Current and Voltage Instrument Transformers
Instruction for Installation, use and maintenance
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Instructions for installation, use and maintenance for current and voltage transformers

This installation, use and maintenance guide is valid for current and voltage transformers operating in indoor conditions.

1. Service conditions

The transformers should be mounted in dry indoor conditions where the ambient air is not significantly polluted by dust, smoke, corrosive gases, 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 or lower ambient temperatures and higher altitudes when agreed between the manufacturer and purchaser.

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:

These instructions are valid for
Current transformer type:
TPU; TPE; TTR; BB; BBO; KOKS; KOFA; IHBF
Voltage transformers types:
TJE; TJCL; TJC; TJCH; TDC; TJP; TJPH; TDP; KGUG; KGUGI; TJC, TDMC

<table>
<thead>
<tr>
<th>1VLT5116001275</th>
<th>serial number + barcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPU 60.23</td>
<td>transformer type code</td>
</tr>
<tr>
<td>or.n. 544234</td>
<td>order number</td>
</tr>
<tr>
<td>150-300/5/5A+CD</td>
<td>rated transformer ratio + capacitive divider</td>
</tr>
<tr>
<td>50 Hz</td>
<td>rated frequency</td>
</tr>
<tr>
<td>151-152</td>
<td>terminal marking for core number 1, first tap</td>
</tr>
<tr>
<td>151-153</td>
<td>terminal marking for core number 1, second tap</td>
</tr>
<tr>
<td>251-252</td>
<td>terminal marking for core number 2</td>
</tr>
<tr>
<td>251-253</td>
<td>terminal marking for core number 2</td>
</tr>
<tr>
<td>0.5FS10, 10P10</td>
<td>accuracy classes</td>
</tr>
<tr>
<td>10 VA</td>
<td>rated output</td>
</tr>
<tr>
<td>ext</td>
<td>extension</td>
</tr>
<tr>
<td>Ck-PE</td>
<td>capacitive voltage divider specifications (see page 5.)</td>
</tr>
<tr>
<td>Ith</td>
<td>rated thermal current</td>
</tr>
<tr>
<td>24/50/125 kV</td>
<td>highest voltage for equipment / power-frequency withstand voltage / rated lightning-impulse voltage</td>
</tr>
<tr>
<td>Ith</td>
<td>rated short time thermal current (thermal time)</td>
</tr>
<tr>
<td>40°C</td>
<td>ambient temperature</td>
</tr>
<tr>
<td>IEC 61869-2</td>
<td>referred standard(s)</td>
</tr>
<tr>
<td>Idyn</td>
<td>rated dynamic current</td>
</tr>
<tr>
<td>E</td>
<td>temperature class</td>
</tr>
<tr>
<td>2016</td>
<td>year of production</td>
</tr>
</tbody>
</table>
Where:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial number + barcode</td>
<td>1VLT5216000812</td>
</tr>
<tr>
<td>Transformer type code</td>
<td>TJC 4</td>
</tr>
<tr>
<td>Rated voltage ratio</td>
<td>6000 √3/100/√3/100/3 V</td>
</tr>
<tr>
<td>Terminal marking for measuring secondary winding</td>
<td>a-n</td>
</tr>
<tr>
<td>Terminal marking for residual (open-delta) winding</td>
<td>da-dn</td>
</tr>
<tr>
<td>Accuracy classes</td>
<td>0.5; 3P</td>
</tr>
<tr>
<td>Rated output</td>
<td>10 VA</td>
</tr>
<tr>
<td>Overtoltage factor</td>
<td>1.9 x Un/8h</td>
</tr>
<tr>
<td>Highest voltage for equipment / power-frequency withstand voltage / rated lightning-impulse voltage</td>
<td>12/28/75 kV</td>
</tr>
<tr>
<td>Rated output</td>
<td>400 VA</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>40°C</td>
</tr>
<tr>
<td>Referred standard</td>
<td>IEC 61869-3</td>
</tr>
<tr>
<td>Temperature class</td>
<td>E</td>
</tr>
<tr>
<td>Year of production</td>
<td>2016</td>
</tr>
</tbody>
</table>

3. Instructions for installation

General informations

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 of voltage transformer are connected to open delta. Residual voltage windings connected to open delta must have dn terminal earthed only on one of three transformers (earthing screws at dn terminals of others two transformers have to be removed). 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 double 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 feroresonance phenomena is stated in Appendix 3. – Damping of the feroresonance in Voltage transformers type range TJx.

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 is not warranting the earthing. Coupling electrode terminals Ck and PE are always delivered interconnected. Remove this connection before installation of indication system. Leave the connection if Ck-PE terminals are not in use.

8. All current and voltage transformers are, for safety reasons, shipped with earthed secondary windings. Earthing of the terminals are shown in Appendix 1. Before putting into operation always check whether it corresponds to the earthing scheme involved in the application and remove earthing screws accordingly (simple examples of network connection are in Appendix 2).

Attention: Manufacturer is not responsible for damage, loss and injuries caused by wrong connection of transformers.

