LOPO®

Low Power Instrument Transformers

For Medium Voltage Switchgear
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The introduction of digital technology to measurement and protection instrumentation has modified the requirements for instrument transformers.

Trench has developed LOPO®, a range of voltage and current low power instruments transformers, covered by patents, compatible with digital technology and meeting the requirements of IEC standards 60044-7 and 60044-8.

LOPO® are designed for burdens significantly lower than conventional instrument transformers.

The output signal for the Trench Low Power Voltage Transformer is volts rather than conventional hundreds of volts; the Low Power Current Transformer output is millivolts rather than conventional amperes.

These low power instrument transformers fit into existing as well as future design of switchgears.

Several combinations of these instrument transformers with relays from different manufacturers (Alstom, SEL, Siemens, Vaasa etc...) and recorders have been successfully tested and field installed.

Please refer to the separate leaflet for an up dated list of available relays.

Example of integration in a medium voltage switchgear and indication of size comparison

LOPO® is a registered trademark of Trench
## Features

- Designed for low power digital protection and measuring in accordance with:
  - IEC 60044-7, Electronic Voltage Transformers,
  - IEC 600044-8, Electronic Current Transformers

- **Cost effective**
  - One LOPO® meets both measuring and protection requirements: a single instrument transformer for measurement and protection purposes,
  - Reduced size and weight: easy to handle, less space required,
  - A new opportunity to optimize medium voltage switchgears for size, manufacture, logistics and operation.

- **The low power instrument transformers are supplied with standardised cables and connectors:**
  - connection cable, standard length 6.5 m,
  - ODU Mini Snap* connector for connection to the secondary device (see page 6).
  * Other types on request

- **EMC immunity.**

- **Operator safety with earthed metal encapsulated housing.**

- **No secondary circuit problem:** low power voltage and current transformers can have their secondary open or short circuited. Important safety feature.

- **High reliability and availability.**

- Environmentally friendly, less raw material required.

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| Medium voltage applications up to 40 kV |
| Rated primary current up to 5000 A |
| Rated short circuit current withstand up to 63 kA / 3 s |
| Type tested to IEC standards |
| Meets IEC 60044-7 and 60044-8 requirements |
| Few models to cover the whole range |
| Compact, light and easy to connect |
| Quality Assurance in accordance with ISO 9001 |
LOPO® Voltage Transformers

The Trench low power voltage transformer LOPO® is a passive device based on a compensated resistive divider, designed for medium voltage protection and measuring systems in accordance with IEC 60044-7.

Benefits:
• One resistive divider for all metering and protection requirements, e.g. class 0.2 or 0.5 and 3P.
• Ferro-resonance free
• No disconnection of the voltage transformer is required during cable and switchgear voltage testing. The voltage transformers are able to withstand the on-line switchgear and cable voltage testing:

<table>
<thead>
<tr>
<th>Applied voltage</th>
<th>Frequency</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2 \ U_m / \sqrt{3}$</td>
<td>$50 / 60 \text{ Hz}$</td>
<td>60 min</td>
</tr>
<tr>
<td>$3 \ U_m / \sqrt{3}$</td>
<td>0.1 Hz</td>
<td>50 min</td>
</tr>
<tr>
<td>$4 \ U_m / \sqrt{3}$</td>
<td>DC</td>
<td>15..30 min</td>
</tr>
</tbody>
</table>

