Current and Voltage (potential) Instrument transformers

Instruction for installation, use and maintenance
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Instruction for installation, use and maintenance for Current and Voltage (potential) transformers

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; KOFA; IHBF

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

1. **Service conditions**

**Indoor transformers**

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.

**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:

**Example of Indoor current transformer label**

<table>
<thead>
<tr>
<th>ABB</th>
<th>1234567890</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPU 40.13</td>
<td></td>
</tr>
<tr>
<td>200-400/1/1 A</td>
<td></td>
</tr>
<tr>
<td>1S1-1S2 200/1A 5VA cl. 0.5 FS 5</td>
<td></td>
</tr>
<tr>
<td>1S1-1S3 400/1A 10VA cl. 0.5 FS 5</td>
<td></td>
</tr>
<tr>
<td>2S1-2S2 200/1A 5VA cl. 5P15</td>
<td></td>
</tr>
<tr>
<td>2S1-2S3 400/1A 10VA cl. 5P15</td>
<td></td>
</tr>
<tr>
<td>12/28/75 kV 50(1s)/125 kA</td>
<td></td>
</tr>
<tr>
<td>2002 IEC 60044-1</td>
<td></td>
</tr>
<tr>
<td>E TCM 212/95-2150</td>
<td></td>
</tr>
</tbody>
</table>
Where:
1234567890  serial number
TPU 40.13  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

Example of Indoor Voltage transformers label

<table>
<thead>
<tr>
<th>ABB</th>
<th>1234567890</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJC 4</td>
<td></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 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 ferroresonance phenomena is stated in appendix 3. – Damping of the ferroresonance in Voltage transformers type TJC/TJP.
7. In case of the current transformer with voltage indication (coupling electrode included) is secondary terminal box equiped 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 reconnectable 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.

In case of Bus CT, there must be always connected CT shielding to the primary bar. Connection must be done at least on one side of the CT. One example of KOKS 12 shielding connection is described on the picture.
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 seal able.

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.
Cross section of double 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.

<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></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>20 - 90</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 24 kV …IEC fuses manufacturer SIBA / ABB

2A products for 36kV …………IEC fuses manufacturer BUSSMANN
4. **Instruction 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 then 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 then 2)
- verification tests

5. **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.

6. **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.

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

- 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

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 the transformer.

For example, these standards:
- IEC 60044-1; IEC 60044-2; IEC 60044-6
- AS 60044-1; AS 60044-2
- AS 1243-1982; AS 1675-1986
- ČSN 351301; ČSN 351302; ČSN 351361
- ČSN EN 60044-1; ČSN EN 60044-2; ČSN EN 60044-6
- IEEE Std C57.13.6-2005
- ANSI C57.13-1978
- CSA Std CAN3-C13-M83
- GOST 1516.3-96; GOST 7746-2001
- BS 3939:1973; BS EN 60044-1

If it is agreed between customer and producer, it is possible to deliver other national or international standards which are mentioned above with different revision.
Appendix 1. Examples of secondary terminal marking for cast terminal box for current transformers

No tap

<table>
<thead>
<tr>
<th>One core</th>
<th>One core with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s1 1s2</td>
<td>1s1 1s2 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 1s3</td>
<td>1s1 1s2 1s3 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 1s3 1s4</td>
<td>1s1 1s2 1s3 1s4 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 1s3 1s4 1s5</td>
<td>1s1 1s2 1s3 1s4 1s5 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 1s3 1s4 1s5 1s6</td>
<td>1s1 1s2 1s3 1s4 1s5 1s6 Ck PE</td>
</tr>
</tbody>
</table>

1 tap

<table>
<thead>
<tr>
<th>Two cores</th>
<th>Two cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s1 1s2 2s1 2s2</td>
<td>1s1 1s2 2s1 2s2 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 1s3 2s1 2s2 2s3</td>
<td>1s1 1s2 1s3 2s1 2s2 2s3 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 2s1 2s2 1s1 1s2 2s1 2s2</td>
<td>1s1 1s2 2s1 2s2 Ck PE</td>
</tr>
</tbody>
</table>

2 taps

<table>
<thead>
<tr>
<th>3 cores</th>
<th>3 cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s3 1s4 2s3 2s4</td>
<td>1s3 1s4 2s3 2s4 Ck PE</td>
</tr>
<tr>
<td>1s1 1s2 2s1 2s2 3s1 3s2</td>
<td>1s1 1s2 2s1 2s2 3s1 3s2 Ck PE</td>
</tr>
</tbody>
</table>

