

High voltage combination transformer for outdoor use

Safety and installation instructions. Please read before use!



The high voltage combination transformer translates high alternating voltages and currents into lower, directly measurable values. It works on the principle of the inductive transformer. The secondary side is galvanically separated from the primary side. It is used in switchgear, switching device combinations and power distribution systems in connection with secondary devices (relays, meters, indication instruments). The instrument transformer is designed in oil-paper insulation technology. Head housing and base are made of aluminum and galvanised steel, the insulator is made of silicone. Refer to the rating plate on the device for the operational specifications.



- 1 Oil level indicator
- 2 Ring bolts for transport purposes
- 3 Primary connection
- 4 Insulator
- 5 Earthing bolt holes
- 6 Oil drain screw
- 7 Terminal box with secondary terminals
- 8 Rating plate

UNPACKING

Check the transformer for completeness and damage. Pay attention to sharp edges. You could get cut on them. If the transformer shows any signs of external damage, there is a risk of electric shock during commissioning.

STORAGE

Store the transformer at an ambient temperature between -25°C and +40°C.

- » The transformer must preferably be stored in a vertical position and screwed to the ground.
- » If you store the transformer in a lying position, the device must stand upright for at least 24 hours before it can be put into operation.

Secure the instrument transformer against slipping, tilting and falling down.

TRANSPORT

The transformer must be handled by trained personnel using suitable transport equipment (crane). Please note the transport instructions on the →dimensional drawing. Observe the weight specified on the →rating plate. Caution: the transformer is top-heavy!

- » Means of transport permitting, the transformers may be transported in a vertical position.
- » Larger transformers are transported in a horizontal position.

If any damage occurs during transport or storage, please contact us directly.

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NOTICE



Ensure a safe working environment during installation, commissioning, shutdown and during inspection work on the electrical system.

INSTALLATION

You may undertake the following installation work only if you are a qualified electrician.

WARNING



Shut down the associated electrical system before installation. Otherwise there is **the risk of suffering an electric shock!**

- » Transport the transformer to the intended location. Secure the base against movement. Bring the transformer into the vertical position as described in the →User manual.
- » Ensure that the mounting surface is even. Secure the transformer using the base fixture. Establish the earthing connection at the transformer base. The lifting fixings should only be released after the transformer has been fully secured!
- » Earth the terminals »N« (directly) and »n«. If the voltage transformer was executed with a winding for earth fault protection (da-dn) and is switched in open delta, only earth one winding at »dn«.
- » Prevent mechanical tension during operation. Ensure that the instrument transformer is not subjected to any dynamic loads such as vibrations, tensile forces or knocks.

DANGER



You must not operate the secondary circuit of the **current transformer part** in open condition under any circumstances. High voltages may occur at the secondary terminals of the current transformer with the secondary circuit open. **There is risk of death!** The voltage levels induced in the process also endanger the functional safety of the transformer.

DANGER



Do not short-circuit the secondary circuit of the **voltage transformer part** under any circumstances. With a short-circuited secondary winding, the voltage transformer will be thermally overloaded. **There is risk of death!** Furthermore, the induced currents endanger the functional safety of the transformer.

COMMISSIONING

Ensure yourself that the instrument transformer is installed properly and the secondary and primary cables are connected correctly.

Have you checked the oil level via the oil level indicator?

In case of downstream earthing measures, ensure you did not integrate a short-circuit loop in the voltage transformer part.

Have you maintained the tightening torques specified? If you have any questions, please ask an experienced colleague or contact us directly.

OPERATION

- » During operation, never touch the primary or secondary terminals.
- » Operate the transformer with the terminal box closed.
- » Ensure that unauthorised persons and children cannot access the instrument transformer.
- » Operate the instrument transformer only with an intact composite insulator. Otherwise, you risk oil leaking, greatly increased partial discharges and an explosion of the instrument transformer.

SHUTDOWN

Shut down the associated electrical system. For your own safety, earth the secondary circuit of the transformer. Ensure that the system remains de-energised while working on the instrument transformer.

DISMANTLING

Follow the work steps as described under → *Shutdown on page 2*. Observe the safety instructions under → *Installation on page 2*.

Then, loosen the secondary and primary terminals, the base fixtures and the earthing screws.

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CLEANING

Follow the work steps as described under → *Shutdown on page 2*. Observe the safety instructions under → *Installation on page 2*.

- » Regularly inspect the current transformer for external soiling and damage, at least once a year and after special weather events (sandstorm, hail).
- » Remove any soiling from the insulator at least once a year as described in the → *User manual*. After that, the transformer must not be taken into use for at least 24 hours.

MAINTENANCE

The instrument transformer is maintenance-free with a low pollution class and sufficient ventilation (→ *Cleaning on page 3*).

Carry out a visual inspection at least once a year:

- » Check the primary and secondary connection terminals and the screw fittings at the earthing connection.
- » Check the oil level at the oil level indicator.
- » Check the insulator for damage.

DO NOT RECTIFY FAULTS ON YOUR OWN!

The transformer cannot be repaired. If you suspect that the transformer is faulty, please contact us immediately.

DISPOSAL

Dispose of the transformer in accordance with the regulations of the country in which the transformer is used.

CMO 123...245

Combined current and voltage transformer for high voltage



HB CMO
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Manufacturer: RITZ Instrument Transformers GmbH · Wandsbeker Zollstraße 92-98 · 22041 Hamburg · Germany

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1 Read first, then take action!

1.1 About this device

1.1.1 What is the device?

This device is a **combined current and voltage transformer of type CMO** for **outdoor use**. The combined transformer works on the principle of the inductive transformer. The secondary side is galvanically separated from the primary side.

Other special properties of the CMO type combined transformer are:

- » The transformer is oil-paper insulated and hermetically sealed. This protects the oil-paper insulation from external influences and oil maintenance is not required. A high-quality **PCB-free insulating oil** in accordance with IEC and ASTM is used for insulation.
- » The external insulation is provided by a **polymer hollow core insulator**. This consists of a glass-fibre reinforced inner tube to which silicone shields with aluminium flanges are attached on the outside. The screws in the insulator flange and the fittings at the top and bottom are made of stainless steel and are tightened at the factory according to the specifications.
- » **Composite and porcelain insulators** are available to cope with different degrees of pollution and load classes. The standard model is already designed for 31 mm/kV and load class 2.
- » Corrosion-resistant components, a stainless steel expansion cell and chambered O-ring seals ensure that it is **maintenance-free** over the entire product life cycle.
- » **High-voltage windings** with double enamel-coated magnet wire ensure insulation between the windings.
- » To change or vary the transformation ratio of a transformer, the **secondary windings can optionally be tapped** (special equipment, → *Chapter 1.4.2 Secondary tapping on page 11*)
- » The secondary terminals are located in the **cast aluminium terminal box** at the front of the transformer base. A removable and field drillable aluminium plate is available on the underside of the terminal box for the customer's cable glands. The terminal box is prepared for the operation of an optional condensation heating element.
- » The electrical configurations from 123 kV nominal voltage up to the voltage series listed on the device, maximum 245 kV, allow connection to digital and conventional measuring and protection devices such as switchgear, switching device combinations and power distribution systems in connection with secondary devices (relays, meters, indication instruments).

Read first, then take action!

- » An **oil drain screw** enables access to the oil chamber in the transformer base from cast aluminium. The oil level indicator is located in the head area of the transformer and is optimised for the operator's viewing angle.
- » Four **transport eyes** on the transformer base facilitate proper handling during installation.

For further information or details regarding the **shield shape, flash-over distance and creepage path**, please refer to the → *Dimensional drawing*.

