the maintenance staff.

1.5. Measuring tools, instruments and accessories

The list of specific measuring tools, testing and other equipment, instruments and accessories required for control, adjustment, maintenance and current repairs of the device IKS–5 and its components is given in Table 1.

Table 1. List of specific measuring tools, testing and other equipment, instruments and accessories

Name	Main technical (and metrological) characteristics	Quantity
1. Clamp probes of the "crocodile" type	130x56x26 mm	2
2. Power supply - charging device	The "Operation" regime 6.9 V, 2 A The "Charging" regime 0.06 A	1
3. Short connecting cable	3±0.2 m	2
4. Long connecting cable	12±0.5 m	2
5. Resistance standard	100 micro-ohm (accuracy better than 500 ppm)	1
6. Resistance standard	1000 micro-ohm (accuracy better than 100 ppm)	1
7. Resistance standard	10 000 micro-ohm (accuracy better than 100 ppm)	1
8. Resistance standard	25 micro-ohm (accuracy better than 5000 ppm)	1
9. Contact device		1
10. Screwdriver		1

1.6. Identification marks

1.6.1. Identification marks for the device IKS–5 match the requirements of GOST.R 22261-94 and GOST.R 26104-89.

1.6.2. Each device IKS–5 is identified by:

– name of the device;

– serial number according to the numeration system of the manufacturing enterprise;

1.6.3. Identification is executed in any manner provided it is legible and undamaged during the whole period of device IKS–5 service life.

1.7. Packing

1.7.1. Packing of the device IKS–5, its manual, accompanying documents and used auxiliary tools match the requirements of GOST.R 9181-74.

2. Device application

2.1. Pre-starting procedure and operation

2.1.1. One should fulfill the following steps before starting the device:

- Study the manual, certificate, device schematic and design.
- Check the device IKS–5 visually.
- Connect measuring cables of required length to the device and feelers by means of corresponding connectors.

2.2. Device IKS–5 operation

2.2.1. To make measurements using the device IKS–5 one should do the following.

2.2.1.1. Switch on the "On/Off" power supply switch located on the device front panel. After the switch is in the "on" position, the ADC is self-calibrated accompanied by countdown at the display during 5 seconds. After self-calibration is over, the display shows 00, which means that the device can be used to make measurements.

2.2.1.2. The clamps are placed onto current-carrying parts of the investigated object – switches or disconnectors - and are shook a little in order to improve contacts between the object and probes. To reduce influence of electromagnetic disturbances

onto measurement results, one should intertwist the measuring cables (this should necessary be done in case one uses long measuring cables).

2.2.1.3. To start the measurement, press the «Пуск» ("Start") button. Measurement results are displayed on the device. If the measurement value does not exceed 11,000 microohm, it can be shown at the device display. In this case the display high-order digit is a hexadecimal number: A=10, b=11, correspondingly. If the measured resistance is much more than 11,000 microohm, the display shows overflow "ПЕР".

2.2.1.4.Read the measurement result from the display.

2.2.1.5. Next measurement can be started not earlier than four seconds after the previous one. During this time period the «Пуск» ("Start") button is disabled. The end of the period is indicated by a short-term lighting of the decimal point after the number of the high-order (leftmost) digit of the display.

2.2.1.6. In order to save power supply stock, switch off device power supply system, if time interval between measurements exceeds 5 min.

2.2.2. It is prohibited to switch on and operate the device, if the display shows “РАЗР” (Discharged state), which means that the accumulators are discharged. Charge the accumulators.

2.2.3. In case of absence or discharged state of the accumulators, one can make measurements using the alternating current circuit of 220 V, 50 Hz – connect the power supply - charging device to the device IKS–5 using the connector and plug it into the circuit, then make measurements according to par. 2.2.1. of the manual.

2.2.4. Charge the accumulators when device power is off. Insert the connector plug of the power supply - charging device into the charge connector hole located at the right sidewall of the device frame. Plug the bracket located in the charging device frame into the socket with the parameters 220 V, 50 Hz. Time required for accumulator charging in case of complete discharge should not exceed 15 hours.

2.2.5. To replace the accumulators in case of breakdown resulting from termination of life time or for any other reasons do the following.

