



# Motor-drive unit ECOTAP<sup>®</sup> VPD<sup>®</sup> MD&C

## Operating instructions

6117331/05 EN



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We reserve the right to change the technical data, design and scope of supply.

Generally the information provided and agreements made when processing the individual quotations and orders are binding.

The original operating instructions were written in German.



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# 1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

## 1.1 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH

Falkensteinstraße 8  
93059 Regensburg  
Tel.: (+49) 9 41/40 90-0  
E-mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

## 1.2 Completeness

This technical file is incomplete without the supporting documents.

The following documents are considered supporting documents:

- Operating instructions for the associated ECOTAP® VPD® on-load tap-changer
- Connection diagrams
- Routine test report

Also observe generally valid legislation, standards, and guidelines as well as specifications on accident prevention and environmental protection in the respective country of use.

## 1.3 Safekeeping

Keep this technical file and all supporting documents ready at hand and accessible for future use at all times.

## 1.4 Notation conventions

### 1.4.1 Hazard communication system

Warnings in this technical file are displayed as follows.

**1.4.1.1 Warning relating to section**

Warnings relating to sections refer to entire chapters or sections, sub-sections or several paragraphs within this technical file. Warnings relating to sections use the following format:

**▲ WARNING**



**Type of danger!**

Source of the danger and outcome.

- ▶ Action
- ▶ Action

**1.4.1.2 Embedded warning information**

Embedded warnings refer to a particular part within a section. These warnings apply to smaller units of information than the warnings relating to sections. Embedded warnings use the following format:

**▲ DANGER!** Instruction for avoiding a dangerous situation.

**1.4.1.3 Signal words and pictograms**

The following signal words are used:

Signal word	Definition
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 1: Signal words in warning notices

Pictograms warn of dangers:

Pictogram	Definition
	Warning of a danger point
	Warning of dangerous electrical voltage
	Warning of combustible substances
	Warning of danger of tipping
	Warning of danger of crushing

Table 2: Pictograms used in warning notices

### 1.4.2 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:



Important information.

### 1.4.3 Instruction system

This technical file contains single-step and multi-step instructions.

#### Single-step instructions

Instructions which consist of only a single process step are structured as follows:



Aim of action

- ✓ Requirements (optional).
- ▶ Step 1 of 1.
  - ⇒ Result of step (optional).
- ⇒ Result of action (optional).

**Multi-step instructions**

Instructions which consist of several process steps are structured as follows:

Aim of action

- ✓ Requirements (optional).
- 1. Step 1.
  - ⇒ Result of step (optional).
- 2. Step 2.
  - ⇒ Result of step (optional).
- ⇒ Result of action (optional).

**1.4.4 Typographic conventions**

The following typographic conventions are used in this technical file:

Typographic convention	Purpose	Example
UPPERCASE	Operating controls, keys	AVR MANUAL
<b>Bold</b>	Displays/menus	<b>P21</b>
<i>Italics</i>	System messages/LED displays	<i>ERROR LED</i>
[▶ Page number].	Cross reference	[▶ 41].

Table 3: Typographic conventions



## 2 Safety

### 2.1 Appropriate use

The product is a motor-drive unit with control unit and adjusts the operating position of on-load tap-changers in regulating transformers to the individual operating requirements. The product is designed solely for use in electrical energy systems and facilities. If used as intended and in compliance with the requirements and conditions specified in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any danger to people, property or the environment. This applies throughout service life of the product, from delivery to installation and operation through to disassembly and disposal.

The following is considered appropriate use:

- Only use the ECOTAP® VPD® on-load tap-changer in systems set up in accordance with IEC 61936-1.
- You will find the standard valid for the product and the year of issue on the nameplate.
- Only operate the product in accordance with this technical file and the agreed delivery conditions and technical data.
- Only operate the ECOTAP® VPD® on-load tap-changer and ECOTAP® VPD® MD&C motor-drive unit in this combination. Operation with another on-load tap-changer or motor-drive unit is not permitted.
- Ensure that all necessary work is performed by qualified personnel only.
- Use the equipment and special tools supplied solely for the intended purpose and in accordance with the specifications of this technical file.

### 2.2 Fundamental safety instructions

To prevent accidents, malfunctions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

#### Personal protective equipment

Loosely worn or unsuitable clothing increases the danger of becoming trapped or caught up in rotating parts and the danger of getting caught on protruding parts. This poses a danger to life and limb.

- Wear appropriate personal protective equipment such as a helmet, work gloves, etc. for the respective activity.
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces, or other jewelry.
- If you have long hair, wear a hairnet.



### Work area

Untidy and poorly lit work areas can lead to accidents.

- Keep the work area clean and tidy.
- Make sure that the work area is well lit.
- Observe the applicable laws for accident prevention in the relevant country.

### Working during operation

The product may only be operated in a sound, operational condition. Otherwise it poses a danger to life and limb.

- Regularly check the operational reliability of safety equipment.
- Comply with the inspection work, maintenance work and maintenance intervals described in this technical file.

### Working with current transformers

Dangerous high voltages may occur when a current transformer is operated with an open secondary circuit. This can lead to injuries and property damage.

- Never operate a current transformer with an open secondary circuit; short-circuit the current transformer to prevent this.
- Observe the information in the current transformer operating instructions.

### Explosion protection

Highly flammable or explosive gases, vapors and dusts can cause serious explosions and fire.

- Do not install or operate the product in areas where a risk of explosion is present.

### Safety markings

Warning signs and safety information plates are safety markings on the product. They are an important aspect of the safety concept.

- Observe all safety markings on the product.
- Make sure all safety markings on the product remain intact and legible.
- Replace safety markings that are damaged or missing.

### Ambient conditions

To ensure reliable and safe operation, the product must only be operated under the ambient conditions specified in the technical data.

- Observe the specified operating conditions and requirements for the installation location.



### **Modifications and conversions**

Unauthorized or inappropriate changes to the product may lead to personal injury, material damage and operational faults.

- Only modify the product after consultation with Maschinenfabrik Reinhausen GmbH.

### **Spare parts**

Spare parts not approved by Maschinenfabrik Reinhausen GmbH may lead to physical injury, damage to the product and malfunctions.

- Only use spare parts that have been approved by Maschinenfabrik Reinhausen GmbH.
- Contact Maschinenfabrik Reinhausen GmbH.

## **2.3 Personnel qualification**

The person responsible for assembly, commissioning, operation, maintenance and inspection must ensure that the personnel are sufficiently qualified.

### **Electrically skilled person**

The electrically skilled person has a technical qualification and therefore has the required knowledge and experience, and is also conversant with the applicable standards and regulations. The electrically skilled person is also proficient in the following:

- Can identify potential dangers independently and is able to avoid them.
- Is able to perform work on electrical systems.
- Is specially trained for the working environment in which (s)he works.
- Must satisfy the requirements of the applicable statutory regulations for accident prevention.

### **Electrically trained persons**

An electrically trained person receives instruction and guidance from an electrically skilled person in relation to the tasks undertaken and the potential dangers in the event of inappropriate handling as well as the protective devices and safety measures. The electrically trained person works exclusively under the guidance and supervision of an electrically skilled person.

### **Operator**

The operator uses and operates the product in line with this technical file. The operating company provides the operator with instruction and training on the specific tasks and the associated potential dangers arising from improper handling.



### Technical Service

We strongly recommend having maintenance, repairs and retrofitting carried out by our Technical Service department. This ensures that all work is performed correctly. If maintenance is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained and authorized by Maschinenfabrik Reinhausen GmbH to carry out the work.

### Authorized personnel

Authorized personnel are trained by Maschinenfabrik Reinhausen GmbH to carry out special maintenance.

## 2.4 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Never wear damaged personal protective equipment.
- Observe information about personal protective equipment provided in the work area.

<b>Protective clothing</b>	Close-fitting work clothing with a low tearing strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts.
<b>Safety shoes</b>	To protect against falling heavy objects and slipping on slippery surfaces.
<b>Safety glasses</b>	To protect the eyes from flying parts and splashing liquids.
<b>Visor</b>	To protect the face from flying parts and splashing liquids or other dangerous substances.
<b>Hard hat</b>	To protect against falling and flying parts and materials.
<b>Hearing protection</b>	To protect against hearing damage.
<b>Protective gloves</b>	To protect against mechanical, thermal, and electrical hazards.

Table 4: Personal protective equipment



### 3 IT security

Observe the following recommendations to operate the product safely.

#### 3.1 General

- Ensure that only authorized personnel have access to the device.
- Only use the device within an ESP (electronic security perimeter). Do not connect the device to the Internet in an unprotected state. Use mechanisms for vertical and horizontal network segmentation and security gateways (firewalls) at the transition points.
- Ensure that the device is only operated by trained personnel who are familiar with IT security.



## 4 Product description

### 4.1 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Motor-drive unit with connection cable
- Control unit
- Control cabinet for outdoor use (optional)
- Control cabinet version with CONTROL PRO (optional)
- Technical documents

Note the following information:

- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation
- The product must remain in its airtight, protective wrapping and may only be removed immediately before installation

You will find more information in the "Packaging, transport, and storage" [► Section 5, Page 24] chapter.

### 4.2 Function description

The motor-drive unit adjusts the operating position of on-load tap-changers in regulating transformers to the individual operating requirements. The tap-change operation is initiated by activating the motor-drive unit (a single control impulse is triggered). This adjustment operation is always completed regardless of any other control impulses issued during the tap-change operation. In the standard design, the next tap-change operation can only proceed once all control devices have reached their resting positions.

#### Voltage regulation

The motor-drive unit is equipped with a control unit which enables automatic voltage regulation. This is used to keep the output voltage of a transformer with an on-load tap-changer constant. The control unit compares the transformer's measured voltage ( $U_{\text{actual}}$ ) with a defined reference voltage ( $U_{\text{desired}}$ ). The difference between  $U_{\text{actual}}$  and  $U_{\text{desired}}$  is the control deviation  $dU$ . If the control deviation  $dU$  is greater than the set bandwidth, the control unit triggers a tap-change operation after the delay time  $T1$  has elapsed in order to reduce the control deviation.

You can set all parameters needed to set the voltage regulation via a parameterization menu.



### OLTC PreCheck

Before each tap-change operation, the motor-drive unit checks whether the drive train of the on-load tap-changer is tight or whether one or more micro-switches have failed. In the event of a micro-switch defect, the device switches to fault mode and issues an error message.



Exception: In the EXTERNAL CONTROL operating mode, the device performs an automatic OLTC-PreCheck once every 24 hours, not before each tap-change operation.

### Behavior in the event of a voltage interruption

Should a voltage interruption occur during a tap-change operation, the motor-drive unit completes the tap-change operation that has already started. Open both relay contacts on X5 and the device will block further on-load tap-change operations until the voltage supply is restored. You can adapt this response using the "Target position for loss of voltage" [► Section 8.3.4, Page 78] function so that the on-load tap-changer is changed to a defined tap position before this blocking. For this purpose, the control unit is equipped with an energy accumulator. If it is ready to work, this is indicated by the  LED staying lit. After a loss of voltage or a deliberate disconnection from the mains, it takes around 30 minutes for this energy accumulator to discharge.

## 4.3 Operating modes



The control ensures that the required cooling time of approx. 3 seconds is maintained after each on-load tap-change operation. During this time, the control will not accept any tap-change commands. An exception to this is the optional multi-tap-change function, which is only possible in the operating mode EXTERNAL CONTROL.

There are 3 operating modes on the control unit for controlling the on-load tap-changer.

### AVR MANUAL manual mode

In AVR MANUAL manual mode, there is no automatic control. The motor-drive unit can be controlled using the device's operating panel ( = increase voltage,  = reduce voltage). The device settings can be changed.

### AVR AUTO auto mode

In auto mode, the device automatically regulates the voltage in accordance with the set parameters. The voltage is measured in a single phase via the supply voltage. You have to switch to AVR MANUAL manual mode to configure the control unit.

### Control via EXTERNAL CONTROL

In the EXTERNAL CONTROL operating mode, the commands of an external control unit (e.g. ECOTAP® VPD® CONTROL PRO) are executed. In this case, manual operation using the RAISE and LOWER keys is not possible.

When operating in this mode, observe the safety instructions and the description in the external control unit operating instructions.

## 4.4 Design

The ECOTAP® VPD® MD&C motor-drive unit consists of a motor and control unit

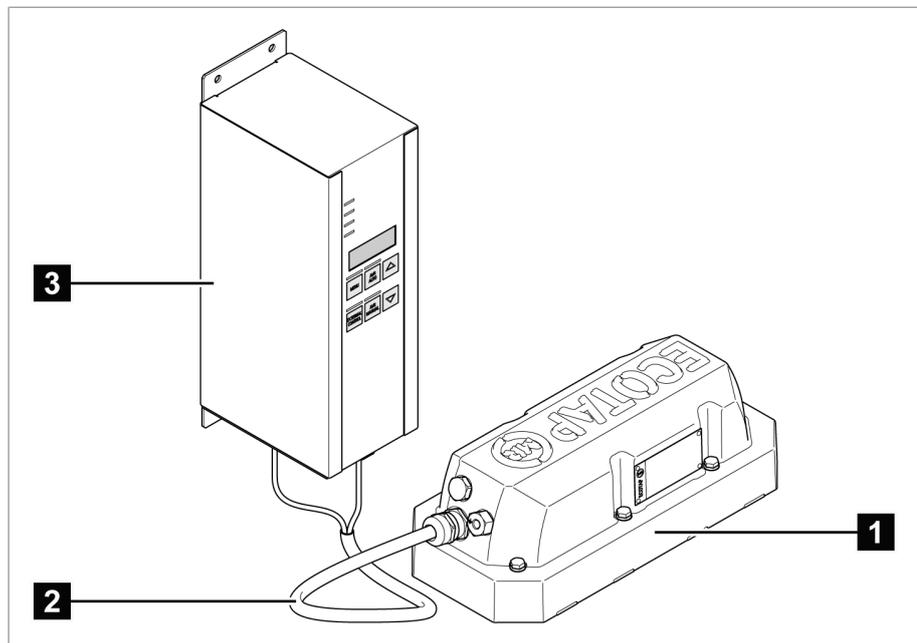


Figure 1: Motor-drive unit with control unit

- |                                   |                    |
|-----------------------------------|--------------------|
| 1 Sealing flange cover with motor | 2 Connection cable |
| 3 Control unit                    |                    |

**Control cabinet (optional)** If you have ordered the device version with control cabinet, the control unit is pre-installed in the control cabinet.

### 4.4.1 Control unit

The control unit is equipped with the following operating controls and display elements:

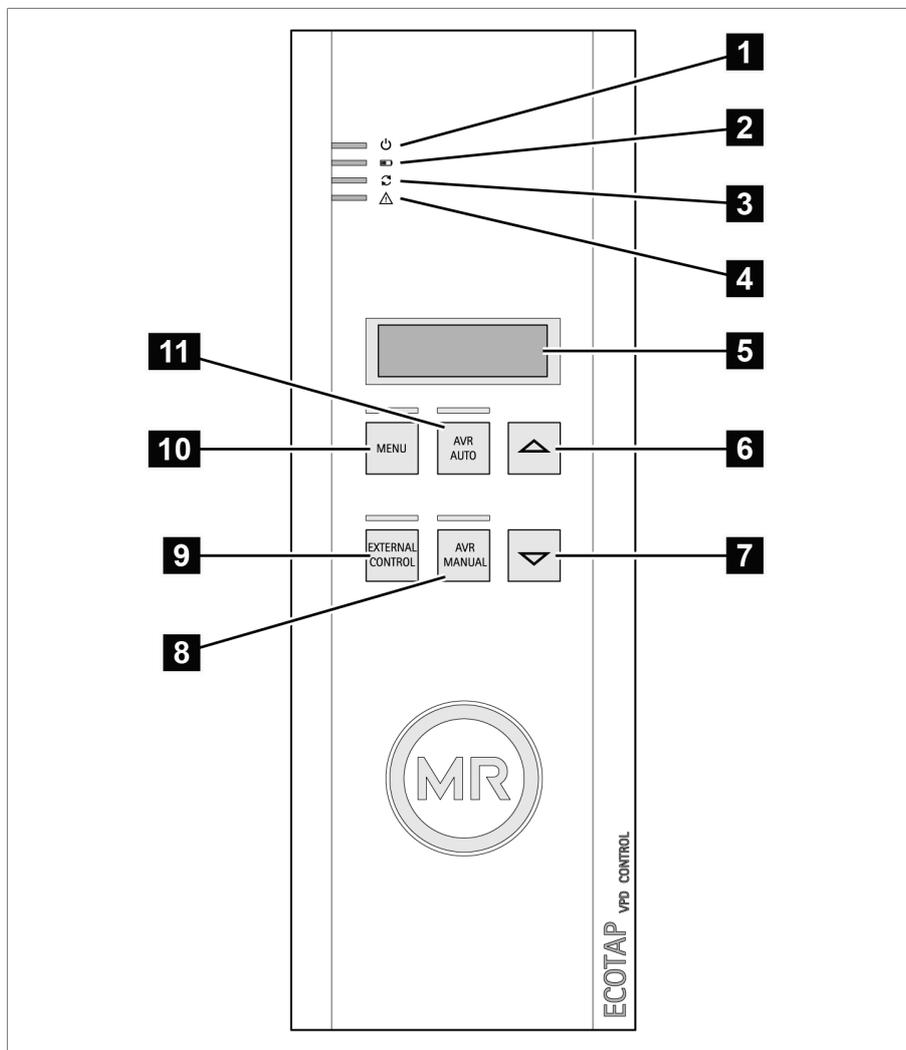


Figure 2: Operating controls and display elements

1	 LED (VOLTAGE)	2	 LED (CAPACITY)
3	 LED (MOTOR)	4	 LED (ERROR)
5	Display	6	RAISE key
7	LOWER key	8	AVR MANUAL key
9	EXTERNAL CONTROL key	10	MENU key
11	AVR AUTO key		

### Display

The display switches every 3 seconds. The following information is displayed:

000097	Operations counter (e.g. 97 tap-change operations)
P05885	Current tap position (e.g. tap position 5)
082247	Measured voltage (e.g. 224.7 V)
E48888	Event code, if an event message is pending (e.g. event code E4)

Table 5: Display

### Interfaces

The following interfaces are located on the underside of the control unit:

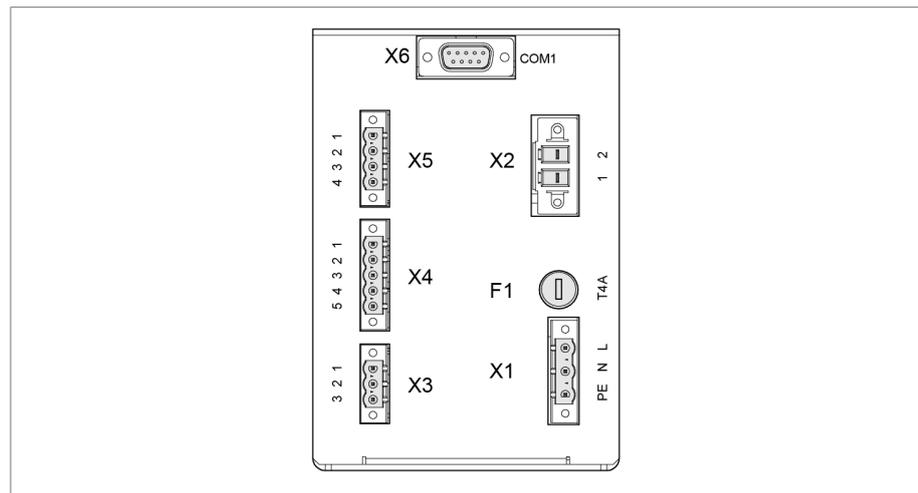


Figure 3: Interfaces

X1 Control unit voltage measurement and power supply	X2 Motor voltage supply
X3 Blocking contact	X4 Control gear signal line
X5 Customer messages	X6 RS 485 communication interface
F1 Fine-wire fuse, 6.3 x 32 mm, min. 250 V, T4A	

#### 4.4.2 Control cabinet (optional)

If you have ordered the device with the optional control cabinet, the control unit is screwed onto a mounting plate in the control cabinet. Depending on the application, different control cabinets are used. Note the supplied connection diagrams and dimensional drawings.

Examples:

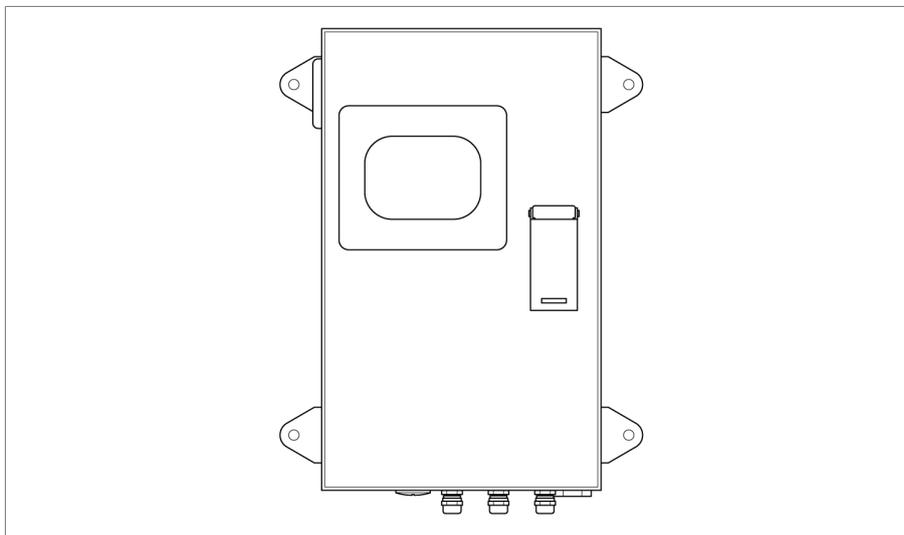


Figure 4: Control cabinet for outdoor use

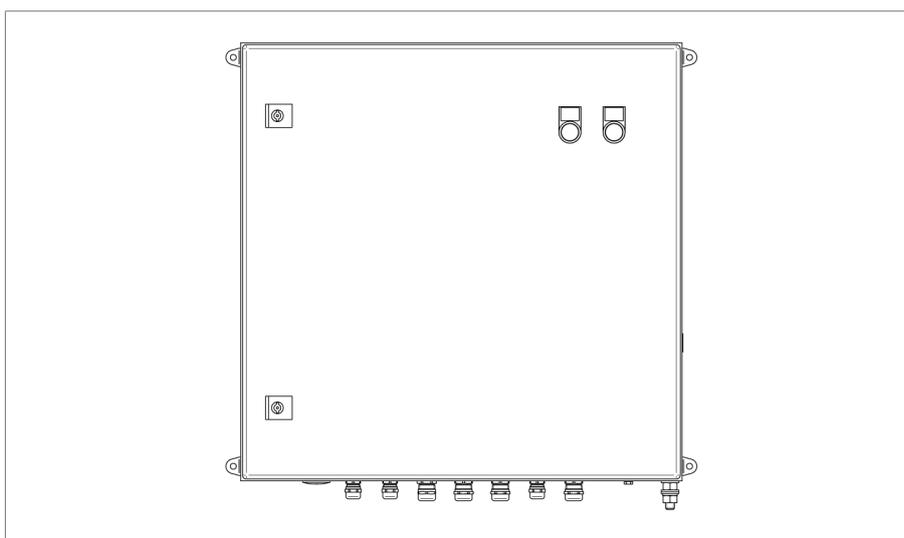


Figure 5: Control cabinet for indoor use version with ECOTAP® VPD® CONTROL PRO

### 4.5 Control unit operating concept

You can operate the device using the operating controls on the front panel.

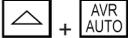
Key		Function
	MENU	Call up or close the parameterization menu
	AVR AUTO	Activate automatic voltage regulation
	RAISE	In AVR MANUAL operating mode: Raise tap-change operation  In parameterization menu: Increase displayed value
	RAISE + AVR AUTO	In parameterization menu: Rapidly increase displayed value (in steps of 30 units or up to the end value of the value range, depending on the parameter)
	LOWER	In AVR MANUAL operating mode: Lower tap-change operation  In parameterization menu: Decrease displayed value
	LOWER + AVR AUTO	In parameterization menu: Rapidly decrease displayed value (in steps of 30 units or up to the end value of the value range, depending on the parameter)
	AVR MANUAL	Activating manual mode  In parameterization menu: Confirm selection
	EXTERNAL CONTROL	Activate voltage regulation via external control unit

Table 6: Operating elements

**Example** To set parameter P2.2, delay time T1, proceed as follows:

- Press  to activate manual mode.
  - ⇒ The LED above the  key lights up.
- Press  to call up the parameterization menu.
  - ⇒ 
- Press  to select the menu **P2**.
  - ⇒ 



4. Press  to confirm the selection.

⇒ 

5. Press  to select the parameter P2.2

⇒ 

6. Press  to confirm the selection.

⇒ 

7. Press  or  to set the desired value (e.g. 15).

⇒ 

8. Press  to accept the selection.

9. Press  to leave the parameterization menu.

⇒ The parameter P2.2, delay time T1, is set.



