

# Thyrobox VR 125 kVA/250 kVA

EN



Instructions for  
Transport  
Storage  
Installation  
Commissioning  
Operation  
Maintenance

**AEG**  
POWER SOLUTIONS

## CONTACT

### TECHNICAL QUERIES

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# 1. NOTES ON THESE OPERATING INSTRUCTIONS

## OBLIGATORY INSTRUCTION

The operating instructions contain important information on the avoidance of hazards and assist you in installing and operating the Thyrobox VR safely, properly and in accordance with regulations. If you have questions relating to the Thyrobox VR which pertain to safety or other questions which are not covered in the operating instructions then please get in touch with our power controller team.

In accordance with the Product Liability Act the manufacturer of this product is obligated to inform about and warn against

- other than the intended use of a product
- the residual hazards of a product (in case of intended use) as well as
- incorrect usages and their consequences.

The following information is intended for this purpose. This information should warn the product user and protect him and his appliances.

## FOR THIS, THESE OPERATING INSTRUCTIONS SHALL CAREFULLY BE READ PRIOR TO FIRST START-UP!

These operating instructions are part of the Thyrobox VR. The operator of this device is committed to provide these operating instructions without limitation to all persons, who transport the device, start it up, maintain it, or perform other work tasks to it. If you misplace your copy of these operating instructions please get in touch with the manufacturer.

## VALIDITY

These operating instructions correspond with the technical status of the Thyrobox VR at the time of issue. The content is not the subject of the contract, but rather serves to provide information.

## WARRANTY AND LIABILITY

We reserve the right to make amendments to the details in these operating instructions, in particular to technical data and operation.

Claims in connection with supplied goods must be submitted within eight days upon receipt, along with the packing slip. Claims made later cannot receive consideration.

In the case of damages which occur due to not heeding the instructions the warranty claim is null and void. AEG PS does not accept liability for subsequent damages. AEG PS will rescind all possible obligations such as warranty agreements, service contracts, etc. entered into by AEG PS or its distributors without prior notice if maintenance and repair work is carried out using anything other than original AEG PS spare parts or spare parts purchased from AEG PS.

## HANDLING

The Thyrobox VR is constructed in such a way that all necessary procedures for commissioning and operation can be carried out without having to open up the device. Maintenance and repair works may only be carried out by specialist personnel with the corresponding training.

Certain process steps are related to figures in order to clarify and to ease necessary work.

If threats to personnel and material cannot be ruled out for certain work, such tasks are marked with a pictogram, from which the according content may be extracted from the before mentioned chapter "Safety instructions".

## 2. INTENDED USAGE

- The Thyrobox VR is a component whose intended usage is as a voltage regulator at the feed point when feeding renewable energies (e.g. photovoltaic systems) into low voltage networks. This is what the Thyrobox VR is designed for and it may only be used as such.
- The Thyrobox VR may only be operated in connection with an appropriate upstream and downstream mains disconnecting device (e.g. switch, take note of VDE 0105 T1).
- The Thyrobox VR is not functional on its own and must be project planned for its appropriate usage in order to minimize the residual hazards of the product.
- The Thyrobox VR may at most be operated with the maximum permissible connection values in accordance with the details on the type plate.
- The Thyrobox VR may only be used for the purpose for which it was intended, as persons may otherwise be exposed to dangers (e.g. electric shock, burns) and systems also (e. g. overload).
- Appropriate usage includes adhering to the operating instructions and, in particular, also the carrying out of inspection and maintenance measures. Functional faults, in particular, those which affect the safety of the device, must be corrected immediately.

### RESIDUAL HAZARDS OF THE PRODUCT

- Even during appropriate usage it is possible, in the case of a fault or incorrect operation, that the following situations occur:
    - Regulation at one or more phases drops out,
    - Disconnection of the photovoltaic network from the power supply company network
- It cannot be ruled out that other loads may show abnormalities in behavior when the Thyrobox VR is being operated. Please take into consideration the physically induced network feedback.

### HAZARD OF ELECTRIC SHOCKS

Even with non-activated thyristors the input and output network of the Thyrobox VR are electrically interconnected. Even after the separation from the mains, capacitors can still contain dangerously high levels of energy.

### INCORRECT OPERATIONS AND THEIR SEQUENCES

In the case of incorrect operations, higher power, voltages or currents than intended can reach the Thyrobox VR or the load. This can cause damage to the Thyrobox VR or the load. In particular, factory-set parameters may not be altered in such a way that the Thyrobox VR is overloaded.

### TRANSPORT

The Thyrobox VR may only be transported upright in the original packaging (protection against damage e.g. from the elements, bangs, knocks, contamination).

### ASSEMBLY

The Thyrobox VR requires installation in an upright position.

## CONNECTION

Before connection of the Thyrobox VR, the indicated voltage on the type plate is to be compared with the mains voltage to make sure they match.

- The electric connection is to be made using the required cross-section in accordance with the device type details; connection using cable lugs.

## COMMISSIONING

Before commissioning the Thyrobox VR needs to be absolutely dry (particularly, without moisture and condensation).

## OPERATION

The Thyrobox VR may only be placed under mains voltage if endangering people and the assembly, particularly in the area of the input and output network, can be ruled out.

In operation

- protect the device against dust and damp.
- ensure that the ventilation openings are not blocked.

## MAINTENANCE, SERVICE, FAULTS

The symbols used in the following are explained in *chapter 4 "Safety"*.



### CAUTION

In the case of smoke or smell development, as well as in the case of fire, the Thyrobox VR shall immediately be disconnected from the power supply.



### CAUTION

For maintenance and repair works the Thyrobox VR must be disconnected from all external voltage sources (by means of a cable distribution cabinet) and safeguarded against it being switched on again.

After switching off the Thyrobox VR it is necessary to

- wait at least 1 minute for the snubber capacitors to discharge.
- ascertain the absence of voltage using appropriate measurement instruments on the part of the utility (EVU) and on the part of the PV system:
  - $L1_{EVU}$ ,  $L2_{EVU}$ ,  $L3_{EVU}$  against PEN, and
  - $L1_{PV}$ ,  $L2_{PV}$ ,  $L3_{PV}$  against PEN.

These activities may only be carried out by an electrically qualified person. The local electro-technical regulations are to be adhered to.



### CAUTION

The Thyrobox VR contains voltages which are hazardous. Repairs are strictly only to be carried out by qualified and trained maintenance personnel.



### ATTENTION

For safety reasons repairs to power components are to be carried out by AEG Power Solutions GmbH.

## 2.1 NON-LIABILITY

No liability is burdened for non-intended use of the device. The owner, operator or user, respectively, shall burden the responsibility.

Every other usage of the Thyrobox VR than its appropriate usage is negligent and can endanger people. In the case of negligent usage any type of liability on the part of the manufacturer ceases to apply. The risks of negligent usage lie solely with the owner, operator or user of the device.

## 2.2 LOSS OF WARRANTY

Our supplies and services are subject to the general conditions of supply for products of the electrical industry, as well as our general sales conditions. Claims in connection with supplied goods must be submitted within eight days upon receipt, along with the packing slip. Claims made later cannot receive consideration. AEG PS will rescind all possible obligations such as warranty agreements, service contracts, etc. entered into by AEG PS or its distributors without prior notice if maintenance and repair work is carried out using anything other than original AEG PS spare parts or spare parts purchased from AEG PS.

In case of complaints, please contact us immediately and include the following information:

- type designation
- fabrication number
- complaint description
- duration in operations
- ambient conditions
- mode of operation

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### 3.2 ABBREVIATIONS

AEG PS	AEG Power Solutions GmbH
Thyrobox VR	Power supply for voltage regulation in low voltage networks
Thyro-P	Power controller from the Thyro-Family
Thyro-Tool Family	Software tool for efficient implementation and on site visualization for power controllers of the Thyro-Family using a laptop
LBA-2	Local operating unit with touch display and optional integrated Bluetooth functionality.
VSC	Voltage Sequence Control



## 4. SAFETY

### 4.1 DEPLOYED SYMBOLS

The following warning, prohibition, command and notice symbols are deployed in these operating instructions, around and within the Thyrobox, and in the immediate vicinity:



#### **WARNING ABOUT A HAZARD AREA – DANGER!**

This warning notice refers to an endangering situation. Upon non-compliance, death or major injuries may occur.



#### **WARNING ABOUT HAZARDOUS ELECTRICAL VOLTAGE – DANGER!**

This warning notice refers to an especially endangering situation. Upon non-compliance, death or major injuries may occur due to electric shock. Please adhere to the described work and process procedures exactly, in order to avoid damage to people or to the device.



#### **WARNING ABOUT ELECTROMAGNETIC FIELD!**

Electrical devices, clocks, magnetic storage cards etc. may malfunction or be uncharged.



