Instruction for installation, use and maintenance for Current and Voltage (potential) transformers
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This installation, use and maintenance guide is valid for current and voltage transformers operating in outdoor or indoor conditions.

These instructions are valid for Current transformer type: TPU; TPO; TP; TTR; BB; BBO; KOKS; KOFD; KOFA; IHBF

Voltage transformers types: TJC; TDC; TDO; TJO; TJP; TDP; KGUG; KGUGI; KRED

1. Operating conditions

Indoor transformers

The transformers should be mounted in dry indoor conditions where the ambient air is not significantly polluted by dust, smoke, corrosive cases, vapours or salt.

The transformers are designed for standard ambient temperature between –5 °C and +40 °C. The altitude for use should be lower than 1000 m above the sea level. The transformers may be used also in higher ambient temperatures and higher altitudes when agreed upon with the manufacturer.

Outdoor transformers

The transformers should be mounted in outdoor conditions where the ambient air may be polluted by dust, smoke, corrosive cases, vapours or salt.

The transformers are designed for standard ambient temperature between –40 °C and +40 °C. The average value of the ambient temperature, measured over a period of 24 hours, should not exceed 35°C.

2. Technical details

The technical details for each individual transformer are mentioned on the rating plate fastened on the transformer. Values mentioned on the rating plate must not be exceeded. Markings used on the rating plate are as follows:

Current transformers

<table>
<thead>
<tr>
<th>ABB</th>
<th>1234567890</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPU 40.13</td>
<td>50 Hz</td>
</tr>
<tr>
<td>200-400/1/1 A</td>
<td></td>
</tr>
<tr>
<td>1S1-1S2</td>
<td>200/1A</td>
</tr>
<tr>
<td>1S1-1S3</td>
<td>400/1A</td>
</tr>
<tr>
<td>2S1-2S2</td>
<td>200/1A</td>
</tr>
<tr>
<td>2S1-2S3</td>
<td>400/1A</td>
</tr>
<tr>
<td>12/28/75 kV</td>
<td>50(1s)/125 kA</td>
</tr>
<tr>
<td>2002</td>
<td>IEC 60044-1</td>
</tr>
<tr>
<td>E</td>
<td>TCM 212/95-2150</td>
</tr>
</tbody>
</table>
Where:
1234567890 serial number
TJC 4 transformer type code
50Hz rated frequency
200-400/1/1 A rated transformer ratio
1S1-1S2 terminal marking for core number 1, first tap
1S1-1S3 terminal marking for core number 1, second tap
5VA rated output
0.5, 5P accuracy classes
FS5 instrument security factor
12/28/75 kV highest voltage for equipment / power-frequency withstand voltage / rated lightning-impulse voltage
IEC 60044-1 referred standard(s)
50(1s)/125kA rated short time thermal current (thermal time) / rated dynamic current
2002 year of production
E temperature class
TCM ……… Type approval mark

Voltage transformers

<table>
<thead>
<tr>
<th>ABB</th>
<th>1234567890</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJC 4</td>
<td>TJC 4</td>
</tr>
<tr>
<td>6600:√3/100:√3/100:3 V</td>
<td>50 Hz</td>
</tr>
<tr>
<td>a-n</td>
<td>30VA cl.0.5</td>
</tr>
<tr>
<td>da-dn</td>
<td>30VA cl.6P</td>
</tr>
<tr>
<td>7.2/20/60 kV</td>
<td>400 VA</td>
</tr>
<tr>
<td>2002</td>
<td>IEC 60044-2</td>
</tr>
<tr>
<td>E</td>
<td>TCM 212/95-2151</td>
</tr>
</tbody>
</table>

Where:
1234567890 serial number
TJC 4 Transformer type code
50Hz rated frequency
6600:√3/100: √3/100:3 V rated voltage ratio
a-n terminal marking for first secondary winding
da-dn terminal marking for residual (open-delta) winding
30VA rated output
0.5, 6P accuracy classes
12/28/75 kV highest voltage for equipment / power-frequency withstand voltage / rated lightning-impulse voltage
IEC 60044-2 referred standard
2002 year of production
E temperature class
TCM……… Type approval mark
3. Instruction for installation

General information
Instrument transformer is an electrical equipment and the electrical installation shall be done by skilled person only. National legislation can set down the minimum age and the criteria for competence of skilled persons working on, with, or near an electrical installation. Where is not the national legislation requirements for competence, the criteria shall be used at least according to EN 50110-1.

