Chelenergopribor

Transformer characteristics meter **SEIT-4M-K540**

EAC

Manual

It is recommended to store together with the device and read carefully before the operation.

Chelyabinsk

1. INTRODUCTION

This operating manual (OM) describes the specifications, design, and principle of operation, as well as the rules of operating the power transformer characteristics meter SEIT-4M-K540 intended for electromagnetic testing of power transformers (hereinafter referred to as the SEIT-4M-K540 meter).

This OM does not give general guidelines for using the PC integrated in the SEIT-4M-K540 meter and assumes the computer skills within the user's scope.

The OM provides information on the design, principle of operation, specifications (properties) of the SEIT-4M-K540 meter, its components, and guidelines for proper and safe operating the SEIT-4M-K540 meter (use as intended, maintenance, repair, storage, and transportation), estimating its technical condition when determining the need for repair, and information on the disposal of the product and its components.

The OM uses the below abbreviations:

ADC analog-to-digital converter,
RVS reference voltage source,
MCT measuring current transformer,
MVT measuring voltage transformer,
ACVS AC voltage source,
OC open circuit,
SC short circuit,
TR transformation ratio,
MC microcontroller,
SW software,
OM operation manual,
MCU measuring and computing unit,
CTU current transformer unit CHEP3905,
HV high voltage,
LV low voltage.

2. SAFETY MEASURES

2.1. In terms of protection against electric shock, the SEIT-4M-K540 meter meets the requirements of GOST IEC 61010. It has the installation (overvoltage) category I (CAT. I) and the electric shock protection class I according to GOST IEC 61140.

2.2. When operating the SEIT-4M-K540 meter, meet the Rules for the Technical Operation of Consumer Electrical Installations up to 1000 V.

2.3. Those who have an Electrical Level of at least 3, have been certified according to the prescribed manner for the right to work with consumer electrical installations up to 1000 V, and have reviewed this manual may operate the SEIT-4M-K540 meter.

2.4. When performing measurements, meet the safety requirements according to GOST 12.3.019.

2.5. Connecting the input and output circuits of the SEIT-4M-K540 meter is forbidden if the tested installation is under voltage.

2.6. When measuring resistance, disconnecting the current clips is strictly forbidden if the measuring current LED lights!

3. DESCRIPTION AND DESIGN OF THE SEIT-4M-K540 METER

3.1. THE METER ASSEMBLY

The SEIT-4M-K540 meter comprises a measuring and computing unit (MCU), a PC-compatible computer (optional), and a current transformer unit (CTU) (optional).

3.2. PURPOSE

The SEIT-4M-K540 meter is intended for electromagnetic testing of power transformers according to GOST 3484.1-88 (testing the transformation ratio and the winding connection group, measuring the winding resistance to direct current, short-circuit (SC) losses and voltage, open circuit (OC) losses and current).

The device is intended for operation in the below conditions:

The SEIT-4M-K540 meter operating conditions:

- Ambient temperature ..... 0 to 40 °C.
- Relative air humidity, no more .....80 % at 25 °C.
- Air pressure ..... 84 to 106.7 kPa.
- Intensity of 50 Hz external magnetic field, no more ..... 400 A/m.

The SEIT-4M-K540 meter normal operating conditions:

- Ambient temperature ..... 20 to 30 °C.
- Relative air humidity, no more .....30 to 80 %.
- Air pressure ..... 84 to 106.7 kPa.
- Intensity of 50 Hz external magnetic field, no more ..... 40 A/m.

3.3. SPECIFICATIONS

3.2.1. The key parameters and characteristics of the meter's measuring and computing unit (MCU):

3.2.1.1	MCU dimensions (length × width × height), mm, no more	360×300×165 mm
3.2.1.2	MCU weight without test wires and connectors, no more	7.5 kg
3.2.1.3	MCU is powered from AC (220 ± 22) V, (50 ± 1) Hz	
3.2.1.4	Power consumption, no more	120 V·A
3.2.1.5	AC rms value measurement range	(0 – 10) A
3.2.1.6	AC voltage rms value measurement range	(0-700)[1] V

3.2.1.7	Active power measurement range	(0 – 4000)[1,2] W
3.2.1.8	DC resistance measurement range	(0.0001 – 200) Ohm
3.2.1.9	Frequency measurement range	(45 – 55) Hz
3.2.1.10	AC rms value measurement limits	1A; 10A
3.2.1.11	AC voltage rms value measurement limits	20 V; 100 V; 400 V; 700 V
3.2.1.12	DC resistance measurement limits	(0.01; 0.2; 2; 20; 200) Ohm
3.2.1.13	The limits of permissible basic reduced error of voltage measurement - within (0-400) V - within (400-700) V	 ± 0.2 % Not rated
3.2.1.14	The limits of the permissible basic reduced error of current measurement	± 0.2 %
3.2.1.15	The limits of the permissible basic reduced error of active power measurement (at cosφ=1, U≤400 V)	± 0.2 %
3.2.1.16	The limits of the permissible basic error of frequency measurement	± 0.05 Hz
3.2.1.17	The limits of the permissible basic reduced error of DC resistance measurement for all DC resistance measurement limits of 0.01, 0.2, 2, 20, and 200 Ohm	± 0.5 %
3.2.1.18	Warm-up time after power-on, no more	15 min
3.2.1.19	Voltage measurement channel input current, no more	5 mA
3.2.1.20	Current measurement channel load voltage drop, no more	250 mV

3.2.2. The key parameters and characteristics of the meter's CTU

3.2.2.1	CTU dimensions (length × width × height), mm, no more	305×245×115 mm
3.2.2.2	CTU weight without test wires and connectors, no more	3.5 kg
3.2.2.3	Current measurement channel load voltage drop: - at a limit of 30 A, no more - at a limit of 60 A, no more	 200 mV 250 mV
3.2.2.4	The CTU rated primary current	30 A, 60 A
3.2.2.5	The CTU rated secondary current	1 A
3.2.2.6	Rated primary voltage	0.66 kV
3.2.2.7	Accuracy class (according to GOST 7746)	0.1

3.2.3. The limits of the permissible additional measurement error caused by a change in the ambient temperature within the operating temperature range of 0 to 40 °C for every 20 °C are equal to the limits of the permissible basic error.

3.2.4. The limits of the permissible additional measurement error when exposed to an external uniform 50 Hz magnetic field with an intensity of up to 400 A/m are equal to the limits of the corresponding permissible measurement error.

3.2.5. The SEIT-4M-K540 meter in a shipping container withstands the ambient temperature within -50 to +50 °C according to GOST 15150 for the 2nd group measuring instruments.

3.2.6. The SEIT-4M-K540 meter in a shipping container withstands the relative humidity of (95 ± 3) % at 35 °C.

3.2.7. The SEIT-4M-K540 meter has durability during transportation according to GOST 22261 for the 4th group measuring instruments.

3.2.8. The SEIT-4M-K540 meter's electric shock protection corresponds to class I according to GOST IEC 61140.

3.2.9. The SEIT-4M-K540 meter reliability under the conditions specified in TU 26.51.43-039-71693739-2019 is characterized as follows:

a) mean time between failures[3] at a failure-free operation probability of 0.95 is 10,000 hours,

b) average service life is at least 10 years.

Notes:

[1]Without using measuring voltage transformers.

[2]For each of the two measuring channels.

[3]The meter failure is its non-compliance with the requirements of paragraphs 1.1.3.13-1.1.3.17, 1.1.4.7 of TU 26.51.43-039-71693739-2019.

3.4. SCOPE OF SUPPLY

Table 1 – Completeness

Description	Designation	Quantity	Note
Measuring and computing unit SEIT-4M-K540	-	1	Modification according to order
Line wire		1	
Set of test wires with alligator clips for resistance measurement		1	
Flash device with software		1	
Operating manual	PTMR.4111722.039 OM	1	
Datasheet	PTMR.4111722.039 DS	1	
Verification technique	PTMR.4111722.039 VT	1	
Current transformer unit CHEP3905		According to order	
MCU-CTU connecting cable			
CTU verification adapter			
Optical patch cord at least 2m long		1	For modification 2
Optics-USB adapter		1	For modification 2

3.5. DESIGN

3.5.1. MCU

The MCU front panel view is shown in Fig.1. 220 V 50 Hz power is supplied to the power connector 8 through the power cord. Fuse 7 (3A) serves to protect the meter circuits from overload. Switch 9 turns on/off the meter power.

The ‘Voltage 1’ (1) and ‘Voltage 2’ (5) terminal groups are intended to connect the transformer sides and are functionally the voltmeter terminals. The ‘Excitation up to 10A’ (6) terminal group serves to connect the excitation voltage source and is functionally the ammeter generator side terminals.

Connector 2 is used to connect the CHEP3905 current transformer unit.

Connector 4 is intended to connect test wires with alligator clips to measure the winding DC resistance. The measuring current LED 3 signals the current flow when measuring the winding DC resistance.

Optional connectors 10 are used to connect the device to a computer via an optical interface.

LEDs 11 serve to indicate hazardous voltage at the corresponding terminals.

Automatic circuit breakers 12 for 10 A protect the meter against the current overload.

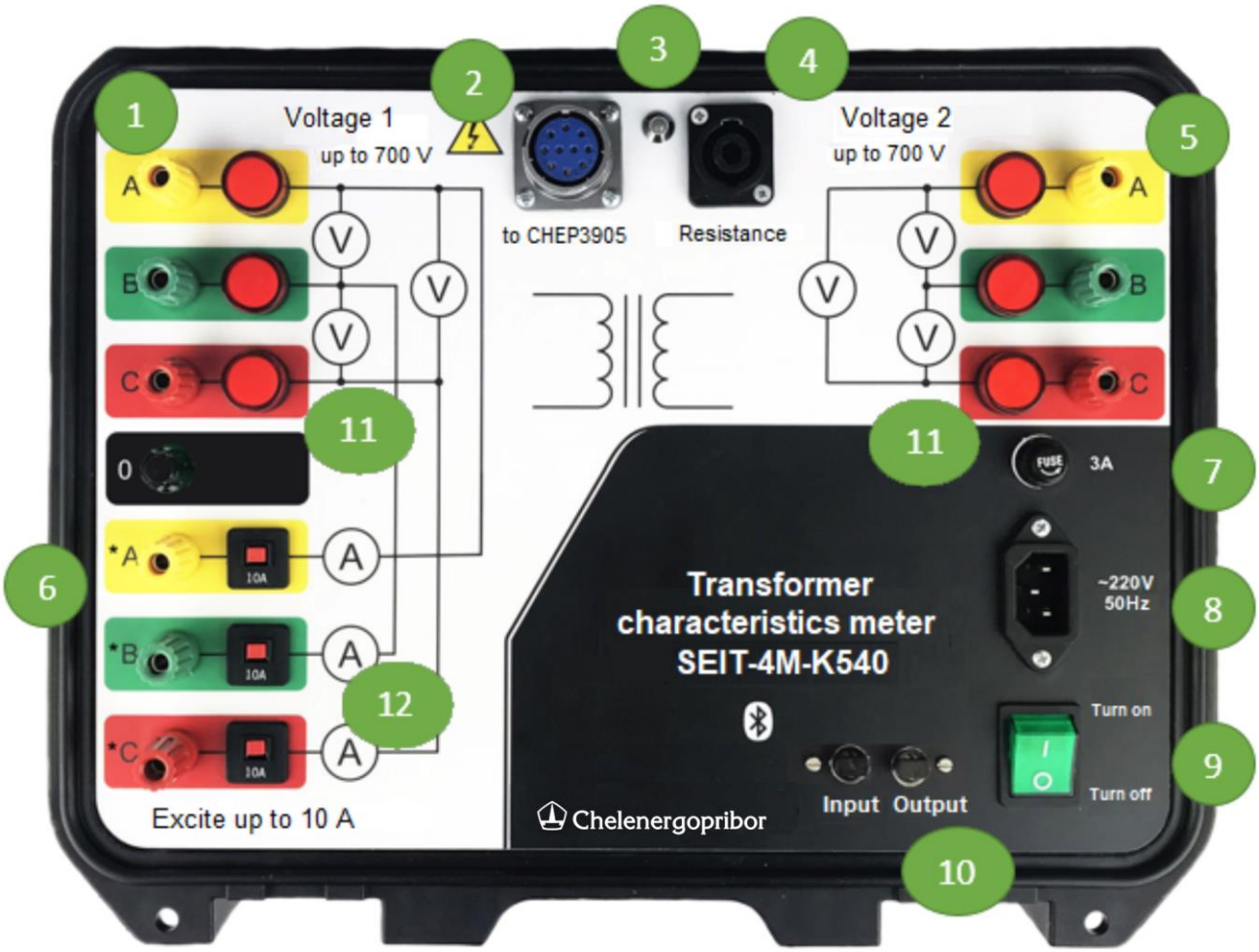

Fig. 1. SEIT-4M-K540 Front Panel

3.5.2. CTU.

CTU comprises 2 measuring current transformers structurally combined into a single housing with a single-connector output for connection to the MCU. This design allows expanding the current measurement range in the most convenient way. CTU expands the input current range to 30 or 60A, depending on the limit chosen.