Mounting
Following informations are 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.

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.

Primary connection
Primary terminals of the current transformer are made of copper and they are silver or tin plated. There are M12 (CT) and M10 (VT) screws used for fastening of primary conductor to the terminal. For primary reconnectable transformers the ratio can be reconnected by changing position of the links fixed by M8 screws without removing already fitted primary conductors.

<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>

Tab. 1. Maximum allowed torques for screw connections of current transformers

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 connectors of metal coated transformers (TJMC, TDMC) should be cleaned by pressured air to eliminate all undesired impurities created from unpacking and manipulation. An alcohol can be used in case of any additional pollution caused by manipulation after unpacking.

In case of Bus CT, there must be always connected CT shielding to the primary bar. Connection must be done on one side of the CT.
Shielding connection example of KOKS 12, 17.5 described in picture 5 and for KOKS 24 in picture 6.
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 used for most types is made from the plastic and provided with three detachable threaded inserts. (Instruction how to provide removing of cable grommet on a secondary terminal cover – please see appendix 5). 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.

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

<table>
<thead>
<tr>
<th>Max. Tightening torque (Nm)</th>
<th>Min. Tightening torque (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5 3.5</td>
<td>2.8</td>
</tr>
<tr>
<td>M6 4</td>
<td>3</td>
</tr>
</tbody>
</table>

Tab. 2. The maximum permissible tightening torques for secondary screw connections

Max. diameter of the cable or wire connected to one terminal of the secondary is: 2x Ø 2.5 mm.
For terminal marking see Appendix 1.

**Capacitive voltage indicator (divider)**
The transformer can be supplied with the capacitive voltage indicator on the request. Integrated voltage detection system is corresponding to Separable Voltage Detection System according to IEC 61234-5. It is integrated coupling electrode connected to secondary terminal (terminal Ck). Electrode acts as a capacitor between electrode and primary winding (C1), or electrode and ground (C2). If the electrode is connected to indication device (not part of delivery – it is part of switchgear) it works as indication of voltage presence – more in IEC 61234-5.

<table>
<thead>
<tr>
<th>Ub (kV)</th>
<th>C1 (pF)</th>
<th>C2 (pF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 – 5.4</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>5.5 – 7.2</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>10 – 13.5</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>13.8 – 17.5</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>20 – 40</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Tab. 3. CE capacity according to nominal voltage

**Note:** Recommended min. capacities for nominal voltage.

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

<table>
<thead>
<tr>
<th>Rated current (A)</th>
<th>Rated voltage (kV)</th>
<th>Length (mm)</th>
<th>Striker pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 – 6.3</td>
<td>12/17.5</td>
<td>192</td>
<td>YES*/NO</td>
</tr>
<tr>
<td>0.5 – 6.3</td>
<td>24</td>
<td>292</td>
<td>YES*/NO</td>
</tr>
<tr>
<td>2 or 4</td>
<td>36</td>
<td>440</td>
<td>NO</td>
</tr>
<tr>
<td>0.3 or 0.6</td>
<td>12/24</td>
<td>255</td>
<td>NO</td>
</tr>
</tbody>
</table>

(*) Available only for certain types

Tab. 4. List of offered fuses

**Warning:** All VT’s type TJP 4.0; TJPH 4.0; TJP 5.0; TJPH 5.0; TJP 6.0, have fuse contact equipped with fixation. Fuse contact fixation is used just for transportation. Before installation must be removed. See picture Fig. 9. and Fig. 10.

For safety fuse replacement see Instructions for installation, use and maintenance for Voltage (potential) transformers. Fuse replacement (1VLM000614).

**External fuse holder**
No special tools are needed for the installation of external fuse holder and it can be installed in any direction. All the necessary mounting accessories are a part of delivery and shall be used for fixing the fuse holder on the top of the VT. Maximum allowed torque for screw connection is 20 Nm.

4. **Instructions for use**

Current and Voltage instrument transformers are used:
- to convert large currents or voltage 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 or voltage appearing during the operation (short circuits).

The use of current or voltage transformer for other purpose than described above is forbidden.
if 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 than 2);
- verification tests.

**5. Instructions for maintenance**

Visible surface pollution shall be cleaned off the transformer. Polluted transformer can be cleaned by alcohol. In case of surface contamination please contact the manufacturer.

**6. Transport and storage**

Temperature for transport and storage the indoor transformers is from -25°C to +70°C. During transportation and storage the transformers must be protected from direct sunlight.

The transformers are shipped in wooden boxes or mounted on the pallets. Other temperature must be agreed by the manufacturer.

**7. 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.

8. Handling with the transformers

Handling with the transformer is described in the Appendix 4.