Safety instructions
1. Always consider transformer as a part of the circuit to which it is connected, and do not touch the leads and terminals or other parts of the transformer unless they are known to be grounded.
2. Always ground the metallic bases of instrument transformer.
3. Always ground one secondary terminal of the transformer, except if the windings are connected to open delta. When the secondary of transformer is interconnected, there should be only one grounded point to prevent accidental paralleling with system grounding wire. In case of disconnection from the ground, the grounding screw has to be removed from the secondary terminal. Connection between secondary terminal and base plate (ground) is shown on the picture “Crossection of single line terminal box”
4. Always short-circuit the secondary of the current transformer, which is not currently in use to prevent secondary voltages which may be hazardous to personnel or damaging to the transformer’s secondary. The secondary like this must be additionally grounded.
5. Never short-circuit the secondary terminal of a voltage transformer even this is not in use. A secondary short-circuit will cause the unit to overheat and fail in a very short period of time.
6. Protection of single pole insulated voltage transformers against ferroresonance phenomena is stated in appendix 3. – Damping of the ferroresonance in Voltage transformers type TJC.
7. In case of the current transformer with voltage indication (coupling electrode included) is secondary terminal box equipped with PE terminal, which is connected with earthing screw to the base plate, which must be generally earthed. Connection between secondary terminal and base plate is shown on the picture “Crossection of single line terminal box”
   Attention: Terminal PE must be always earthed, this is hold generally, even if the base plate is removed. In case of disassembling the base plate, producer doesn’t warranting the earthing.

Mounting
Following information is general and some details can differentiate according to type and variants of transformers. It is necessary to combine it with other technical and marketing specifications like catalogues, dimensional drawings and rating plate for specific transformer type.

Indoor current and voltage transformers
The mounting position of the indoor transformer can be freely chosen. The transformer is fixed using the mounting base with four screws M10 and washers. Fastening must be done on a smooth surface.
There is a M8 screw for earthing the transformer on the base plate.
Outdoor current and voltage transformers

The mounting position of the outdoor transformer is only horizontal. The other position can be agreed with the supplier. The transformer is fixed using the mounting base (VT) with four screws M10 and washers or two U profiles (CT) with M12 screws. Fastening must be done on a smooth surface.

There is a M12 screw for grounding of current transformer and M8 screw for grounding of voltage transformer.

Primary connection

Primary terminals of the current transformer are made of cooper and they are silver or tin plated. There are M12 screws used for fastening of primary conductor to the terminal. For primary reconnectible transformers the ratio can be reconnected by changing position of the links fixed by M8 screws without removing already fitted primary conductors.

Maximum allowed torques for screw connections of current transformers:

<table>
<thead>
<tr>
<th>Screw</th>
<th>Max. torque [Nm]</th>
<th>Min. torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>3.5</td>
<td>2.8</td>
</tr>
<tr>
<td>M6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>M8</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>M10</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>M12</td>
<td>70</td>
<td>56</td>
</tr>
</tbody>
</table>

Maximum allowed torque for screw connection of voltage transformer is 20 Nm.

Maximum allowed cantilever strength is:
- Voltage transformers 2000 N.
- Current transformers 5000 N.

