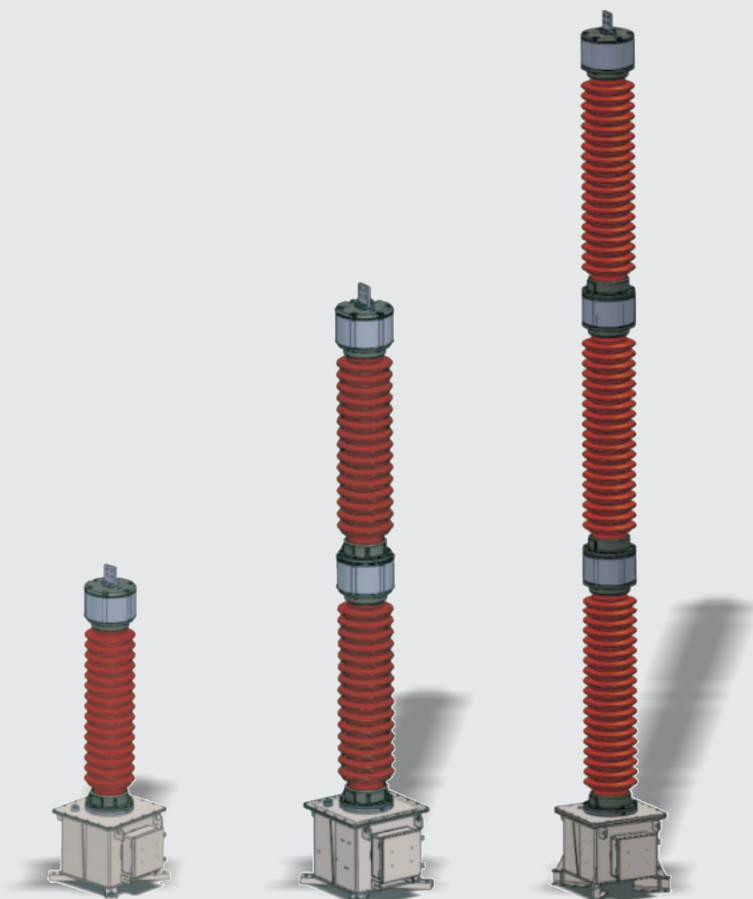


Product manual

# **TYD 72.5-550**

## Capacitor voltage transformer



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# Working principle

## Working principle

The electric schematic diagram of the product shall be shown in Figure 1.

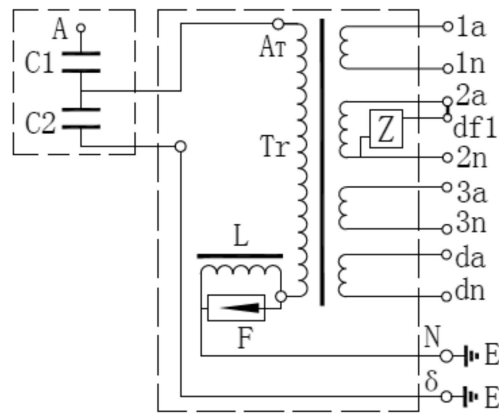


Figure 1

- C1--high voltage capacitance
- C2--intermediate voltage capacitance
- Tr--intermediate transformer
- L--compensating reactor
- Z--damping device
- F--protective device for compensating reactor
- 1a,1n--Main secondary winding 1#
- 2a,2n--Main secondary winding 2#
- 3a,3n--Main secondary winding 3#
- da,dn--Residual winding

## WARNING!

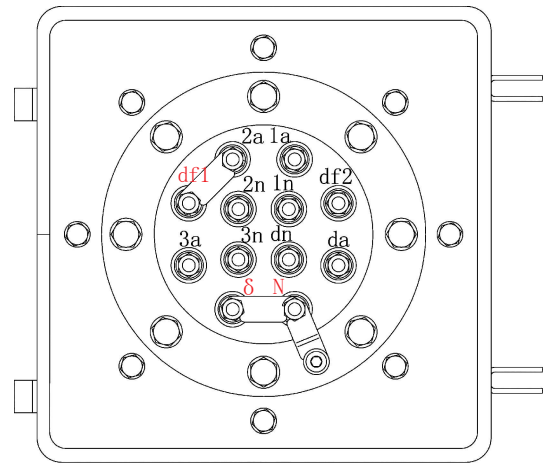


Figure 2

1. Terminal df1 and 2a inside terminal box are connected before delivery, the connection must be recovered after any onsite disconnection during testing or installation.
2. The low voltage terminal of capacitor voltage divider, marked as  $\delta$ , is connected to the ground upon delivery. Both the  $\delta$  and N-terminals are accessible in the transformer's terminal box. The connector between the  $\delta$ -terminal and the N-terminal must be disconnected when carrier equipment is connected.
3. The reliable electrical contact should be inspected regularly during usage, and the tank must be earthed reliably.

