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**INDICATOR OF DEFECTS OF ELECTRICAL MACHINES  
WINDINGS**

**IDO-07**

**Operation manual**

<https://tetra.kharkiv.com>

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## 1 Contact information

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## 2 Purpose

2.1 The indicator is designed for monitoring windings of electrical machines and provides the following checks:

1) three-phase windings for the presence of turn-to-turn short circuits, phase loss and incorrect connection of the phases;

2) coils of windings laid in slots, for the presence of turn-to-turn short circuits;

3) insulation states of the windings relative to the machine body and between the windings.

2.2 The main consumers of indicators are enterprises that operate or repair three-phase electrical machines with a voltage up to 1000 V.

## 3 Technical data

1) controlled parameters:

- when checking the three-phase winding for the presence of turn-to-turn short circuits, phase loss and the correct connection of the phases difference coefficient of the phase currents ( $K_d$ );

- when checking the coils of the windings laid in the slots for the presence of turn-to-turn short circuits current in the checked coil;

- when checking the insulation condition of the windings relative to the machine body and between the windings insulation resistance ( $R_i$ );

2) controlled range  $K_d$ , % 0-99;

3) controlled range  $R_i$ , MOhm 0-500;

4) output DC voltage when measuring  $R_i$ , V  $1000 \pm 100$ ;

5) indication LED;

6) power supply stand-alone or from an external power supply;

7) supply voltage, V 5;

8) power consumed, W, no more 4;

9) overall dimensions, mm 205 x 80 x 50;

10) weight\*, kg, no more 0.4;

11) operating position arbitrary;

12) parameters of the external power supply:	
- rated DC output voltage, V	5;
- rated output current, A, not less	1;
- rated AC input voltage, V	220.

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\* the weight of the indicator with the battery is indicated, the weight of the delivery set is  $0.67 \pm 0.04$  kg

#### 4 Kit content

1) IDO-07, pcs.	1;
2) battery (Li-Ion, type 14500), pcs.	1;
3) connecting cable, pcs.	1;
4) induction sensor, pcs.	1;
5) connecting wire, pcs.	2;
6) power supply, pcs.	1;
7) cable USB Type-C, pcs.	1;
8) operation manual, copies	1;
9) casing, pcs.	1.

#### 5 Indicator design and operation principles

5.1 Indicator design (fig. 5.1, 5.2).

Structurally, the indicator is made in the form of a portable device, the plastic body of which consists of two parts, tightened with rubber edging.

On the front side of the case there is a seven-segment three-digit display and LEDs, as well as inscriptions explaining the purpose of the indicator buttons.