Settings are only saved once the parameterization menu is exited via the  key. If you do not press the  key within 30 s, the parameterization menu is exited automatically and the changes are not saved.

You will find a detailed description of all control unit parameters and functions in the "Configuring control unit" [► Section 8.3, Page 71] chapter.



## 5 Packaging, transport and storage

### 5.1 Packaging

The products are sometimes supplied with sealed packaging and sometimes in a dry state, depending on requirements.

Sealed packaging surrounds the packaged goods with plastic foil on all sides.

Products that have also been dried are identified by a yellow label on the sealed packaging. In the dry state, delivery is also possible in a transport container.

The information in the following sections should be applied as appropriate.

#### 5.1.1 Suitability

##### **NOTICE**

##### **Property damage due to incorrectly stacked crates!**

Stacking the crates incorrectly can lead to damage to the packaged goods.

- ▶ The outer marking on the packaging states if, for example, the on-load tap-changer or selector has been packed upright. Never stack these crates.
- ▶ General rule: Do not stack crates above a height of 1.5 m.
- ▶ For other crates: Only stack up to 2 equally sized crates on top of one another.

The packaging is suitable to ensure undamaged and fully functional means of transportation in compliance with local transportation laws and regulations.

The packaged goods are packed in a sturdy crate. This crate ensures that, when in the intended transportation position, the packaged goods are stabilized to prevent impermissible changes in position, and that none of the parts touch the loading surface of the means of transport or touch the ground after unloading.

Sealed packaging surrounds the packaged goods with plastic foil on all sides. The packaged goods are protected from humidity using a desiccant. The plastic foil was bonded after the desiccant is added.



### 5.1.2 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment of non-hazardous goods. Adherence to these symbols is mandatory.

---

				
Protect against moisture	Top	Fragile	Attach lifting gear here	Center of mass

---

Table 7: Shipping pictograms

## 5.2 Transportation, receipt and handling of shipments

### ▲ WARNING



#### Danger of death or severe injury!

Danger of death or serious injuries due to tipping or falling load.

- ▶ Only transport the crate when closed.
- ▶ Do not remove the securing material used in the crate during transport.
- ▶ If the product is delivered on a pallet, secure it sufficiently.
- ▶ Only trained and authorized persons may select the sling gear and secure the load.
- ▶ Do not walk under the suspended load.
- ▶ Use means of transport and lifting gear with a sufficient carrying capacity in accordance with the weight stated on the delivery slip.

In addition to oscillation stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a crate tips over, falls from a certain height (e.g. when slings tear) or is subject to an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type

The checks must take place after unloading when the crate or transport container can be accessed from all sides.

**Visible damage** If external transport damage is found upon receipt of the shipment, proceed as follows:

- Immediately record the identified transport damage in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the manufacturer and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately on site together with the carrier involved. This is essential for any claim for damages.
- Photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- **NOTICE!** Damage to packaged goods due to damaged sealed packaging. If the product is delivered in sealed packaging, check the sealed packaging immediately. If the sealed packaging is damaged, do not under



any circumstances install or commission the packaged goods. Either re-dry the dried packaged goods as per the operating instructions, or contact the manufacturer to agree on how to proceed.

- Identify the damaged parts.

**Hidden damage** When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

### 5.3 Storage of shipments

#### **Packaged goods dried by Maschinenfabrik Reinhausen**

Upon receipt of the shipment, immediately remove the packaged goods dried by Maschinenfabrik Reinhausen from the sealed packaging and store air-tight in dry insulating fluid until used if the packaged goods were not supplied in insulating fluid.

#### **Non-dried packaged goods**

Non-dried packaged goods but with a functional sealed packaging can be stored outdoors when the following conditions are complied with.

When selecting and setting up the storage location, ensure the following:

- Protect stored goods against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Ensure sufficient carrying capacity of the ground.
- Keep entrance paths free.
- Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

Protect the packaging foil from direct sunlight so that it does not disintegrate under the influence of UV rays, which would cause the packaging to lose its sealing function.



If the product is installed more than 6 months after delivery, suitable measures must be taken without delay. The following measures can be used:

- Correctly regenerate the drying agent and restore the sealed packaging.
- Unpack the packed goods and store in a suitable storage space (well ventilated, as dust-free as possible, humidity < 50% where possible).

### 5.4 Unpacking shipments and checking for transportation damages

- **NOTICE!** Damage to packaged goods due to ineffectively sealed packaging. Transport the packaged crate to the place where the packaged goods are to be installed. Do not open the sealed packaging until just before installation.
- **▲ WARNING!** Serious injuries and damage to the packaged goods due to the packaged goods tipping out. Place the packaged goods in an upright crate and protect it from tipping out.
- Unpack the packaged goods and check the condition.
- Check the completeness of the accessories kit using the delivery slip.

## 6 Mounting

This chapter describes how to correctly install and connect the device.

### ⚠ WARNING



### Danger of death or severe injury!

An energized transformer and energized on-load tap-changer components can cause death or serious injuries during installation of the drive!

- ▶ Ensure the de-energized state of the transformer and on-load tap-changer components during installation of the drive.

### 6.1 Mounting motor-drive unit

To mount the motor-drive unit, proceed as follows:

1. Remove the transport locking plate as well as any kerosene residue from the sealing module. Retain the transport locking plate for later use. Keep the screws for mounting the motor-drive unit.

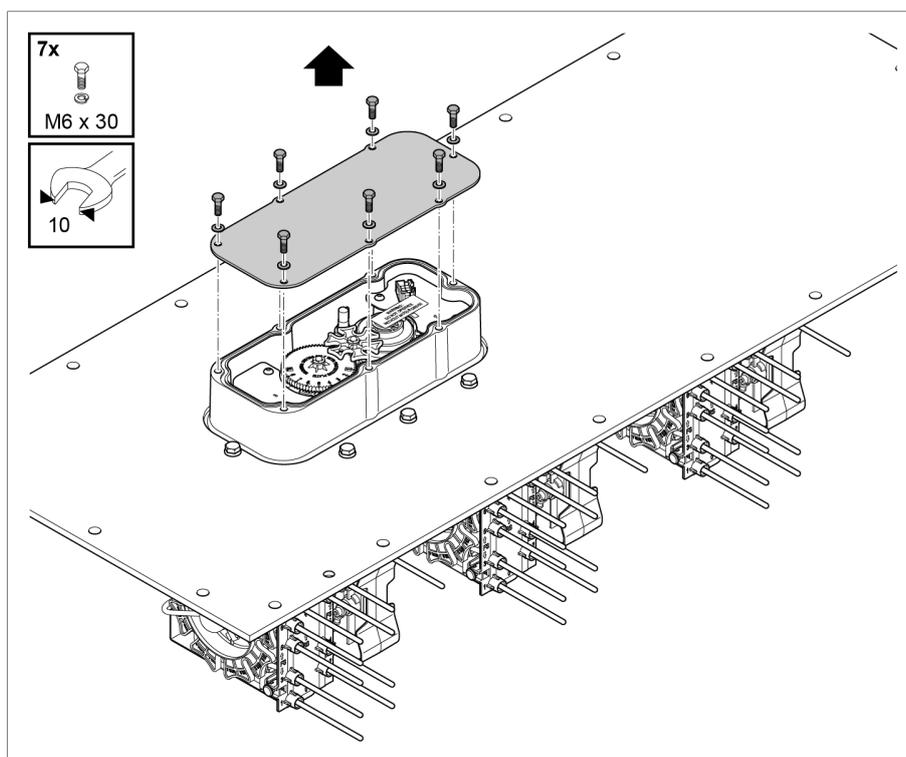


Figure 6: Removing the transport locking plate

2. Clean sealing surfaces on the sealing module and underside of the motor-drive unit and check that the o-ring is in the correct position.

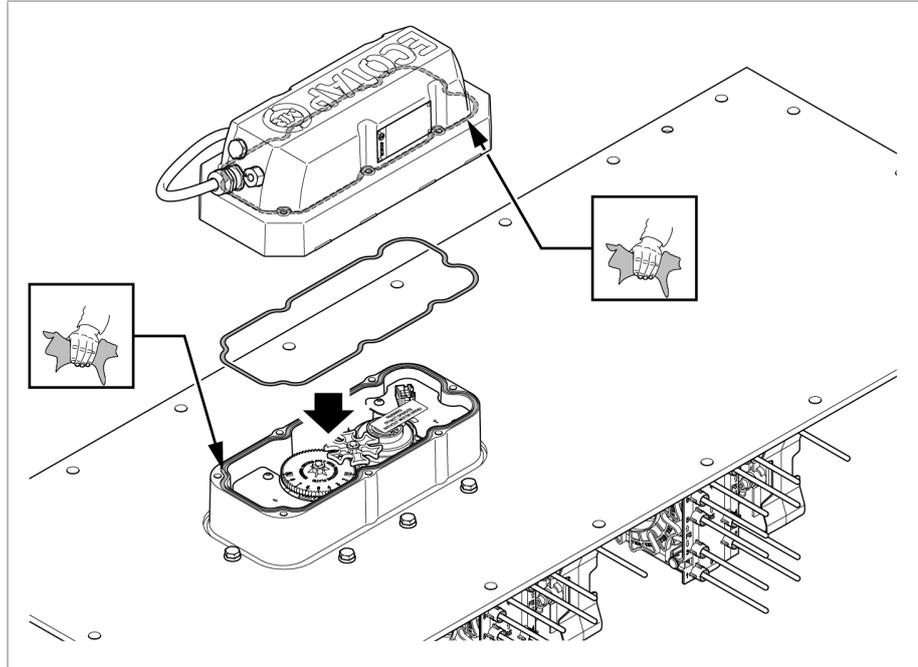


Figure 7: Cleaning sealing surfaces of the motor-drive unit

3. When mounting for the first time: remove label with warning.

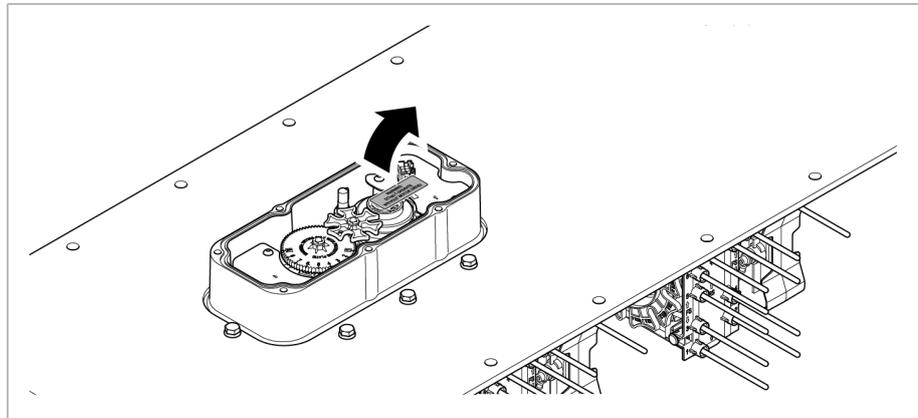


Figure 8: Removing the label

4. Ensure that the feather key is seated correctly.

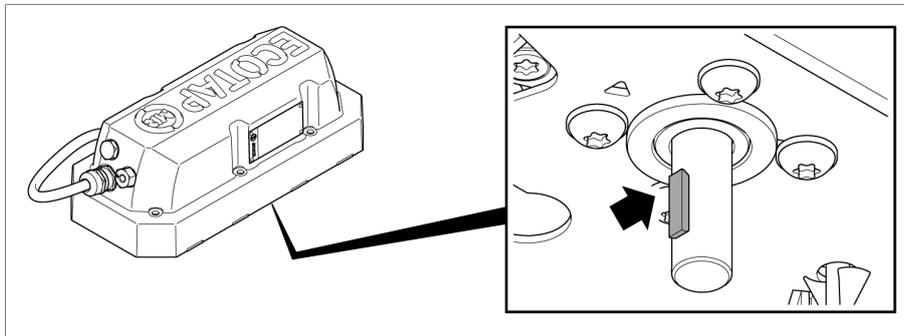


Figure 9: Checking the feather key is seated correctly

5. Check the position of the motor-drive unit. If mounted incorrectly, the motor-drive unit may be damaged. The feather key **1** of the motor shaft must be facing the mark **2**. If necessary, cover the motor shaft with a cloth and carefully turn using pliers until the feather key is facing the mark.



Ensure that the motor-drive unit and on-load tap-changer are aligned as described below. In the event of incorrect mounting, the control unit recognizes the incorrect mounting and delivers the event code E6 [► Section 12.2, Page 108]. This event code can only be reset by the Maschinenfabrik Reinhausen GmbH Technical Service department.

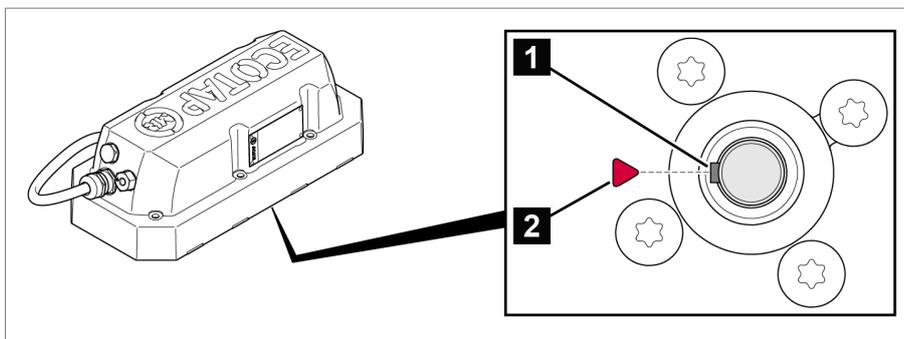


Figure 10: Check the position of the motor-drive unit

6. Checking the position of the on-load tap-changer: the mark on the cam disk **1** must be in the marked area on the cover **2**. If not, correct the position as described in the "Actuating motor-drive unit with emergency drive shaft" [► Section 8.2, Page 67] section.

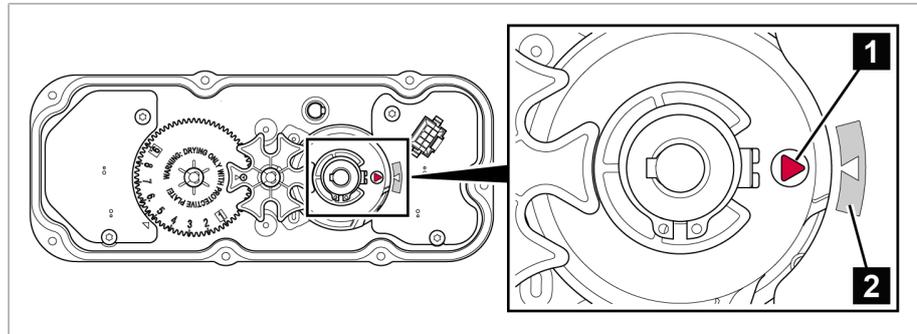


Figure 11: Checking the position of the on-load tap-changer

7. Attach motor-drive unit to sealing module.
8. **NOTICE!** Attach the motor-drive unit without warping or deforming; to do so, gradually tighten screws crosswise. Otherwise the motor-drive unit is not correctly connected to the on-load tap-changer, which may result in damage to the on-load tap-changer and transformer.

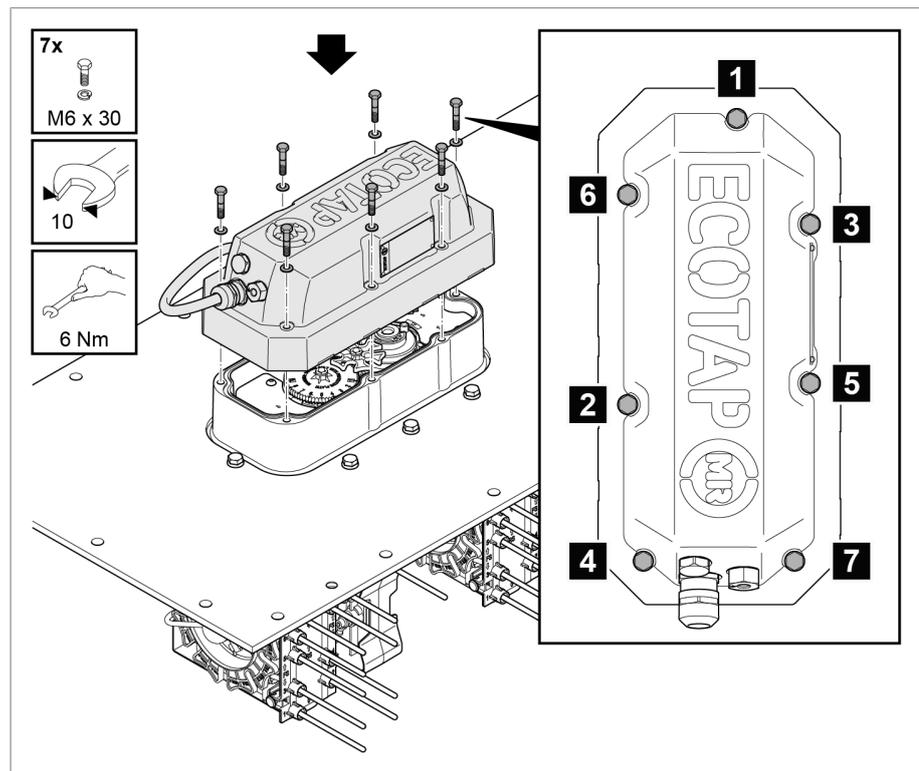


Figure 12: Mounting the motor-drive unit

9. Connect the motor-drive unit and transformer cover with a grounding conductor. For the ground connection on the motor-drive unit, we recommend using an M8 cable shoe.

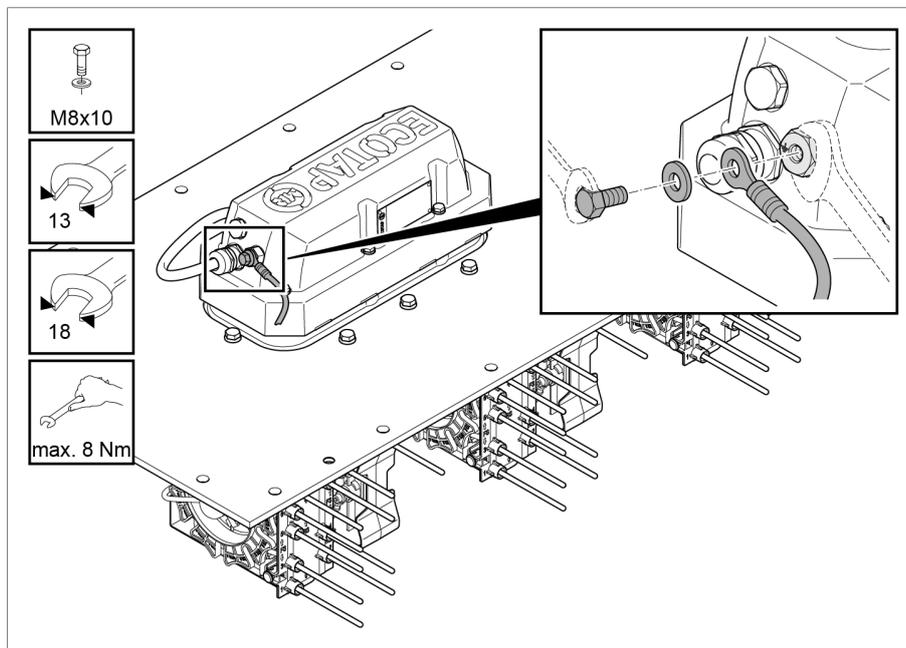


Figure 13: Connecting the motor-drive unit grounding



Perform an automatic adjustment [► Section 8.3.9.1, Page 84] each time the motor-drive unit is replaced or mounted.

## 6.2 Attaching the on-load tap-changer nameplate to the control unit

- ▶ Attach the nameplate (included in the scope of delivery) in a clearly visible position on the side wall of the control unit to satisfy the requirements in accordance with IEC 60214-1.

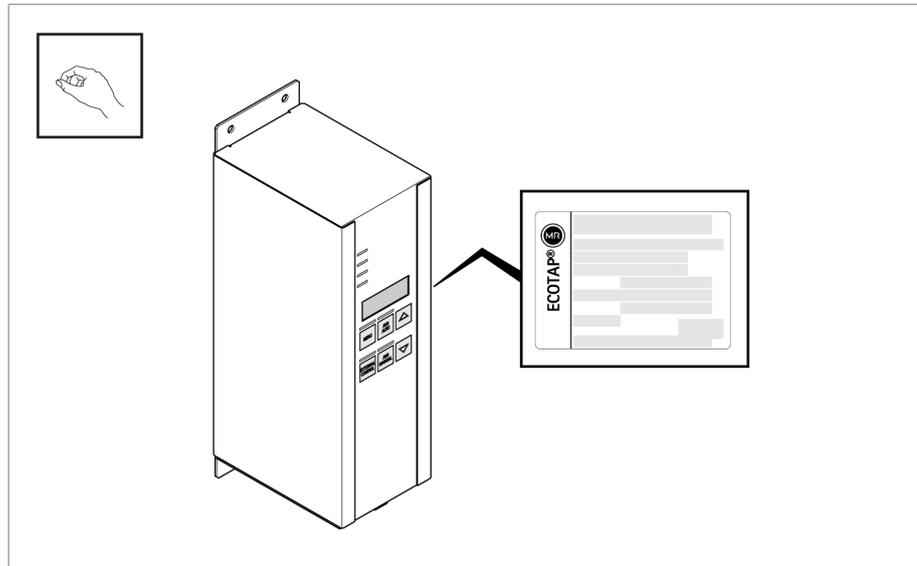


Figure 14: Attaching the nameplate

## 6.3 Connecting control unit at the transformer manufacturer's site

This section describes how you connect the control unit before initial commissioning. Connection and mounting of the control unit for permanent operation are described in the Commissioning transformer at operating site [▶ Section 7.3, Page 46] chapter.

**⚠ DANGER**



### Risk of fatal injury due to electrical voltage!

Danger of death due to electrical voltage when assembling and connecting the device.

- ▶ De-energize the device and system peripherals and lock them to prevent them from being switched back on.

### 6.3.1 Cable recommendation

Please note the following recommendation from Maschinenfabrik Reinhausen GmbH when wiring the device:

Cable	Terminal	Cable type	Conductor cross-section	Max. length
Power supply and voltage measurement	X1	Unshielded	1.5 mm <sup>2</sup> with ferrule 2.5 mm <sup>2</sup> without ferrule	-
Blocking contact	X3			-
Customer messages	X5			-
RS485; SUB-D	X6	Shielded	0.25 mm <sup>2</sup>	500 m
Optional control cabinet grounding	-	Unshielded	≥ 16 mm <sup>2</sup>	-

Table 8: Recommendation for connection cables

The connection cable between the motor-drive unit and the control unit is supplied as standard.

#### **▲ DANGER**



#### **Danger of explosion!**

An impermissibly long connection cable between the motor-drive unit and control unit can lead to malfunctions of the motor-drive unit and the on-load tap-changer. This allows the on-load tap-changer to remain in an impermissible operating position. This can lead to an explosion in the transformer.

- ▶ Only use the connection cable provided.
- ▶ The connection cable may not be altered.

### 6.3.2 Connecting motor-drive unit and voltage supply

#### **All-pole isolating device**

You may connect the control unit only to circuits with an external overcurrent protection device and an all-pole isolating device, enabling the equipment to be fully de-energized if required (service, maintenance, etc.).

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC 60947-3 (e.g. circuit breakers). Observe the properties of the relevant circuits (voltage, maximum currents) when selecting the circuit breaker type. In addition, observe the following:

- It must be easy for the operator to access the isolating device
- The isolating device must be labeled for the device and the circuits to be isolated
- The isolating device may not be a part of the power line
- The isolating device may not interrupt the main protective conductor

You must connect the power supply circuit with a conductor cross-section of at least 1.5 mm<sup>2</sup> (AWG 16) and protect it with a C10A or B10A type miniature circuit breaker.