#### **WARNING ABOUT HOT SURFACES!**

Danger of burning. Prevent touching or wear protection clothes.



#### **FIRE DANGER!**

Smoking or open fire is forbidden.



#### **ACCESS FOR UNAUTHORIZED IS FORBIDDEN!**



#### **ACCESS FOR PERSONS USING A CARDIAC PACEMAKER IS FORBIDDEN!**



#### **ACCESS FOR PERSONS USING METAL IMPLANTS IS FORBIDDEN!**



#### **WEAR SAFETY SHOES!**



#### **INFORMATION, NOTE**

Notes regarding technical requirements and additional information are provided here, which the user shall observe.

## 4.2 SAFETY INSTRUCTIONS

### 4.2.1 ACCIDENT PREVENTION REGULATIONS

Please unconditionally observe the accident prevention regulations of your country and the generally valid safety instructions.

**The following 5 safety rules must be strictly complied with, prior to the beginning of all work performed to the Thyrobox VR and the device:**



- Disconnect the device from the power supply (establish a voltage free status)
- Secure against re-activation
- Verify by measurement that there is no voltage present
- Ground and short-circuit equipment
- Cover or shield adjacent parts which are under voltage

### 4.2.2 GENERAL SAFETY NOTES



The device is designed in accordance with state-of-art technology and accepted technical safety rules. In spite of this, in the course of its use may unfold

- dangers for the user or third parties, as well as
- impairments to the device and other assets.



Poor knowledge about operations and maintenance may create damage to persons or assets. Operations and maintenance within the set rule boundaries, as well as compliance with the following listed safety instructions, are necessary for the protection of personnel and for the conservation of operational readiness.



Personnel, who assemble, dis-assemble, start-up, operate, maintain and repair the devices, must know and observe these safety instructions.

All work may only be performed by expert personnel trained for the task assigned using those tools, fixtures, inspection means and materials for consumption as designed for.



Please observe all legal or otherwise committing regulations for accident prevention and environmental protection.

Prior to task start-up, personnel assigned for tasks to the device must have read the general and special safety notes, and have sufficiently become acquainted with the operations of the device.



Please observe all safety and danger notes compiled on the device!

All safety and danger notes compiled on the device shall be held in full number and in a readable status.



No changes, assemblies, and re-fittings, which impact the safety of the device, are allowed to be performed to the device without approval of the manufacturer.



Please secure that only personnel, who are accordingly assigned for work on the device, are deployed. Third parties shall be held away from the devices, and also be pointed to the possible dangers.

Work performed to electrical installations of the device may only be performed by an expert electrical technician or by vocationally trained persons under the management and supervision of an expert electrical technician in accordance with the technical electrical regulations.



In normal operation the device must always be closed.



For all maintenance and repair work, the device must be completely de-activated and secured against unintended re-activation in accordance with the 5 safety rules.

Existing safety switches are not permitted to be by-passed, de-activated, or be manipulated in any manner within any operational mode of the device whatsoever!



Only AEG PS original spare parts or original spare parts purchased from AEG PS may be used for maintenance or repair.



Personnel must always wear safety shoes during repair and maintenance work.



Only physically and psychologically healthy staff members are allowed to work on the device. Personnel under the influence of impairing medication or under the influence of alcohol are not permitted to work on the device.



#### 4.2.3 SPECIAL SAFETY NOTES

Coming into contact with the hinge side of the doors can lead to finger injuries!



Protective casings for guarding against hazardous areas may only be removed when the device is switched off and is protected from unauthorized switching on in accordance with the 5 safety regulations. Accessing voltage carrying components within the assembly is prevented by covers made of acrylic glass. They may not be removed during operation.



The owner is obligated, for the safe and responsible operation of this device, to apply further safety notices to adhere to country-specific guidelines. The safety symbol shown on the left next to the text is mounted on the device by the manufacturer.



#### 4.2.4 FIRE PROTECTION

Smoking or open fire is forbidden.

In the case of smoke or smell development, as well as in case of fire, the device shall immediately be switched free of voltage, and a report shall be made to maintenance personnel.



#### 4.2.5 QUALIFIED PERSONNEL

The device may only be transported, be assembled, be connected, be started up, be maintained, and be operated by expert staff members who master the respectively valid safety and assembly regulations.

Safety instructions shall unconditionally be complied with!

All work performed shall be controlled by responsible expert personnel.

The duly responsible manager for device safety with regard to the necessary tasks envisioned must authorize expert personnel. Expert personnel are those staff members, who

- possess the vocational training and experience within the according work area,
- are knowledgeable about the respectively valid legal regulations (laws and codes), standards, rules, instructions, and accident prevention rules,
- are vocationally trained as to the functional features and operational conditions of the device,
- are capable of recognizing dangers and implementing measures in order to prevent dangers.

Regulations and definitions regarding expert personnel are contained within DIN EN 50110-1:2004 (DIN EN 50110-1:2004 substitutes DIN 57105-1 and DIN VDE 0105 part 1).

#### 4.2.6 SAFETY-CONSCIOUS WORKING

Qualified personnel are responsible for safety. These personnel are also responsible that only accordingly qualified persons are located at the device or within the operating room.



Refrain from any kind of working behavior, which impacts the safety of persons and the function of the device in any form.

Operate the device only in a proper condition.

No safety fixtures are allowed to be dis-assembled or be put out of function.

Operationally contingent measures shall be implemented prior to the removal of safety fixtures for the execution of maintenance and service, or other work tasks.

Always work in compliance with the 5 electrotechnical safety rules!



Safety conscious working means drawing colleagues' attention to inappropriate behavior if they are acting incorrectly or unsuitably, and reporting any deficiencies to the relevant institution or person for the purpose of improving safety and accident prevention.

## 5. SCOPE OF SUPPLY

The supply of the Thyrobox VR consists of the following parts:

- Thyrobox VR
- Operating instructions Thyrobox VR
- Operating instructions Thyro-P
- PC software Thyro-Tool Family, material no. 2.000.000.380
- Data cable 9-pole (PC ↔ Thyro-P controller unit), material no. 0048764
- Adapter cable (USB1.1 ↔ RS232), material no. 8.000.019.086

as well as

- Concrete pedestal Rittal CS 9765.089 H=1000 on pallet, consisting of
  - 1 base plate
  - 2 side parts
  - 2 divided pedestal plates
  - Assembly material and screws (for securing the Thyrobox VR on the concrete pedestal)

## 6. TRANSPORT

The Thyrovox VR was fixed to a transport pallet with four screws at the factory ready for transport and packaged in foil to protect against moisture and paint damage.

To prepare for transport at the installation site remove the packaging and the transport pallet from the Thyrobox VR.

### 6.1 TRANSPORT WITH CRANE OR HOIST

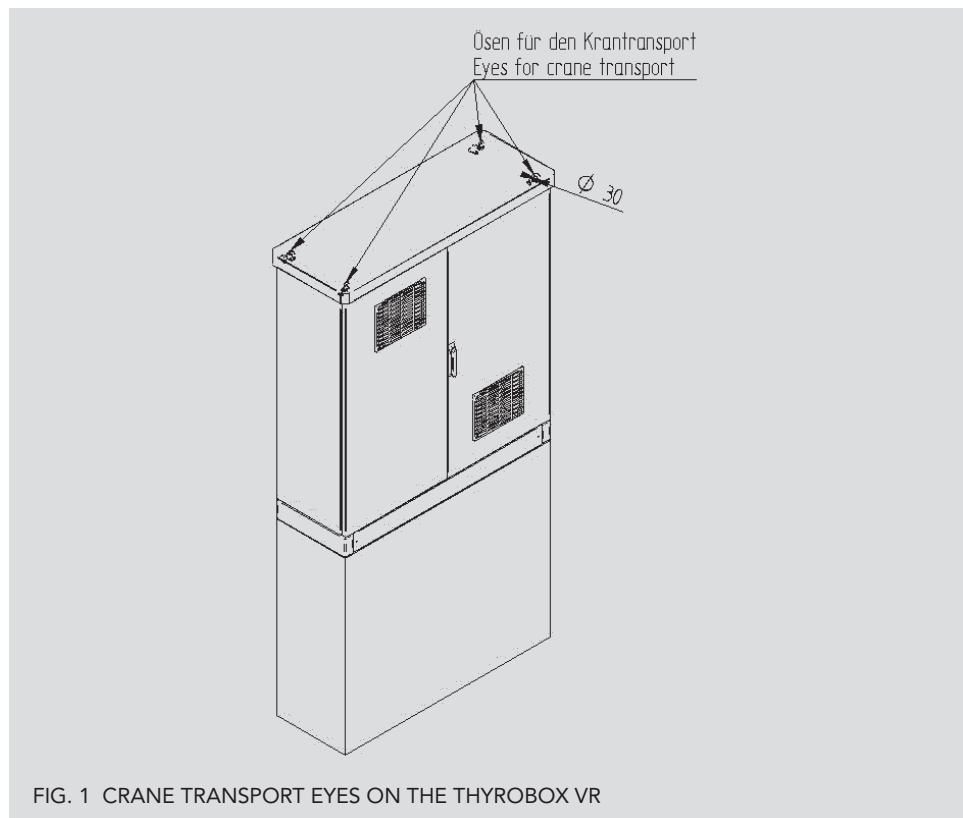


FIG. 1 CRANE TRANSPORT EYES ON THE THYROBOX VR

After removing the packaging the Thyrobox VR and the concrete pedestal can be transported to the set-up site.



