SKB EP®

MIKO-9(A)
MIKO-8M(A)
MIKO-7M(A)

Milliohmmeters

Features and benefits:

- mΩ — Wide application area
- Selection or creation of the measurement object
- Special start and stop measurement modes
- 10A — High-precision measurement mode with AUTO test current selection
- AUTO — Various auto calculations and non-volatile memory
- Automatic measurement of 3-phase transformers
- Y||Δ — Simultaneous resistance measurement across 2 windings
- AUTO and manual demagnetization mode
- °C — Heat run test
- DRM — On Load Tap Changers - DRM test

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Wide application area

MIKO-group instruments are used for DC resistance measurement in inductive and non-inductive circuits with current up to 10 A in different R range:

MIKO-9 MIKO-9A	MIKO-8M MIKO-8MA	MIKO-7M MIKO-7MA
10 μΩ ÷ 30 kΩ	10 μΩ ÷ 10 kΩ	10 μΩ ÷ 2 kΩ

A - the instrument with built-in battery (on order)

- Windings of power and instrument transformers;
- Windings of electric motors, generators, linear compensators;
- Windings of other high-inductance equipment;
- Windings of electromagnets;
- Contacts of circuit breakers, resistors, busbars, and other non-inductive circuits;
- Resistors of compensatory, current limiting, and other HV circuit breakers;
- Cables.

Resistance and current ranges are specified both in automatic and manual modes.

The instruments ensure fully automated R measurement of highly inductive load and thermal EMF balancing in external circuit.

MIKO-7M / MIKO-7MA

MIKO-8M / MIKO-8MA

High level of protection and safety conformity

These characteristics relate to:

- Measurement current excess;
- Emf self-induction;
- Cable ends polarity reversal of storage battery.

MIKO-group instruments have back-up protection against emf self-induction in case of accidental disconnection of measurement cables or mains cables. This feature protects the User from electric shock and the instrument from damage. MIKO-group instruments include the following features:

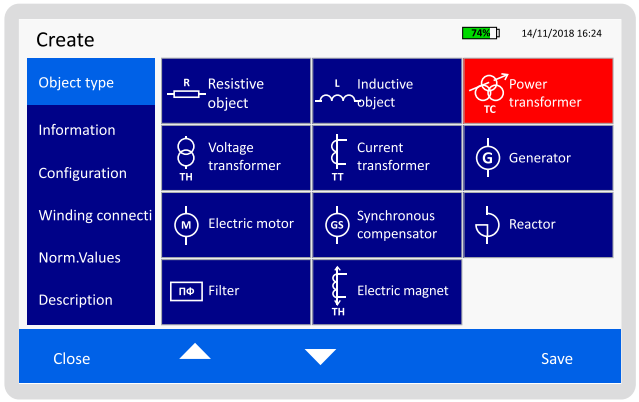
- Set of necessary protection against test block overheat;
- Grounding contact in the mains plug;
- Grounding terminal on the test block case.

Selection or creation of the measurement object *, **

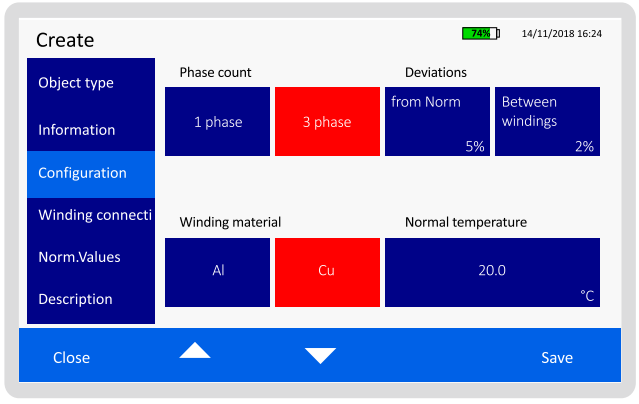
To obtain the most accurate diagnostics results each User can select a standard object from the list, or create his own object to specify its technical parameters. That is possible due to the built-in measurement modes for different objects.

The User can add following specifications about the measurement object:

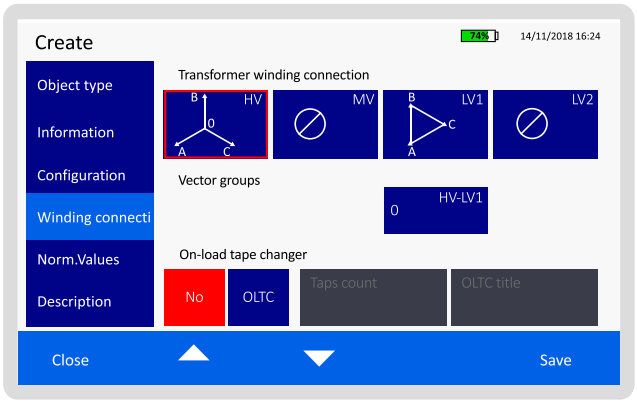
- Object type;
- Object information;
- Configuration;
- Winding circuit;
- Passport values;
- Description.