# Packing, transport and storage

## Packing

ABB will prepare, pack and load its materials and instrument transformer according to requirement of customer inspection, guaranteeing that equipment and packing material are qualified for international freight by sea or by air.

Instrument transformer will be packed in horizontal or vertical direction in wood crate and plywood, the packing crate will be treated by steam to guarantee that it will be free of insect eggs, plant seeds or animalcule. Instrument transformer packed in horizontal or vertical direction should be in the plywood package. The crate is strong enough for transport under normal conditions by sea and road freight.

All parts of the plant shall be carefully packed and marked to ensure quick identification and erection on site. All packing will be seaworthy for on-deck/under-deck transport.

## Transport

For extreme bad freight condition, purchaser should provide information before award of order and special packing can be applied accordingly with agreement of the customer.

When products are transported by trucks, the speed of trucks shall be steady to avoid mechanical damage.

## Storage

Upon arrival each unit should be checked according to the shipping documents and the order. If damage is discovered or suspected, the case should be opened and photos should be taken. The package should be opened carefully to avoid the damage on the outer insulation.

If intermediate storage cannot be avoided, please recover the package for safety storage.

Storage site: The ground should be strong enough to stand the pressure of packing case. Please make sure the rain-proof measure is taken if instrument transformer is stored in outdoors.

Ambient condition: The surrounding air must be free from dust and corrosive medium. The temperature is not less than -30.

Outdoor storage time should be less than 12 months. For long term storage, products must be packed. Please clean the outer insulation before assembling.

For capacitor voltage transformers and coupling capacitors, power losses may result from capacitor components that have not been energized for an extended period. After connecting the capacitors to the rated voltage, power losses will begin to decrease. They will likely recover their original values after a period of continuous operation at rated voltage. Note that although the trend of increasing power loss is counteracted after a period of time in operation, the site power loss measurements may still show a slight discrepancy in relation to factory values due to the much lower test voltage applied on site.

Stacking of cases: Stacked layers should be confirmed with the packing requirements (please refer to the markings on the packing cases). Cases of different widths shall normally not be stacked. If cases of different widths need to be stacked, a framework must be used between the cases in order to distribute the pressure evenly. Stacking of more than two cases is not allowed. It must be noted that stacking causes instability sidewise and therefore the cases must be secured, i.e., prevented from tumbling down or rolling over.

An approved store is defined as:

Stored in indoor or under the roof to avoid the exposure to sunshine and rain. The equipment can be stored outdoors. If this happens they should be protected by at least a tarpaulin. The tarpaulin shouldn't be so tight so that air circulation to zinc coated surfaces is still prevented.

# Packing, transport and storage

## Marking

There are clear markings to indicate the terminals which should meet the requirements of instrument transformer standards.

Nameplate: All permanent equipment of the works shall be provided with a securely fixed nameplate maker's name, model, serial number, year of manufacturing, main characteristic data of the respective equipment and further relevant information. All main equipment should have the nameplates in English or language upon request.

## Packing crate illustration

Product packing and markings:



Figure 3. Product packing



Figure 4. Transportation marks

Note: Products are not free of secondary transfer. If necessary, please contact to us!

# Installation

## CAUTION

### FOR YOUR SAFETY

DO NOT ATTEMPT TO HANDLE, INSTALL, USE OR SERVICE THIS PRODUCT BEFORE READING THE INSTRUCTION MANUAL.

Failure to read the instruction manual prior to performing these actions can lead to serious injury and/or damage.



### Safety notice

This capacitor voltage transformer should be installed within the design limitations as described on its rating plate and in these instructions. Follow your company's safety procedures.

This product is intended to be operated and maintained by qualified persons who are thoroughly trained and who understand the hazards involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in safety procedures for this device.

## WARNING!

DETAILED DESCRIPTIONS OF STANDARD REPAIR PROCEDURES, SAFETY PRINCIPLES AND SERVICE OPERATIONS ARE NOT INCLUDED. IT IS IMPORTANT TO NOTE THAT THIS DOCUMENT CONTAINS CERTAIN WARNINGS AND CAUTIONS REGARDING CERTAIN SPECIFIC SERVICE METHODS THAT COULD CAUSE PERSONAL INJURY TO SERVICE PERSONAL OR COULD DAMAGE EQUIPMENT OR RENDER IT UNSAFE. PLEASE UNDERSTAND THAT THESE WARNINGS CANNOT COVER ALL CONCEIVABLE WAYS IN WHICH SERVICE, WHETHER OR NOT RECOMMENDED BY ABB, MIGHT BE PERFORMED OR POSSIBLE HAZARDOUS CONSEQUENCES OF EACH CONCEIVABLE WAY, NOR COULD ABB INVESTIGATE ALL SUCH WAYS. ANYONE USING SERVICE PROCEDURES OR TOOLS, WHETHER OR NOT RECOMMENDED BY ABB, MUST THOROUGHLY ENSURE ONESELF THAT NEITHER PERSONAL NOR EQUIPMENT SAFETY WILL BE JEOPARDIZED BY THE SERVICE METHOD OR TOOLS SELECTED.