### Supply via voltage transformers

**⚠ DANGER**



#### Electric shock!

If you supply the device via a voltage transformer, the output voltage of the voltage transformer has no bearing on the protective conductor. As a result, protection of the device against electric shock in the event of an error is not guaranteed.

- ▶ Take appropriate measures to protect against electric shock according to IEC 61140 and the local connection regulations.

Further conditions:

- Assurance that there are no voltage drops in the converter under load to ensure regular operation.
- For the correct dimensioning of the voltage transformer, observe the information in the section "Technical data of the control unit" [▶ Section 15.1, Page 113].
- The measurement accuracy is influenced by the measuring error of the voltage transformer.
- During the charging process for the energy accumulator, the measuring error of the voltage transformer can increase significantly ( $\pm 2.3\%$ ). The charging process for the energy accumulator takes approx. 35 s during initial charging and approx. 0.3 s after each on-load tap-change operation.
- The transmission ratio of the voltage transformer must be taken into consideration when setting the desired value.

The transmission ratio influences the voltage measurement value shown in the display. Conversion within the controller is not possible.

### Connecting the control unit

1. Connect the 5-wire connection cable of the motor-drive unit to terminal X4 (0.4 Nm).
2. Connect the 2-wire connection cable of the motor-drive unit to terminal X2 (0.5 Nm).

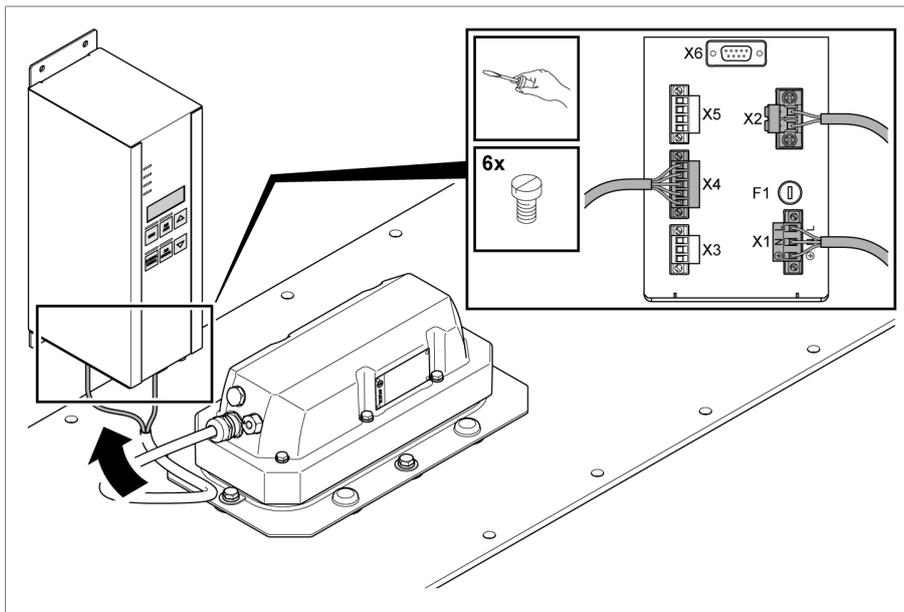


Figure 15: Connection cable connection

3. **⚠ DANGER!** Ensure that the connections PE, N, and L are not interchanged. Otherwise, dangerously high voltages could occur at the housing. Tighten (0.5 Nm) the control unit power supply to the plug connector for X1 in accordance with the supplied connection diagram. In addition, use the green cable housing supplied for touch protection.
4. The plug connector is coded. Carry out the installation without using force. Connect the plug connector to terminal X1 correctly according to the device labeling and screw it tight with 0.5 Nm.

## 7 Commissioning

Commissioning is broken down into the following sections:

- Commissioning at the transformer manufacturer's site
- Transporting transformer to the operating site
- Commissioning at the operating site

### 7.1 Commissioning at the transformer manufacturer's site

**⚠ DANGER**



#### Danger of explosion!

An incorrect position of the on-load tap-changer or the motor drive shaft can lead to malfunction and, consequently, to an overload of the on-load tap-changer. This overload can lead to an explosion in the transformer.

- ▶ Carry out automatic adjustment and trial tap-change operations on a voltage-free transformer.
- ▶ Supply the controller and motor-drive unit via a separate voltage source during these tests.
- ▶ If a separate voltage source is not available, it is imperative that the correct position of the on-load tap-changer and motor-drive unit be checked again according to the section "Mounting the motor drive" [▶ Section 6.1, Page 29] before these tests.

1. Ensure correct position of the motor-drive unit: The feather key **1** of the motor shaft must be facing the mark **2**:

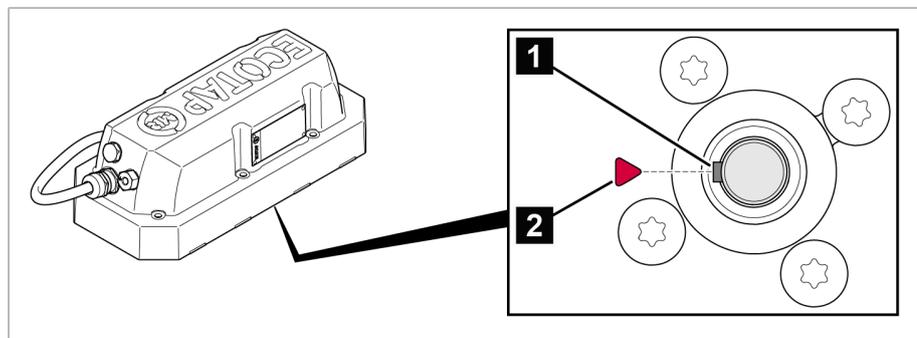


Figure 16: Check the position of the motor-drive unit

2. Ensure correct position of the on-load tap-changer: the mark on the cam disk **1** must be in the marked area on the cover **2**:

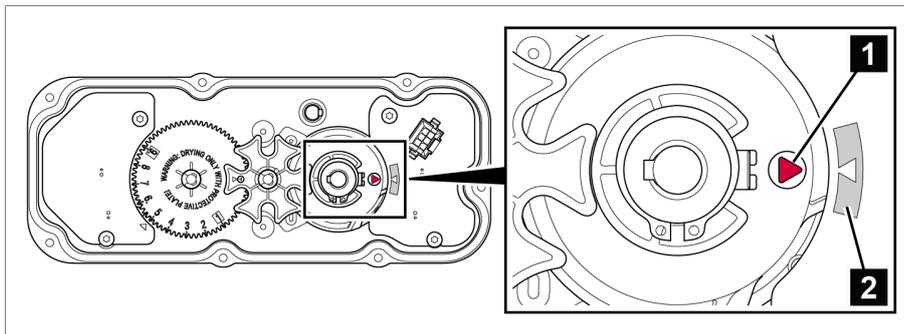


Figure 17: Checking the position of the on-load tap-changer

Further details: See section "Mounting the motor-drive unit" [► Section 6.1, Page 29].

## NOTICE

### Damage to device and system periphery

An incorrectly connected device can cause damage to the device and system periphery.

- Check the entire configuration before commissioning.
- Make sure that the supply voltage (= measured voltage) corresponds to the specifications in the technical data.

For the initial commissioning, proceed as follows:

1. Activate power supply for motor-drive unit and control unit.
  - ⇒ The control unit starts automatically. The  LED flashes for 10 s to indicate the inrush interlock. After 10 s, this LED lights up blue continuously.
  - ⇒ The  LED also starts by flashing and then lights up continuously as soon as the internal energy accumulator is fully charged.
  - ⇒ At the same time, the red  LED on the control unit lights up and the event code *E4* appears on the display to indicate that adjustment is necessary.
2. Carry out "Automatic adjustment" [► Section 8.3.9.1, Page 84].
3. Then carry out the trial tap-change operations as described below.

Also note the information provided in the "Commissioning the on-load tap-changer at the transformer manufacturer's site" section in the operating instructions for the ECOTAP® VPD® on-load tap-changer.

### 7.1.1 Performing trial tap-change operations

Before you activate the transformer, you must carry out trial tap-change operations to check the mechanical and electrical functions of the on-load tap-changer and the motor-drive unit.

✓ You have already carried out automatic adjustment [► Section 8.3.9.1, Page 84] of the on-load tap-changer and the motor-drive unit.

1. Press  to activate the AVR MANUAL operating mode.
  - ⇒ The status LED above the key lights up.

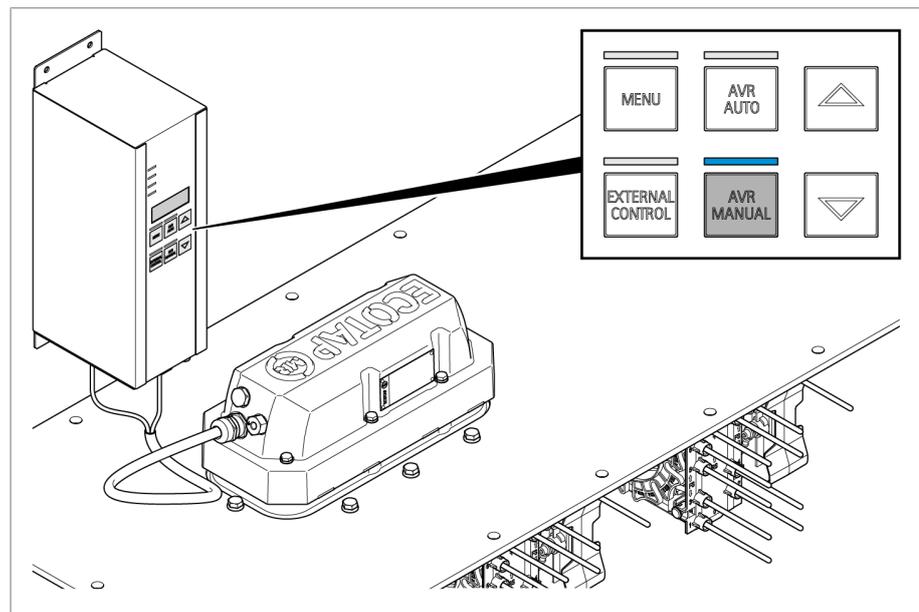


Figure 18: Activating manual mode

2. Use the RAISE/LOWER arrow keys to undertake trial tap-change operations across the entire range of settings.
3. Check that the control unit records and correctly displays every position. Otherwise, carry out automatic adjustment again.



The control ensures that the required cooling time of approx. 3 seconds is maintained after each on-load tap-change operation. During this time, the control will not accept any tap-change commands.

### 7.1.2 Disassembly before transformer drying

After the trial tap-change operations, first perform the transformer ratio test and DC resistance measurement as described in the operating instructions for the ECOTAP® VPD® on-load tap-changer.

To prepare for transformer drying, then proceed as follows:

1. **⚠ DANGER!** Ensure that all cables in the working area are de-energized and that the shutdown equipment is locked so it cannot be switched on again. Otherwise, there is a risk of fatal injury due to electrical voltage during the following work.
2. Remove the plug connector from terminal X1 on the control unit.
3. Remove the plug connector from terminal X2 on the control unit.
4. Remove the plug connector from terminal X4 on the control unit.

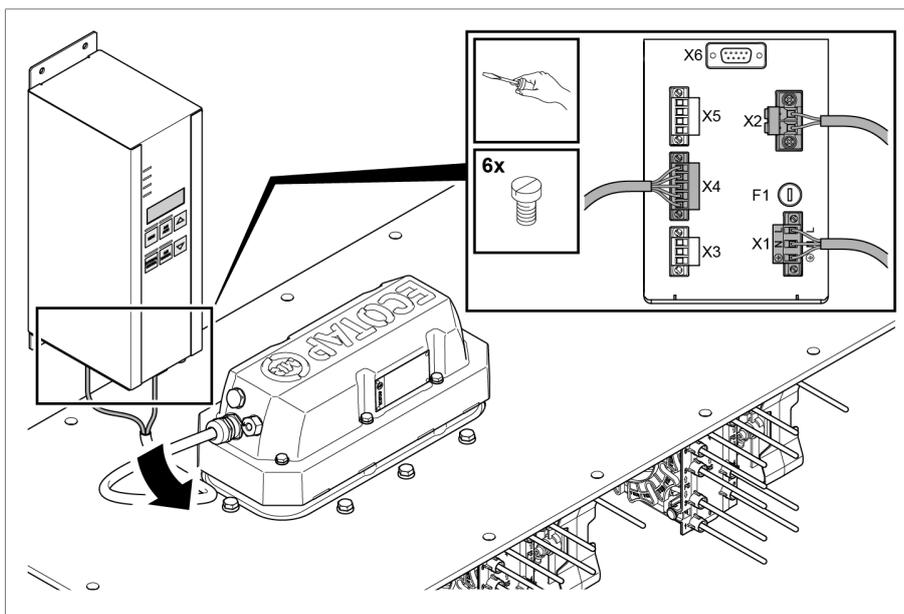


Figure 19: Disconnecting the connection cable

5. Wind up the connection cable and secure on the motor-drive unit.

6. Remove the motor-drive unit and keep the screws for the next mounting step.

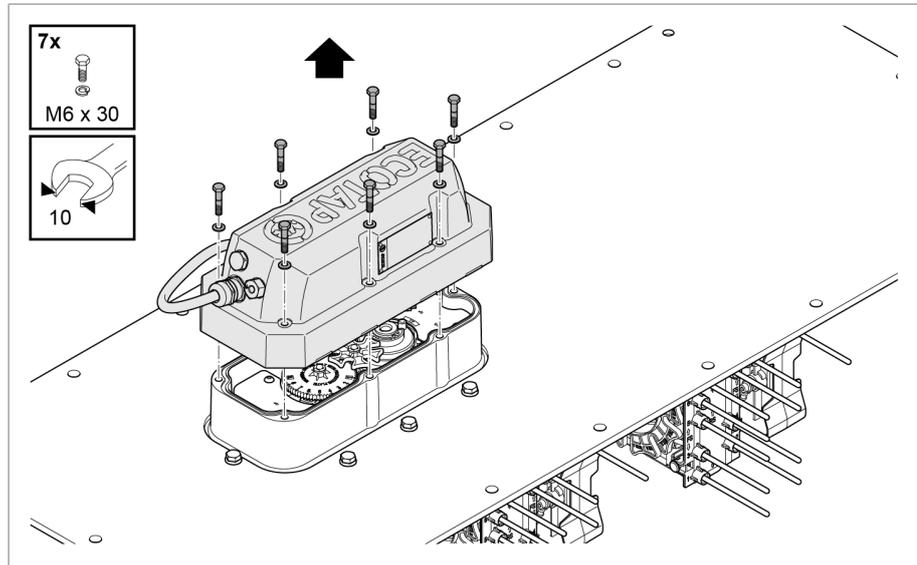


Figure 20: Removing the motor-drive unit

7. Clean sealing surfaces on the sealing module and transport locking plate and check that the o-ring is in the correct position.

8. Attach and fasten the transport locking plate before drying.

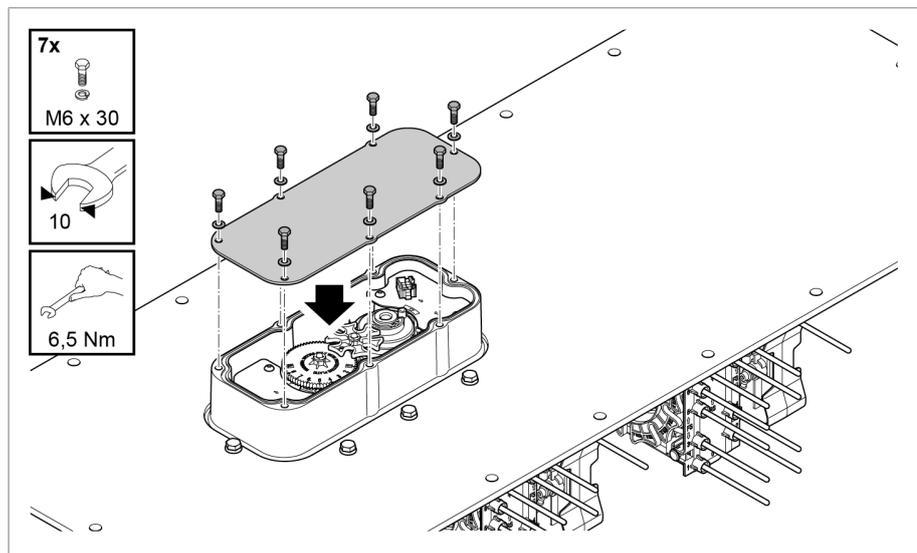


Figure 21: Fastening the transport locking plate

For drying on-load tap-changer and transformer, observe the information provided in the "Drying the on-load tap-changer" chapter in the operating instructions for the ECOTAP® VPD® on-load tap-changer.

In order to perform on-load tap-change operations during the transformer test, you will again need to mount and commission the motor-drive unit and control unit. To do this, follow the description provided in the "Mounting motor-drive unit" [► Section 6.1, Page 29] section.

### 7.1.3 Tests on the transformer



Please contact Maschinenfabrik Reinhausen GmbH (MR) if any aspect of the tests is not clear.

#### 7.1.3.1 Electrical high-voltage tests on the transformer

##### **▲ WARNING**



##### **Danger of death or severe injury from explosive gases when testing the transformer!**

Danger of death from flying debris and spraying of hot oil if incorrect action is taken when explosive gases accumulate under the transformer cover, in the piping, in the oil conservator, and at the dehydrating breather opening!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ Ensure that the on-load tap-changer is fully submerged in oil.
- ▶ Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.
- ▶ Ensure that all safety equipment is ready for use.
- ▶ Use suitable personal protective equipment/clothing.
- ▶ Keep away from the danger area during the transformer test.
- ▶ Observe applicable fire protection regulations.
- ▶ Make sure that only trained technicians perform work on the transformer.

Every on-load tap-changer has been specially designed by the manufacturer for the transformer in the respective purchase order and is subjected to strict tests and quality controls at the manufacturer's factory.

However, joint operation of transformer and on-load tap-changer cannot be simulated by the manufacturer and cannot be tested on the on-load tap-changer alone.

For this reason, irregularities or malfunctions cannot be completely ruled out during the transformer test (i.e. testing the first joint operation of transformer and on-load tap-changer).

It is essential that you ensure only trained, instructed expert personnel who are familiar with and comply with the pertinent safety and technical regulations, who are aware of the potential risks, and who consistently use the occupational safety equipment provided to prevent injury and property damage are assigned to perform such a transformer test.

Remove all leads used for testing before the high voltage test as these function as antennas. Ensure that the clearance needed between bushings and motor-drive unit, including the connection cable, is observed at all times.

If you have any questions about possible sources of danger, consult the manufacturer before starting to test the transformer.

Only undertake the electrical tests required for transformer acceptance once the aforementioned work is complete.

### 7.1.3.2 Resetting automatic adjustment

Reset the automatic adjustment prior to transporting the transformer to the installation site. This ensures that automatic adjustment is carried out again during commissioning at the installation site.

To reset the automatic adjustment, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press .

2. Press  +  for longer than 5 seconds.

⇒ 

3. Press  until code 3 is displayed.

⇒ 

4. Press  to confirm the selection.

⇒ The LED  lights up and event code E4 is displayed.

### 7.1.3.3 Dielectric tests on transformer wiring

The motor-drive unit and control unit are subjected to dielectric tests before delivery. Another dielectric test is not necessary.

1. **⚠ DANGER!** Ensure that all cables in the working area are de-energized and that the shutdown equipment is locked so that it cannot be switched on again. If this is not done, there is a risk of fatal injury due to electrical voltage.
2. **📢 NOTICE!** Ensure that the dielectric test of the transformer wiring is only performed when the control unit is completely disconnected. Otherwise, it will be damaged.



## 7.2 Transporting transformer to the operating site

### **▲ DANGER**



#### **Risk of life-threatening injury due to electric shock!**

If the device and system peripherals are not disconnected from the mains, electric shock may occur!

- ▶ De-energize the device and system peripherals and lock them to prevent them from being switched back on.

### **NOTICE**

#### **Damage to the on-load tap-changer!**

Damage to the on-load tap-changer due to incorrect positioning!

- ▶ Do not disconnect the motor-drive unit from the on-load tap-changer after the on-load tap-changer's automatic adjustment.

1. To transport the transformer, disconnect connection cable from control unit. You will find a description of this process in the "Dielectric tests on the transformer wiring" [▶ Section 7.1.3.3, Page 44] section.
2. **NOTICE!** Damage to the motor-drive unit due to moisture ingress. Coil the connection cable, secure it on the motor-drive unit and use plastic film and adhesive tape to protect from moisture.
3. **NOTICE!** Damage to the control unit due to incorrect transportation or storage. Transport control unit in MR packaging used for delivery. Do not transport or store the control unit in the open.

## 7.3 Commissioning transformer at operating site

Before energizing the transformer, you must mount and connect the control unit and perform trial tap-change operations.

### 7.3.1 Mounting control unit

Depending on design, you can mount the control unit as follows:

- Mounting on a flat surface
- Mounting on a low-voltage busbar using a device carrier
- Mounting the control cabinet

Observe the description below.

### 7.3.1.1 Mounting on a flat surface

To mount the control unit on a flat surface, proceed as follows:

1. Secure the control unit to the flat surface using the fixing brackets provided for this purpose. Note the dimensional drawing in the appendix.
2. Use one of the lower attachment points to ground the control unit housing. To do so, crimp an earthing cable (minimum cross-section 8 mm<sup>2</sup>) with a ring-type cable terminal and attach it with washers (contact washer and safety washer) and M6 bolt.

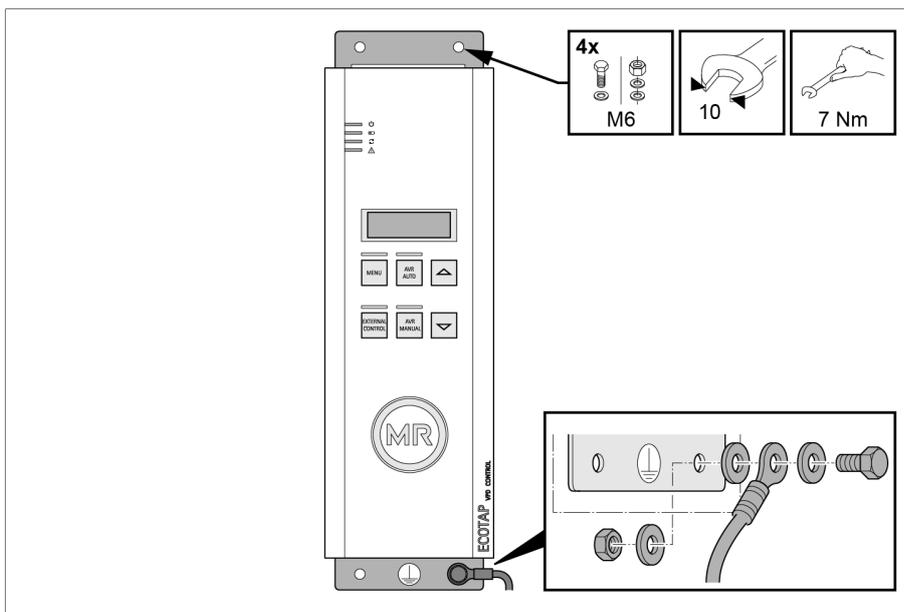


Figure 23: Mounting the control unit

### 7.3.1.2 Mounting on low-voltage busbar

You can mount the control unit on the low-voltage busbar using an optional device carrier.

**⚠ DANGER**



#### Risk of life-threatening injury due to electric shock!

If the low-voltage busbar is not disconnected from the mains when the device carrier is being mounted, this may result in electric shock!

- ▶ To mount the device carrier, disconnect the low-voltage busbar from the mains.
- ▶ If the low-voltage busbar cannot be disconnected from the mains, observe national requirements for working on live equipment.