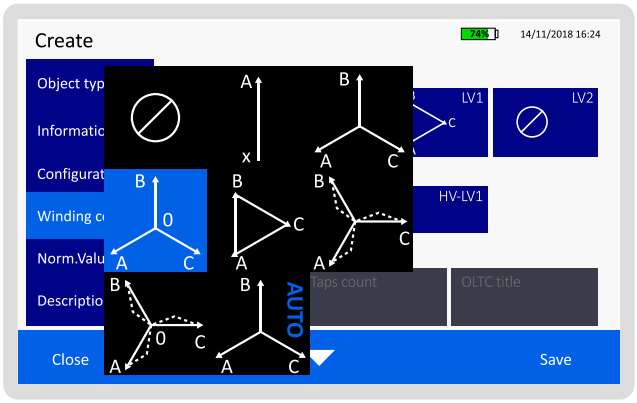
Measurement object creation panel



Configuration selection panel



Winding circuit selection panel



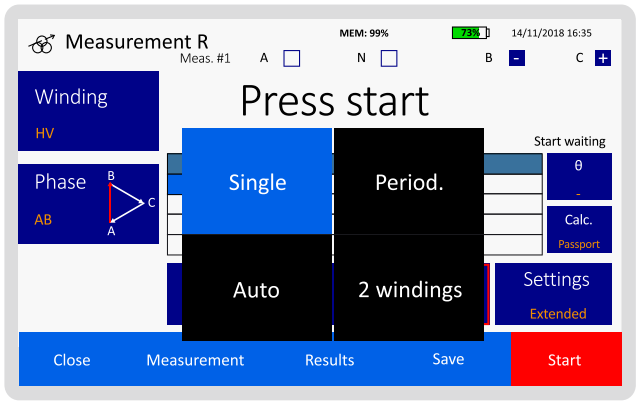
Winding circuit selection panel
Selection of the high voltage (HV) winding circuit

MIKO-9 / MIKO-9A

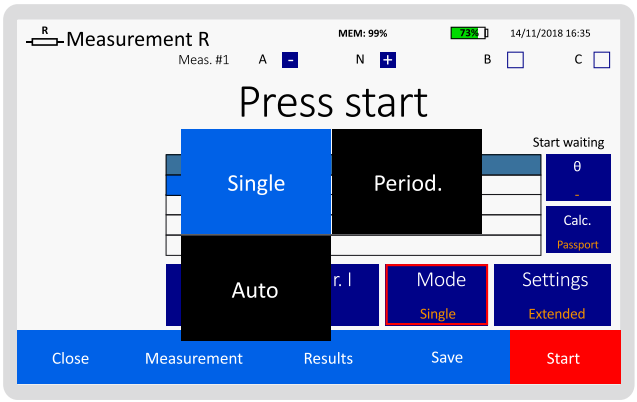
Special start and stop measurement modes *, **

MIKO-group instruments have special start modes for different objects. For example, there are 3 start modes for the resistive object: AUTO, SINGLE, and PERIODIC. For the inductive object the User can choose any out of 4 start modes:

- in **MANUAL** mode start and stop of the measurement are conducted manually by pressing the START/STOP button.
- in **AUTO 1Ph** mode the measurement is started by pressing the START/STOP button and stopped automatically with the achievement of specified criterium.
- in **AUTO 3Ph** mode the start of the measurement is initiated by pressing the START/STOP button. The instrument enables an automatic and consecutive 3-phase measurement with auto stop and indication of the results.
- in **2 windings** mode current is passed through two consecutive-connected windings with simultaneous measurement of voltage drop on each of them and their resistance calculation. This mode may be used for:
  - Simultaneous resistance measurement of HV or LV phase / linear windings;
  - Resistance measurement of phase Star/Wye connected windings;
  - Measurement and subsequent calculation of the ratio between Delta connected windings.



