Insulation Control

GZ 12z
Application

The GZ 12z is an insulation guarding device that indicates a drop in the insulation resistance under the permissible limit. This device is used for continuous checking of the insulation resistance in insulated lowvoltage networks or the earth insulation of power supplies and consumers, and for indication of a dangerous deterioration in the insulation. For indication, visual signals (green/red LEDs, colour scale) are provide, or the output contact can control different types of signalling devices. This equipment does not measure the insulation resistance in absolutes values, but watches over state of the insulation resistance within predetermined limits.

Design

The device is mounted in two-piece up insulating cover designed to installation on a vertical panel. The supply mains transformer and the separation choking coil are located on the baseplate. Two single row terminal plates are the component part of baseplate. The terminals make it possible to connection Cu or Al conductors - two up to the section 2,5 mm² or one up to the section 4 mm². Electronical circuits, signalling elements, output relay and fuse are located on the board with printed circuit. The signalling LEDs and the scale of indicator pass through the front panel with the label. The GZ 12z device is protected by the transparent plastic cover.

Description

The direct current bridge is a basis of the GZ 12z. Two arms of the direct current bridge compose a voltage divider with constantan resistors R14 and R15. The other two arms constitute insulation resistance with separation choking coil and resistance voltage divider with switchable shunts R5 to R7. The separation choking coil TL makes high input impedance for alternating component and the TL represents only small resistance for measuring direct current.

The current dimension which flows through insulation resistance is indicated at embedded measuring instrument. The capacitors C1 and C2 lead off an alternating voltage component. The diode D1 protects measuring instrument at overloading. The bridge is fed by 15 V from the GZ12z own source. A transistor flip-flop circuit is located at one diagonal of the bridge. The auxiliary output relay is controlled by transistor T2, which is normally switched on so that the relay coil current can flow through it - the relay is activated. The protective diode D2 is connected as parallel to the relay coil.

If there is a drop in the insulation resistance the transistor T1 switches on. The transistor T2 switches off and the relay suddenly releases. The LED "ON - PROVOZ" turns off and the LED "FAULT - PORUCHA" turns on. The measuring instrument indicates informatively the state of insulation:

- Green field - insulation in order
- Orange field - deterioration in insulation
- Red field - insulation failure
Projecting, installation and operation instructions

The GZ 12z is designed entirely for feeding from guarded insulated network. When the device guards an insulation resistance of an electrical appliance that isn’t connected to the operating voltage, it can be fed from own separating transformer, for example producer’s type OT1. The separating transformer OT1 can feed up to seven GZ 12z.

The RMS value of voltage the guarded insulated network must not overstep the maximal defined limit according the performance. Any LEDs don’t light, when a loss of supply voltage or a fuse disruption occur. The auxiliary relay is inactivated (in the position FAULT), so that signalling or another circuits, connected to output relay contacts, signal the same state as the insulation failure (connected terminals 13 and 14). A guarded insulated network always connect to the terminal 1 and the earthing to the terminal 10.

The testing of GZ 12z function in the recommended basic connection (see Fig. 2)

- Switch position A (function guarding an insulation state). In case of good insulation state the green LED “ON - PROVOZ” lights and informative indication of the insulation resistance value with respect to the connected earth is provided by the measuring element.

- Switch position X (the input of GZ 12z isn’t connected to guarded insulated network). The green LED “ON - PROVOZ” lights and the measuring element pointer is at the left margin position.

- Switch positions B to E (testing function). An earth connection is simulated by the resistance at the GZ 12z input. The value of resistance depends on the switch position and a GZ 12z performance.

The following table shows the LEDs lighting for individual switch positions. The measuring element pointer indicates a deflection corresponding to simulated insulation resistance.

<table>
<thead>
<tr>
<th>Switch position</th>
<th>Range (according to the performance)</th>
<th>Setting</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Connected testing resistance</td>
<td>200Ω / 500Ω / 15kΩ</td>
<td>18, 16</td>
<td>18, 17</td>
<td>18, 19</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Interconnected terminals</td>
<td>1kΩ / 1kΩ / 35kΩ</td>
<td>2kΩ / 2kΩ / 50kΩ</td>
<td>5kΩ / 5kΩ / 80kΩ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>infinite</td>
<td>green</td>
<td>green</td>
<td>green</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>200Ω / 500Ω / 15kΩ</td>
<td>red</td>
<td>red</td>
<td>red</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1kΩ / 1kΩ / 35kΩ</td>
<td>green</td>
<td>red</td>
<td>red</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>2kΩ / 2kΩ / 50kΩ</td>
<td>green</td>
<td>green</td>
<td>red</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>5kΩ / 5kΩ / 80kΩ</td>
<td>green</td>
<td>green</td>
<td>green</td>
<td>red</td>
<td></td>
</tr>
</tbody>
</table>

The testing should be effected every three months.

