Tester
of power transformers
K-540-4P
Operation Manual
К5404-411182.1104001 РЭ

(file K-540-4P-13-05-19---V4)

Table of content

Present Operation Manual (OM) contains the data required to operate the tester of power transformers “K-540-4P”, hereinafter – meter or instrument. These data include information on purpose and scope of use for the meter, composition and operation principle, preparation for work, operation and maintenance procedure.

Maintenance staff shall be authorized for work in electrical units of 1000V+ voltage.

Abbreviations used in the manual:

HV, MV, LV – high, medium, low voltage;

OD – operating documentation

OM – operation manual

I_X – measured amperage, A;

U_X – measured voltage, V;

R_X – measured resistance, Ohm;

l.s.d. – least significant digit

Pxx – standby loss

Pxx_{LV} – standby loss at low voltage

Pxx_{RV} – standby loss at rated voltage

Psc – short-circuit loss

Rtrp – transformation ratio

Y_L – “star” winding circuit, with neutral terminal

Y – “star” winding circuit, without neutral terminal

Δ_{LV} – “delta” winding circuit of transformer (low-voltage windings)

Δ_{HV} – “delta” winding circuit of transformer (high-voltage windings)

1 DESCRIPTION AND OPERATION

1.1 Purpose

Purpose of “K-540-4P” kit is conducting the electromagnetic tests of transformers (all connection diagrams and groups) Tester of power transformers “K-540-4P” ensures the following functions:

a) Measuring the amperage and standby loss at low/rated drive voltage of transformers **(automatic switching of drive circuit, while measuring the standby loss at low drive voltage, is assumed for transformers of zero and eleventh vector groups only. For other vector groups, these measurements shall be made with external switching of transformer windings);**

b) Measuring the short-circuit amperage and standby loss;

c) Measuring the transformation ratio;

d) Defining the vector group and polarity of terminals for 1-phase transformers;

e) Measuring the resistance of transformer windings to direct current.

In the course of measurement, asymmetric nature, non-sinusoidal nature, and frequency of drive voltage are controlled.

1.1.2 The kit is used for maintenance, repair, adjustment, and testing of power transformers – both in laboratory and in the field.

1.2 Application environment

Measuring kit “K-540-4P” ensures the exercise of its functions in application environment compliant with Group 3:

1.2.1 Normal application environment

- ambient temperature, °C	20±5;
- relative air humidity, %	30-80;
- atmospheric pressure, kPa (mm Hg)	84-106 (630-795);
- AC supply voltage, V	220±4.4;
- supply frequency, Hz	50.0±0.5.

1.2.2 Operating environment:

- ambient temperature, °C	+5 to +40
- relative air humidity, %	up to 80, at 30°C
- atmospheric pressure, kPa (mm Hg)	84-106.7 (630-800)

- AC supply voltage, V 220±22
- supply frequency, Hz 50±1

1.3 Basic specifications

Basic specifications of “K-540-4P” kit are given in Tables 1-6.

Table 1.

No	Parameter or feature	Value	
		K-540-4P	K-540-4C
1	Mean time to failure (reliability), at least, hours	10,000	10,000
2	Calibration interval, max, months	12	12
3	Overall dimensions of the meter, mm, no more	400×180×320	280x240x125
4	Weight, kg, no more	8	4

Table 2. Parameters of inner voltage source

No	Parameter or feature	Value
1	Mode of measuring the transformation ratio and defining the vector group in 3-phase mode	
1a	Output voltage adjustment range, V	0÷30
1b	Max value of output current, A	1.0
1c	Difference between the max and min linear voltage does not exceed, %	0.5
2	Mode of measuring the standby loss, at low voltage	
2a	Output voltage adjustment range, V	0÷380
2b	Max value of output current, A	0.3

Table 3. Parameters of 3-phase voltage/amperage meter, at rated drive voltage

No	Parameter or feature	Value
1	AC amperage measurement range, A	0.01 to 10.0
2	Limit of allowed absolute basic error at AC measurements, no more, A	0.002·Ix+1 l.s.d.
3	Alternating voltage measurement range:	
3a	phase alternating voltage, V	1 to 400
3b	linear alternating voltage, V	1 to 600
4	Limit of allowed absolute basic error at AC voltage measurements, no more, V	0,002•Ux+1 l.s.d.
5	Active power measurement range, without use of current and/or voltage transformer*, W	0.1 to 4,000
6	Limit of allowed absolute basic error at active power measurements, W	0.005•Ux•Ix+1 l.s.d.

Table 4. Parameters of voltage/amperage meter, at low drive voltage from internal source.

No	Parameter or feature	Value
1	AC amperage measurement range, A	0.01 to 0.3
2	Limit of allowed absolute basic error at AC measurements, no more, A	0.002·Ix+1 l.s.d.
3	Alternating voltage measurement range:	
3a	phase alternating voltage, V	1 to 400
3b	linear alternating voltage, V	1 to 600
4	Limit of allowed absolute basic error at AC voltage measurements, no more, V	0,002•Ux+1 l.s.d.
5	Active power measurement range, W*	0.1 to 100

6	Limit of allowed absolute basic error at active power measurements, W	0.005•Ux•Ix+1 l.s.d.

Table 5. Parameters of voltage/amperage meter, at low drive voltage from external source.

No	Parameter or feature	Value
1	AC amperage measurement range, A	0.01 to 2
2	Limit of allowed absolute basic error at AC measurements, no more, A	0.002·Ix+1 l.s.d.
3	Alternating voltage measurement range:	
3a	phase alternating voltage, V	1 to 400
3b	linear alternating voltage, V	1 to 600
4	Limit of allowed absolute basic error at AC voltage measurements, no more, V	0.002•Ux+1 l.s.d.
5	Active power measurement range, W*	0.1 to 700
6	Limit of allowed absolute basic error at active power measurements, W	0.005•Ux•Ix+1 l.s.d.

Table 6. Parameters of 3-phase voltage meter, at defining the transformation ratio and vector group.

No	Parameter or feature	Value
1	Alternating voltage measurement range:	
1a	phase alternating voltage, V	1 to 400
1b	linear alternating voltage, V	1 to 600
2	Limit of allowed absolute basic error at AC voltage measurements, no more, V	0.002•Ux+1 l.s.d.
3	Input resistance, at least, kilo Ohm	600
4	Range of measuring the alternating voltage from internal source:	
4a	phase alternating voltage, V	1 to 30
4b	linear alternating voltage, V	1 to 30
5	Limit of allowed absolute basic error at AC voltage measurements, no more, V	0.002•Ux+1 l.s.d.

Notes: I_X – measured amperage, A;

U_X – measured voltage, V;

l.s.d. – least significant digit.

Limits of allowed additional error, caused by ambient temperature change (from normal to any, within the operating values), shall not exceed the half of maximum allowed basic error.

1.4 Completeness

Composition and completeness of supplied “K-540-4PC” instrument is given in Table _.

Table 7

Designation	Name	Quantity	Note
К5404-411182.001 РС	Testing kit of power transformers “K-540-4P” Passport	1	
К5404-411182.001 РЭ	Tester of power transformers “K-540-4P” Operation manual	1	
К5404-411182.002	Tester of power transformers “K-540-4P”	1	
КИС-8 К5404-685621.002	Measuring cable 8m length	8	
КС	Power cable	1	Bought item
	Cable bag	1	
	Tablet PC or laptop		Bought item, as agreed
К5404-323229.001	Transportation package	1	Bought item
	USB flash drive with OTG cable	1	Bought item, as agreed

Note: the instrument can be supplied in maximum or reduced configuration, as agreed with the customer. If necessary, tablet PC or laptop is purchased and equipped upon agreement with the customer. Cable length can be adjusted as well.

