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**INDICATOR OF ELECTRICAL MACHINES  
WINDINGS DEFECTS  
IDO-06**

Operating manual  
**IDO-06.00.000.OM**

## 1 Purpose

1.1 The indicator is designed for monitoring three-phase 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) insulation states of the windings relative to the machine body and between the windings.

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

## 2 Technical specifications

- |  |  |
|--|--|
| 1) testing 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 | asymmetry coefficient of the phase currents ( $K_n$ ); |
| – when checking the insulation condition of the windings relative to the machine body and between the windings                               | insulation resistance ( $R_i$ );                       |
| 2) controlled range $K_n$ , %  | 0-99;  |
| 3) controlled range $R_i$ , MOhm   | 0-500;   |
| 4) $K_n$ value when closing one turn in phase, %, not less   | 10;  |
| 5) output DC voltage when measuring $R_i$ , V  | $1000 \pm 100$ ;                                       |
| 6) indication  | LED;   |
| 7) power supply  | stand-alone or from an external power supply;          |
| 8) supply voltage, V   | $4^{+0,2}_{-1,0}$ ;                                    |
| 9) power consumed, W, no more  | 3;   |
| 10) overall dimensions, mm   | 205 x 80 x 50;   |
| 11) weight*, kg, no more   | 0.4;   |
| 12) operating position   | arbitrary;   |

- |  |      |
|--|------|
| 13) parameters of the external power supply: |      |
| - rated DC output voltage, V                 | 4;   |
| - rated output current, A                    | 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

### **3 Delivery set**

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|---------------------------------------|----|
| 1) IDO-06, pcs.                       | 1; |
| 2) battery (Li-Ion, type 14500), pcs. | 1; |
| 3) power supply BPID-3, pcs.          | 1; |
| 4) connecting cable, pcs.             | 1; |
| 5) connecting wire, pcs.              | 2; |
| 6) operating manual, copies           | 1; |
| 7) casing, pcs.                       | 1; |

### **4 Structure and functioning of the indicator**

#### 4.1 Structure of the indicator (fig. 4.1, 4.2)

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-06 indicator



Fig. 4.1

## Accessories to IDO-06 indicator

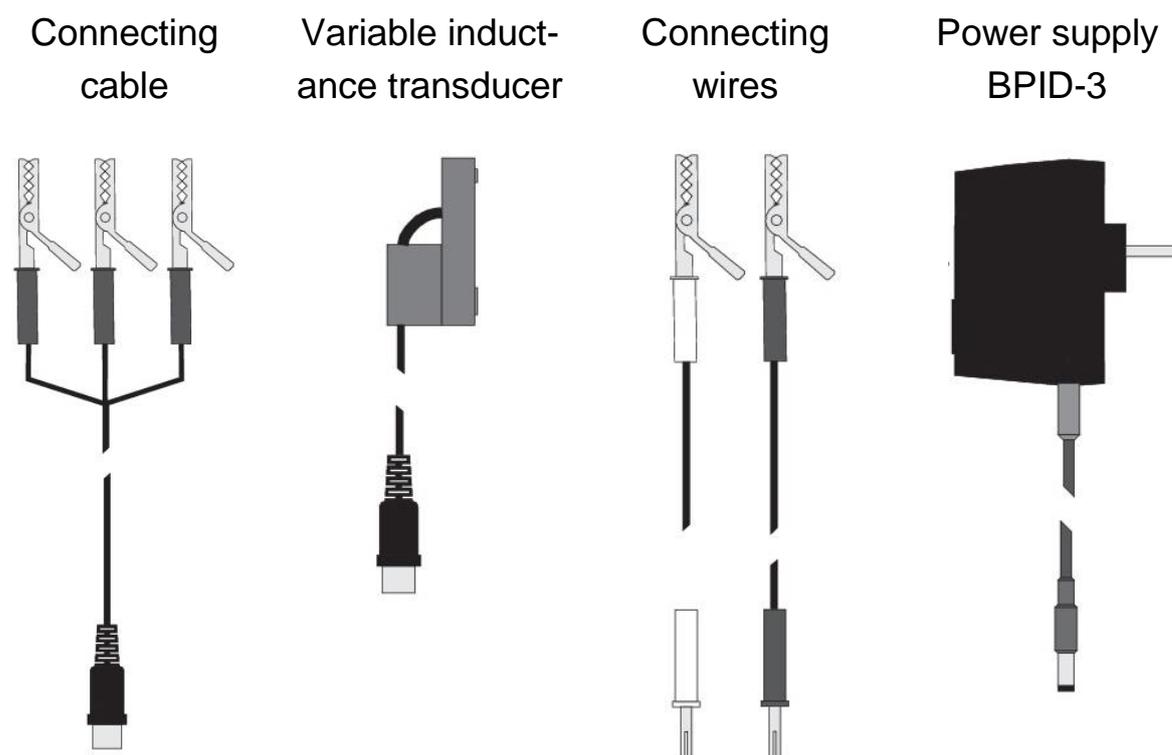


Fig.4.2

There are sockets on the upper wall of the case: «» – to connect a connecting cable or variable inductance transducer 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 is a socket on the right wall of the case «4V, 1A» – to connect an external power supply BPID-3 to the indicator (hereinafter referred to as the «power supply»).