Primary reconnectable transformers

PRIMARY CONNECTION

LOW RATIO

![Low Ratio Diagram]

HIGH RATIO

![High Ratio Diagram]
Secondary connections

The terminals, screws, nuts and washers are made of stainless steel. Secondary grounding screws and secondary terminal fastening screws are made of nickel-plated brass.

The secondary terminal cover box for indoor use is made from the plastic and provided with three detachable threaded inserts Pg16. The terminals are provided with M5 screws for secondary wiring connection and with through going holes for direct earthing of the secondary circuit by M5 screws. The terminal cover is sealable.

The secondary cover for outdoor CT is made of epoxy resin and provided with one insert Pg21. The secondary cover for outdoor VT is made of plastic and provided with two insert Pg21.

Degrees of IP protection
Indoor transformers: IP40, or IP30 for transformers TTR, BB, KOKS
Outdoor transformers: IP54

For terminal marking see appendix 1.

Details of current transformers casted terminal boxes

Details of voltage transformers casted terminal boxes
Cross section of single line secondary terminal box

**Capacitive voltage indicator (divider)**

The transformer can be supplied with the capacitive voltage indicator on the request. There are two possible solutions:

a. HR – Indicator complies with the IEC 61234-5 standard for high resistive voltage indicators

b. CE – Where the values of capacity C1 and C2 are measured. C1 is the capacitance between primary winding and Ck terminal and C2 is the capacitance between grounded parts and CK terminal. These values are mentioned on the rating plate.

### CE capacity according to nominal voltage

<table>
<thead>
<tr>
<th>Ub (kV)</th>
<th>C1 (pF)</th>
<th>C2 (pF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 – 5,5</td>
<td>28 – 55</td>
<td></td>
</tr>
<tr>
<td>5,5 – 7,2</td>
<td>23 – 40</td>
<td></td>
</tr>
<tr>
<td>10 – 13,8</td>
<td>19 – 33</td>
<td>20 - 90</td>
</tr>
<tr>
<td>13,8 – 17,5</td>
<td>13 – 23</td>
<td></td>
</tr>
<tr>
<td>20 – 24</td>
<td>10 - 18</td>
<td></td>
</tr>
</tbody>
</table>

**Fuses**

The fuse can be a part of a supply of voltage transformers with fuse. We can supply following fuses:

0.3A – 12 and 24 kV products… fuse type JT6 specially designed for voltage transformers

0.6A – 12 kV products ……… …fuse type JT6 specially designed for voltage transformers

2A – 6.3A all products up to 36 kV …IEC fuses manufacturer SIBA

2A products up to 36kV …….. IEC fuses manufacturer BUSSMANN

**8. Instruction for use**

Current transformers are used:

- to convert large currents in the primary circuit to an appropriate level for secondary circuit equipment (relays and meters)
- to insulate primary and secondary circuit from each other to protect the secondary equipment from the harmful effects of large current appearing during the operation (short circuits).

The use of current transformer for other purpose then described above is forbidden in not agreed with the producer.

**Routine test report**

Together with instrument transformer are delivered:
- routine test report
- two rating plates (one plastered on the transformer and one free)

The following information can be included on the request. These are free of charge.
- theoretical current/voltage errors and phase displacement values
- theoretical excitation curves

There are additional extra paid reports which can be supplied on request:
- accuracy test report
- magnetizing curve (for current transformers)
- additional labels (if more then 2)
- verification tests

9. **Instruction for maintenance**

Excessive dust or other kind of pollution must be brushed off the transformer. Polluted transformers can be cleaned with spirit, petrol or toluene.

Traces of arcs and minor surface damages can be easily removed with sandpaper after which the surface is to be treated by applying a thin layer of silicone paste on it.

Instruction for repairing greater surface damages must be requested from the manufacturer.

10. **Transport and storage**

The permissible transport and storage temperature is from –40 °C to +70 °C. During transport and storage the transformers must be protected against direct sunshine. The transformers are delivered fastened to a transport pallet.