Remove the device from the frame. To do so unscrew two screws located at frame profile planes (they are used to fix the belt for device transportation) and one screw at the device frame bottom. After the device is removed from the frame, one can get access to the accumulator battery located at the device frame. Unscrew the screws used to fix the buckle for holding the accumulator battery. Remove knife connectors used to connect the accumulator battery with the device. Assemble the device in a reverse order. **Note that the connector with red identification mark is connected to plus sign of the accumulator battery**.

2.3. Safety requirements

Follow the requirements of electrosecurity according to GOST.R 12.3.019-80 and "Rules of safety engineering for use of electric installations" approved by Gosenergonadzor in 1997 during operation and maintenance of the device IKS–5.

2.4. Troubleshooting

Table 2 shows some possible failures and methods of maintenance.

Table 2. Possible failures

Failure	Possible origin	What to do
1. "РАЗР" ("Discharged state") is displayed or LCD wouldn't function when one switches on power supply or during operation.	The accumulator battery is discharged or disabled. Possible oxidation of battery connector junctions.	Charge the accumulator battery. Check and trim the junctions. In case the battery is disabled – replace it.

3. Maintenance

3.1. General

Preventive inspection is done in order to ensure stable operation of the device IKS–5 during its exploitation period. Frequency of preventive inspections depends on environmental conditions of the device and operational rate.

Routine maintenance connected with device opening is combined with any repairs or device regular calibration.

Recommended methods and terms of preventive inspection:

- visual examination and external cleaning – on monthly basis.
- internal examination, examination of technical parameters of device mechanical assemblies – on annual basis.

For inner inspection unscrew two screws located at frame profile planes (they are used to fix the belt for device transportation) and one screw at the device frame bottom. After the device is removed from the frame, one can get access to the accumulator battery. Check reliability of inner mechanical connections and tighten them if necessary. Assemble the device in a reverse order.

3.2. Adjustment of the device IKS–5

Adjust the device before each calibration. Adjustment is done under normal conditions by an engineer-metrologist. The device IKS–5 is connected to the resistance standard for 0.01 Ohm through the contact device according to the schematic given in Fig. 4 using in-service short measuring cables with probes.

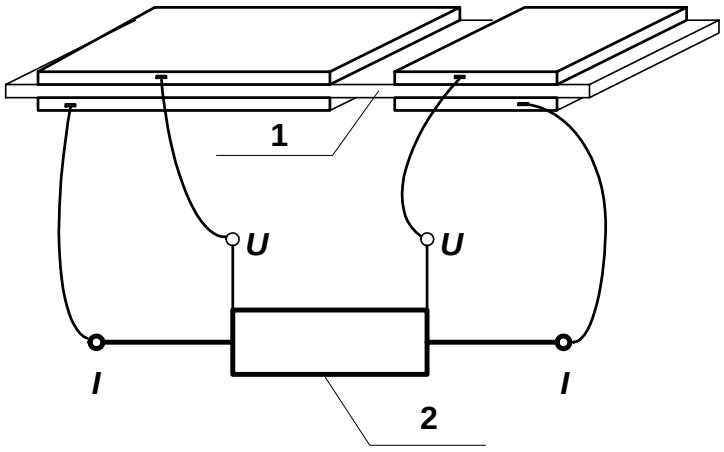

Fig. 4

1 – contact device – plate made from insulation material with metal isolated contact plates with flexible current outlets for connection to measuring resistor fixed on the surface of the plate.

2 – resistance coil (measuring resistor) with potential (*U*) and current (*I*) clamps.

After switching on the device power wait five minutes so that the device warms up. After the device is warmed up, press the «Пуск» (“Start”) button and after the display shows the data, press the «Пуск» (“Start”) button five times successively and hold it pressed not less than 1 second. The display would show “Adj”, which means that the device is in the regime of adjustment. One can see numbers 9999, 8888, …, 0000 on the display before the adjustment procedure. If one presses the “Start” button when the numbers appear, the device would make one measurement and quit the regime of adjustment. Otherwise adjustment begins and lasts for about 24 seconds. The adjustment regime stops automatically and is indicated by “End” on the display.

4. Calibration of the device IKS–5

4.1. General

Calibration of the device IKS–5 is done once a year under normal working conditions according to the document CP 25-233-00 “GSI. Small-size portable microohmmeter IKS–5. Calibration procedure” (CP), developed by the Ural Scientific-Research Institute of Metrology.