Inductive object
Start and stop mode selection panel



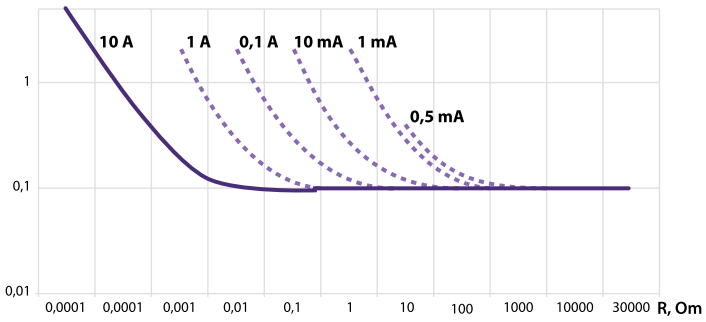
Resistive object
Start and stop mode selection panel

10A High-precision measurement mode with AUTO test current selection

AUTO 1Ph and AUTO 3Ph modes have SKB EP patented automatic measurement method that guarantees results with the highest accuracy.

It is achieved by setting the max current in the measurement circuit not on a staggered basis (depending on the value of the measured resistance), but continuously without fixed measurement ranges in a wide load range.

This measurement mode provides high signal level in a complex electromagnetic environment of industrial production or substation. Moreover, in AUTO modes of the measurement process the instrument produces the highest current that enables guaranteed saturation of the transformer magnetic system.



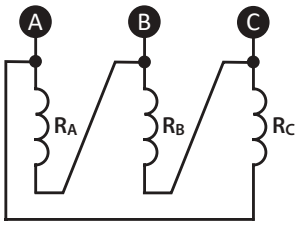
Accuracy in AUTO mode (with automatic current selection)
Accuracy in MANUAL mode (with manual current selection)

Various auto calculations and non-volatile memory *, **

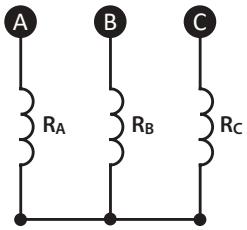
Internal archive provides various calculations:

- Auto **δ** calculation of **Rphase** between one another.
- Auto conversion of **Rlinear** to **Rphase**. Linear windings are Delta or Star / Wye (with no neutral) connected.
- Auto correction of **R** measured at **t°** to **R** at **t°p**.
- Auto **δ** calculation between **Rcorrected** and **Rp**.
- Auto calculation of **t°** by its **R**.

Delta



Star / Wye (with no neutral)



Delta

Phase	A-B	B-C	C-A	
R	8.8645mΩ	9.0956mΩ	9.1415mΩ	t°=10 °C
Rp	9.9500mΩ	9.9000mΩ	9.9000mΩ	t°p=29 °C
R(t°p)	9.5520mΩ	9.8010mΩ	9.8510mΩ	
δ (Rp-R(t°p))	4.16%	0.81%	0.49%	

Tap	R_A	R_B	R_C
1	14.9541mΩ	14.0684mΩ	14.7984mΩ

Star / Wye (with no neutral)

Phase	A-B	B-C	C-A	
R	2.5322Ω	2.5273Ω	2.5421Ω	t°=10 °C
Rp	2.845Ω	2.831Ω	2.847Ω	t°p=29 °C
R(t°p)	2.7285Ω	2.7232Ω	2.7392Ω	
δ (Rp-R(t°p))	4.27%	3.95%	3.94%	

Tap	R_A	R_B	R_C
1	1.3723Ω	1.3563Ω	1.3563Ω

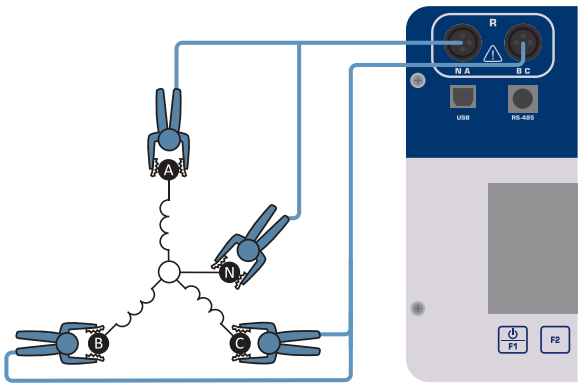
R - measured resistance
t° - temperature during the R measurement
Rphase- phase resistance
Rlinear - linear resistance
t°p - passport temperature value
Rp - passport resistance value
Rcorrected - corrected resistance value
δ - relative deviation

Automatic measurement of 3-phase transformers **

MIKO-9 and MIKO-9A have a special feature to connect to 3 phases of power transformer simultaneously and to perform measurement process with auto phase change.