The current transformer unit front panel is shown in Fig. 2. Terminal group 1 with voltage absence testers is used to connect a test voltage source.

Switch 2 allows choosing the CTU operating mode - 30A or 60A limit. Additionally, this switch performs the emergency shutdown function when the permissible currents are exceeded. Setting switch 2 to neutral (Off) position disconnects the excitation voltage source from the transformer under test.

Terminal group 3 is used to connect to the windings of the transformer under test.

Connector 4 is designed to connect CTU to MCU.

LEDs 5 serve to indicate hazardous voltage at the corresponding terminals.

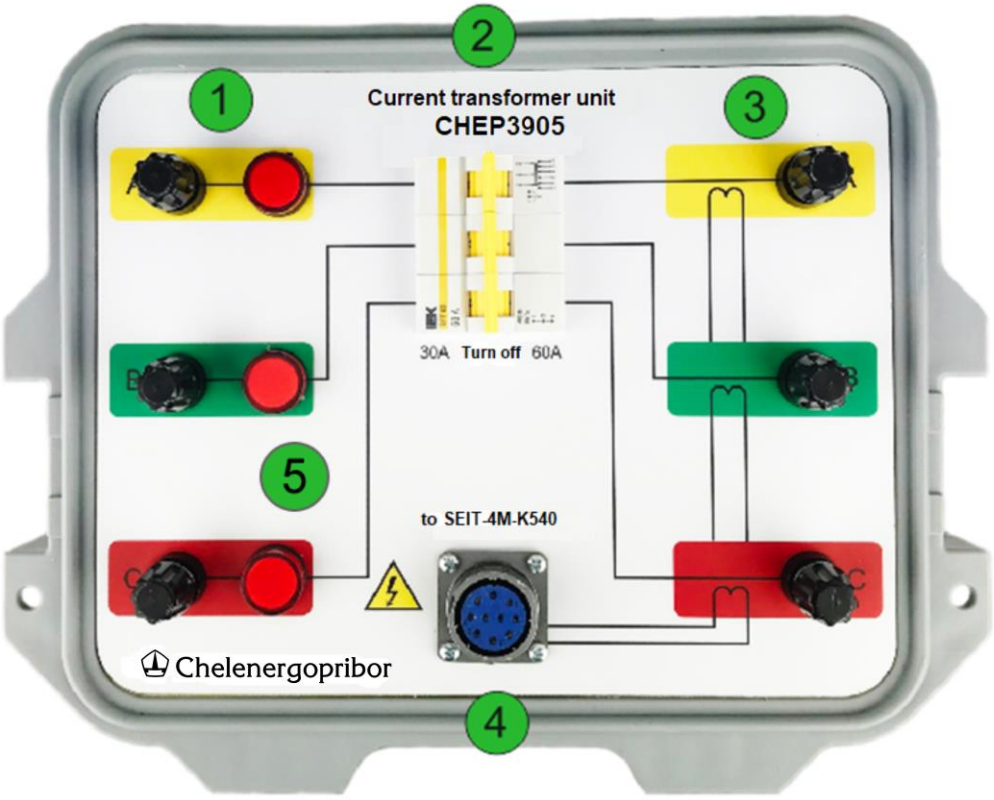

Fig. 2. CHEP3905 Front Panel

3.5.3. Test Wire Set

The test wire set comprises a connector to connect to the meter and two connecting wires with alligator clips, structurally including galvanically isolated potential and current probes. This structure allows to measure resistance by four-wire cheme in the most convenient way.

3.5.4. The Meter Block Diagram and Principle of Operation

MCU records input signals, converts them into a digital code, processes, transmits them to a computer, and generates a stable DC when measuring resistance.

A simplified block diagram of the SEIT-4M-K540 meter is shown in Fig.3.

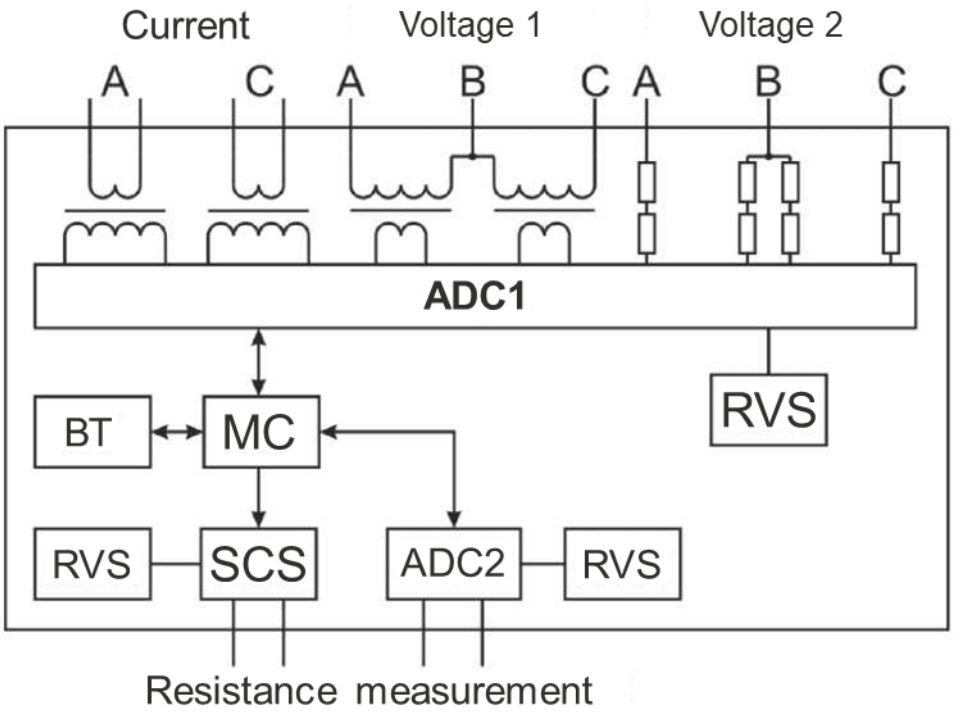

Fig. 3. Block Diagram of the SEIT-4M-K540 Meter.

MCU comprises the below modules:

- Two channels to receive and convert current, each of which contains a built-in measuring current transformer.
- Four channels to receive and convert voltage.
- Six-channel analog-to-digital converter ADC1 designed to convert input current and voltage signals into 16-bit binary code.
- Reference voltage sources RVSs.
- Microcontroller MC designed to receive and process the ADC data.
- Stabilized current source SCS generating measuring current depending on the chosen resistance measurement limit.
- 16-bit analog-to-digital converter ADC2 to measure resistance.
- Wireless transmitter/receiver Bluetooth BT.

4. CONFIGURING THE METER FOR THE FIRST USE

4.1. INSTALLING THE SOFTWARE

The software for the SEIT-4M-K540 meter is supplied on a CD. To install the software, run the exe-file and follow the installer guidelines.

4.2. Turning the Meter On and Establishing Communication with the PC

4.2.1. Turning the Meter On

To prepare the device for establishing communication with a PC:

- Connect the power cord to the device.
- Turn the power switch on and make sure that the main power LED lights.
- Make sure that the current flow LED does not light.

Caution! Continuously lighting measuring current LED immediately after turning the device power on indicates a malfunction and requires promptly de-energizing the device.

4.2.2. Configuring the Communication Channel.

4.2.2.1. The standard meter communication interface is Bluetooth. To establish the communication, choose SEIT4M in the list of detected devices in your PC Bluetooth settings and activate the connection.

4.2.2.2. The meter can be optionally equipped with an optical interface. In this case, a complete USB-optics adapter is connected to the computer. After installing the appropriate drivers (included in the scope of supply), virtual COM ports appear in the system, through which the measuring unit is connected.

4.2.3. Starting the Software and Establishing Communication with the Meter.

After starting the software, the main working window is displayed. It is shown in Fig.4.

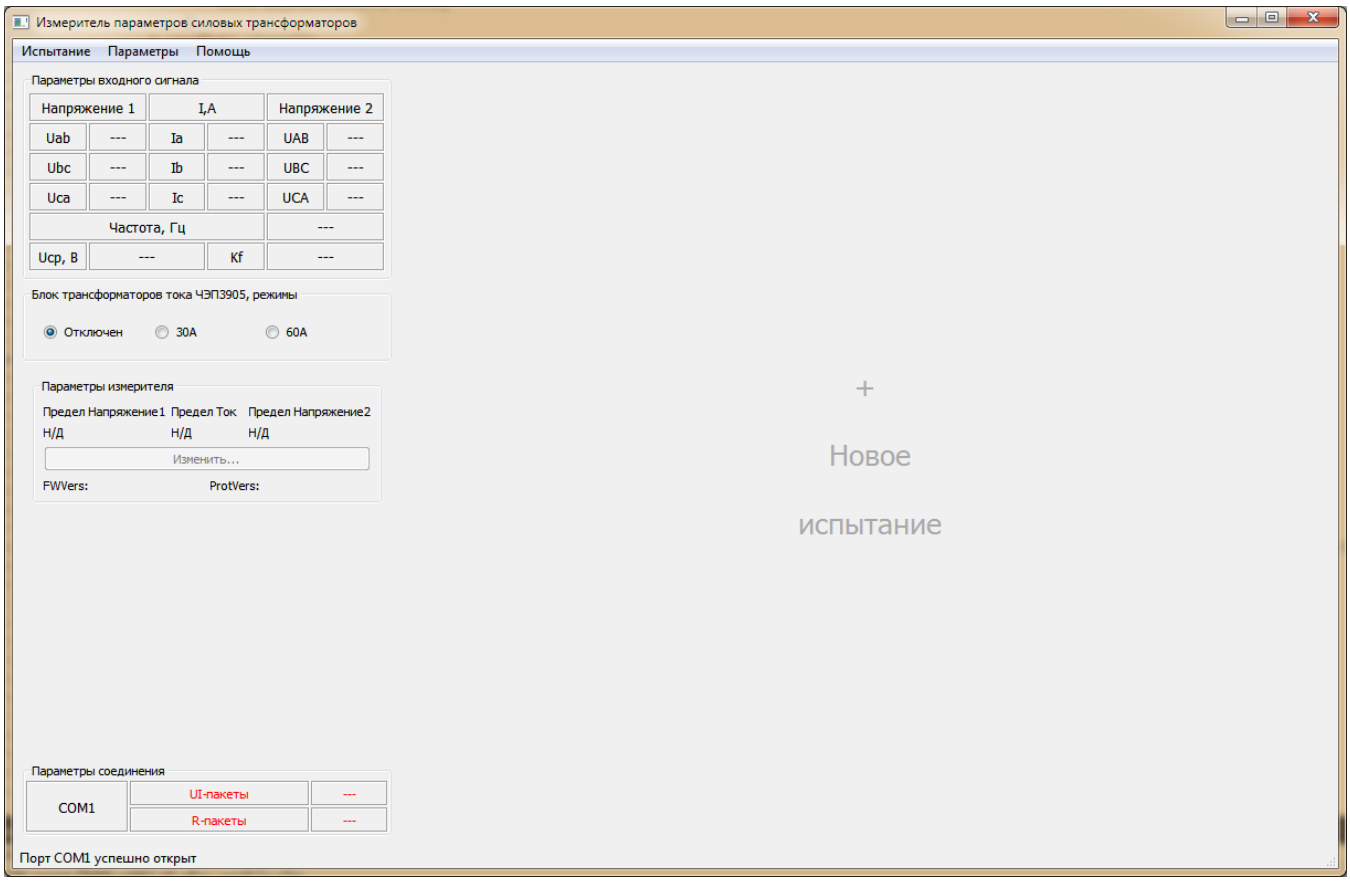

Fig. 4. The Main Working Window of SEIT Software.

To establish communication with the meter, choose the ‘Connection Port’ in the ‘Parameters’ menu and specify the correct port number in the pop-up dialog box. The communication is successfully established, and the measurement data appear in the ‘Input Signal Parameters’ area.

5. Testing Using the Meter.

5.1. Setting-up Procedure

5.1.1. Starting and Configuring the Software.

Before starting the test, start the software and configure the working environment to work with a specific test object. To do this:

1) Start the software and wait for the loading and displaying the main working window (Fig.4.).