9. Normative references

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61869-1</td>
<td>Instrument transformers – general requirement</td>
</tr>
<tr>
<td>IEC 61869-2</td>
<td>Instrument transformers – additional requirements for current transformers</td>
</tr>
<tr>
<td>IEC 61869-3</td>
<td>Instrument transformers – additional requirements for voltage transformers</td>
</tr>
<tr>
<td>IEC 61243-5</td>
<td>Voltage detectors – Voltage detecting systems (VDS)</td>
</tr>
<tr>
<td>IEC 60529</td>
<td>Degrees of protection provided by enclosures (IP Code)</td>
</tr>
<tr>
<td>ISO 12100</td>
<td>Safety of machinery — Basic concepts, general principles for design</td>
</tr>
<tr>
<td>EN 50110-1</td>
<td>Operation of electrical installations</td>
</tr>
</tbody>
</table>

Current and Voltage transformers are designed, tested and produced according to international or national standards required by customers and agreed by producer. Specific standard is always mentioned on the Rating plate of transformer.

For example these standards:

- IEC 60044-1; IEC 60044-2; IEC 60044-6; IEC 61869-1, IEC 61869-2; IEC 61869-3
- AS 60044-1; AS 60044-2
- AS 1243-1982; AS 1675-1986
- ČSN 351301; ČSN 351302; ČSN 351361
- ČSN EN 61896-1; ČSN EN 61896-2; ČSN EN 61896-6
- IEEE Std C57.13.6
- CSA Std CAN3-C13-M83
- GOST 1516.3-96; GOST 7746-2001
- BS 3939:1973; BS EN 61869-2

If it is agreed between customer and producer it is possible to deliver also other standard or standards which are mentioned above with different
## Appendix 1

### Examples of secondary terminal marking for cast terminal box

- **Current transformers according to IEC**

### One core

<table>
<thead>
<tr>
<th>Nb tap</th>
<th>1st line of terminal</th>
<th>2nd line of terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tap</td>
<td>s1, s2</td>
<td></td>
</tr>
<tr>
<td>1 tap</td>
<td>s1, s2</td>
<td>PE</td>
</tr>
<tr>
<td>2 tap</td>
<td>s1, s2, s3</td>
<td></td>
</tr>
<tr>
<td>3 tap</td>
<td>s1, s2, s3, s4</td>
<td></td>
</tr>
<tr>
<td>4 tap</td>
<td>s1, s2, s3, s4, s5</td>
<td>s6</td>
</tr>
</tbody>
</table>

### Two cores

<table>
<thead>
<tr>
<th>Nb tap</th>
<th>1st line of terminal</th>
<th>2nd line of terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tap</td>
<td></td>
<td>s1, s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>s1, s2</td>
<td>PE</td>
</tr>
<tr>
<td>2 tap</td>
<td>s1, s2, s3, s4</td>
<td></td>
</tr>
<tr>
<td>3 tap</td>
<td>s1, s2, s3, s4, s5</td>
<td>s6</td>
</tr>
</tbody>
</table>

### Three cores

<table>
<thead>
<tr>
<th>Nb tap</th>
<th>1st line of terminal</th>
<th>2nd line of terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tap</td>
<td></td>
<td>s1, s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>s1, s2</td>
<td>PE</td>
</tr>
<tr>
<td>2 tap</td>
<td>s1, s2, s3, s4</td>
<td>s5</td>
</tr>
<tr>
<td>3 tap</td>
<td>s1, s2, s3, s4, s5</td>
<td>s6</td>
</tr>
</tbody>
</table>

### Four cores

<table>
<thead>
<tr>
<th>Nb tap</th>
<th>1st line of terminal</th>
<th>2nd line of terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tap</td>
<td></td>
<td>s1, s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>s1, s2</td>
<td>PE</td>
</tr>
<tr>
<td>2 tap</td>
<td>s1, s2, s3, s4</td>
<td>s5, s6</td>
</tr>
</tbody>
</table>

### Five cores

<table>
<thead>
<tr>
<th>Nb tap</th>
<th>1st line of terminal</th>
<th>2nd line of terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tap</td>
<td></td>
<td>s1, s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>s1, s2</td>
<td>PE</td>
</tr>
<tr>
<td>2 tap</td>
<td>s1, s2, s3, s4</td>
<td>s5, s6</td>
</tr>
</tbody>
</table>

### Six cores

<table>
<thead>
<tr>
<th>Nb tap</th>
<th>1st line of terminal</th>
<th>2nd line of terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tap</td>
<td></td>
<td>s1, s2</td>
</tr>
<tr>
<td>1 tap</td>
<td>s1, s2</td>
<td>PE</td>
</tr>
<tr>
<td>2 tap</td>
<td>s1, s2, s3, s4</td>
<td>s5, s6</td>
</tr>
</tbody>
</table>

### Variants of connections

- double row terminal
- Special CT according
- Voltage transformers according to IEC