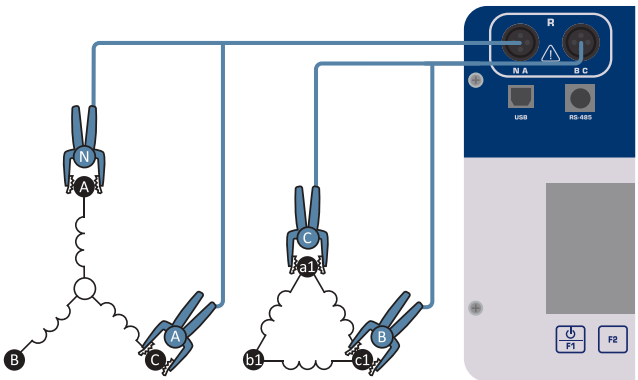
Measurement results are automatically stored in the non-volatile memory and can be later processed by special software on PC or transmitted via Bluetooth to a smartphone. High output capacity (up to 60 W on load) of the built-in current source enables the max saturation of power transformer core, which guarantees reliable winding resistance measurement results.

Furthermore, there is a special mode for resistance measurement of transformer windings with switch-over devices of OLTC and OFTC types.



Simultaneous resistance measurement across 2 windings **

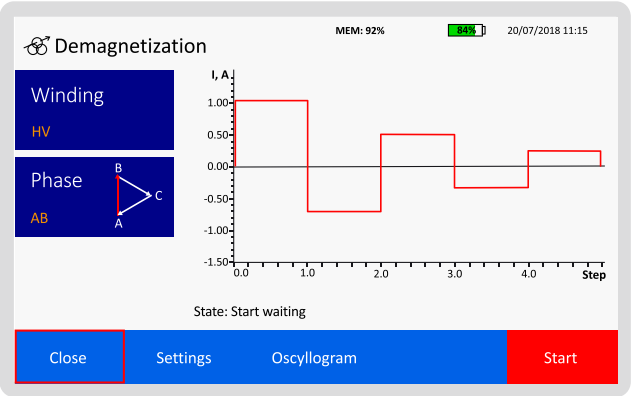
This mode provides fast and accurate DC resistance measurement of power transformers with delta connected secondary windings, when conventional methods do not guarantee reliable results.



AUTO and manual demagnetization mode **

Demagnetization mode is designed to eliminate the remnant magnetism of the transformer magnetic core. It is compulsory before open-circuit test, short-circuit loss measurement, transformation ratio measurement, etc.

The instrument can be used for demagnetization of both single-phase and three-phase transformers. Magnetic core demagnetization requires alternating current applied to the corresponding winding bidirectionally.



Demagnetization result panel

Demagnetization is performed automatically. Current decreases with each direction change. Each rod of a three-phase transformer is subjected to demagnetization.

Current change is displayed at the same time in a graph form to control demagnetization accuracy. Demagnetization stops automatically when the current reaches threshold value or upon the User's command.

Heat run test **

The test is performed by continuous measurement and periodic result saving of the transformer winding **R** (recalculated to **t°**) during the cooling process of the winding.

To receive the most reliable information about the max winding **t°** the User should connect the instrument to the winding and start the measurement immediately after the transformer heating is stopped.

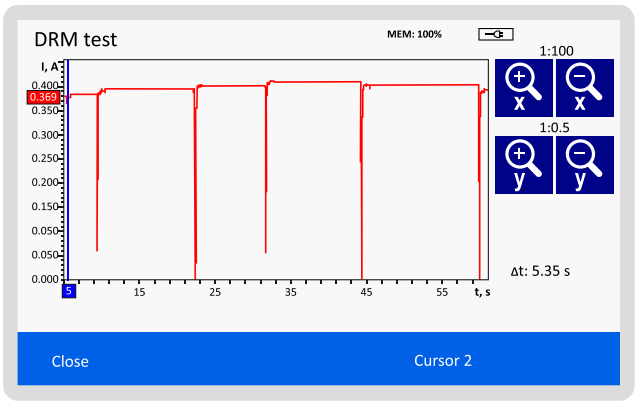
Berofe the start of the measurement process the User has to specify winding, phase, max measurement duration, frequency of measurement results saving, winding **R** and **t°** under normal conditions. Correlation between the winding **t°** and the time can be represented in tabular or graphical form. The time is counted from the moment of the measurement start. Heat run test stops automatically on expiry of preset test duration or manually by the User.

On Load Tap Changers - DRM test *,**

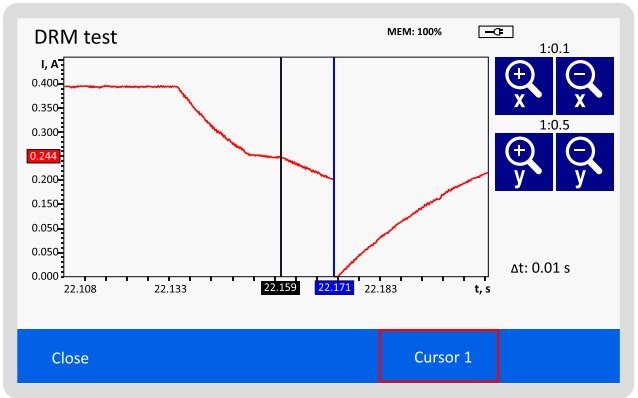
OLTC in-place check mode allows the User to assess the state of the switching OLTC equipment with current limiting resistors without removing contactor tank cover.