All information contained in this manual is based on the latest product information available at the time of printing. The right is reserved to make changes at any time without notice.

### Delivery

Check the capacitor voltage transformer for any transport damages immediately upon delivery. Damage to packaging may be a sign of rough handling. Note any damage (it is advisable to take pictures). Check the transformer. Be especially observant of signs of oil leakage and insulator damage and that oil is visible in the oil level glass. Leakage must be immediately localized.

### Lifting the instrument transformer

Lifting must follow the detailed lifting instructions. Any deviation from the instructions may harm the product. If the transformer is delivered in the horizontal or vertical position, be sure to carefully read the instructions since tilting the product may be harmful.

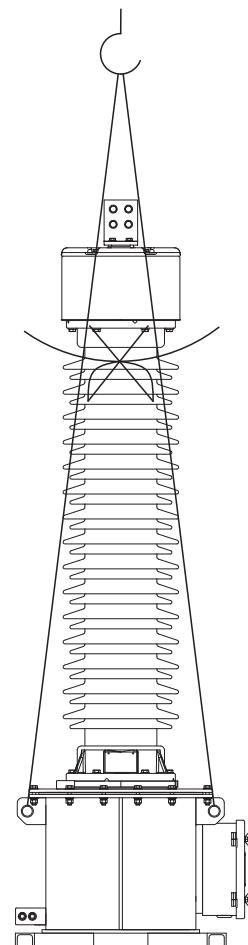


Figure 5. Vertical lift overview

# Installation



Figure 6. Lifting of upper capacitor stacks, if any

TYD capacitor voltage transformers are transported in 3-pack in the vertical position or, if ordered, in a 1-pack in the horizontal position. If transported horizontally the unit is oriented with the secondary terminal box facing upwards. In the case of upper capacitor voltage divider units, these are transported exclusively horizontally in separate packages.

The magnetic transformer and capacitor voltage divider's bottom unit are always delivered preassembled and may not be taken apart. Top sections, if so equipped, are packed separately with up to three sections in each crate.

### Caution!

The supports mounted at the bottom of the transformer are not to be removed until it has been raised.

The detailed lifting instructions can be sent separately if requested. Please contact your ABB representative for further information.

### Caution!

The capacitor voltage transformer must be placed in the vertical position at least 24 hours before energization.

### Connecting secondary terminals in the terminal box

The secondary terminals must be carefully connected. There are markings on the terminal block. There is a wiring diagram on the transformer's rating plate, inside the terminal box. Each unused secondary winding must have one end grounded. Ground terminals are located in the secondary terminal box.

### Caution!

Never short circuit a secondary winding. Very high current will occur between the terminals, dangerous for both personnel and transformers.

### Caution!

2a and df1 terminals must be connected, N and  $\delta$  terminals should be grounded before energization.



# Installation

## Assembly

Each transformer should be checked for possible oil leakage, porcelain damage and other damage caused by rough handling. Check that the oil level is correct according to the maintenance chapter. If not, carefully check for possible oil leakage and contact ABB for further instructions.

**Prior to assembly, ensure that the support structure is flat and horizontal.** If not, correct with washers. Deformation of the bottom tank may otherwise occur and possibly lead to oil leakage and/or insulator damage. The tolerance for flatness is 1.5 mm. If there is an upper unit, it is carefully placed on top of the bottom unit.



### Note!

The same manufacturing number must be on the top and bottom units.

The upper unit, if any, is secured with the supplied bolts and washers, see Figure 7, at a tightening torque of 79 Nm for M12 bolts or 121 Nm for M14. The bolts are included in the delivery. If the apparatus consists of additional units, repeat this procedure. Pay attention to the orientation of the upper unit since this will affect the position of the primary terminal.

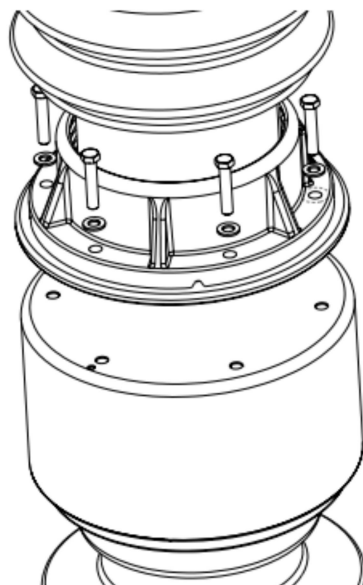


Figure 7. Assembly of upper capacitor stacks, if any

## Connecting the primary terminal

The primary terminal is secured to the bottom of the crate. With horizontal transport, it's placed in the package near the expansion tank and with vertical transport at the bottom of the crate.

