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The product may have been altered since this document was published.

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 also apply in addition to this technical file:

• Connection diagrams
• Routine test report
• Supplement

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:

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER</td>
<td>Indicates a hazardous situation which, if not avoided, will result in death or serious injury.</td>
</tr>
<tr>
<td>WARNING</td>
<td>Indicates a hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.</td>
</tr>
<tr>
<td>NOTICE</td>
<td>Indicates measures to be taken to prevent damage to property.</td>
</tr>
</tbody>
</table>

Table 1: Signal words in warning notices

Pictograms warn of dangers:

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Warning of danger point" /></td>
<td>Warning of a danger point</td>
</tr>
<tr>
<td><img src="image" alt="Warning of dangerous electrical voltage" /></td>
<td>Warning of dangerous electrical voltage</td>
</tr>
</tbody>
</table>
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:
1.4.4 Typographic conventions

The following typographic conventions are used in this technical file:

<table>
<thead>
<tr>
<th>Typographic convention</th>
<th>Purpose</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPERCASE</td>
<td>Operating controls, switches</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>[Brackets]</td>
<td>PC keyboard</td>
<td>[Ctrl] + [Alt]</td>
</tr>
<tr>
<td>Bold</td>
<td>Software operating controls</td>
<td>Press <strong>Continue</strong> button</td>
</tr>
<tr>
<td>...&gt;...&gt;...</td>
<td>Menu paths</td>
<td>Parameter &gt; Control parameter</td>
</tr>
<tr>
<td>Italics</td>
<td>System messages, error messages, signals</td>
<td><strong>Function monitoring</strong> alarm triggered</td>
</tr>
</tbody>
</table>

[► Number of pages]. Cross reference [► 41].

Table 3: Typographic conventions
2 Security

- Read this technical file through to familiarize yourself with the product.
- This technical file is a part of the product.
- Read and observe the safety instructions provided in this chapter.
- Read and observe the warnings in this technical file in order to avoid function-related dangers.
- The product is manufactured on the basis of state-of-the-art technology. Nevertheless, risks to life and limb for the user or impairment of the product and other material assets due to the function may arise in the event of improper use.

2.1 Appropriate use

The motor-drive unit adjusts the operating position of on-load tap-changers in regulating transformers to the individual operating requirements. The motor-drive unit 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 motor-drive unit does not present any danger to people, property or the environment. This applies throughout the service life of the product, from delivery, installation and operation to removal and disposal.

The following is considered appropriate use:
- Only operate the product in accordance with this technical file and the agreed delivery conditions and technical data.
- Use the equipment and special tools supplied solely for the intended purpose and in accordance with the specifications of this technical file.
- Use the product only with the transformer/on-load tap-changer/de-energized tap-changer specified in the order.
- You will find the standard valid for the product and the year of issue on the nameplate.
- The serial numbers of on-load tap-changer / de-energized tap-changer and on-load tap-changer accessories / de-energized tap-changer accessories (drive, drive shaft, bevel gear, protective relay, etc.) must match if these products are supplied as a set for one order.
- Electrically operate the motor-drive unit remotely during normal operation.
- In special operating cases (such as during maintenance tasks), the motor-drive unit can also be operated electrically on site via control switch S3.
- Never operate the motor-drive unit electrically or with the hand crank before the transformer has been disconnected if you think there may be a fault in the transformer or on-load tap-changer/de-energized tap-changer. For more information, refer to the "Troubleshooting" [► Section 8, Page 47] chapter.
• The provided hand crank is for activating the motor-drive unit during installation and tests in the transformer plant or during maintenance tasks if the transformer has been disconnected.

• For details about using the hand crank in emergency operation when the transformer is energized, refer to the "Operation" [►Section 7, Page 44] chapter.

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.

Drying the transformer

Drying the motor-drive unit will cause damage to property as well as motor-drive unit malfunctions.

• Never dry the motor-drive unit.

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.
Hand crank aperture

Reaching into the hand crank aperture during a tap-change operation may lead to injuries caused by a rotating drive shaft.

- Never reach into the hand crank aperture.

Securing the motor-drive unit

If you open the motor-drive unit during operation, there is a danger of electric shock due to live components behind the swing frame.

- Secure the motor-drive unit against unauthorized opening during operation by using a padlock.
- The motor-drive unit may only be opened by an electrically skilled person.

Opening the swing frame

Opening the swing frame while the motor-drive unit is in operation may result in electric shocks due to live components.

- The swing frame may only be opened by an electrically skilled person.