The device meets the relevant VDE-, IEC- and EN-standards. You will find the electrical data on the → *Rating plate*.



The type designation and specification of the device can be found on the → *Datasheet* and the device's → *Rating plate*. The rating plate is usually located at the front of the secondary terminal box.

Upon request, the CMO type combined transformer will be factory designed to meet all national and international standards including IEEE / ANSI, CSA, IEC as well as all customer requirements.

1.1.2 What is the purpose of the device?

The combined current and voltage transformer of type CMO translates high AC voltages into lower, directly measurable AC voltages and high currents into lower, directly measurable currents, which are adapted to the downstream secondary technology. The electrical configurations are suitable for digital and conventional measuring and protection devices.

Depending on the version, the CMO type combined transformer is suitable for use at a maximum voltage for operating equipment (U_m) of 123 kV, 145 kV, 170 kV or 245 kV.

The CMO type combined transformer can be equipped with windings for measuring and protection purposes. It is intended for use in

- » switchgear, switching device combinations,
- » power distribution systems in connection with secondary devices (relays, meters, indication instruments).

1.2 About this manual

1.2.1 Who is this manual intended for?

The target group includes everyone involved in the installation, operation and maintenance of this device.



Fig. 1: Read this user manual first than take action!

NOTICE

Please read this user manual carefully before commissioning the device and observe all the regulations and information. This helps prevent personal injury and damage to property.

1.2.2 How is this manual set out?

Layout of the manual

The theory section gets you ready to use the device safely and correctly.

The practical section shows you how to connect the device and when to disconnect it from the mains.

The fourth section deals with questions about repair and service.



Some of the information and illustrations in this manual may differ from the features of your device. This includes details of special equipment, abstractions and example illustrations.

Layout of the safety instructions

The safety instructions are differentiated according to the type and severity of the hazard:

DANGER

Danger to life

WARNING

Warning of serious injury

**CAUTION**

Beware of health hazards and serious damage to property

**NOTICE**

Note on the possibility of considerable damage to property

1.2.3 How do you use this manual?

This user manual is part of the device you have received.

**NOTICE**

Keep this manual and all applicable documents available at all times, to all users, at the place where the device is used.



In addition to this user manual, the applicable versions of the pertinent national laws, regulations and provisions must be observed.

1.3 For your safety

1.3.1 When is it dangerous to use the device?

Foreseeable misuse

Any applications of the transformer not described in this user manual could result in serious personal injury, or even death, and cause serious damage to property. Any other or additional use as well as use outside the permissible operating values (\rightarrow *Rating plate*) contradicts the intended use of the device.



Fig. 2: Working with the device only permitted for electrotechnical qualified personnel

1.3.2 Who is allowed to work with this device?

Everyone involved in the installation, operation and maintenance of the device must hold the appropriate qualifications. In order to prevent accidents, everyone who works with the transformer must meet the following minimum requirements. They must:

- » be a qualified electrician or a suitably instructed person under the supervision of a qualified electrician,
- » be able to implement the information in this user manual in a professional manner,
- » be capable of performing work on the device within the scope of this user manual in accordance with safety requirements.

i NOTICE

For safety reasons, everyone involved in the installation, operation and maintenance of the device must be familiar with, have understood and follow this manual.

1.3.3 What are the obligations of the operator of this device?

The operator is responsible for defining the responsibilities and monitoring of the personnel. The operator must:

- » ensure that everyone who works on the transformer has read and understood this user manual,
- » inform everyone who works on the transformer of the applicable regulations regarding work, safety and accident prevention,
- » provide everyone who works on the transformer with the necessary protective equipment and advise them of the requirement to wear it,
- » train everyone who works on the transformer at regular intervals and inform them of the risks,
- » ensure that the transformer is only operated in a condition compliant with safety requirements,
- » be aware of the hazards arising from the auxiliary materials used.
- » Furthermore, the operator may only employ personnel who are specially qualified to handle the auxiliary materials.



Fig. 3: Working on the device only in personal protective equipment

1.3.4 Which legal aspects should you be aware of?



No claims may be made for changes to devices already delivered due to the specifications, illustrations and descriptions in this user manual.

We as the manufacturer are not liable:

- » if you do not follow the instructions in this user manual,
- » for direct damage or consequential damage due to incorrect installation, operation or maintenance of this device,
- » if you operate this device outside the specifications given on the rating plate,
- » for personal injury or damage to property caused either wholly or in part by untrained persons or by non-compliance with the regulations regarding work, safety and accident prevention.

1.3.5 What should you do in the event of damage?



WARNING

Damage to the device

Damage can impair the functionality and operational safety of the transformer. This may cause personal injury.

- » Remove the damaged transformer from service immediately.
- » If necessary, contact the manufacturer → *Chapter 7 Contact / customer service on page 47.*

In the event of transport damage or other defects, please take photographs of the damaged components and the rating plate. Write a damage report and send it to us, the manufacturer.

1.4 Special equipment

1.4.1 Primary reconnection

Primary reconnection is possible with current transformers and combined current and voltage transformers with multiple primary windings. Depending on the customer's requirement, it can be carried out in a ratio of 1:1, 1:2 and 1:4.

NOTICE

Reconnection is provided by parallel or series connection of the primary winding via reconnecting tabs in the primary connection area. The power ratings, the overcurrent limiting factor and the secondary internal resistance values remain unchanged with primary-side reconnection.

Circuit diagram for the primary reconnection

If the transformer is reconnectable on the primary side, the associated circuit diagram is located near to the primary conductor on the head housing.

1.4.2 Secondary tapping

To change or vary the transformation ratio of a transformer, not only the start and end of a winding are connected to the terminal, but also one or more of its parts.

In transformers, usually the secondary windings, and less frequently the primary windings, are tapped → *Primary reconnection*.

Read first, then take action!

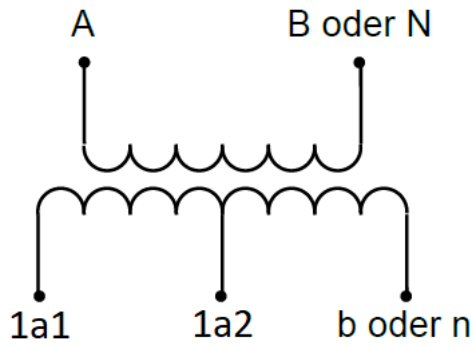


Fig. 4: Circuit diagram with tapping of the voltage transformer's secondary winding

Connection of the secondary technology at the terminals?	
a1–b/n	High secondary rated voltage (small ratio)
a2–b/n	Low rated secondary voltage (large ratio)

2 How to use this device as intended

2.1 Important general safety instructions

2.1.1 Working disconnected from voltage

During operation, the transformer is live at high voltage. When connected and not earthed on the high-voltage side, the transformer may be live at high voltage. This can cause personal injury, even in the vicinity of the transformer. The following applies before all work on the transformer, such as installation, maintenance and troubleshooting:

- » Disconnect the source of high voltage.
- » Safeguard against reconnection.
- » Ensure no voltage is present.
- » Earth the device.
- » Cover or block off adjacent live parts.

2.1.2 Technically flawless condition of the transformer

External damage and improper handling or maintenance can impair the operational safety of the transformer. There is a risk of accidents in which people could be injured.

- ➔ Only perform work on the undamaged transformer in accordance with these instructions!

2.1.3 Deviating operating conditions

Deviating operating conditions can impair the functionality and operational safety of the transformer. This may cause personal injury.

- ➔ Operation only if the information in → *Chapter 5.1 Technical data on page 39* and → *Chapter 5.2 Environmental conditions on page 40* is taken into account.