1.5 Product design and operation

1.5.1 Description of appearance

Appearance of “K-540-4P” meter is shown in Figure 1.1

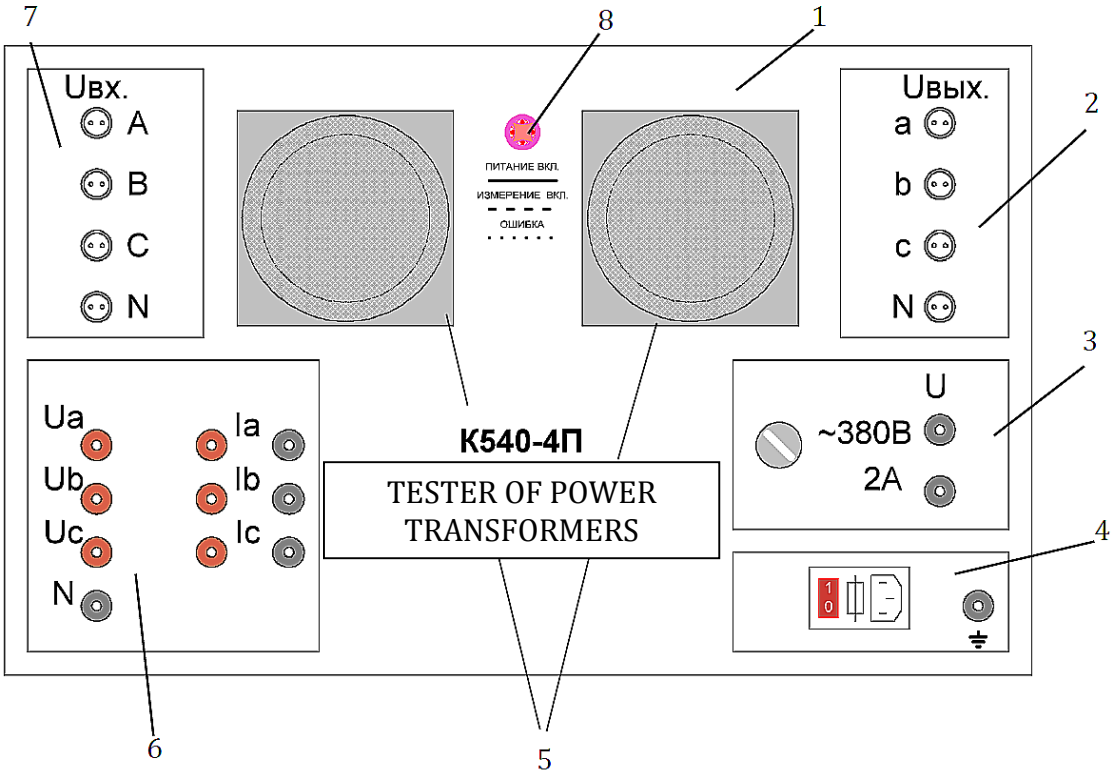

Figure 1.1

1 – faceplate of “K-540-4P” instrument.

2 – group of connectors (internal excitation generator).

3 – group of terminals for connecting the external excitation source – up to 380 V, current up to 2 A (used to measure the standby loss at low voltage and excitation current 300 mA to 2 A).

4 – network connector, power switch, and ground terminal.

5 – cooling fan.

6 – terminals for measuring the transformer parameters at nominal excitation voltage.

7 – input terminals, for voltage measuring at defining the transformation ratio.

8 – warning indicator of the instrument status:

a) steady light – power supply to the meter, measurement mode not selected;

b) flashing with 0.5÷1 sec. interval – successful pairing with host PC, measurement mode selected, power supply to terminals according to selected mode;

c) frequent flashing with 0.1÷0.3sec. interval – system error.

1.5.2 Description of the meter operation

Functional diagram of the instrument is shown in Figure 1.2

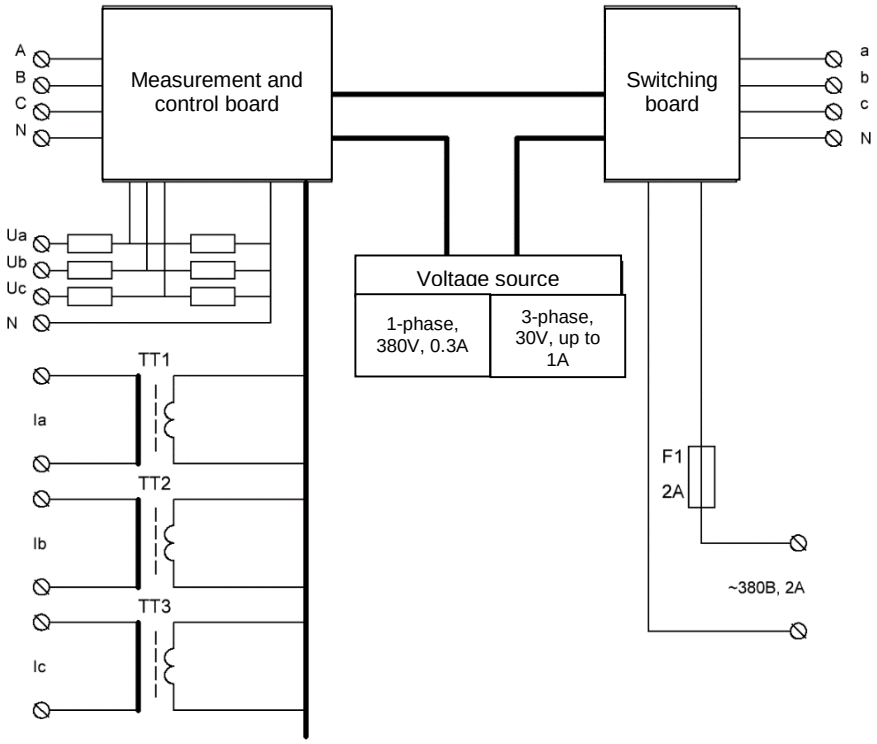

Figure 1.2

Figure 1.2 shows that the meter consists of input/output connectors, current/voltage sensors, and microprocessor control/measurement board.

Using the switching board in different operation modes, internal voltage sources (up to 380V, 1-phase voltage or up to 30V, 3-phase voltage) can be connected to certain output terminals – to ensure the required operation mode. Besides, operation from external voltage source assumes relevant terminals – for connection of 3-phase or 1-phase excitation.

Voltage divider/current transformer signals arrive at input switching device and microprocessor measuring/control board, where they are processed under relevant algorithm. Results of measured and calculated values are displayed on PC (connected by Wi-Fi).

The following parameters are measured by the instrument:

- Current of three phases (Ia, Ib, Ic)
- Linear and phase voltage of winding (low and high voltage)
- Frequency of input voltage

Based on these measured parameters, the instrument calculates the following values:

- power of standby/short circuit loss in transformers;
- transformation ratio;

- voltage shift angle (windings of high and low voltage).

Thus, the instrument virtually hosts the following devices:

- twelve voltmeters;
- three ammeters;
- three power meters;
- frequency meter;
- three voltage shift angle meters.

The instrument assumes connection of three external current transformers and three external voltage transformers, thus enabling the extended values of measured current, voltage, power – up to limits set by parameters of current and voltage transformers. Transformation ratio of additional transformers is considered by microprocessor module, and PC displays the actual parameters of tested transformer.

The instrument can be paired with PC, laptop or tablet PC provided with Wi-Fi, Windows or Android OS (with software installed from supplied USB flash drive).

1.6 Operation of the meter

1.6.1 Upon stay at ambient temperature below minus 5°C, the instrument shall be kept under normal conditions (in OFF state) for at least one hour.

1.6.2 In case of overload by any measurement channel of the meter, immediately reduce the drive voltage – to value not resulting in overload. Fact of the overload is indicated on PC screen of the meter.

2 MARKING AND SEALING

2.1 The instrument is provided with marking on its body – instrument name, No. _____, year of issue.

2.2 The packing box is provided with marking – instrument name, No. _____, year of issue.

2.3 The product is sealed by metrological body – by sealing the screw attaching the instrument chassis to its body, thus preventing the unauthorized interference in the instrument operation and settings (during its use).

The sealing is ensured by imprint on sealing wax (front left leg of the instrument, on fixing screw). The sealing shall be done by seal press of “rod” type (5 mm diameter).

3 PACKAGING AND WRAPPING MATERIALS

Along with operating documentation and set of cables, the meter is put into packing box.

Components of the meter shall be put into box so that gaps between them and the box walls are filled with shock-absorbing materials.

4 SAFETY PRECAUTIONS

4.1 Work at the meter shall be performed by persons with no less than 3rd safety category (operation of electric units above 1,000V voltage).

4.2 The meter shall be operated under safety regulations for electric units above 1,000V voltage (DNAOP 0.00-1.21).

ATTENTION! All preparations for work may be done at de-energized terminals of the meter and test object only.

5 PREPARATION FOR WORK

Prior to start of work with the meter, you shall:

- study the present document and get familiarized with diagram/design of the meter;
- perform visual inspection of the meter;
- install the software (from USB flash drive supplied with the meter) to laptop with OS Windows XP and above or to tablet PC with Android OS (use K540_setup.apk file for tablet PC and K540_setup.exe file for laptop). Hereinafter, tablet PC, smartphone or laptop is referred to as personal computer (PC).
- ground the meter;

5.1 Switching the meter ON

Use the power cable to connect the meter to industrial network (220V, 50Hz). Switch the meter ON, by setting the “POWER” switch to position “1” (Item 4, Figure 1.1).

5.2 Pairing the meter with PC

Connect the PC to Wi-Fi network of K-540 meter (network name – K540#XXXXXXXX, where XXXXXXXX is unique code – e.g., d5156e4a, access code – 90117732); at that, during use of this network, access to other Wi-Fi networks will be lost. Follow the procedure of connecting to wireless network of your PC.