4.2. Calibration procedure

Table 3 gives the description of the calibration procedure for the device IKS–5.

Table 3

№	ND Number for calibration	Procedure for	
		first calibration	repeating calibration
External examination	7.1	Yes	Yes
Testing	7.2	Yes	Yes
Checking basic relative error	7.3	Yes	Yes

4.3. Calibration devices

For calibration, devices listed in Table 1, par. 5-9 are used. One can also use other calibration devices with similar metrological parameters.

4.4. Requirements for calibration

4.4.1. To make calibration, one should stick to normal conditions when basic relative error of the examined device IKS–5 is normalized:

- Ambient temperature..... 20±5°C
- Relative humidity, not more..... 30…80%
- Atmospheric pressure .....84…106.7 kPa

4.4.2. The accumulator of the device IKS–5 should be fully charged before calibration. In case of absence of accumulator, use in-service charging and feeding device supplied from the alternating current circuit with the frequency of 50 Hz and voltage of 220±20 V.

4.4.3. Before calibration store the device IKS–5 under environmental conditions mentioned in par. 3.3.4.1. not less than 4 hours.

4.4.4. Before testing, the device IKS–5 should by in an "on" position during the time period identified in standard-technical documentation for the device.

4.5. Calibration

4.5.1. External examination

Calibrated device IKS–5 should be fully assembled (excluding accessories). The device IKS-5 should be examined and the following failures should be mended:

- inadequate fixing of connectors, plugs and socking connectors used for connecting external circuits and micro-ohmmeter;
- breakdown in insulation of external current-carrying parts of the device;
- major mechanical damage of device external parts, absence of adjustment arms.

4.5.2. Testing

4.5.2.1. During testing the device IKS–5, connecting cables, current and potential probes of device feelers, and contact device are examined.

4.5.2.2. The device is switched on and prepared for operation according to the requirements identified in its technical documentation. Connect resistors with resistance values close to maximum scale value in turn to the device IKS–5 input (contact device), measure them directly (by pressing the “Start” button) and check operation in the whole range.

4.5.3. Calculation of basic relative error

4.5.3.1. Basic relative error is calculated by direct measurement of sample coil resistance or branch circuit by the checked device IKS–5 under normal application conditions.

4.5.3.2. Connect sample coil or branch circuit through the contact device (Fig. 4) to input clamps (probes) of device feelers and make ten measurements of the coil or branch circuit.

The following parameters are calculated:

– average value of resistance measurement results for each j coil or branch circuit

$$R_j = \frac{1}{10}\sum_{j=1}^{10} R_{ij};$$

– resistance value deviation from the value identified in coil or branch circuit certificates $R_{\text{атт}j}$

$$\Delta_{cj}=|R_j - R_{\text{атт}j}|,$$

in the relative form

$$\Delta_{\text{с}rj}=(\Delta_{cj}/R_j)\cdot 100\%,$$

which is assumed to be systematic component of measurement errors of investigated microhmmeter;

– average quadratic deviation (AQD) of measurement results for *j* coil or branch circuit

$$S_j = \sqrt{\frac{1}{9}\sum_{j=1}^{10}(R_{ij} - R_{\text{arr}j})^2}$$

and in relative form

$$S_{rj}=(S_j/R_j)\cdot 100\%,$$

which is assumed to be random component of measurement error of investigated microhmmeter.

4.5.3.3. In case $\Delta_{cj}/S_j<0.8$, error systematic component is not considered and basic error is calculated as

$$\Delta_j=\Delta_{js},$$

where $\Delta_{js}=t(0.95,n=9)\ S_j=2.262\ S_j$. Here $t(P,n)$ is Student's coefficient.

4.5.3.4. If $\Delta_{cj}/S_j>8$, then random error contrary to systematic error is not considered and

$$\Delta_j=\Delta_{cj}.$$

4.5.3.5. In case the equations 4.5.3.3 и 4.5.3.4 are not satisfied, error value for investigated microhmmeter is calculated as

$$\Delta_j=K_j\cdot S_{\Sigma j}$$

where K_j – coefficient depending on ratio of error random and systematic components;

$S_{\Sigma j}$ – mean-square deviation value of the sum of error random and systematic components.