This mode involves measuring of instantaneous current drops. Test current firstly passes through the transformer winding and then through OLTC contacts at changing from one tap to another. The DRM graph is built on the basis of the measurement results and shows current change during tap changing. This graph enables to check tap changing time and general object state.

Analysis of the acquired graphs enables not only to sort out OLTC by fault-free/faulty criteria, but also to define the nature of the defect eliminating opening of fault-free OLTCs. Milliohmmeter mode and DRM test complement each other and provide the User comprehensive information about the transformer state.



DRM test result panel



DRM test result panel (zoomed part)

Application field: for use at high-voltage substations and industrial environments

General features

Power supply (mains voltage) MIKO-9, MIKO-8M, MIKO-7M	 AC 90-253 V, 47-63 Hz DC 127-354 V
Power supply (built-in battery) MIKO-9A, MIKO-8MA, MIKO-7MA	 Li-ion battery
Max. consumed power	120 W
Max. output capacity	60 W
Battery lifetime (in continious operation)	8 hours
Battery recharge time	3 hours
Built-in memory MIKO-9 / MIKO-9A MIKO-8M / MIKO-8MA MIKO-7M / MIKO-7MA	 up to 1000 tests up to 200 tests
Dimensions	270 x 250 x 130 mm
Test block weight with battery	4.0 kg (8.81 lbs)
Test block weight w/o battery	2.7 kg (5.95 lbs)
Warranty	3 years
Calibration period	3 years

Measurement features

Resistance range MIKO-9 / MIKO-9A MIKO-8M / MIKO-8MA MIKO-7M / MIKO-7MA	 10 μΩ ÷ 30 kΩ 10 μΩ ÷ 10 kΩ 10 μΩ ÷ 2 kΩ
Accuracy	±(0.1%+0.5 μΩ)
Best resolution	0.1 μΩ
Number of digits in the output of the measurement result	5
Current range	0.005 ÷ 10 A
Current range in the DRM mode *, **	0.1 ÷ 10 A

Environment

Environmental protection	IP 67 (with closed cover) IP40 (with open cover)
Storage temperature	from -20 °C to + 55 °C (up to +60 °C in 50 days)
Operating temperature	from -20 °C to + 55 °C
Relative humidity	95% (non condensing)

Interface

PC communication	USB, Bluetooth, RS-485 **
Display MIKO-9 / MIKO-9A MIKO-8M / MIKO-8MA MIKO-7M / MIKO-7MA	 Color graphic TFT touch-screen, 800 x 480 pix Monochrome graphic 128 x 64 pix
PC software	Windows®-based analysis software
Interface language	English
User's manual language	English

Safety and Certificates

Thermal protection	Protects all sensitive components, avoiding any damage due to overheating
Safety	IEC 61010-1
EMC	IEC 61326-1

Power cable lines

- Cable lines monitoring

Current transformers

- Transformer secondary winding resistance measurement

Voltage transformers (electromagnetic and capacitive)

- Secondary resistance measurement

Power transformers, auto transformers and oil-immersed reactors

- Transformer winding resistance measurement
- Demagnatization mode of transformer's magnetic circuit
- Heat run test
- In-place estimation of the OLTC contactors state (DRM-test)
- Contactor operation oscillography

Synchronous generators, compensators and AC / DC motors

- Object winding resistance measurement

PKR-2 / PKR-2M

MIKO-2.3

Please note that for the specified application area you can choose other instruments that may be more suitable for your purposes and requirements.

We recommend you to check our offer for **PKR-2**, **PKR-2M**, and **MIKO-2.3**. More information is available at our website www.skbpribor.com.