2) Click the ‘New Test’ area or choose the menu item Test -> New Test .... In the ‘New Test’ pop-up dialog box (Fig.5.), set the parameters of the transformer tested or choose the previously described type of transformer from the library in the ‘Type’ drop-down list.

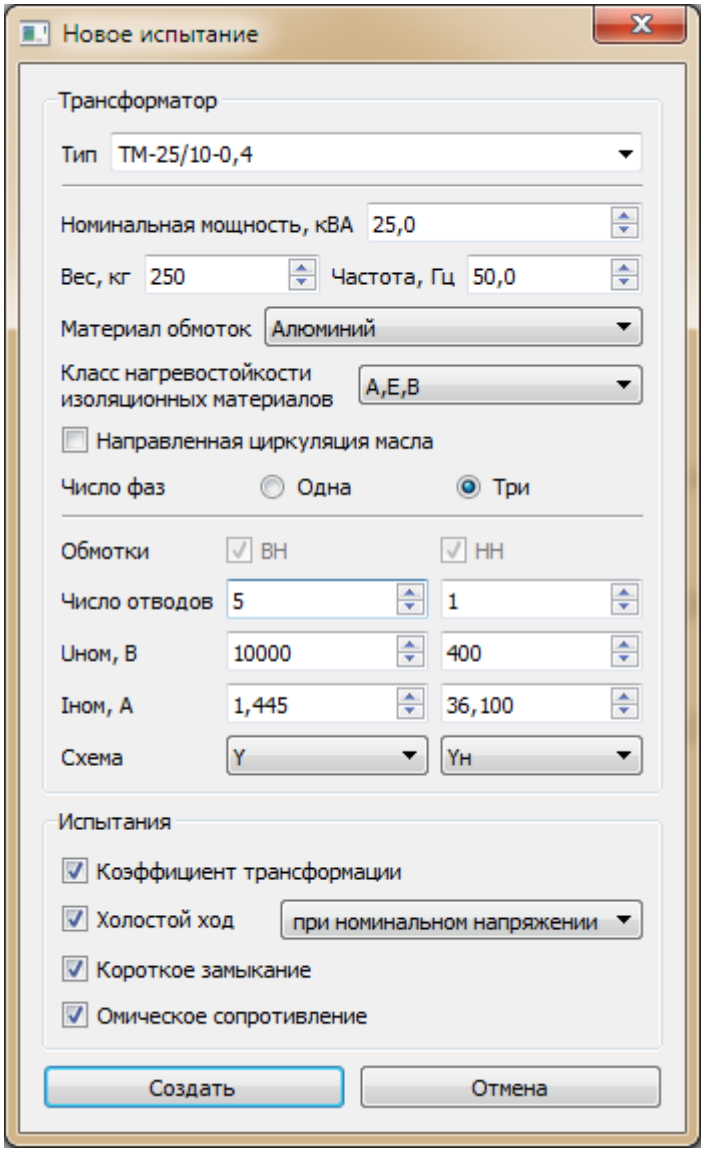

Fig. 5. ‘New Test’ Dialog Box

3) In the ‘Tests’ dialog box section, mark the tests to be performed. Then click ‘Create’. As a result, a working panel will be created with the required set of tabs to record the test results. An example is shown in Fig.6.

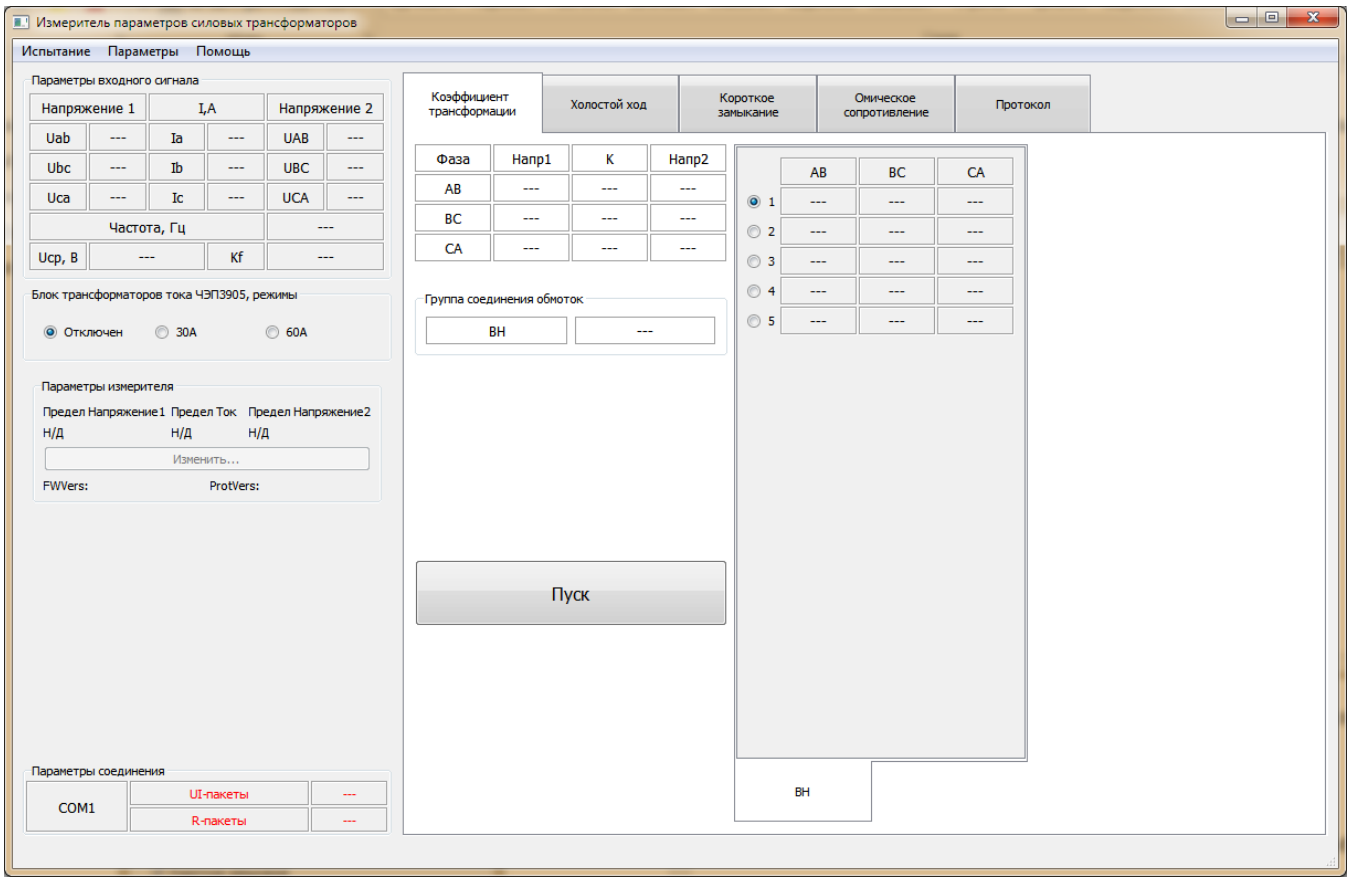

Fig. 6. The Software Main Working Window with the ‘Tests’ Panel.

5.1.2. Preparing for TR, OC, SC Testing

To prepare for the tests specified:

1) Make sure that the test object terminals are not under voltage.

2) Assemble a circuit corresponding to the test performed. For more details, see pp. 5.2.1, 5.3.1, 5.4.1.

3) Turn the device on and establish communication with the PC.

4) When using CTU, choose the appropriate mode in the ‘Current Transformer Unit CHEP3905’ section.

5.1.3. Preparing for Measuring the DC Resistance of Windings

To prepare for measuring the DC resistance of the windings:

1) Connect a set of resistance measurement wires to the meter.

2) Connect the test wire clips to one of the windings.

3) Turn the device on, make sure that the operating current flow does not light.

4) Establish communication with the PC.

5.2. MEASURING THE TRANSFORMATION RATIO

5.2.1. To measure the transformation ratio and determine the three-phase transformer winding connection group, assemble the measuring circuit shown in Fig.7.

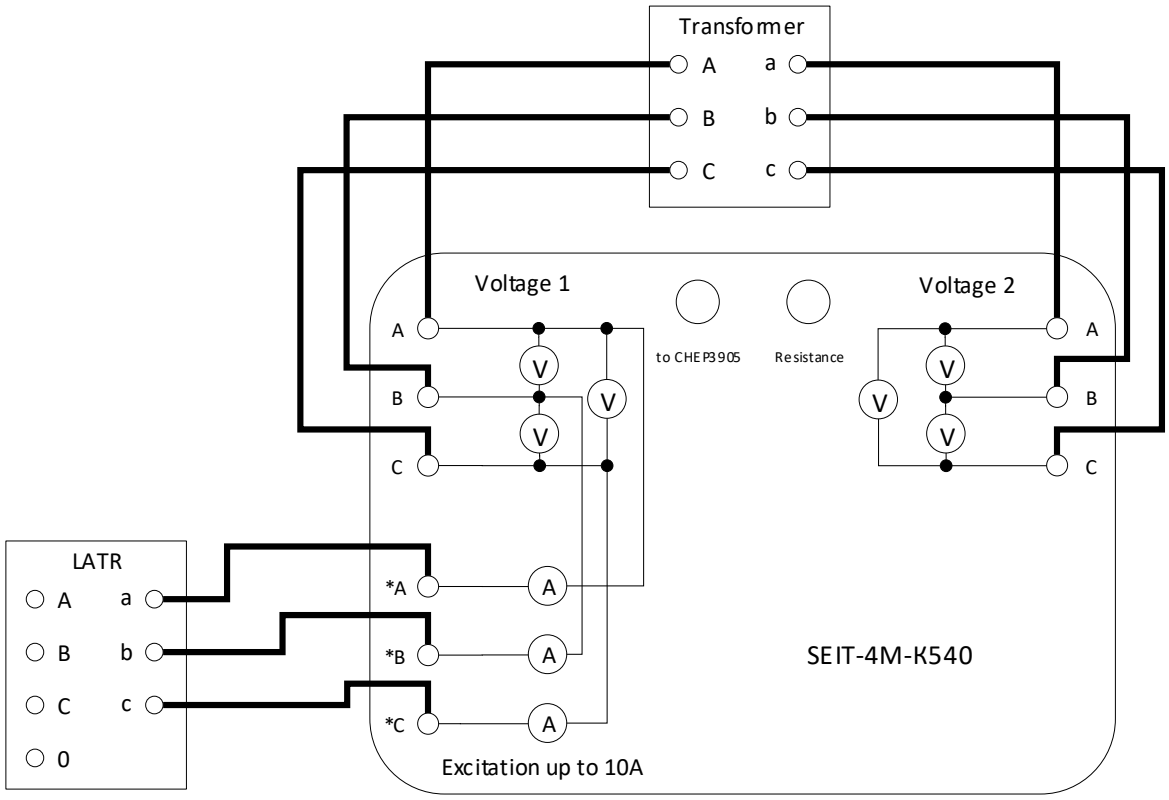

Fig. 7. Three-Phase Transformation Ratio Measurement Circuit

A 30 kVA three-phase autotransformer (LATR) of, e.g., TSGC2-30 type connected to a three-phase 380 V, 50 Hz network can be used as an excitation voltage source.