5.3 Overview of the main menu

Upon start of “K540setup” software, PC will display the start screen of “K-540-4P” software, Figure 5a.

On successful pairing of PC and the meter in K540#XXXXXXXX network, measurement in selected mode can be conducted with use of “K-540-4P”. “Start” function is active at Wi-Fi connection only.

At lost connection, inputs and outputs of the meter are reset.

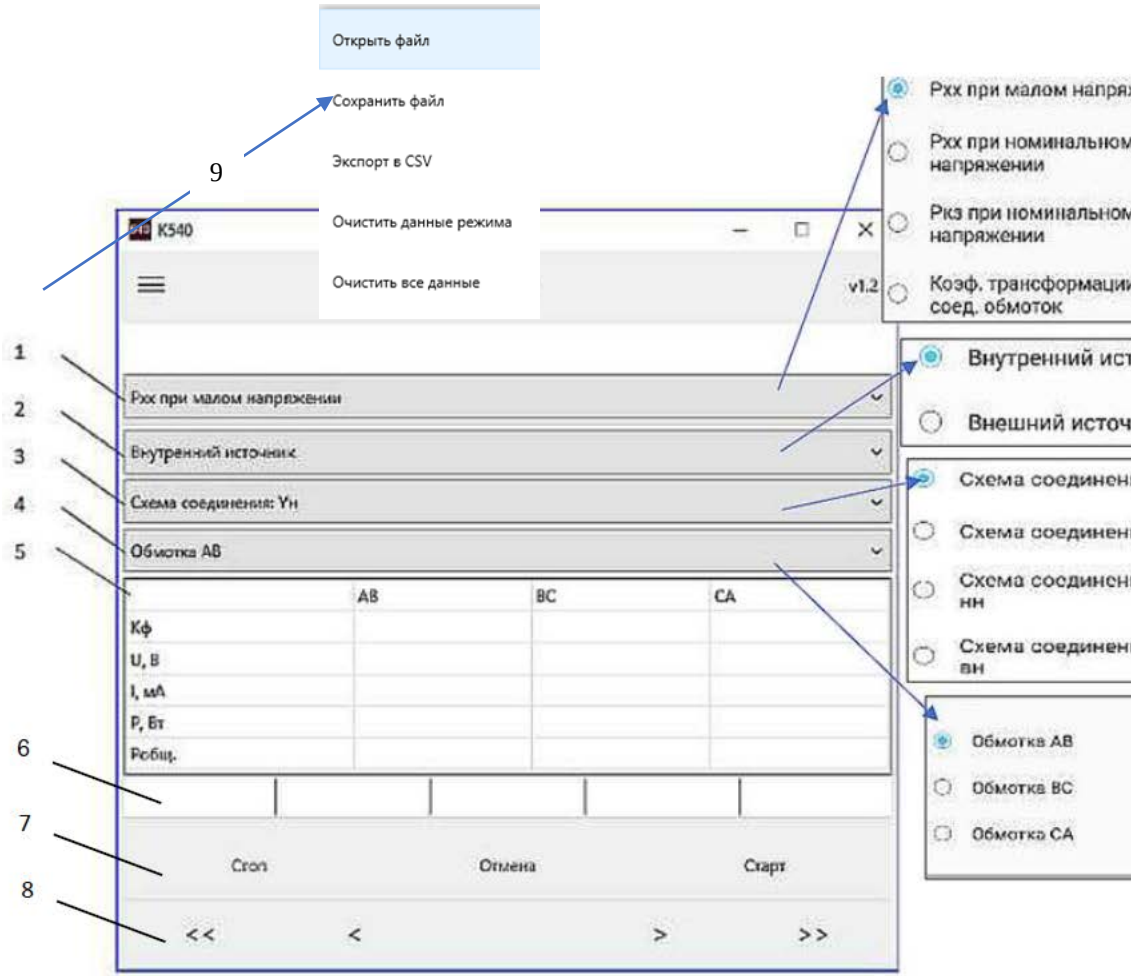

Figure 5a

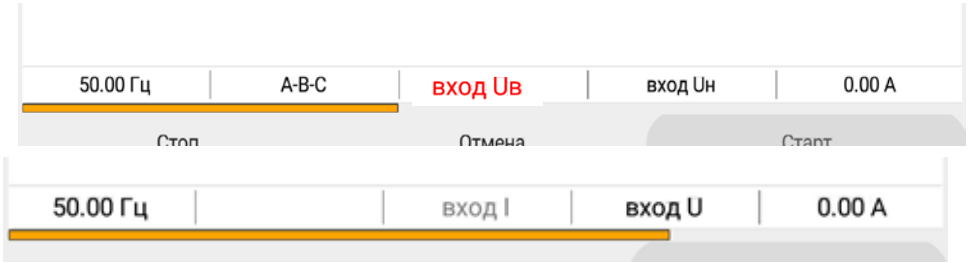

Figure 5b

Where:

1 – Line for selecting the operation mode.

2 – Line for selecting the type of transformer excitation source (internal/external).

3 – Line for selecting the connection of winding, where excitation is supplied.

4 – Line indicating the outputs of winding, where excitation is supplied.

5 – Field indicating the measurement results.

6 – Output line of frequency, phase rotation, and control over level of input/output voltage and current.

List of displayed parameters depends on selected mode and source type, see Fig. 5b. Color of displayed symbols provides additional information: red – overload, gray – low level of input signal, black – normal level.

7 – Line for selecting the measurement process start mode, with activating the internal source (Start) and disconnecting the source with stop of measurement – without saving the result (Cancel) or with saving the result (Stop).

8 – Line of setting the output voltage for internal source:

<< , < – decrease of output voltage: roughly (-2%), smoothly (-0.2%);

> , >> – increase of output voltage: smoothly (+0.2%), roughly (+2%);

9 – menu key for saving, export, deleting the result of current measurement session, and viewing the previously saved sessions.

6 OPERATING PROCEDURE

Operating procedure of the instrument will be described below, for all modes – upon connection to windings of “Yн” type (star with neutral terminal).

6.1 Conducting the no-load test in 3-phase transformers (Pxx)

6.1.1 Pxx measurement on 3-phase transformers, at low drive voltage.

To conduct these measurements, power shall be supplied (typically, 380V/50Hz) to transformer winding, rated voltage of which is above 380V. Thus, in 10,000/0.4 transformers, drive voltage is supplied to high voltage (HV) winding, and in 35,000/10,000; 11,0000/35,000, and other transformers, voltage is supplied to low voltage (LV) winding.

Given the different diagrams of LV and HV winding connection (delta), we must distinguish the drive voltage supply ΔHV and ΔLV (this selection is made in Line 3, Figure 5a).

To measure Pxx in 3-phase transformers, at low drive voltage, circuit in Figure 6.1 shall be assembled.