#### **DO NOT WALK UNDER SUSPENDED LOADS!**

Wear personal protective gear (helmet, safety shoes, working gloves)!

Always carry out the transport with the necessary caution, adhering to the safety requirements!



#### **ONLY TRANSPORT DEVICE IN UPRIGHT POSITION!**

Do not tip or tilt! Avoid shifting the center of gravity!

The device may not be hoisted by its construction parts!



Measure the length of the slinging gear (cable, chain or straps) so that there is an angle of more than 45° between the slinging gear and the upper side of the device (DIN 580).

Use separate slinging gear for each transport eye, so 4 sets of slinging gear in total.

**PROCEDURE FOR TRANSPORT WITH THE CRANE/HOIST:**

- Open the cabinet doors of the Thyrobox VR.
- After releasing two, concealed front mounted screws (Fig. 10) at the top of the cabinet frame the roof cover can be removed. Carefully lay the roof cover to one side. On the upper side at the corners of the frame are four eyes for inserting slinging gear into (Fig. 1).
- Close cabinet doors.
- Insert the four sets of slinging gear.
- Carefully hoist the cabinet and lift to the set-up site.
- Carefully lower the cabinet, without banging it, and fix into place.
- Remove slinging gear, replace roof cover and secure with the two screws

**6.2 TRANSPORT WITH ELEVATING TRUCK OR FORK LIFT**

Before transporting with fork lift, elevating truck or crane make sure that the transport devices are set up for the load in question (for weight see technical data).

Procedure for transport with elevating truck or fork lift:

- Drive the prongs under the device.
- Carefully lift the device and transport to the set-up site.
- Carefully lower the device without banging it.
- Withdraw the fork lift or elevating truck.

## 7. STORAGE

The devices in original packaging may be stored in dry, aerated rooms with a solid protective roof for a maximum of six months.

- permissible storage temperature: –25 °C to 70 °C
- permissible relative air humidity: max. 85%

## 8. ASSEMBLY OF CONCRETE PEDESTAL AND THYROBOX VR

Procedure for the assembly of the Thyrobox VR:

- For setting up the Thyrobox VR a suitable open air site is to be used. Amongst other things, in accordance with country- specific or regional guidelines the area for set up must be horizontal and even.
- Lower the concrete pedestal 700 mm deep into the ground and then backfill.
- The load capacity of the ground must be sufficient for the weight of the Thyrobox VR.
- Guide power cables in through the concrete pedestal from below and then backfill the concrete pedestal.
- Mount the Thyrobox VR on the concrete pedestal and screw into place (assembly material and fixing screws are included in scope of supply).
- Check the entry points of the power cables into the box when assembling and, if necessary, seal them.



### NOTE

The Thyrobox VR is to be protected from moisture getting into it (e.g. rain) – even if working with open doors – during set up.

## 9. FUNCTIONAL DESCRIPTION

### 9.1 GENERAL DESCRIPTION

The Thyrobox VR is a component which can be used as a voltage regulator at the feed point when feeding renewable energies (e.g. systems for photovoltaic, combined heat and power, wind energy) into low voltage networks.

The Thyrobox VR permanently measures the direction of energy flow in the network. In the case of energy flow from the power supply company side in the direction of the PV side the device is in standby mode, which means that the Thyrobox VR does not kick in. If the direction of energy flow alters e.g. through feeding from a PV system into the power supply company network, then, from a configurable current value (default value = 10% of the nominal current), the Thyrobox VR activates the voltage regulation and regulates the PV side continuously at the pre-configured voltage setpoint. The voltage adjusting range is then 0 to -18 V each phase. As such, potential excessive voltage increases at the renewable energies feed point can be regulated down to the nominal value of, for example, 230 V AC Y/400 V ACΔ with the Thyrobox VR (on this subject see *Chapter 16 Technical data*).

The Thyrobox VR 125 kVA is set up for throughput powers of up to 125 kVA.

The Thyrobox VR 250 kVA is set up for throughput powers of up to 250 kVA.

The Thyrobox VR must be planned for usage as part of the project planning. In particular, the Thyrobox VR must only be operated in conjunction with a suitable upstream and downstream network breaker.



#### NOTE

If the current in the Thyrobox VR becomes capacitive (leading current) through other loads which are in the network then the Thyrobox VR deactivates the voltage regulation as long as the  $\cos \varphi$  is below 0,9 capacitive. To avoid unwanted shut down of the regulation by capacitive current, it is recommended to configure the feeding PV inverters to inductive (lagging) current of  $\cos \varphi$  up to 0,9.

The Thyrobox VR works automatically with contactless graduated regulation. To minimize circuit feedback the Thyrobox VR uses tried and tested VSC technology. High quality power semiconductors are used.

### 9.2 KEY COMPONENTS

The key components of the Thyrobox VR are (on this subject see also *Chapter 9.3 Thyrobox VR illustrations*):

- Power supply company side power connection for a 4-pole cable with cross-sections up to 150 mm<sup>2</sup>, feed from below. (Fig. 2, Fig. 3)
- PV system side power connection for 4-pole cable with cross-sections up to 150 mm<sup>2</sup>, feed from below. (Fig. 2, Fig. 3)
- Fuse load switch F1
- 3 Thyro-P control devices for VSC voltage regulation, activation of the power semiconductors, current and voltage capture as well as monitoring. (Fig. 7)
- 4 thyristor stacks
- 3 low voltage transformers
- Lightning current and surge arresters, F2 (Fig. 5)
- Automatic circuit breakers F3-F5 for control voltage (Fig. 6)
- Automatic circuit breakers F6 for plug socket (Fig. 6)
- Control voltage supply from the connected network
- Temperature monitoring of the Thyrobox VR with PT 1000 (Fig. 9) in conjunction with control device Thyro-P.
- 2 level temperature monitoring of the transformers.
- 1 front fan in the cabinet door (Fig. 8), whether the fan is switched on depends on the temperature.



### 9.3 Thyrobox VR ILLUSTRATIONS

Below are depictions of several of the components to make things clearer. The components depicted are examples and may, in some circumstances, differ in appearance.