5.2.2. When working with a single-phase transformer, assemble the circuit shown in Fig.8.

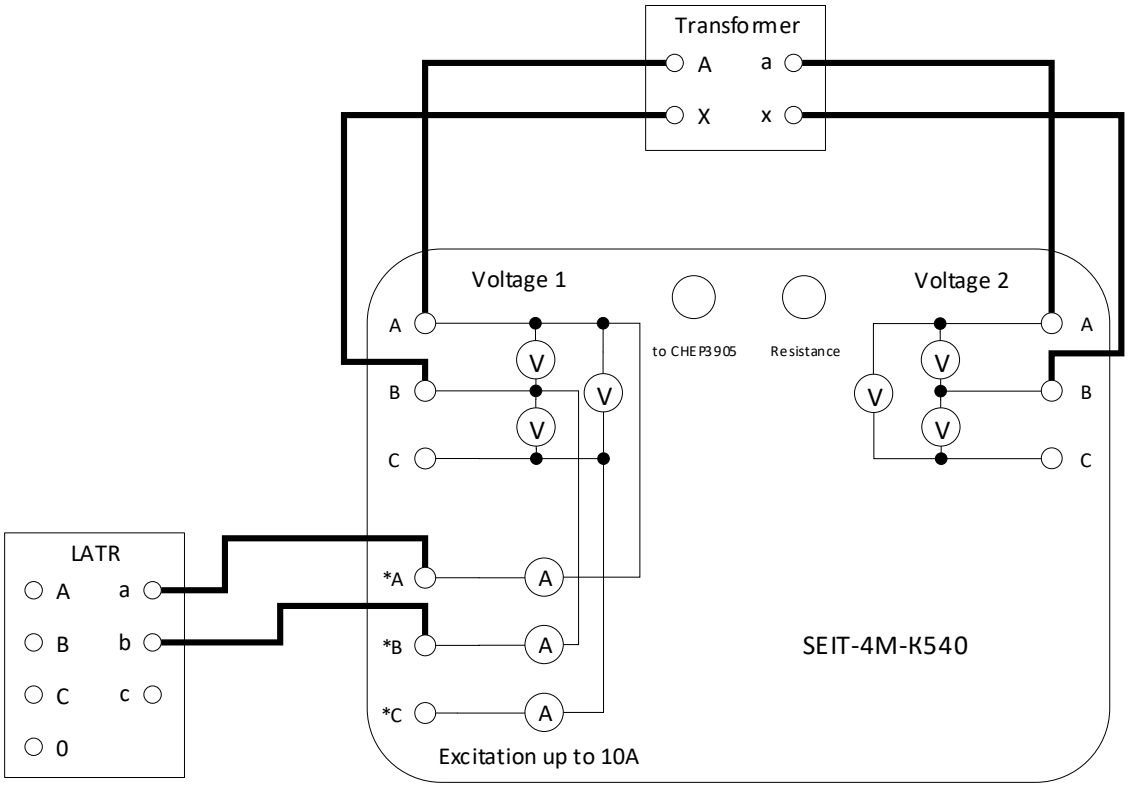

Fig. 8. Single-Phase Transformation Ratio Measurement Circuit

5.2.3. Before starting the test, choose the appropriate measurement limits in the 'Meter Parameters' section. Some possible options are given in the table:

Rated transformer voltage		Test voltage		Recommended measuring limits	
Uhv, V	Ulv, V	Uhv, V	Ulv, V	Vol1, V	Vol2, V
10,000	400	400	16	400	20
6,000	400	300	20	400	20
10,000	6,000	400	240	400	400
35,000	10,000	350	100	400	100
35,000	6,000	400	68	400	100

5.2.4. Switch to the ‘Transformation Ratio’ tab (Fig.9.) and choose the tap tested.

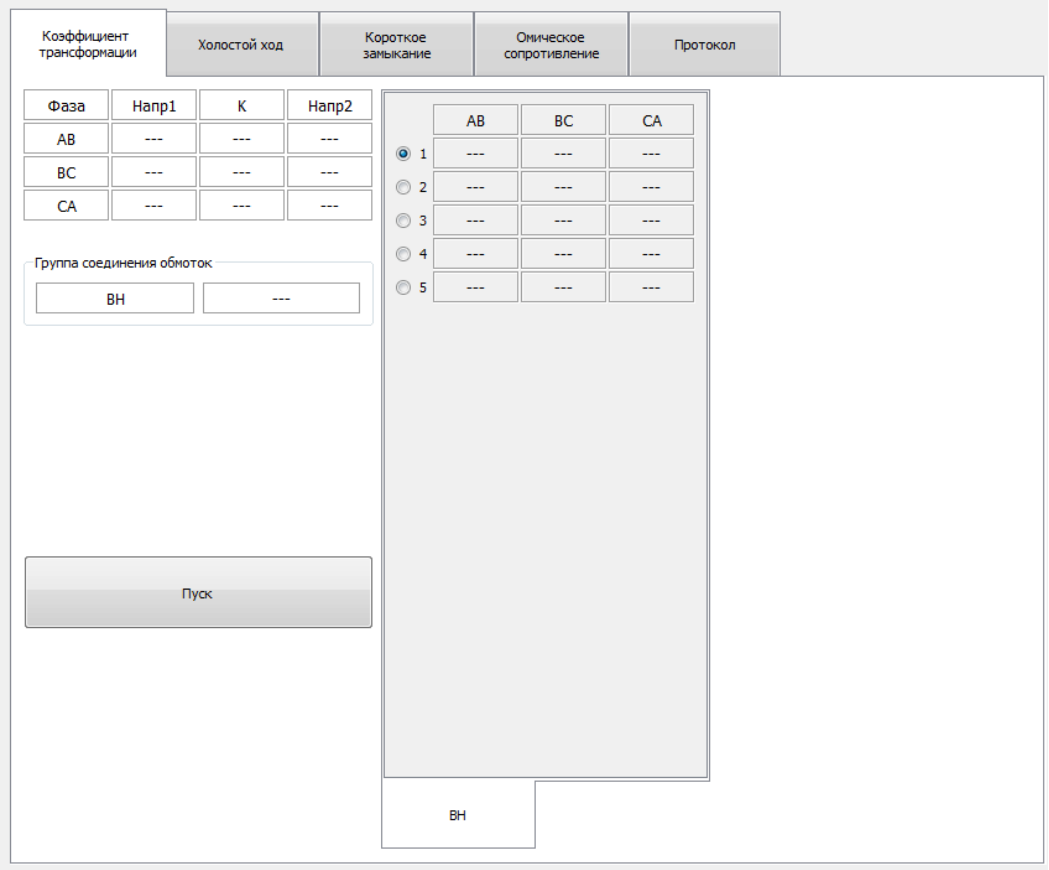

Fig. 9. The ‘Transformation Ratio’ Tab

5.2.5. Power the high-voltage side of the transformer and click ‘Start’.

5.2.6. The transformation ratio is calculated by the formula:

$$Kt = \frac{U_{HV_{meas}}}{U_{LV_{meas}}},$$

Where,

$U_{HV_{meas}}$ is the voltage measured on the high-voltage side,

$U_{LV_{meas}}$ is the voltage measured on the low-voltage side.

5.2.7. The winding connection group is determined by the low- and high-voltage side AB voltage phase shift.

5.3. OPEN-CIRCUIT TEST

5.3.1. *At Rated Excitation Voltage*

For transformers with a rated voltage of about 400 V, an open-circuit test is performed at the rated excitation voltage.

Caution! When the excitation voltage of 400 V is applied to the LV winding of the tested transformer, its HV winding voltage may reach dangerous values !!!

5.3.1.1. To perform an open-circuit test at rated voltage, assemble the measuring circuit shown in Fig.10.

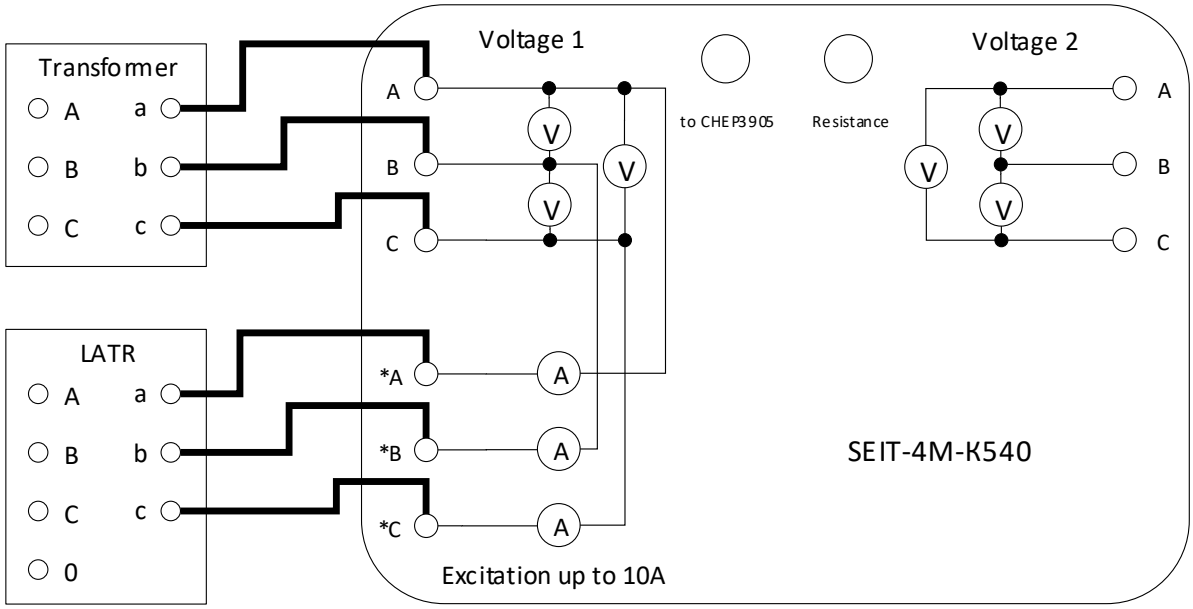

Fig. 10. Connection Circuit for an Open-Circuit Test at Rated Voltage

5.3.1.2. When using CTU, assemble the circuit shown in Fig.11.

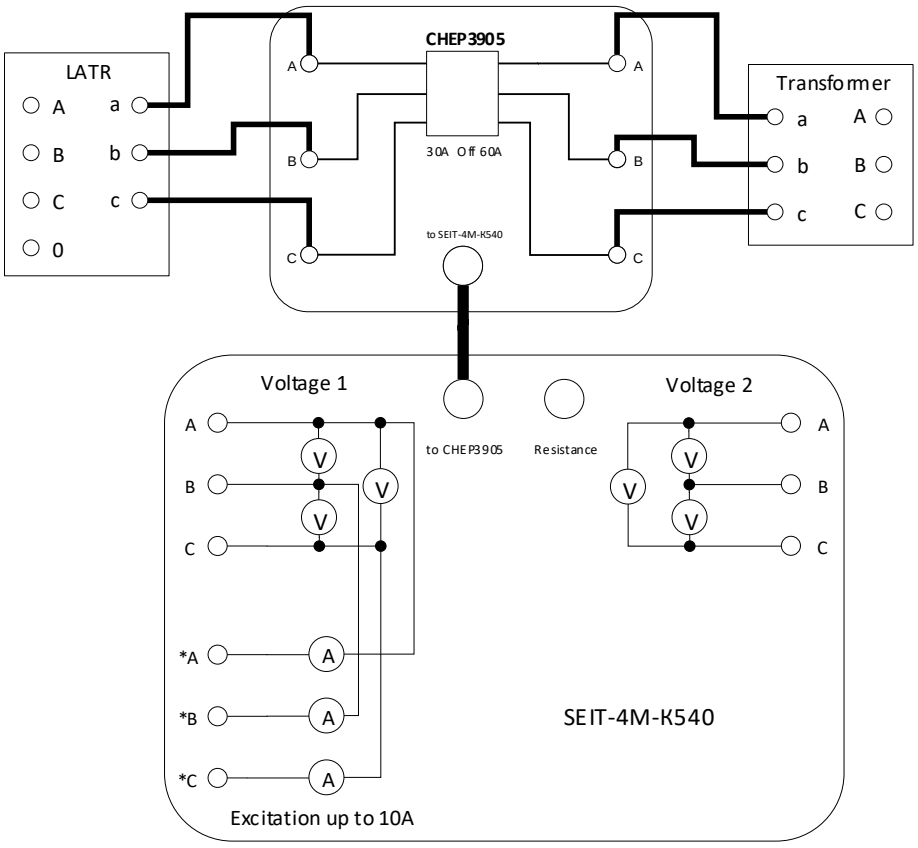

Fig. 11. Connection Circuit for an Open-Circuit Test at Rated Voltage using CTU.