Explosion protection

Highly flammable or explosive gases, vapors and dusts can cause serious explosions and fire. This increases the danger to life and limb.

- Do not install, operate or perform maintenance work on 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.
Auxiliary materials and operating materials

Auxiliary materials and operating materials not approved by the manufacturer can lead to personal injury, damage to property and malfunctions of the product.

- Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.
- Only use lubricants and auxiliary materials approved by the manufacturer.
- Contact the manufacturer.

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.

<table>
<thead>
<tr>
<th>Protective clothing</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety shoes</td>
<td>To protect against falling heavy objects and slipping on slippery surfaces.</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>To protect the eyes from flying parts and splashing liquids.</td>
</tr>
<tr>
<td>Visor</td>
<td>To protect the face from flying parts and splashing liquids or other dangerous substances.</td>
</tr>
<tr>
<td>Hard hat</td>
<td>To protect against falling and flying parts and materials.</td>
</tr>
<tr>
<td>Personal protective equipment</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Hearing protection</strong></td>
<td>To protect against hearing damage.</td>
</tr>
<tr>
<td><strong>Protective gloves</strong></td>
<td>To protect against mechanical, thermal, and electrical hazards.</td>
</tr>
</tbody>
</table>

Table 4: Personal protective equipment
3 Product description

3.1 Scope of delivery

The motor-drive unit is packaged with protection against moisture and is delivered as follows:

- Motor-drive unit
- Product documentation

Please note the following:

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

3.2 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 activated by starting the motor-drive unit (a single control impulse triggered, for example, by a voltage regulator of the TAPCON®-series). This operation is always completed regardless of any other control pulses emitted 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.

Behavior in the event of a voltage interruption

Should the voltage be interrupted during an on-load tap-change operation, once the voltage supply returns, the motor-drive unit completes the started on-load tap-change operation.

3.3 Type designation

The various basic designs of the TAPMOTION® ED are clearly identified by explicit product definitions.

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Description</th>
<th>Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED 100-ST</td>
<td>Product designation</td>
<td>Electric Drive</td>
</tr>
<tr>
<td>ED 100-ST</td>
<td>Transmission gear design</td>
<td>100 or 200 (depending on the torque required)</td>
</tr>
<tr>
<td>ED 100-ST</td>
<td>Protective housing design</td>
<td>S = small protective housing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L = large protective housing</td>
</tr>
</tbody>
</table>
### 3.4 Design

This chapter contains an overview of the design of the motor-drive unit.

Components not described here in detail are described in the motor-drive unit's technical data.
3 Product description

3.4.1 Indication field

A clear indication field is fitted in the motor-drive unit. Pointer and operations counter are mechanically driven and indicate the tap-change operation sequence and operating position of the motor-drive unit. The reset wheel on the operations counter is lead-sealed at the factory.

![Indication field]

**Figure 2: Indication field**

<table>
<thead>
<tr>
<th>1 Tap position indicator</th>
<th>3 Tap-change indicator: Shows the current position of the control cam (33 tap-change indicator sections per operating position)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 The two drag hands indicate the regulating range currently used</td>
<td>4 The mechanical operations counter shows the overall number of tap-change operations</td>
</tr>
</tbody>
</table>

3.4.2 Anti-condensation heater

The anti-condensation heater is designed as a panel heater which also acts as the front cover of the swing frame.

The design of the motor-drive unit and panel heater ensures that air circulates inside the motor-drive unit and therefore that there is a constant interior temperature which is always higher than the outside temperature.
3.4.3 Swing frame/terminal rail

The swing frame protects all electrical and mechanical parts of the motor-drive unit behind the swing frame against accidental contact.

The terminal rail behind the swing frame makes electrical connection of the motor-drive unit a simple task. The wiring is easily connected using vertically arranged cap rails with the corresponding installed terminal bars.

Figure 3: Terminal rail

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Swing frame</td>
</tr>
<tr>
<td>2</td>
<td>Position transmitter module</td>
</tr>
<tr>
<td>3</td>
<td>Terminal bar X1</td>
</tr>
<tr>
<td>4</td>
<td>Cable duct</td>
</tr>
<tr>
<td>5</td>
<td>Cap rail</td>
</tr>
<tr>
<td>6</td>
<td>Opening for cable entry (sealed by base plate)</td>
</tr>
</tbody>
</table>
3.4.4 Position transmitter equipment

**NOTICE**

Damage to the on-load tap-changer and motor-drive unit!

