Trench and HSP Group

Bushings, Instrument transformers and Coils
## Trench and HSP Product Portfolio

### Bushings
- **Transformer**
  - Bushings
- **HVDC**
  - Bushings
- **Generator**
  - Bushings
- **Wall**
  - Bushings

### Instrument Transformers
- **Current Transformers**
  - (Oil, SF6)
- **Inductive Voltage Tr.**
  - Capacitor Voltage Tr.
- **Combined Instrument Transformers**
  - (Oil, SF6)
- **Non-conventional Instrument Transformers**
- **Special Capacitors**
- **GIS Instrument Transformers**

### Coils
- **Dry Type Air Core Reactors**
- **Special Reactors**
- **Line Traps**
- **Earth Fault Protection Systems**
- **Power Line Carrier Terminals**
Trench and HSP
Global Manufacturing Network
Bushings

Overview
Bushings Products Portfolio and footprint

### Transformer bushings
- Connected to oil-insulated power transformers
- Operate with different environmental media: outdoors, cable junction box-oil and gas insulated substations
- Condenser grading and a choice of active part insulation:
  - **OIP** Oil Impregnated Paper
  - **RIP** Resin Impregnated Paper
  - **RIS** Resin Impregnated Synthetics

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Rated voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIP</td>
<td>up to 1100 kV</td>
<td>up to 5000 A</td>
</tr>
<tr>
<td>RIP</td>
<td>up to 1200 kV</td>
<td>up to 6000 A</td>
</tr>
<tr>
<td>RIS</td>
<td>up to 245 kV</td>
<td>up to 2000 A</td>
</tr>
</tbody>
</table>

### Wall Bushings
- Wall bushings are designed to lead the electrical current through walls.
  - **OIP** Oil Impregnated Paper
  - **RIP** Resin Impregnated Paper

### Generator, high current and GIS Bushings

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HSP, Germany (RIP/RIS)
- City, Country: Troisdorf, Germany
  - Founded: 1893
  - New factory: 2007
  - Extension: 2018

Trench France (OIP)
- City, Country: Saint-Louis, France
  - Founded: 1929

THVS, China (OIP and RIP/RIS)
- City, Country: Shenyang, China
  - Founded: 1995

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Transformer OIP
- 24 kV - 1100 kV

Transformer RIP
- 24 kV – 1200 kV

Wall
- 24 kV - 1000 kV

Generator & High Current
- up to 45,000 A

Gas Insulated Switchgear
- 125 kV - 1100 kV
Instrument transformers

Overview
Instrument Transformers
Product Portfolio

Current Transformers
Current Transformers (CT) are used for current metering and protection in high voltage network systems. They transform the high current on the high voltage side into low current (1 or 5 A) adequate to be processed in measuring and protection instruments (secondary equipment, such as relays and recorders). A current transformer also isolates the measuring instruments from the high voltage of the monitored circuit. Current transformers are commonly used for metering and protection in the electrical power industry.

Voltage Transformers
Voltage Transformers (VT) – inductive or capacitive – are used for voltage metering and protection in high voltage network systems. They transform the high voltage into low voltage adequate to be processed in measuring and protection instruments secondary equipment, such as relays and recorders. A VT isolates the measuring instruments from the high voltage of the monitored circuit. Voltage Transformers are commonly used for metering and protection in the electrical power industry.

Combined Current and Voltage Transformers
Combined Current and Voltage Transformers contain both, a VT and CT in one unit saving a lot of space. Combined Transformers, just as the individual units, have the main functions as described above for the CT and the VT. Combined Instrument Transformers are commonly used in the electrical power industry when the space at the substation is limited.

Capacitors
Capacitor Products, such as Coupling Capacitors, Energy Storage Capacitors, Transient Recovery Voltage Capacitors or Grading Capacitors are used within HV networks for various purposes. Examples are: coupling high frequency carrier signals to the power line, generating high voltage or current pulses, as well as (in combination with CB) reducing transient over voltages, ensuring uniform voltage distribution or increasing the switching capacity of a breaker.

Trench Germany
- City, Country: Bamberg, Germany
- Founded: 1946

Trench Italy
- City, Country: Cairo Montenotte, IT
- Founded: 1919

Trench High-Voltage Shenyang
- City, Country: Shenyang, China
- Founded: 1995

Trench Canada IN
- City, Country: Toronto, Canada
- Founded: 1972

Siemens India
Examples for special products

GIS
CTs and VTs
(72,5 kV to 800 kV)

Test equipment for High-Voltage Labs and on site testing

Non-conventional instrument transformers

Instrument Transformers
Product Portfolio

Current Transformers - AIS & GIS
- Oil insulated (72,5 kV to 550 kV)
- SF₆ insulated (72,5 kV to 800 kV)
- Low Power CTs
- SF₆ insulated Switchgear (GIS) (72,5 kV to 800 kV)