To mount, proceed as follows:

1. Attach the device carrier to the stud bolts of the low-voltage busbar using retaining brackets and tighten.

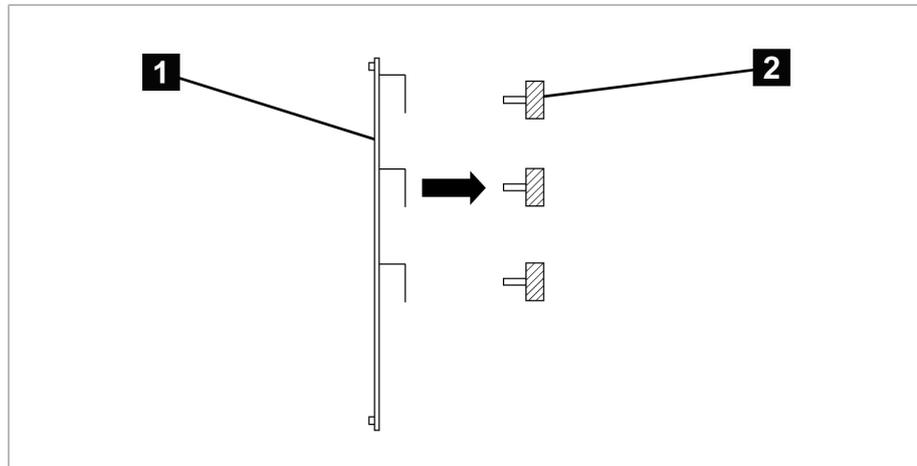


Figure 24: Attaching the device carrier to stud bolts of the low-voltage busbar

1 Device carrier

2 Low-voltage busbar stud bolt

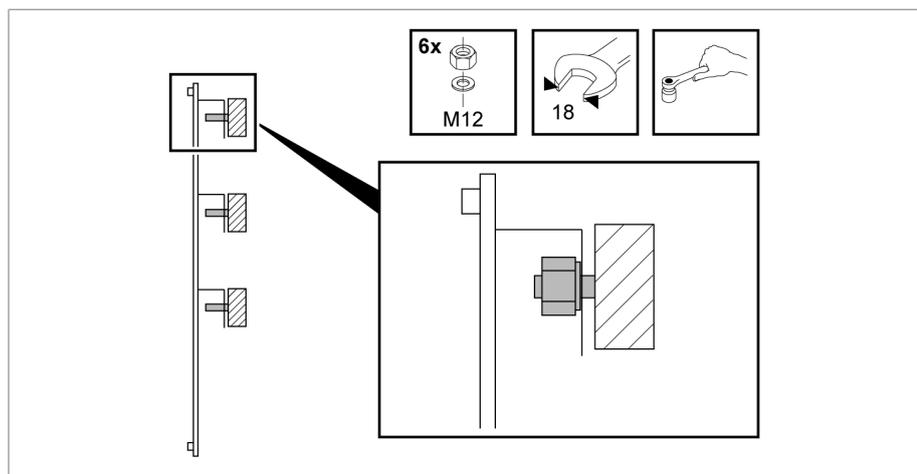


Figure 25: Fastening the device carrier

2. Attach the control unit to the device carrier and fasten using washers, spring washers, and nuts.

- Use one of the lower attachment points to ground the control unit housing. To do so, crimp an earthing cable (minimum cross-section 8 mm<sup>2</sup>) with a ring-type cable terminal and attach it with contact washer, safety washer, and M6 nut.

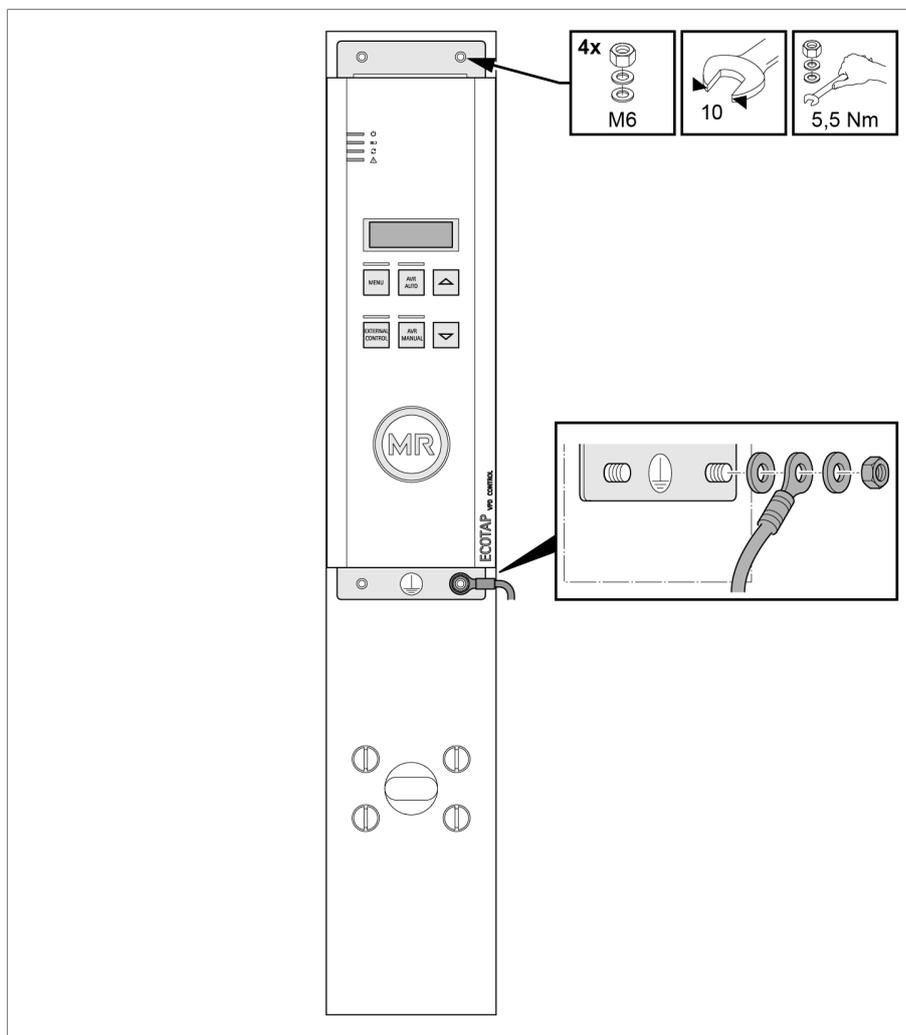


Figure 26: Fastening the control unit

### 7.3.1.3 Mounting the control cabinet

#### **NOTICE**

#### **Damage to the device.**

Direct solar irradiation can lead to impermissibly high temperatures in the control cabinet and damage the control unit.

- Ensure that the control cabinet is not exposed to direct solar irradiation.

As an option, the control unit is supplied in the control cabinet. To mount the control cabinet on a level surface, proceed as follows:

1. Secure the control cabinet to the level surface using the fixing brackets provided for this purpose. Observe the dimensional drawing supplied with the control cabinet when doing so.



The fastening material for fastening the control cabinet is not included in the scope of delivery.

2. Connect the control cabinet grounding using a ground strap or grounding cable made of copper (cross-section of at least 16 mm<sup>2</sup>).



The ground connection is located in the lower right-hand corner of the control cabinet (side wall or base). The following illustrates the two possible ground connection versions.

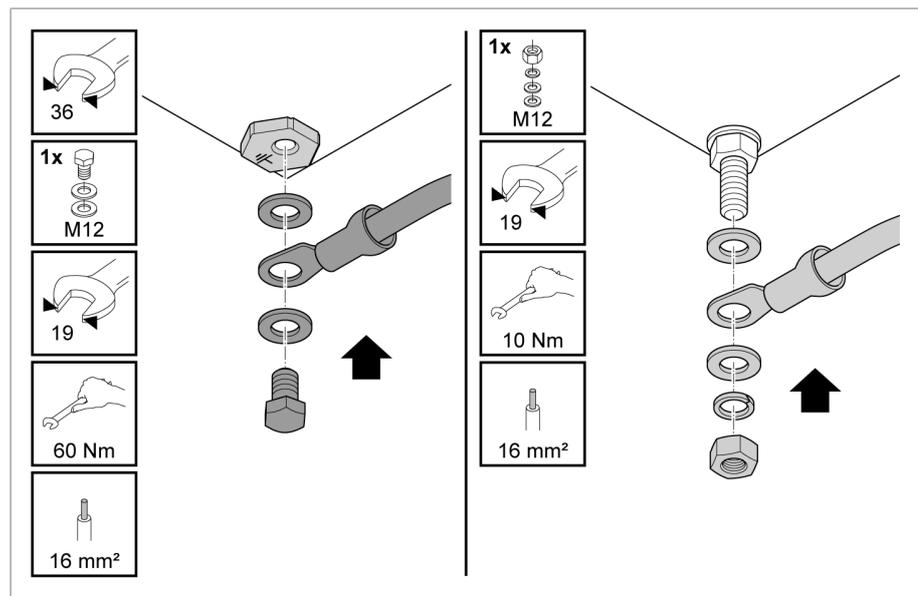


Figure 27: Control cabinet ground connection examples

### 7.3.2 Connecting control unit at operating site

The following section describes how to make the electrical connection to the control unit at the operating site.

**⚠ DANGER**



#### Risk of fatal injury due to electrical voltage!

Danger of death due to electrical voltage when assembling and connecting the device.

- ▶ De-energize the device and system peripherals and lock them to prevent them from being switched back on.

### 7.3.2.1 Cable recommendation

Please note the following recommendation from Maschinenfabrik Reinhausen GmbH when wiring the device:

Cable	Terminal	Cable type	Conductor cross-section	Max. length
Power supply and voltage measurement	X1	Unshielded	1.5 mm <sup>2</sup> with ferrule 2.5 mm <sup>2</sup> without ferrule	-
Blocking contact	X3			-
Customer messages	X5			-
RS485; SUB-D	X6	Shielded	0.25 mm <sup>2</sup>	500 m
Optional control cabinet grounding	-	Unshielded	≥ 16 mm <sup>2</sup>	-

Table 9: Recommendation for connection cables

The connection cable between the motor-drive unit and the control unit is supplied as standard.

#### **⚠ DANGER**



#### **Danger of explosion!**

An impermissibly long connection cable between the motor-drive unit and control unit can lead to malfunctions of the motor-drive unit and the on-load tap-changer. This allows the on-load tap-changer to remain in an impermissible operating position. This can lead to an explosion in the transformer.

- ▶ Only use the connection cable provided.
- ▶ The connection cable may not be altered.

### 7.3.2.2 Electromagnetic compatibility

The device has been developed in accordance with applicable EMC standards. The following points must be noted in order to meet the EMC standards.

#### 7.3.2.2.1 Wiring requirement of installation site

Note the following when selecting the installation site:

- The system's overvoltage protection must be effective.
- The system's ground connection must comply with all technical regulations.
- Separate system parts must be joined by a potential equalization.

### 7.3.2.2.2 Wiring requirement of operating site

Note the following when wiring the operating site:

- Route the connecting leads in grounded metal cable ducts.
- Do not route lines which cause interference (for example power lines) and lines susceptible to interference (for example signal lines) in the same cable duct.
- Maintain a clearance of at least 100 mm between lines causing interference and lines susceptible to interference.

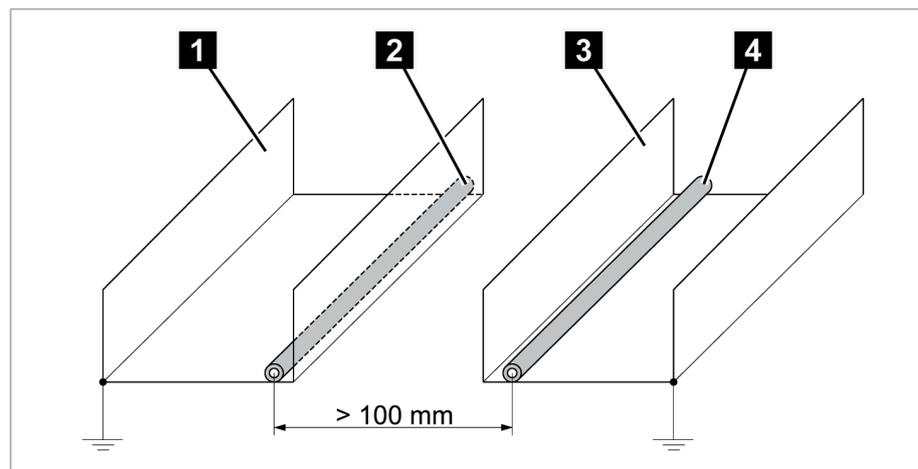


Figure 28: Recommended wiring

1 Cable duct for lines causing interference	3 Cable duct for lines susceptible to interference
2 Line causing interference (for example power line)	4 Line susceptible to interference (e.g. signal line)

- Short-circuit and ground reserve lines.
- Never connect the device with a multi-core bus line.
- For signal transmission, use shielded lines with individual conductors (outgoing conductor / return conductor) twisted in pairs.
- The shield must be connected across the entire surface (360°).

For optional installation of the control unit in a control cabinet, also note the following:

1. If both the control cabinets in which the start and end of the cable are connected are on the same potential: Use shield on both sides.
2. **NOTICE!** If both the control cabinets in which the start and end of the cable are connected are on a different potential: Only use shield on one side. Otherwise circulating currents caused by potential equalization will arise which may cause damage due to grounding loops.

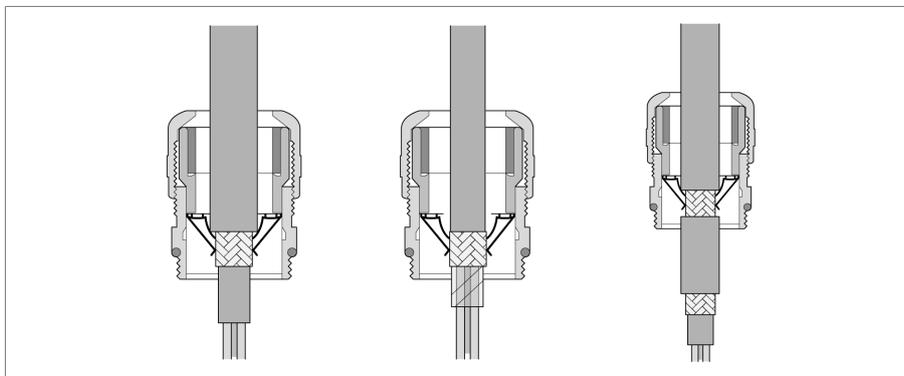


Figure 29: Example: Shield with cable screw connections

### 7.3.2.3 Requirements for the power supply circuit

#### Power supply during commissioning tests

**⚠ DANGER**



#### Danger of explosion!

An incorrect position of the on-load tap-changer or the motor drive shaft can lead to malfunction and, consequently, to an overload of the on-load tap-changer. This overload can lead to an explosion in the transformer.

- ▶ Carry out automatic adjustment and trial tap-change operations on a voltage-free transformer.
- ▶ Supply the controller and motor-drive unit via a separate voltage source during these tests.
- ▶ If a separate voltage source is not available, it is imperative that the correct position of the on-load tap-changer and motor-drive unit be checked again according to the section "Mounting the motor drive" [▶ Section 6.1, Page 29] before these tests.

Ensure the correct position of motor-drive unit: The feather key **1** of the motor shaft must be facing the mark **2**:

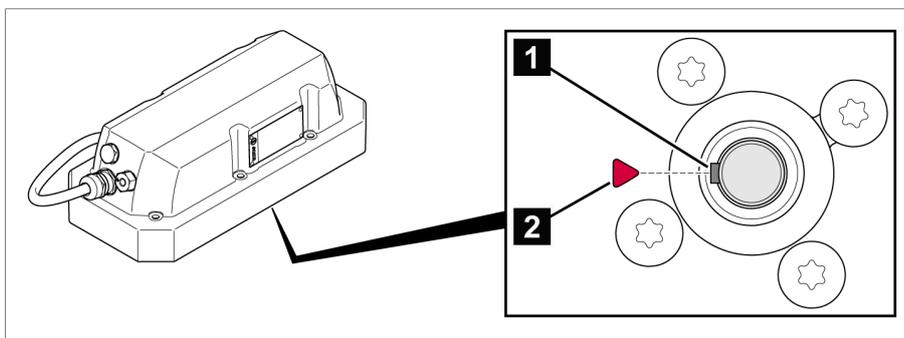


Figure 30: Check the position of the motor-drive unit

Ensure the correct position of the on-load tap-changer: The marking on the cam disk **1** must be in the marked area on the cover **2**:

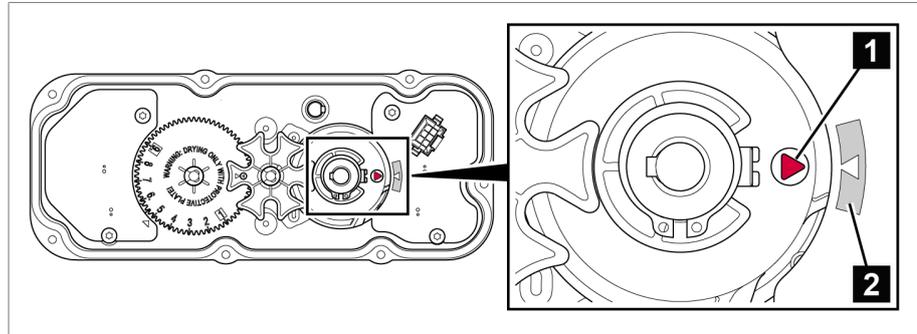


Figure 31: Checking the position of the on-load tap-changer

Further details: See section "Mounting the motor-drive unit" [► Section 6.1, Page 29].

### Power supply during operation

After completing the test tap-change operations, you must adjust the power supply for the control unit supplied from a separate power source for the tests.



The electrical voltage of the motor-drive unit and control unit has to be supplied by the controlled transformer itself during operation, because this signal is also used as the measurement signal.

### All-pole isolating device

You may connect the control unit only to circuits with an external overcurrent protection device and an all-pole isolating device, enabling the equipment to be fully de-energized if required (service, maintenance, etc.).

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC 60947-3 (e.g. circuit breakers). Observe the properties of the relevant circuits (voltage, maximum currents) when selecting the circuit breaker type. In addition, observe the following:

- It must be easy for the operator to access the isolating device
- The isolating device must be labeled for the device and the circuits to be isolated
- The isolating device may not be a part of the power line
- The isolating device may not interrupt the main protective conductor

You must connect the power supply circuit with a conductor cross-section of at least 1.5 mm<sup>2</sup> (AWG 16) and protect it with a C10A or B10A type miniature circuit breaker.

### Supply via voltage transformers

**▲ DANGER**



#### Electric shock!

If you supply the device via a voltage transformer, the output voltage of the voltage transformer has no bearing on the protective conductor. As a result, protection of the device against electric shock in the event of an error is not guaranteed.

- ▶ Take appropriate measures to protect against electric shock according to IEC 61140 and the local connection regulations.

Further conditions:

- Assurance that there are no voltage drops in the converter under load to ensure regular operation.
- For the correct dimensioning of the voltage transformer, observe the information in the section "Technical data of the control unit" [▶ Section 15.1, Page 113].
- The measurement accuracy is influenced by the measuring error of the voltage transformer.
- During the charging process for the energy accumulator, the measuring error of the voltage transformer can increase significantly ( $\pm 2.3\%$ ). The charging process for the energy accumulator takes approx. 35 s during initial charging and approx. 0.3 s after each on-load tap-change operation.
- The transmission ratio of the voltage transformer must be taken into consideration when setting the desired value.

The transmission ratio influences the voltage measurement value shown in the display. Conversion within the controller is not possible.

### 7.3.2.4 Connecting control unit in standard design

For the correct connection, observe the connection diagram supplied.

1. Connect the 5-wire connection cable of the motor-drive unit to terminal X4 (0.4 Nm).
2. Connect the 2-wire connection cable of the motor-drive unit to terminal X2 (0.5 Nm).

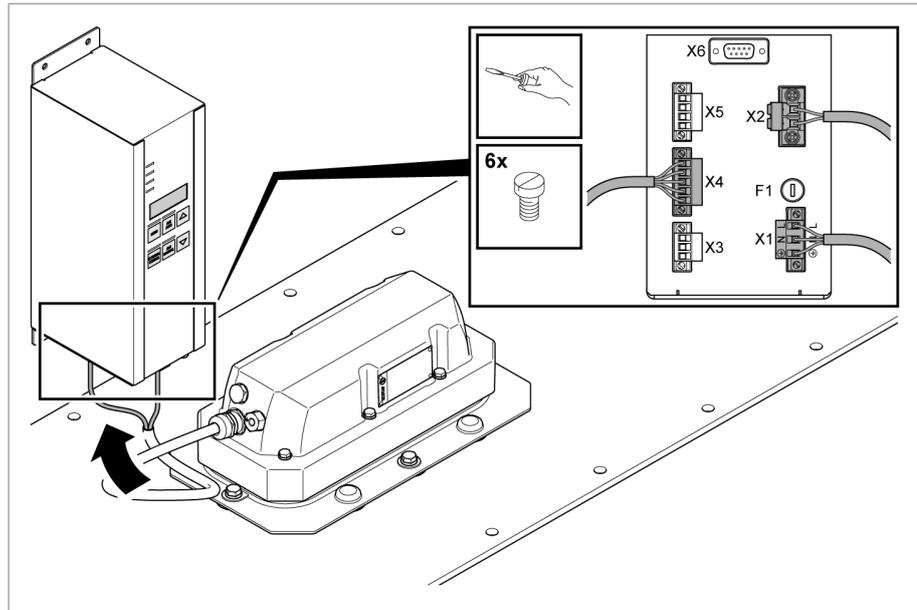


Figure 32: Connection cable connection

3. Secure the connecting cable of the motor-drive unit with a strain relief in the area before the cable harness is split.
4. Screw the signal for blocking (e.g. door interlock or temperature blocking) onto the supplied plug connector for X3 with a torque of 0.4 Nm. Tighten the plug connector onto terminal X3 with a torque of 0.4 Nm.
5. Screw the wiring for the "Customer messages" interface (*ready/error*) to the supplied plug connector for X5 with a torque of 0.4 Nm. Tighten the plug connector onto terminal X5 with a torque of 0.4 Nm.
6. **⚠ DANGER!** Ensure that the connections PE, N, and L are not interchanged. Otherwise, dangerously high voltages could occur at the housing. Tighten (0.5 Nm) the control unit power supply to the plug connector for X1 in accordance with the supplied connection diagram. In addition, use the green cable housing supplied for touch protection.
7. The plug connector is coded. Carry out the installation without using force by connecting the plug connector to terminal X1 correctly according to the device labeling and screwing it tight with 0.5 Nm.
8. Tighten the SUB-D connector (Modbus communication) at X6 with a torque of 0.1 Nm.



- When using the optional adapter cables [► Section 15.1, Page 113] for the X1 and X6 connections (control unit with material number 1016530700), ensure sufficient strain relief. Tighten X1 with 0.5 Nm and X6 with 0.1 Nm.

### 7.3.2.5 Connecting the control unit in the control cabinet



Depending on the control cabinet version, the control cabinet door can be secured using a padlock to protect the control cabinet against unauthorized access.

There are several cable bushings on the floor of the control cabinet. To feed through the cable, proceed as follows:

- Remove the pre-assembled plugs of the connecting cable to the motor-drive unit (connectors X2 and X4).
- Remove the cap nut and the red dummy plug.

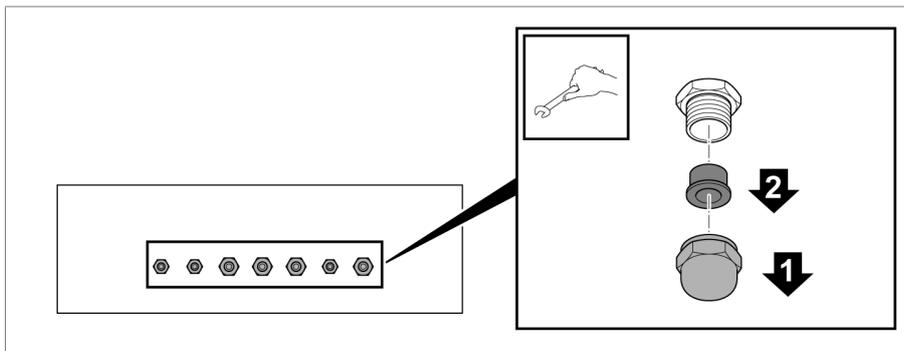


Figure 33: Removing the cover

- Thread the cap nut onto the cable.
- Pull the cable through the bushing and tighten the cap nut.

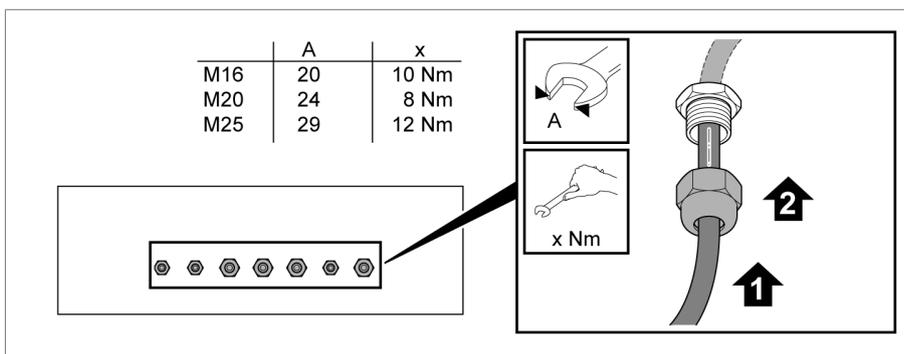


Figure 34: Fastening the cable bushing

- Install plugs for the connecting cable to the motor-drive unit (connectors X2 and X4).