Damage to on-load tap-changer and motor-drive unit due to incorrect use of position transmitter equipment.

- Only circuits stated in the chapter Technical data for position transmitter equipment [►Section 13.2, Page 57] may be connected to the position transmitter module connections.

- The switchover point of the position transmitter equipment in the motor-drive unit is not the same as the switchover point of the diverter switch operation. This depends on the type of diverter switch. This fact should be noted when project planning the locking circuits between the motor-drive unit and external equipment (e.g. transformer circuit breaker).

- Therefore, the “Tap changer in operation” position transit contact shown in the connection diagram should be used for external monitoring, locking and control purposes instead of the position transmitter equipment.

The position transmitter equipment is used to indicate the operating position of the on-load tap-changer/off-circuit tap-changer when idle.

The remote display is available in various versions.

The position transmitter module for connection by the customer is located on the terminal rail [►Section 3.4.3, Page 19].

For more information about the position transmitter equipment, see Technical data for position transmitter equipment [►Section 13.2, Page 57].

3.4.5 Transmission gear cover plate

**WARNING**

Danger of death and severe injury from electrical voltage!

Danger of death and severe injury from electrical voltage if the transmission gear cover plate is not fitted.

- Never start up motor-drive unit without transmission gear cover plate.
The touch-protected transmission-gear cover plate features an opening for the hand crank used in manual mode.

3.5 Protective devices

The following protective devices are fitted in the motor-drive unit:

- End stop device (mechanical and electric)
- Device protecting against unintentional passage
- Motor protection device
- Protection against accidental contact
### 3.6 Safety markings

The following safety markings are used on the product:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Warning of rotating parts</td>
</tr>
<tr>
<td>2</td>
<td>Warning of dangerous electrical voltage</td>
</tr>
<tr>
<td>3</td>
<td>Warning of hot surface</td>
</tr>
<tr>
<td>4</td>
<td>Read the documentation</td>
</tr>
</tbody>
</table>

Figure 4: Overview of safety markings
4 Packaging, transport and storage

4.1 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.

4.1.1 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.
4.1.2 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 6: Shipping pictograms

4.2 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.
4 Packaging, transport and storage

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.

4.3 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).

### 4.4 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.
5 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.

### 5.1 Fitting motor-drive unit on transformer

1. Attach four stud bolts (not supplied by MR) to the transformer tank. The arrangement and diameter of the fixing lugs can be found in the drawings in the Appendix [►Section 14, Page 60].

![Stud bolts](image)

**Figure 5: Stud bolts**

2. For motor-drive unit with vibration damper: Attach the vibration damper to the motor-drive unit.

3. **NOTICE!** Damage to the drive due to mechanical tension. Make sure the drive is de-energized and fit it vertically to the transformer tank so that the output shaft of the drive is exactly aligned with the vertical shaft of the bevel gear.
The assembly holes for attaching the drive are located externally on the protective housing's fixing lugs.

4. Connect grounding screw of motor-drive protective housing to transformer tank. It is essential that a CUPAL washer be placed between the cable shoe and connecting lug. The aluminum side of the CUPAL washer must be facing the connecting lug.

5. Connect the main protective conductor to the protective conductor terminal on terminal bar X1 (minimum connection cross-section 2.5 mm²).
5.2 Mounting drive shafts and bevel gear

The process of mounting the drive shafts and bevel gear is described in the installation and commissioning instructions for the on-load tap-changer / de-energized tap-changer.

5.3 Centering on-load tap-changer and motor-drive unit

**WARNING**

Danger of death or severe injury!

Danger of death or severe injury due to motor-drive unit starting up by accident and due to electric voltage!

- Before starting any coupling work make sure that the motor protective switch is tripped.
- Carry out any adjustment work in manual mode only.
- When manually operating the motor-drive unit only use the hand crank provided for this purpose.
- Note that the hand crank safety switch causes a 2-pole disconnection of the motor circuit but that the control circuit is not interrupted.
**NOTICE**

Damage to property!

The on-load tap-changer will be damaged by incorrectly centering the motor-drive unit.

- Do not perform more than 250 tap-change operations on the on-load tap-changer. If more than 250 tap-change operations are performed, completely fill oil compartment with insulating oil and lubricate sliding surfaces of contacts on selector and selector gear with insulating oil.

The following steps for centering the on-load tap-changer and motor-drive unit do not apply to the DEETAP® DU and COMTAP® ARS. The process for centering the motor-drive unit and DEETAP® DU or COMTAP® ARS is described in the relevant operating instructions.