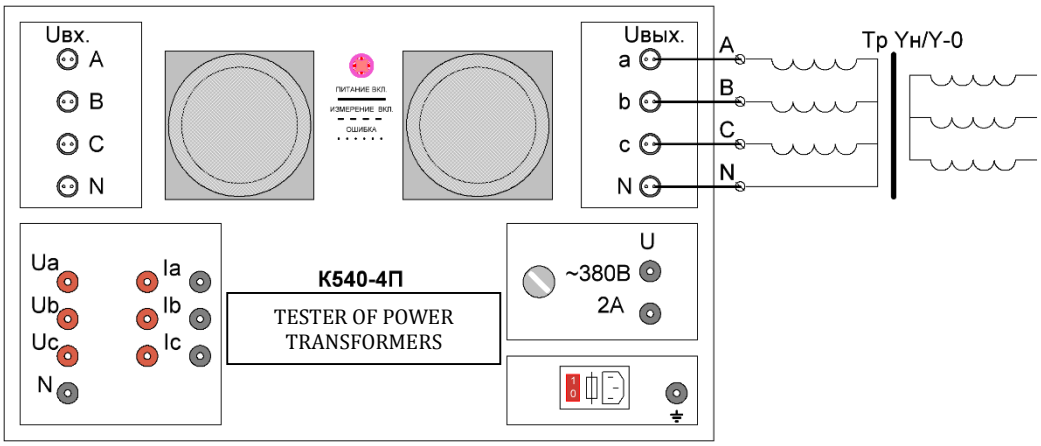

Figure 6.1

6.1.1.1 Switch on the meter, while following the requirements in Section 5.

6.1.1.2 Activate Line 1, Figure 5a on PC screen and select “Pxx at low voltage” mode.

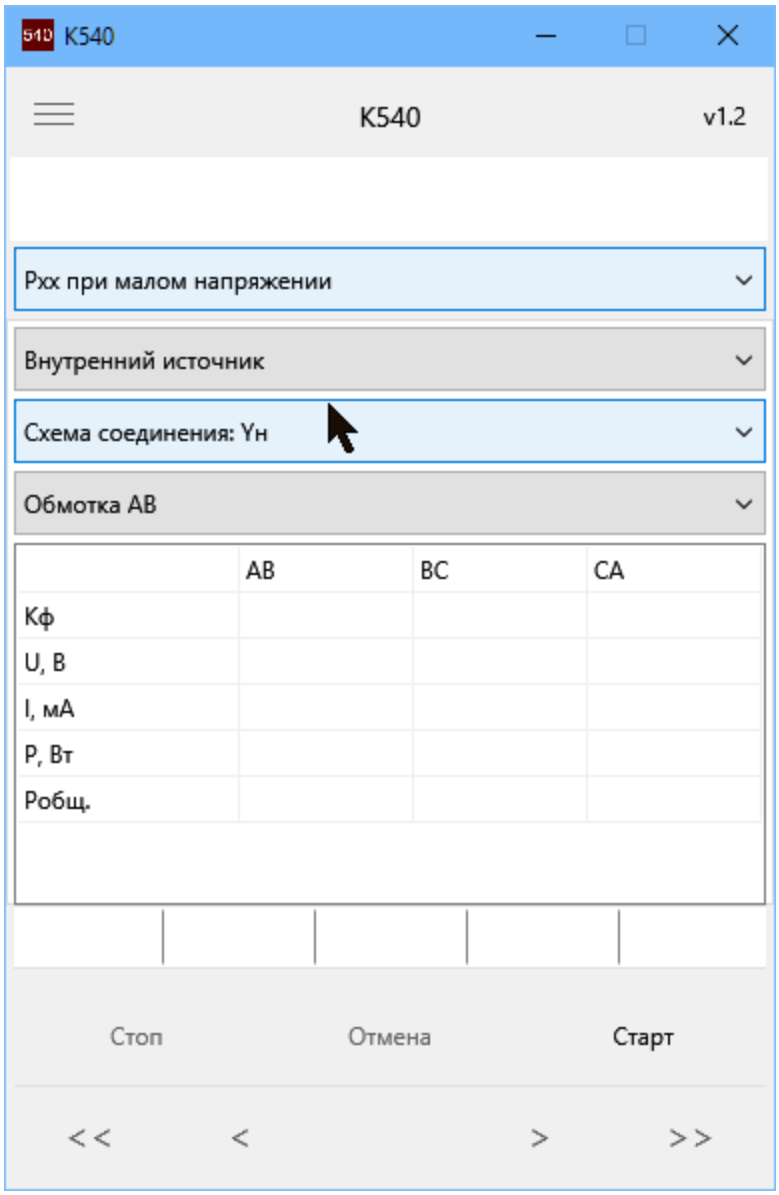

Figure 6.2

6.1.1.3 Activate Line 2, Figure 5a on PC screen and select “Internal source” mode (at that, 380V voltage will be generated by “K-540-4P” meter itself).

6.1.1.4 Activate Line 3, Figure 5a on PC screen and select one of five possible circuits for connection of winding, where drive voltage will be supplied (for circuit in Figure 6.1, select Yн – star with neutral terminal).

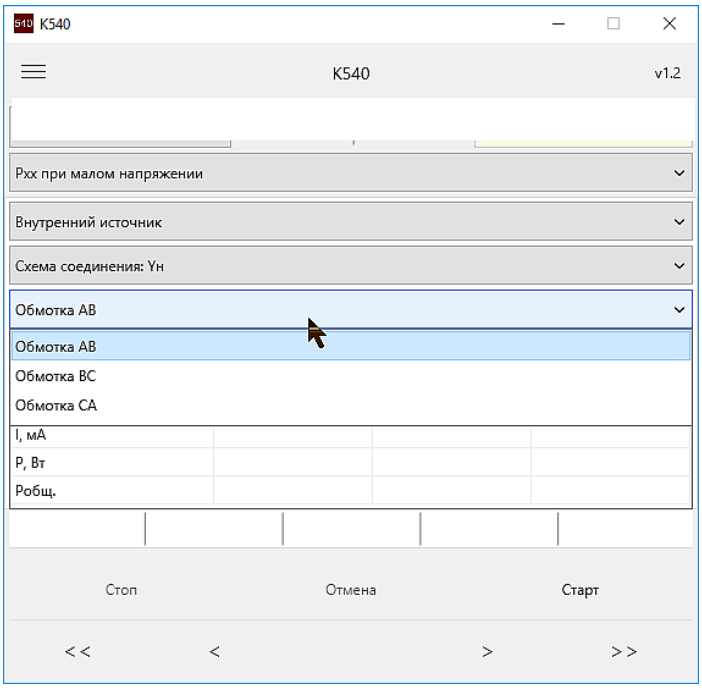

Figure 6.3

6.1.1.5 Activate Line 4, Figure 5a on PC screen and select one of three pairs (combinations of winding outputs), where drive voltage will be supplied (AB, BC, CA). View of resulting start screen for this mode is shown in Figure 6.3.

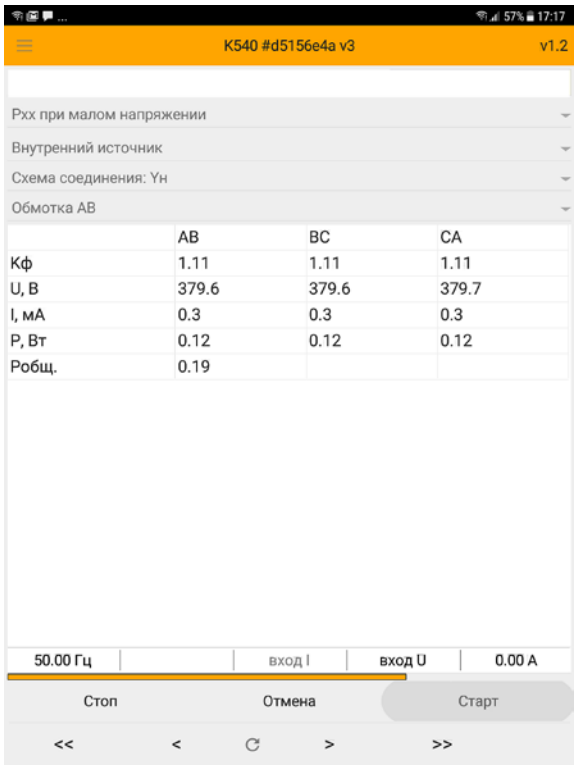

Figure 6.4

6.1.1.6 Activate the screen field labeled “Start” and click on the field with icon “>>”. Watch the growth of drive voltage shown in columns AB, BC, AC (Figure 6.4).

6.1.1.7 Set required voltage, while activating the keys “>>”, “<<”, “>” or “<”.At that, each click on the key leads to increase/decrease of output voltage by 2% or by 0.2%.

Column AB, BC or CA will display the measurement results:

Kϕ – form factor of drive voltage;

U, V – drive voltage

I, mA – drive current

P, W – standby loss in respective transformer cores (AB, BC, or AC)

Besides, screen displays the total amperage and frequency of drive voltage.

6.1.1.8 If all displayed measurement results satisfy the operator – activate the screen fields labeled “Stop”.

At that, measurement result in selected table column is saved. If measurement results are unsatisfactory for some reason, activate the screen field labeled “Cancel” and repeat the measurements.

6.1.1.9 Perform the standby loss measurement – under procedure in 6.1.1.5-6.1.1.7, for two other phase combinations (AB, BC, AC). At that, the entire table (Figure 6.4) will be filled, and bottom line will display the total standby loss value, at low drive voltage.

$$Psum=(P_{AB}+P_{BC}+P_{AC})/2$$

Comparison of obtained P_{AB}, P_{BC}, and P_{AC} results with factory measurement results determines the absence of defects in transformer. Besides, operative transformer shall comply with the following ratios of measured values:

$$P_{AB}=P_{BC}=P_{AC}/1.35$$

Measurement results will be stored in RAM of the meter, till its disconnection from power network. If you need to save the results on PC, follow the guidelines of Annex 1.

6.1.1.10 To accelerate the setting of voltage, its value can be set in semi-automatic mode.

Sequence of actions:

- Perform the measurement for AB only (under Items 6.1.1.2 - 6.1.1.7);
- Select BC winding and perform the “Start”;
- Perform the auto-setting of voltage (), Figure 6.5 – the voltage will gradually rise to value, which was set in previous paragraph; upon achieving the stable voltage value, record the result and perform the “Stop”;
- Select CA winding and perform the “Start”;

- Perform the auto-setting of voltage (Ↄ) – the voltage will gradually rise to value, which was set in previous paragraph; perform the “Stop”;

6.1.2 Pxx measurement on 3-phase transformers, at low drive voltage from external power source.

In most cases, these measurements just need the power of internal supply source (see Item 2, Table 2). But, in practice, drive current of some transformers exceeds 300 mA, at 380V voltage. In this case, Pxx can be measured at low voltage (under 380 V) or more powerful source/network voltage can be used (U=380V, 50Hz).