Standard complete set

№	Item	Description		Order №
1	Test block	Instrument and documents: Calibration Certificate, User's Manual, and Log book A - the instrument with built-in battery (on order).	**MIKO-7M**	SKB048.00.00.000
			MIKO-7MA	SKB048.00.00.000-01
			MIKO-8M	SKB049.00.00.000
			MIKO-8MA	SKB049.00.00.000-01
			MIKO-9	SKB041.00.00.000
			MIKO-9A	SKB041.00.00.000-01
2	Measuring cables **on order**	As a matter of convenience for the user, measuring cables are not included in the standard complete set. Each user can select a cable to his/her own requirements. Select at least one measuring cable (see below «Recommended complete set» / «Optional complete set»).		-
3	Mains cable	Mains cable 1 x 2 m (0.24 kg) for connecting the instrument to the power line, as well as for charging the instrument battery through the in-built charger.		SKB018.09.00.000
4	Ground cable	Ground cable 1 x 2.24 m (0.08 kg) for instrument grounding. The cable is equipped with a ground clamp and a screw end cap. Rated current is 50 A.		SKB010.01.00.000
5	Zero resistance equivalent	Resistance zero point accuracy check. Value – 0.000 μOhm.		SKB023.15.00.000
6	Shunt	Type 75ShSM M3 (75ШСМ М3) for checking the operability of the instruments.		-
7	Safety devices	Type VP2B-1V-2A (ВП2Б-1В-2А) (2 pcs) for the power source protection.		-
8	USB 2.0 A-B Cable	USB cable 1 x 2 m. For computer connection and data transfer.		-
9	Attachment devices set kit bag	Carrying case for standard complete set cables of MIKO group instruments.		SKB126.06.02.000

2 Select at least one measuring cable (see below «Recommended complete set» / «Optional complete set»).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Optional accessories

№	Item	Description	kV	L	W	Order №
10	Manipulating rod 35kV	The rod is designed to ensure convenient connection to contacts of a high-voltage item. The rod is completed with a clamp with current and potential contacts connected by wires with the measurement platform. Test cables are connected to the measurement platform from the ground.	35	2.2 m	3.4 kg	SKB110.41.00.000
	Manipulating rod 110kV		110	3.7 m	4 kg	SKB110.41.00.000-01
	Manipulating rod 220kV		220	5.1 m	4.6 m	SKB110.41.00.000-02

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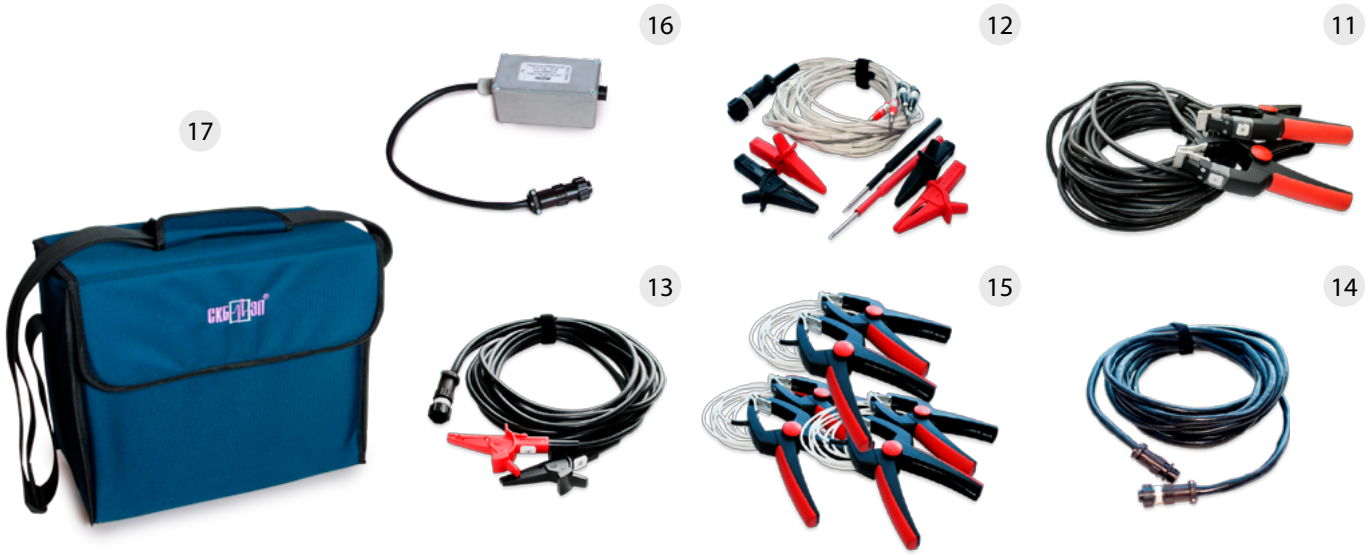
Recommended complete set