3 taps

<table>
<thead>
<tr>
<th>4 cores</th>
<th>4 cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s2 2s2 3s2 4s2</td>
<td>1s2 2s2 3s2 4s2 Ck PE</td>
</tr>
<tr>
<td>1s1 2s1 3s1 4s1</td>
<td>1s1 2s1 3s1 4s1 Ck PE</td>
</tr>
</tbody>
</table>

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

6 cores

No tap

<table>
<thead>
<tr>
<th>5 cores</th>
<th>5 cores with CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1s2 2s2 3s2 4s2 5s2</td>
<td>1s2 2s2 3s2 4s2 5s2</td>
</tr>
<tr>
<td>1s1 2s1 3s1 4s1 5s1</td>
<td>1s1 2s1 3s1 4s1 5s1</td>
</tr>
</tbody>
</table>

6 cores with CD
Examples of secondary terminal marking for cast and assembled (Phoenix) terminal box for Voltage transformers

### One pole insulated voltage transformer

<table>
<thead>
<tr>
<th>2 measuring windings</th>
<th>1a</th>
<th>1n</th>
<th>2a</th>
<th>2n</th>
<th>N</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring and residual winding</td>
<td>a</td>
<td>n</td>
<td>da</td>
<td>dn</td>
<td>N</td>
<td>PE</td>
</tr>
<tr>
<td>2 ratios measuring winding</td>
<td>a1</td>
<td>a2</td>
<td>n</td>
<td>N</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>One measuring winding</td>
<td>a</td>
<td>n</td>
<td>N</td>
<td>PE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Assembled secondary terminal (Phoenix)

<table>
<thead>
<tr>
<th>2 measuring and residual winding</th>
<th>1a</th>
<th>1n</th>
<th>2a</th>
<th>2n</th>
<th>da</th>
<th>dn</th>
<th>N</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 measuring double ratios winding</td>
<td>1a1</td>
<td>1a2</td>
<td>1n</td>
<td>2a1</td>
<td>2a2</td>
<td>2n</td>
<td>N</td>
<td>PE</td>
</tr>
<tr>
<td>2 ratios measuring and residual winding</td>
<td>a1</td>
<td>a2</td>
<td>n</td>
<td>da1</td>
<td>la2</td>
<td>dn</td>
<td>N</td>
<td>PE</td>
</tr>
</tbody>
</table>

### Double pole insulated transformer

<table>
<thead>
<tr>
<th>2 measuring windings</th>
<th>1a</th>
<th>1b</th>
<th>2a</th>
<th>2b</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 ratios measuring winding</td>
<td>a1</td>
<td>a2</td>
<td>b</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>One measuring winding</td>
<td>a</td>
<td>b</td>
<td>PE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2.

Wiring diagram examples

Current transformers:
Wiring diagram examples

Voltage transformers:

[Diagrams showing voltage transformers with primary and secondary windings]
Examples of current transformers connection
Examples of voltage transformers connection
Appendix 3.

Damping ferroresonance for voltage transformer type TJC/TJP

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 with 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 Fig.1, can considerably reduce the risk for ferroresonance.

There is additionally a factor that can in some cases reduce or totally eliminate the risk for ferroresonance and it is over-voltage factor. According to IEC standard, the rated over-voltage factor is 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 to some kind of transients usually initiate 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.

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:

Simple diagram

a) In case of full balance in a three-phase network, there is zero voltage on an open delta winding (VT Guard terminals) $U_o=0$. 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 $U_o>0$.
If the $U_o$ is lower than threshold voltage $U_t$ ($U_t = 20-24$V), then current
\[
I = \frac{U_o}{(R_{PTC} // R_{EFI}) + R_1 + R_2}
\]
flows through the device. Total resistance value is higher then 100ohm and voltage $U_o$ is max 24V in this case. Current flowing thorough the device has very low value.

c) In case $U_o$ is higher then 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 trough the device for short time, the PTC resistors aren't warm up significantly.

d) In case $U_o$ is higher then 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 trough 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 $U_o = 100$V 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.
Appendix 4.  
Handling with transformers

There are few possibilities of handling:

1) **Manual handling.**
Transformers are possible to handle by hands in case if the weight of the transformer is not higher than 25kg. Always use the glows in case of manual handling. For grasp of the transformers always use handling grip (see the picture), or the base of the transformer. Note. Types TJP or TDP never handle by gripping of the fuse holder – risk of break.