When checking the insulation by a megger or another similar high-voltage meter, the switch must not be in the position A. The switch must be in some of testing positions (B to E).

The GZ 12z is determined to guard insulated AC networks and devices. No rectifiers can be used in the guarded network. There is a threat of defective operation of the insulation control or its damage due to earth fault behind a rectifier.
Fig. 1 The diagram of the insulation control GZ 12z
**Technical data**

Nominal voltage \( U_n \) | 230 V, 50 or 60 Hz from insulated AC network
---|---
Operating range | from 0.8 to 1.1 \( U_n \)
Power consumption | max. 4.5 VA
Measuring voltage | 15 V DC from own GZ 12z source
Guarded insulation resistance value \( R_g \) | adjustable in the range from 0.2 to 80 k\( \Omega \) (according to the GZ 12z performance)
Insulated network voltage | max. 500/3 or 1000/3 V, 50 Hz (according to the GZ 12z performance)
Input impedance | min. 100 k\( \Omega \), typ. 200 k\( \Omega \) at 250 V, 50 Hz

**Contacts**

Number | 1x break-make
Sustained rating | 5 A
Breaking capacity | 1.5 A, \( \cos \varphi = 0.4 \) at 230 V AC
\( \text{Max. voltage on the contacts} \) | 0.2 A, \( \tau = 40 \text{ ms} \) at 220 V DC
250 V
Electrical life | \( 8 \times 10^6 \) operations

Temperature range | from -10 to +40 °C
Fuse | 0.1 A / F35
Testing voltage | 2.5 kV, 50 Hz
IP code | IP 20

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**Fig. 2** The basic recommended wiring
### Insulation Control GZ 12z

#### 0.2 - 1 - 2 - 5 kΩ performance:

<table>
<thead>
<tr>
<th>Range</th>
<th>Interconnected terminals</th>
<th>Rg [kΩ]</th>
<th>Measuring current max. [mA]</th>
<th>Accuracy of operation for insulated network 500/3 V</th>
<th>Accuracy of operation for insulated network 1000/3 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18, 16</td>
<td>0.2</td>
<td>6.5</td>
<td>1 to 1.5 Rg</td>
<td>1 to 1.6 Rg</td>
</tr>
<tr>
<td>2</td>
<td>18, 17</td>
<td>1</td>
<td>5</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>3</td>
<td>18, 19</td>
<td>2</td>
<td>4</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>5</td>
<td>3</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
</tbody>
</table>

#### 0.5 - 1 - 2 - 5 kΩ performance:

<table>
<thead>
<tr>
<th>Range</th>
<th>Interconnected terminals</th>
<th>Rg [kΩ]</th>
<th>Measuring current max. [mA]</th>
<th>Accuracy of operation for insulated network 500/3 V</th>
<th>Accuracy of operation for insulated network 1000/3 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18, 16</td>
<td>0.5</td>
<td>6</td>
<td>1 to 1.5 Rg</td>
<td>1 to 1.6 Rg</td>
</tr>
<tr>
<td>2</td>
<td>18, 17</td>
<td>1</td>
<td>5</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>3</td>
<td>18, 19</td>
<td>2</td>
<td>4</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>5</td>
<td>3</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
</tbody>
</table>

#### 15 - 35 - 50 - 80 kΩ performance:

<table>
<thead>
<tr>
<th>Range</th>
<th>Interconnected terminals</th>
<th>Rg [kΩ]</th>
<th>Measuring current max. [mA]</th>
<th>Accuracy of operation for insulated network 500/3 V</th>
<th>Accuracy of operation for insulated network 1000/3 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18, 16</td>
<td>15</td>
<td>0.95</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>2</td>
<td>18, 17</td>
<td>35</td>
<td>0.50</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>3</td>
<td>18, 19</td>
<td>50</td>
<td>0.40</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>80</td>
<td>0.30</td>
<td>1 to 1.45 Rg</td>
<td>1 to 1.5 Rg</td>
</tr>
</tbody>
</table>
Examples of application

a) Application without main switch on the separating transformer secondary

When no main switch is fitted on the separating transformer secondary winding, the GZ 12z watches insulation of all parts the insulation system, no matter whether the loads are switched on or off (in a one-pole circuit arrangement).

b) Application with the main switch on the separating transformer secondary

In this connection, the GZ 12z guards the secondary winding of the separating transformer and the line up to the main switch. With the switch in the ON-state, it also watches insulation of the line beyond the switch, including insulation of the associated loads.
c) Application with the main switch on the separating transformer secondary, disconnecting only one conductor

