Power Voltage Transformers for Air Insulated Substations
Introduction

Trench Power Voltage Transformers (Power VTs) combine the attributes of an inductive voltage transformer with the application of a small power transformer. Therefore, they are the perfect solution wherever low voltage is needed and high voltage is available.

Power VTs simply have to be connected to the high voltage overhead line to provide power at low voltage. Due to this direct connection to the transmission line, the reliability of Power VTs is very high, as they are not dependent on distribution lines that are more susceptible to outages.

The Power VTs are designed as single-phase line to ground transformers. By using three devices a “three-phase power supply” with accumulated output power is also possible. The Trench Power VT portfolio covers the high voltage range up to 550 kV. The maximum continuous output power in single phase operation is 125kVA. Therefore, the maximum power performance in three phase operation is up to 375kVA.

The standard output voltages on the secondary side are 120V or 240V. Deviating voltages are also available on request.

Trench Power VTs are equipped with two completely identical secondary winding groups that can be switched in parallel and series connection. Due to that fact it is possible to split the output power evenly to each group to avoid compensation currents. They can be operated completely independent of each other.

Applicable standards

Trench Power VTs are designed and tested referring to the following standards*:

- IEC 61869 concerning instrument transformers
- IEEE C57.13 concerning instrument transformers
- IEC 60076 concerning power transformers
- IEEE C57.12 concerning power transformers (liquid insulated)
- IEEE 693 concerning seismic requirements

* not all contents are applicable for these transformers
Applications

Auxiliary power supply for substations
Auxiliary power for substations is mostly supplied over a tertiary winding of the power transformer. With a Power VT, such a tertiary winding can be avoided, supplying the power needed directly from the transmission line within the substation, while serving as conventional Voltage Transformer at the same time.

Electrification of remote areas
In developing countries or isolated areas such as villages or farms where the distribution network is weak or non-existent, but where transmission lines exist, the Power VT can be used as an economical and feasible solution to supply power to such remote users of electricity. The output of such a small substation can be customized to the needs of the respective consumers.

Power supply during substation construction works
A Power VT can be a temporary solution for power supply during the construction of substations, wind farms, power plants, etc. or when emergency power is required. It is also possible to equip a trailer with a Power VT to have a mobile power supply instead of using a diesel generator set.

Arguments for a Power VT over Alternative Solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel generator</td>
<td>• Easy to install</td>
<td>• Investment&lt;br&gt;• High operation &amp; maintenance costs&lt;br&gt;• Reliability, redundancy&lt;br&gt;• High environmental- &amp; carbon footprint</td>
</tr>
<tr>
<td>Distribution network</td>
<td>• Easy access if available</td>
<td>• Investment&lt;br&gt;• Redundancy&lt;br&gt;• Availability (distribution lines, substations)</td>
</tr>
<tr>
<td>Power Transformer Tertiary</td>
<td>• Easy access/installation if available</td>
<td>• Higher transformer costs&lt;br&gt;• Possible impact on transformer performance&lt;br&gt;• Not available in switching substations&lt;br&gt;• No power supply if transformer is de-energized</td>
</tr>
<tr>
<td>MV-Network</td>
<td>• Easy access if available</td>
<td>• No power supply if transformer is de-energized&lt;br&gt;• HV-MV-transformer needed</td>
</tr>
<tr>
<td>Power VT</td>
<td>• Low investment&lt;br&gt;• Easy to install&lt;br&gt;• Low operation &amp; maintenance costs&lt;br&gt;• Low environmental- &amp; carbon footprint&lt;br&gt;• No distribution network needed&lt;br&gt;• Easy and cheap redundant system (by using two devices)</td>
<td>• Distribution line needed</td>
</tr>
</tbody>
</table>
Standard Features and Design of Trench Power VTs

- Combination of Inductive Voltage Transformer and Power Transformer
- Low cost alternative to small power transformers or distribution feeders
- Available with windings for metering and protection purpose
- Accuracy classes according to international standards
- Output power up to 125 kVA in single phase operation
- SF₆-insulated, composite insulator
- Design and dimensions based on proven Trench Inductive Voltage Transformers (SVS, field experience since 1978) and Trench Test Transformers (TES, field experience since 1975)
- Compact size and weight as compared to conventional power transformers
- Excellent control of internal and external insulation stresses through the use of a proprietary finely graded bushing system
- Exclusive use of corrosion resistant material
- Easy transportation and handling due to light weight
- Output power and voltage customizable to needs of application site
- Single phase unit
- Maintenance free
- Explosion proof design due to the compressible insulation medium SF₆ and rupture disk
- No insulation ageing
- Remote supervision of insulation condition by monitoring internal gas density