Mount the primary terminal on the top of the expansion system, see Figure 8, with four M10 bolts and washers and torque to 45Nm. Also mount other enclosed components, if any, such as dampers, adapters etc. This can be done before the transformer is mounted on the support.

Connect the transformer's high voltage terminal to the line, preferably with a flexible aluminum cable so as to minimize the mechanical load on the primary terminal. The maximum permitted static test load for all directions is according to the dimensional drawing in compliance with IEC.

## Low voltage terminal

The low voltage terminal of capacitor voltage divider, marked as  $\delta$ , is connected to the ground upon delivery. Both the  $\delta$  and N-terminals are accessible in the transformer's terminal box. The connector between the  $\delta$ -terminal and the N-terminal must be disconnected when carrier equipment is connected.

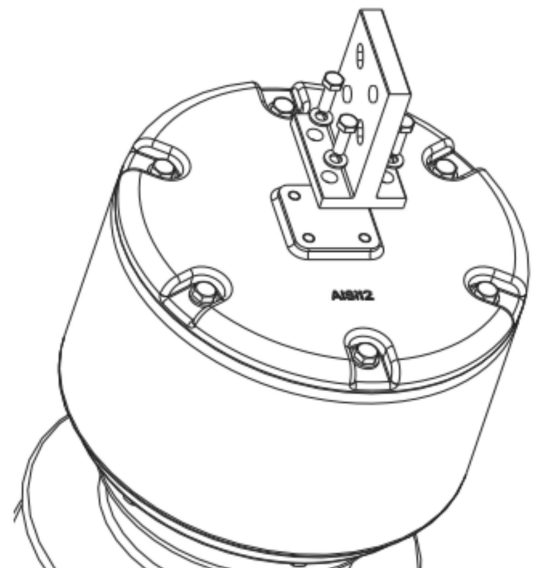


Figure 8. Assembly of primary terminal

# Installation

## Connection of ground terminals

As option the transformer is delivered with a ground clamp which is to be installed on one of the mounting pads for grounding of the entire apparatus, see standard ground terminal in Figure 9. In case the ground clamp is not installed on the mounting pad, upon delivery, the ground clamp is found inside the package. Make sure that the ground terminal, by means of a separate conductor, is securely connected to ground. Also make sure that the ground terminal is galvanically connected to the mounting pad of the apparatus.

There are also ground terminals in the terminal box for connection of appropriate winding terminals and cable screens.

## Use of special load in secondary circuit

If for any reason an intermediate transformer or other load with an iron core is required in the capacitor voltage transformer's secondary circuit, it must be especially designed for this purpose. Undesired sub-harmonic oscillations may otherwise occur. To counteract this, the load's core must be designed to withstand at least three times the rated voltage without becoming saturated.

## Damping circuit

The damping circuit terminals are located in the terminal box.



### Caution!

2a and df1 terminals must be connected before energization.

The damping circuit has two bridged terminals: df1-2a. The damping circuit is factory-calibrated to obtain optimal performance and normally no further adjustment is needed. However, in particular cases and after agreement with ABB, this bridge can be opened to check that the circuit is intact by resistance measurement.