When the insulation control is required to be effective even after a part of the line is disconnected from the voltage, the disconnected part should be guarded via a lamp resistance and others. This resistance $R$ is added to the overall insulation resistance:

$$R_g' \begin{cases} \text{start resistance value} \\ R_g \begin{cases} \text{preset resistance value} \\ R_g' = R_g - R \end{cases} \end{cases}$$

The GZ 12z device guards insulation of the line and all one-phase appliances.

d) Insulated three-phase system with the led-out neutral wire

The GZ 12z device guards insulation of the line and all one-phase appliances.
e) Disconnected insulated three-phase appliance without neutral wire

When checking the insulation of a disconnected three-phase appliance is required it is necessary to connect GZ 12z via an artificial neutral formed by lamps or other resistances, which are added to insulation resistance $R_g$.

$$R_g' = R_g - \frac{R}{3}$$

f) Insulated three-phase system without neutral wire

In an insulated three-phase system without neutral wire, where the GZ 12z cannot, for any reason, be connected to the centre of the secondary winding of the separating transformer, an artificial neutral point should be provided. For this purpose, lamps, resistances or measuring transformers can be employed.
g) Low-voltage generator stator

Fig. 9 The example g)

The GZ 12z is connected to the center of the winding. If the midpoint tap isn’t brought out, an artificial neutral point should be provided.
Extension of GZ 12z application (0.5 - 5 kΩ or 15 - 80 kΩ, 1000√3 V performance) with the aid of transformer NT for networks up to 3x1000 V

The transformer NT includes choking coils which create an artificial neutral of a guarded network. Therefore it is possible the connection to phases. The neutral needn’t be led out.
In case a wiring with neutral, this wire isn’t applied to GZ 12z connection.

*Insulated three-phase system without neutral wire*

![Diagram of a network without neutral wire](image)

*Fig. 10* A network without neutral wire

*Insulated three-phase system with the led-out neutral wire*

![Diagram of a network with neutral wire](image)

*Fig. 11* A network with neutral wire

The same connection is available to apply in the d) to g) cases.

With the transformer NT is possibility to connect GZ 12z at voltage from 0 to 1000 V of three- or four-conductors network. Maximal voltage value between conductors of an insulated network is 1000 V.

While using transformer NT:
Rg ‘ ≅ Rg – 280
GZ 12z application with the separating transformer OT1

The OT1 is separating protective transformer. It is applied for galvanic separation the insulation control GZ 12z in cases with inaccessible insulated network or neutral wire at a place of application. One transformer OT1 can feed up to seven devices GZ 12z.

Design

The transformer OT1 is mounted in the same transparent plastic size KO cover as the GZ 12z. The cover is intended to installation on a panel at a switch-board. The connecting terminals, at the lower part, make it possible to connection one or two wires (Cu or Al) with a section from 1 to 2,5 mm². The separating transformer and the socket with a tubular fuse are placed on the internal insulating supporting board.

Description

The mainstay of the OT1 is specially designed separating protective transformer that corresponds to the category II. in consonance with the standard ČSN IEC 742 + A1, 1995. The transformer is stiff and conditionally shortcircuit-proof.

Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal input voltage</td>
<td>230 or 400 V</td>
</tr>
<tr>
<td>Nominal output voltage</td>
<td>230 V</td>
</tr>
<tr>
<td>Rated power</td>
<td>20 VA</td>
</tr>
<tr>
<td>Rated output current</td>
<td>0,1 A</td>
</tr>
<tr>
<td>Nominal frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Fuse</td>
<td>0,1 A / F35</td>
</tr>
<tr>
<td>Weight</td>
<td>1,9 kg</td>
</tr>
<tr>
<td>Dimensions</td>
<td>215 x 111 x 137 mm</td>
</tr>
<tr>
<td>IP code</td>
<td>IP 20</td>
</tr>
<tr>
<td>Testing voltage</td>
<td>6 kV, 50 Hz / 1 min</td>
</tr>
<tr>
<td>Working conditions:</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>from -10 to +40 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>max. 80 % (at 20 °C)</td>
</tr>
</tbody>
</table>

![Diagram](image)

**Fig. 12** The loading characteristics of the OT1 (data in the parentheses applies for the performance 400 V)
Fig. 13 The general diagram of the separating transformer OT1

Fig. 14 The wiring of the separating transformer OT1 and insulation controls GZ 12z
Dimensioned drawings

Fig. 15 The dimensioned drawing of the GZ 12z, NT and OT1
Ordering

Information required for ordering:
- Quantity
- Type designation
- $R_g$ resistance range
- Voltage value to earth of the insulated network

Also these combinations are possible to order:
- GZ 12z + OT1
- GZ 12z + NT
- GZ 12z + OT1 + NT

The kit GZ 12z, OT1, NT can be delivered in one casing K II.

Fig. 16 The dimensioned drawing of the casing K II