Special Features of Trench Power VTs

- Adjustment of the secondary voltage in defined fixed taps by additional transformer (up to three steps in positive and negative direction)
- 30kV lightning impulse withstand for the secondary side – also for the neutral
- Short circuit protection on the secondary side by fuse
- BIL up to 1800kV (chopped wave 2070kV)
- IP 55 qualified
- NEMA 4X qualified
- Overload capability – cycle operation
- Seismic performance tested up to 0.5g
- Cable discharge capability
- Online monitoring via optical sensors inside the coils
- Mobile solution on trailer
Trench Power VTs are equipped with two identical secondary windings. Both ends of each winding are connected to solid copper bolts. Due to both windings being identical, it is possible to realize different interconnections. These interconnections (parallel, series optional with middle tap) are connected by using copper bus bars. The customer connection points are clearly marked e.g. with “a-n”. Each power connection is equipped with NH fuse by default.

In order to offer a maximum of flexibility we installed connection plates on the bottom of the terminal box. For connecting the power windings remove these plates and drill suitable holes for the cable glands.

The terminal block is located at the lower middle of the terminal box. The contact of the temperature sensors, of the gas density monitor as well as optional metering and protecting windings are connected to the terminal block. Cable glands for signal cables are installed by default.

* Other terminal box installations are also available on request.
## Technical Data

<table>
<thead>
<tr>
<th>Type</th>
<th>PSVS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage level [kV]</td>
<td>123, 145, 170, 245, 300, 362, 420, 550</td>
</tr>
<tr>
<td>Rated power frequency withstand voltage [kV]</td>
<td>230, 275, 325, 460, 460, 510, 630, 680</td>
</tr>
<tr>
<td>Rated lighting impulse withstand voltage [kV]</td>
<td>550, 650, 750, 1,050, 1,050, 1,175, 1,425, 1,550</td>
</tr>
<tr>
<td>Rated switching impulse withstand voltage [kV]</td>
<td>- - - - 850, 950, 1,050, 1,175</td>
</tr>
<tr>
<td>Output power [kVA]</td>
<td>up to 125</td>
</tr>
<tr>
<td>Standard output voltage [V]</td>
<td>120 / 240</td>
</tr>
<tr>
<td>Rated voltage factor [Hz]</td>
<td>1.5 (30 s)</td>
</tr>
<tr>
<td>Rated frequency [Hz]</td>
<td>50 – 60</td>
</tr>
<tr>
<td>Creepage distance [mm/kV]</td>
<td>25 – 31 (higher upon request)</td>
</tr>
<tr>
<td>Standard temperature range [°C]</td>
<td>-50(^1) – +40(^1)</td>
</tr>
<tr>
<td>Insulation class</td>
<td>E</td>
</tr>
<tr>
<td>Metering accuracy class</td>
<td>0.2(^2) – 0.5(^2) – 1.0(^2) – 3.0</td>
</tr>
<tr>
<td>Protection accuracy class</td>
<td>3P(^2) – 6P(^2)</td>
</tr>
</tbody>
</table>

Values in accordance with IEC; other values like ANSI are available
1) lower or higher temperature upon request
2) not under full load condition

### Dimensions

<table>
<thead>
<tr>
<th>Output Power</th>
<th>Housing Diameter</th>
<th>Housing Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>50kVA</td>
<td>1160mm</td>
<td>≈1500mm</td>
<td>≈2.0t – 2.2t*</td>
</tr>
<tr>
<td>100kVA</td>
<td>1415mm</td>
<td>≈1800mm</td>
<td>≈3.1t – 3.4t*</td>
</tr>
<tr>
<td>125kVA</td>
<td>1415mm</td>
<td>≈2000mm</td>
<td>≈3.7t – 4.1t*</td>
</tr>
</tbody>
</table>

*weight depending on voltage level
With a strong focus on reliability, customer expectations and continuous innovation, as well as operational experience of over 100 years, Trench is a recognized world leader in the design and manufacture of high voltage equipment for applications in electric utility and high energy industrial systems.

Features such as sustainable accuracy, operational safety and lifetime support make Trench a key supplier and proven partner for both oil-immersed and gas-insulated type instrument transformers.

With instrument transformer factories spanning three continents and a global sales network, we ensure that we are always close to our customers and partners.

Trench Power Voltage Transformers are the ideal solution for many varied applications, combining the economy of an inductive voltage transformer and the versatility of a small power transformer, with the safety and reliability features expected from Trench products.

The table on the previous page is showing our standard Power VT ratings. For other ratings, please contact us.
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.

For more information check out our website at www.trench-group.com or send an e-mail to: sales@trench-group.com

PSVS_JEC
Subject to change without notice (08.2016)