Variants of connections of double row terminal - One pole VT according to IEC

<table>
<thead>
<tr>
<th>1 measuring winding with no tap</th>
<th>a</th>
<th>n</th>
<th>N</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 measuring winding with 1 tap</td>
<td>a1</td>
<td>a2</td>
<td>n</td>
<td>N</td>
</tr>
<tr>
<td>1 measuring + residual</td>
<td>a</td>
<td>n</td>
<td>da</td>
<td>dn</td>
</tr>
<tr>
<td>2 measuring winding with no tap</td>
<td>1a</td>
<td>1n</td>
<td>2a</td>
<td>2n</td>
</tr>
<tr>
<td>2 measuring winding with 1 tap</td>
<td>1a1</td>
<td>1a2</td>
<td>2a1</td>
<td>2a2</td>
</tr>
<tr>
<td>2 measuring + residual</td>
<td>1a</td>
<td>2a</td>
<td>da</td>
<td>1n</td>
</tr>
<tr>
<td>3 measuring</td>
<td>1a</td>
<td>2a</td>
<td>3a</td>
<td>1n</td>
</tr>
<tr>
<td>2 measuring with tap + residual with 1 tap</td>
<td>1a1</td>
<td>1a2</td>
<td>2a2</td>
<td>da1</td>
</tr>
<tr>
<td>1 measuring with tap + residual with 1 tap</td>
<td>a1</td>
<td>a2</td>
<td>da1</td>
<td>da2</td>
</tr>
<tr>
<td>1 measuring with tap + residual</td>
<td>a1</td>
<td>a2</td>
<td>da</td>
<td>n</td>
</tr>
</tbody>
</table>

Variants of connections of double row terminal - Double pole VT according to IEC

<table>
<thead>
<tr>
<th>1 measuring</th>
<th>a</th>
<th>b</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 measuring winding with 1 tap</td>
<td>a1</td>
<td>a2</td>
<td>b</td>
</tr>
<tr>
<td>2 measuring</td>
<td>1a</td>
<td>1b</td>
<td>2a</td>
</tr>
<tr>
<td>1 measuring + residual</td>
<td>a</td>
<td>b</td>
<td>da</td>
</tr>
<tr>
<td>2 measuring winding with tap</td>
<td>1a1</td>
<td>1a2</td>
<td>2a1</td>
</tr>
</tbody>
</table>

Residual voltage windings connected to open delta must have dn terminal earthed only on one of three transformers (earthing screws at dn terminals of others two transformers have to be removed).
- Current transformers according to IEEE

**One core**

No tap

| x1 | x2 |

1 tap

| x1 | x2 | x3 |

2 taps

| x1 | x2 | x3 | x4 |

3 taps

| x1 | x2 | x3 | x4 | x5 |

4 taps

| x1 | x2 | x3 | x4 | x5 | x6 |

**One core with CD**

| x1 | x2 | Ck |

**Two cores**

No tap

| x1 | x2 | y1 | y2 |

1 tap

| x1 | x2 | x3 | y1 | y2 | y3 |

2 taps

| x1 | x2 | x3 | y1 | y4 | y4 |

3 taps

| x1 | x2 | x3 | y1 | y2 | y3 |

**Two cores with CD**

| x1 | x2 | y1 | y2 | Ck |

**Three cores**

No tap

| x1 | x2 | y1 | y2 | z1 | z2 |

1 tap

| x1 | x2 | x3 | y1 | z2 | z3 |

2 taps

| x1 | x2 | x3 | y2 | y3 | z2 | z3 |

3 taps

| x1 | x2 | x3 | y1 | y2 | y3 | z1 | z2 | z3 |

**Three cores with CD**

| x1 | y1 | z1 | Ck |

| x1 | y1 | z1 | PE |

| x2 | x3 | y3 | z2 | z3 | Ck |

| x2 | x3 | y2 | z2 | z3 | PE |

| x1 | y1 | y4 | z1 | z4 | PE |

| x1 | x4 | y2 | z1 | z4 | PE |

| x1 | x4 | y1 | y4 | z1 | z4 | PE |

| x2 | x3 | y2 | y4 | z1 | z4 | PE |

| x3 | x4 | y5 | z1 | z4 | PE |

| x2 | x3 | y2 | y4 | z1 | z4 | PE |

| x1 | x4 | y1 | y4 | z1 | z4 | PE |

| x1 | x4 | y1 | y4 | z1 | z4 | PE |

| x3 | x4 | y5 | z1 | z4 | PE |

| x2 | x3 | y2 | y4 | z1 | z4 | PE |
- Voltage transformers according to IEEE

Variants of connections of double row terminal

<table>
<thead>
<tr>
<th>1 measuring winding with no tap</th>
<th>1 measuring winding with 1 tap</th>
<th>2 measuring winding with no tap</th>
<th>2 measuring winding with 1 tap</th>
<th>3 measuring</th>
</tr>
</thead>
<tbody>
<tr>
<td>x1 x2</td>
<td>x1 x2 x3</td>
<td>x1 x2 y1 y2</td>
<td>x3 y3</td>
<td>x1 y1 z1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x2 y2 z3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>H2 PE</td>
</tr>
</tbody>
</table>
Appendix 2
Wiring diagram examples

Current transformers:

Voltage transformers:
Examples of current transformers connection
Examples of voltage transformers connection
Appendix 3
Damping ferroresonance for voltage transformer type range TJ

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 is usually 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 cases. 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 figure below, can considerably reduce the risk for ferroresonance. There is an additional 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 1.9xUn/8h. Higher rated over-voltage factor shifts the operating point towards lower flux values of voltage transformer. It results in smaller sensitivity of transformer. Some kind of transients usually initiates ferroresonance.