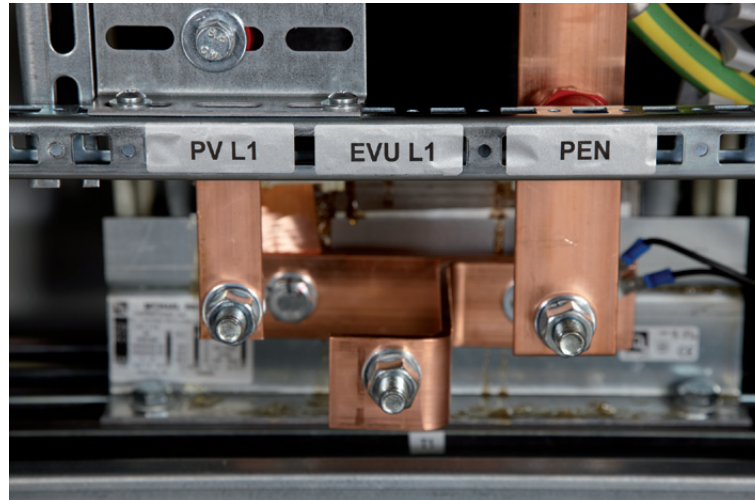


FIG. 2 CONNECTIONS FOR POWER CABLES

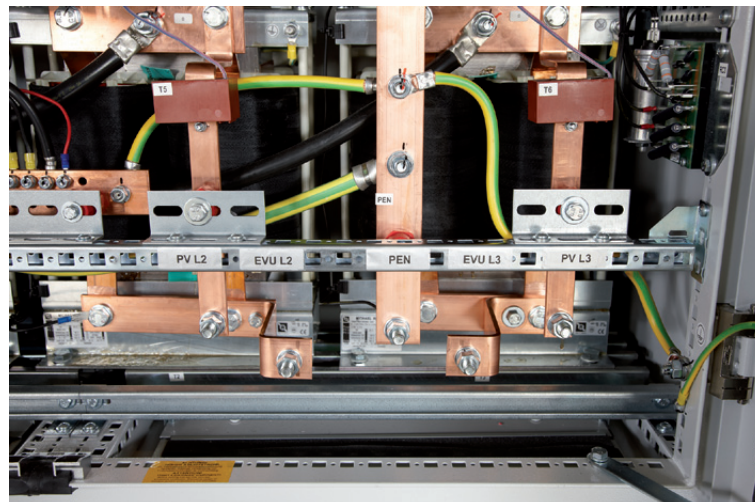


FIG. 3 CONNECTIONS FOR POWER CABLES



FIG. 4 FUSE LOAD SWITCH F1



FIG. 5 LIGHTNING CURRENT AND SURGE ARRESTER

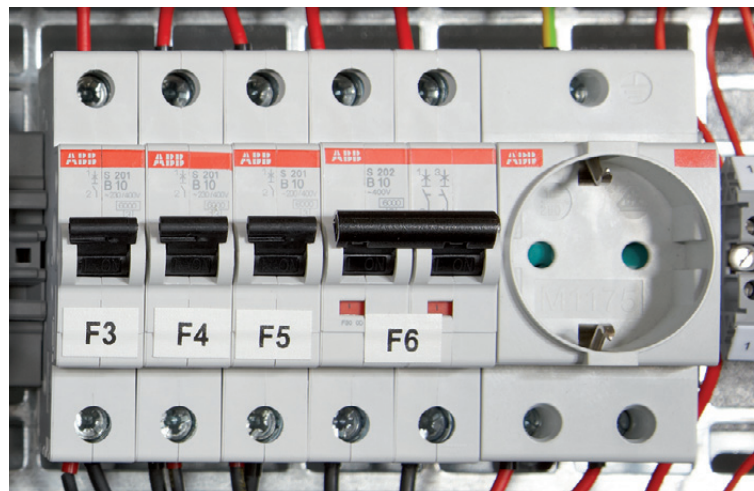


FIG. 6 AUTOMATIC CIRCUIT BREAKERS F3-F6 FOR CONTROL VOLTAGE



FIG. 7 CONTROL DEVICES THYRO-P A11, A21, A31



FIG. 8 FRONT FAN IN SWITCH CABINET DOOR

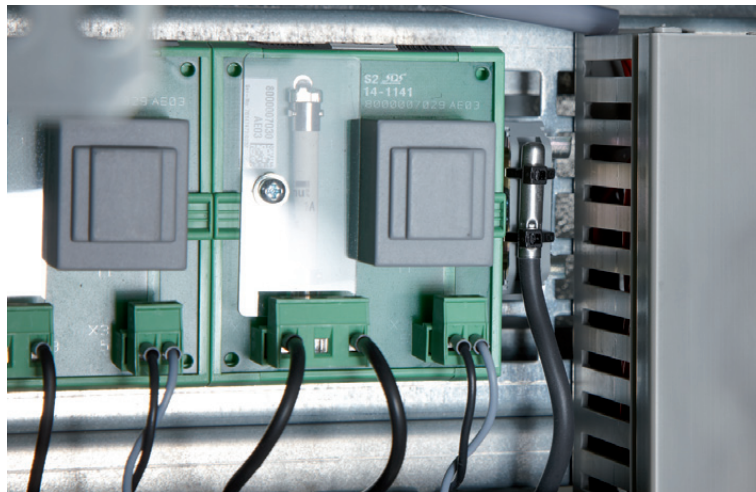


FIG. 9 TEMPERATURE MONITORING OF THE Thyrobox VR WITH PT1000

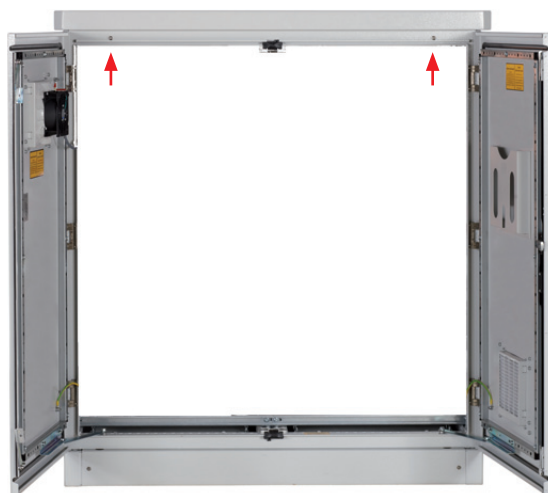
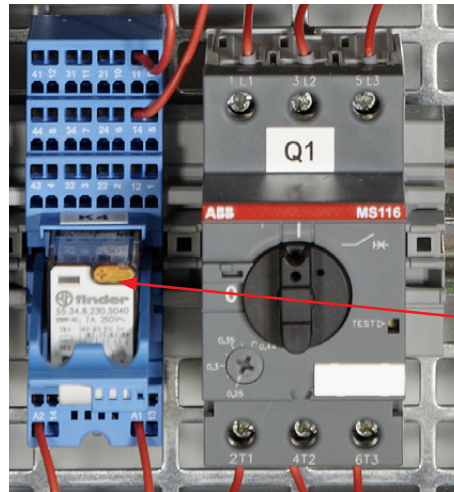


FIG. 10 CONCEALED FRONT MOUNTED SCREWS





fan test by  
manual operation of K4

FIG. 11 RELAY K4

#### 9.4 GENERAL (PURPOSE)

Voltage regulation in local networks – also see *Chapter 1: General Description*

#### 9.5 ON SITE POWER SUPPLY OF THE Thyrobox VR

For the on site power supply of the Thyrobox VR (for activation, measurement, regulation, for monitoring and internal notifications) the Thyrobox VR takes its auxiliary supply directly from the local network; 3/PEN, 230 VAC, 10 A.

For service purposes a Euro plug socket (X20) with 10 A fuse is installed in addition which makes 230 VAC available.

#### 9.6 SWITCHING ON AND OFF

Switching the Thyrobox VR on takes place under adherence to and in accordance with the information in *Chapter 11, Commissioning*. For switching off the necessary information is contained in *Chapter 13, Decommissioning*. Switching the Thyrobox VR on and off via remote control is not possible with the standard set-up.

#### 9.7 TEMPERATURE MONITORING

Cabinet:

- Temperature capture system with a sensor PT1000 built into the interior of the cabinet captures the interior temperature of the Thyrobox VR and activates the front fan via the Thyro-P control device A11.

Transformer:

To protect the transformers, temperature sensors are built in. There are two activation thresholds:

- at first threshold (CT1.1, CT2.1, CT3.1) a relay switches the front fan on.
- at second threshold (CT1.2, CT2.2, CT3.2) the sensor switches the input of the relevant Thyro-P control device, which then sets the regulator stop of the phase in question and deactivates the regulation of this phase (current flow is retained in this phase, however, without voltage regulation).

#### 9.8 SAFETY DEVICES

##### 9.8.1 LIGHTNING CURRENT AND SURGE ARRESTER

The integrated lightning current and surge arrester (F2) serves to discharge overvoltages and over-currents.

##### 9.8.2 TRANSFORMER PROTECTION

Surge and attenuation elements are in place to protect the transformers.

## 10. ELECTRICAL INSTALLATION

### 10.1 SAFETY NOTES

**Before starting any work on the system the 5 safety rules must be adhered to (see also *Chapter on Safety instructions*).**

- If required regionally specific warning and restriction symbols must be mounted on the Thyrobox VR in addition by the operator.

### 10.2 REQUIREMENTS FOR ELECTRICAL INSTALLATION

The electrical installation refers to the following illustrations:

*Fig. 12 Block diagram Thyrobox VR and cable distribution cabinet,*

*Fig. 13 Cable connecting terminals in the Thyrobox VR 125 kVA,*

*Fig. 14 Cable connecting terminals in the Thyrobox VR 250 kVA.*

**The following technical requirements must be available in the operating area:**

- A suitable cable distribution cabinet is available and functional as an upstream and downstream mains circuit breaker with corresponding fuses to the cable protection. The electrical connections are to be made according to the illustrations in the block diagram.

#### **Valid for Thyrobox VR 125 kVA:**

- 4 wire local network connection cable (utility (EVU) side connection) set up for 3 x 181 A, 3/PEN, 400 V  $\Delta$ , 50 Hz. The cable must be separated from the utility (EVU) side of the network using the cable distribution cabinet
- 4 wire local network connection cable (PV system side connection) set up for 3 x 181 A, 3/PEN, 400 V  $\Delta$ , 50 Hz. The cable must be separated from the PV system side of the network using the cable distribution cabinet.