2.1.4 Structural changes

Structural changes can impair the functionality and operational safety of the transformer. This can result in personal injury, as well as damage to adjacent operating equipment.

- ➔ Do not make any structural changes to the transformer!

2.2 Unpacking

- » Observe the notes on transport (→ *Chapter 3.4.1 Transporting the device on page 33*) and move the device to the place of use.
- » Loosen the screw connection and the lashing of the device to the transport frame.
- » Unload the device from the transport vehicle using suitable aids (textile hoisting slings / crane). Observe the instructions for lifting the transformer under → *Transporting and lifting in a horizontal position, chap. 3.4.1*.
- » Check the following based on the dimensional drawing: Is the device complete and undamaged? Be careful of sharp edges. You could be injured!

NOTICE

If there is external damage to the transformer, personal and operational safety are at risk → *Chapter 1.3.5 What should you do in the event of damage? on page 10*.

2.3 Installation

2.3.1 Installing the device

Before you start the installation, think about your safety!



Fig. 5: Work on the device only in personal protective equipment



DANGER

High voltage in conductive components

There is danger to life through electric shock! Observe the **5 safety rules** of electrical engineering.

- » Disconnect the source of high voltage.
- » Safeguard against reconnection.
- » Ensure no voltage is present.
- » Earth.
- » Block off adjacent live parts.



Fig. 6: Disconnect mains!

1. Connect the transformer **mechanically to the switchgear**:

- » Maintain the insulation distance between system components and live surfaces!
- » If present, remove the transport protection. Do not make any structural changes to the transformer → *Chapter 2.1.4 Structural changes on page 13.*
- » Ensure that the installation surface is even.
- » Level out any unevenness between the transformer and the installation surface.
- » The position of the transformer during installation is upright.
- » Secure the transformer to the foundation. For fixing dimensions please refer to the → *Dimensional drawing*. Depending on the diameter of the drilled hole we recommend the following bolt size:

Drilled hole Ø[mm]	Bolt size
18	M16
24	M20

The required tightening torques are shown in the table, refer to → *Table on page 19.*

2. Ensure that the **composite insulator** is in perfect working order:

- » Check the composite insulator for damage to and between the insulator shields. If you notice any abnormalities, proceed as described here: → *Chapter 1.3.5 What should you do in the event of damage? on page 10*
- » Clean the insulator if necessary. In this regard follow the instructions as described under → *Chapter 3.1.1 Cleaning the device on page 25*

3. Check the **oil level**:

Check the transformer for oil leaks.

Check the oil level using the oil level indicator on the head of the transformer (Fig. 7). For further information please refer to → *Procedure step 7 on page 27*

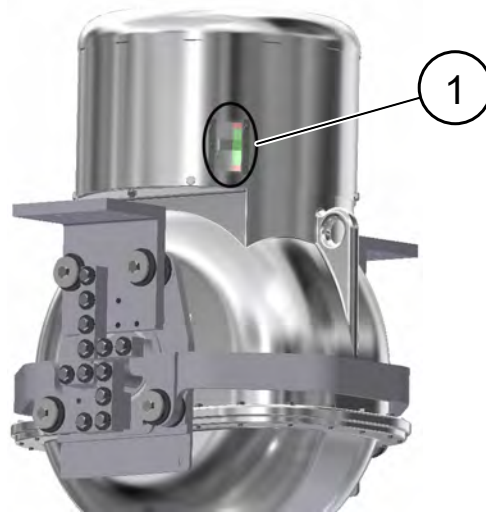


Fig. 7: CMO type combined transformer: position of the oil level indicator

1 Oil level indicator

➔ The oil level indicator should be in the green area.

4. Prepare the transformer for **connection on the primary side**:

Always ensure a conductive contact at the primary connection plates. If available, completely remove the protective coating (wax emulsion) from the contact surfaces.

**Cleaning of the contact surfaces**

- » Use a grease-dissolving cleaning agent such as white spirit or acetone.
- » Use a soft cloth or, if necessary, fine sandpaper to avoid scratching the contact surfaces.

**NOTICE**

Do not use wire brushes when cleaning aluminium or galvanised contact surfaces!

After cleaning, apply a thin layer of contact grease to the contact surfaces. Only use auxiliary materials recommended and **approved by the manufacturer**, e.g. Penatrox, special grease Pfisterer MV.

**CAUTION****Safe handling of auxiliary materials**

Health hazards can arise from the auxiliary materials used, depending on their chemical composition.

- » It is essential to observe the safety datasheets of the auxiliary materials, and the instructions and regulations they contain.

5. Establish the **primary connection at the transformer.**

Screw the two primary terminals on the transformer to the stranded conductor or rail of the switchgear.

Observe the required tightening torques, → *Table on page 19*



Fig. 8: CMO type combined transformer: position of the primary terminals

1 Primary connection plates

Ensure that the primary conductors are adequately dimensioned:



WARNING

Thermal stresses due to high contact resistances

The transformer can be thermally overloaded by primary conductors whose cross-sections or materials are not enough electrically load-bearing.

- » Only use primary conductors whose cross-sections are sufficiently dimensioned to withstand the secondary thermal short-time rated current.

2.3.2 Earthing the device

Establish the earthing connection!

Earth the transformer using the earthing bolt holes in the transformer base.

For the required tightening torques please refer to the following table:



Fig. 9: Earth the device!

Bolt size		Tightening torque [Nm]		Tightening torque [lb*ft]	
Metric	Imperial	A2-70	A2-80	A2-70	A2-80
		5.6	8.8	5.6	8.8
M6	1/4	5	7.5	3.5	5.5
M8	5/16	15	20	11	15
M10	3/8	30	40	22	30
M12	1/2	50	75	35	55
M16	5/8	120	190	90	140
M20	3/4	180	380	130	280
M24	1	270	570	200	420

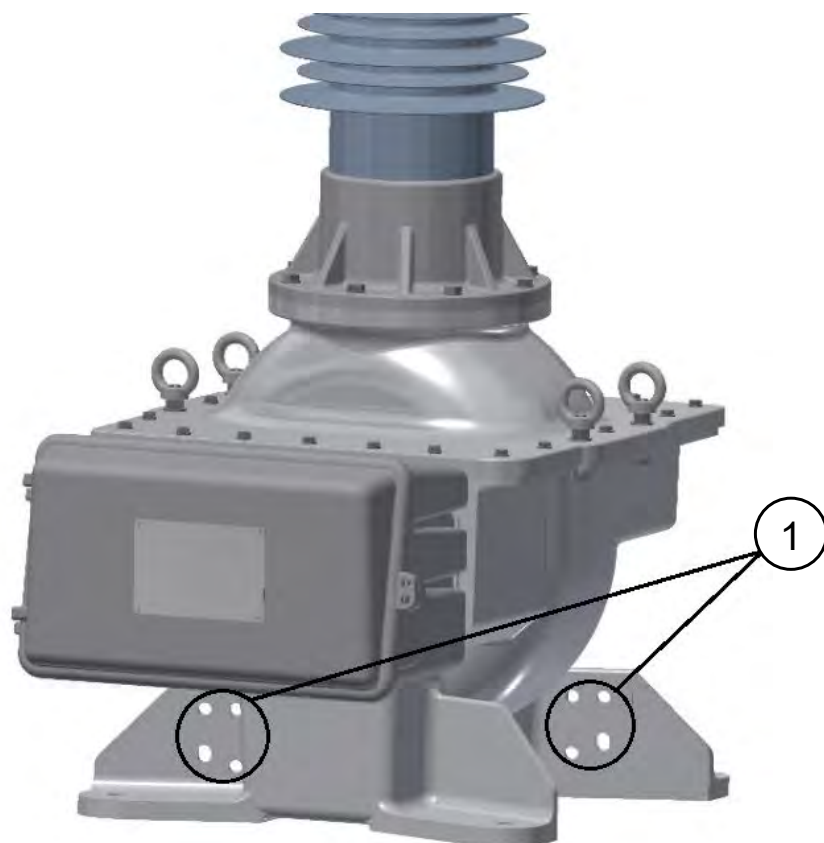


Fig. 10: Earthing bolt holes in the transformer base

1 Boreholes for the earthing bolts

Make an electrically conductive connection between the earthing bolts and the earthing point of the switchgear.