### General view of IDO-07 indicator



Fig. 5.1

## Accessories to IDO-07 indicator

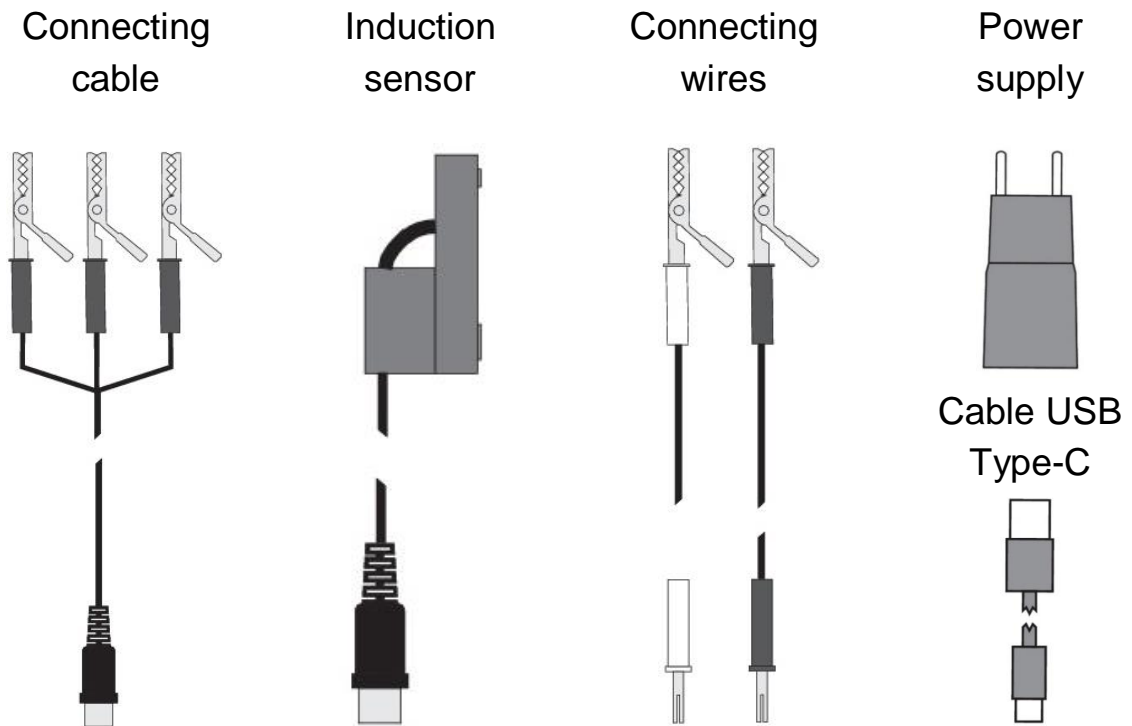





Fig.5.2

There are sockets on the upper wall of the case: «» – to connect a connecting cable or induction sensor to the indicator – and «**1000 V**», «» – to connect connecting wires to the indicator.

There are two buttons on the left side of the case: «» – to turn on / off the indicator – and «**Enter**» – to control the indicator.

There are a socket on the right wall of the case «**5V, 1A**» – to connect an external power supply to the indicator – and bicolor LED – to control the battery charge.

On the back of the case there are inscriptions explaining the purpose of the indicator sockets and containing basic information about it.

Inside the case there are a printed circuit board with elements of the indicator circuit and a battery.

### 5.2 Operating principle of the indicator.

5.2.1 When checking the three-phase winding for the presence of turn-to-turn short circuits, phase loss and the correct connection of the phases,

the currents of the two phases of the winding are compared when an alternating voltage up to 10 V is applied to them with a frequency up to 10 kHz. If there are defects, the phase currents will be different. The degree of this difference is determined by the value of the phase current difference coefficient  $K_d$ :

$$K_{d1} = k \frac{I_A - I_B}{I_A + I_B} \times 100\%; K_{d2} = k \frac{I_B - I_C}{I_B + I_C} \times 100\%; K_{d3} = k \frac{I_C - I_A}{I_C + I_A} \times 100\%,$$

where:  $I_A, I_B, I_C$  – effective values of phase currents;  
 $k$  – the coefficient is set by the manufacturer.


5.2.2 When checking the coil of the winding put in the slots for the presence of turn-to-turn short circuits, a pulse EMF of 1V / turn is induced in it. If there are short - circuited turns in the coil, the magnetic induction pulse of the field generated by the short-circuit current flowing through them is registered.

5.2.3 When checking the insulation state of the windings relative to the machine body and between the windings, a DC voltage is applied to the winding, the insulation resistance is determined and the latter is compared with the threshold value (0.5 MOhm).


## 6 Safety warnings

6.1 The indicator case has the following signs:



«  »Attention! Please read this manual before using the indicator.



«  »Attention! Dangerous voltage is generated at the clamps of the connecting wires.

6.2 The windings of the testing machine shall be de-energized.

6.3 Before checking a three-phase winding, briefly short-circuit the three-phase winding to the machine casing if the winding has previously been tested with high DC voltage.

6.4 When checking insulation of the windings relative to the machine case and between the windings disconnect the protection devices (if any)

and do not touch the clamps of the connecting wires. After its completion, the windings shall be discharged to the grounded machine case.




## 7 Preparation for operation

7.1 Perform an external inspection of the indicator.


7.1.1 Check for completeness in accordance with the kit content.

7.1.2 Make sure that there is no external damage to the case, connecting cable or connecting wires.

7.2 Check the power indicator.


7.2.1 Turn on the indicator by pressing the «» button. In this case when the battery charge level is indicated («» – maximum level, «» – minimum) the reading "500" and the green LED will light up.