To perform such measurements, circuit in Figure 6.6 shall be assembled.

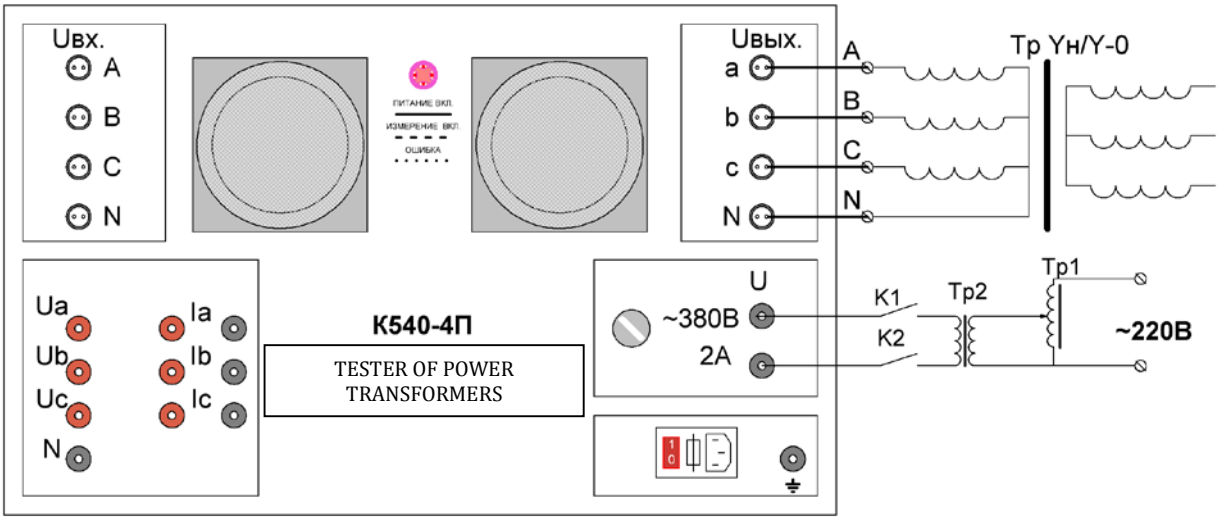

Figure 6.6

Where: Тр1 – laboratory transformer with current 2-9 A

Тр2 – transformer 22/380, with load current about 2 A.

К1 and К2 – switches.

Note. In extreme cases, 2 phases of mains voltage may be connected. At that, avoid touching the output terminals with hands or connecting the outputs to grounded parts.

Procedure of Pxx measurement in this mode is similar to one described in Section 6.1.1, but Item 6.1.1.3 requires selecting the “external source” mode.

6.1.3 Pxx measurement at rated 3-phase drive voltage, without use of additional current/voltage transformers.

"K-540-4P" meter allows Pxx and Psc measurements at 400V voltage and up to 10A current – without external current/voltage transformers.

To perform these measurements, circuit in Figure 6.7 shall be assembled.

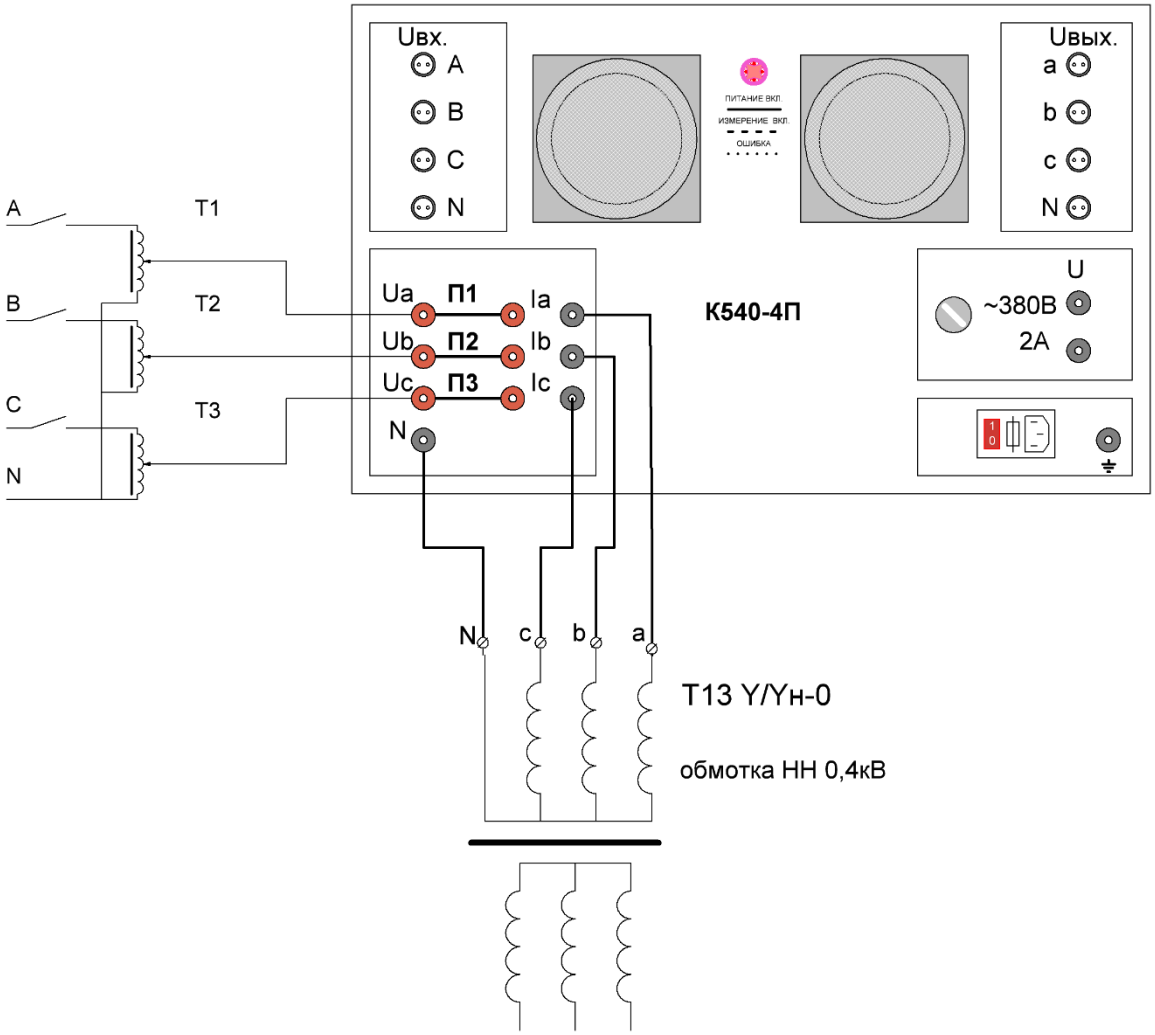

Figure 6.7

Where:

T1, T2, T3 – auto-transformers for equalizing the phase drive voltage.

P1, P2, P3 – jumpers for current up to 10 A.

A1 – 3-phase switch.

6.1.3.1 De-energize T1-T3 transformers, while ensuring the visible interruption of mains voltage.

6.1.3.2 Disable P1-P3 jumper.

6.1.3.3 Switch on the “K-540-4P” meter and PC, as described in Section 5.

6.1.3.4 In Line 1, Figure 5a, select the mode “Pxx at rated voltage”. In fields “voltage transformer” and “current transformer”, “default” start screen of this mode shows transformation ratios equal to 1 (no additional current/voltage transformers), see Figure 6.8. Do not change these values for this mode!!!