Ensure there is a clean potential connection at the earthing connection.

→ The housing is earthed.

2.3.3 Connecting the device

Prepare the transformer for connection on the **secondary side**:

The secondary terminals are located in the terminal box at the transformer base. Please refer to the → *Dimensional drawing* for detailed information on the number and arrangement of the secondary terminals.

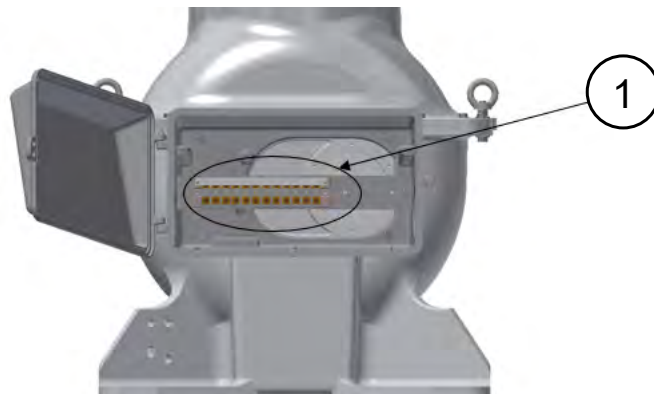


Fig. 11: Terminal box with secondary terminals

1 Secondary terminals

Also the secondary circuit diagram is located in the terminal box.

There is an aluminium plate on the underside of the terminal box to which cable connections can be attached.

Observe the required tightening torques, → *Table on page 19*.

Establish access to the terminal area for electrical connection:

1. Undo the locking screws on the terminal box.
2. Open the terminal box cover.

3. Guide the cables on the secondary side through the cable entry on the underside of the terminal box, Fig. 11.

**WARNING****Thermal stresses due to high contact resistances**

The transformer can be thermally overloaded by connecting cables whose cross-sections or materials are not enough electrically load-bearing or which are uneven or not properly screwed at the contact point.

- » Only use connecting cables whose cross-sections are sufficiently dimensioned to withstand the secondary thermal short-time rated current.



Use polyester line pipes to prevent creepage current traces, especially in areas with high air pollution. An internal metal shield ensures that the surface currents can flow off unhindered.

4. Connect the secondary cables to the secondary terminals (M6) in the terminal box of the transformer (Fig. 11, tightening torque: max. 5 Nm).

Current transformer part:

- » Connect the secondary connecting cables to the secondary terminals **1 S1-1 S3** or **2 S1-2 S3**.

**DANGER****High voltage at open secondary terminal**

If the secondary windings of the current transformer part are operated in open condition, there is risk of death due to high voltage.

- » Never operate the secondary windings without burden.
- » Always load the secondary windings with the specified burden or short-circuit it.



The start of each secondary winding of the current transformer part has been earthed in the terminal box at the factory.

Voltage transformer part:

- » Connect the secondary cables to the secondary terminals **1a-1n** or **2a-2n**.

**DANGER****Heat damage due to short circuit**

With a short-circuited secondary winding, the voltage transformer part will be thermally overloaded. This can cause the transformer to burst within a short time. **There is risk of death!** Furthermore, the induced currents endanger the functional safety of the transformer.

- » Do not short-circuit the secondary circuit of the voltage transformer part under any circumstances.
- » Earth fault windings wired in open delta must be earthed on only one of the three transformers.



The end of each secondary winding of the voltage transformer part has been earthed in the terminal box at the factory.

5. Close the terminal box and retighten the cover ($M_A = 1,8 \text{ Nm}$).

2.4 Commissioning

Before putting the transformer into operation, check whether all necessary prerequisites have been met:

2. Ensure that you have carried out the required earthing measures correctly → *Chapter 2.3.2 Earthing the device on page 18* and → *Chapter 2.3.3 Connecting the device on page 20*.
3. Have you checked the oil level via the oil level indicator? → *Procedure step 7 on page 27*
4. Have you checked the transformer for oil leaks? In the event of leaks, please contact us, the manufacturer → *Chapter 7 Contact / customer service on page 47*.
5. Have you cleaned and checked the insulator for damage? The instructions for cleaning can be found here: → *Chapter 3.1.1 Cleaning the device on page 25*
6. Have you completed all the previous points?
→ Switch on the power supply.

2.5 Operating

Prerequisites for operation



WARNING

Operation only after correct commissioning

The operational safety of the transformer is not guaranteed if it is not commissioned correctly in accordance with this user manual. This can result in accidents with serious personal injury or death.

- » Do not put the transformer into operation until you have fulfilled the prerequisites for doing so, see → *Chapter 2.4 Commissioning on page 23*

Operation

Observe the following safety precautions during operation:

- » Do not touch the primary and secondary terminals under any circumstances.
- » Always keep the terminal box closed.
- » Ensure that the prescribed environmental conditions are maintained during operation, → *Chapter 5.2 Environmental conditions on page 40.*

2.6 Shutdown

It is essential to disconnect the transformer and the surrounding equipment from the power supply.



Fig. 12: Disconnect the power source!



DANGER

High voltage in conductive components

There is a danger to life through electric shock!

Observe the **5 safety rules** of electrical engineering:

- » Disconnect the source of high voltage.
- » Safeguard against reconnection.
- » Ensure no voltage is present.
- » Earth.
- » Cover or block off adjacent live parts.



For your safety, earth the secondary circuit of the transformer.

3 When to interrupt the running operation

3.1 Cleaning and maintenance

3.1.1 Cleaning the device

Check this device regularly for external soiling. Please note before cleaning procedures:



CAUTION

Cleaning measures are only permitted after the device has been shut down, → *Chap. 2.6*.



NOTICE

Surfaces can be damaged using unsuitable auxiliary materials.

» Only use auxiliary materials approved by the manufacturer.

How often the surface of the transformer should be cleaned depends on the degree of pollution:

Pollution level	Measures
Light to medium pollution (under normal operating conditions)	The surface of the transformer should be cleaned annually.
Heavy pollution (e.g. in coastal locations or areas with high air pollution)	The surface of the transformer should be visually inspected several times a year and cleaned accordingly frequently.

 **CAUTION****Negligent handling of cleaning agents and preservatives:**

There is a risk of harm to health from irritant substances.

- » Protective clothing is required when cleaning.
- » Wear gloves and protective goggles.
- » Observe the safety data sheets for the auxiliary materials.
- » Observe the application instructions of the manufacturer of the auxiliary materials (e.g. SAEKA products: www.saekaphen.de)



Fig. 13: *Disconnect mains!*

If cleaning is required, proceed as follows:

1. Proceed according to the **five rules of electrical engineering!**
2. Clean the insulator with a soap solution (neutral detergent, dissolved in water). Use a cotton cloth for this purpose. Rinse the surfaces with clear water afterwards.
3. If using a high pressure cleaner, take care to avoid causing any damage. Only use equipment with a maximum nozzle pressure of 35 bar for this purpose.
 - ➔ In this case the distance between the nozzle and the insulator must be at least 3 m and the water jet must not be applied to any one point for longer than 10 seconds at a time.