Terminal	Plug connection	Cable
X2	1	1
	2	2
X4	1	3
	2	4
	3	5
	4	6
	5	7

Table 10: X2 and X4 connector assignment

**Connect the control unit as shown in the connection diagram provided**

1. Connect the 5-wire connection cable of the motor-drive unit to terminal X4 or X4.1 (depending on control cabinet version).
2. Connect the 2-wire connection cable of the motor-drive unit to terminal X2 or X2.1 (depending on control cabinet version).
3. Connect the signal for blocking (e.g. door interlock or temperature blocking) to terminal X3.1.
4. Connect the wiring for the "Customer messages" interface (*ready/error*) to terminal X5.1.
5. Connect the power supply for the control unit to terminal X1.1 in the control cabinet.

**Control cabinet version with multi-piece cable gland**

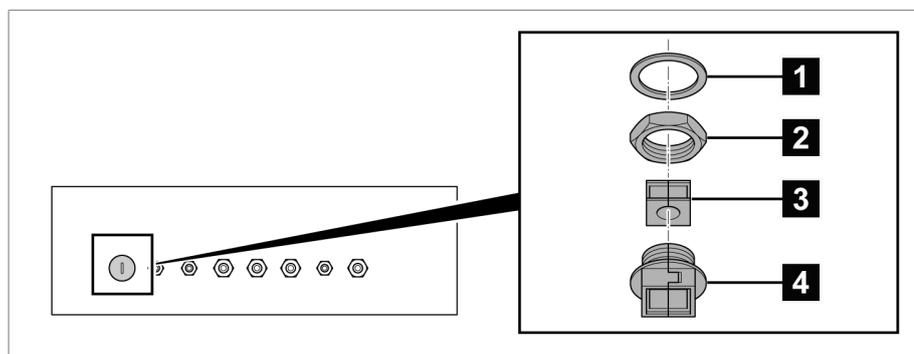


Figure 35: Cable bushing for the connection cable to the motor-drive unit

1 Sealing ring	2 Hexagon nut
3 Cable sleeve	4 Separable cable bushing

To feed through the connection cable to the motor-drive unit, proceed as follows:

1. Remove the blank cover using a screwdriver; hold against the hexagon nut inside of the control cabinet using an open-ended wrench while doing so.

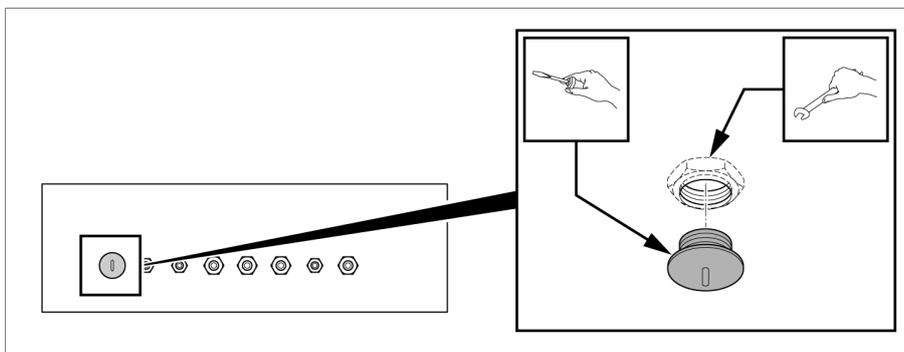


Figure 36: Removing the blank cover

2. Remove the latch of the separable cable gland using a screwdriver.

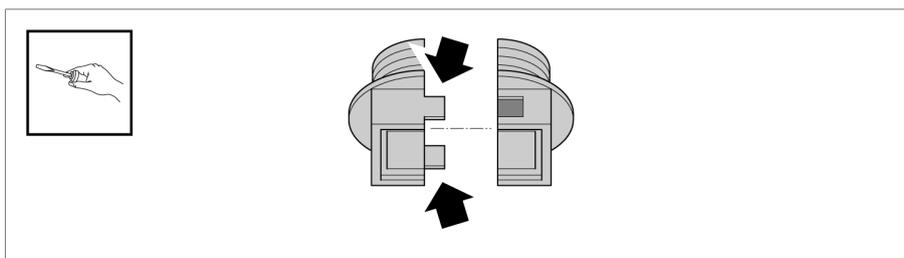


Figure 37: Separating the cable gland

3. Insert the cable into the cable sleeve.
4. Place the cable sleeve in one half shell of the separable cable bushing, snap the second half of the cable bushing into place.

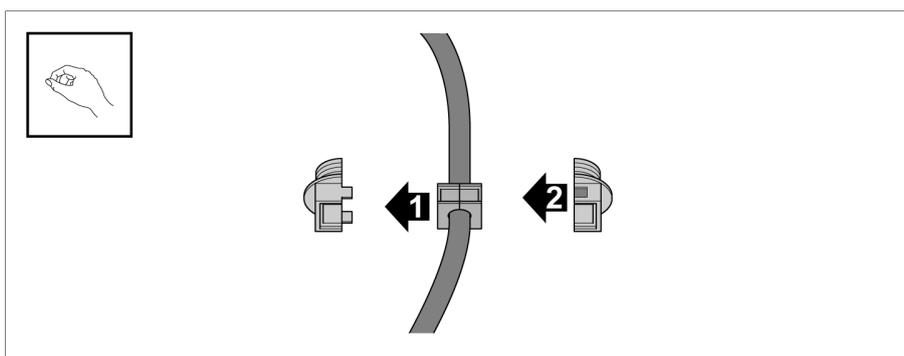


Figure 38: Snapping the cable sleeve into place

5. Push the sealing ring over the plug and the cable.

6. Feed the cable with plug through the enclosure opening.

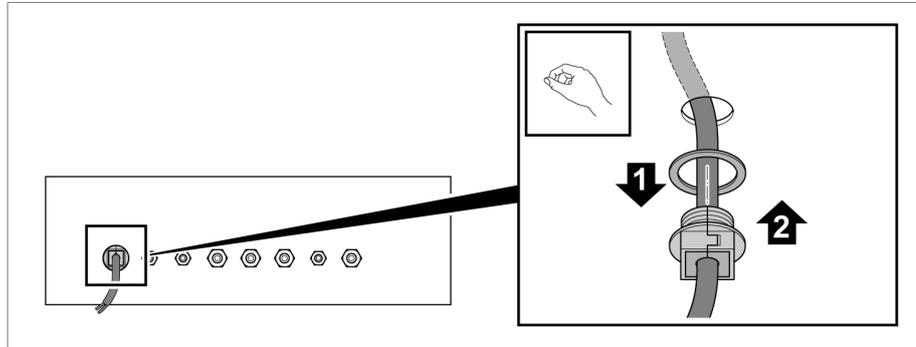


Figure 39: Feeding the cable through

7. Inside the control cabinet enclosure, push the hexagon nut over the plug and the cable.

8. Tighten the hexagon nut on the enclosure bushing.

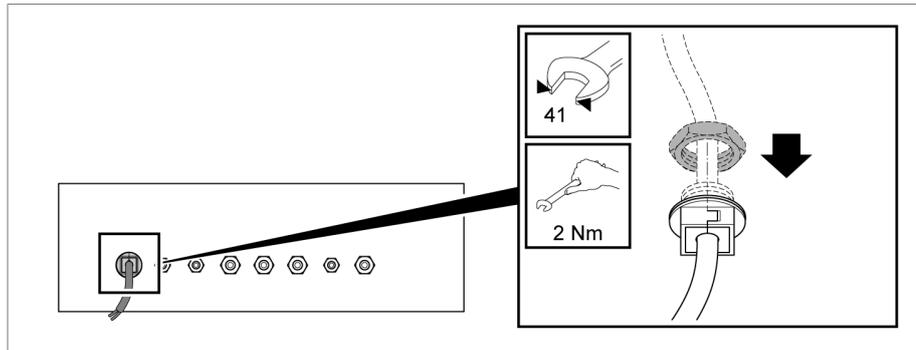


Figure 40: Fastening the cable bushing

9. Secure the cable to the strain-relief rail on the cap rail using two cable ties.

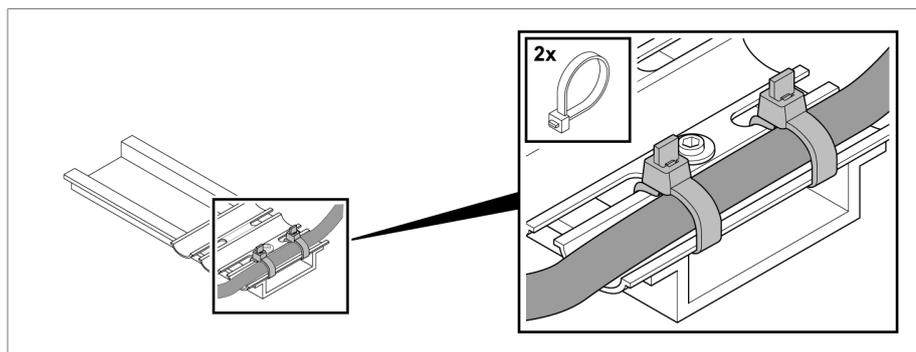


Figure 41: Securing the cable to the strain-relief rail

### 7.3.3 Switching on power supply

#### **▲ DANGER**



#### **Danger of explosion!**

An incorrect position of the on-load tap-changer or the motor drive shaft can lead to malfunction and, consequently, to an overload of the on-load tap-changer. This overload can lead to an explosion in the transformer.

- ▶ Carry out automatic adjustment and trial tap-change operations on a voltage-free transformer.
- ▶ Supply the controller and motor-drive unit via a separate voltage source during these tests.
- ▶ If a separate voltage source is not available, it is imperative that the correct position of the on-load tap-changer and motor-drive unit be checked again according to the section "Mounting the motor drive" [▶ Section 6.1, Page 29] before these tests.

Ensure that the transformer is idle.



To protect the loads from impermissible fluctuations in voltage, only activate the load circuits (low-voltage busbar) after all tests are finished.

To activate the motor-drive unit and control unit, proceed as follows:

**NOTICE!** Serious delay in commissioning due to wiring errors! Ensure the correct connection in accordance with section "Connecting control unit at operating site" [▶ Section 7.3.2, Page 50].

1. Activate the power supply for the control unit.

- ⇒ The control unit starts automatically after a few seconds. The  LED flashes for 10 s to indicate the inrush interlock. After 10 s, this LED lights up blue continuously.
- ⇒ The  LED also starts by flashing and then lights up continuously as soon as the internal energy accumulator is fully charged.
- ⇒ If the  LED is not lit up, then the control unit is ready.
- ⇒ In rotation, the display shows: measured voltage, switch position, number of tap-change operations and event message (if present).
- ⇒ If the red  LED is lit up and the *E4* event code appears in the display, the motor-drive unit and control unit have not yet been adjusted to one another.

2. Before commissioning, an automatic adjustment of the on-load tap-changer and the motor-drive unit must be made. Observe section "Automatic adjustment" [▶ Section 8.3.9.1, Page 84] for this.

### 7.3.4 Performing trial tap-change operations

Before you activate the transformer, you must carry out trial tap-change operations to check the mechanical and electrical functions of the on-load tap-changer and the motor-drive unit.

✓ You have already carried out automatic adjustment [► Section 8.3.9.1, Page 84] of the on-load tap-changer and the motor-drive unit.

1. Press  to activate the AVR MANUAL operating mode.  
⇒ The status LED above the key lights up.

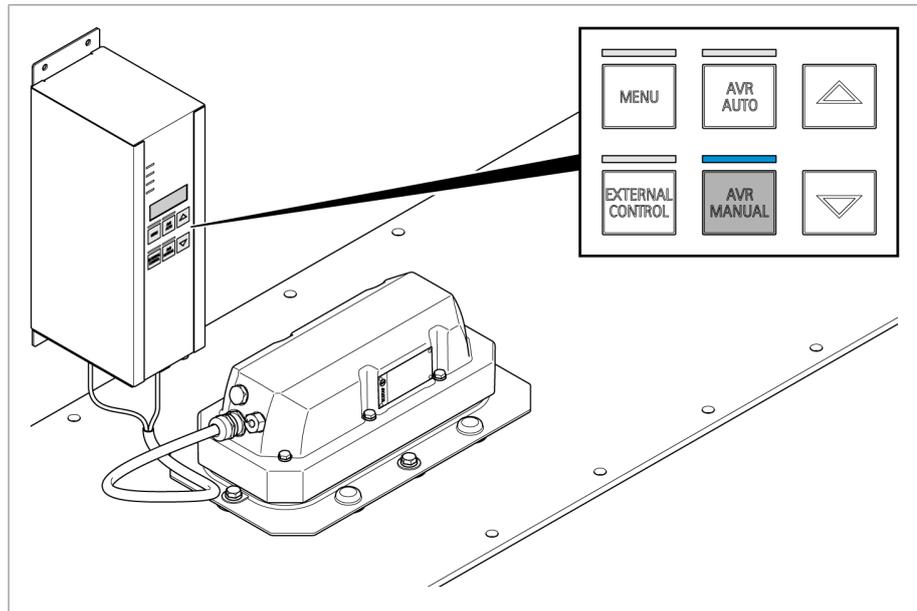


Figure 42: Activating manual mode

2. Use the RAISE/LOWER arrow keys to undertake trial tap-change operations across the entire range of settings.
3. Check that the control unit records and correctly displays every position. Otherwise, carry out automatic adjustment again.



The control ensures that the required cooling time of approx. 3 seconds is maintained after each on-load tap-change operation. During this time, the control will not accept any tap-change commands.



### 7.3.5 Switching on medium voltage

After completing the trial tap-change operations, you must adjust the voltage supply for the control unit supplied through a separate power source. The voltage supply has to be supplied by the controlled transformer itself during operation, because this signal is also used as the measurement signal.

1. **⚠ DANGER!** Ensure that all cables in the working area are de-energized and that the shutdown equipment is locked so that it cannot be switched on again. Otherwise, there is a risk of fatal injury due to electrical voltage during the subsequent work.
2. Screw on the plug connector for terminal X1 on the control unit.
3. Disconnect wiring to the separate power source from this plug connector.
4. Adjust the voltage supply from the transformer to the specification and the information in the technical data [► Section 15, Page 113].
5. **⚠ DANGER!** Ensure that the connections PE, N, and L are not interchanged. Otherwise, dangerously high voltages could occur at the housing. Tighten (0.5 Nm) the wiring for the transformer power supply to the plug connector for X1 in accordance with the supplied connection diagram.
6. The plug connector is coded. Carry out the installation without using force. Connect the plug connector to terminal X1 correctly according to the device labeling and screw it tight with 0.5 Nm.



To protect the loads from impermissible fluctuations in voltage, only activate the load circuits (low-voltage busbar) after all tests are finished.

To activate the motor-drive unit and control unit, proceed as follows:

► Switch on medium voltage (transformer is idle).

- ⇒ The control unit starts automatically after a few seconds. The  LED flashes for 10 s to indicate the inrush interlock. After 10 s, this LED lights up blue continuously.
- ⇒ The  LED also starts by flashing and then lights up continuously as soon as the internal energy accumulator is fully charged.
- ⇒ If the  LED is not lit up, then the control unit is ready.
- ⇒ If the red  LED lights up and the *E4* event code is shown in the display, the automatic adjustment was not carried out correctly.

### 7.3.6 Setting parameters

Set the most important parameters for commissioning the device in accordance with your requirements:

1. P1: Set desired voltage [► Section 8.3.1.1, Page 72].
2. P2.1: Set bandwidth B1 [► Section 8.3.1.2, Page 73].

3. P2.2: Set delay time T1 [► Section 8.3.1.3, Page 74].
4. P3.1: Set bandwidth B2 [► Section 8.3.1.4, Page 74].
5. P3.2: Set delay time T2 [► Section 8.3.1.5, Page 75].
6. P4.1: Set undervoltage blocking [► Section 8.3.2.1, Page 76].
7. P4.2: Set overvoltage blocking [► Section 8.3.2.2, Page 76].
8. P5: Set blocking function [► Section 8.3.3, Page 77].
9. F5: Set inverting [► Section 8.3.13, Page 89].

⇒ The most important parameters for voltage regulation have been set.

If you would like to set further parameters, follow section Configuring the control unit [► Section 8.3, Page 71].

### 7.3.7 Checking automatic voltage regulation

To check the automatic voltage regulation, proceed as follows:

1. Measure voltage on low-voltage side of transformer.
2. Press  to activate the AVR MANUAL operating mode.
3. Press  or  as often as necessary until the measured voltage is beyond the range of the set bandwidth (desired voltage  $\pm$  bandwidth).
4. Press  to activate AVR AUTO operating mode.
  - ⇒ After the delay time, the on-load tap-changer moves back into the range of the set bandwidth. If this does not happen, check the voltage regulation parameters [► Section 8.3.1, Page 71] and repeat the test.
5. Press  to activate the AVR MANUAL operating mode.
  - ⇒ Automatic voltage regulation has been checked.

### 7.3.8 When operating with alternative insulating liquids: activating temperature blocking

You can operate the on-load tap-changer with alternative insulating fluids upon request. When doing so, you must ensure that switching operations cannot be performed during operation if the transformer's insulating fluid temperature is less than the permissible temperature. You can use the control unit blocking contact for this.

To use the control unit blocking contact, observe the following points:

- The temperature sensor in the transformer tank must be adjusted to the permissible temperature range.
- The temperature sensor must make a signal in the form of a floating contact available, and it must be connected to the control unit blocking contact (terminal X3).
- The blocking function parameter (P5) must be set to the value 2 [► Section 8.3.3, Page 77].



### 7.3.9 Switching on the low-voltage busbar

#### NOTICE

#### Damage to the on-load tap-changer and transformer!

An inrush current impulse which has not fully subsided can damage the on-load tap-changer and transformer in the event of an on-load tap changing operation!

- ▶ Once the transformer has been switched on, ensure that the inrush current impulse has fully subsided before undertaking an on-load tap changing operation. The inrush current impulses are usually a multiple of the transformer rated current and can overload the on-load tap-changer during the diverter switch operation.

Once you have connected the control unit and undertaken trial tap-change operations, you can commission the low-voltage busbar as follows:

1. Move the on-load tap-changer to the adjustment position.



It may be a good idea to move the on-load tap-changer into a position other than the adjustment position. This allows you to reduce the voltage differences between the grids to be connected and thereby minimize the inrush current impulse.

2. On the control unit, set the desired operating mode by pressing the corresponding key:
  - Auto mode: AVR AUTO
  - Manual mode: AVR MANUAL
  - Control via remote connection: EXTERNAL CONTROL.
3. Switch on the low-voltage busbar.
4. Once the transformer has been switched on, ensure that the inrush current impulse has subsided.
  - ⇒ On-load tap-change operations can now be undertaken both when idling and under load conditions.

## 8 Operation

This chapter describes all the functions and setting options for the device.

### 8.1 Selecting the operating mode

You can select the operating mode via the operating controls on the front panel of the control unit.

#### AVR MANUAL manual mode

In manual mode, you can perform tap-change operations via the  (= increase voltage) and  (= reduce voltage) keys.

#### NOTICE

#### Damage to property through uncontrolled on-load tap-change operations.

As a result of uncontrolled manual tap-change operations, the line voltage of the consumers may exceed the permitted limit values. This may result in damage to the devices and subsequent damage.

- ▶ Only undertake manual tap-change operations if no consumers are connected or if you can ensure that the line voltage on the consumer side does not leave the permitted operating range.

To perform manual tap-change operations, proceed as follows:

1. Press  to activate manual mode.
2. Press  or  to execute a tap-change operation.

#### AVR AUTO auto mode

In auto mode, the device executes the tap-change operations automatically, depending on the set control parameters. Observe section "Configuring the control unit" [▶ Section 8.3, Page 71] for further information on the control parameters. To activate auto mode, proceed as follows:

- ▶ Press  to activate auto mode.

#### Control via EXTERNAL CONTROL

In the EXTERNAL CONTROL operating mode, the device executes the control commands of an external control unit (e.g. ECOTAP® VPD® CONTROL PRO). Refer to the operating instructions supplied with the control unit for more information.

To activate control via EXTERNAL CONTROL, proceed as follows:

- ▶ Press  to activate control via EXTERNAL CONTROL.
- ⇒ The device will perform the OLTC-PreCheck. In this mode, the OLTC-PreCheck is automatically repeated every 24 hours.

## 8.2 Actuating on-load tap-changer using the emergency drive shaft

### ⚠ WARNING



### Danger of death or severe injury!

Improper actuation of the on-load tap-changer may result in death or serious injury!

- ▶ Fully de-energize the transformer and lock to prevent it from being switched back on.
- ▶ Only actuate the on-load tap-changer using the emergency drive shaft to set the adjustment position or for emergency operation. Emergency operation is to be understood as the failure of the motor-drive unit's voltage supply when there is an urgent need to perform an on-load tap-change operation.
- ▶ Only actuate the on-load tap-changer using the emergency drive shaft installed in the sealing module.

To actuate the on-load tap-changer using the emergency drive shaft, proceed as follows:

1. **⚠ DANGER!** Ensure that all cables in the working area are de-energized and that the shutdown equipment is locked so that it cannot be switched on again. Otherwise, there is a risk of fatal injury due to electrical voltage during the subsequent work.
2. Remove the plug connector from terminal X1 on the control unit.
3. Remove the plug connector from terminal X2 on the control unit.
4. Remove the plug connector from terminal X4 on the control unit.