The value is calculated as

$$S_{\Sigma j} = \sqrt{S_{cj}^2 + S_j^2 + S_{окj}^2},$$

Device IKS–5 zero shift is calculated by making measurements when the two device IKS–5 feelers are connected to one broad couple of contact plates.

The device IKS–5 is serviceable if basic relative error value does not exceed that in par. 1.2.2.

5. Current repairs

Current repairs are executed by the manufacturing enterprise.

6. Transportation and storage

6.1. The device IKS–5 can be stored up to 6 months in the packing of the manufacturing enterprise under ambient temperature from 5 to 40°C and relative humidity of up to 80% at the temperature of 25°C. Dust, aggressive gases and other impurities resulting in device corrosion are prohibited in storage rooms.

In case of the device IKS–5 long-term storage, it is recommended to store charged accumulators outside the device frame. It is prohibited to store the device in switched on state.

6.2. Transportation methods of the device IKS–5 should match GOST.R 22261-94.

Transportation conditions for the device IKS–5 with respect to mechanical and environmental factors should not exceed the following values:

1) impact loads:
   - max. acceleration 30 m/s^2;
   - number of impacts per minute from 80 to 120;
   - exposure time 1 h
2) high temperature 50°C;
3) low temperature minus 50°C;
4) relative humidity 98% at 35°C;
5) atmospheric pressure 86…105 kPa.

6.3. Environmental influence onto the device IKS–5 under extreme conditions of transportation should match the storage requirements 3 or 5 of GOST.R 15150-69.

7. Reclamation

Reclamation procedures for the device IKS–5 match the requirements and instructions of the consumer enterprise. Reclamation procedures for the accumulators match the requirements of the accumulator manufacturing enterprise.

CERTIFICATE

for the small-size portable microhmmeter

IKS–5

1. Application

1.1. The device IKS–5 is used for operative measurement of low electrical resistance to continuous current including intermediate resistance of high voltage cut-off switches and disconnectors.

The device IKS–5 also allows measure electrical resistance of low inductance circuits of other devices
and mechanisms in the range of 0 – 10,000 microohm.

1.2. The device operates under the following conditions:

Operating conditions:

- ambient temperature, °C.....–20…55;
- relative humidity, %.....90 at 30°C;
- atmospheric pressure, kPa.....84…106.7;
- electrical field strength with the frequency of 50 Hz up to 5 kV/m.
- magnetic field strength with the frequency of 50 Hz up to 400 A/m.

Standard conditions:

- ambient temperature, °C.....20±5;
- relative humidity, %.....30…80;
- atmospheric pressure, kPa..... 84…106.7;
- voltage of alternating current supply main, V at the frequency of 50 Hz 220±20.

1.3. The device IKS–5 has a self-contained power supply using the accumulator battery 6 V with nominal capacity not less than 1.2 A·h and alternating current circuit with the voltage of 220 V and frequency of 50 Hz through in-service power supply - charging device.

1.4 Measured resistance value is displayed visually using the four-digit system.

2. Technical characteristics

2.1The range of measured electrical resistance is 0…10,000 microohm.

2.2. Admissible basic relative error of measurements should not exceed: ± (0.2+0.01(10000/*R*–1))%,

where: *R* – measured resistance value, microohm.

2.3. Admissible additional relative error of measurements in case of change in ambient temperature from normal to limit values in the temperature operating range should not exceed the limit of the admissible basic error (± (0.2+0.01(10000/*R*–1))%, where: *R* – measured resistance value, microohm) for every 10 °C.

2.4.Admissible additional relative error of measurements in case of presence of the outer magnetic field with the frequency of 50 Hz and intensity of up to 400 A/m

should not exceed the limit of admissible basic error (± (0.2+0.01(10000/*R*–1))%, where: *R* – measured resistance value, microohm).