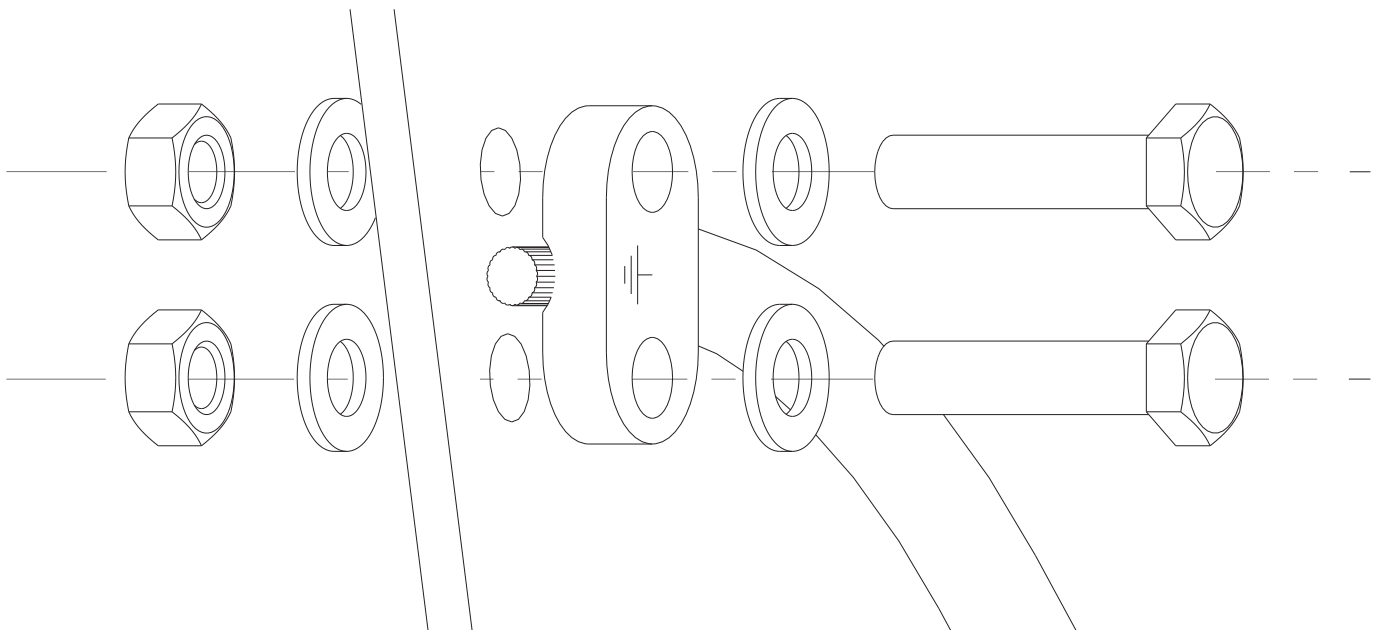


Figure 9. Connection of standard ground terminal (other types can be supplied upon request when an order is placed)

# Maintenance

**Minimal maintenance is required due to the transformer being hermetically sealed. A visual check is normally sufficient with the recommendation of following the checklist at the back of this manual.**

Check for oil leakage at the following positions:

- Oil level glass and oil filling plug
- Seals above and below the insulator Drain slots on expansion housing Seal between oil tank and cover
- Seal between cover and CVD
- Seal between terminal box and oil tank
- Oil drain plug

## Transformer damage

Metal, porcelain and epoxy components are checked. Porcelain components are cleaned as necessary.

Minor damage to insulator sheds can be repaired on site. Instructions for repair of porcelain insulators can be obtained from your ABB representative; see the contact information at the end of the document.

## Oil filling

Filling of oil can be necessary when one liter of oil has been extracted from the EMU. If oil needs to be filled, contact the manufacturer for further instructions. Contact information can be found at the end of the document.

## Tan- $\delta$ measurement (capacitor voltage divider only)

After a longer period of service (15-20 years) or if a fault is suspected after for example, a major operational disturbance, the tan- $\delta$  for the capacitor voltage divider can be measured electrically. Note that the capacitor voltage divider consists of one or more sections that cannot be opened. Consequently, oil samples cannot be taken.

tan- $\delta$  is normally obtained in conjunction with capacitance measurement. The value of the tan- $\delta$  varies with age, the test method, the selected voltage level and temperature. An absolute reference value can thus not be provided. Consequently, the tan- $\delta$  is primarily compared to previous values obtained with equivalent methods

and conditions so that any trends can be detected. It is therefore helpful if one or more reference values have been obtained by measuring the tan- $\delta$  at an earlier stage, for example in conjunction with commissioning, (first energizing).

## Oil level check of the electromagnetic unit

The electromagnetic unit is supplied with an oil level glass which is designed, as seen in Figure 10.

The oil level must always be between the maximum and the minimum oil level as per Figure 11 at ambient temperatures. If the oil level is lower than minimum level, the transformer should be checked for leakage and corrected as soon as possible. When there is leakage, moisture can enter the transformer.

### Note!



The oil level must always be between the maximum and minimum oil level for units as in Figure 10, when the transformer is in service.

## Oil sampling (electromagnetic unit only)

After a longer period of service (15-20 years) or if damage is suspected after for example, a major operational disturbance, an oil sample can be extracted for testing of the oil's moisture and gas contents.

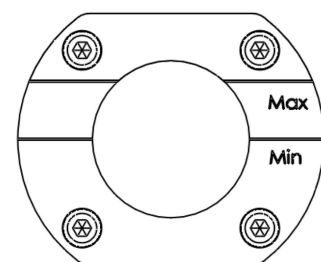


Figure 10. Oil level glass indicating empty

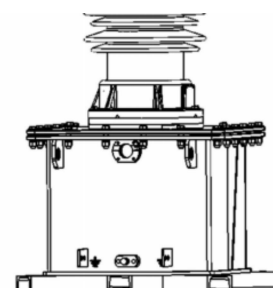


Figure 11. Oil level glass location on electromagnetic unit

# Oil sampling

**Oil sampling and oil filling must be performed in dry weather and with the transformer dry. The transformer must be taken out of service and the transformer top must be grounded.**

There is an oil filling plug on the cover of the capacitor voltage transformer's electromagnetic unit where oil samples can be taken. Ensure that tools are at hand before beginning work.

## Preparation and information

Before taking the oil sample, the following should be checked:

- That the glass syringe is in proper condition, i.e. clean and dry.
- Suitable tools are at hand for opening and sealing the transformer.
- That a vessel for surplus oil is at hand to avoid spilling oil onto the ground.
- It is recommended that a special oil sampling kit be used, which can be ordered from ABB's diagnostic lab. Contact information can be found at the end of the document.
- Replacement seal for oil filling plug are at hand.