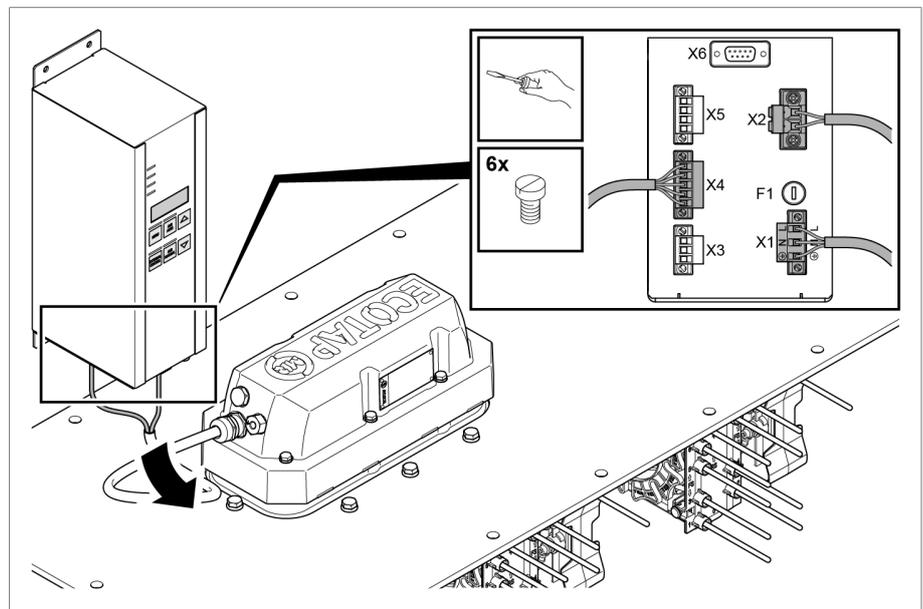


Figure 43: Removing the connection cable

5. Loosen screws and lift motor-drive unit off sealing module.

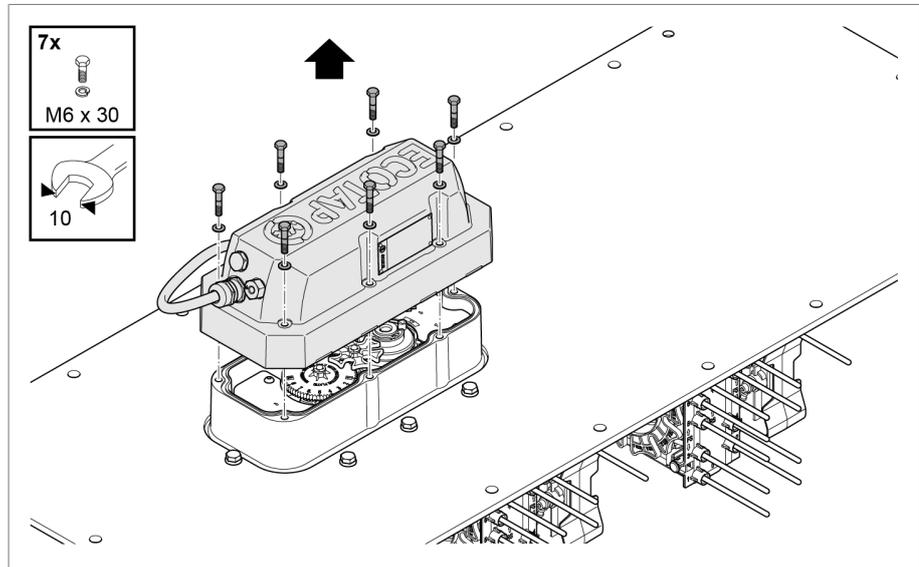


Figure 44: Removing the motor-drive unit

6. Pull the emergency drive shaft out of the bracket in the sealing module.

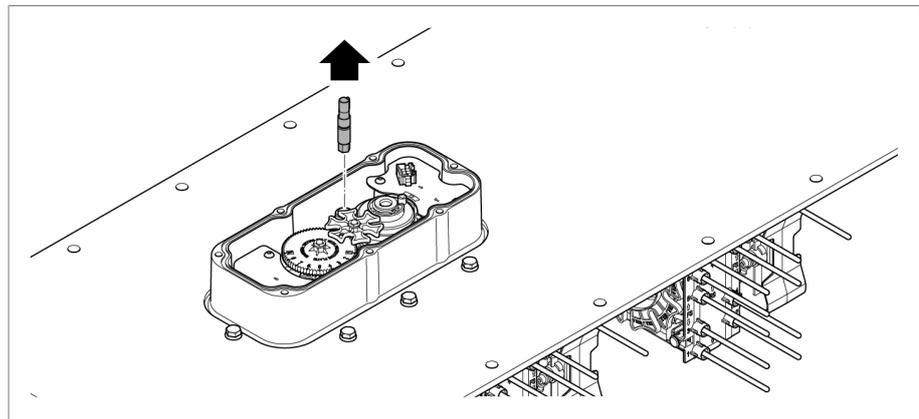


Figure 45: Pulling the emergency drive shaft out of the bracket

7. Plug the emergency drive shaft with feather key into the shaft of the on-load tap-changer.

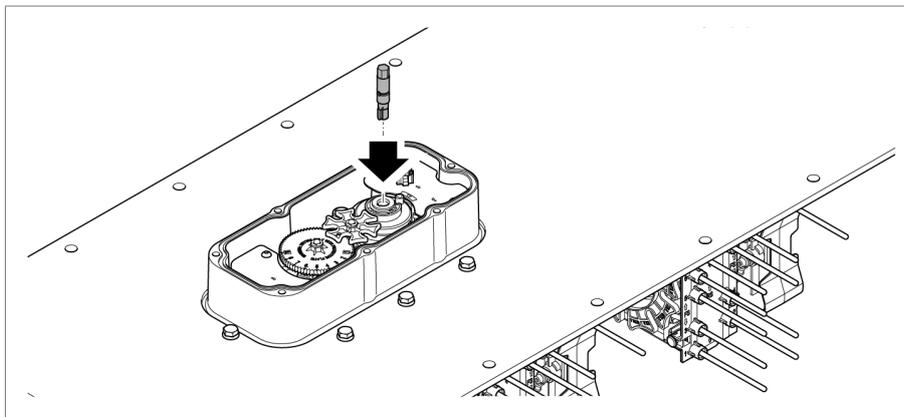


Figure 46: Inserting the emergency drive shaft into the shaft of the on-load tap-changer

8. Rotate the emergency drive shaft in the direction of the desired operating position using an appropriate tool.

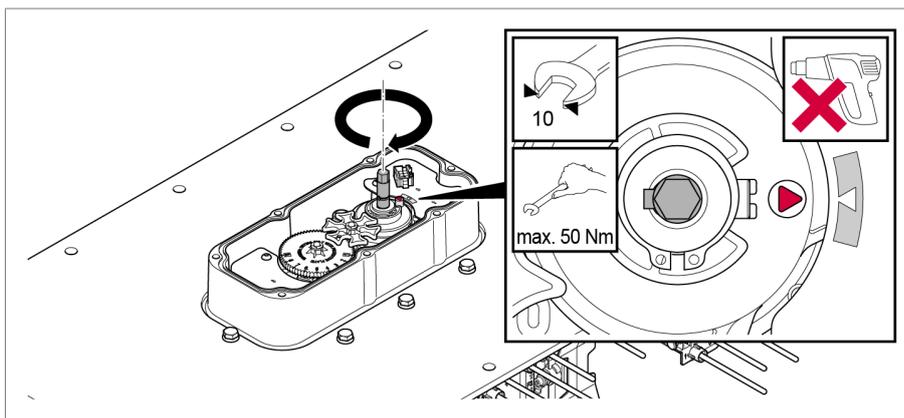


Figure 47: Example Actuating the emergency drive shaft toward operating position 1

9. **NOTICE!** Using the emergency drive shaft, turn in one direction until one complete revolution has been made and the arrow on the cam disk is again pointing to the arrow in the cover. Otherwise, the tap-change operation has not been completed correctly, which may result in damage to the on-load tap-changer and transformer.

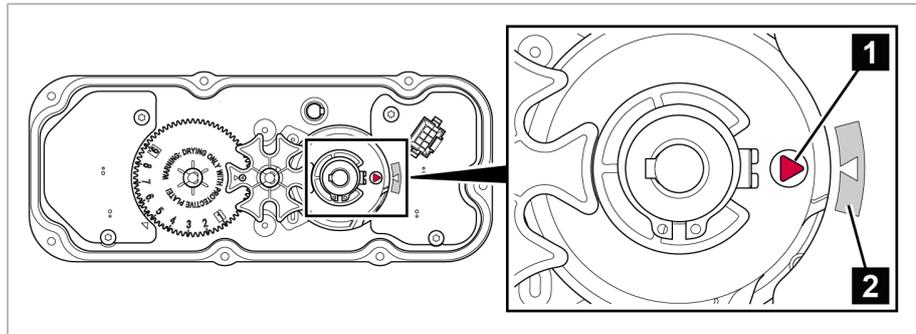


Figure 48: Checking the position of the on-load tap-changer

⇒ The operating position reached is displayed by the control wheel.

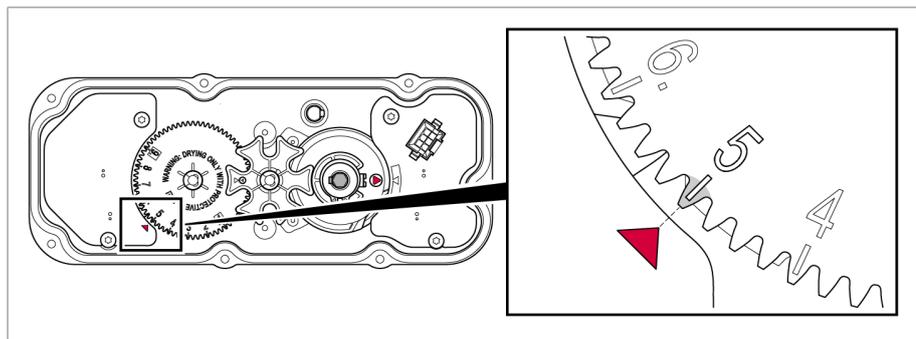


Figure 49: Checking the operating position

10. Pull the emergency drive shaft out of the shaft of the on-load tap-changer and insert it into the bracket.

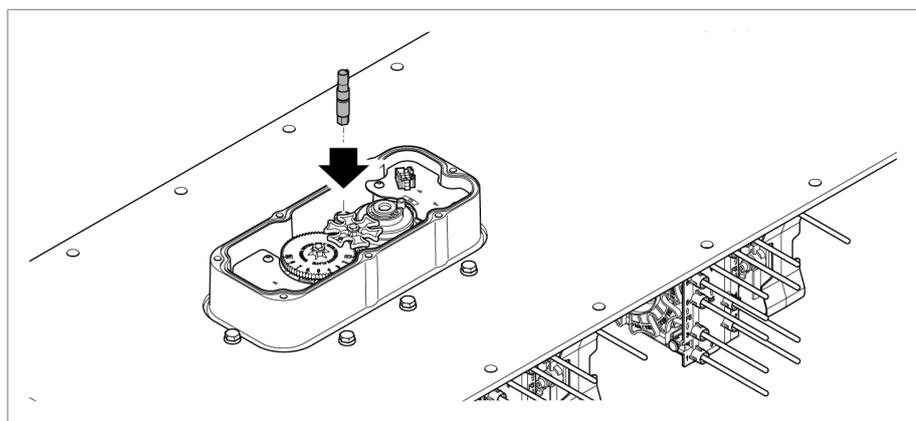


Figure 50: Inserting the emergency drive shaft into the bracket

11. Mount the motor-drive unit as described in section "Mounting the motor-drive unit" [► Section 6.1, Page 29].



12. Connect the plug connector to terminal X4 on the control unit.
13. Connect the plug connector to terminal X2 on the control unit.
14. Connect the plug connector to terminal X1 on the control unit.

### 8.3 Configuring the control unit

This chapter describes how to configure the control unit.



Settings are only saved once the parameterization menu is exited via the **MENU** key. If you do not press the **MENU** key within 30 s, the parameterization menu is exited automatically and the changes are not saved.

#### 8.3.1 Regulation

All of the parameters required for the regulation function are described in this section.

Two adjustable bandwidths with associated delay times are available for adjusting the regulation.

First, specify the parameters for bandwidth B1 and delay time T1.

Then, specify parameters B2 and T2 for rapid regulation in the event of larger deviations:  $B2 > B1$  and  $T2 < T1$ .

The regulation function works in accordance with the same principle in both cases, and therefore is not displayed twice in the graphic for better clarity.

In AVR AUTO auto mode, voltage regulation works as follows:

- If the measured voltage  $U_{\text{actual}}$  **5** is within the set bandwidth **6**, no control commands are issued to the motor-drive unit for the tap-change operation.
- Control commands will also not be issued to the motor-drive unit if the measured voltage returns **B** to the tolerance bandwidth within the set delay time T **4**.
- However, if the measured voltage deviates from the set bandwidth for a longer period **C**, a tap-change command **D** occurs after expiration of the set delay time. The on-load tap-changer carries out a tap-change in a raise or lower direction to return to the tolerance bandwidth.

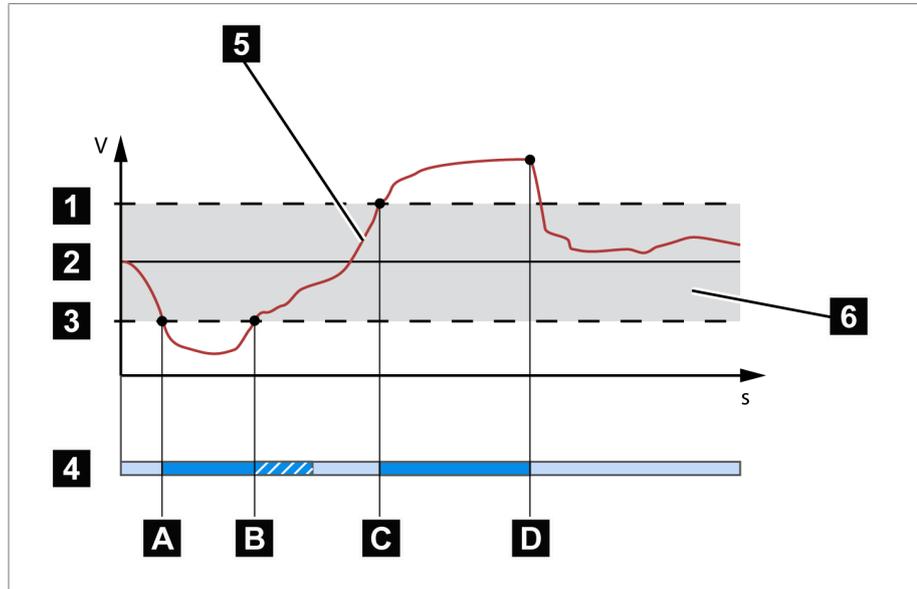


Figure 51: Regulation function response

1 + B%: Upper limit	2 $U_{\text{desired}}$ : Desired value
3 - B%: Lower limit	4 Set delay time T
5 $U_{\text{actual}}$ : Measured voltage	6 B%: Tolerance bandwidth
A $U_{\text{actual}}$ is outside the bandwidth. Delay time T starts.	B $U_{\text{actual}}$ is back within the bandwidth before delay time T is complete.
C $U_{\text{actual}}$ is outside the bandwidth. Delay time T starts.	D $U_{\text{actual}}$ is still outside the bandwidth when delay time T is complete. Tap-change operation is initiated.

### 8.3.1.1 Desired voltage (P1)

You can use this parameter to set the desired value for voltage regulation. To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press **MENU** > **▲** until the desired parameter is displayed.

⇒ **P1** **000000**

2. Press **AVR MANUAL** to confirm the selection.

3. Press **▲** or **▼** to select the desired value.

4. Press **AVR MANUAL** to confirm the selection.

5. Press **MENU** to save the setting.



**8.3.1.2 Bandwidth B1 (P2.1)**

You can use this parameter to set the maximum permissible deviation in measured voltage  $U_{actual}$  from the desired value  $U_{desired}$ . The following section describes how you determine and set the bandwidth.

**Determining bandwidth**



In order to set a correct value, the nominal voltage of the transformer and the voltages in the tap positions must be known. Note that a large bandwidth will result in a large control deviation.

The bandwidth must always be greater than the following value:

$$\pm B\% \geq 0,6 \cdot \frac{|U_{n-1} - U_n|}{U_{nom}} \cdot 100\%$$

Figure 52: Calculation of minimum bandwidth

$U_{n-1}$	Voltage of tap position n-1
$U_n$	Voltage of tap position n
$U_{nom}$	Nominal voltage

The following transformer values are used to determine the minimum bandwidth:

- Nominal voltage  $U_{nom} = 400\text{ V}$
- Voltage in tap position 4  $U_{Pos.4} = 390\text{ V}$
- Voltage in tap position 5  $U_{Pos.5} = 400\text{ V}$



$$\pm B\% \geq 0,6 \cdot \frac{|U_{Pos.4} - U_{Pos.5}|}{U_{nom}} \cdot 100\%$$

$$\pm B\% \geq 0,6 \cdot \frac{|390\text{ V} - 400\text{ V}|}{400\text{ V}} \cdot 100\%$$

$$\pm B\% \geq 1,5\%$$

**Setting bandwidth B1 (P2.1)**

To set the bandwidth, proceed as follows:

✓ The AVR MANUAL operating mode is active.

- Press > until the desired parameter is displayed.



2. Press  to confirm the selection.

⇒ 

3. Press  to confirm the selection.

4. Press  or  to set the desired value.

5. Press  to confirm the selection.

6. Press  to save the setting.

### 8.3.1.3 Delay time T1 (P2.2)

The delay time T1 delays the issuing of a tap-change command for a defined period. This prevents unnecessary tap-change operations if the tolerance bandwidth is exited only briefly.

To set the delay time T1, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ 

2. Press  to confirm the selection.

3. Press  until the desired parameter is displayed.

⇒ 

4. Press  to confirm the selection.

5. Press  or  to select the desired value. Alternative: Press  +  or  +  to set the value in larger steps.

6. Press  to confirm the selection.

7. Press  to save the setting.

### 8.3.1.4 Bandwidth B2 (P3.1)

You can use this parameter to set the maximum permissible deviation of measured voltage  $U_{\text{actual}}$  from the desired value  $U_{\text{desired}}$  for fast regulation. Ensure that the value is always at least 0.5% greater than the bandwidth B1. If you set a lower value, the device corrects the setting automatically. If you select the "off" option, fast regulation is deactivated.



To set the B2 bandwidth, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired parameter is displayed.

⇒ P3 00000

2. Press to confirm the selection.

⇒ P3 10000

3. Press to confirm the selection.

4. Press or to select the desired value.

5. Press to confirm the selection.

6. Press to save the setting.

### 8.3.1.5 Delay time T2 (P3.2)

The delay time delays the issuing of a tap-change command for a defined period. This prevents unnecessary tap-change operations if the tolerance bandwidth is exited only briefly. Delay time T2 enables a faster response to larger changes in voltage compared with T1. Note that the setting range is dependent on the delay time T1:

- For  $T1 \leq 10$  s:  $T2 = 2 \text{ s} \dots (T1 - 1 \text{ s})$
- For  $T1 > 10$  s:  $T2 = 2 \text{ s} \dots (T1 - 5 \text{ s})$

To set the delay time T2, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired parameter is displayed.

⇒ P3 00000

2. Press to confirm the selection.

3. Press until the desired parameter is displayed.

⇒ P32 0000

4. Press to confirm the selection.

5. Press or to select the desired value. Alternative: Press + or + to set the value in larger steps.

6. Press to confirm the selection.

7. Press to save the setting.

### 8.3.2 Voltage blocking (P4)

You can use voltage blocking to define limit values for blocking the automatic voltage regulation (AVR AUTO). This allows you to avoid unnecessary tap-change operations in the event of strong voltage changes in the mains. Manual stepping is also possible when the value is greater than the voltage limit.

- Undervoltage blocking: Blocking is activated as soon as the measured value is less than the limit value.
- Overvoltage blocking: Blocking is activated as soon as the measured value is greater than the limit value.

#### 8.3.2.1 Undervoltage blocking (P4.1)

To set the undervoltage blocking, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ P4 00000

2. Press  to confirm the selection.

⇒ P4 10000

3. Press  to confirm the selection.

4. Press  or  to select the desired value. Alternative: Press  +  or  +  to set the value in larger steps.

5. Press  to confirm the selection.

6. Press  to save the setting.

#### 8.3.2.2 Overvoltage blocking (P4.2)

To set the overvoltage blocking, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ P4 00000

2. Press  to confirm the selection.

3. Press  until the desired parameter is displayed.

⇒ P4 20000

4. Press  to confirm the selection.



5. Press or to select the desired value. Alternative: Press + or + to set the value in larger steps.
6. Press to confirm the selection.
7. Press to save the setting.

### 8.3.2.3 Activating/deactivating voltage blocking (P4.3)

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired parameter is displayed.

⇒ P4 8888

2. Press to confirm the selection.

⇒ P43 8888

3. Press to confirm the selection.
4. Press or to set the desired value (1 = active, 0 = inactive).
5. Press to confirm the selection.
6. Press to save the setting.

### 8.3.3 Blocking function (P5)

The control unit is equipped with a blocking contact. You can use this to connect a door contact switch or a temperature sensor, for example. If you use a temperature sensor, the temperature sensor must make a signal in the form of a floating contact available. Observe the supplied connection diagram and section "Connecting the control unit at the installation site" [► Section 7.3.2, Page 50] for this.

You cannot change the device behavior in the event of a closed blocking contact via the communication interface – you can only set this behavior locally on the control unit:

- Mode "0" = inactive: The status of the blocking contact does not affect the behavior of the device. Use this setting if you have not connected a door contact switch or temperature sensor to the device.
- Mode "1" = active AUTO/EXTERNAL: If the blocking contact is closed, all switching operations in the operating modes AVR AUTO and EXTERNAL CONTROL are blocked by the device. Manual switching operations can still be performed in the AVR MANUAL operating mode.
- Mode "2" = active MANUAL/AUTO/EXTERNAL: If the blocking contact is closed, all switching operations in all operating modes (AVR MANUAL, AVR AUTO, and EXTERNAL CONTROL) are blocked by the device.

The LED lights up if blocking is active.

To set the blocking function, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ P5 88888

2. Press  to confirm the selection.
3. Press  or  to select the desired option.
4. Press  to confirm the selection.
5. Press  to save the setting.

### 8.3.4 Target position for loss of voltage (P6)

The control unit is fitted with an integrated energy accumulator so that, in the event of a voltage failure, a tap-change operation that has been started can be reliably completed and a defined transformer transmission ratio can be reached through further switching operations.

This function will be triggered as soon as the control unit supply voltage falls below 80 V. Movement to the target position will be initiated after a waiting time of 10 s.



You can only use the function "Target position for loss of voltage" in the operating modes AVR AUTO and EXTERNAL CONTROL.

#### NOTICE

#### Damage to the on-load tap-changer and transformer!

The inrush interlock is not active when switching to the target tap position. If the voltage returns while switching to the target tap position, the on-load tap-changer and transformer may be damaged.

- ▶ Only switch the transformer back on after a voltage failure once the on-load tap-changer is in the set target position (approximately 30 seconds after the voltage failed).

#### 8.3.4.1 Setting the target position (P6.1)

You can use this parameter to set the target position. To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ P6 88888

2. Press  to confirm the selection.



3. Press until the desired parameter is displayed.

⇒

4. Press to confirm the selection.

5. Press or to set the desired target position.

6. Press to confirm the selection.

7. Press to save the setting.

#### 8.3.4.2 Activating/deactivating target position for loss of voltage (P6.2)

You can use this parameter to activate and deactivate the function "Target position for loss of voltage". You can select the following options:

- 0 = inactive
- 1 = active

To activate or deactivate the "Target position for loss of voltage" function, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired parameter is displayed.

⇒

2. Press to confirm the selection.

3. Press until the desired parameter is displayed.

⇒

4. Press to confirm the selection.

5. Press or to set the desired option.

6. Press to confirm the selection.

⇒

7. Press until code 3 is displayed.

⇒

8. Press to confirm the selection.

9. Press to save the setting.

### 8.3.5 Number of operating positions (P7)

The control unit can be configured for different types of ECOTAP® VPD® on-load tap-changer. You must set the number of operating positions accordingly.



When you perform the automatic adjustment (F1.1), the parameter P7 is automatically set to the correct value.

To set the number of operating positions, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ 

2. Press  to confirm the selection.

3. Press  or  to select the desired value.

4. Press  to confirm the selection.

5. Press  to save the setting.

### 8.3.6 Regulating range (P8)

You can limit the permissible regulating range as necessary. Here, you can set the lowest operating position and the highest operating position.



The limited regulating range applies to all operating modes. You can, however, move to an operating position outside of the permissible regulating range via the "Target position for loss of voltage" function.

#### 8.3.6.1 Lowest operating position (P8.1)

You can use this parameter to set the lowest permissible operating position. To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ 

2. Press  to confirm the selection.

3. Press  until the desired parameter is displayed.

⇒ 

4. Press  to confirm the selection.



5. Press or to select the desired value.
6. Press to confirm the selection.
7. Press to save the setting.

### 8.3.6.2 Highest operating position (P8.2)

You can use this parameter to set the highest permissible operating position. To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired parameter is displayed.

⇒

2. Press to confirm the selection.

3. Press until the desired parameter is displayed.

⇒

4. Press to confirm the selection.

5. Press or to select the desired value.

6. Press to confirm the selection.

7. Press to save the setting.

### 8.3.7 Remote behavior (P9)

You can use this parameter to set the remote behavior of the device in connection with the ECOTAP® VPD® CONTROL PRO control unit. This setting only has an effect in the EXTERNAL CONTROL operating mode. You can select the following options:

- 0 = local: In the EXTERNAL CONTROL operating mode, automatic voltage regulation is performed via the ECOTAP® VPD® CONTROL PRO control unit. Control commands via SCADA are not possible.
- 1 = remote: In the EXTERNAL CONTROL operating mode, you can select the desired operating mode via SCADA command:
  - Automatic voltage regulation via the ECOTAP VPD CONTROL PRO control unit
  - Manual tap-change operations via SCADA commands

To set the remote behavior, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ 

2. Press  to confirm the selection.
3. Press  or  to select the desired option.
4. Press  to confirm the selection.
5. Press  to save the setting.

### 8.3.8 Password protection (P10)

The device is equipped with password protection in order to prevent unauthorized parameter changes. If you activate the password protection function, you must first enter the password, before you can display the parameterization menu and make settings. If you do not operate the device within 5 minutes, the device is automatically blocked again.

#### 8.3.8.1 Setting the password (P10.1)

You can use this parameter to set the password (maximum 3 characters, factory setting 0). To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired parameter is displayed.

⇒ 

2. Press  to confirm the selection.
3. Press  until the desired parameter is displayed.

⇒ 

4. Press  to confirm the selection.
5. Press  or  to select the desired value. Alternative: Press  +  or  +  to set the value in larger steps.
6. Press  to confirm the selection.
7. Press  to save the setting.



### 8.3.8.2 Activating/deactivating password protection (P10.2)

You can use this parameter to activate or deactivate the password protection function. You can select the following options:

- 0 = inactive
- 1 = active

To activate or deactivate the password protection function, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired parameter is displayed.