2) **Handling by the belt**
Transformers where it is possible, from safety reasons, can be handling by hanging on the belts. Than 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 200kg at. Always make sure that the belts hold safely on the crane and on the transformer.

3) **Handling by the self-locking hooks.**
With transformers which are equioped with handling grips is possible to handle by self-locking hooks hanging on the crane. With transformer without this handling grips is possible to grip the hooks under the base of the transformer. Note. This system is recommended for types: **TPU, TJC TJP, 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 200kg at least. Always make sure that the hooks hold safely on the crane and on the transformer.
4) **Handling by the self-locking hooks under primary screws.**

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

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

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

5) **Handling by the chain and loops.**

All transformers which are equipped with the base plate is possible to handle by using chains and loops. Srew the loops (at least M10) into the baseplate and hang on the crane by chains as it is shown on the picture.

Note. This system is recommended for most transformers with baseplate and with weight more than 40kg mainly for types: **TPO, TJO, TDO, TDC7, TJC 7, TJP 7.**

This handling system is visualized on the picture.

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

**SAFETY WARNING:** During the manipulation with transformer is necessary to follow safety work instructions. Never stay 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 this chapters, are not a part of delivery.
### Drawing N.: Polarity

<table>
<thead>
<tr>
<th>Drawing N.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614080</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614090</td>
<td>P2 to sec. term.</td>
</tr>
</tbody>
</table>

### Drawing N.: Polarity

<table>
<thead>
<tr>
<th>Drawing N.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614100</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614110</td>
<td>P2 to sec. term.</td>
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</table>

<table>
<thead>
<tr>
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<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614120</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614130</td>
<td>P2 to sec. term.</td>
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</table>

<table>
<thead>
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<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614140</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614150</td>
<td>P2 to sec. term.</td>
</tr>
</tbody>
</table>
TPU 54.31
TPU 55.31
TPU 56.31
TPU 57.31
TPU 58.31

**Weight:** 28-31 kg

<table>
<thead>
<tr>
<th>Drawing N:</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614790</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614800</td>
<td>P2 to sec. term.</td>
</tr>
</tbody>
</table>

TPU 54.41
TPU 55.41
TPU 56.41
TPU 57.41
TPU 58.41

**Weight:** 43-48 kg

<table>
<thead>
<tr>
<th>Drawing N:</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614830</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614840</td>
<td>P2 to sec. term.</td>
</tr>
</tbody>
</table>

TPU 54.33
TPU 55.33
TPU 56.33
TPU 57.33
TPU 58.33

**Weight:** 28-31 kg

<table>
<thead>
<tr>
<th>Drawing N:</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614810</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614820</td>
<td>P2 to sec. term.</td>
</tr>
</tbody>
</table>

TPU 54.43
TPU 55.43
TPU 56.43
TPU 57.43
TPU 58.43

**Weight:** 43-48 kg

<table>
<thead>
<tr>
<th>Drawing N:</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44614850</td>
<td>P1 to sec. term.</td>
</tr>
<tr>
<td>44614860</td>
<td>P2 to sec. term.</td>
</tr>
</tbody>
</table>
**TPU 60.11**

**TPU 60.12**

---

**TPU 60.13**

**TPU 60.14**

---

**drawing N:** | **polarity**
---|---
44615000 | P1 to sec. term.
44615010 | P2 to sec. term.

---

**drawing N:** | **polarity**
---|---
44615020 | P1 to sec. term.
44615030 | P2 to sec. term.

---

**drawing N:** | **polarity**
---|---
44615040 | P1 to sec. term.
44615050 | P2 to sec. term.

---

**drawing N:** | **polarity**
---|---
44615060 | P1 to sec. term.
44615070 | P2 to sec. term.
TPU 70.51
TPU 73.51

WEIGHT: appr. 49Kg
CREP. DISTANCE: 400mm

L = 96mm for 6 or 12 clamps
L = 122mm for 16 clamps

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615730</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615740</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPU 70.52
TPU 73.52

WEIGHT: appr. 49Kg
CREP. DISTANCE: 409mm

L=96mm for 6 or 12 clamps
L=122mm for 16 clamps

<table>
<thead>
<tr>
<th>Drawing no.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615750</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615760</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPU 70.53
TPU 73.53

WEIGHT: appr. 49Kg
CREP. DISTANCE: 397mm

<table>
<thead>
<tr>
<th>Drawing no.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615650</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615660</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>