 **NOTICE****Re-commissioning after 24 hours at the earliest**

After cleaning with any cleaning products, the transformer must rest for 24 hours and only then be put back into operation.

3.1.2 Maintaining the device

The instrument transformer is maintenance-free.

To ensure the safety of the transformer, carry out a **visual inspection** at least once a year: This includes the following steps:

1. Proceed according to the **five rules of electrical engineering!**
2. Check the pollution level of the transformer.
 - ➔ If necessary, clean the transformer. Surface protection is not required, see ➔ *Chapter 3.1.1 Cleaning the device on page 25.*
3. Check the insulator surface for cracks and any other damage especially on and between the insulator shields.
 - ➔ Any cracks in the insulator as well as severe damage to the insulator shields necessitate replacing the transformer!
4. Inspect the terminal box for cracks, damage and leaks.
5. Inspect the condition and fit of the primary and secondary terminals.
6. Inspect possible covers and seals for cracks, damage and leaks.
7. Check the oil level using the oil level indicator on the head of the transformer. You can see here how to correctly interpret the result:



CAUTION

The oil level indicator on RED

- » If the oil level indicator is in the upper or lower red area, please inform the manufacturer immediately, ➔ *Chapter 7 Contact / customer service on page 47*
- » Always mention anomalies such as oil leaks and excess voltages.

When to interrupt the running operation

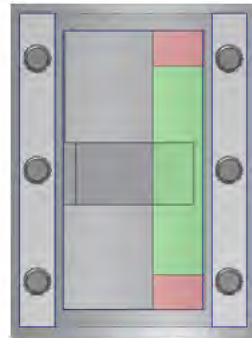


Fig. 14: The marker is in the green area → The transformer is operating in the normal range.

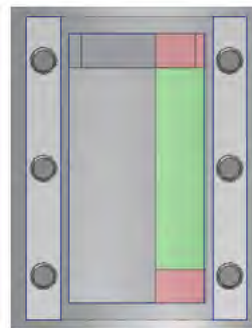


Fig. 15: The oil level indicator is in the upper red area → The transformer is operating at abnormally high pressure and does not operate correctly.

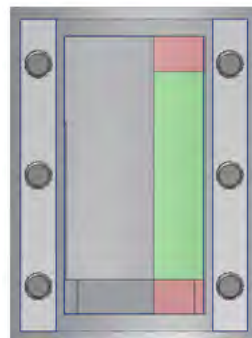


Fig. 16: The oil level indicator is in the lower red area → The transformer is operating at abnormally low pressure and does not operate correctly.

Oil sampling



The transformer requires no maintenance in relation to oil over the entire product life cycle.

i NOTICE

Unless there are good grounds for, we advise against any oil investigation.

Oil samples should be taken only if circumstances have arisen that might have caused damage to the transformer or if the transformer has malfunctioned.

If it is necessary to take an oil sample you can remove the oil via the oil drain screw. The oil drain screw is located on the base of the transformer.

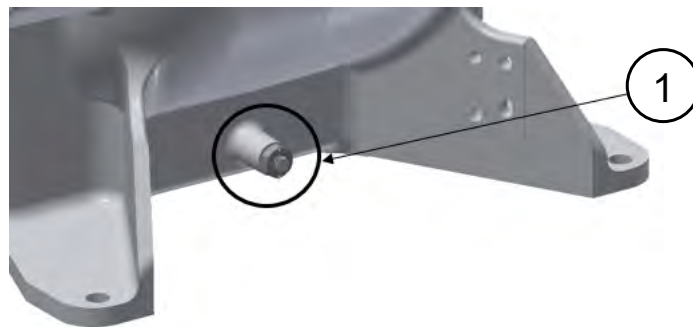


Fig. 17: Oil drain screw on the transformer base

- 1 Oil drain screw

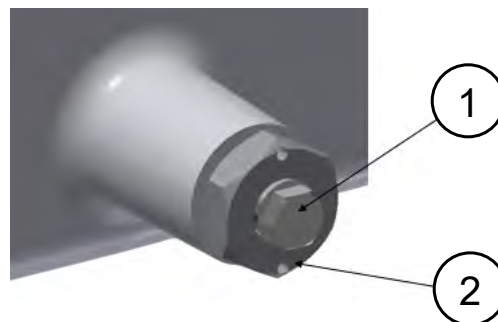


Fig. 18: Oil drain screw in detail

- 1 M8 screw,
2 M20 screw,

To draw oil from the device, perform the following steps:

1. If this is the first time that an oil sample is to be taken, remove the sealing from the oil drain screw.
2. Remove the bolt (1) using a screw spanner size 13.
3. Screw your oil sampling set into the M8 female thread.

When to interrupt the running operation

4. Loosen the bolt (2) using a screw spanner size 30 and turn it, together with the oil sampling set, through two to three complete rotations.
→ Oil will now flow and you can take the sample.
5. When you have drawn sufficient oil, screw the bolt (2) back in, together with the oil sampling set.
6. Remove the oil sampling set.
7. Tighten the bolt (2) with the torque spanner to 25 Nm.
8. Re-insert the bolt (1) and tighten it with a torque of 15 Nm.
9. Clean any oil residues from the oil drain plug.
10. Check the oil drain plug for tightness after a maximum of 24 hours.
11. Keep a precise record of the amounts of oil removed so that you never draw more than the maximum permitted quantity from the system.



Please observe the following instructions:

- » A total of no more than 0.5 litres of oil may be drawn from a transformer over its entire service life.
- » Oil sampling should only be carried out at temperatures of at least +5 °C.
- » Should problems arise when drawing oil, please contact us immediately: → *Chapter 7 Contact / customer service on page 47*
- » You can obtain the oil sampling set directly from the manufacturer: → *Chapter 7 Contact / customer service on page 47*

**CAUTION****Leakage during operation**

In rare cases, leaks may occur during operation of the high voltage transformer. There is a risk of injury and explosion!

- » Regularly inspect the transformer for damage.
- » In the event of a malfunction, immediately disconnect the transformer from the mains and contact the customer service.

3.2 Troubleshooting

In rare cases, faults may occur during operation of the device.

- » Disconnect the switchgear from the power supply → *Chapter 2.1.1 Working disconnected from voltage on page 13.*
- » First check the connections according to the table below.

If the measures listed below do not rectify the fault or if other faults not listed here occur, please contact us (→ *Chapter 7 Contact / customer service on page 47*).