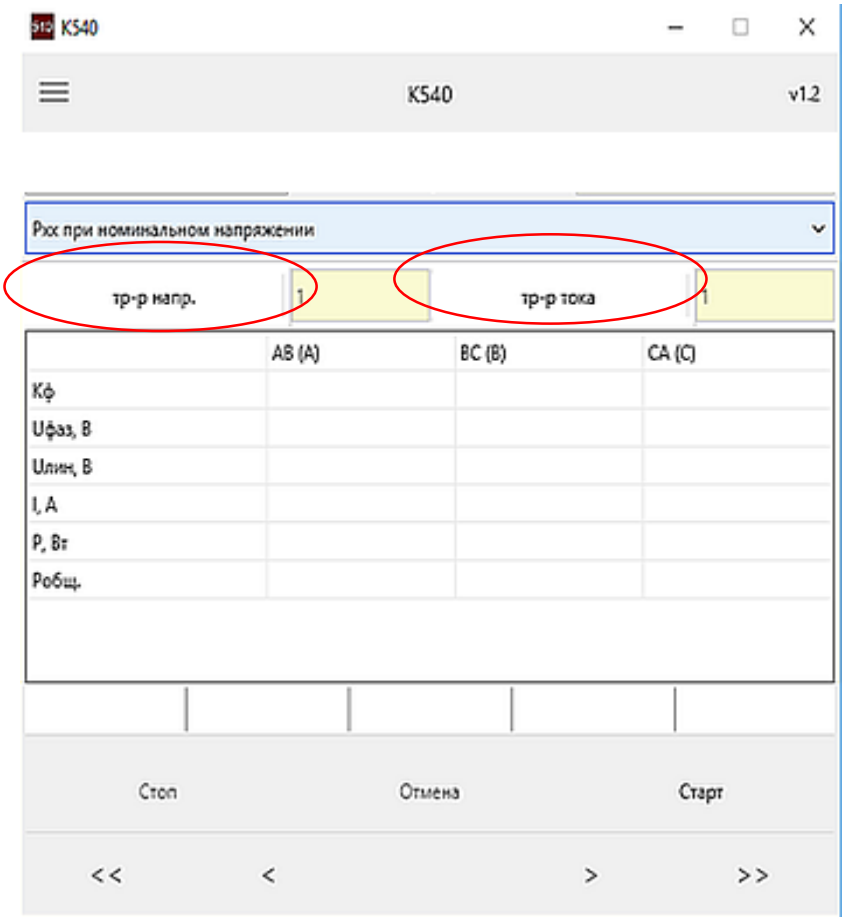

Figure 6.8

6.1.3.5 Supply power to T1, T2, T3 transformers (Figure 6.3) and activate the “Start” field. At that, AB, BC, and AC lines show linear/phase drive voltage, while “Кф” line shows the form factor of this voltage.

6.1.3.6 Set symmetrical drive voltage of AB, BC, and AC phases – by T1-T3 knobs (380-400V).

6.1.3.7 De-energize T1-T3 transformers.

6.1.3.8 Set P1, P2, and P3 jumpers under Figure 6.7 and supply power to T1, T2, and T3 transformers. At that, control the symmetry of drive voltage by lines UfaseB, UlinB and, if necessary, adjust it – by turning the knobs of respective T1, T2, and T3 transformers.

6.1.3.9 Table lines will show the values of drive voltage (I, A) and loss (P, W). These values may be negative and have no significance.

Result of measurement is value in line “Psum”.

In this mode, screen fields “Start” and “Stop” are suspended and measurements are started, but without de-energizing the load.

6.1.4. Pxx measurement at rated drive voltage, with use of additional current/voltage transformers.

At current over 10A and voltage over 400V, such measurements require assembling the circuit in Figure 6.9, while observing the phasing of current/voltage transformers.

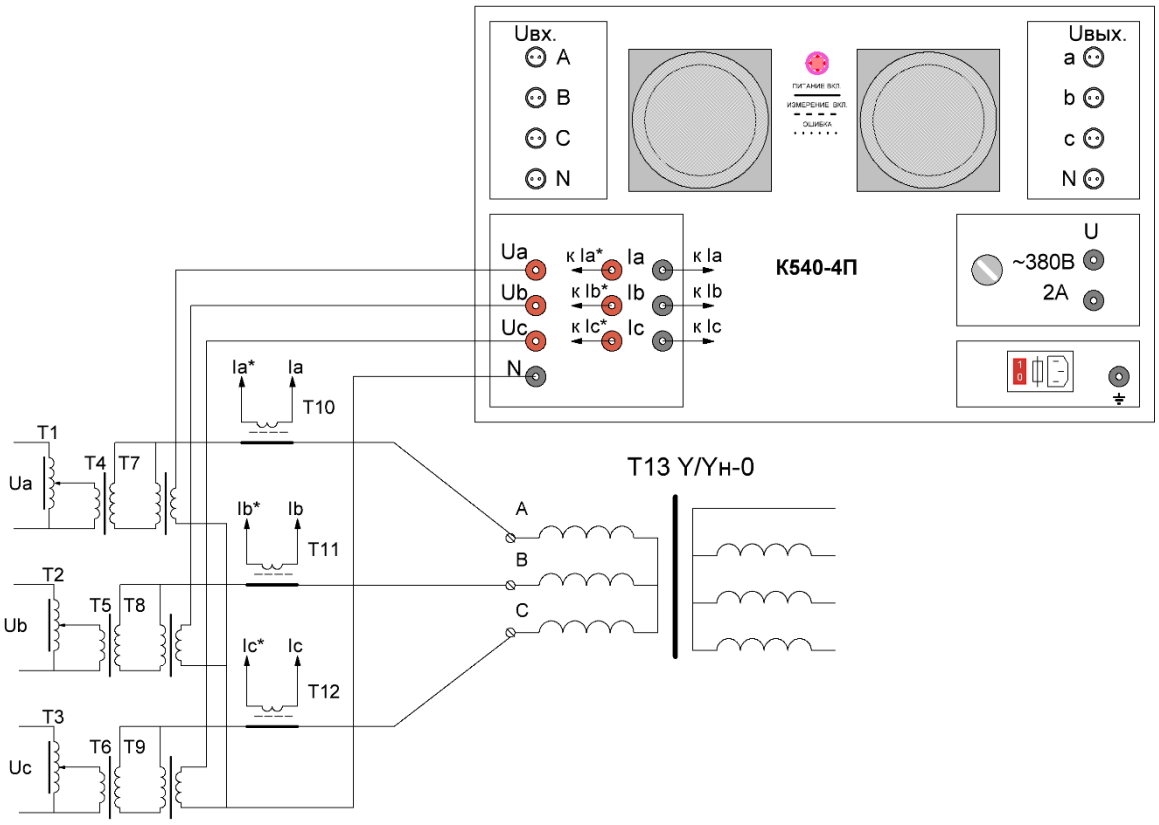

Figure 6.9

Where:

T1-T3 – auto-transformers of relevant power.

T4-T6 – step-up transformers (“star” connection).

T7-T9 – measuring voltage transformers.

T10-T11 – measuring current transformers.

T13 – tested transformer.

Procedure of these measurements has no practical difference from the one described in Section 6.1.3.

6.1.4.1 Switch on the “K-540-4P” meter and PC, as described in Section 5.

6.1.4.2 In Line 1, Figure 5a, select the mode “Pxx at rated voltage”. In fields “voltage transformer” and “current transformer” (start screen of this mode, see Fig. 6.8), set transformation ratios of applied current/voltage transformers.

6.1.4.3 Disconnect the test transformer from excitation circuit (Figure 6.9, points A, B, and C).

6.1.4.4 Supply power to T1, T2, T3 transformers (Figure 6.9) and activate the “Start” field. At that, AB, BC, and AC lines show linear/phase drive voltage, while “Kф” line shows the form factor of this voltage.

6.1.4.5 Set symmetrical drive voltage of AB, BC, and AC phases – by T1-T3 knobs.

6.1.4.6 De-energize T1-T3 transformers.

6.1.4.7 Connect the test transformer to excitation circuit (Figure 6.4, points A, B, and C) and supply power to T1, T2, and T3 transformers. At that, control the symmetry of drive voltage by lines UfaseB, UlinB and, if necessary, adjust it – by turning the knobs of respective T1, T2, and T3 transformers.

6.1.4.8. Table lines (Figure 6.4) show the values of drive voltage (I, A) and loss (P, W).

These values may be negative and have no significance. Result of measurement is value in line “Psum”.

In this mode, screen fields “Start” and “Stop” are suspended and measurements are started, but without de-energizing the load.

6.1.5 Measuring the short-circuit loss, at rated drive current

For measuring the short-circuit loss, at rated drive current, circuit in Figure 6.11 shall be assembled.