Electrical data

<table>
<thead>
<tr>
<th>Type</th>
<th>Design</th>
<th>Highest voltage for equipment $U_m (\text{kV})^*$</th>
<th>Rated primary voltage $U_p (\text{kV})^*$</th>
<th>Rated power frequency test voltage $U_d (\text{kV})^*$</th>
<th>BIL $U_p (\text{kV})^*$</th>
<th>Rated secondary voltage $U_{sr} (\text{kV})^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPVT 7,2-</td>
<td>A I G P</td>
<td>7.2</td>
<td>6/$\sqrt{3}$</td>
<td>20</td>
<td>60</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
<tr>
<td>LPVT 12-</td>
<td>A I G P</td>
<td>12</td>
<td>10/$\sqrt{3}$</td>
<td>28</td>
<td>75</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
<tr>
<td>LPVT 15-</td>
<td>A I G P</td>
<td>15.5</td>
<td>15/$\sqrt{3}$</td>
<td>35</td>
<td>95</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
<tr>
<td>LPVT 24-</td>
<td>A I G P</td>
<td>24</td>
<td>20/$\sqrt{3}$</td>
<td>50</td>
<td>125</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
<tr>
<td>LPVT 36-</td>
<td>I G P</td>
<td>36</td>
<td>30/$\sqrt{3}$</td>
<td>70</td>
<td>170</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
<tr>
<td>LPVT 38-</td>
<td>I G P</td>
<td>38</td>
<td>34.5/$\sqrt{3}$</td>
<td>95</td>
<td>200</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
<tr>
<td>LPVT 40-</td>
<td>I G P</td>
<td>40.5</td>
<td>36/$\sqrt{3}$</td>
<td>95</td>
<td>200</td>
<td>3.25 /$\sqrt{3}$</td>
</tr>
</tbody>
</table>

*: other values and designs on request

- System frequency: 16 2/3, 50, 60 Hz
- Accuracy: Class 0.2 or 0.5 & 3P
  the accuracy of the voltage transformer is guaranteed between 40% and 120% of the rated voltage
- Rated voltage factor: 1.2/continuous; 1.9/8 hours
- Type tests: In accordance with IEC 60044-7, including immunity tests and measurement of transmission overvoltage factor

These transformers provide a secondary voltage proportional to the primary voltage, without saturation. LOPO® transformers are available in different designs, covering the range 6 to 36 kV. The components are cast in resin and encapsulated in a metallic housing.

The components are cast in resin and encapsulated in a metallic housing.
Principle scheme

Example of accuracy performance

Typical voltage error with class 0.2 & 3P

Typical phase error with class 0.2
**LPVT -A:** Low power voltage transformer
Available up to Um 24 kV
Same dimensions for all voltages.
Primary connector according to EN 50181 (DIN 47636), type 24 kV, 250 A.
Outline drawing: 16300000
Weight: 3.2 kg

**LPVT -I:** Low power voltage transformer
Available up to Um 36 kV.
Same dimensions for all voltages.
Primary connector according to EN 50181 (DIN 47637), type 36 kV, size 2.
Outline drawing: 16320000
Weight: 4.0 kg

**ODU - MINI SNAP connector**
Protection against polarity reversal
Test voltages: 2.5 kV AC / 5 kV peak
**LPVT-G:** Low power voltage transformer for SF6 switchgear. Available up to Um 36 kV with the same dimensions. The LPVT-G model is suitable for single phase encapsulated SF6 switchgear. Outline drawing: 16340000. Weight: 5.2 kg.

**LPVT-P:** Low power voltage transformer for SF6 switchgear. Available up to Um 36 kV with the same dimensions. The LPVT-P series is suitable for encapsulated SF6 switchgear. Outline drawing: 16360000. Weight: 4.0 kg.
LOPO® Current Transformers

The Trench low power current transformer LOPO® is a passive device, based on the principle of a ring core transformer with an integrated precision shunt, designed for medium voltage protection and measuring systems in accordance with IEC 60044-8. The LOPO® current transformer provides a voltage output proportional to the primary current. It replaces conventional current transformers with significant space and weight advantages.

Benefits:

- Only one core required for all measurement and protection requirements, e.g. class 0.2 or 0.5 and 5P, with the transient performances of TPY cores in accordance with IEC 60044-6.
- Reduced inventory: one LOPO® current transformer covers currents from 50 A to 5000 A.
- Linear and saturation free up to short time current.
- Insensitive to burden: accurate for a total burden $\geq 20 \, \text{k}\Omega$, making it possible for several relays and meters to be connected in parallel to the LOPO® current transformer without affecting accuracy.
- Connecting cable (double shielded twisted pair) and connector are parts of the LOPO® CT
- Very low voltage error and phase displacement (ideal for earthfault protection).