№	Item	Description		Order №
11	Measuring cable	Current cable 1 x 8.5 m (1.72 kg) with crocodile clips (jaw up to 80 mm). Elastic silicone tube resistant to low or high temperatures and corrosive media.	**MIKO-7M(A)**	SKB041.18.00.000
			MIKO-8M(A)	SKB041.18.00.000
			MIKO-9(A)	SKB041.18.00.000 SKB041.18.00.000-01
12	Measuring cable	Current cable 1 x 3 m (0.5 kg) with 2 crocodile clips (jaw up to 25 mm) and 2 removable probes (length: 70 mm, plug: 3 mm) for resistance measurement of CT and VT contact joints and windings.	**MIKO-7M(A)**	SKB041.19.00.000
			MIKO-8M(A)	SKB041.19.00.000
			MIKO-9(A)	SKB041.19.00.000
13	Test cables for CT and VT	Current cable 1 x 4 m (0.61 kg) with crocodile clips (jaw up to 25 mm) for resistance measurement of CT and VT windings. Capable for in-built and stand-alone transformers / circuit-breakers.	**MIKO-7M(A)**	SKB041.21.00.000
			MIKO-8M(A)	SKB041.21.00.000
			MIKO-9(A)	SKB041.21.00.000
14	Measuring cable extension	Extension cable 1 x 6.5 m (1.18 kg). Elastic silicone tube resistant to low and high temperatures and corrosive media. To be used together with measuring cables SKB041.18.00.000 / SKB041.18.00.000-01 (jaw up to 80 mm) and SKB041.26.00.000 / SKB041.26.00.000-01 (jaw up to 103 mm).	**MIKO-7M(A)**	SKB031.20.00.000
			MIKO-8M(A)	SKB031.20.00.000
			MIKO-9(A)	SKB031.20.00.000 (set of 2 pcs)
15	Short-circuiting cable (set of 3 pcs)	Short-circuiting cable set 3 x 3m (0.63 kg) with crocodile clips (jaw up to 80 mm). The set is used for applying the DRM-test by closing secondary circuits. This cable is used for OLTC of power and auto transformers. Furthermore, this cable is needed for connecting the high-voltage and low-voltage windings when performing measurements in 2 consecutive windings mode.	**MIKO-7M(A)**	-
			MIKO-8M(A)	SKB041.23.00.000
			MIKO-9(A)	SKB041.23.00.000
16	Additional resistor	Resistor 1 x 0.11 m + 0.35 m (0.23 kg) for in-place OLTC monitoring at apparent resistance of the winding of no more than 0.5 Ω.	**MIKO-7M(A)**	-
			MIKO-8M(A)	SKB032.25.00.000
			MIKO-9(A)	SKB032.25.00.000
17	Tool bag	Robust, convenient, wear proof bag for transportation of cables, documentation and other accessories. The bag is especially useful when the set is carried to an object, so that all the needed accessories are kept together.	**MIKO-7M(A)**	SKB126.06.00.000
			MIKO-8M(A)	SKB126.06.00.000
			MIKO-9(A)	SKB126.06.00.000



Optional complete set

№	Item	Description		Order №
18	Measuring cable	Current cable 1 x 8.5 m (2.26 kg) with a G-clamp (jaw up to 103 mm) for connection to transformer. Elastic silicone tube resistant to low or high temperatures and corrosive media. Alternative version of measuring cable SKB041.18.00.000 / SKB041.18.00.000-01.	**MIKO-7M(A)**	SKB041.26.00.000
			MIKO-8M(A)	SKB041.26.00.000
			MIKO-9(A)	SKB041.26.00.000 SKB041.26.00.000-01
19	Short-circuiting cable (set of 3 pcs)	Short-circuiting cable set 3 x 12 m (0.27 kg) with crocodile clips (jaw up to 50 mm). The set is applied for the DRM-test by closing secondary circuits. This cable is used for OLTC of power and auto transformers.	**MIKO-7M(A)**	-
			MIKO-8M(A)	SKB035.31.00.000
			MIKO-9(A)	SKB035.31.00.000
20	Reference inductor adaptor	Adaptor 1 x 0.025 m + 0.16 m (0.04 kg) for checking laboratories: inspection / calibration of the instrument.	**MIKO-7M(A)**	SKB023.12.00.000
			MIKO-8M(A)	SKB023.12.00.000
			MIKO-9(A)	SKB023.12.00.000
21	KMDLAX-6P plug	An adapter for the RS-485 cable for analyzer communication with the SCADA-controlled measurement system.	**MIKO-7M(A)**	-
			MIKO-8M(A)	-
			MIKO-9(A)	KMDLAX-6P