If «**LO**» appears and the green and red LEDs flash, the battery shall be charged. For this:

- 1) turn off the indicator by pressing the «» button;
- 2) connect the power supply to the indicator (see fig. 5.1, 5.2);
- 3) connect the power supply to the AC network with a voltage of 220 V and a frequency of 50 Hz. In this case, the LED on the right wall of the indicator case lights up in red. The change in color of the LED from red to green indicates the end of the battery charge;
- 4) disconnect the power supply from the indicator and from the mains.

### Note

The battery charging is also performed when the indicator is powered by the power supply.

7.3.2 Turn off the indicator by pressing the «» button.



## 8 Operating procedure

8.1 Three-phase winding checks for the presence of turn-to-turn short circuits, phase loss and for the correct connection of the phases.

8.1.1 Connect the connecting cable to the indicator (see fig. 5.1, 5.2).

8.1.2 Connect the connecting cable using the clamps «**A**», «**B**» and «**C**» to the terminals of the three-phase winding of the machine. In this case, the phases shall be connected according to the connection diagram for this machine (in a star or in a triangle).

8.1.3 Turn on the indicator. At the same time, after indicating the battery charge level, the «**AbC**» reading and the green LED will light up.

If instead of one of the symbols «**A**», «**b**» or «**C**», the symbol «**-**» appears and the red LED lights up, this indicates that the corresponding phase is lost and there is no need to follow the further recommendations of clauses 8.1.4 – 8.1.7.

### Note

Possible states and defects of the winding and their indication options are shown in table 8.1.


8.1.4 Press the «**Enter**» button. After the flashing «**---**» symbols, the «**A**» symbol, the  $K_d$  value of the phases to which the «**B**» and «**C**» clamps of the connecting cable are connected, and one of the LEDs: green or red will light up.

### Note

**When checking the stator winding of the machine assembly, the  $K_d$  value of the phases is also affected by the unevenness of the air gap and rotor defects. To exclude these factors, the measured  $K_d$  value should be the lowest of the  $K_d$  values that the indicator shows when the rotor is turned slowly manually.**

8.1.5 Press «**Enter**». The symbol «**b**» and the  $K_d$  value of the phases to which the clamps «**A**» and «**C**» of the connecting cable are connected will appear, and the green or red LED will light up.

Table 8.1 Possible states and defects of the three-phase winding and their indication options

Indicator readings	State or type of winding defect
<b>-bC</b> <b>A-C</b> <b>Ab-</b> red LED	Phase loss
<b>A00 – A09</b> <b>b00 – b09</b> <b>C00 – C09</b> green LED	No turn-to-turn short circuits. The phases are connected correctly
<b>A10 – A99</b> <b>b10 – b99</b> <b>C10 – C99</b> red LED	Turn-to-turn short circuits are present. Incorrect phase connection
- - - green LED	No turn-to-turn short circuits.
 red LED	Turn-to-turn short circuits are present
<b>0.50 – 500</b> green LED	Insulation of windings relative to the machine case and between windings is in normal condition
<b>0.00 – 0.50</b> red LED	Insulation of windings relative to the machine case and between windings is in unsatisfactory condition

8.1.6 Press «**Enter**». The «**C**» symbol, the  $K_d$  value of the phases to which the «**A**» and «**B**» clamps of the connecting cable are connected will be displayed, and one of the LEDs will light up: green or red.


8.1.7 According to the values of the measured  $K_d$  and the glow of the LEDs establish the fact of the presence or absence of turn-to-turn circuits in the winding, phase loss, incorrect phase connection (see table 8.1).


8.1.8 Turn off the indicator.

8.1.9 Disconnect the connecting cable from the indicator.

8.2 Checking the coils of the windings inserted in the slots for the presence of turn-to-turn circuits.

8.2.1 Attach the induction sensor to the indicator (see fig. 5.1, 5.2).

8.2.2 Turn on the indicator. In this case after the battery charge level is indicated, the indication «» and green LED will light up.


8.2.3 By placing the induction sensor along the axis of the slot and pressing it tightly to the surface of the core package, «pass» through all the slots in turn. If a coil with short-circuited turns is detected, an intermittent beep will appear, and a flashing indication will appear «» and the red LED will light up.