Fault	Possible cause	Remedy
No measurement signal	Connecting cable loose	Check the secondary terminals, → <i>Chapter 2.3.1</i>
	Damaged transformer	Check transformer and replace if necessary
Faulty measurement signal	Incorrect frequency	Frequency according to → Rating plate
	Connections connected wrong way round	Arrange connecting cables correctly
	Damaged transformer	Check transformer and replace if necessary
Thermal stresses of the primary screw fitting	Loose screw on the primary connection	Check the primary connection, → <i>Chapter 2.3.1</i>
Thermal stresses of the primary screw fitting	Insufficient cross-sections of the busbars	Use bus bars with a larger cross-section, → <i>Chapter 2.3.1</i>
Thermal stresses of the secondary screw fitting	Loose screw on secondary clamp	Check the secondary terminals, → <i>Chapter 2.3.1</i>
	Insufficient cross-sections of the connecting cables	Use connecting cables with a larger cross-section, → <i>Chapter 2.3.1</i>
High voltage on the transformer base	Incorrect assembly, the transformer not earthed	Check the connections, → <i>Chapter 2.3.3</i>
		Check the earthing measures, → <i>Chapter 2.3.2</i>
Limited device function through overheating of the secondary winding	Overload (the burden is higher than the specified limit power)	Burden according to the information on the device's rating plate
Limited device function through overheating of the primary winding	Short circuit in the secondary winding(s)	Contact the responsible sales representative or the manufacturer, → <i>Chapter 7</i>

When to interrupt the running operation

Fault	Possible cause	Remedy
Limited device function through overheating of the primary circuit	Current-carrying connections not screwed correctly	Check the connections according to → <i>Chapter 2.3.1</i>
Damage to the high voltage insulation during operation	Leakage	Immediately interrupt the running operation and contact the responsible sales representative or the manufacturer
	Greatly increased partial discharges	
Incorrect measurement results due to excessive heating of the transformer	Operation outside the specification limits	Checking the technical specifications limits, → Rating plate.
Reduced insulation due to excessive heating of the transformer	Increased contact resistances at the secondary terminals	

3.3 Dismantling

1. Disconnect the transformer and the surrounding equipment from the power supply, see → *Chapter 2.6 Shutdown on page 24*.
2. Interrupt the **primary connection** by loosening the screw fitting on the primary terminal of the transformer.
3. Release the **secondary connections** as follows:
 - » Undo the screw connection of the terminal box cover and open the terminal box.
 - » Loosen the connection terminals and remove the secondary cables.
 - » Loosen the cable glands from the underside of the terminal box .
4. Release the separate earthing connection on the earthing screws.
5. Release the screw fittings at the base of the transformer.
6. Protect the composite insulator from damage and soiling.
7. Transport the transformer to the new destination, → *Chapter 3.4.1 Transporting the device on page 33*.

3.4 Transport and storage

3.4.1 Transporting the device



Fig. 19: Work on the device in personal protective equipment, → Chapter 1.3.3, p. 9

NOTICE

Transportation and assembly may only be carried out by specially qualified persons!

Qualified persons are familiar with transportation and assembly in relation to installation and commissioning of the transformer. They demonstrably hold qualifications relevant to the activity, such as:

- » They are authorised in the operation of lifting equipment and crane systems by training or instruction.
- » They know the occupational safety instructions and apply them according to the national regulations.

Before lifting the device and transporting it to its destination, observe the following instructions:

- » Depending on the size of the device and the means of transport available, the transformer can be transported vertically or horizontally.
- » The transformer must be transported on vehicles or trailers with air suspension.
- » Transportation by rail is not permitted.
- » Lift each transformer individually.



WARNING

The transformer can tip over!

The transformer is top-heavy. If not transported correctly, the transformers may tip or fall over causing serious injury or damage.

During transport the transformer is bolted to a transport frame.

When to interrupt the running operation**Transporting and lifting in a vertical position**

1. Before lifting, remove the bolts securing the transformer to the transport frame.
2. Attach one hook to each of the two transport eyes on the head housing. Use a lifting beam so that the cover of the expansion vessels is not damaged.
3. Lift the transformer one at a time (→ *Further information on page 34*).



Fig. 20: CMO type combined transformer: correct anchoring of the transport aids



WARNING

Danger to risk due to suspended loads

Loads can swing out and fall during lifting operations. This can result in serious personal injury or death.

- » Never stand under suspended loads or in their swing area.
- » Only move loads under supervision.
- » Only use approved lifting gear and sling gear with sufficient load bearing capacity.
- » Only use lifting gear that is in perfect working order.

Ensure that the environmental conditions for transport and storage are met (→ *Chapter 3.4.2 Storing the device on page 37*).

Transporting and lifting in a horizontal position

- » Larger transformers are transported in a horizontal position. Observe the information plate for transport on the terminal box of the device.
- » Always position the transformer with the flange of the head housing resting on the padding. This corresponds to the left-hand side of the device as seen when facing the terminal box. **Caution: The primary terminals and the cover of the expansion vessel must not be loaded!**
- » Support the head of the transformer on vibration-reducing foam and lash it to the transport frame.
- » Screw the base of the transformer to a transport frame.

Lifting the transformer in a horizontal position

1. Attach the lifting gear to the ring nuts on the base and the lifting eye on the head housing,
2. Bring the two lifting straps together in the middle and slowly lift the transformer from the centre (Fig. 21).
3. Lift the transformer one at a time.

When to interrupt the running operation

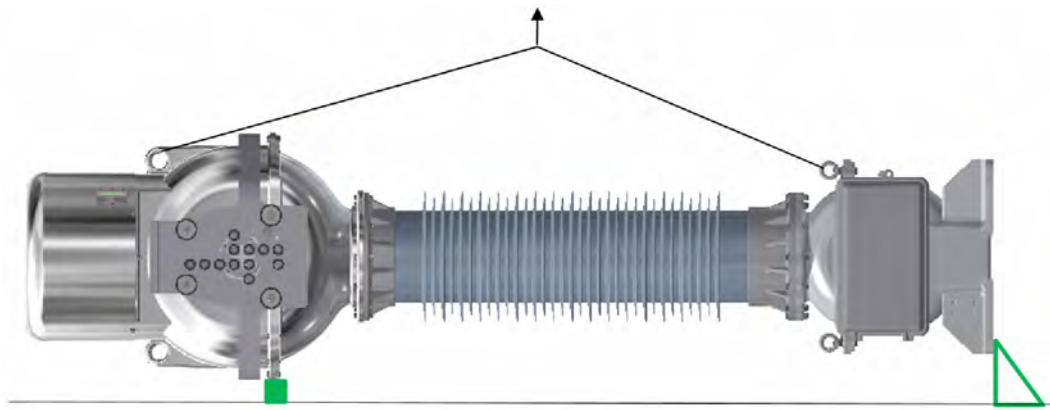


Fig. 21: CMO type combined transformer: transporting and lifting in a horizontal position



Fig. 22: Standing the CMO type combined transformer up

Standing and moving the transformer

1. Before standing the transformer up, release the bolt in the base and then untie the head housing.
2. Attach both hooks of the lifting gear to the transport eye on the head housing.
3. Secure the base against movement and only then bring the transformer into the vertical position (Fig. 22).
4. In order to move the transformer, attach one hook to each of the two transport eyes on the head housing. Use a lifting beam so that the cover of the expansion vessels is not damaged.
5. Lift the transformer one at a time.

3.4.2 Storing the device

Please observe the following storage and transport conditions:

- » The transformers must always be stored in a vertical position and bolted to the base on which they are mounted, to prevent them from falling over during storms or similar.
- » If the transformers have to be stored in a horizontal position, they must be stood up vertically **at least 24 hours before commissioning**.

Storage and transport conditions

temperature

-25°C to +40 °C

3.5 Disposal**ENVIRONMENT**

Dispose of the transformer in accordance with the regulations of the country in which it is used:

- » Dispose of the packaging materials correctly.
- » Dispose of removable plastic and metal parts separately and professionally.
- » Dispose of the transformer's oil in accordance with national, regional and local waste disposal regulations.

4 How we as the manufacturer can help

4.1 Repairs

The device cannot be repaired on site

If you suspect that the device is defective, contact the responsible sales representative or get in touch with us, the manufacturer, directly (→ *Chapter 7 Contact / customer service on page 47*).



To enable us to process your enquiry as quickly as possible, please give us the **type designation** and **serial number** of the device in question. These are located on the rating plate, which is usually located above the secondary terminals.

4.2 Spare parts

Spare parts for this device are available on request.

4.3 Other queries

Do you have any questions about this user manual, special equipment or our product range? Please do not hesitate to contact us. We look forward to hearing from you (→ *Chapter 7 Contact / customer service on page 47*)!