L=96mm for 6 or 12 clamps
L=122mm for 16 clamps
TPU 70.54
TPU 73.54

WEIGHT: appr. 49Kg
CREP. DISTANCE: 409mm

L=96mm for 6 or 12 clamps
L=122mm for 16 clamps

<table>
<thead>
<tr>
<th>Drawing no.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615710</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615720</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPU 74.51
TPU 75.51
TPU 76.51

WEIGHT: appr. 49Kg
CREP. DISTANCE: 386mm

<table>
<thead>
<tr>
<th>Drawing no.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615690</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615700</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>

L=96mm for 6 or 12 clamps
L=122mm for 16 clamps
TPU 74.53  
TPU 75.53  
TPU 76.53

WEIGHT: appr. 49Kg
CREP. DISTANCE: 386mm

<table>
<thead>
<tr>
<th>Drawing no.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615670</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615680</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPU 70.63
TPU 73.63

WEIGHT: appr. 78kg
CREP. DISTANCE: 46.3mm

L=96mm for 6 or 12 clamps
L=122mm for 16 clamps

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615570</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615580</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TUU 70.64
TUU 73.64

WEIGHT: appr. 76kg
CERP. DISTANCE: 456mm

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615510</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615520</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPU 74.63
TPU 75.63
TPU 76.63

WEIGHT: appr. 78kg
CREP. DISTANCE: 463mm

L=95mm for 6 or 12 clamps
L=122mm for 16 clamps

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615590</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615600</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPU 70.66
TPU 73.66

WEIGHT: approx. 78kg
CREP. DISTANCE: 413mm

L=96mm for 6 or 12 clamps
L=122mm for 16 clamps

<table>
<thead>
<tr>
<th>Drawing n.</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>44615630</td>
<td>P1 to secondary term.</td>
</tr>
<tr>
<td>44615640</td>
<td>P2 to secondary term.</td>
</tr>
</tbody>
</table>
TPO 70.12

WEIGHT: appr. 90kg
CREP. DISTANCE: 1600mm

Drawing n. 44615800
TPO 71.11–76.11

WEIGHT: appr. 90kg
CREP. DISTANCE: 1800mm

Drawing n. 44615810
## TP xx.x

### Primary Terminals

<table>
<thead>
<tr>
<th>Type</th>
<th>Insulation voltage (kV)</th>
<th>Primary current (A)</th>
<th>Dimensions (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP 40.1</td>
<td>&lt;500</td>
<td>320</td>
<td>160</td>
<td>240</td>
</tr>
<tr>
<td>TP 40.2</td>
<td>&lt;500</td>
<td>400</td>
<td>160</td>
<td>240</td>
</tr>
<tr>
<td>TP 41</td>
<td>400</td>
<td>320</td>
<td>160</td>
<td>150</td>
</tr>
<tr>
<td>TP 42</td>
<td>500-600</td>
<td>320</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>TP 43</td>
<td>12</td>
<td>750</td>
<td>320</td>
<td>160</td>
</tr>
<tr>
<td>TP 44</td>
<td>850</td>
<td>320</td>
<td>160</td>
<td>180</td>
</tr>
<tr>
<td>TP 45</td>
<td>1150</td>
<td>320</td>
<td>160</td>
<td>180</td>
</tr>
<tr>
<td>TP 46</td>
<td>1450</td>
<td>320</td>
<td>160</td>
<td>180</td>
</tr>
<tr>
<td>TP 60.1</td>
<td>&lt;500</td>
<td>340</td>
<td>170</td>
<td>265</td>
</tr>
<tr>
<td>TP 60.2</td>
<td>&lt;500</td>
<td>420</td>
<td>170</td>
<td>265</td>
</tr>
<tr>
<td>TP 61</td>
<td>400</td>
<td>320</td>
<td>170</td>
<td>265</td>
</tr>
<tr>
<td>TP 62</td>
<td>500-600</td>
<td>320</td>
<td>170</td>
<td>265</td>
</tr>
<tr>
<td>TP 63</td>
<td>25</td>
<td>750</td>
<td>320</td>
<td>170</td>
</tr>
<tr>
<td>TP 64</td>
<td>1150</td>
<td>320</td>
<td>170</td>
<td>255</td>
</tr>
<tr>
<td>TP 65</td>
<td>1450</td>
<td>320</td>
<td>170</td>
<td>255</td>
</tr>
<tr>
<td>TP 66</td>
<td>1550</td>
<td>320</td>
<td>170</td>
<td>255</td>
</tr>
</tbody>
</table>