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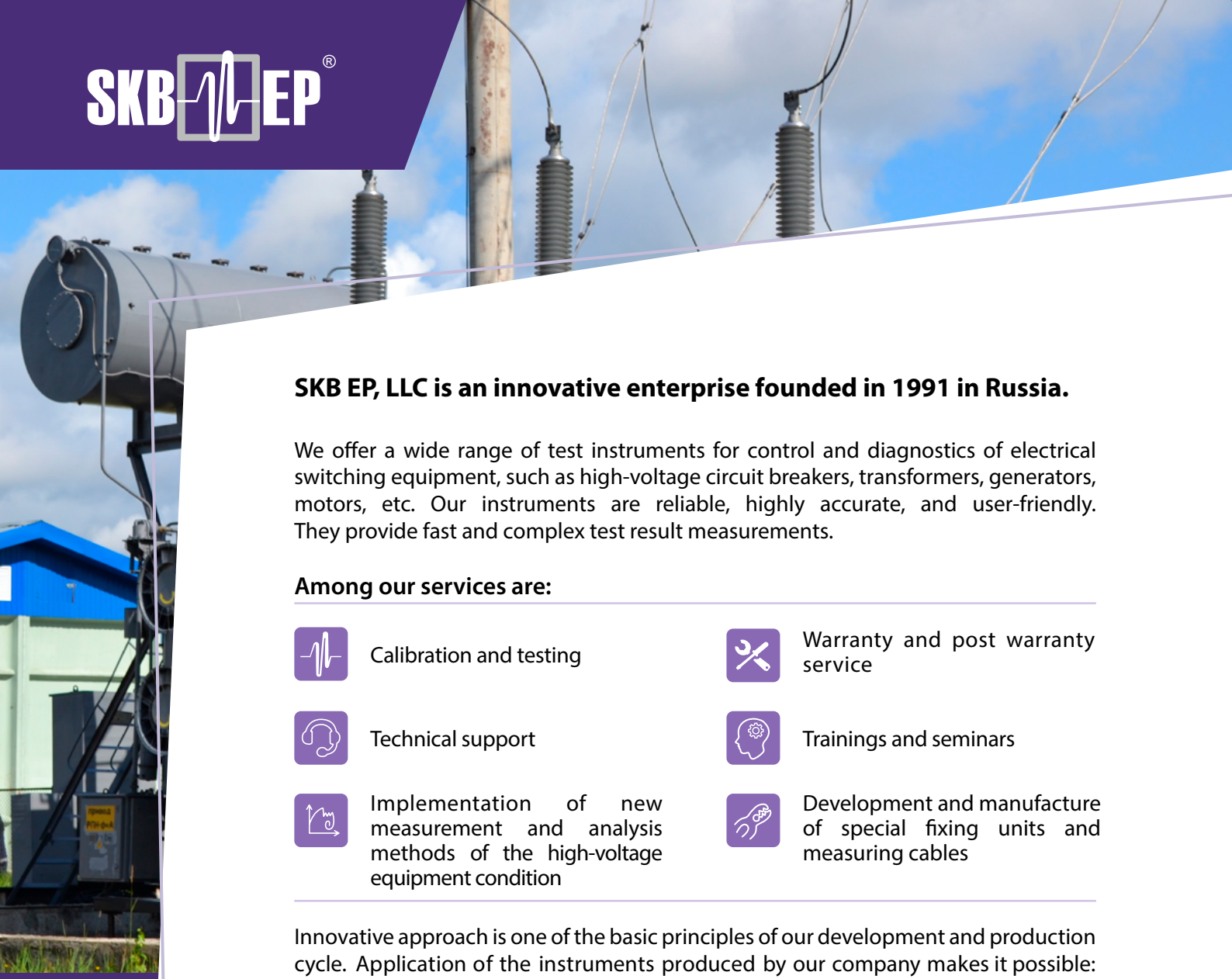

SKB EP, LLC is an innovative enterprise founded in 1991 in Russia.

We offer a wide range of test instruments for control and diagnostics of electrical switching equipment, such as high-voltage circuit breakers, transformers, generators, motors, etc. Our instruments are reliable, highly accurate, and user-friendly. They provide fast and complex test result measurements.

Among our services are:

- Calibration and testing
- Warranty and post warranty service
- Technical support
- Trainings and seminars
- Implementation of new measurement and analysis methods of the high-voltage equipment condition
- Development and manufacture of special fixing units and measuring cables

Innovative approach is one of the basic principles of our development and production cycle. Application of the instruments produced by our company makes it possible:

- to save time for diagnostics and control of high-voltage equipment;
- to simplify working process;
- to reduce the costs for equipment repairs.

>13,000

Today we have more than 13,000 loyal customers. Our instruments are successfully applied in:

- energy systems;
- industrial enterprises;
- railways.

Please visit our website to find more information about our company, instruments and provided services.

www.skbpribor.com

SKBPRIBOR

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