5 Technical data

5.1 Technical data

Type	CMO 123	CMO 145	CMO 170	CMO 245
Highest voltage for operating equipment U_m	123 kV	145 kV	170 kV	245 kV
Dimensions	→ <i>Dimensional drawing</i>			
Weight	→ <i>Rating plate on the device</i> Example CMO 145: 630 kg total weight, 120 kg oil weight			
Principle of operation	Combined current and voltage transformer			
Area of application	Outdoor			
Connection type	In accordance with standard and/or customer requirements → <i>Dimensional drawing</i>			
Secondary connection	Terminal box with connection terminals: Marathon 16XX SC or Pheonix PT6			
Protection class	IP 54			
Input				
Primary rated current U_{pr}	≤ 5000 A			
Primary rated voltage U_N	→ <i>Rating plate on the device</i> Example IVO 145: 80.5 kV			
rated frequency	16 2/3 Hz 50 Hz 60 Hz → <i>Rating plate on the device</i>			
Output				
Secondary rated voltage	→ <i>Rating plate on the device: V / Ratio</i> Example IVO 145: 115 V/700:1 (X1-X3); 67,08 V/1200:1 (X2-X3)			
Secondary rated current U_{sr}	1 or 5 A			
Rated burden	→ <i>Rating plate on the device</i>			
Thermal load	max. 5,000 VA			
Accuracy				
Accuracy class	→ <i>Rating plate on the device</i> Example IVO 145: 0.3			

Type	CMO 123	CMO 145	CMO 170	CMO 245
Standard values for insulation				
Rated withstand AC voltage (50 Hz/1 min.)	230 kV	275 kV	325 kV	460 kV
Rated lightning impulse withstand voltage (1,2/50 μs)	550 kV	650 kV	750 kV	1050 kV
insulating class	E			



Device-specific data

Deviating, customer-specific values are possible! For these specifications and other information required for operation of the transformer (e. g. accuracy class, rated voltage, burden power, etc.) please refer to the → *Rating plate*.

5.2 Environmental conditions

For deviating environmental conditions, see → *Datasheet* and → *Rating plate*. Observe the following instructions:

- » Never use the device in areas at risk of explosion.
- » Never use the device near easily flammable materials.

Installation altitude	Up to 1000 m above sea level ¹
-----------------------	---

¹This information refers to the standard version of the device. Modifications for greater heights are possible. Please contact your sales partner or get in touch with us directly → *Chapter 7 Contact / customer service on page 47*.

Rated operating conditions	
Temperature class	-25°C to +40 °C

5.3 Rating plate

The rating plate shown here contains the type designation of the transformer, the rated data and the name of the manufacturer.

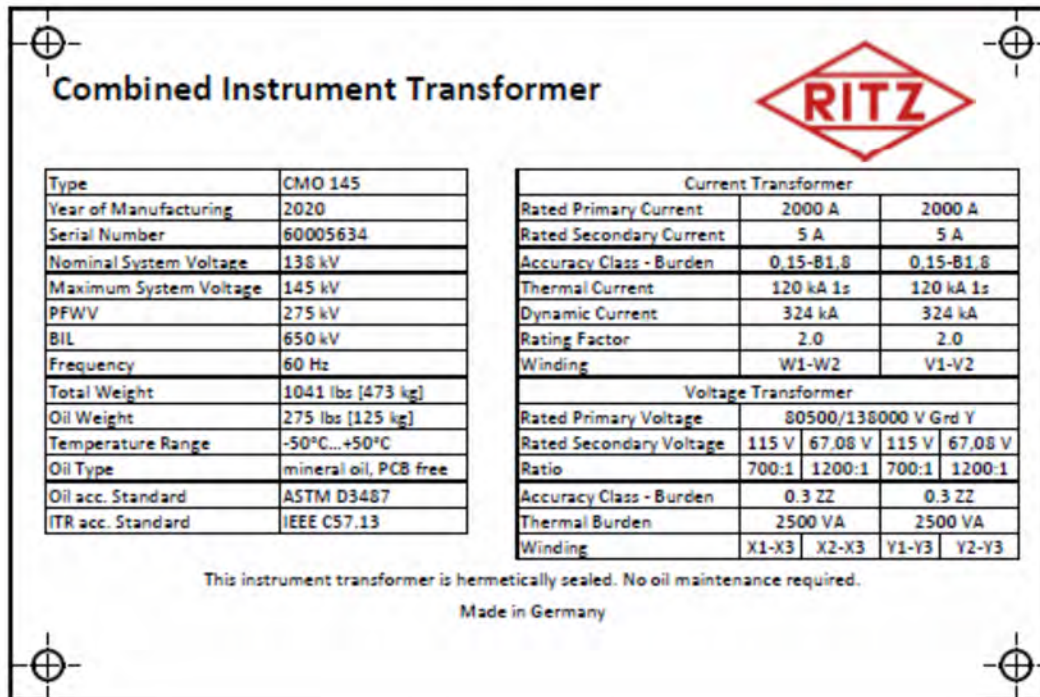


Fig. 23: Sample rating plate for the CMO type combined current and voltage transformer in the 145 kV version. Subject to modifications.



The rating plate is located on the terminal box. Please refer to the → *Dimensional drawing* for the exact position.

5.4 Circuit diagram

The circuit diagram shows a combined current and voltage transformer according to IEC¹ standard. The end of the primary winding of the current transformer part P1-P2/A is also the beginning of the primary winding of the voltage transformer part P2/A. The end of the primary winding of the voltage transformer part must be earthed.

The current transformer part has 5 cores with one winding each, all without tapping. The voltage transformer part has 3 secondary windings, also without tapping.

¹(International Electrotechnical Commission)

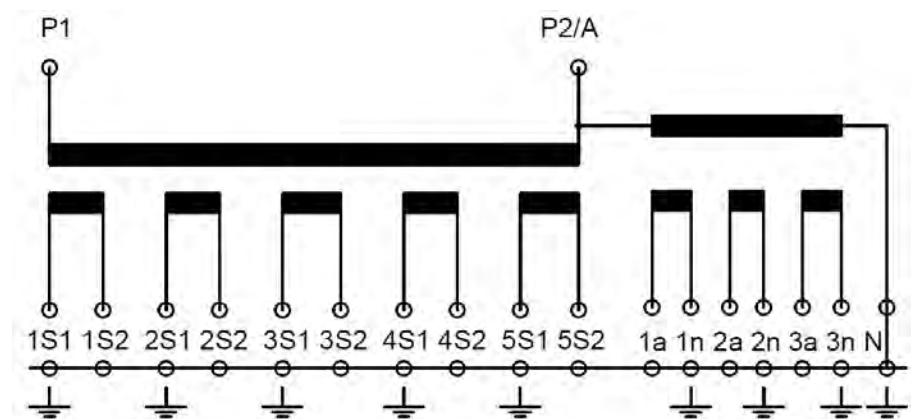


Fig. 24: Circuit diagram of the combined current and voltage transformer of type CMO