⇒

2. Press to confirm the selection.

3. Press until the desired parameter is displayed.

⇒

4. Press to confirm the selection.

5. Press or to set the desired option.

6. Press to confirm the selection.

7. Press to save the setting.

### 8.3.8.3 Entering password (C2)

If you have activated the password protection function, you must enter the password to unblock the device and to be able to call up the parameterization menu. To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press .

⇒

2. Press or to select the desired value. Alternative: Press + or + to set the value in larger steps.

3. Press to confirm the selection.

⇒ The device is unblocked.

### 8.3.9 Adjustment (F1)

Automatic adjustment is necessary, for example, if a new control unit is connected to a tap changer. If the control unit is not yet adjusted to the tap changer, message *E4* appears on the display.



A manual adjustment is only possible if an automatic adjustment has been carried out at least once beforehand.

### 8.3.9.1 Automatic adjustment (F1.1)

This function starts the automatic adjustment of the on-load tap-changer. The entire regulating range of the on-load tap-changer is passed through until the signals of the respective micro-switch for recording the end position are detected. In conclusion, the position display is synchronized with the position of the tap changer and the parameters Number of the operating positions (P7), Lowest operating position (P8.1) and Highest operating position (P8.2) are set.



Only carry out automatic adjustment with an open busbar on the low-voltage side since the on-load tap-changer moves through the entire regulating range and this can result in excessive voltage deviations for loads.

To start the automatic adjustment, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.

3. Press  until the desired parameter is displayed.

⇒ 

4. Press  to confirm the selection.

⇒ 

5. Press  until code 3 is displayed.

⇒ 

6. Press  to confirm the selection.

⇒ Automatic adjustment starts.

⇒ Once automatic adjustment is complete, the on-load tap-changer is in the middle operating position.

### 8.3.9.2 Manual adjustment n-1 (F1.2)

You can use this function to perform a manual adjustment of the on-load tap-changer starting from the current tap position through to the lowest tap position (Pos. 1). The manual adjustment does not run through the entire regulating range of the on-load tap-changer.



If you perform a manual adjustment with the busbar closed, you must check that the measured voltage is within the permitted range after the tap change operations.

To start the manual adjustment n-1 function, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.

3. Press  until the desired parameter is displayed.

⇒ 

4. Press  to confirm the selection.

5. Press  to perform one on-load tap-change operation (n-1).

⇒ The current measured voltage is displayed.

6. Repeat step 5 until the lowest tap position (Pos. 1) has been reached.

⇒ Once the lowest tap position (Pos. 1) has been reached, the display switches between operations counter, tap position and measured voltage.

⇒ Manual adjustment is complete.

### 8.3.9.3 Manual adjustment n+1 (F1.3)

You can use this function to perform a manual adjustment of the on-load tap-changer starting from the current tap position through to the highest tap position (Pos. N). The manual adjustment does not run through the entire regulating range of the on-load tap-changer.



If you perform a manual adjustment with the busbar closed, you must check that the measured voltage is within the permitted range after the tap change operations.

To start the manual adjustment n+1 function, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.

3. Press  until the desired parameter is displayed.

⇒ 

4. Press  to confirm the selection.

5. Press  to perform one on-load tap-change operation (n+1).

⇒ The current measured voltage is displayed.

6. Repeat step 5 until the highest tap position (Pos. N) has been reached.

⇒ Once the highest tap position (Pos. N) has been reached, the display switches between operations counter, tap position and measured voltage.

⇒ Manual adjustment is complete.

### 8.3.10 Reading remaining life (F2)

With the function "Read remaining life", you can request the current status (as a percentage).



If the remaining life is less than or equal to 1(%), contact the Maschinenfabrik Reinhausen GmbH's Technical Service department.

For functional reasons, the remaining life drops more quickly at the beginning of the product life cycle and the curve becomes flatter as the operating time increases:

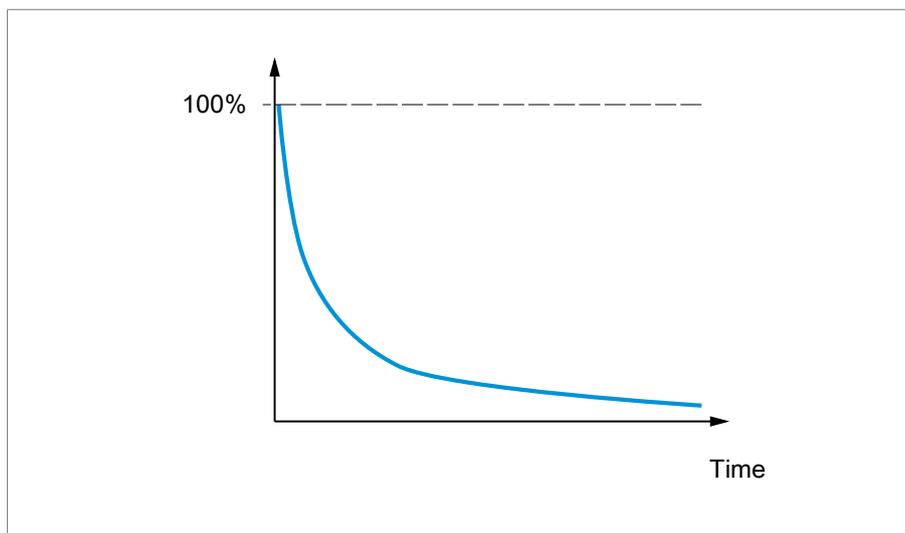


Figure 53: Typical progression of the remaining life

The progression is influenced by external influences – in particular high ambient temperatures – and is subject to certain fluctuations. With regular observation, the progression of the remaining service life can be better estimated. Recommendation:

- Read off and note remaining life annually.

A remaining lifetime of 0% does not necessarily lead to blocking.

The controller monitors the capacity and voltage of the energy accumulator to prevent undefined switching states. As a result, switching commands are only executed if there is sufficient energy to reach the preselected target position even in the event of a voltage failure.

Switching commands are blocked if error message E5.2 (undervoltage) is present during a pre-check.

Event	Necessary action
Remaining life = 1% => no blocking	Maschinenfabrik Reinhausen GmbH Technical Service.  Prepare control unit replacement.  Monitor event messages constantly.
Controller detects undercapacity in operation <ul style="list-style-type: none"> <li>Error message E5.1</li> <li>No blocking</li> </ul>	Control unit replacement recommended.
Controller detects undervoltage in operation <ul style="list-style-type: none"> <li>Error message E5.2</li> <li>No blocking</li> </ul>	Control unit replacement recommended.
Pre-check detects voltage drop under load <ul style="list-style-type: none"> <li>Error message E5.2 (undervoltage)</li> <li>Error message E2.4 (energy in energy accumulator too low.)</li> <li>Tap-change operations blocked</li> </ul>	Control unit replacement necessary.

Table 11: Remaining life recommendations for action

To start the remaining life query, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.

⇒ The remaining life is displayed as a percentage value.

3. Press  to exit the display.

4. Press  to leave the parameterization menu.

### 8.3.11 LED function test (F3)

You can use this function to test the function of all LEDs and the display on the front of the control unit. To do so, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1.  > Press  until the desired function is displayed.

⇒ 



2. Press  to confirm the selection.  
⇒ All display elements on the front of the control unit light up.
3. Press  to exit the display.
4. Press  to leave the parameterization menu.

### 8.3.12 Software update (F4)

This function is not currently available.

### 8.3.13 Invert travel commands (F5)

You can use this parameter to invert the travel commands. You can use this to adjust the behavior of the device based on how your on-load tap-changer and motor-drive unit are configured. You can select the following options:

Setting	Meaning
0	Normal configuration: <ul style="list-style-type: none"> <li>▪ Lowest voltage (low-voltage side) in operating position 1</li> <li>▪ Highest voltage (low-voltage side) in operating position n</li> </ul>
1	Inverted configuration: <ul style="list-style-type: none"> <li>▪ Highest voltage (low-voltage side) in operating position 1</li> <li>▪ Lowest voltage (low-voltage side) in operating position n</li> </ul>

Table 12: Behavior

To set this function, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.
3. Press  or  to select the desired option.
4. Press  to confirm the selection.
5. Press  to save the setting.

### 8.3.14 Read out software version (F6)

To read out the software version, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1.  > Press  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.  
⇒ The control unit's software version is displayed.
3. Press  to exit the display.
4. Press  to leave the parameterization menu.

### 8.3.15 Customer message for event messages E1 and E2 (F7)

You can set whether the event messages E1 *EXTERNAL CONTROL* and E2 *Remote control* are to be reported via the customer messages interface *Ready/Error* (terminal X5). All further event messages will always be reported via the customer messages interface *ready/error* (terminal X5).

#### 8.3.15.1 Customer message for event message E1 (F7.1)

With this function, you can set whether the event message E1 *EXTERNAL CONTROL* is to be reported via the customer messages interface *Ready/Error* (terminal X5). You can select the following options:

- 0: inactive
- 1: active

To set the customer message for event message E1, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.

⇒ 

3. Press  to confirm the selection.
4. Press  or  to select the desired option.
5. Press  to confirm the selection.
6. Press  to save the setting.

#### 8.3.15.2 Customer message for event message E2 (F7.2)

With this function, you can set whether the event message E2 *Remote control* is to be reported via the customer messages interface *Ready/Error* (terminal X5). You can select the following options:

- 0: inactive
- 1: active



To set the customer message for event message E2, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired function is displayed.

⇒

2. Press to confirm the selection.

3. Press until the desired parameter is displayed.

⇒

4. Press to confirm the selection.

5. Press or to select the desired option.

6. Press to confirm the selection.

7. Press to save the setting.

### 8.3.16 Reset to factory setting (F8)

You can use this function to reset the device to the factory settings [[▶ Section 13, Page 110](#)].



Note all parameters before resetting to factory settings. After resetting, check that all parameters are suitable for the application, in particular the blocking function (P5).

✓ The AVR MANUAL operating mode is active.

1. Press > until the desired function is displayed.

⇒

2. Press to confirm the selection.

⇒

3. Press until code 3 is displayed.

⇒

4. Press to confirm the selection.

⇒ The device is reset to the factory settings.

5. Press to exit the display.

6. Press to leave the parameterization menu.

### 8.3.17 Display control parameters (F9)

You can use this function to check the set values of the device. Here, the device successively displays the parameter designation and the set values of the following parameters and functions:

- Parameters P1...P9
- Functions F2, F5, F6, F7.1 and F7.2

To check the control parameters, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  until the desired function is displayed.

⇒ 

2. Press  to confirm the selection.

⇒ The display displays the parameter designation and the set values successively at a rate of 1 second.

3. Press  to exit the display.

4. Press  to leave the parameterization menu.

### 8.3.18 Displaying event memory (E)

The event memory will show you the saved event codes. You can find an overview of the event codes in the Event messages [► Section 12.2, Page 108] section.

The event memory has 20 memory slots and displays the last 20 entries. Memory slot 1 is the latest entry, memory slot 20 is the earliest entry. The device records the number of tap-change operations when an event message happens or is reset.

A memory slot entry contains the following information:

- Event code
- Number of tap-change operations

If an entry only includes the number of tap-change operations and not an event code, this means that the event code in the previous memory slot was reset at this number of tap-change operations.

With the exception of event code *E6*, all event codes are reset once the fault has been eliminated and the next correct tap-change operation has been completed. Event code *E6* can only be reset by the Maschinenfabrik Reinhausen GmbH Technical Service department.



To display the event memory, proceed as follows:

✓ The AVR MANUAL operating mode is active.

1. Press  >  repeatedly until the first memory slot in the event memory is displayed.

⇒ 

2. Press  or  to select the desired memory slot.

⇒ 

3. Press  to call up the memory slot.

⇒ The event code or a number of tap-change operations will be displayed.

⇒ 

4. Press  to display further event codes. If there are no further event codes present, the number of tap-change operations will be displayed.

⇒ 

5. Press  to exit the memory slot.



## 9 Control system protocol

### 9.1 Modbus RTU Parameters

These parameters remain permanently stored even in the event of a voltage failure. Status bits are queried again when the power returns.

The device uses the Modbus RTU control system protocol (master-slave communication) with the following parameters:

#### Device parameters upon delivery

Parameter	Material No. 10117333XX	Material No. 10165307XX
Transmission format	RTU	RTU
Serial interface	RS485	RS485
Baud rate [baud]	38400	19200
Modbus address (slave)	1	51
Number of data bits	8	8
Parity	Even	Even
Number of stop bits	1	1

Table 13: Device parameters upon delivery

#### Adjustable device parameters

Parameter	Modbus RTU
Baud rate [baud]	9600, 19200, 38400, 57600
Modbus address (slave)	1...247

Table 14: Device parameter setting range

The baud rate is only changed after the function FC8.1 "Restart Communications Option" has been triggered.

Alternative option:

1. Disconnect the controller from the mains for approx. 4 hours until the energy accumulator has completely discharged (LED  Energy accumulator off).
2. Electrically restart the controller.



### 9.2 Function codes

Function code	Group description	R = read / W = write
01 (0x01)	Read Discrete Output Coil	R
02 (0x02)	Read Discrete Input Contact	R
03 (0x03)	Read Analog Output Holding Registers	R
04 (0x04)	Read Analog Input Register	R
05 (0x05)	Write Discrete Output Coil	W
06 (0x06)	Write Analog Output Holding Registers	W
15 (0x0F)	Write multiple Discrete Output Coil	W
16 (0x10)	Write multiple Analog Output Holding Registers	W

Table 15: Function codes

### 9.3 Data format

Type	Description	Range
BIT	1 bit	0, 1 (= OFF, ON)
UINT16	unsigned integer 16 bit	0...65 535
SINT16	signed integer 16 bit	-32 768...+32 768
SINT32	signed integer 32 bit	-2.147483648 x 10 <sup>9</sup> ... +2.147483648 x 10 <sup>9</sup>
FLOAT32	32 bit (single precision) according to IEEE 754	IEEE 754

Table 16: Data format

### 9.4 Data points (single inquiry)

#### 9.4.1 Coils

Address (no offset)	Name	Type	Status	EXTERNAL CONTROL R = read / W = write	
				CONTROL PRO	Others
0	Change tap position raise	BIT	1 = raise	R/W	R/W
1	Change tap position lower	BIT	1 = lower	R/W	R/W
2	P9 Parameter local/remote	BIT	1 = remote	R	R
3	Error ISM	BIT	1 = error	R/W	R/W
4 <sup>1)</sup>	Blocking activation P5, mode 1	BIT	1 = active	R	R
5	Internal datapoint	BIT	-	-	-
6	Internal datapoint	BIT	-	-	-
7	F5 command inverted	BIT	1 = active	R	R/W



Address (no offset)	Name	Type	Status	EXTERNAL CONTROL R = read / W = write	
				CONTROL PRO	Others
8	Internal datapoint	BIT	-	-	-
9	Internal datapoint	BIT	-	-	-
10	F7.1 E1 to relay output	BIT	1 = active	R	R/W
11	F7.2 E2 to relay output	BIT	1 = active	R	R/W
12 <sup>1)</sup>	Blocking activation P5, mode 2	BIT	1 = active	-	R
13	Set mechanical PreCheck (test)	BIT	1 = active	-	R/W
14	Release of multiple tap-change operation	BIT	1 = active	-	R
15 <sup>2)</sup>	E1 at AVR AUTO	BIT	1 = active	-	R/W
16	P4.3 Voltage blocking activation/deactivation	BIT	1 = active	-	R/W

Table 17: Coils

<sup>1)</sup> Activation of the Blocking function (P5) [► Section 8.3.3, Page 77]

Address 4	Address 12	Result
0	0	Mode 0 = inactive
1	0	Mode 1 = active in operating mode AUTO/EXTERNAL
0	1	Mode 2 = active in operating mode MANUAL/AUTO/EXTERNAL
1	1	Not permitted

Table 18: blocking function mode

<sup>2)</sup> Set status to 1 if Event E1 [► Section 12.2, Page 108] is also to be displayed in the operating mode AVR AUTO.

### 9.4.2 Discrete Inputs

Address (no offset)	Name	Type	Coil status	EXTERNAL CONTROL R = read / W = write	
				CONTROL PRO	Others
0	E1 No connection to EXTERNAL CONTROL	BIT	1 = active	R	R
1	E2 EXTERNAL CONTROL command could not be performed	BIT	1 = active	R	R
2	E3.1 Error mosfet switch	BIT	1 = active	R	R
3	E3.2 Error direction of rotation	BIT	1 = active	R	R
4	E3.3 Time delay microswitch	BIT	1 = active	R	R
5	E3.4 Both end microswitch active or not wired	BIT	1 = active	R	R
6	E4.1 Automatic adjustment not undertaken or incorrect	BIT	1 = active	R	R



Address (no off- set)	Name	Type	Coil status	EXTERNAL CONTROL R = read / W = write	
				CONTROL PRO	Others
7	E4.2 Desired target position could not be reached when voltage failed (error blackstart)	BIT	1 = active	R	R
8	E5.1 Residual capacity buffer	BIT	1 = active	R	R
9	E5.2 Undervoltage buffer	BIT	1 = active	R	R
10	E5.3 Error power supply	BIT	1 = active	R	R
11	E6.1 Motor blocking	BIT	1 = active	R	R
12	E6.2 Motor rough-running	BIT	1 = active	R	R
13	E6.3 Tap change command cannot be performed, timeout motor run	BIT	1 = active	R	R
14	E7.1 Permanent signal microswitch	BIT	1 = active	R	R
15	E7.2 Position fail, loss microswitch	BIT	1 = active	R	R
16	Internal datapoint	BIT	-	-	-
17	Internal datapoint	BIT	-	-	-
18	Internal datapoint	BIT	-	-	-
19	Internal datapoint	BIT	-	-	-
20	Signal: blocking contact	BIT	0 = door open 1 = door closed	R	R
21	Relay OK	BIT	1 = active	R	R
22	Relay error	BIT	1 = active	R	R
23 <sup>1)</sup>	E2.1 Highest or lowest operating position reached	BIT	1 = active	R	R
24 <sup>1)</sup>	E2.2 Previous tap-change operation has not been completed or fault motor-drive unit	BIT	1 = active	R	R
25 <sup>1)</sup>	E2.3 Inrush interlock is active or automatic adjustment required	BIT	1 = active	R	R
26 <sup>1)</sup>	E2.4 Energy in the energy accumulator too low	BIT	1 = active	R	R
27 <sup>1)</sup>	E2.5 Signal for blocking activated (door interlock or temperature blocking)	BIT	1 = active	R	R
28	Motor drive running	BIT	1 = active	R	R
29	Ready for tap-change operation	BIT	1 = active	R	R
30	Voltage failure (detection < 60 V, communication impossible)	BIT	1 = active	R	R
31 <sup>1)</sup>	E2.6 Error in wiring	BIT	1 = active	R	R
32200	AVR error (including E2.6, E3.x, E4.x, E5.x, E6.x and E7.x)	BIT	1 = active	-	R
32201	Out of bandwidth: Highest or lowest operating position reached + tap change command (AVR AUTO or EXTERNAL CONTROL)	BIT	1 = active	-	R

Table 19: Discrete inputs



<sup>1)</sup> Event belongs to group error message E2 (Modbus address 1)

### 9.4.3 Input Register

Address (no offset)	Name	Type	Unit	Decimal places	EXTERNAL CONTROL R = read / W = write	
					CONTROL PRO	Others
0	Device number part 1/2	SINT32	-	0	R	R
1	Device number part 2/2	SINT32	-	0	R	R
2	Capacitor health	UINT16	%	0	R	R
3	Input voltage (data value = 2 x measured value; example: measured value = 125.5 V => data value = 251)	UINT16	V	0	-	R
4	Voltage capacitor (data value = 10 x measured value; example: measured value = 10.6 V => data value = 106)	UINT16	V	0	-	R
5	Software version year (YY)	UINT16	-	0	R	R
6	Software version month (MM)	UINT16	-	0	R	R
7	Software version day (DD)	UINT16	-	0	R	R
8	Motor pause before next tap-change operation (data value = 10 x measured value; example: measured value = 3 sec. => data value = 30)	UINT16	seconds	1	R	R
9	Status activation Modbus RTU (1 = active, 0 = inactive)	UINT16	-	0	-	R
10	Remaining time to the next PreCheck	UINT16	minutes	1	-	R
11	Internal datapoint	UINT16	-	-	-	-
12	Input voltage	FLOAT32	V	-	-	R
13	Input voltage	FLOAT32	V	-	-	R
14	Buffer voltage	FLOAT32	V	-	-	R
15	Buffer voltage	FLOAT32	V	-	-	R
36600	Tap position	UINT16	-	-	-	R

Table 20: Input register



9.4.4 Holding register

Address (no offset)	Name	Type	Unit	Decimal places	EXTERNAL CONTROL R = read / W = write	
					CONTROL PRO	Others
0	Operating mode ▪ 1 = AVR AUTO ▪ 2 = AVR MANUAL ▪ 3 = EXTERNAL CONTROL	UINT16	-	0	R	R
1	Tap position	UINT16	-	0	R	R
2	Operations counter (MSB)	SINT32	-	0	R	R
3	Operations counter (LSB)		-	0	R	R
4	Internal datapoint	SINT32	-	-	-	-
5	Internal datapoint		-	-	-	-
6	P1 Desired value	UINT16	V	0	-	R/W
7	P2.1 Bandwith B1 (data value = 2 x set value; example: set value = 2.5% => data value = 5)	UINT16	%	0	-	R/W
8	P2.2 Delay time T1	UINT16	seconds	0	-	R/W
9	P3.1 Bandwith B2 (data value = 2 x set value; example: set value = 4.5% => data value = 9)	UINT16	%	0	-	R/W
10	P3.2 Delay time T2	UINT16	seconds	0	-	R/W
11	P4.1 Undervoltage blocking	UINT16	V	0	-	R/W
12	P4.2 Overvoltage blocking	UINT16	V	0	-	R/W
13	P7 Number of operating positions	UINT16	-	0	-	R/W
14	P8.1 Lowest operating position	UINT16	-	0	-	R/W
15	P8.2 Highest operating position	UINT16	-	0	-	R/W
16	P6.1 Setting the target position (black start)	UINT16	-	0	-	R/W
17	Tap-change operation (-3, -2, -1, +1, +2, +3) <sup>1)</sup>	UINT16	-	0	-	R/W
18	Internal datapoint	UINT16	-	-	-	-
19	P2.1 bandwidth 1	FLOAT32	-	-	-	R
20	P2.1 bandwidth 1		-	-	-	R
21	P3.1 bandwidth 2	FLOAT32	-	-	-	R
22	P3.1 bandwidth 2		-	-	-	R
31506	Internal datapoint	UINT16	-	-	-	-
31507	Set baudrate	UINT16	Baud	0	-	R/W
31508	Modbus ID	UINT16	-	0	-	R/W

Table 21: Holding register



<sup>1)</sup> With the command "Multiple switching operations" (optional), up to 3 successive switching operations can be executed without a regular pause of 3 seconds. This is followed by a cooling period of

- 3 seconds for 1 on-load tap-change operation
- 6 seconds for 2 on-load tap-change operations
- 9 seconds for 3 on-load tap-change operations.