**Notes:**
- TP 40.1 to TP 46 are for primary terminals.
- TP 60.1 to TP 66 are for secondary terminals.

---

1VLM000610 Rev.4, en 2009.6.16
### Insulation voltage [kV]

<table>
<thead>
<tr>
<th>Type</th>
<th>Rated current [A]</th>
<th>Dimensions</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation voltage [kV]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>12</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTR 41.11</td>
<td>to 600</td>
<td>A 402, B 214, C 170, D 120, E 60, F 30, G 16, H 6, I 71</td>
<td>156, 136, 160</td>
</tr>
<tr>
<td>TTR 42.11</td>
<td>to 300</td>
<td>A 500, B 214, C 170, D 220, E 162, F 60, G 30, H 16, I 6, J 71</td>
<td>156, 136, 160</td>
</tr>
<tr>
<td>TTR 43.11</td>
<td>750-1250</td>
<td>A 472, B 214, C 170, D 120, E 162, F 95, G 30, H 20, I 10, J 71</td>
<td>156, 136, 160</td>
</tr>
<tr>
<td>TTR 44.11</td>
<td>1500</td>
<td>A 462, B 252, C 208, D 120, E 162, F 100, G 30, H 16, I 20, J 110</td>
<td>192, 174, 196</td>
</tr>
<tr>
<td>TTR 45.11</td>
<td>2000</td>
<td>A 462, B 252, C 208, D 120, E 162, F 100, G 30, H 20, I 20, J 110</td>
<td>192, 174, 196</td>
</tr>
<tr>
<td>TTR 46.11</td>
<td>2500</td>
<td>A 502, B 252, C 208, D 120, E 162, F 110, G 30, H 20, I 20, J 110</td>
<td>192, 174, 196</td>
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</table>
### TTR 6x.xx

#### Insulation voltage [kV]

<table>
<thead>
<tr>
<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>to 600</td>
<td>A: 602  B: 224  C: 180  D: 238  E: 262  F: 60  G: 30  H: 16</td>
<td>6  71  166  146  170  14.0</td>
</tr>
<tr>
<td>TTR 62.11</td>
<td>to 300</td>
<td>A: 680  B: 224  C: 180  D: 298  E: 262  F: 60  G: 30  H: 16</td>
<td>6  71  166  146  170  21.0</td>
</tr>
<tr>
<td>TTR 63.11</td>
<td>750-1250</td>
<td>A: 690  B: 224  C: 180  D: 238  E: 262  F: 95  G: 30  H: 20</td>
<td>10  71  166  146  170  15.0</td>
</tr>
<tr>
<td>TTR 64.11</td>
<td>1500</td>
<td>A: 700  B: 274  C: 230  D: 238  E: 262  F: 100  G: 30  H: 16</td>
<td>20  110  216  190  220  23.0</td>
</tr>
<tr>
<td>TTR 65.11</td>
<td>2000</td>
<td>A: 700  B: 274  C: 230  D: 238  E: 262  F: 100  G: 30  H: 20</td>
<td>20  110  216  190  220  32.0</td>
</tr>
<tr>
<td>Type</td>
<td>Type</td>
<td>Rozmery / Dimension</td>
<td>Hmotnost</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td>BB 103</td>
<td>280</td>
<td>341</td>
<td>252</td>
</tr>
<tr>
<td>BB 104</td>
<td>465</td>
<td>369</td>
<td>322</td>
</tr>
<tr>
<td>BB 223</td>
<td>600</td>
<td>351</td>
<td>274</td>
</tr>
</tbody>
</table>
DRAWING NUMBER 44402020
Weight: 55 kg
* Marked M5 terminal must be connected to the primary bar

DRAWING NUMBER 44402540
Weight: 50 kg
* Marked M5 terminal must be connected to the primary bar

DRAWING NUMBER 44402530
Weight: 35 kg
* Marked M5 terminal must be connected to the primary bar

DRAWING NUMBER 44402500
Weight: 50 kg
* Marked M5 terminal must be connected to the primary bar
KOKS 24