8.2.4 Turn off the indicator.

8.2.5 Disconnect the induction sensor from the indicator.

8.3 Checking the insulation status of the windings relative to the machine case and between the windings.

8.3.1 Connect the connecting wires to the indicator (see fig. 5.1, 5.2).

8.3.2 Connect the clip connected to the socket «**1000 V**» to one of the windings, and the clip connected to the socket «», – to the machine case.

8.3.3 Turn on the indicator. At the same time, after indicating the battery charge level, the value of  $R_i$  and the green or red LED will light up.

8.3.4 According to the indicator readings evaluate the insulation status of the windings relative to the machine case and between the windings (see table 8.1).

8.3.5 Turn off the indicator.

8.3.6 Disconnect the connecting wires from the indicator.

## 9 Check of indicator serviceability

9.1 Connect the connecting cable to the indicator.

9.2 Short-circuit the clamps «**A**», «**B**» and «**C**» of the connecting cable.

9.3 Turn on the indicator. At the same time, after indicating the battery charge level, the «**AbC**» reading and the green LED should light up.

9.4 Press the «**Enter**» button. At the same time, after the flashing «**---**» symbols, the reading «**A00**», «**A01**» or «**A02**» should appear and the green LED should light up.

9.5 Press «**Enter**». The reading should change to «**b00**», «**b01**» or «**b02**».

9.6 Press «**Enter**». In this case, the display should take the form «**C00**», «**C01**» or «**C02**».

9.7 Turn off the indicator.

9.8 Disconnect the connecting cable from the indicator.

9.9 Connect the induction sensor to the indicator.

9.10 Make a short-circuited turn from a piece of insulated wire and place it on one side in the slot of an unwound stator or an unwound rotor of any machine.

9.11 Turn on the indicator. The indication «**-<sup>-</sup>**» and the green LED should light up.

9.12 Place the induction sensor along the axis of the slot with a short-circuited turn, pressing it tightly against the surface of the core package. An intermittent beep, a flashing «**□□**» and a red LED should appear.

9.13 Open a short-circuited turn. The audio signal should stop and the flashing indication «**□□**» should be changed to the indication «**-<sup>-</sup>**».

9.14 Turn off the indicator.

9.15 Disconnect the induction sensor from the indicator.

9.16 Connect connecting wires to the indicator.

9.17 Turn on the indicator. At the same time, after indicating the battery charge level, the reading “**500**” and the green LED should light up.

9.18 Turn off the indicator.

9.19 Short-circuit the clamps of the connecting wires.

9.20 Turn on the indicator. At the same time, after indicating the battery charge level, the reading “**0.00**” and the red LED should light up.

9.21 Turn off the indicator.

9.22 The indicator is correct if the requirements of section 9 are met.

## 10 Typical malfunctions and methods of their elimination

The failure nature and its manifestation	Probable reason	Method of elimination
1. In case of short-circuited terminals of the connecting cable, the indicator displays a reading «-bC», «A-C» or «Ab-»	Break in the connection cable	Find location of the break and restore contact
2. The indicator does not respond to the simulated short-circuited turn	Break in cable of the induction sensor	Find location of the break and restore contact

## 11 Operating and storage conditions

11.1 Temperature range operation: -10°C to + 40°C (+14°F to +112°F).

11.2 Temperature range storage: -20°C to + 50°C (-4°F to +122°F).

11.3 Humidity: 0-80% relative humidity, non-condensing.

## 12 Acceptance certificate

The indicator IDO-07 No. \_\_\_\_\_ corresponds to TC U 33.2–14105464.001–2002 and is classified as fit for operation.

Head of QC Department

**Place of Seal** \_\_\_\_\_

personal signature

\_\_\_\_\_  
date

### **13 Warranty liabilities**

13.1 The manufacturer guarantees the indicator performance if the owner observes the operating rules set out in the operation manual.

13.2 The warranty period is 24 months from the date of sale.

13.3 During the warranty period, the manufacturer undertakes to repair or replace the indicator free of charge. If the indicator fails, contact the manufacturer.

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