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

<table>
<thead>
<tr>
<th>Voltage of residual winding</th>
<th>Value of Rdamp</th>
<th>Power Dissipation</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>

Tab. 5. Recommended values of damping resistor
Appendix 4
Handling with transformers

There are few possibilities of handling:

1) Manual handling
Transformers can be handled by hands in case the weight of the transformer is not higher than 25 kg. Always use glows during the manual handling. For grasp of the transformers always use handling grip (see the picture), or the base of the transformer.

**Note.** This system is recommended for metal coated instrument transformers. Types TJP, TDP, TJMC or TDMC never handle by gripping the fuse holder – risk of break.

Transformers heavier than 25 kg can be handled by hands in case the transformer is equipped with baseplate. In this case the transformer must be carried by at least two persons using the baseplate. It is necessary to follow all safety instructions during the manipulation.

2) Handling by belts
For safety reasons transformers can be handled by hanging on belts when it is possible. Then the handling can be done by hanging of the transformer on the crane.

**Note.** This system is recommended for types: TTR, TSR, BB(O), KOKS. Hanging systems for those types are visualized on pictures.

**Safety warning!** Lifting capacity of the belts and the crane has to be at least 200 kg. Always make sure that the belts hold safely on the crane and on the transformer.

3) Handling by the self-locking hooks
It is possible to handle transformers by self-locking hooks hanging on the crane, if the transformer is equipped with handling grips. When the transformer has no handling grips, is it possible to grip the hooks under the base of the transformer.

**Note.** This system is recommended for types: TPU, TPE, TJC, TJCL, TJCH, TJP, TJPH, TDP, TDC, KGUG, KGUGI. This handling system is visualized on the pictures.

**Safety warning!** Lifting capacity of the hooks and the crane has to be 200 kg at least. Always
4) Handling by the self-locking hooks under primary screws

In case of indoor current transformers, which are equipped with primary terminal screws M12, it is possible to hang the transformer on self-locking hooks holding under the primary screws. The handling can be done by hanging of the hooks on the crane.

**Note.** This system is recommended for types: TPU, TPE, IHBF, KOFA. This handling system is visualized on the picture.

---

**Safety warning!** Lifting capacity of the hooks and the crane has to be 200 kg at least. Always make sure that the hooks hold safely on the crane and on the transformer.

**SAFETY WARNING:** During the manipulation with transformer it is necessary to follow safety work instructions. Never stand under the freight. Always make sure that the freight is safely locked on the crane and make sure that there is no risk of unexpected release or turnover of the freight.

**Note.** Holding jigs, described in these chapters, are not a part of delivery.
Appendix 5
Removing of cable grommet on a secondary terminal cover

1) Step drill procedure
In case of use of a step drill, it is necessary to dismount a secondary terminal cover to prevent a damage of a transformer body. Maximal drill bit size is 20 mm.

A drilled plastic part shall be fully fixed to avoid any injuries. The pictures are for illustration purpose only.

It is recommended to clear the edges of all new holes immediately after drilling these holes. For these purposes, a rasper or a knife can be used. Cleaned secondary terminal cover can be mounted back to a body of transformer.

2) Screwdriver procedure
It is recommended to use a screwdriver to puncture a hole in a secondary terminal cover.

A screwdriver shall be placed to a weakened place close to a pre-perforated ring. Two dimensions of hole can be punctured.

1/ an inner diameter

2/ an outer diameter

If necessary, a plastic mallet can be used. The plastic mallet shall be used with ease.

It is recommended to clear the edges of all new holes immediately after puncturing these holes. For these purposes, a rasper or a knife can be used.

Note: Whole procedure must be realized with all caution, to avoid damage of a secondary terminal.
Appendix 6
Dimensional Drawing TPU 4x.xx and TPU 5x.xx

<table>
<thead>
<tr>
<th>Dimension</th>
<th>TPU 4(5)0.11, TPU 4(5)3.11</th>
<th>TPU 4(5)0.21, TPU 4(5)3.21</th>
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</thead>
<tbody>
<tr>
<td>a [mm]</td>
<td>340</td>
<td>248</td>
</tr>
<tr>
<td>B [mm]</td>
<td>355</td>
<td>455</td>
</tr>
<tr>
<td>C [mm]</td>
<td>266</td>
<td>386</td>
</tr>
<tr>
<td>D [mm]</td>
<td>148</td>
<td>148</td>
</tr>
<tr>
<td>E [mm]</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>F [mm]</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>G [mm]</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>H [mm]</td>
<td>355</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>135</td>
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<td>20</td>
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<td>20</td>
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</table>
Dimensional Drawing TPU 6x.xx