5.3.1.3. To perform a test with a single-phase transformer, assemble the circuit shown in Fig.12.

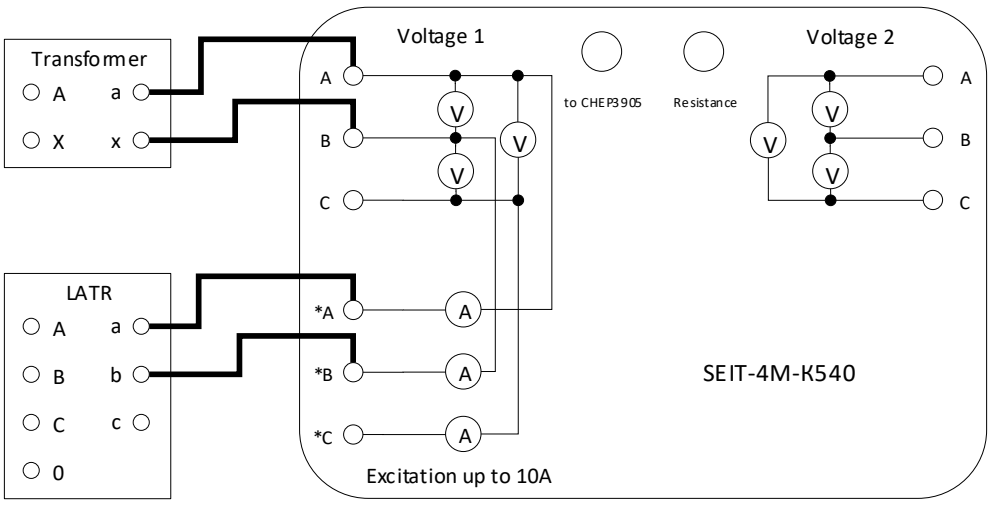

Fig. 12 Connection Circuit for a Single-Phase Transformer Open-Circuit Test

5.3.1.4. When using CTU to test a single-phase transformer, assemble the circuit shown in Fig.13.

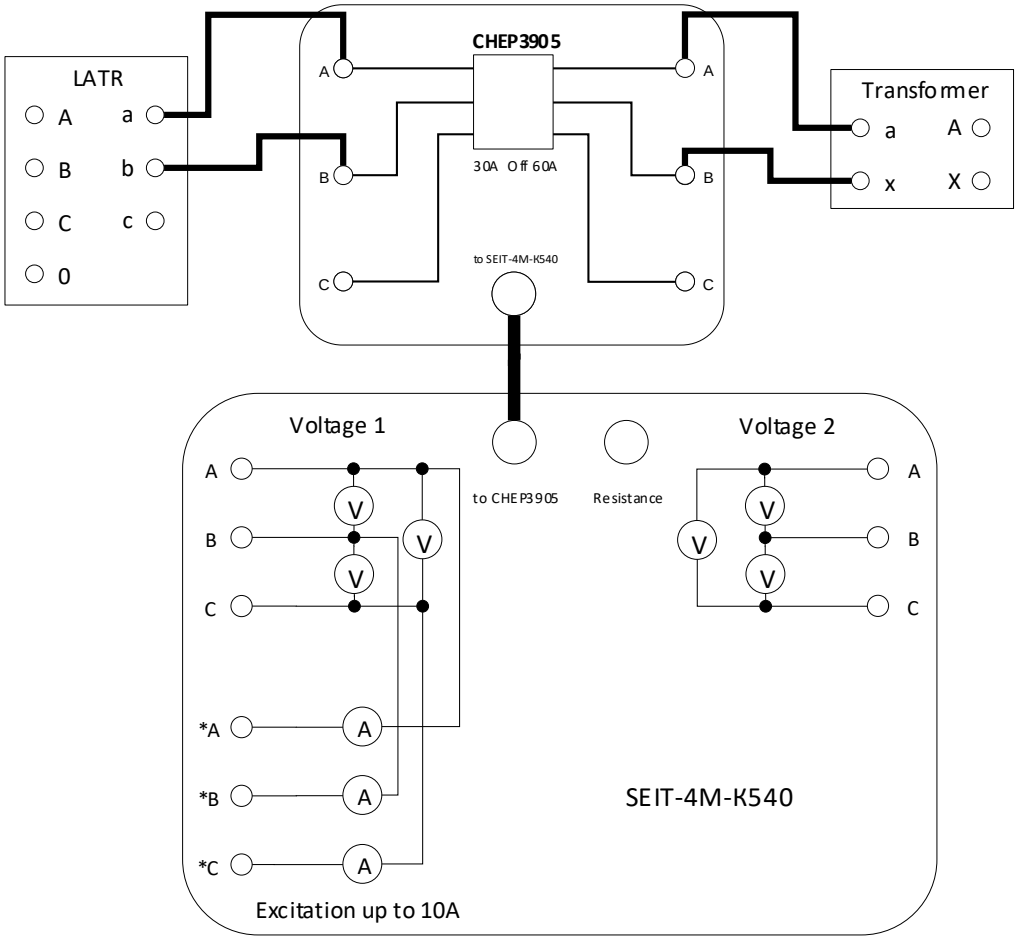

Fig. 13. Connection Circuit for a Single-Phase Transformer Open-Circuit Test using CTU

5.3.1.5. Set the measurement limit for the ‘Voltage 1’ input to 400 V. Choose the upper current measurement limit closest to the values obtained during the tests. When using the CTU, set the current limit to 10 A.

5.3.1.6. Switch to the ‘Open Circuit’ tab (Fig.14), smoothly set the test voltage with an error of max. ± 0.5 % of the rated value and click ‘Start’. The test results are displayed in the corresponding tab fields.

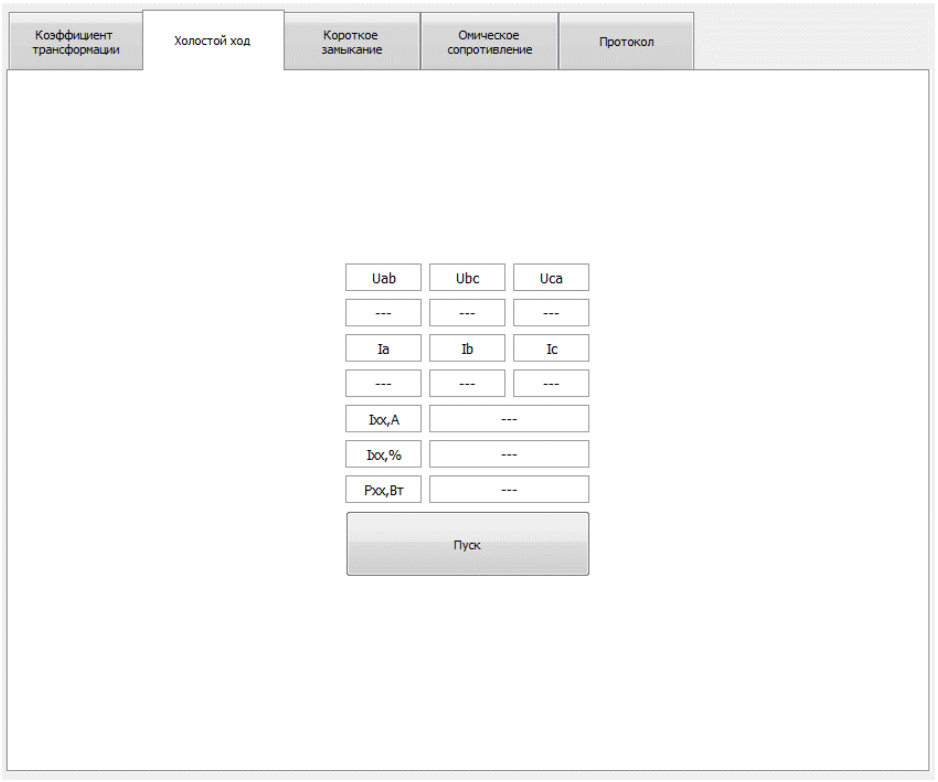

Fig. 14. ‘Open Circuit’ Tab for Testing at Rated Voltage.

5.3.2. *At Low Voltage*.

For transformers with a rated voltage of over 400 V, the open-circuit test is performed at low voltage. Before the open-circuit test at low voltage, demagnetize the transformer. This can be done using a transformer demagnetizer CHEP3601.

5.3.2.1. Open-circuit testing of a three-phase transformer at low voltage is performed as a set of the below three single-phase tests:

1) Close the transformer phase A winding onto short-circuit, excite phases B and C, and measure the losses. The measuring circuits of this test for the Y_0 and Δ winding connection circuits are shown in Figs. 15 and 16, respectively.