11. **Disposal**

Materials used in instrument transformers are considered as materials without dangerous environmental impact and materials are not toxic. Disposal of instrument transformers is controlled by national legislation of communal waste.

12. **Normative references**

IEC60044-1… Instrument transformers – Current transformers
IEC60044-2… Instrument transformers – Voltage transformers
IEC61243-5… Voltage detectors – Voltage detecting systems (VDS)
IEC60529…..Degrees of protection provided by enclosures (IP Code)
ISO12100…..Safety of machinery — Basic concepts, general principles for design
EN 50110-1 …Operation of electrical installations
**Appendix 1. Examples of secondary terminal marking for casted terminal box for current transformers**

<table>
<thead>
<tr>
<th>No tap</th>
<th>One core</th>
<th>One core with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1s1 1s2</td>
<td>1s1 1s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>1s1 1s2 1s3</td>
<td>1s1 1s2 1s3</td>
</tr>
<tr>
<td>2 taps</td>
<td>1s1 1s2 1s3 1s4</td>
<td>1s1 1s2 1s3 1s4</td>
</tr>
<tr>
<td>3 taps</td>
<td>1s1 1s2 1s3 1s4 1s5</td>
<td>1s5</td>
</tr>
<tr>
<td>4 taps</td>
<td>1s1 1s2 1s3 1s4 1s5 1s6</td>
<td>1s5 1s6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No tap</th>
<th>Two cores</th>
<th>Two cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1s1 1s2 2s1 2s2</td>
<td>1s1 1s2 2s1 2s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>1s1 1s2 1s3 2s1 2s2 2s3</td>
<td>1s3 2s3</td>
</tr>
<tr>
<td>2 taps</td>
<td>1s3 1s4 2s3 2s4</td>
<td>1s3 1s4 2s3 2s4</td>
</tr>
<tr>
<td>3 taps</td>
<td>1s4 1s5 2s4 2s5</td>
<td>1s4 1s5 2s4 2s5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No tap</th>
<th>Three cores</th>
<th>Three cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1s1 1s2 2s1 2s2 3s1 3s2</td>
<td>1s2 2s2 3s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>1s3 2s3 3s3</td>
<td>1s2 1s3 2s3 3s2 3s3</td>
</tr>
<tr>
<td>2 taps</td>
<td>1s3 1s4 2s3 2s4 3s3 3s4</td>
<td>1s2 1s3 2s3 3s2 3s4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No tap</th>
<th>Four cores</th>
<th>Four cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1s2 2s2 3s2 4s2</td>
<td>1s2 2s2 3s2 4s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>1s1 2s1 3s1 4s1</td>
<td>1s1 2s1 3s1 4s1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No tap</th>
<th>Five cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1s2 2s2 3s2 4s2 5s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>1s1 2s1 3s1 4s1 5s1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No tap</th>
<th>Six cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1s2 2s2 3s2 4s2 5s2 6s2</td>
</tr>
</tbody>
</table>

---

2nd line of terminal - terminal not earthed
1st line of terminal - terminal earthed

1VLM000610 Rev.1, en 2008.12.3
Examples of secondary terminal marking for casted and assembled (phoenix) terminal box for Voltage transformers

### One pole insulated voltage transformer

- 2 measuring windings
  - 1a, 1n, 2a, 2n, N, PE
- Measuring and residual winding
  - a, n, da, dn, N, PE
- 2 ratios measuring winding
  - a1, a2, n, N, PE
- One measuring winding
  - a, n, N, PE

### Assembled secondary terminal (Phoenix)

- 2 measuring and residual winding
  - 1a, 1n, 2a, 2n, da, dn, N, PE
- 2 measuring double rations winding
  - 1a1, 1a2, 1n, 2a1, 2a2, 2n, N, PE
- 2 ratios measuring and residual winding
  - a1, a2, n, da1, la2, dn, N, PE

### Double pole insulated transformer

- 2 measuring windings
  - 1a, 1b, 2a, 2b, PE
- 2 ratios measuring winding
  - a1, a2, b, PE
- One measuring winding
  - a, b, PE
Appendix 2.