2.5. Device input resistance, not less than: ..... 9 kOhm
2.6. Length of long measuring cables: ..... 12 m
2.7. Length of short measuring cables: ..... 3 m
2.8. Resistance of current measuring cables not more than ..... 0.3 Ohm
2.9. Device overall dimensions ..... 145x102x55 mm
2.10. Weight without measuring cables, not more than: ..... 0.9 kg
2.11. Time used for a single measurement, not more than: .....2 s
2.12. Transition time for the operational regime, not less than: .....5 s
2.13. Time interval between measurements, not less than: .....5 s
2.14. The device IKS–5 possesses heat resistant, cold resistant and wet strength characteristics; besides, it has increased durability during transportation according to GOST.R 22261-94 for measurement devices of the 4th category.
2.15. Unit cost of the minimum control character at measured electrical resistance less than 1000 microohm:.....0.1 microohm
2.16. Unit cost of the minimum control character at measured electrical resistance of 1000 microohm and more: .....1 microohm
2.17. Accumulator charge period, not more than..... 15 hours
2.18. Average service period of the device, not less than .....10 years
2.19. Average error-free running time, not less than ..... 3,000 h

3. Device components

Table 1. Components of the device IKS–5

№	Name	Amount
1	Micro-ohmmeter IKS–5	1
2	Long measuring cables	2
3	Short measuring cables	2
4	Clamp probes of the "crocodile" type	2
5	Pin probes	2
6	Power supply - charging device	1
7	User Manual and certificate	1

4. Conservation

Table 2. Conservation of the device IKS–5

Date	Procedure	Period of validity, years	Position, surname and signature

5. Certificate of packing

Small-size portable micro-ohmmeter IKS–5 № …… was packed by the LLC "Chelenergopribor" according to the requirements of effective technical documentation.

_____ _____ _____
(position) (signature) (name and surname)

_____
(date)

6. Certificate of acceptance

6.1. Small-size portable micro-ohmmeter IKS–5 № …… matches the requirements of TU 4221.012.34547804-2011 and is serviceable.

Head of QCD

Stamp _____ _____
(signature) (name and surname)

_____
(date)

6.2. Small-size portable micro-ohmmeter IKS–5. № …… was calibrated under the conditions of the manufacture according to CP 25-233-00 "GSI. Small-size portable microhmmeter IKS–5. Calibration procedure" (CP), and is serviceable.

Date of calibration: _____

Verification officer: _____ _____
(signature) (name and surname)

7. Guarantees

7.1 The manufacturer guarantees that the device IKS–5 matches standard technical requirements provided the consumer adheres to the directions for operation, storage and transportation given in the manual.

The warranty period is 12 months starting from the date of device delivery to the customer.

During the warranty period revealed failures are mended without compensation.

The warranty policy does not cover devices with major mechanical defects and accumulator failures.

7.2 The manufacture can re-examine customer claims in order to determine their validity.

7.3 Current and after-guarantee repairs are executed by the developing and manufacturing institution.

8. Route of device exploitation

Table 3. Route of device IKS–5 exploitation

Date of installation	Place of installation	Date of demounting	Nonfailure operating time		Cause of demounting	Signature of the person responsible for installation (demounting)
			From commencement of operation	After last repair		

9. Transportation and storage

9.1. The device IKS–5 can be stored up to 6 months in the packing of the manufacturing enterprise under ambient temperature from 5 to 40°C and relative humidity of up to 80% at the temperature of 25°C. Dust, aggressive gases and other impurities resulting in device corrosion are prohibited in storage rooms.

In case of the device IKS–5 long-term storage it is recommended to store charged accumulators outside the device frame. It is prohibited to store the device in switched on state.

9.2. Transportation methods of the device IKS–5 should match GOST.R 22261-94.

Transportation conditions for the device IKS–5 with respect to mechanical and environmental factors should not exceed the following values:

1) impact loads:
   - max acceleration 30 m/s^2;
   - number of impacts per minute from 80 to 120;
   - exposure time 1 h.
2) high temperature 50°C;
3) low temperature minus 50°C;
4) relative humidity 98% at 35°C;
5) atmospheric pressure 86…105 kPa.

9.3. Environmental influence onto the device IKS–5 under extreme conditions of transportation should match the storage requirements 3 or 5 of GOST.R 15150-69.

10. Reclamation

Reclamation procedures for the device IKS–5 match the requirements and instructions of the consumer enterprise. Reclamation procedures for the accumulators match the requirements of the accumulator manufacturing enterprise.

Address of the developing and manufacturing institution: LLC “Chelenergopribor”, ul. Severnaya (Shershni), 52, Chelyabinsk, 454902, Russian Federation. E-mail: info@limi.ru. Internet: www.limi.ru/en/
Phone/fax +7-351-211-54-01.