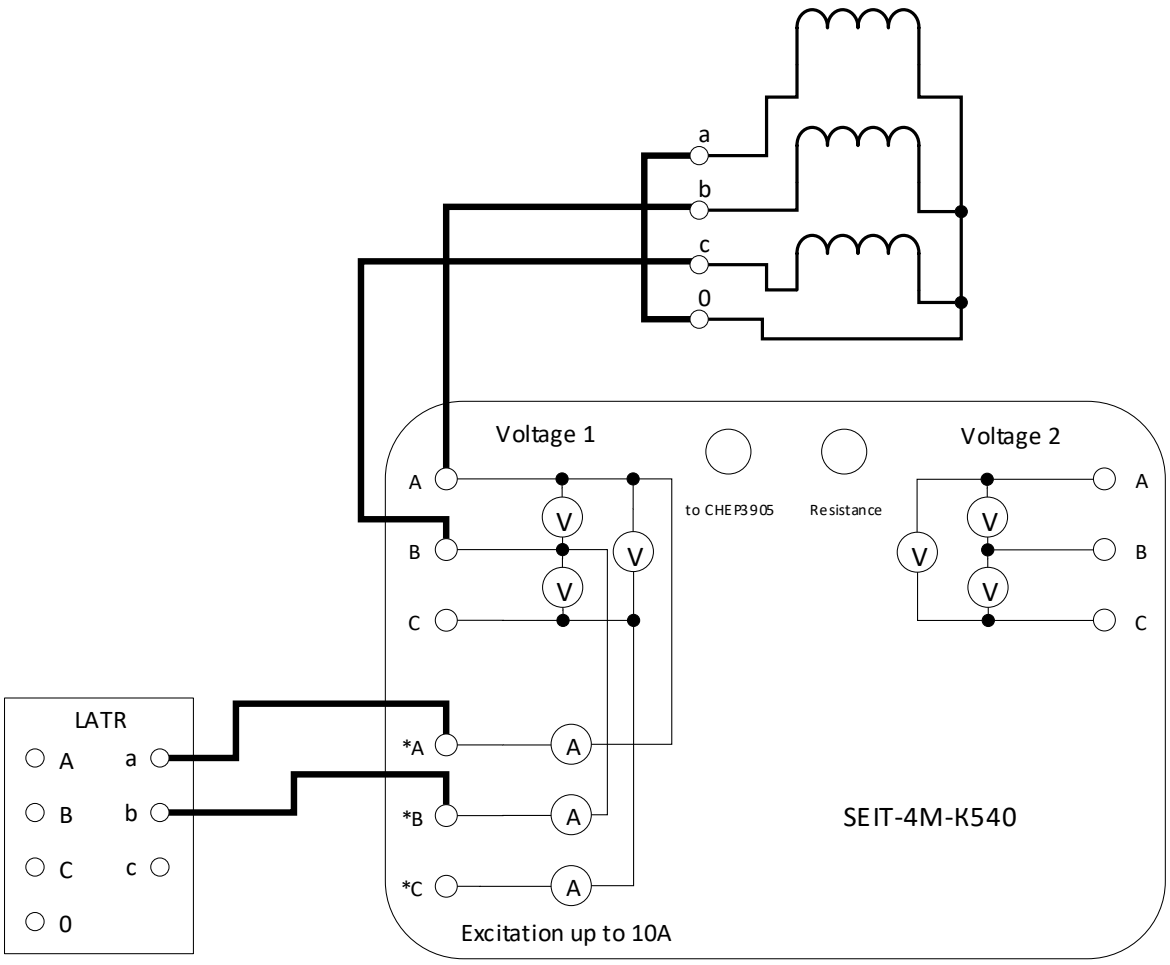

Fig. 15. Open-Circuit Test at Low Voltage for Y_0-Connected Windings

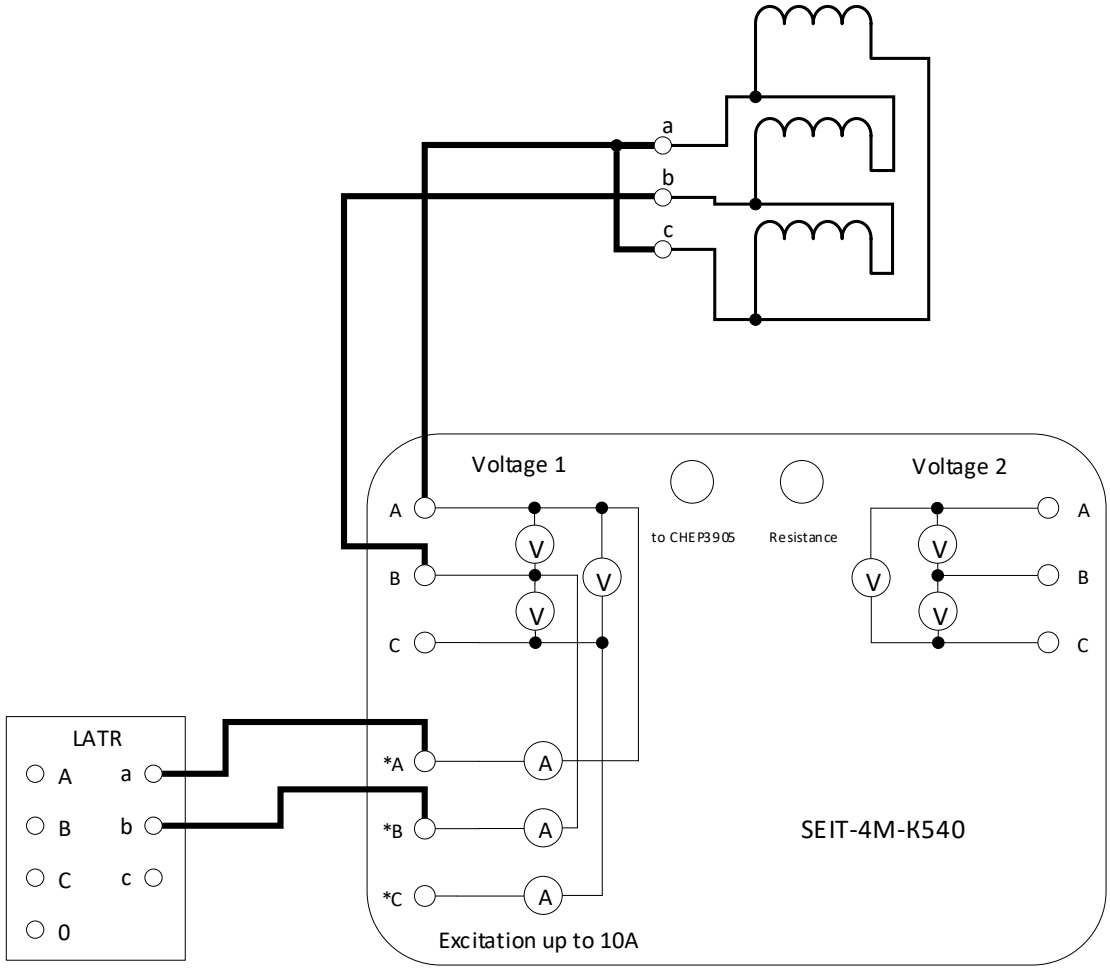

Fig. 16. Open-Circuit Test at Low Voltage for Δ-Connected Windings

2) Close the transformer phase B winding onto short-circuit, excite phases A and C, and measure the losses.

3) Close the transformer phase C winding onto short-circuit, excite phases A and B, and measure the losses.

5.3.2.2. Switch to the 'Open-Circuit' tab (Fig.17) and perform all 3 tests described in subparagraph 5.3.2.1, alternately choosing the appropriate 'Phase Voltage'. Click 'Start' to keep the measurement results.

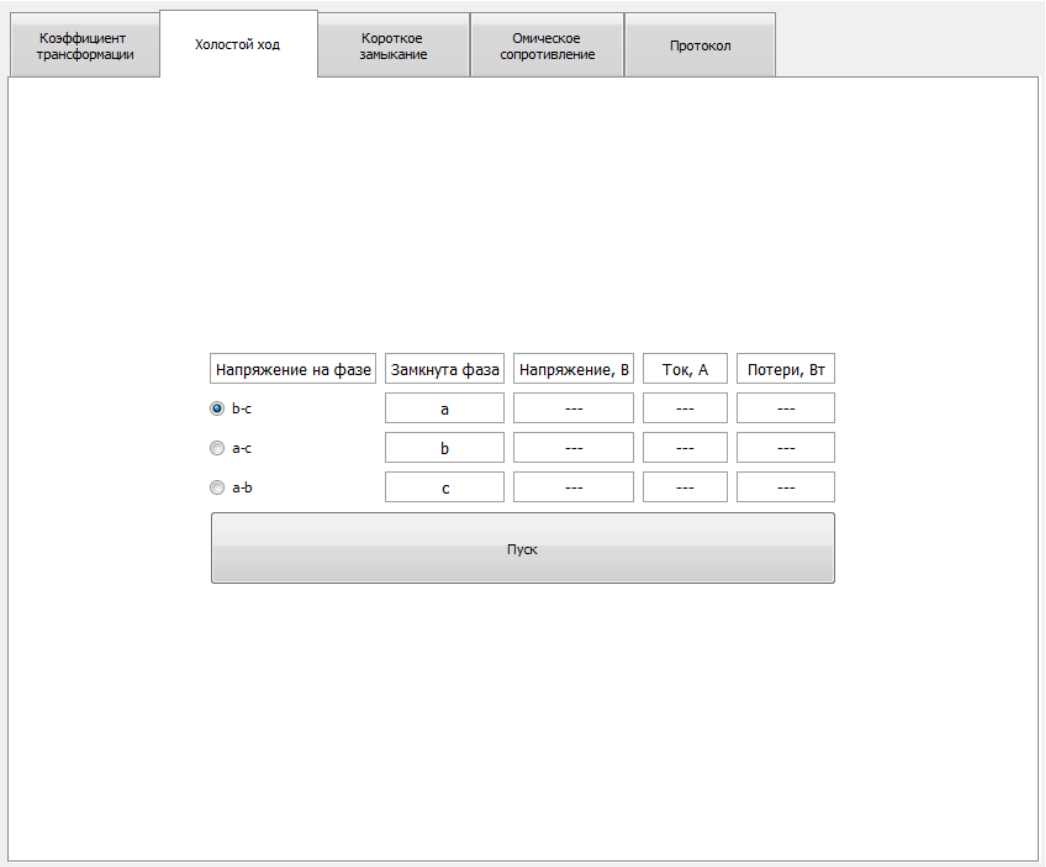

Fig. 17. ‘Open-Circuit’ Tab for Testing at Low Voltage.

5.3.2.3. Choose the upper measurement limits closest to the values obtained during the tests for the voltage and current inputs. When using the CTU, set the current limit to 10 A.

5.3.2.4. Losses and open-circuit current at low voltage are measured to compare them with the similar operating measurement results. These data are not recount to the rated voltage.

5.4. Short Circuit Test

5.4.1. To perform a short-circuit test, assemble the measuring circuit shown in Fig.18. Close the LV winding inputs of the transformer tested onto fault and connect the HV winding inputs to the MCU terminals, as shown in Fig.18.

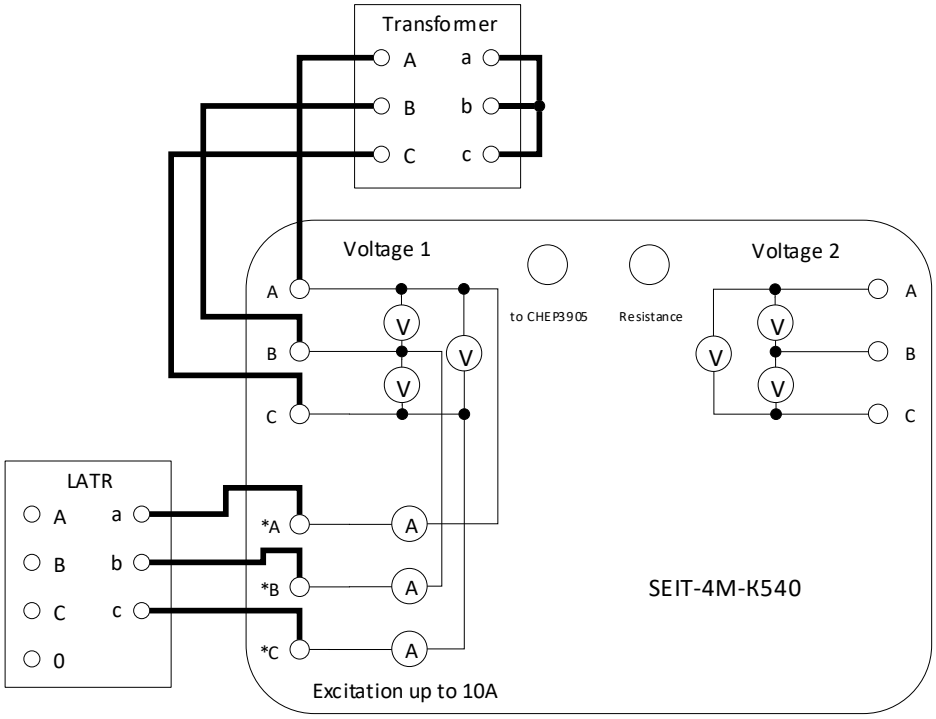

Fig. 18. Connection Circuit for Short Circuit Test

5.4.2. When using the CTU, assemble the circuit shown in Fig.19.

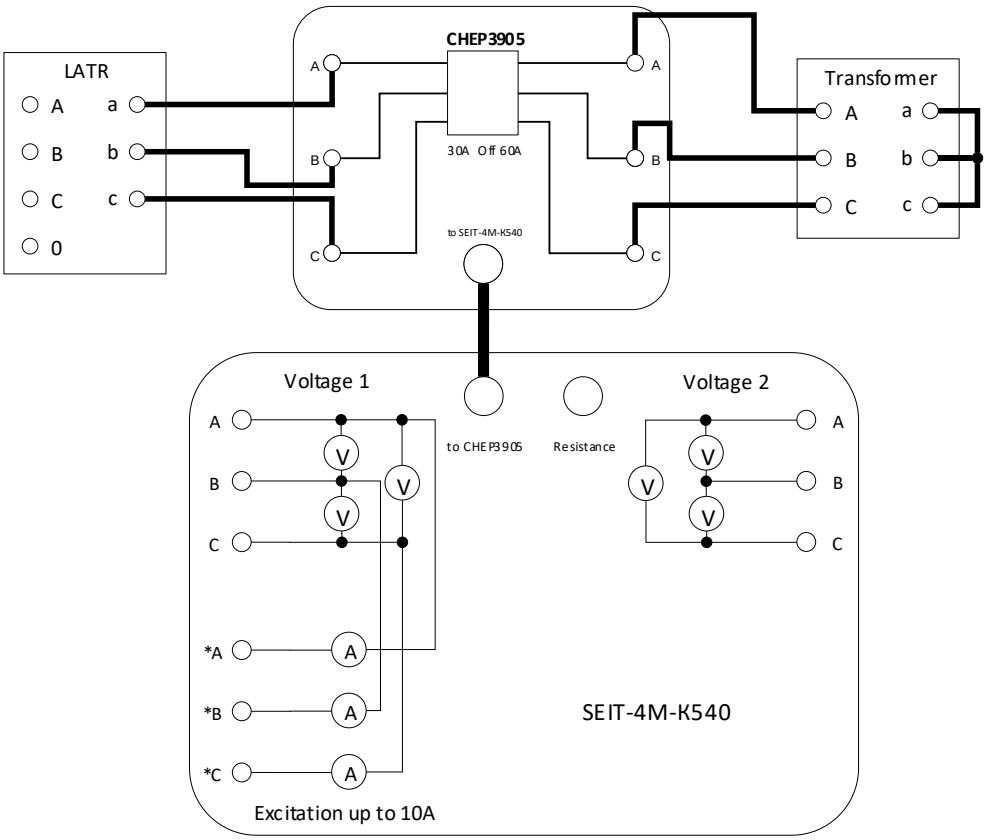

Fig. 19. Connection Circuit for Short Circuit Test using CTU.