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 is a printed circuit board with elements of the indicator circuit and a battery.

### 4.2 Operating principle of the indicator

4.2.1 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 asymmetry coefficient  $K_n$ :

$$K_{n1} = \frac{I_A - I_B}{(I_A + I_B)/2} \times 100\%; K_{n2} = \frac{I_B - I_C}{(I_B + I_C)/2} \times 100\%; K_{n3} = \frac{I_C - I_A}{(I_C + I_A)/2} \times 100\%$$

where  $I_A, I_B, I_C$  – effective values of phase currents.

4.2.2 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).

## 5 Safety instructions

5.1 The indicator case has the following signs:



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



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

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

5.3 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 terminals of the connecting wires. After its completion, the windings shall be discharged to the grounded machine case.

## 6 Pre-starting procedure

6.1 Perform an external inspection of the indicator.

6.1.1 Check for completeness in accordance with the delivery set.

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

6.2 Check the power indicator.

6.2.1 Turn on the indicator by pressing the «» button. In this case when the battery charge level is indicated («» – maximum level,

«\_\_\_\_\_ I» – 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. 4.1, 4.2);
- 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 LEDs on the power supply case will light up «» and «Charge». Turning off the «Charge» led indicates the end of the battery charge.
- 4) disconnect the power supply from the indicator and from the mains.

### Notes

1. The battery charging should only be carried out by using the power supply included in the delivery set.
2. The battery charging is also performed when the indicator is powered by the power supply.

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

## 7 Operation procedure

7.1 Inspection of the three-phase windings for the presence of turn-to-turn short circuits, phase loss and for the correct connection of the phases.

**7.1.1 Short-circuit the three-phase winding to the machine case for a short time!**

7.1.2 Connect the connecting cable to the indicator (see fig. 4.1, 4.2).

7.1.3 Connect the connecting cable using the terminals «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).

7.1.4 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 7.1.5 – 7.1.8.

### **Note**

Possible States and defects of the winding and their indication options are shown in table 7.1.

7.1.5 Press the «**Enter**» button. After the flashing «**-**» symbols, the «**A**» symbol, the  $K_n$  value of the phases to which the «**B**» and «**C**» terminals 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  $K_n$  value of the phases is also affected by the unevenness of the air gap and rotor defects. To exclude these factors, the measured  $K_n$  value should be the lowest of the  $K_n$  values that the indicator shows when the rotor is turned slowly manually.**

7.1.6 Press «**Enter**». The symbol «**b**» and the  $K_n$  value of the phases to which the terminals «**A**» and «**C**» of the connecting cable are connected will appear, and the green or red led will light up.

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

7.1.8 According to the values of the measured  $K_n$  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 7.1).

7.1.9 Turn off the indicator.

7.1.10 Disconnect the connecting cable from the indicator.

Table 7.1 Possible states and defects of the three-phase winding and their indication options

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

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

7.2.1 Connect the connecting wires to the indicator (see fig. 4.1, 4.2).

7.2.2 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.

7.2.3 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.

7.2.4 According to the indicator readings evaluate the insulation status of the windings relative to the machine case and between the windings (see table 7.1).

7.2.5 Turn off the indicator.

7.2.6 Disconnect the connecting wires from the indicator.

## 8 Indicator integrity monitoring

8.1 Connect the connecting cable to the indicator.

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

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

8.4 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.

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

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

8.7 Turn off the indicator.

8.8 Disconnect the connecting cable from the indicator.

8.9 Connect connecting wires to the indicator.

8.10 Turn on the indicator. At the same time, after indicating the battery charge level, the reading «**500**» and the green led should light up.

8.11 Turn off the indicator.

8.12 Short-circuit the terminals of the connecting wires.

8.13 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.

8.14 Turn off the indicator.

8.15 The Indicator is correct if the requirements of section 8 are met.

## 9 Typical failures and methods of their elimination

The failure nature and its manifestation	Probable reason	Method of elimination
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

## 10 Operating and storage conditions

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

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

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

## 11 Acceptance certificate

The indicator IDO-06 No. \_\_\_\_\_ corresponds to TC U 33.2–14105464.001–2002 and recognized as serviceable.

Quality Control Head

Seal \_\_\_\_\_

Personal signature

\_\_\_\_\_

Full name

\_\_\_\_\_

Date

## 12 Warranty liabilities

12.1 The manufacturer guarantees the operation of the indicator if the owner complies with the operating rules set out in the operating instructions.

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

12.3 During the warranty period, the manufacturer undertakes to repair or replace the indicator free of charge. In case of failure of the indicator you should contact the manufacturer.

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

### **Developer and manufacturer:**

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