Wiring diagrams

Current transformers:
Wiring diagrams

Voltage transformers:
Appendix 3.

Damping ferroresonance for voltage transformer type TJC

TECHNICAL BACKGROUND

Ferroresonance is a phenomenon usually characterized by over-voltages and very irregular wave shapes and is associated with the excitation of one or more saturable inductors through capacitance in parallel with nonlinear inductor. The saturable inductor usually is present in the form of an instrument transformer, power transformer or reactor which utilizes an iron core.

Ferroresonance of single-pole insulated transformers in unearthed network is one of the most common ferroresonance case. Depending on the supply voltage, capacitance and inductance the oscillation can be either periodic (over- or sub-harmonic or with fundamental frequency) or aperiodic.

Using damping resistor or VT guard in the residual voltage secondary, shown in Fig.1, can considerably reduce the risk for ferroresonance.

There is additionally factor that can in some cases reduce or totally eliminate the risk for ferroresonance and it is over-voltage factor. According to IEC standard is the rated over-voltage factor \(1.9\times U_n / 8h\). Higher rated over-voltage factor shift the operating point towards lower flux values of voltage transformer. It results in smaller sensitivity of transformer to some kind of transients usually initiate ferroresonance.

RECOMMENDATION

Rated voltage factor: We recommended using the voltage transformers with the over-voltage factor in the range \((2.5-3) \times U_n / 8h\). We cannot guarantee the value of the over-voltage factor if the requirements for the secondary winding are too high.

Damping resistor: See the recommended value of damping resistor below:

<table>
<thead>
<tr>
<th>Voltage of residual winding</th>
<th>Value of Rdamp</th>
<th>Damping power</th>
</tr>
</thead>
<tbody>
<tr>
<td>100:3 V</td>
<td>22 Ω</td>
<td>450 W</td>
</tr>
<tr>
<td>110:3 V</td>
<td>27 Ω</td>
<td>450 W</td>
</tr>
</tbody>
</table>

Fig.1.
VT Guard – function

1. VT-Guard description:
   VT Guard is a preventive device against the ferroresonance phenomenon which may be triggered in power networks with ungrounded or not directly grounded neutral point. VT Guard should be used in cooperation with voltage transformers connected in open delta – more in User’s manual.

   Important: Read the User’s manual before use.

2. Basic operating states:

   Simpl diagram

   a) In case of full balance in a three-phase network, there is zero voltage on an open delta winding (VT Guard terminals) Uo=0. No current flows through VT Guard. The device isn’t active.

   b) In case of unbalance in a three-phase network, there is voltage on VT Guard terminals Uo>0. If the Uo is lower than threshold voltage Ut (Ut = 20-24V), then current flows through the device. Total resistance value is higher than 100ohm and voltage Uo is max 24V in this case. Current flowing through the device has very low value.

   c) In case Uo is higher than threshold voltage (ferroresonance), the “switching circuit” is switched on and current flows through R_PTC//R_EFI and R1. Because of low values of these resistors there is steep increase of current and fast ferroresonance dumping. High current flows through the device for short time, the PTC resistors aren’t warm up significantly.

   d) In case Uo is higher than threshold voltage (earth fault), the „switching circuit“ is switched on and current flows through R_PTC//R_EFI and R1. Because of low values of these resistors there is steep increase of current. High current flows through the device and cause to warm up PTC resistors. PTC resistor increase their resistance (The resistance is proportional to flowing current). Current is limited. Time needed for warming up PTC resistors for Uo = 100V is approximately 1.4s. After earth-fault is removed, the PTC resistors cool-down (approximately 3 min). It is necessary to mount VT Guard in vertical position far from other thermal sources.
The data and illustrations in this catalogue are not binding. We reserve the right to make changes of the content, in the course of technical development of the product.