Voltage Transformers - AIS & GIS
- Inductive
  - Oil insulated (72,5 kV to 550 kV)
  - SF₆ insulated (72,5 kV to 800 kV)
  - SF₆ insulated Switchgear (GIS) (72,5 kV to 800 kV)
- Capacitive VT (CVT) (46 kV to 1200 kV)
- Low Power VTs

Combined Transformers - AIS
- Oil insulated (72,5 kV to 145 kV)
- SF₆ insulated (72,5 kV to 420 kV)

Capacitors
- Coupling Capacitors (10 kV to 800 kV)
- Grading Capacitors
- Storage Capacitors
- RC-Dividers (AIS & GIS) (10 kV to 800 kV)
Coils Overview
Special Reactors and Earth Fault Protection System

Trench offers a far range of Special Reactors, such as Dry Type Iron Core Reactors, Variable Oil-Immersed Shunt Reactors or Earth Fault Protection Systems (Arc Suppression Coils). Arc Suppression Coils are intended to compensate single-phase to ground faults. This way they enable to continue with the power supply of the other two phases even during a ground fault.

Dry Type Air Core Reactors

Reactors improve the overall efficiency of transmission and distribution systems through reduction of losses and fault current levels improving reliability and increasing transmission capacity.

Applications are Current Limiting, Capacitor Reactors and Harmonic Filter Reactors, as well as Shunt Reactors providing reactive Power compensation, Power Flow Control Series Reactors and HVDC Smoothing Reactors utilized in an HVDC.

Line Traps

Line Traps form part of the Power Line Carrier communication scheme. It’s function is to present a high impedance at the carrier frequency band while introducing negligible impedance at the power frequency.

Coil Products
Product Portfolio and footprint

Trench Canada
- City, Country: Toronto, Canada
- Founded: 1962, 2009 expansion

Trench Austria
- City, Country: Linz-Leonding, Austria
- Founded: 1954

Trench Brazil
- City, Country: Jundiaí, Brazil
- Founded: Founded in 2000 in Contagem and moved to Jundiaí in 2014
# Dry Type Air Core Reactors Portfolio

**Voltages:**
600 V to 1000 kV (Series) 600 V to 345 kV (Shunt)

**Power:**
5 kVar to 600 MVAr (60 Hz Equivalent)

**Inductance:**
0.01 mH to 10 H

**Current:**
up to 75 kA_{RMS}
up to 320 kA_{peak}

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### HVDC Reactors
- **HVDC Smoothing Reactors**
  - up to 800 kV, 600 MVar (incl. seismic design)

### Current Limiting & Power Flow Control Reactors
- **for Transmission Systems**
  - up to 765 kV

### Shunt Reactors
- up to 345 kV, up to 100 MVAr/phase

### Thyristor Controlled Shunt Reactors
- up to 100 MVAr/phase

### Electric Arc Furnace Reactors
- up to 4000 A

### Current Limiting Reactors
- for Distribution Systems

### Filter Reactors

### Capacitor (Damping) Reactors

### Test Reactors
- built according to specific customer’s requirements

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**Note:**
Modern Dry Type Air Core Reactors are Custom Designed to the application. There are no “standard” ratings.
**Line Traps**

### Line Traps and Power Line Carrier (PLC)

- Line traps are inserted into high voltage AC transmission lines to prevent undue loss of carrier signal power (40 kHz to 500 kHz) under all power system conditions.

- Line Traps for Power Line Carrier (PLC) communication systems represent a significant application segment for high voltage inductors.

- Power Line Carrier (PLC) is a common method of Power System Communication, such as teleprotection, voice and data communication. It has developed the reputation of being one of the most economical and reliable forms of communication and versatile in its application.

### Main function

- The main function of the Line Trap is to present a high impedance at the carrier frequency band while introducing insignificant impedance at the power frequency. The high impedance limits the attenuation of the carrier signal within the power system by preventing the carrier signal from being:
  - Dissipated in the substation
  - Grounded in the event of a fault outside the carrier transmission path and
  - Dissipated outside of the main transmission path
Special Reactors and Earth Fault Protection System

Dry Type Iron Core Reactors
- Trench offers special reactors incorporating iron cored reactors with air natural, air forced or water cooling.
- The application for such iron cored reactors may range from smoothing reactors, shunt reactors, energy storage reactors, to name just a few.

Variable Shunt Reactors
- VSR are used for applications requiring a wide reactive power range with a non-dynamic regulation (e.g. wind farms)
- Functions which may be achieved by VSRs:
  - Maintain steady-state voltage limit conditions
  - Keep reactive power flow within predefined limits
  - Maintain a desired power factor

Earth Fault Protection System
- Trench offers equipment (Arc Suppression Coil) and services for high impedance (resonant or compensated) systems.
- This type of grounding is mainly used in Central Europe, Eastern Europe and Scandinavia, but due to a variety of technical advantages over other solutions, the resonant grounding is considered as future solution also in other countries.
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