<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>Weight/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOKS 24 D 11</td>
<td>420</td>
<td>360</td>
<td>525</td>
<td>150</td>
<td>450</td>
<td>282</td>
<td>380</td>
<td>35</td>
<td>190</td>
<td>360</td>
<td>80</td>
</tr>
<tr>
<td>KOKS 24 D 21</td>
<td>420</td>
<td>360</td>
<td>525</td>
<td>150</td>
<td>450</td>
<td>282</td>
<td>380</td>
<td>75</td>
<td>245</td>
<td>500</td>
<td>115</td>
</tr>
<tr>
<td>KOKS 24 F 11</td>
<td>420</td>
<td>360</td>
<td>525</td>
<td>205</td>
<td>450</td>
<td>282</td>
<td>380</td>
<td>35</td>
<td>195</td>
<td>400</td>
<td>65</td>
</tr>
<tr>
<td>KOKS 24 F 21</td>
<td>420</td>
<td>360</td>
<td>525</td>
<td>205</td>
<td>450</td>
<td>282</td>
<td>380</td>
<td>75</td>
<td>250</td>
<td>510</td>
<td>90</td>
</tr>
</tbody>
</table>
Type KOFA 12 B1, D1, B2, D2, F2, B3, D3, F3

Weight approx. 18kg

Type KOFA 12 A3, C3, E3

Weight approx. 20kg
Type KOFA 24 B1, D1, B2, D2, F2, B3, D3, F3

Weight approx. 24kg

Type KOFA 24 B1, D1
A: 265
B: 185
C: 132

Type KOFA 24 B2, D2, F2
A: 355
B: 245
C: 192

Type KOFA 24 B3, D3, F3
A: 415
B: 365
C: 252

Connection to 2 x Iₚₙ current
Sealable screw

Weight approx. 18kg

Creepage distance 220 mm
Arcing distance 210 mm

Type KOFA 24 A3, C3, E3

Weight approx. 24kg

Creepage distance 225 mm
Arcing distance 210 mm
IHBF 12 A, 17 A and 24 C

Weight approx. 19kg

IHBF 12 A, 17 A
\[ H_1 = 212 \]
\[ H_2 = 242 \]
24 C
\[ H_1 = 292 \]
\[ H_2 = 322 \]

IHBF 12 B and 17 B

Weight approx. 27kg

1. Plug-in contact
IHBF 24 B

Weight approx. 14kg

Transformers with base plate, clamp type secondary terminals
IHBF 12 A, 17 A and 24 C

Weight approx. 14kg
IHBF 12 A, 17 A and 24 C

Weight approx. 14kg
Weight approx. 10kg
TJC 4, TJC 5

Weight approx. 19kg
Weight approx. 36kg
Weight approx. 36kg
TJC 7

Weight approx. 47kg

Possible solution for 6 terminals
TJC 7.1

WEIGHT: appr. 48kg
CREP. DISTANCE: 398mm

Drawing n. 44204010
TJC 7.0-G

Weight approx.: 45kg

POVRCHOVÁ VZDÁLENOST: 398 mm
(CREEPAGE DISTANCE: 398 mm)
TDC 4, TDC 5

Weight approx. 20kG
TDC 6

Weight approx. 36kg
TDO 6

WEIGHT: appr. 60kg
CAREP. DISTANCE: 1120mm

Drawing n. 44204040
TJO 6

WEIGHT: appr. 57kg
CREEPAGE DISTANCE: 1250mm

Drawing n. 44204050
Weight approx. 52 kg
TJP 4.0 TJP 5.0, fuse IEC 60282-1

Drawing n. 44204060

Weight: 27 kg
TJP 4.0-F TJP 5.0-F, fuse IEC 60282-1

Weight: 27kg
TJP 4.1, TJP 5.1 fuse JT6 300,600mA

TJP 4.2, TJP 5.2 fuse IEC 60282-1

TJP 4.1, TJP 5.1
Drawing n. 44204080

Weight: 24 kg

TJP 4.2, TJP 5.2
Drawing n. 44204090
TJP6.1: fuse JT6 300,600mA  

TJP6.2: fuse IEC 60282-1

TJP6.1:

Drawing n. 44203980
Weight: 42 kg

TJP6.2:

Drawing n. 44203990
TJP 7.1

WEIGHT: appr. 54kg
CREP. DISTANCE: 376mm

Drawing n. 44204020
TJP 7.2

WEIGHT: appr. 54kg
CREP. DISTANCE: 344mm

Drawing n. 44204030
TDP 4.1 fuse JT6 300,600mA  
TDP 4.2 Fuse IEC 600282-1

Drawing n. 44203970
Weight: 29 kg
TDP 6.1 fuse JT6 300,600mA  TDP 6.2 Fuse IEC 600282-1

Drawing n. 44204100
Weight: 38 kg
### KGUGI 24 36

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<th>C</th>
<th>D</th>
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TDC 7 (KRED 36B1)

Weight approx: 72kg