5.4.3. To perform a test with a single-phase transformer, assemble the circuit shown in Fig.20.

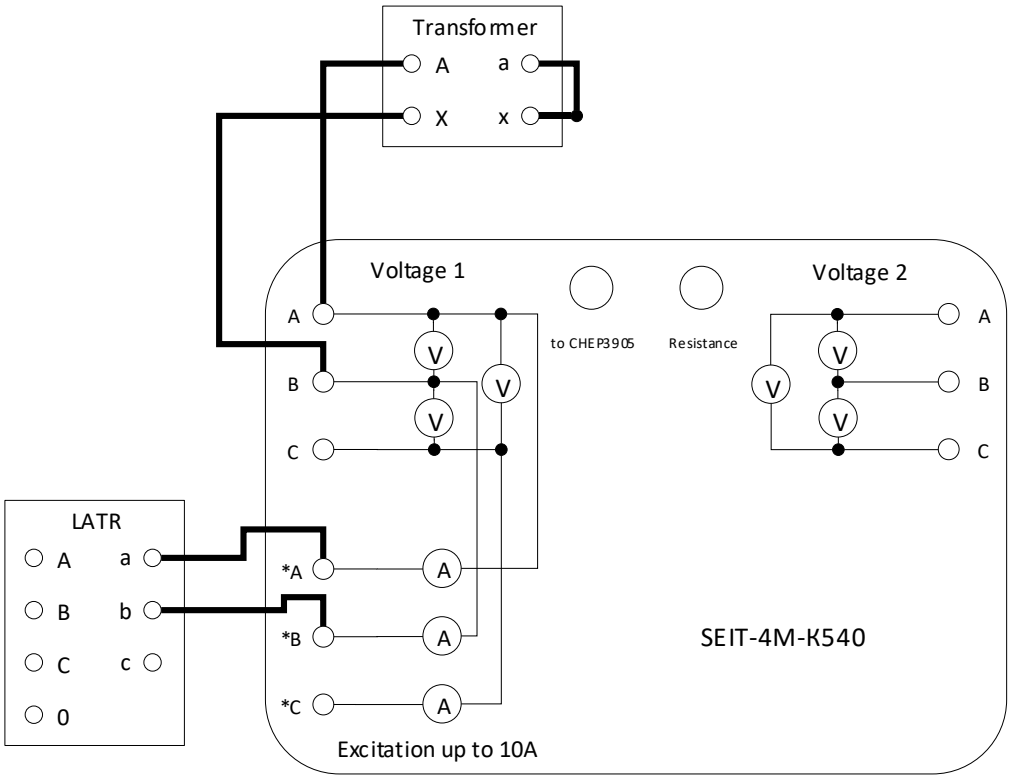

Fig. 20. Connection Circuit for a Single-Phase Short Circuit Test

5.4.4. When using the CTU in a single-phase short circuit test, assemble the circuit shown in Fig.21.

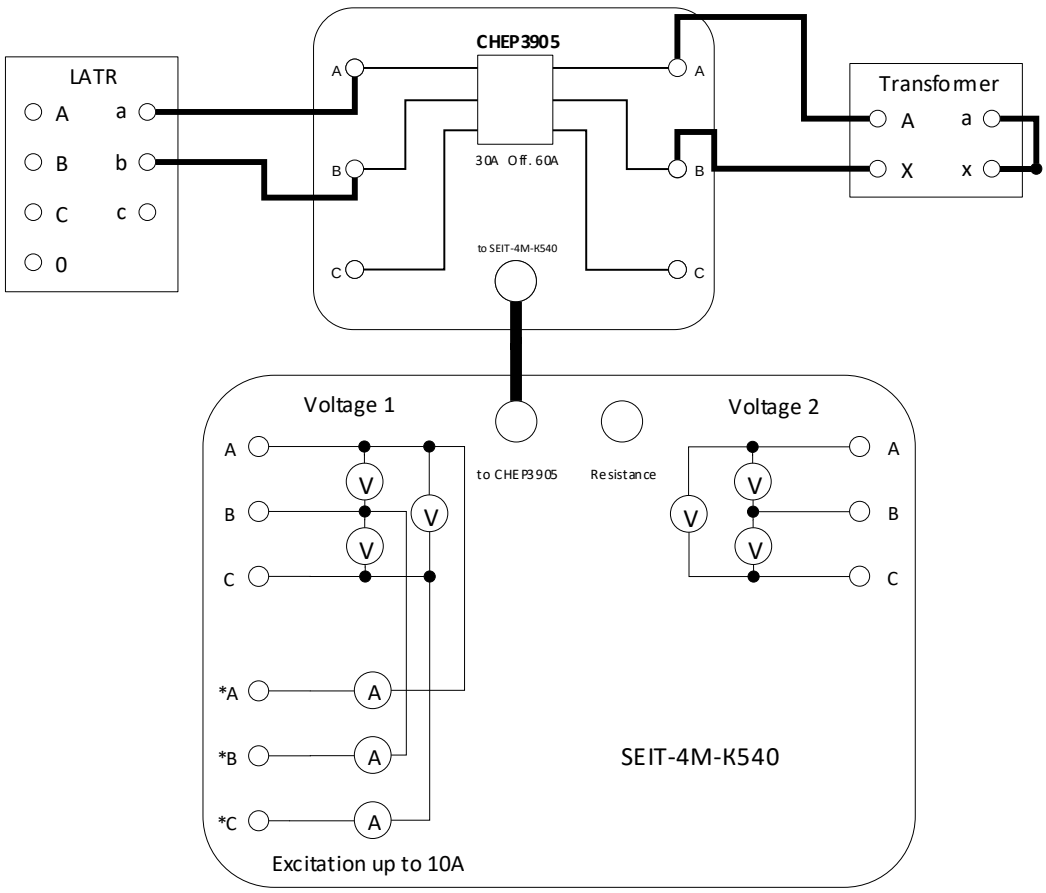

Fig. 21. Connection Circuit for a Single-Phase Short Circuit Test using CTU

5.4.5. Switch to the ‘Short Circuit’ tab (Fig.22). Open a dialog box by clicking ‘...’ in the ‘Winding Temperature’ field and set the correct temperature. Then, apply the test voltage ensuring the phase currents not exceeding the rated value. The control is performed using the ‘Input Signal Parameters’ panel. Click ‘Start’ to perform measurement.

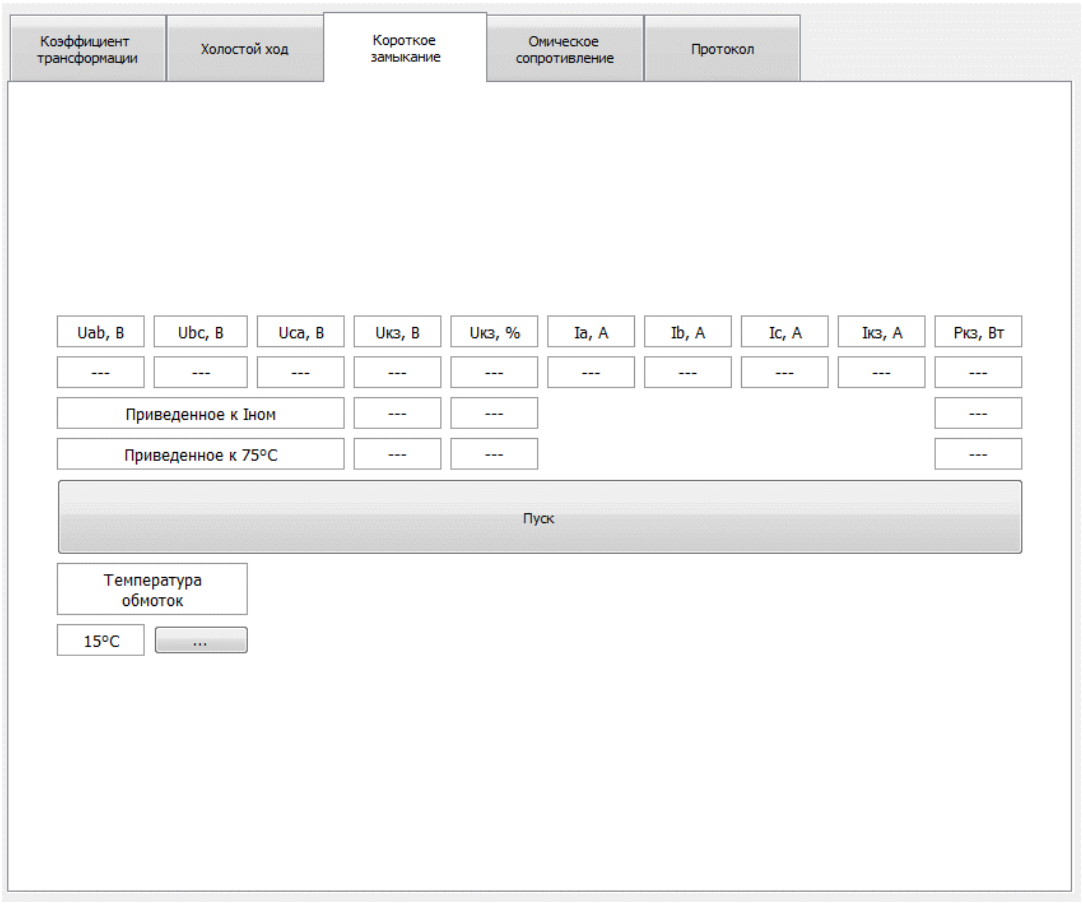

Fig. 22. ‘Short Circuit’ Tab

5.4.6. Choose the upper measurement limits closest to the values obtained during the tests for the voltage and current inputs. When using the CTU, set the current limit to 10 A.

5.4.7. The measurement results are automatically recount to the rated current of the transformer tested by the formulas:

$$P_{sc} = P'_{sc}\left(\frac{I_{rated}}{I'_{sc}}\right)^2 W, \qquad U_{sc} = \frac{U'_{sc}}{U_{rated}}\frac{I_{rated}}{I'_{sc}} * 100\ \%,$$

Where, P'_{sc} is the losses in the short circuit test, W,

I'_{sc} is the current in the short circuit test, A,

I_{rated} is the current corresponding to the rated transformer power, A,

U'_{sc} is the voltage in the short circuit test, V,

U_{rated} is the rated voltage of the main winding tap to which the voltage is supplied, V.

5.4.8. The measurement results (recounted to the rated current) are recount to the design conventional winding temperature by the formulas:

$$P_{sc} = P_{sc} * K\ W, \qquad U_{sc} = \sqrt{U_{sc}^2 + \left(\frac{P_{sc}}{10S_{rated}}\right)^2 (K^2 - 1)}\ V,$$

Where,

S_{rated} is the rated transformer power, kVA,

K is the coefficient calculated by the formula:

$$K = \frac{T + \Theta_d}{T + \Theta_{amb}},$$

Where,

Θ_d is the design conventional winding temperature (for insulating materials of A, E, B heat resistance classes, adopt $\Theta_d = 80\ ^0\text{C}$ for the oil directed cooling transformers and $\Theta_d = 75\ ^0\text{C}$ for others; for H, C, F classes, adopt $\Theta_d = 115\ ^0\text{C}$).

Θ_{amb} is the ambient temperature,

T is the temperature equal to 235 and 225 °C for copper and aluminum windings, respectively.

5.5. MEASURING WINDING RESISTANCE

5.5.1. To measure the DC resistance of the winding, connect the test wire clips to the terminals of the corresponding transformer winding.

5.5.2. Switch to the ‘Ohmic Resistance’ tab (Fig.23.) and choose the cell corresponding to the required phase and tap number in the ‘Measured Resistance’ table.

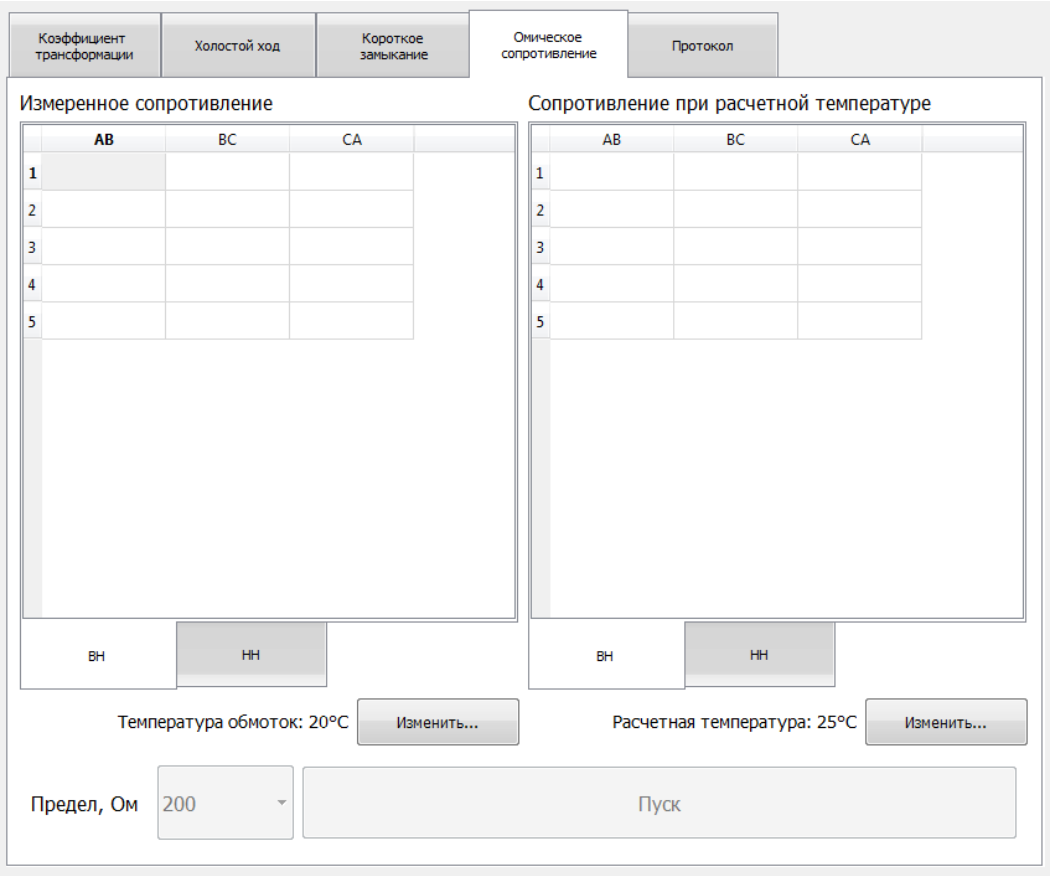

Fig. 23. ‘Ohmic Resistance’ Tab

5.5.3. The resistance values recounted to the specified temperature value are automatically recorded to the table ‘Resistance at Design Temperature’. To change the design and current temperature values, click the corresponding ‘Change’ button located next to the temperature value. Specify the current value in the pop-up dialog box.