### 9.4.5 Function Code 8 – Diagnostics

Subfunction code	Function
FC8.1	Restart Communications Option
FC8.10	Clear Counters and Diagnostic Register
FC8.11	Return Bus Message Count
FC8.12	Return Bus Communication
FC8.13	Return Bus Exception Error Count
FC8.14	Return Server Message Count
FC8.15	Return Server No Response Count
FC8.16	Return Server NAK Count
FC8.17	Return Server Busy Count

Table 22: Function Code 8 – Diagnostics



### 9.5 Data points (collective inquiry)

Address (no offset)	Range	Parameter	Description	Type	Value	R/W Others
201	0	E1	No connection to EXTERNAL CONTROL	BIT	0 = ok 1 = error	R
201	1	E2	EXTERNAL CONTROL command could not be performed	BIT	0 = ok 1 = error	R
201	2 3 4	E3.1 E3.2 E3.3 E3.4	Error in connection between control unit and motor-drive unit	BIT	0 = ok 1 = error	R
201	6	E4.1	Automatic adjustment not undertaken or incorrect	BIT	0 = ok 1 = error	R
201	7	E4.2	The desired target position could not be reached when voltage failed.	BIT	0 = ok 1 = error	R
201	8 9 10	E5.1 E5.2 E5.3	System not ready	BIT	0 = ok 1 = error	R
201	11 12 13	E6.1 E6.2 E6.3	Tap change command cannot be performed	BIT	0 = ok 1 = error	R
201	14 15	E7.1 E7.2	Correct positioning not possible	BIT	0 = ok 1 = error	R
202	4	n/a	Blocking contact	BIT	1 = ok	R
202	5	n/a	Relay OK	BIT	1 = ok	R
202	6	n/a	Relay ERROR	BIT	1 = error	R
202	7	E2.1	Highest or lowest operating position reached	BIT	0 = ok 1 = error	R
202	8	E2.2	Previous tap-change operation has not been completed or fault motor-drive unit	BIT	0 = ok 1 = error	R
202	9	E2.3	Inrush interlock is active or automatic adjustment required	BIT	0 = ok 1 = error	R
202	10	E2.4	Energy in the energy accumulator too low	BIT	0 = ok 1 = error	R
202	11	E2.5	Signal for blocking activated (door interlock or temperature blocking)	BIT	0 = ok 1 = error	R
202	12		Motor drive running	BIT	1 = motor running	R
202	13		Ready for tap-change operation	BIT	1 = ready	R
202	14		Voltage failure	BIT	0 = ok, 1 = error	R
202	15	E2.6	No connection to OLTC	BIT	0 = ok 1 = error	R



Address (no offset)	Range	Parameter	Description	Type	Value	R/W Others
203	0...15		Operating mode	UINT16	1 = AVR AUTO 2 = AVR MANUAL 3 = EXTERNAL CONTROL	R
204	0...15		Current tap position	UINT16	1...15	R
205, 206	0...31		Counter	SINT32		R
207	0...15		Cooling time motor drive after tap change	UINT16	e. g. value "12" = 1.2 s	R
209	0...15		Hardware version year (18, high-byte), month (19, low-byte)	UINT16	0...65,535	R
210	0...15		Firmware version (1/2) month (21, high-byte) year (22, low-byte)	UINT16	0...65,535	R
211	0...15		Reserve: Firmware-Version (2/2) day (23, low-Byte)	UINT16	0...65,535	R
212	0...15		Reserve: MR serial number MD&C (1/2)	UINT16	0...65,535	R
213	0...15		Reserve: MR serial number MD&C (2/2)	UINT16	0...65,535	R
214	0...15		Reserve: MR serial number OLTC (1/2)	UINT16	0...65,535	R
215	0...15		Reserve: MR serial number OLTC (2/2)	UINT16	0...65,535	R
216	0...15		Reserve: Material number MD&C (1/3)	UINT16	0...65,535	R
217	0...15		Reserve: Material number MD&C (2/3)	UINT16	0...65,535	R
218	0...15		Reserve: Material number MD&C (3/3)	UINT16	0...65,535	R
219	0...15		Reserve: Set of parameters	UINT16	0...65,535	R
220	0...15		Remaining time to the next PreCheck [min]	UINT16	0...65,535	R
401 <sup>1)</sup>	0...15		Multiple tap changes	SINT16	-3 to +3	W
403	0		Testing PreCheck	BIT	1 = active	W
404	0...15		MR serial number MD&C (1/2)	UINT16	0...65,535	W
405	0...15		MR serial number MD&C (2/2)	UINT16	0...65,535	W
406	0...15		MR serial number OLTC (1/2)	UINT16	0...65,535	W
407	0...15		MR serial number OLTC (2/2)	UINT16	0...65,535	W
408	0...15		Material number MD&C (1/3)	UINT16	0...65,535	W
409	0...15		Material number MD&C (2/3)	UINT16	0...65,535	W
410	0...15		Material number MD&C (3/3)	UINT16	0...65,535	W
411	0...15		Set of parameters	UINT16	0...65,535	W

Table 23: Data points



<sup>1)</sup> With the command "Multiple switching operations" (optional), up to 3 successive switching operations can be executed without a regular pause of 3 seconds. This is followed by a cooling period of

- 3 seconds for 1 on-load tap-change operation
- 6 seconds for 2 on-load tap-change operations
- 9 seconds for 3 on-load tap-change operations.

## 10 Fault elimination

This chapter describes how to rectify simple operating faults.

### 10.1 General faults

Characteristics/details	Cause	Remedy
No function	No voltage supply	Check the voltage supply.
<ul style="list-style-type: none"> <li>⏻ LED not lit up</li> </ul>	Device-internal fuse (F1) tripped	Check fuse (F1) [▶ Section 4.4.1, Page 19] and replace if necessary.

Table 24: General faults

### 10.2 Problem with automatic voltage regulation (AVR AUTO)

Characteristics/details	Cause	Remedy
Automatic voltage regulation not functioning.	Bandwidth set too high.	Check parameter "Bandwidth B1" (P2.1) [▶ Section 8.3.1.2, Page 73].
Automatic voltage regulation not functioning. <ul style="list-style-type: none"> <li>The on-load tap-changer is in the end position.</li> <li>Travel commands for regulating the measured voltage are in the wrong direction.</li> </ul>	Function "Invert travel commands (F5)" is set incorrectly.	Check "Invert travel commands (F5)" function [▶ Section 8.3.13, Page 89].
Automatic voltage regulation is blocked. <ul style="list-style-type: none"> <li>⚠ LED is lit.</li> <li>The display does not show an event code.</li> </ul>	Blocking function is activated and blocking contact (X3) is closed.	Check signal source. Set blocking function (P5) [▶ Section 8.3.3, Page 77].
Automatic voltage regulation is blocked. <ul style="list-style-type: none"> <li>⚠ LED is lit.</li> <li>The display shows an event code, e.g. "E6".</li> </ul>	Collective message from ECOTAP® VPD® CONTROL PRO.	Check the ECOTAP® VPD® CONTROL PRO.
Automatic voltage regulation is blocked. <ul style="list-style-type: none"> <li>⚠ LED is lit.</li> <li>The display shows an event code, e.g. "E6".</li> </ul>	Event code is present.	Displaying event memory [▶ Section 8.3.18, Page 92]. Check event messages [▶ Section 12.2, Page 108]. Check the wiring of all connections in accordance with the supplied connection diagram.
Automatic voltage regulation is blocked.	Voltage blocking is active.	Check voltage blocking settings [▶ Section 8.3.2, Page 76].
The regulating range of the transformer cannot be used.	The parameter "Number of operating positions (P7)" does not match the on-load tap-changer.	Check parameter "Number of operating positions (P7)" [▶ Section 8.3.5, Page 80].
	Regulating range limited.	Check regulating range settings [▶ Section 8.3.6, Page 80].

Table 25: Problem with automatic voltage regulation (AVR AUTO)



### 10.3 Other faults

In the event of faults on the on-load tap-changer, motor-drive unit, or control unit which cannot be easily corrected on site, please inform your authorized MR representative, the transformer manufacturer or contact Maschinenfabrik Reinhausen GmbH (MR) directly.

Please have the following data ready:

- Serial number (nameplate)
- Control unit software version [► Section 8.3.14, Page 89]

#### Contact address

Maschinenfabrik Reinhausen GmbH  
Technical Service

Postfach 12 03 60  
93025 Regensburg  
Germany

Phone: +49 941 40 90-0

E-mail: [service@reinhausen.com](mailto:service@reinhausen.com)  
Internet: [www.reinhausen.com](http://www.reinhausen.com)

## 11 Inspection and maintenance

### ▲ CAUTION



#### Risk of injury

A switching operation triggered suddenly by an external source can lead to injuries.

- ▶ Remove the D-SUB connector on the COM1 communication interface of the control unit (X6) to prevent the execution of external tap-change commands.

### 11.1 Inspection

When inspecting the transformer, at the same time undertake an inspection of the motor-drive unit and control unit. To do so, proceed as follows:

#### 11.1.1 Visual check

Start with the visual check as follows:

- ▶ Check whether any external damage or leaks are visible.
- ⇒ In the event of visible damage, contact Maschinenfabrik Reinhausen GmbH's Technical Service department.

#### 11.1.2 Checking the control unit

1. Check remaining life of the energy accumulator [▶ Section 8.3.10, Page 86].
  - ⇒ If the remaining life is less than 1(%), contact Maschinenfabrik Reinhausen GmbH's Technical Service department.
2. Check the function of the LEDs [▶ Section 8.3.11, Page 88].

#### 11.1.3 Checking the temperature blocking

If you operate the on-load tap-changer with alternative insulating fluids, you must check the function of the temperature blocking [▶ Section 7.3.8, Page 64]. To do so, proceed as follows:

- ✓ Check the function of the temperature sensor in accordance with the manufacturer's details.
- ✓ The  LED is not lit; if this is not the case, resolve the cause of the error.
- ▶ Remove the plug at terminal X3 to simulate a blocking signal.
  - ⇒ Blocking is active and the LED  is lit.



## 11.2 Maintenance

The ECOTAP® VPD® on-load tap-changer and ECOTAP® VPD® MD&C motor-drive unit are maintenance-free.

Interval	Action
After 500,000 operations	Replacing the on-load tap-changer: Contact the Maschinenfabrik Reinhausen Technical Service department for this.
After a maximum of 20 years	Replace the control unit. Contact the Maschinenfabrik Reinhausen Technical Service department for this.

## 11.3 Care

You can clean the device's housing with a dry cloth.

## 12 Messages

### 12.1 LEDs

LED	State	Meaning
	Off	Voltage supply missing
	Flashing	Inrush interlock active
	Lit	Ready
	Off	Energy accumulator not ready
	Flashing	Energy accumulator is charging
	Lit	Energy accumulator is ready
	Off	Motor stationary
	Lit	Motor running
	Off	Ready
	Lit	Fault

Table 26: Messages via LEDs

### 12.2 Event messages

Code	Type	Cause	Remedy
E1	Info	No connection to EXTERNAL CONTROL	<p>Check that the cable connection between the control unit and EXTERNAL CONTROL is connected correctly.</p> <p>Check that the EXTERNAL CONTROL is working correctly. Follow the corresponding operating instructions when doing so.</p> <p>If the error is still present, contact MR.</p>
E2	Info	EXTERNAL CONTROL command could not be performed.	<p>Check the EXTERNAL CONTROL operating mode setting.</p> <p>Check whether the on-load tap-changer is in a permitted position. To do so, set the operating mode to MANUAL and test manual tap-change operations.</p> <p>After a successful manual tap-change operation in EXTERNAL CONTROL operating mode, test the remote control.</p> <p>If the error is still present, contact MR.</p>
E2.1	Info	Highest or lowest permitted operating position reached.	Check regulating range settings.
E2.2	Info	Tap-change operation has not been completed or motor-drive unit error	If error is still present after the next tap-change command, contact MR.
E2.3	Info	Inrush interlock is active or automatic adjustment required.	Wait for inrush interlock. If error is still present, carry out automatic adjustment.



Code	Type	Cause	Remedy
E2.4	Info	Energy in the energy accumulator is too low.	Adjust the voltage supply to the specification. Check remaining life of the energy accumulator (F2).
E2.5	Info	Signal for blocking the automatic voltage regulation active.	Check signal source.
E2.6	Info	Connection error to OLTC	Check that the connection cable is plugged in correctly.
E3.1 E3.2 E3.3 E3.4	Warning	Error in connection between control unit and motor-drive unit	Check that all plug connections on the control unit are tight and correct. Check whether the connection cable is free of damage. Has the factory-set wiring on X2 or X4 been changed? If yes, restore to original status. If the error is still present, contact MR.
E4.1	Error	Adjustment not carried out or incorrect.	Carry out automatic adjustment (again).
E4.2	Error	The desired target position could not be reached when voltage failed.	Check correct setting of "Target position for loss of voltage" function (P6). The target position must be within the regulating range. Check remaining life of the energy accumulator (F2). If the error is still present, contact MR.
E5.1 E5.2 E5.3	Warning	System not ready	Check operational readiness:  LED (voltage supply) and  LED (energy accumulator) must light up continuously. Adjust the voltage supply to the specification. Check remaining life of the energy accumulator (F2). If the error is still present, contact MR.
E6.1 E6.2 E6.3	Error	Tap-change operation command cannot be performed	Contact MR.
E7.1 E7.2	Error	Correct positioning not possible	Has the factory-set wiring on X2 or X4 been changed? If yes, restore to original status. Carry out automatic adjustment. If the error is still present, contact MR.

Table 27: Event codes



### 13 Overview of parameters

Parameter	Setting range	Factory settings	Current settings
P1: Desired voltage	100...240 V	230 V	
P2: Normal regulation			
P2.1: Bandwidth B1	0.5...8%	2%	
P2.2: Delay time T1	3...1,800 s	10 s	
P3: Fast regulation			
P3.1: Bandwidth B2	3...9%; off <sup>1)</sup>	4%	
P3.2: Delay time T2	2 s...(T1 - 1 s / 5 s) <sup>2)</sup>	2 s	
P4: Voltage blocking			
P4.1: Undervoltage blocking	85...265 V	85 V	
P4.2: Overvoltage blocking	85...265 V	265 V	
P4.3: Activate/deactivate voltage blocking	0 = inactive 1 = active	0	
P5: Blocking function	0 = inactive 1 = active AUTO/EXTERNAL 2 = active MANUAL/AUTO/EXTERNAL	0	
P6: Target position for loss of voltage			
P6.1: Set target position	1...9 (17)	1	
P6.2 Activate/deactivate function	0 = inactive, 1 = active	0	
P7: Number of operating positions	9 or 17	9	
P8: Regulating range			
P8.1: Lowest operating position	1...9 (17) <sup>3)</sup>	1	
P8.2: Highest operating position	1...9 (17) <sup>3)</sup>	9	
P9: Remote behavior	0 = local, 1 = remote	1	
P10: Password protection			
P10.1: Set password	0...999	0	
P10.2: Activate/deactivate password protection	0 = inactive, 1 = active	0 = inactive	
F1: Automatic/manual adjustment			
F1.1: Automatic adjustment	-	-	
F1.2: Manual adjustment n-1	-	-	
F1.3: Manual adjustment n+1	-	-	
F2: Remaining life of the energy accumulator	-	-	
F3: LED function test	-	-	



Parameter	Setting range	Factory settings	Current settings
F4: Software update	-	-	
F5: Invert travel commands	0 = inactive, 1 = active	0 = inactive	
F6: Read out software version	-	-	
F7: Error relay			
F7.1: Error relay E1	0 = inactive, 1 = active	1 = active	
F7.2: Error relay E2	0 = inactive, 1 = active	1 = active	
F8: Factory settings	-	-	
F9: Display control parameters	-	-	
Baud rate holding register 31507	9600, 19200, 38400, 57600	38400	
Modbus address holding register 31508	1...247	1	

Table 28: Parameter overview

<sup>1)</sup> The bandwidth B2 is always at least 0.5% greater than the bandwidth B1.

<sup>2)</sup> The delay time T2 is always at least 1 s less than T1 (if T1 ≤ 10 s) or 5 s less than T1 (if T1 > 10 s).

<sup>3)</sup> Depending on the number of tap positions of the on-load tap-changer.



## 14 Disposal

For disposal, observe the national requirements applicable in the country of use.

If you have any questions about disassembly and disposal, please contact Maschinenfabrik Reinhausen GmbH's Technical Service department.



## 15 Technical data

### 15.1 Technical data of the control unit

Permissible nominal voltage range	U <sub>N</sub> : 100...240 V AC Measuring range: 85...264 V AC
Note: The measured voltage is the supply voltage	Measuring accuracy at U <sub>N</sub> = 100 V (-25...+70°C): < ±2.00% Measuring accuracy at U <sub>N</sub> = 240 V (-25...+70°C): < ±0.85% Intrinsic consumption: 7.5 W
Permissible frequency range	50/60 Hz
Overvoltage category	IV
Overvoltage category when using the optional adapter cables	III
Input current	Max. 1.5 A at 100 V AC Max. 0.63 A at 240 V AC
Power consumption	Max. 150 W
Internal fuse (F1)	Fine-wire fuse, 6.3 x 32 mm, min. 250 V, T4A
Nominal voltage of the control circuit	24 V DC
Nominal current of the control circuit	5 A
Duration of the tap-change operation	Approx. 420 ms

Table 29: Electrical data

Operating temperature	-25°C...+50°C (continuous) -25°C...+70°C (max. 2 h per day)
Storage temperature	-25°C...+85°C
Relative humidity	10...95% non-condensing
Air pressure	Corresponds to 2000 m above sea level
Degree of protection	Control unit: IP30 With control cabinet: See dimensional drawing
Contamination level	2
Installation site	With/without standard control cabinet: Indoors Optional: Control cabinet for outdoor use The control cabinet must be protected against direct sunlight.

Table 30: Permissible ambient conditions

**Interfaces**

Interface X5	Terminal	Description
Customer messages	1, 2	Ready
	3, 4	Error

Table 31: X5/customer messages

Switching capacity X5 contacts	U <sub>N</sub>	I <sub>N</sub>
AC	125 V	0.5 A
DC	30 V	1.0 A
DC	60 V	0.3 A

Table 32: X5/switching capacity

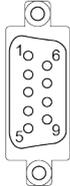
Interface X6/COM1 (RS485)	Terminal	Description
	5	GND
	6	A (+)
	9	B (-)

Table 33: X6/COM1 (RS485)

**Terminating resistor**

Control unit	Version
Material No.10117333XX	With terminating resistor
Material No.10165307XX	Without terminating resistor

Table 34: Device versions (terminating resistor)

Two optional adapter cables are available for Material No. 10165307XX:

**Optional adapter cable for X1 (250 mm)**

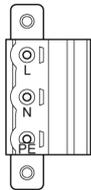
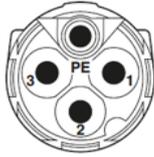
Coupling plug for X1	Pin	Description	Coupling plug, round	Pin
	X1: L	L (black)		1
	X1: N	N (black)		3
	X1: PE	PE (green-yellow)		PE

Table 35: Optional adapter cable for X1



**Optional adapter cable for X6 (250 mm)**

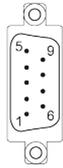
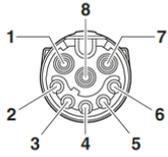
Coupling plug for X6	Pin	Description	Coupling socket	Terminal
	X6: 5	GND (green)		5
	X6: 9	(white)		2
	X6: 6	(brown)		3
	X6: 4	(yellow)		6

Table 36: Optional adapter cable for X6

**15.2 Technical data for the motor-drive unit**

Operating temperature	-25 °C...+70 °C
Storage temperature	-25 °C...+85 °C
Air pressure	Corresponds to 2000 m above sea level
Degree of protection	IP66
Installation site	Indoors, outdoors

Table 37: Permissible ambient conditions

Length	10 m
Connections	pre-assembled
Operating temperature	-25 °C...+70 °C
Storage temperature	-25 °C...+85 °C

Table 38: Connection cables from motor-drive unit to control unit



## 16 Drawings

	Datum	Name	Dokumentennummer
Gez.	17.11.2016	JANKERM	SED 4827758 000 02
Gepr.	05.12.2016	KINDLJ	Änderungsnummer Maßstab
Norm.	05.12.2016	PROBASTSCHUK	1078253 1:2

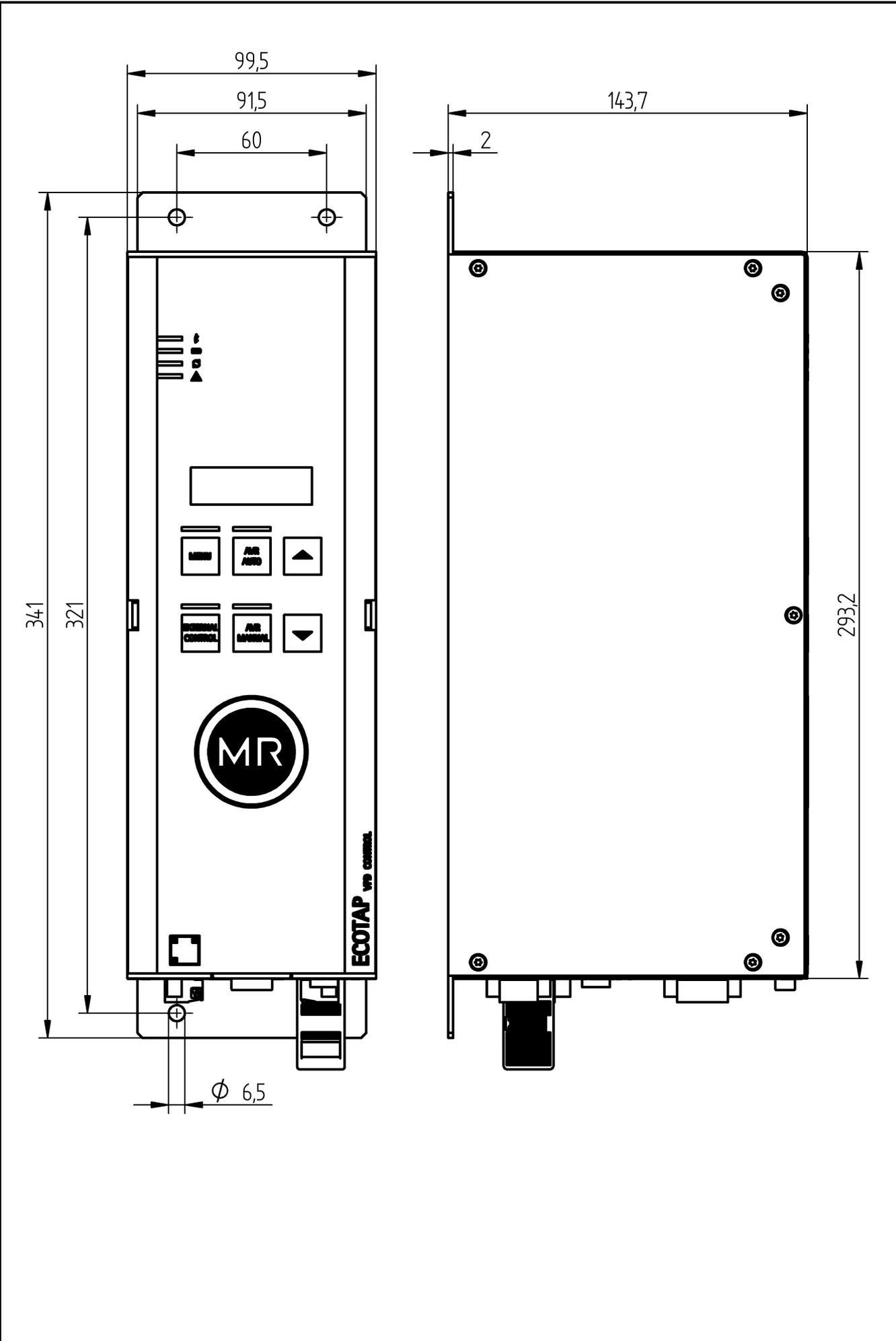
Maßangaben  
in mm, soweit  
nicht anders  
angegeben



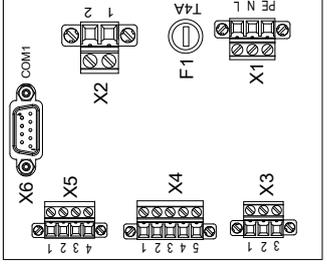
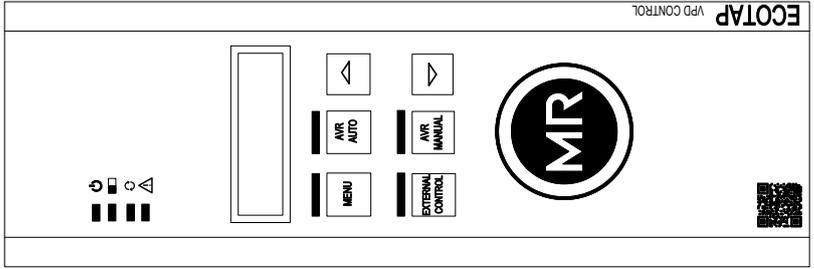
Ecotap VPD Control  
DIMENSION DRAWING

Serialnummer	
-	
Materialnummer	Blatt
100146800M	1 / 1

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DRAWING BY CAD  
DO NOT MODIFY MANUALLY

03	And. rev X3	09.06.16	SCHMID	DATE	11.01.2016
05	"Optional" entfernt	21.11.17	ETH	EXEC.	SCHMID
04	Hrweise Messung	28.07.16	SCHMID	VERIFIED	CTPC
NO.	MODIFICATION	DATE	NAME	STANDARD	

AUFBAUPLAN  
CABINET LAYOUT



ECOTAP VPD CONTROL

LANGUAGE: DE EN  
PROJECT: 4784850\_05

SHEET 2  
2 SH.



List of key words



<b>V</b>				
<hr/>	Voltage blocking		Undervoltage blocking	76
	Overvoltage blocking	76	Voltage interruption	17



## Glossary

### **OLTC PreCheck**

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Check of the on-load tap-changer operating conditions prior to a tap-change operation to prevent damage to the on-load tap-changer and transformer.

### **RTU**

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Remote Terminal Unit



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