## Taking an oil sample

To take an oil sample, follow the steps below.

- First open the oil filling plug; see Figures 12.
- Check the sampling syringe.
- Carefully insert the hose into the oil filling hole. The hose must be beneath the oil surface.
- Take an oil sample after pre-filling the syringe with oil according to the instructions above. If a little air has entered the syringe despite preventive measures, hold the syringe upright and slowly press out the air with the plunger. If air has been drawn into the syringe, note this in the report.
- Close the valve after sampling.
- Clean the sealing surfaces at the oil filling opening from spilled oil and foreign matter, and install new O-rings if necessary.
- Seal the transformer with a torque of 25 Nm.

## Capacitor voltage divider

The capacitor voltage divider, consisting of one or more sections, may not be opened. Consequently, oil samples cannot be taken.

As an alternative to oil sampling, the  $\tan\delta$  can instead be measured in conjunction with capacitance measurement.

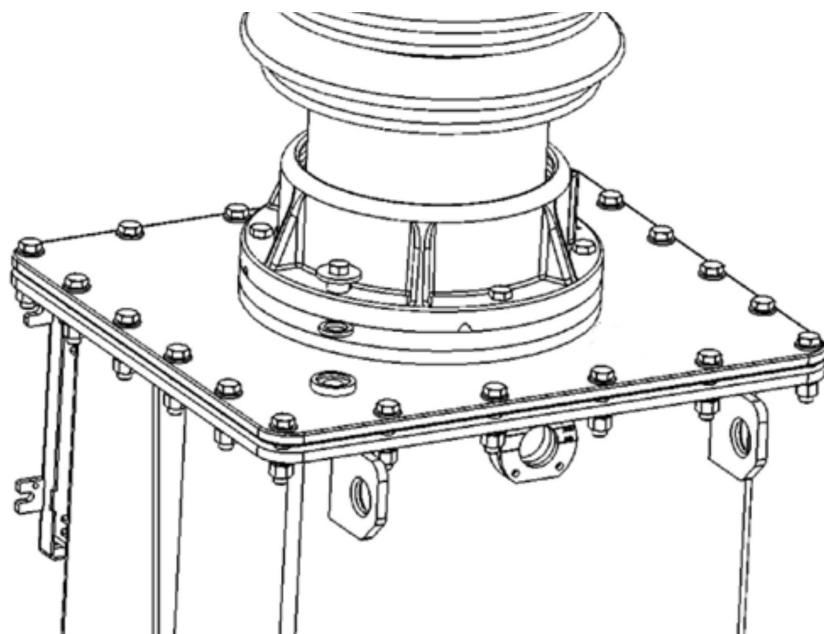


Figure 12. Oil filling and sampling pluses on the electromagnetic unit

# Optional accessories

## Drilled top plate

The undrilled top plate is always mounted to the top capacitor stack in the factory, for both the capacitor voltage transformer and the coupling capacitor, unless a top plate, drilled for Line Trap (LT), is ordered before manufacturing. The primary terminal is mounted on the extrusion in the middle of the top plate as shown in Figure 13. If a LT shall be mounted on top of the capacitor voltage transformer or the coupling capacitor the top plate must be drilled. This requires the top plate to be removed after delivery and drilled according to the fixturing holes of LT or its pedestal.

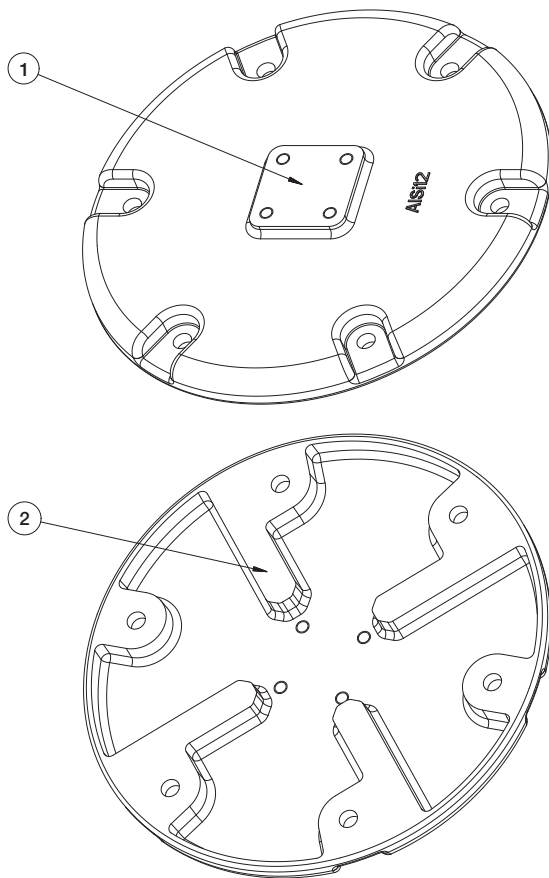


Figure 13. View of the undrilled top plate. Point one (1) is the mounting extrusion for the primary terminal and point two (2) is the gusset which can be drilled.