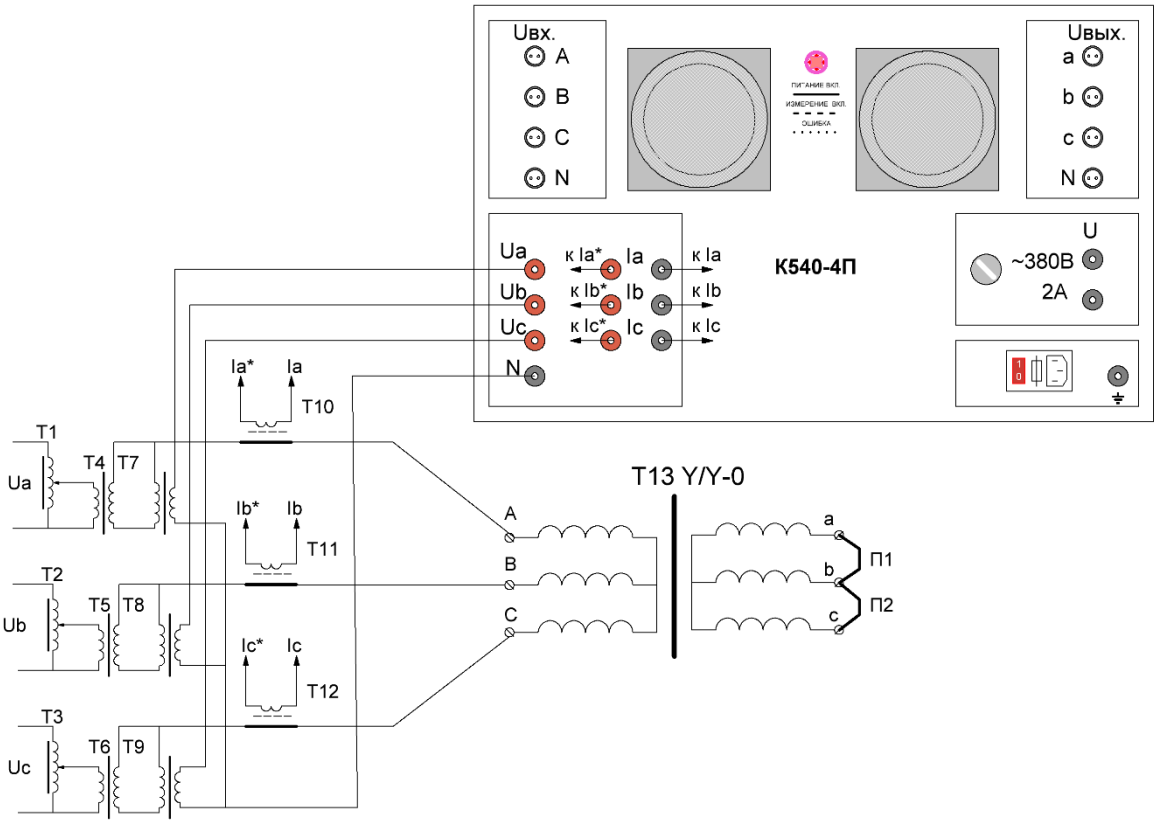

Figure 6.11

Where: P1, P2 – short-circuiting jumpers of relevant cross-section.

Application.

1. Psc is usually measured at drive current over 10A. Use of current transformers in the circuit (Figure 6.11) is practically always necessary.

2. At Psc measurement, drive voltage (400V) is usually not involved and, in most cases (T4-T9 transformers), is not necessary. In this case, drive voltage and current are measured as shown in Figure 6.12.

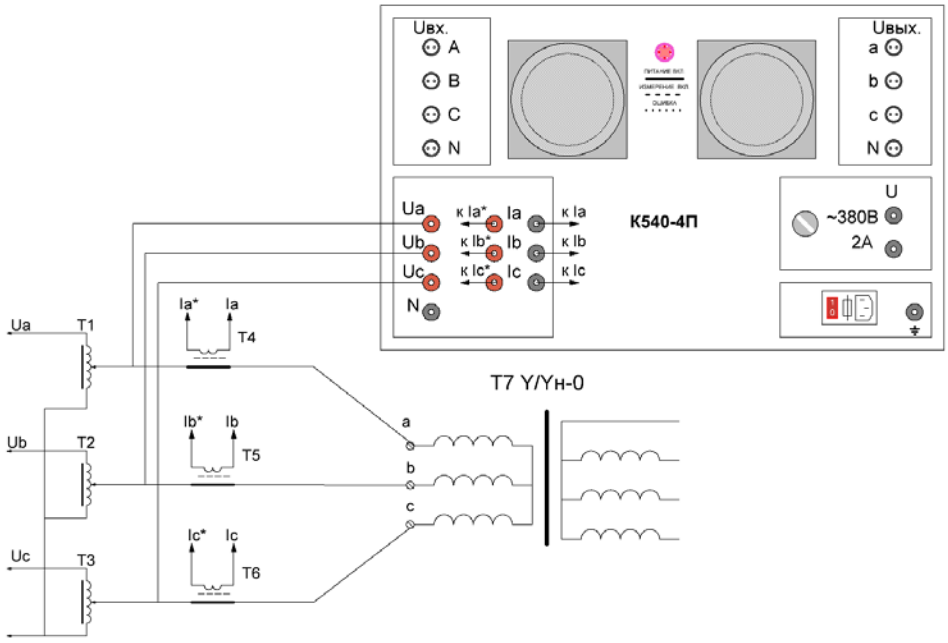

Figure 6.12

Psc measurement principle is not different from Pxx measurement at rated excitation.

6.1.5.1 Switch on the “K-540-4P” meter and PC, as described in Section 5.

6.1.5.2 In Line 1, Figure 5a, select the mode “Psc at rated voltage”. In fields “voltage transformer” and “current transformer” (start screen of this mode, see Fig. 6.13), set transformation ratios of applied current/voltage transformers.

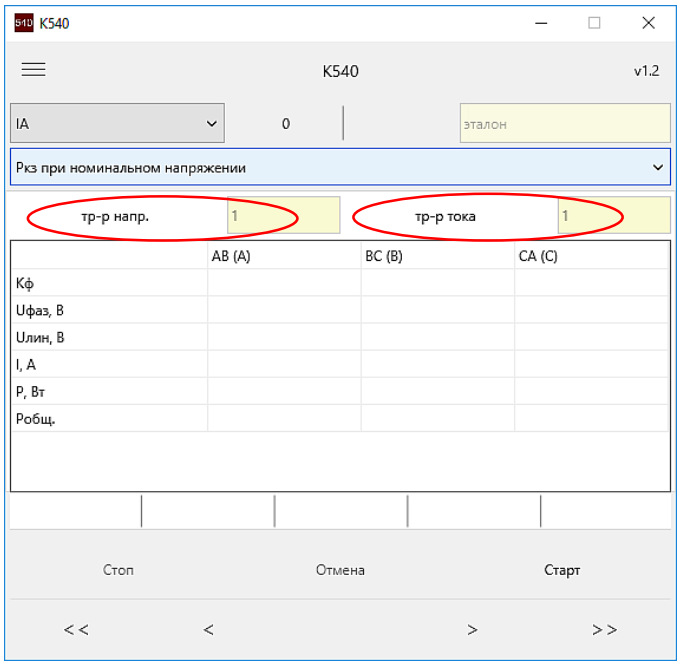

Figure 6.13

6.1.5.3 Disconnect the test transformer from excitation circuit (Figure 6.4, points A, B, and C).

6.1.5.4 Supply power to T1, T2, T3 transformers (Figure 6.12) and activate the “Start” field. At that, AB, BC, and AC lines show linear/phase drive voltage, while “Кф” line shows the form factor of this voltage.

6.1.5.5 Set symmetrical drive voltage of AB, BC, and AC phases – by T1-T3 knobs (voltage value is set as several tens of volts).

6.1.5.6 De-energize T1-T3 transformers.

6.1.5.7 Connect the test transformer to excitation circuit (Figure 6.12, points A, B, and C) and supply power to T1, T2, and T3 transformers. At that, control the symmetry of drive voltage by lines UfaseB, UlinB and, if necessary, adjust it – by turning the knobs of respective T1, T2, and T3 transformers.

(Psc measurement is conducted at pre-determined drive current. To set it, gradually and sequentially raise the voltage on all phases – till setting the symmetric drive currents).

6.1.5.8 Table lines show the values of drive current (I, A) and loss (P, W).

Result of measurement is value in line “Psum”.

In this mode, screen fields “Start” and “Stop” are suspended and measurements are started, but without de-energizing the load.

6.1.6 Measuring the transformer ratio and defining the winding connection group.

To conduct these measurements, circuit in Figure 6.14 shall be assembled.