5.5 Technical illustration

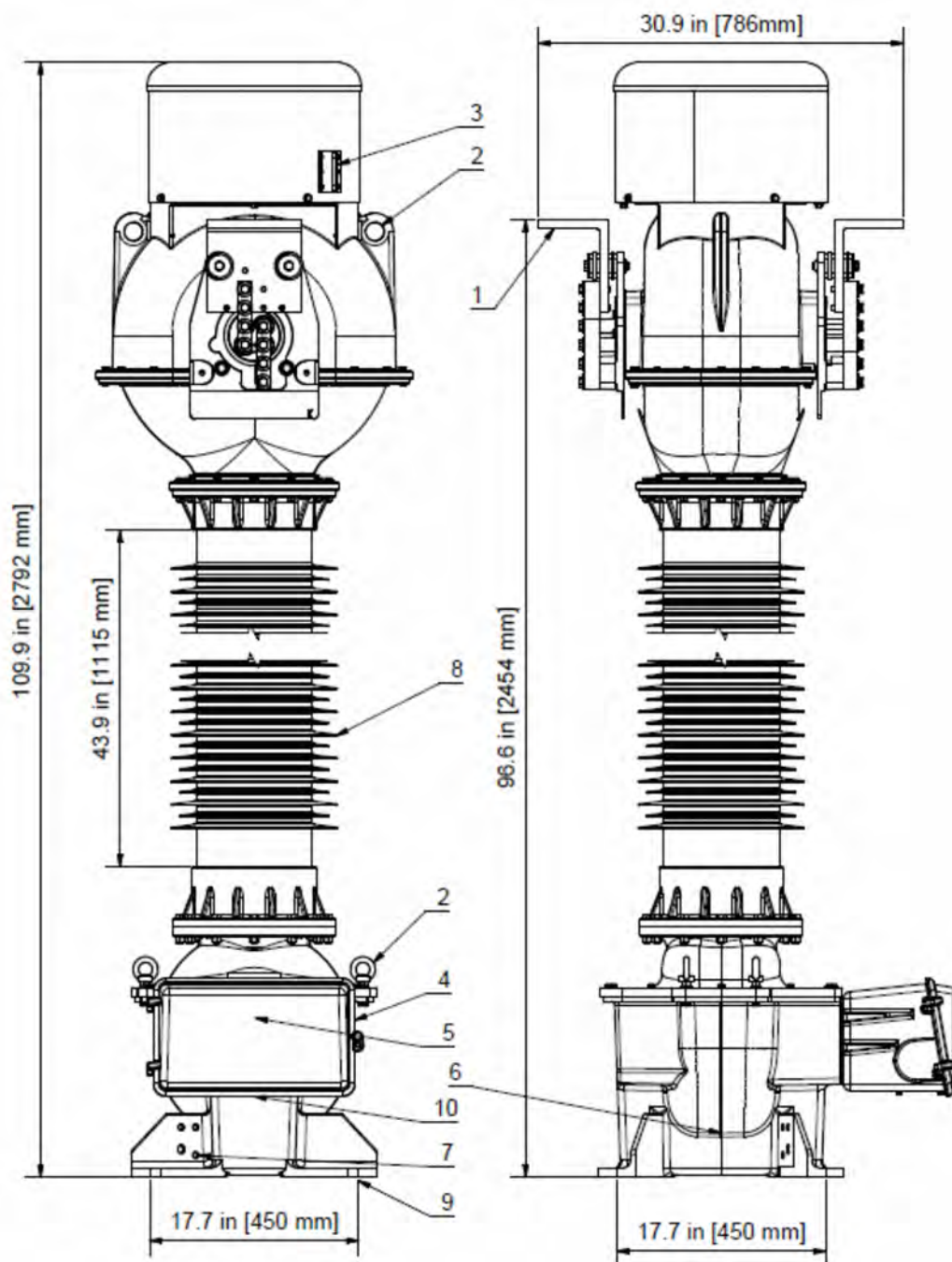


Fig. 25: Example combined transformer of type CMO.. Subject to modifications.

- | | |
|---|---|
| 1 Primary connection, aluminium | 6 Oil drain screw |
| 2 Transport eyelet: 2x Ø30 mm (above),
4x Ø30 mm (below) | 7 Earth terminal |
| 3 Oil level indicator | 8 Composite insulator |
| 4 Terminal box | 9 Drill hole for fastening: 4x Ø18 mm |
| 5 Rating plate | 10 Cover panel for cable gland, removable:
340 mm x 110 mm |




6 Symbols and abbreviations



6.1 Symbols and abbreviations

The following abbreviations have been used in this manual:

Abbreviation	Explanation
1. 2. 3.	The numbers in a list indicate the individual steps of an instruction that follow on from one another
➔	Outcome
»	1. Measures to prevent the consequences of a hazard warning 2. List with no fixed sequence
MA*	Tightening torque for dry installation without additional lubricant (coefficient of friction $\mu = 0.14$)

The following symbols have been used in this manual:

	The mandatory sign "Earth before use" indicates that this device may only be put into operation if it has been earthed beforehand.
	The mandatory sign "Disconnect before maintenance or repair" is a reminder to only work on this device when the associated electrical system is de-energized.
	This symbol indicates that work on this device should only be carried out by specially qualified personnel.

	<p>The mandatory sign "Read instructions for use" solicits attention to this user manual.</p>
	<p>The two symbols "Wear head protection" and "Use protective gloves" are a reminder to wear personal protective equipment.</p>

6.2 Safety labels

The following symbols and signs may be located on the transformer:

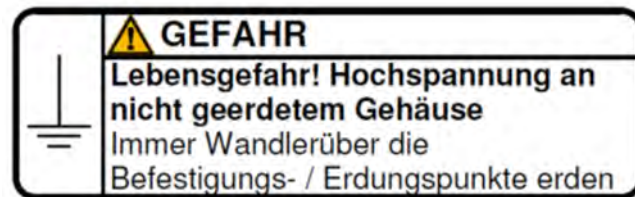


Fig. 26: **Always earth the housing!**

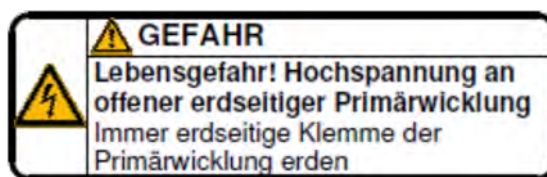


Fig. 27: **Always earth the primary terminal on the earth side!**

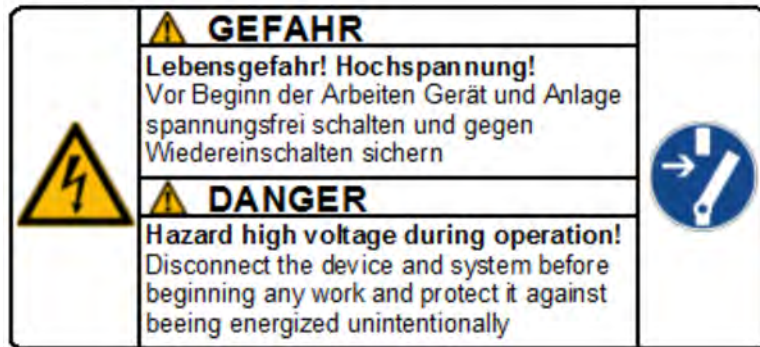


Fig. 28: **Always disconnect the device from the power supply before working on it!**

Voltage transformer part:

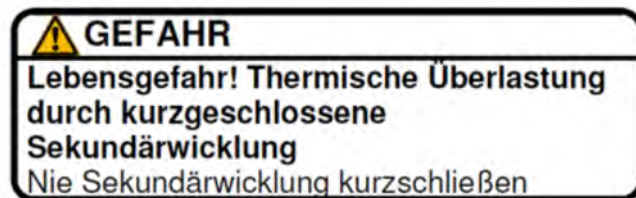


Fig. 29: **Never short-circuit the secondary windings!**

Current transformer part:



Fig. 30: **Never operate the secondary terminals without burden.**

7 Contact / customer service

Please contact your sales partner or get in touch with us directly:

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D-22041 Hamburg

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Email: info@ritz-international.com

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