A top plate, normally undrilled with respect to line trap, is always mounted, if nothing is specified before order, on top of the capacitor voltage transformers of type TYD, except the models with lower capacitance.

Drilled top plate can, if ordered, prior to manufacturing, be supplied to avoid drilling on site.

### Limitations

- Maximum screw size is M16.
- Minimum bolt circle radius from center of the top plate is 64 mm.
- Maximum bolt circle radius from center of the top plate is 148 mm.
- Number of drilling points is limited to four (4) points in midway of the gusset marked with two (2) in Figure 13.
- Center radius clearance for LT or its pedestal required, due to extrusion marked with point one (1) in Figure 13 is minimum 55 mm.

### Note!



Make sure that the pedestal for the line trap can be used together with the undrilled top plate.

### Caution!



Make sure that the unit, where the line trap is to be mounted on, can handle the extra load before assembly.

Follow below steps to drill holes in the top plate:

- Remove the six (6) screws and remove the top plate from the unit.
- Drill and thread the holes along center line of the gusset according to the limitation specified above.
- Mount the top plate on the unit and tighten the six (6) screws with tightening torque of 79 Nm for M12 bolts or 121 Nm for M14.
- Mount the pedestal and do not to use any washers and nut between the top plate and expansion housing. The screw's length must be selected so as to achieve sufficient active thread length that is 1.5 times its nominal diameter. As an example a M12 screw must have a minimum active thread length of  $1.5 \times 12$  mm which equals 18 mm. Also note that there is no room for protruding screws underneath the top plate. Thus make sure that the screw's thread length in the top plate does not exceed the top plate gusset thickness of 25 mm. Allowed tightening torque for LT on the top plate is 79 Nm for M12, 121 Nm for M14 and 190 Nm for M16.

# Disposal

**The environmental effects for ABB CNTIS, High Voltage Products' instrument transformers have been evaluated according to methods for appraising environmental effects such as EPS, ET, ECO and TELLUS.**

After disassembling all components, as seen in Figures 14, can be recycled as described below.

1	Oil	8	Porcelain
2	Paper	9	Iron
3	Copper	10	Hardening plastic
4	Aluminum	11	O-rings
5	Stainless steel	12	Glass
6	Zinc-coated iron	13	Thermoplastic
7	Brass	14	Impregnant

Disposal in general must be carried out in accordance with local legal provisions, laws and regulations.

#### Note!



ABB CNTIS, High Voltage Products, Instrument Transformers can be engaged to uninstall transformers. There is a charge for this service.

Component	Recommendations for reuse, recycling and incineration
<b>Oil</b>	Mineral oil according to IEC 61039: L-NTIO-296, is used as impregnating agents. This type of oil is free from PCB and other heavy toxic substances and has low environmental impact. In Germany, the oil is classified in water conversation class WGK1. The oil can be compared with fuel class 1 and used as fuel (due to the low sulfur content in the oil).
<b>Paper</b>	Paper and oil can be easily consumed in a waste incinerator with a very high temperature. The decomposition products are water, carbon dioxide and small amounts of nitrogen oxides.
<b>Copper</b>	Return to a recycling company
<b>Aluminum</b>	Return to a recycling company
<b>Stainless steel</b>	Return to a recycling company
<b>Zinc-coated iron</b>	Return to a recycling company
<b>Brass</b>	Return to a recycling company
<b>Iron</b>	Return to a recycling company
<b>Porcelain</b>	Crushed and used as filling material
<b>O-rings</b>	Ground down and used as filling material
<b>Glass</b>	Return to a recycling company
<b>Thermoplastic</b>	Return to a recycling company
<b>Impregnant</b>	Faradol 600 are used as impregnating agents in the capacitor part of the CVT. These hydrocarbon type fluids are mixtures of isomers known chemically as mono- and dibenzyltoluenes in Faradol 600. Type of fluid is characterized by their excellent electrical properties, especially PD characteristics, low bioaccumulation and relatively rapid biodegradability. Faradol 600 is class IIIB (OSHA classification) combustible fluids.
	Incineration of Faradol 600 produces no poisonous gases, only water and carbon dioxide. It is the refore suitable to dispose of the fluid and the impregnated components through incineration. The fluids however, are toxic to aquatic organisms. The fluids must therefore be handled accordingly. It is thus recommended that the impregnant be incinerated in a plant intended for this purpose.