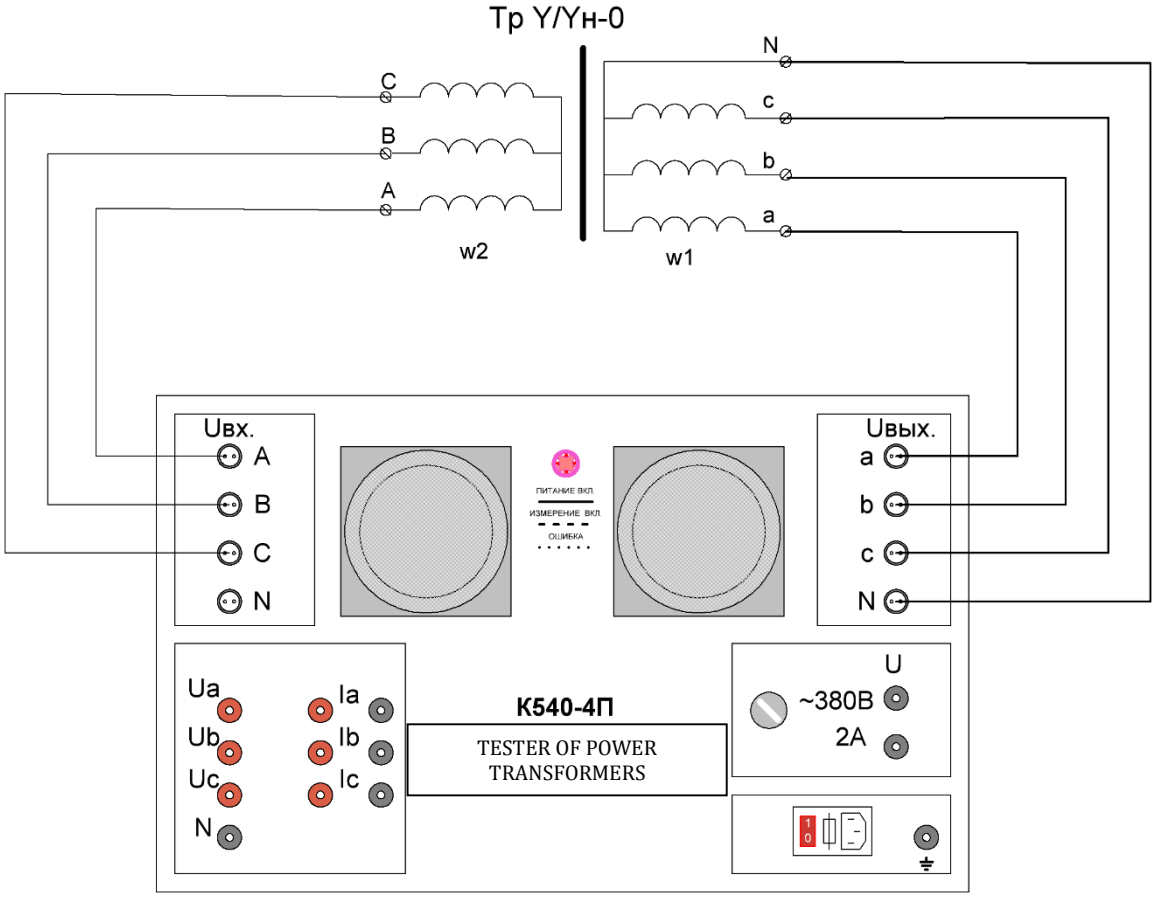

Figure 6.14

Where:

W1 – low-voltage winding of measured transformer.

W2 – high-voltage winding of measured transformer.

3-phase drive voltage (up to 30V) is generated in “K-540-4P” meter and supplied to output terminals “Uout” (2, Figure 1.1). Voltage from HV winding is supplied to input terminals “Uin” (7, Figure 1.1) of the meter.

Measurement procedure.

6.1.6.1 Comply with requirements of Section 5.

6.1.6.2 Activate Line 1, Figure 5a on PC screen, select “Transformation ratio and group of connected windings” mode, and select “Tap 1”, Figure 6.15.

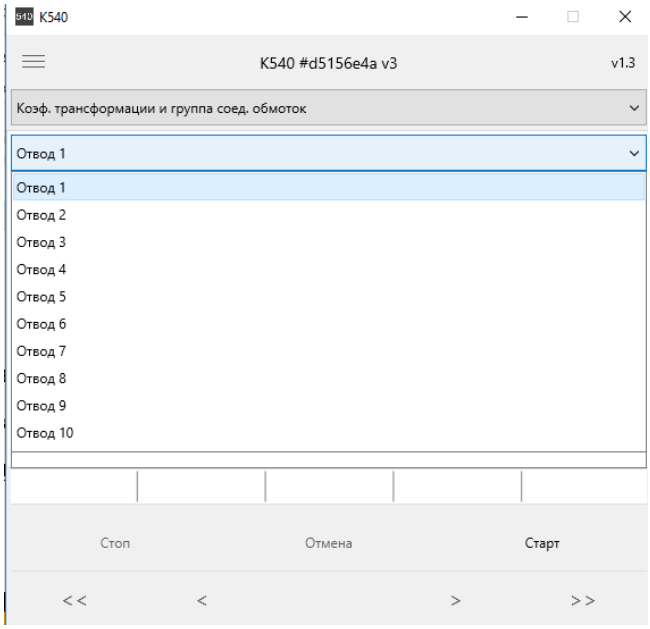

Figure 6.15

6.1.6.3 Activate the screen field labeled “Start” and click on the field with icon “>>”. Watch the growth of drive voltage shown in columns AB, BC, AC (Figure 6.16). Do not exceed the voltage over 400V (at any winding connected to the meter).

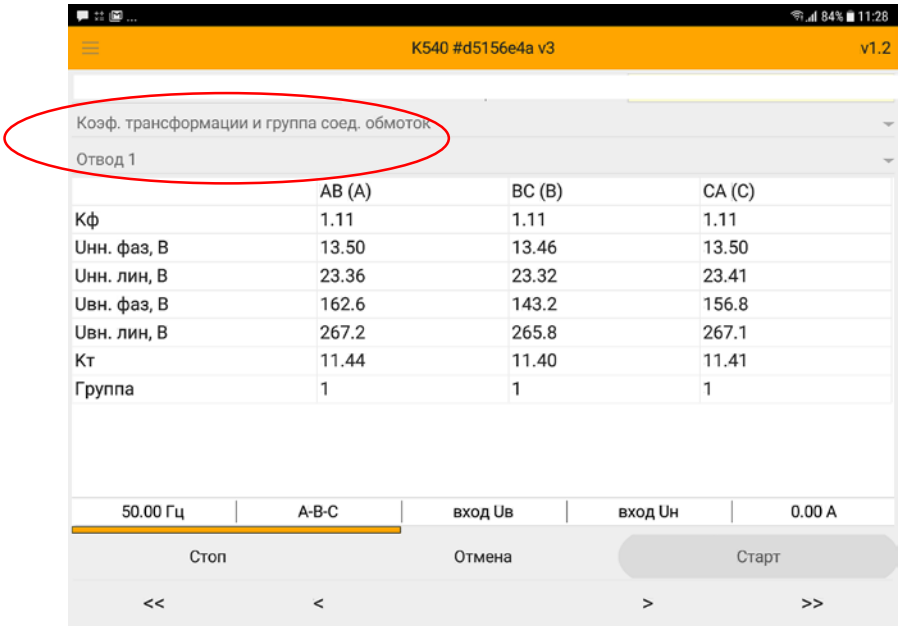

Figure 6.16

6.1.6.4 Measuring the transformation ratio and winding connection group for transformers with taps

To accelerate the setting of voltage, its value can be set in semi-automatic mode.

Sequence of actions:

- Perform the measurement for “Tap 1” only (under 6.1.5.2, 6.1.5.3)

- Switch the winding tap, using OLTC or SCU. Select “Tap 2” (Figure 6.15) and perform the “Start”;

- Perform the auto-setting of voltage (), the voltage will gradually rise to value, which was set in previous paragraph; upon achieving the stable voltage value, record the result and perform the “Stop”;

6.1.5. If you need to perform the measurement on other winding taps, select the next tap, while repeating the operations from previous paragraph.

For each tap, result of measuring the transformation ratio and connection group is shown in lines “Rtr” and “Group”.

7. STORAGE AND TRANSPORTATION REGULATIONS

7.1 The device should be stored indoors under conditions appropriate to the operating conditions. Under conditions of increased humidity it should be stored in manufacturer shipping container.

7.2 The storage place must be free of dust and vapors of aggressive liquids caused corrosion.

7.3 Transportation of the meter in manufacturer' shipping container can be executed by water, rail, road (on roads with improved surface) and air (in sealed compartments). The device should be protected from blows and self-movement.

8. ACCEPTANCE CERTIFICATE

The meter «К-540-4Р» serial number _____ conforms with obligatory requirements of state standards, current technical documentation and is classified as ready for operation.

Date of manufacture _____

Stamp here

Signature of person responsible for the acceptance _____

9. MANUFACTURE'S WARRANTY (SUPPLIER)

9.1 The Manufacturer (Supplier) guarantees the meter «K-540-4P» operability (stable performance characteristics) during 12 months from the date of its transfer to the Customer.

9.2 A free repair of the meter is performed by the Manufacturer during the warranty period provided that the operating rules are not violated by the Consumer.

The warranty does not apply to the equipment with mechanical defects obtained as a result of careless transportation and operation.

9.3 Upon expiration of the warranty period, the service is carried out by the Manufacturer under a separate contract.