#### **Valid for Thyrobox VR 250 kVA:**

- 4 wire local network connection cable (utility (EVU) side connection) set up for 3 x 362 A, 3/PEN, 400 V  $\Delta$ , 50 Hz. The cable must be separated from the utility (EVU) side of the network using the cable distribution cabinet
- 4 wire local network connection cable (PV system side connection) set up for 3 x 362 A, 3/PEN, 400 V  $\Delta$ , 50 Hz. The cable must be separated from the PV system side of the network using the cable distribution cabinet.
- An appropriate and suitable ground connection is required, which is to be connected to the PEN bus bar of the cable distribution cabinet.
- The cables are attached to the cable mounting rails and hooked onto the Cu bus bars
- Contact surfaces of the Cu bus bars must be clean and must not display any deformities.

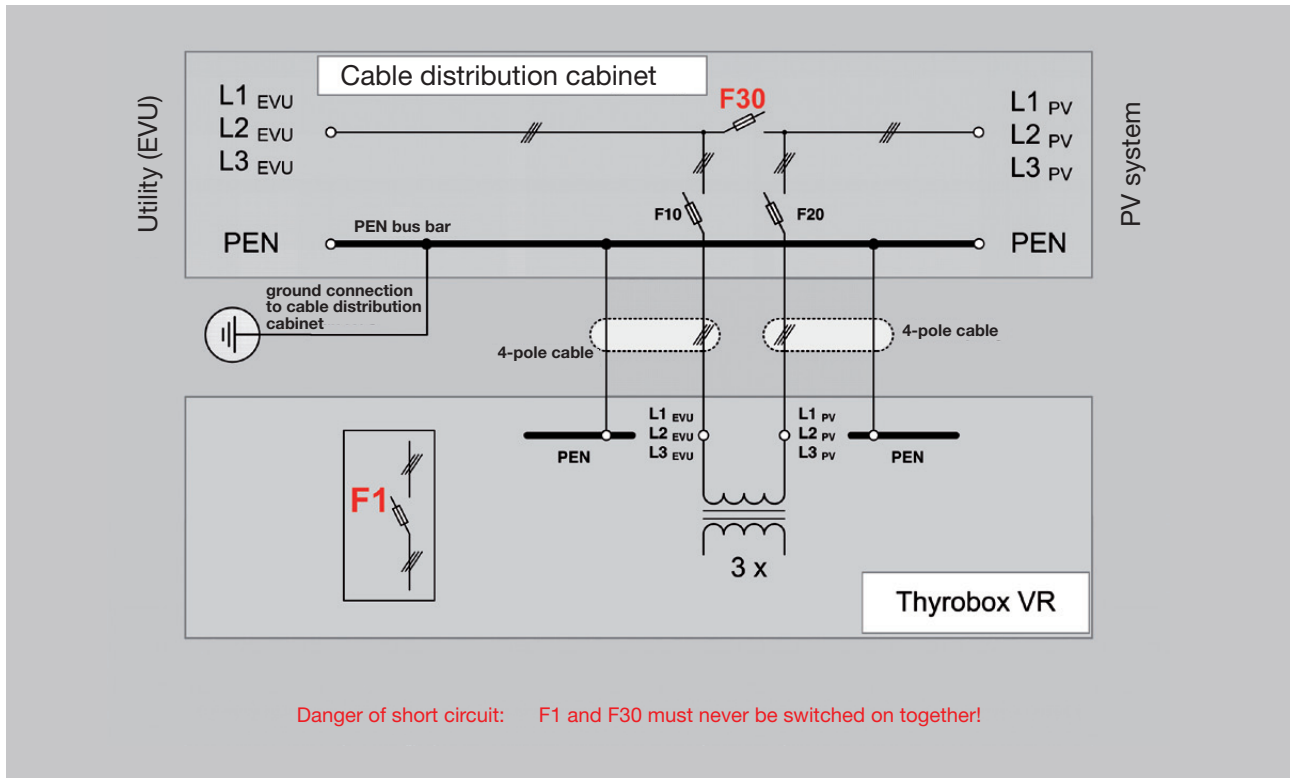


FIG. 12 BLOCK DIAGRAM Thyrobox VR AND CABLE DISTRIBUTION CABINET

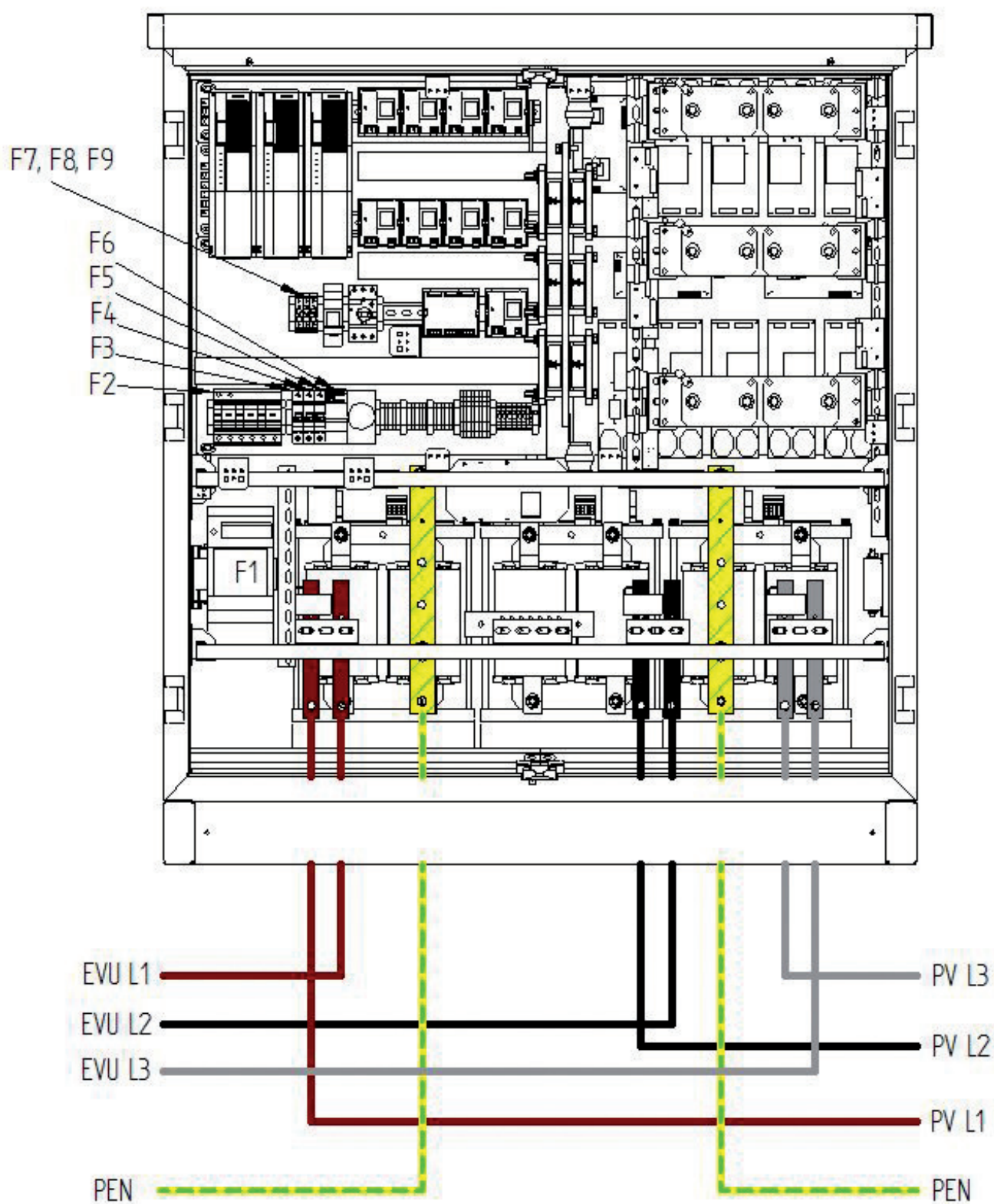


FIG. 13 CABLE CONNECTING TERMINALS IN THE THYROBOX VR 125 KVA

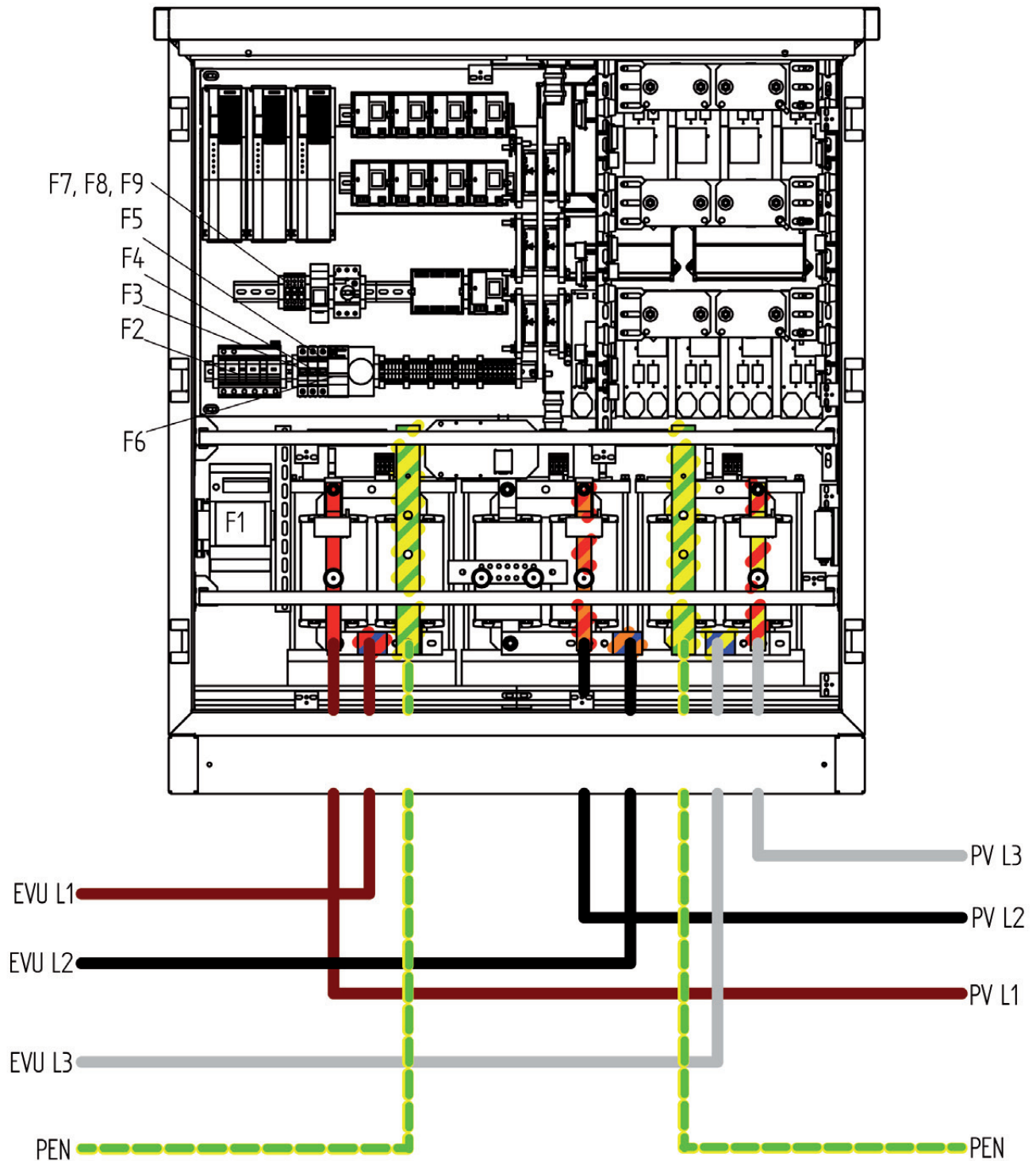


FIG. 14 CABLE CONNECTING TERMINALS IN THE THYROBOX VR 250 KVA



## 11. COMMISSIONING

Following the technically correct installation of the Thyrobox VR commissioning takes place. The following steps apply for commissioning and initial start-up at the installation site.



### WARNING ABOUT HAZARDOUS ELECTRICAL VOLTAGE – DANGER!

Accessing voltage carrying components within the device is prevented by transparent window coverings. They must not be removed during operation.

Only switch the Thyrobox VR or the local network on when you have ensured that voltage carrying components cannot be touched.

### 11.1 SEQUENCE OF COMMISSIONING

Commissioning is the switching on and „starting up“ of the Thyrobox VR following installation at the set-up site.

For the on-site commissioning ensure all units relevant to the functionality are operating flawlessly:

- the operator's safety devices
- loads or sources at the network stage

The commissioning of the Thyrobox VR refers to:

*Fig. 12 Block diagram ThyroboxVR and cable distribution cabinet:*



### ATTENTION

#### DANGER OF SHORT CIRCUIT

F30 in the cable distribution cabinet and F1 in the Thyrobox VR must **not** be closed simultaneously, otherwise there is a short circuit.



### ATTENTION

Danger of short circuit when not adhering to the sequence of the following steps.



### ATTENTION

Danger of power failure (PV side) through tripping fuses F30 when not adhering to the switching sequence.

The commissioning of the Thyrobox VR is carried out with the following steps one after the other:

Initial situation:

In the cable distribution cabinet the following switching positions are configured (if this is not the case, then these switching positions are to be configured in the sequence from 1 to 4):

- |                                |                            |
|--------------------------------|----------------------------|
| 1. F10 is open                 | cable distribution cabinet |
| 2. F20 is open                 | cable distribution cabinet |
| 3. Fuse load switch F1 is open | ThyroboxVR                 |