<table>
<thead>
<tr>
<th></th>
<th>TPU 64-68.21</th>
<th>TPU 64-68.23</th>
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</thead>
<tbody>
<tr>
<td>a [mm]</td>
<td>-</td>
<td>340</td>
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</table>
Dimensional Drawings TPU 7x.xx

TPU 7x.4x

TPU 7x.5x

TPU 7x.6x

TPU 7x.7x
Dimensional Drawings TPE

<table>
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<th>TPE 60.31</th>
<th>TPE 63.31</th>
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<tr>
<td>X [mm]</td>
<td>150</td>
<td>175</td>
<td>175</td>
</tr>
<tr>
<td>Y [mm]</td>
<td>40</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Z [mm]</td>
<td>28</td>
<td>28</td>
<td>40</td>
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</table>
## Dimensional Drawings TTR

### TTR 4x.xx

<table>
<thead>
<tr>
<th>Insulation voltage [kV]</th>
<th>Type</th>
<th>Rated current [A]</th>
<th>Dimensions</th>
<th>Weight [kg]</th>
</tr>
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<tbody>
<tr>
<td>TTR 41.11</td>
<td></td>
<td>to 600</td>
<td>A B C D E F G H H+ Ø1 Ø2 ØK ØS</td>
<td>10.0</td>
</tr>
<tr>
<td>TTR 42.11</td>
<td></td>
<td>to 300</td>
<td>402 214 170 120 162 60 30 16 6 71 156 150 160</td>
<td>17.0</td>
</tr>
<tr>
<td>TTR 43.11</td>
<td>750-1250</td>
<td>472 214 170 120 162 95 30 20 10 71 156 150 160</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td>TTR 44.11</td>
<td>1500</td>
<td>482 252 208 120 162 100 30 16 20 110 192 174 196</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>TTR 45.11</td>
<td>2000</td>
<td>482 252 208 120 162 100 30 20 20 110 192 174 196</td>
<td>21.0</td>
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</table>

### TTR 6x.xx

<table>
<thead>
<tr>
<th>Insulation voltage [kV]</th>
<th>Type</th>
<th>Rated current [A]</th>
<th>Dimensions</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTR 61.11</td>
<td></td>
<td>to 600</td>
<td>A B C D E F G H H+ Ø1 Ø2 ØK ØS</td>
<td>14.0</td>
</tr>
<tr>
<td>TTR 62.11</td>
<td></td>
<td>to 300</td>
<td>620 224 180 238 262 60 30 16 6 71 166 146 170</td>
<td>21.0</td>
</tr>
<tr>
<td>TTR 63.11</td>
<td>750-1250</td>
<td>690 224 180 238 262 95 30 20 10 71 166 146 170</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>TTR 64.11</td>
<td>1500</td>
<td>700 274 230 238 262 100 30 16 20 110 216 190 220</td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>TTR 65.11</td>
<td>2000</td>
<td>700 274 230 238 262 100 30 20 20 110 216 190 220</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td>TTR 66.11</td>
<td>2500</td>
<td>720 274 230 238 262 110 30 20 20 110 216 190 220</td>
<td>35.0</td>
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</table>
Dimensional Drawing BB

BB 103
BB 104
BB 223

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>Weight kg</th>
</tr>
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<tbody>
<tr>
<td>BB 103</td>
<td>280</td>
<td>341</td>
<td>262</td>
<td>115</td>
<td>116</td>
<td>132</td>
<td>212</td>
<td>328</td>
<td>22.0</td>
</tr>
<tr>
<td>BB 104</td>
<td>465</td>
<td>390</td>
<td>322</td>
<td>132</td>
<td>312</td>
<td>216</td>
<td>276</td>
<td>300</td>
<td>346</td>
</tr>
<tr>
<td>BB 223</td>
<td>500</td>
<td>351</td>
<td>274</td>
<td>116</td>
<td>116</td>
<td>238</td>
<td>224</td>
<td>290</td>
<td>340</td>
</tr>
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</table>
**Dimensional Drawings KOKS xx A xx**

### KOKS 17.5 A 31
- **KOKS 12 A 31**
- **WEIGHT: 39kg**

### KOKS 17.5 A 41
- **KOKS 12 A 41**
- **WEIGHT: 42kg**

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Polarity</th>
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</thead>
<tbody>
<tr>
<td>44402520</td>
<td>P1 to secondary terminal</td>
</tr>
<tr>
<td>44402530</td>
<td>P2 to secondary terminal</td>
</tr>
</tbody>
</table>

**M5 TERMINAL MUST BE CONNECTED TO THE PRIMARY BAR**

### KOKS 17.5 C 31
- **KOKS 12 C 31**
- **WEIGHT: 34kg**

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1VL4400076R0101</td>
<td>P1 to secondary terminal</td>
</tr>
<tr>
<td>1VL4400076R0102</td>
<td>P2 to secondary terminal</td>
</tr>
</tbody>
</table>