5.5.4. Before starting the measurement, choose an appropriate measurement limit in the ‘Limit’ drop-down list.

5.5.5. Start measurement by clicking ‘Start’. In this case, the measuring current is set at the device output.

5.5.6. The readings will change at 1 second intervals as the magnetic state of the tested transformer core is set.

5.5.7. Clicking ‘Stop’ forcibly ends the measurement.

Caution! In inductive circuits, instantaneous interruption of the measuring current flow is impossible. The dangerous current is indicated by lighting measuring current LED. Therefore, disconnect the measuring wires strictly after the LED is out.

5.5.8. When recounted resistances to the design temperature, the below formula is used:

$$\frac{R_{\Theta 2}}{R_{\Theta 1}} = \frac{T+\Theta_2}{T+\Theta_1},$$

Where,

Θ_1 and Θ_2 are winding temperatures at which its resistance was measured, °C,

$R_{\Theta 1}$ and $R_{\Theta 2}$ are, respectively, winding resistance values measured at Θ_1 and Θ_2 temperatures, Ohm,

T is the temperature equal to 235 and 225 °C for copper and aluminum windings, respectively.

5.6. CREATING PROTOCOL

5.6.1. The 'Protocol' tab (Fig.24.) allows saving the measurement results in the form of a protocol.

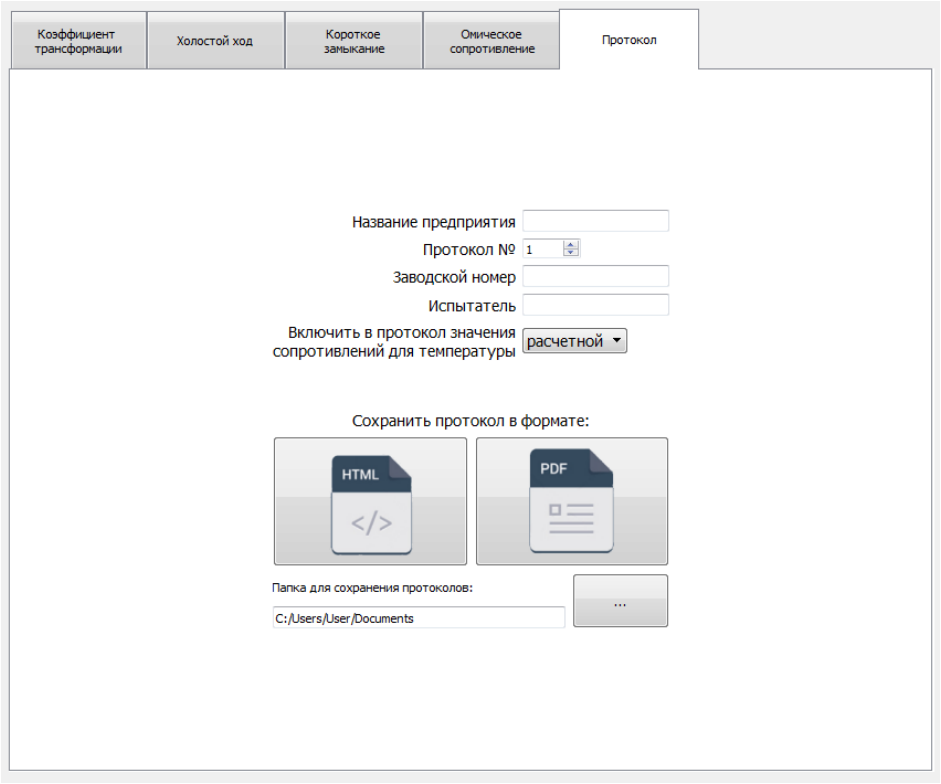

Fig. 24. ‘Protocol’ Tab

5.6.2. Fields ‘Enterprise Name’, ‘Protocol No.’, ‘Serial number’, ‘Test Operator’ allow entering the corresponding data into the protocol.

5.6.3. If the test contains the winding DC resistance measuring results, then the values to be specified in the protocol can be chosen. The field ‘Include Resistance Values for Temperature in the Protocol’ allows specifying the temperature to which the values will be recounted – the design or actual one, at which the measurement is performed.

5.6.4. The field ‘Protocol Saving Folder’ allows specifying the protocol saving location.

5.6.5. ‘Protocol Saving Format’ allows saving the measurement protocol in the HTML or a PDF document format.

6. SERVICE FUNCTIONS AND MODES

6.1. TRANSFORMER TYPE GUIDE

The software allows saving the transformer type specifications in a directory for further use during testing.

6.1.1. The directory opens through the menu ‘Test -> Transformer Types...’. The directory window is shown in Fig.25.

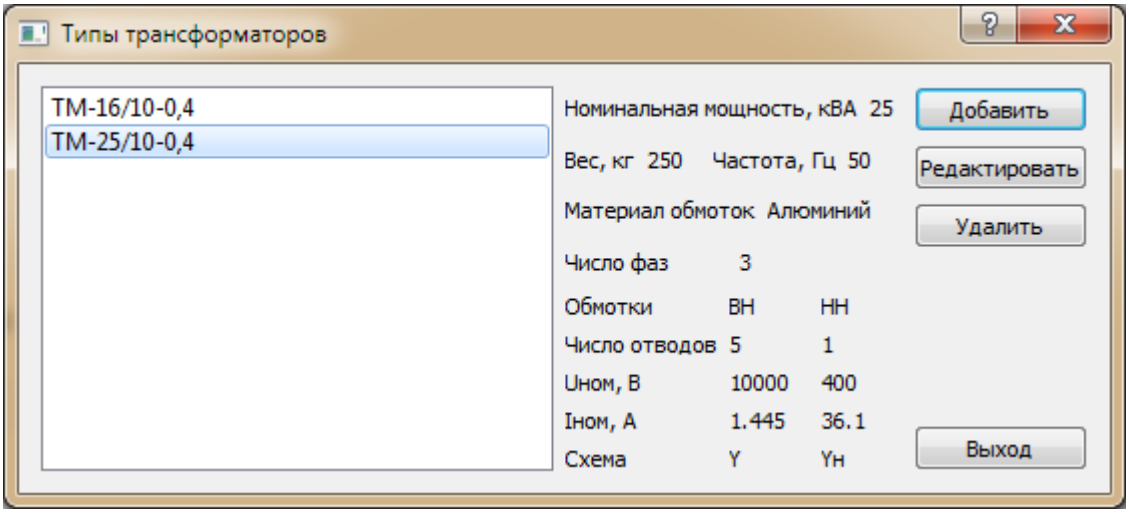

Fig. 25. Transformer Type Directory

The left window part represents a list of transformer types stored in the directory. The chosen type specifications are displayed to the right of the list.

6.1.2. The ‘Add’ button allows adding a new transformer type to the directory. Thereat, ‘Transformer Parameters’ dialog box opens (Fig.26).

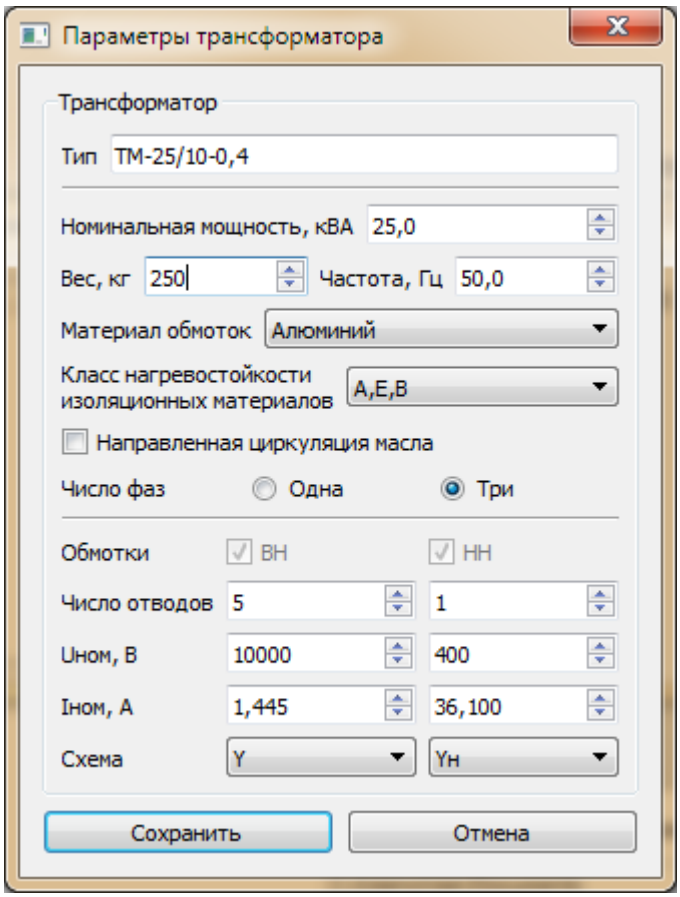

Fig. 26. ‘Transformer Parameters’ Window

Upon specifying all the required data and filling in the ‘Type’ field, the new transformer type can be saved to the directory.

6.1.3. The ‘Edit’ button allows changing the specifications of a transformer already included in the directory. This also opens the ‘Transformer Parameters’ dialog box, but the field data will already correspond to the chosen type. In this mode, the operator can correct the data and save the changes.

6.1.4. The ‘Delete’ button allows deleting the chosen transformer type from the directory.

6.1.5. The ‘Exit’ button closes the directory.

6.2. TROUBLESHOOTING

Malfunction	Possible cause	Troubleshooting
1. The LED on the power switch does not light when the power is on	Lack of main voltage	Repair the main wiring
	Faulty power cord	Replace power cord
2. The status bar says, 'Connection error: Time is over'	MCU is off	Turn the MCU on
	Wrong port chosen	Change port in the 'Settings' dialog box
	Faulty cable	Replace cable
3. A negative total power value is displayed in the SC or OC modes	Wrong connection of the current circuits of the corresponding phases	Change the connection order of the current circuits of the corresponding phases
4. 'OVERLOAD' is displayed when the DC resistance measured is obviously less than the measurement limit	Break in the potential probe circuit	Check and restore contacts in faulty wires and probes. Check the probe installation reliability on the tested transformer terminals
5. Readings close to zero are displayed when the resistance measured obviously exceeds zero	Break in the current probe circuit.	Check and restore contacts in faulty wires and probes. Check the probe installation reliability on the tested transformer terminals
6. The resistance readings differ significantly from the expected values, or there is a significant change in several resistance readings measured for the same winding	Poor contacts in connectors and probes	Check and restore contacts in connectors and probes. Tighten the thread connections of the probes

7. CALIBRATION OF THE METER

The SEIT-4M-K540 meter is calibrated once every five years according to the document PTMR.411722.039 MP Power Transformer Parameter Meters SEIT-4M-K540. Calibration Technique.

8. MAINTENANCE

The device is maintained to ensure normal operation during its service life. The inspection frequency is determined by the device environment and the intensity of its operation.

All routine work associated with opening the meter should be combined with any repair or the regular check of the device.

Recommended types and timing of preventive maintenance:

● visual inspection and external cleaning – monthly,

● checking the technical condition of external wires and mechanical modules of the device – quarterly,

● comprehensive inspection of the technical condition of the device – annually.

9. REPAIR

Repair is performed by the manufacturer.

10. TRANSPORTATION AND STORAGE

10.1 The SEIT-4M-K540 meter storage modes and conditions should comply with GOST 22261.

10.2 The SEIT-4M-K540 meter transportation modes should comply with GOST 22261.

The SEIT-4M-K540 meter transportation mechanical and climatic conditions should not exceed the below limits:

1) shock loads:

- maximum acceleration – 30 m/s^2,
- shocks per minute – 80 to 120,
- duration of exposure – 1 hour.

2) high temperature – 55 °C,

3) low temperature – -25 ºC,

4) relative humidity – 95 % at 30 °C,

5) atmospheric pressure – 70 - 106.7 kPa.

10.3 Climatic impact on the SEIT-4M-K540 meter under extreme transportation conditions should comply with storage conditions 3 or 5 of GOST 15150 (-25 to +55 ºC).

11. DISPOSAL

The SEIT-4M-K540 meter should be prepared for disposal according to the requirements and guidelines of the consumer enterprise.

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