| 4. F30 is closed               | cable distribution cabinet |



### NOTE

If the configuration of the initial situation is not in place, then this must be carried out taking note of the previous cautionary notes.

### Status of the Thyrobox:

With the previous configuration (no. 1 – 4) the Thyrobox VR is not in operation, it is free of voltage and bridged.

With this configuration (initial situation) the 6 following switch actions are now to be carried out in the sequence indicated:

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1. Switch on Q1                     | ThyroboxVR                 |
| 2. Switch on F3, F4, F5, F6         | ThyroboxVR                 |
| 3. Open fuse load switch F1(125A)   | ThyroboxVR                 |
| 4. Close F10 and F20                | cable distribution cabinet |
| 5. Open F30                         | cable distribution cabinet |
| 6. Close fuse load switch F1 (125A) | ThyroboxVR                 |

#### Status of the Thyrobox:

With the previous configuration the Thyrobox VR is in operation and kicks in actively with the voltage regulation.

On all Thyro-P control devices the frontal LEDs must be in the following condition:

LED	Meaning
ON	Control voltage supply is OK
CONTROL	Flashing or permanently lit: Voltage regulation active (only in the case of sufficient energy being fed in from the PV side, circa 10% of nominal current). Current can be depicted on one up to three optional local display units (LBA-2) that can be retrofitted very easily. Remark LBA-2 Local Display Unit incl. TouchDisplay and SD memory card (order no. 2.000.000.408 )
LIMIT	„dark“
PULSE LOCK	„dark“
FAULT	„dark“

If all the LEDs of the 3 Thyro-P control devices are in this condition, then, according to the previous switching actions, the Thyrobox VR has been successfully put into operation.

## 12. OPERATION

After commissioning or switching on the Thyrobox VR does not require any further operational handling.



### NOTE

If required the setpoint for the voltage to be regulated can be configured for each phase – however, this is not normally required. For this requirement the PC software Thyro-Tool Family, which is supplied as part of the package, is needed as well as a data cable (9-pole) and possibly the adapter cable for the implementation of USB 1.1 ↔ RS 232 (also included in the scope of supply).

To avoid operational errors, parameter and/or setpoint alterations are only to be made by trained personnel.

Alternatively there is the option of contacting the support service of AEG Power Solutions.

### 12.1 OPERATING WITH Thyro-Tool Family SOFTWARE

Before configuring the voltage setpoint the Thyro-Tool Family software provided must be installed along with the driver for the USB → RS232 adapter (if needed).

Alter voltage setpoint:

1. Insert the data cable into the frontal RS232 terminal of the Thyro-P control device. This can take place whilst the device is running.

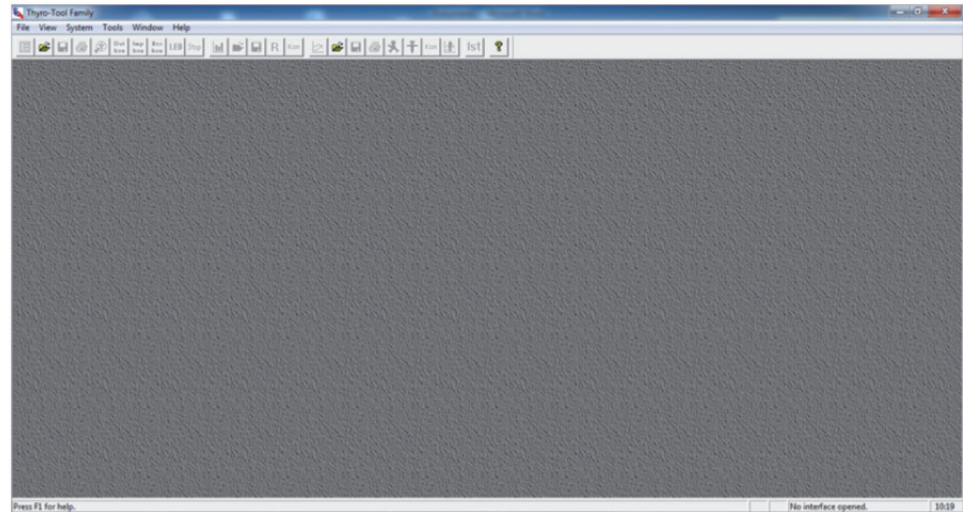


2. Connect the data cable with the PC/laptop. If no RS232 interface is available on the PC, use the adapter USB → RS232 supplied in the package (install driver for USB adapter).