**M5 TERMINAL MUST BE CONNECTED TO THE PRIMARY BAR**
Dimensional Drawing KOKS 24

KOKS 24

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Type</th>
<th>D  [mm]</th>
<th>H  [mm]</th>
<th>J  [mm]</th>
<th>K  [mm]</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1VL4600900R0101</td>
<td>KOKS 24 D 11</td>
<td>150</td>
<td>35</td>
<td>190</td>
<td>390</td>
<td>80</td>
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<tr>
<td>1VL4600900R0102</td>
<td>KOKS 24 D 21</td>
<td>150</td>
<td>75</td>
<td>245</td>
<td>500</td>
<td>115</td>
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<tr>
<td>1VL4600900R0103</td>
<td>KOKS 24 F 11</td>
<td>205</td>
<td>35</td>
<td>195</td>
<td>400</td>
<td>65</td>
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<tr>
<td>1VL4600900R0104</td>
<td>KOKS 24 F 21</td>
<td>205</td>
<td>75</td>
<td>250</td>
<td>510</td>
<td>90</td>
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</table>

ϕD = MAX. CIRCLE AROUND BUSBARS
Dimensional Drawings KOFA

KOFA 12 B1, D1
KOFA 12 B2, D2, F2
KOFA 12 B3, D3, F3
Weight: appr. 18 kg
Creepage distance: 160 mm
Arcing distance 150 mm

KOFA 12 A3
KOFA 12 C3
KOFA 12 E3
Weight: appr. 20 kg
Creepage distance: 165 mm
Arcing distance 150 mm

KOFA 24 B1, D1
KOFA 24 B2, D2, F2
KOFA 24 B3, D3, F3
Weight: appr. 24 kg
Creepage distance: 225 mm
Arcing distance 210 mm

KOFA 24 A3
KOFA 24 C3
KOFA 24 E3
Weight: appr. 24 kg
Creepage distance: 225 mm
Arcing distance 210 mm
Dimensional Drawings IHBF

IHBF 12 A
IHBF 17 A
IHBF 24 C

Weight: appr. 19 kg

IHBF 12 B
IHBF 17 B

Weight: appr. 27 kg

IHBF 12 A, 17 A  H₁ = 212  H₂ = 242
24 C  H₁ = 292  H₂ = 322

1. Plug-in contact

IHBF 24 B

Weight: appr. 14 kg

1. Plug-in contact
Transformers with base plate, clamp type secondary terminals

- IHBF 12 A
- IHBF 17 A
- IHBF 24 C

Weight: appr. 14 kg

---

12 A, 17 A

$H_1 = 215$, $H_2 = 245$

24 C

$H_1 = 295$, $H_2 = 325$
### Dimensional Drawings TJC

#### TJC(H) 4(5,6,7)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>TJC 4(5), TJCH 4(5)</th>
<th>TJC 6</th>
<th>TJC 7.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A [mm]</td>
<td>220</td>
<td>282</td>
<td>324</td>
</tr>
<tr>
<td>B [mm]</td>
<td>338</td>
<td>352</td>
<td>393</td>
</tr>
<tr>
<td>C [mm]</td>
<td>148</td>
<td>178</td>
<td>250</td>
</tr>
<tr>
<td>D [mm]</td>
<td>270</td>
<td>275</td>
<td>300</td>
</tr>
<tr>
<td>E [mm]</td>
<td>125</td>
<td>150</td>
<td>225</td>
</tr>
<tr>
<td>F [mm]</td>
<td>11</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>G [mm]</td>
<td>130</td>
<td>143</td>
<td>150</td>
</tr>
<tr>
<td>H [mm]</td>
<td>11</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>
Weight: 48 kg
Creepage distance: 398 mm

TJC 7.1

Drawing n.
44204010
TJC 7.1
medium baseplate

Weight: 47 kg
Creepage distance: 398 mm

Drawing n.
1VL4200541R0101
TJC 7.1
narrow baseplate

Weight: 48 kg
Creepage distance: 398 mm
TJC 7

Weight: 50 kg
Creepage distance: 480 mm

Drawing n.
44203800
Weight: appr. 25 kg
Creepage distance: 326 mm

Drawing n.
1VL4200396R0101
Dimensional Drawings TJE

TJE 3
TJE 4

Weight: 10 kg
Creepage distance: 245 mm

TJE 3.1
TJE 4.1

Weight: 11.5 kg
Creepage distance: 245 mm
Dimensional Drawings TJP

---

**TJP 4.0, TJPH 4.0**  
**TJP 5.0, TJPH 5.0**  
fuse IEC 60282-1  
Weight: 24 kg  
Creepage distance: 400 mm

---

**TJP 4.3**  
**TJP 5.3**  
Weight: appr. 28 kg  
Creepage distance: 385 mm

---

**TJP 6.0**  
Weight: 42 kg  
Creepage distance: 548 mm

---

**TJP 6.3**  
Weight: 42 kg  
Creepage distance: 547 mm

---

**OPTIONAL FOR CABLE CONNECTION**  
CREEPAGE DISTANCE: 418mm

---

**OPTIONAL FOR CABLE CONNECTION**  
CREEPAGE DISTANCE: 566mm

---

**OPTIONAL FOR CABLE CONNECTION**  
CREEPAGE DISTANCE: 566mm

---

**OPTIONAL FOR CABLE CONNECTION**  
CREEPAGE DISTANCE: 566mm
CURRENT AND VOLTAGE INSTRUMENT TRANSFORMERS
INSTRUCTIONS FOR INSTALLATION, USE AND MAINTENANCE