# Disposal

Cut-away view of a TYD capacitor voltage transformer

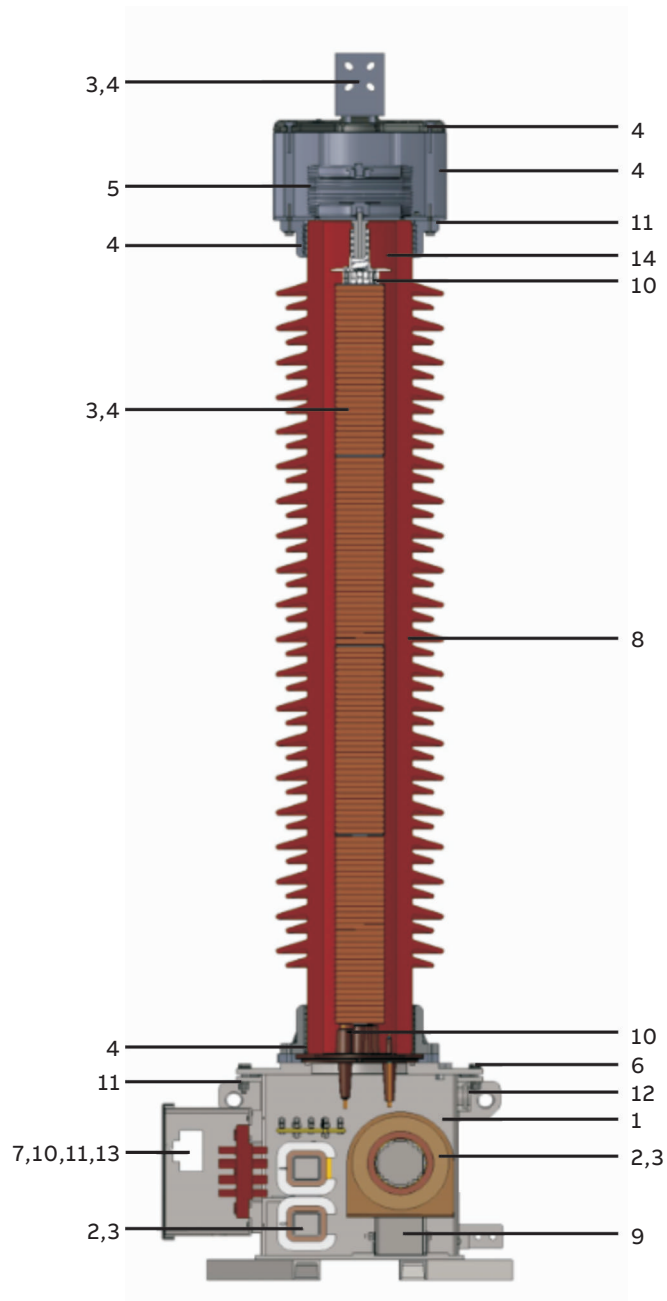


Figure 14

# Troubleshooting

For Symptom	Possible cause	Corrective measure <sup>1</sup>
<b>TYD Zero output, voltage</b>	1. Potential ground switch grounded (if so equipped) 2. Load shorted, or secondary leads shorted 3. Step-down transformer arcing or partially shorted	1. Open switch (if so equipped) 2. Trace origin or replace leads 3. Replace complete CVT or only the EMU.
<b>TYD Insulation resistance of secondary terminals low (&lt;50,000 ohm) megger &lt;= 2 kV</b>	Damaged insulation on secondary wires. Any winding	Replace the damaged wires with new oil-resistant wires internally. Corrective action inside electromagnetic unit is required.
<b>TYD Lower than normal voltage, more than -1.2%</b>	Heavy load on secondary exceeding thermal load	Reduce load

1) Some measures require breaking warrant seals. During the warranty period, please obtain authorization from your ABB representative prior to taking corrective measures.



# Checklist

## Prior to energizing

What to check	When	Applies to	Check for
External package damage	A	TYD	Broken bracing, signs of rough handling
Signs of oil leakage	A, B, C	TYD	Visible oil spillage
Transformer damage	B, C	TYD	Damage to insulator and terminals
Corrosion on primary and ground terminals	B	TYD	Corrosion on the contact surface. If present remove the same.
Oil level	B, C	TYD	Oil visible in level glass
Tan-d measurement	C	TYD	On-site reference value

## After energizing

What to check	When	Applies to	Check for
Signs of oil leakage	D, E	TYD	Visible oil spillage
Transformer damage	D, E	TYD	Damage to insulator and terminals
Oil level	D, E	TYD	Oil visible in level glass
Tan-d measurement	E	TYD	Trends and change of values. Values depend on age, voltage level, test method and temperature.
Insulation test on secondary windings	E	TYD	Values depend on age, voltage level, test method and temperature
Oil sample and gas analysis	E	TYD	Content of critical gases indicating possible damage

## Definitions

A	After arrival of the transformer at the destination
B	Upon unpacking
C	Immediately before energizing
D	During periodic routine checks according to established schedule for the S/S
E	After 15-20 years

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