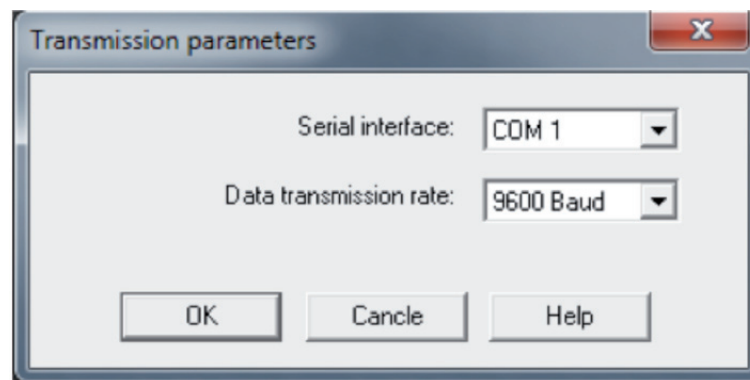
3. Start Thyro-Tool Family software



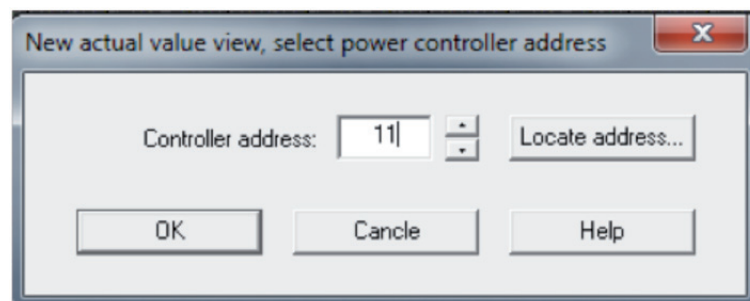
The start window of the Thyro-Tool software appears:



4. Under the menu entry **extras** → **transmission parameters**, select the serial COM interface to which the data cable is connected:



5. For the transmission speed the value 9600 Baud must be configured! Confirm the input with the "OK".
6. Using the "IST" (actual) button you can open the actual value view. Here, at the start, you need to enter the address of the control device/controller. The addresses of the control devices are for A11 = address 11, for A21 = address 21 and for A31 = address 31.



7. After inputting the controller address and pressing "OK" the actual value view opens.

In the actual value view the current actual values of each phase can be seen.

Here, the key actual values:

voltage load U\_L1 = voltage  $U_{L1PV}$

voltage mains U\_L1 = voltage  $U_{L1EVU}$

current I\_L1 = current L1

Motorpoti = voltage setpoint of the regulation

Actual value view - 1P 230V-300A HF

Address: 11 Locate address... OK

Voltage Load U_L1 [V] 230.0	U_L2 [V] 0.0	U_L3 [V] 0.0	Voltage Mains Un_L1 [V] 236	Un_L2 [V] Static	Un_L3 [V] Static
Current I_L1 [A] 39.9	I_L2 [A] 0.0	I_L3 [A] 0.0	Load G_L1 [mS] 173.4	G_L2 [mS] 0.0	G_L3 [mS] 0.0
Power P_L1 [kW] 9.109	P_L2 [kW] 0.000	P_L3 [kW] 0.000	P_ges [kW] 9.109	Miscellaneous Rotating field T Static	Heat sink 24.9
Energy E_ges [kWh] 1079.280	Operating hour t [h] 114.62	Relay status K1 K2 K3	Frequency f [Hz] 49.97		
Setpoints Master Static	Terminal 10 0.00 %	Terminal 11 0.00 %	Motorpoti 230.0 V	Total 230.0 V	Control Alpha 126.53

8. Under the entry motor potentiometer (Motorpoti) the voltage setpoint of the control device can now be altered.

Actual value view - 1P 230V-300A HF

Address: 11 Locate address... OK

Voltage Load U_L1 [V] 230.0	U_L2 [V] 0.0	U_L3 [V] 0.0	Voltage Mains Un_L1 [V] 236	Un_L2 [V] Static	Un_L3 [V] Static
Current I_L1 [A] 40.2	I_L2 [A] 0.0	I_L3 [A] 0.0	Load G_L1 [mS] 174.7	G_L2 [mS] 0.0	G_L3 [mS] 0.0
Power P_L1 [kW] 9.148	P_L2 [kW] 0.000	P_L3 [kW] 0.000	P_ges [kW] 9.148	Miscellaneous Rotating field T Static	Heat sink 24.9
Energy E_ges [kWh] 1079.374	Operating hour t [h] 114.63	Relay status K1 K2 K3	Frequency f [Hz] 49.97		
Setpoints Master Static	Terminal 10 0.01 %	Terminal 11 0.00 %	Motorpoti 230	Total 230.0 V	Control Alpha 126.05

9. To do this click in the Motorpoti field and alter the voltage setpoint and confirm with **enter**.

The new setpoint is now displayed in the Motorpoti field. The output voltage of the Thyrobox VR is displayed in the field "Voltage Load U\_L1". Here you can check if the device is regulating the newly inputted setpoint.

Actual value view - 1P 230V-300A HF

Address: 11 Locate address... OK

Voltage Load			Voltage Mains		
U_L1 [V]	U_L2 [V]	U_L3 [V]	Un_L1 [V]	Un_L2 [V]	Un_L3 [V]
225.1	0.0	0.0	236	Static	Static

Current			Load		
I_L1 [A]	I_L2 [A]	I_L3 [A]	G_L1 [mS]	G_L2 [mS]	G_L3 [mS]
44.2	0.0	0.0	196.3	0.0	0.0

Power				Miscellaneous	
P_L1 [kW]	P_L2 [kW]	P_L3 [kW]	P_ges [kW]	Rotating field	T_Heat sink
9.849	0.000	0.000	9.849	Static	24.9

Energy	Operating hour	Relay status	Frequency
E_ges [kWh]	t [h]	<input type="radio"/> K1 <input type="radio"/> K2 <input checked="" type="radio"/> K3	f [Hz]
1079.473	114.63		49.99

Setpoints					Control
Master	Terminal 10	Terminal 11	Motorpoti	Total	Alpha
Static	0.01 %	0.01 %	225.0 V	225.0 V	57.37

With this configuration the voltage setpoint for a phase is configured. If required the other two phases can also be configured.

Regarding phases and control device the following allocation applies

Control device A11	L1
Control device A21	L2
Control device A31	L3

## 13. DECOMMISSIONING

If the Thyrobox VR is only to be temporarily shut down then the following steps are necessary for decommissioning.

The decommissioning of the Thyrobox VR refers to *fig. 12 Block diagram Thyrobox VR and Cable Distribution Cabinet*.

### 13.1 SEQUENCE OF DECOMMISSIONING



#### ATTENTION

Danger of short circuit

F30 in the cable distribution cabinet and F1 in the Thyrobox VR must **not** be closed simultaneously, otherwise there is a short circuit.



#### ATTENTION

Danger of short circuit when not adhering to the sequence of the following steps.



#### ATTENTION

Danger of network fall out (PV side) through tripping fuses F30 when not adhering to the switching sequence.

For decommissioning the Thyrobox VR the following steps are required:

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1. Open fuse load switch F1 (125 A) | Thyrobox VR                |
| 2. Close F30                        | cable distribution cabinet |
| 3. Open F10 and F20                 | cable distribution cabinet |

#### Status of the Thyrobox:

The Thyrobox VR is now free of voltage and bypassed, which means voltage regulation is no longer taking place, utility (EVU) and PV side are connected directly with one another via F30 (cable distribution cabinet).

With these steps the decommissioning for the purpose of temporary (short term) shutdown is completed. If the Thyrobox VR is to be shut down for a longer period then further measures are required (see also *Chapter Storage and Chapter Disassembly*).

## 14. DISASSEMBLY



### NOTE

The prerequisite for the disassembly of the Thyrobox VR is that all steps of the decommissioning have initially been carried out.

Following this the Thyrobox VR can be disconnected from the power cables and then mechanically separated from the concrete pedestal (remove screws).

*The subsequent procedure for handling the Thyrobox VR can then be taken from the chapters Transport/Storage/Assembly according to the intended further usage (e.g. further use at a different location).*



### NOTE

Disassembly of the cable distribution cabinet, if required, is not described here as the cable distribution cabinet is not part of the package supplied by AEG Power Solutions.

### 14.1 DISASSEMBLY IN DETAIL

#### Disconnect electrical connections

- The decommissioning process described previously (*Chapter 13 Decommissioning*, page 29) must be carried out. This separates the Thyrobox VR from both networks (utility (EVU) and PV system).
- Utility (EVU) side and PV side power cables can now be disconnected.