Technical data

- Measuring range
- Rated primary current
  - $I_{pr}$: 50 A up to 5000 A
- Secondary voltage*
  - $U_{sr}$: 22.5 mV up to 2.25 V
  - e.g. $I_{pr} = 1000 \, \text{A}$ $\Rightarrow$ $U_{sr} = 0.450 \, \text{V}$
  - $I_{th} = 10 \, \text{kA}$ $\Rightarrow$ $U_{sr} = 4.50 \, \text{V}$
- System frequency: 16 2/3, 50, 60 Hz
- Rated short time thermal current: up to 63 kA / 3 s
- Accuracy*: Class 0.2, 0.5 or 1.0 and simultaneously class 5P up to 63 kA
- Burden: $\geq 20 \, \text{k}\Omega$
- For distance protection

*: other values and designs on request

- Type tests: In accordance with IEC 60044-8, including immunity tests and measurement of the overvoltage transmission factor

Each LOPO® CT covers the range from 50 up to 5000 A

<table>
<thead>
<tr>
<th>$I_{pr}$ (A)</th>
<th>0.1</th>
<th>1</th>
<th>10</th>
<th>100</th>
<th>1000</th>
<th>10000</th>
<th>100000</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_{sr}$ (V)</td>
<td>0.01</td>
<td>0.1</td>
<td>1</td>
<td>10</td>
<td>100</td>
<td>1000</td>
<td>10000</td>
</tr>
</tbody>
</table>
Typical current error with class 0.2

Typical phase error with class 0.2

Example of accuracy performance

Principle scheme

1. Metal housing
2. High stability shunt
3. Double shielded cable

3.1 Twisted cable pair
3.2 Internal screen
3.3 External screen

1. Metal housing
2. High stability shunt
3. Double shielded cable

3.1 Twisted cable pair
3.2 Internal screen
3.3 External screen
LPCT 25-A: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16100000.
Weight: 4.0 kg

LPCT 25-B: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16110000.
Weight: 4.2 kg

LPCT 25-C: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16120000
Weight: 6.0 kg

LPCT 25-D: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16130000
Weight: 5.5 kg

LPCT 25-A: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16100000.
Weight: 4.0 kg

LPCT 25-B: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16110000.
Weight: 4.2 kg

LPCT 25-C: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16120000
Weight: 6.0 kg

LPCT 25-D: Low power current transformer
Available for rated current up to 5000 A.
Outline drawing number: 16130000
Weight: 5.5 kg
**Principle:**
The LOPO® split core current transformer sums magnetically the three line currents (Fig. 1) to measure the zero sequence current of the three lines. This method provides a better result than obtaining the zero sequence by the summation of the output signals of three single current transformers.

**Application:**
Measurement of zero sequence in networks with isolated or compensated neutral point (arc suppression coil or Petersen coil) for detection and disconnection of faulty feeders in a substation (Fig. 2).

Error of a LOPO® split core transformer type LPCT K with voltage output.

<table>
<thead>
<tr>
<th>Current %</th>
<th>0,6</th>
<th>6</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (A) (kN=100 A)</td>
<td>0,6</td>
<td>6</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>Current error (%)</td>
<td>6</td>
<td>3</td>
<td>1,5</td>
<td>1,2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Phase error (°)</td>
<td>3</td>
<td>1,5</td>
<td>1</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
</tr>
</tbody>
</table>

**Fig. 1:** Measurement of earthfault current

**Fig. 2:** Mounting of the split core transformer

**LPCT K-60:** Split core low power current transformer
Rated current 60 A (Available for rated current up to 100 A).
Outline drawing number: 16140000
Weight: 5.0 kg

**Twisted pair and double shielded cable with connector**

**Metallic screen**

**Split core transducer**

**Cable**

**Earthing of the metallic screen**
The Trench Group is your partner of choice for electrical power transmission and distribution solutions today; and for the development of your new technology solutions of tomorrow.

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