**TJP 4.1**
- TJP 5.1
- fuse JT6 300 mA
- fuse JT6 600 mA

**TJP 4.2**
- TJP 5.2
- fuse IEC 60282-1

Weight: 24 kg
Creepage distance: 296 mm

**TJP 6.1**
- TJP 6.2
- fuse JT6 300 mA
- fuse JT6 600 mA

Weight: 42 kg
Creepage distance: 342 mm

**TJP 4.0-F**
- TJP 5.0-F
- fuse IEC 60282-1

Weight: 24 kg
Creepage distance: 403 mm

**TJP 4.2**
- TJP 5.2
- fuse IEC 60282-1

Weight: 24 kg
Creepage distance: 403 mm
TJP 6.0-G
with long baseplate

Weight: 43 kg
Creepage distance: 536 mm

TJP 6.0-G

Weight: appr. 42 kg
Creepage distance: 536 mm

---

fuse IEC 60282-1

---

fuse IEC 80282-1

---

Drawing n.
1VL42003790/109

---

Drawing n.
1VL42003790/109
TJP 7.0
Weight: appr. 53 kg
Creepage distance: 745 mm

TJP 7.1
Weight: appr. 54 kg
Creepage distance: 745 mm

TJP 7.2
Weight: appr. 54 kg
Creepage distance: 745 mm

TJP 7.3
Weight: appr. 54 kg
Creepage distance: 745 mm
Dimensional Drawings TDC

TDC 4(5,6)

<table>
<thead>
<tr>
<th></th>
<th>TDC 4(5)</th>
<th>TDC 6</th>
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</tr>
<tr>
<td>B [mm]</td>
<td>338</td>
<td>352</td>
</tr>
<tr>
<td>C [mm]</td>
<td>148</td>
<td>178</td>
</tr>
<tr>
<td>D [mm]</td>
<td>270</td>
<td>275</td>
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<td>E [mm]</td>
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<td>G [mm]</td>
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<td>60</td>
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<tr>
<td>J [mm]</td>
<td>11</td>
<td>14</td>
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</table>
Dimensional Drawings TDP

---

TDP 4.1
fuse JT6 300 mA
fuse JT6 600 mA
Weight: 29 kg

---

TDP 4.2
fuse IEC 600282-1
Weight: 29 kg

---

TDP 6.1
fuse JT6 300 mA
fuse JT6 600 mA
Weight: 38 kg

---

TDP 6.2
fuse IEC 600282-1
Weight: 38 kg
Dimensional Drawings KGUGI and KGUG

KGUG 24

KGUG 36

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>m/kg</th>
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</thead>
<tbody>
<tr>
<td>KGUG 24</td>
<td>391</td>
<td>202</td>
<td>455</td>
<td>376</td>
<td>320</td>
<td>200</td>
<td>222</td>
<td>215</td>
<td>260</td>
<td>179</td>
<td>72</td>
<td>approx. 80</td>
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<tr>
<td>KGUG 36</td>
<td>443</td>
<td>227</td>
<td>505</td>
<td>427</td>
<td>348</td>
<td>310</td>
<td>248</td>
<td>230</td>
<td>300</td>
<td>186</td>
<td>72</td>
<td>approx. 80</td>
</tr>
</tbody>
</table>
**KGUGI 24**

Weight: 60 kg

**KGUGI 36**

Weight: 80 kg
External fuse holder up to 17.5 kV

- M8
- 6-40
- 75
- 300
- fuse JT6 300, 600mA

External fuse holder up to 25 kV

- M8
- 6-40
- 75
- 300
- fuse JT6 300, 600mA

---

fuse JT6 300 mA 1VL4200499R0101
fuse JT6 600 mA 1VL4200499R0102
fuse JT6 300 mA 1VL4200499R0201
fuse JT6 600 mA 1VL4200499R0202
Dimensional rawing metal coated types

TJMC 7.1

Weight: appr. 40 kg
TJMC 7.2
Plug-in secondary terminal

<table>
<thead>
<tr>
<th>Version</th>
<th>Type</th>
<th>Connector box</th>
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<tbody>
<tr>
<td>A0002</td>
<td>W12</td>
<td>12 pole connector</td>
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<tr>
<td>A0003</td>
<td>W10</td>
<td>10 pole connector</td>
</tr>
</tbody>
</table>
TDMC 6.0 C

Weight: appr. 38 kg
Creepage Distance A-B: 210 mm
Creepage Distance A(B)-: 285mm

Primary connection acc. to EN 50181:2010 - Interface C

Drawing n.:

026554
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