#### Mechanical disassembly

- The electrical connections must be disconnected and free of voltage.
- Close openings to protect against contamination.
- Release and remove the anchor screws on the concrete pedestal, remove the device from the pedestal as appropriate.
- Lift with crane, elevating truck or fork lift, slide transport pallet beneath and secure.

#### Packaging

If a change of location is to take place, then the device must be repackaged. The individual components of the set-up – pedestal and device – are secured to the transport pallet with 4 screws each and packaged in foil to protect against paint damage and moisture.

#### Disposal

Legal guidelines: the disposal of the device must take place in accordance with applicable guidelines. The device does not contain any hazardous or environmentally damaging chemical substances.



## 15. MAINTENANCE

To ensure the highest level of operational safety both in terms of protecting personnel and equipment, regular monitoring, maintenance and repair works of electronic assemblies are required by law.

### 15.1 MAINTENANCE PLAN

The Thyrobox VR is to be included by the operator in the plans for maintenance management strategy with regard to monitoring, maintenance and repair measures.

### 15.2 MAINTENANCE ACTIVITIES

The following maintenance activities are required for the Thyrobox VR in accordance with the maintenance plan. If required, the necessary cleaning and/or repair works are to be carried out:

1. Check Thyrobox VR for contamination and clean as needed.
2. Check Thyrobox VR to see if any moisture has got in, particularly water, and, as needed, dry, seal, exchange and check affected components.
3. Check electrical connections are securely anchored, particularly in the case of power connections,
4. Visual check of the fuse load switch F1
5. Visual check of the lightning current and surge arrester F2
6. Visual check of the circuit breakers F3-6
7. Visual check of the motor protection switch Q1
8. Visual check of the fan including filter pad
9. Functional test of the fan by activating the hand operation of relay K4



#### ATTENTION

Danger of injury by running fan.

### 15.3 REPAIRS

Repairs to the Thyrobox VR may only be carried out by personnel from AEG Power Solutions or **trained** personnel from the operator.

### 15.4 SPARE PARTS

The spare parts named below are applicable for the Thyrobox VR 125 kVA with the material number 2.250.000.602 and for Thyrobox VR 250 kVA with the material number 2.250.000.581.

Please check if the material number given is identical to the number on the type plate of the Thyrobox VR. If this is not the case then please get in contact with our support service (page 2, *Contact*).

MATERIAL NO.	DESIGNATION		ACRONYM
0018467	Fuse load switch	3-pole NH00 160A	F1
0018478	Grip protection top/ bottom 3-pole NH00	for fuse load switch F1	
8000007954	Fuse NH-GL/GG 00- 125 A 690 VAC	fuses for fuse load switch F1	
8000043989	Lightning current and surge arrester	Lightning current and surge arrester	F2
8000014188	Automatic circuit breaker 1-pole 10 A S201 B10 ABB	Circuit breaker	F3, F4, F5
8000019136	Automatic circuit breaker 2-pole 10 A S202 B10	Circuit breaker	F6
8000025631	Safety socket ST 2+PE 16 A ABB	Socket	X20
2000003738	Control unit	Version Thyro-P for Thyrobox VR	A11, A21, A31
8000048437	Radial fan K3G190- RD45-03 230 V 50/60 Hz	Front fan in switch cabinet door	M1
0048589	Air filter pad CTM 60	Filter pad for front fan	
8000025692	Motor circuit breaker MS116 1.6-2.5 A ABB	Motor circuit breaker	Q1
8000041803	Relay complete 4 W 7 A 230 VAC AgNiAu	Relay with manual actuation	K4

## 16. TECHNICAL DATA

### WEIGHT

Thyrobox VR, circa	385 kg
Concrete pedestal, circa	260 kg
Total weight	645 kg

TYPE	Thyrobox VR 125 kVA	Thyrobox VR 250 kVA
Thyrobox VR	In the case of load flow from the PV side to the utility (EVU) side it regulates continuously to 230 V (can be parameterized, conductor against N); regulation becomes active from 10% (can be parameterized) of the nominal current.	In the case of load flow from the PV side to the utility (EVU) side it regulates continuously to 230 V (can be parameterized, conductor against N); regulation becomes active from 10% (can be parameterized) of the nominal current.
Set-up location of Thyrobox VR	Suitable for open air installation	Suitable for open air installation
Voltage	Outer cable voltage 400 V (3-phase), against PEN 230 V	Outer cable voltage 400 V (3-phase), against PEN 230 V
Mains frequency	47-63 Hz	47-63 Hz
Throughput power, maximum	125 kVA, $1 \geq \cos \varphi \geq 0.8$ (inductive) in the case of energy flow direction from PV to utility (EVU) (the throughput power can occur in both load flow directions).	250 kVA, $1 \geq \cos \varphi \geq 0.8$ (inductive) in the case of energy flow direction from PV to utility (EVU) (the throughput power can occur in both load flow directions).
Nominal throughput current	3 x 181 A	3 x 362 A
Control voltage	3 x 230 VAC	3 x 230 VAC
Regulation	Continuous voltage regulation of the power circuits with VSC technology	Continuous voltage regulation of the power circuits with VSC technology
Accuracy of regulation	1,0%	1,0%
Adjusting range of voltage	0 to -8%	0 to -8%
Efficiency at nominal power	99,6%	99,8%
THD <sub>U</sub>	< 1,5%	< 1,5%
Setpoint setting (if required)	locally via Thyro-Tool Family	locally via Thyro-Tool Family
Messages	LED notifications on the control devices Thyro-P	LED notifications on the control devices Thyro-P
Potential equalization	Grounding via power cable in the cable distribution cabinet (PEN bus bar)	Grounding via power cable in the cable distribution cabinet (PEN bus bar)
Cooling	Air cooling, with fan	Air cooling, with fan
Temperature monitoring	Transformers with 2 sensors each, interior temperature measurement of the Thyrobox VR with sensor PT1000	Transformers with 2 sensors each, interior temperature measurement of the Thyrobox VR with sensor PT1000

Measurements		
- width	1250 mm	1250 mm
- height	1355 mm (cabinet without concrete pedestal) 1000 mm (total height concrete pedestal), of which 700 mm in the ground as well as 300 mm above the ground circa 460mm	1355 mm (cabinet without concrete pedestal) 1000 mm (total height concrete pedestal), of which 700 mm in the ground as well as 300 mm above the ground circa 460mm
- depth		
Standard	Applicable parts of the technical connecting conditions for the connection to the low voltage distribution network (TAB 2007) EN 50160 (voltage characteristics in public distribution networks) EN 50178 (electronic equipment for use in power installations)	Applicable parts of the technical connecting conditions for the connection to the low voltage distribution network (TAB 2007) EN 50160 (voltage characteristics in public distribution networks) EN 50178 (electronic equipment for use in power installations)
Type of protection	IP54	IP54
Ambient temperature for operation	-20 °C to +45 °C	-20 °C to +45 °C
Ambient temperature for storage and transport	-25 °C to +55 °C	-25 °C to +55 °C
Humidity in operation mode	< 93%, in accordance with EN 60721-3-3	< 93%, in accordance with EN 60721-3-3
Contamination	Grade 2 in accordance with EN 50178	Grade 2 in accordance with EN 50178
Housing	Outdoor housing, metal, powder coated	Outdoor housing, metal, powder coated
Paint	RAL7035	RAL7035
Noise generation	< 45 dB	< 45 dB
Lightning and surge protection	Types I + II in accordance with EN 61643-11	Types I + II in accordance with EN 61643-11
Connection	Connection space at the bottom via the pedestal, height circa 20 cm for two 4-pole cables up to 150 mm <sup>2</sup> Insertion from below, secure with cable mounting rail	Connection space at the bottom via the pedestal, height circa 20 cm for two 4-pole cables up to 150 mm <sup>2</sup> Insertion from below, secure with cable mounting rail
In the case of a regulator fault	Bridging without external error notification, error notification via LED on control device	Bridging without external error notification, error notification via LED on control device
Certification	CE conformity	CE conformity

## 17. ERROR DIAGNOSES

OPERATING STATUS		ERROR STATUS	POSSIBLE CAUSE OF ERROR
LED ON Control device	LED ON lit	LED ON not lit	F3, F4, F5
			F1
			Check mains voltage
LED CONTROL Control device	LED CONTROL flashing or lit	LED CONTROL not flashing, not lit	F1, F3 - F5
			Check current value for regulation activation
			Current is capacitive ( $\cos \phi < 0.9$ capacitive)
			Current direction EVU -> PV (desired direction PV -> EVU)

In the case of other errors our support service will be glad to help you (page 2, *Contact*).



OPERATING INSTRUCTIONS 8000048621  
EN, 06/13 - V1

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