One on-load tap-change operation is represented by one rotation of the tap-change indicator. This indicator is divided into 33 tap-change indicator sections, each of which corresponds to one hand crank revolution in the standard motor-drive unit design. The time of the switchover depends on the on-load tap-changer/de-energized tap-changer type, but is always 2 tap-change indicator sections before the area marked in gray on the tap-change indicator at the latest.

To center the on-load tap-changer and motor-drive unit, proceed as follows.

1. **NOTICE!** Move the on-load tap-changer/de-energized tap-changer and the motor-drive unit into the adjustment position before commencing any adjustment work. Ensure that the tap position indicators for the motor-drive unit and the on-load tap-changer/de-energized tap-changer match. Otherwise damage to the on-load tap-changer and transformer may result.

![Figure 9: Adjustment position](image-url)
2. Attach the hand crank in the motor-drive unit to the shaft end located in the upper cover plate. This activates a hand crank interlock switch, which disconnects the motor circuit at 2 poles.

![Figure 10: Hand crank](image)

3. Turn clockwise using the hand crank until the diverter switch operation begins. When turning the hand crank, observe the tap-change indicator, which mechanically reflects the progress of the tap-change operation.

![Figure 11: Turning the hand crank](image)
4. Once the diverter switch operation begins, continue to turn in the same direction while counting the tap-change indicator sections required for the pointer to reach the mid-position of the area marked in gray on the tap-change indicator. Note the number counted (value A) and the direction of rotation (example: A=2).

![Figure 12: Counting the tap changes needed to reach the mid-position](image)

5. If value A is greater than 8 tap-change indicator sections, the tap-change operation has been completed correctly. If value A is less than 8 tap-change indicator sections, turn another 8-A tap-change indicator sections in the same direction (example: 8-2=6) to complete the tap-change operation. Then turn in the opposite direction until the pointer is in the mid-position of the area marked in gray on the tap-change indicator.

![Figure 13: Completing the diverter switch operation](image)

6. Turn the hand crank counter-clockwise until the diverter switch operation begins.
7. Once the diverter switch operation begins, continue to turn in the same direction while counting the tap-change indicator sections required for the pointer to reach the mid-position of the area marked in gray on the tap-change indicator. Note the number counted (value B) and the direction of rotation (example: B=5).

8. If value B is greater than 8 tap-change indicator sections, the tap-change operation has been completed correctly. If value B is less than 8 tap-change indicator sections, turn another 8-B tap-change indicator sections in the same direction (example: 8-5=3) to complete the tap-change operation. Then turn in the opposite direction until the pointer is in the mid-position of the area marked in gray on the tap-change indicator.
9. If the values obtained for A and B are identical, the on-load tap-changer and the motor-drive unit are correctly coupled (a slight imbalance of maximum 1 tap-change indicator section is permitted). If the values obtained for A and B are different, establish correction value C by halving the difference between A and B: \[ C = \frac{|A - B|}{2} \]

Example: \[ C = \frac{|2 - 5|}{2} = \frac{|-3|}{2} = 1.5 \]

Also take numbers after the decimal point into account.

10. If the correction value [C] is less than 0.5 tap-change indicator sections, no further action is required. Refer to point 18 for how to proceed next.

11. Use the hand crank to crank in the direction in which the determined value A or B was higher (example: counter-clockwise, because B > A) until the diverter switch operation begins.

12. Once the diverter switch operation begins, continue turning another 8 hand crank revolutions in the same direction to correctly complete the diverter switch operation.

13. Uncouple the motor-drive unit and vertical drive shaft by removing the coupling brackets. After uncoupling, do not turn the drive shaft any further.
Figure 17: Uncoupling the motor-drive unit and drive shaft

14. Operate the motor-drive unit using the hand crank in the same direction, continuing by C tap-change indicator sections on the tap-change indicator (example: 1.5 tap-change indicator sections).

15. Couple the motor-drive unit and on-load tap-changer by refitting the vertical drive shaft (tightening torque 9 Nm). Do not turn the drive shaft and output shaft of the bevel gear and motor-drive unit any further.

16. Continue to turn in the same direction while counting the tap-change indicator sections required for the pointer to reach the mid-position of the area marked in gray on the tap-change indicator. Note the number counted (value A) and the direction of rotation. If value A is greater than 8 tap-change indicator sections, the tap-change operation has been completed correctly. If value A is less than 8 tap-change indicator sections, turn another 8-A tap-change indicator sections in the same direction (example: 8-4=4) to complete the tap-change operation. Then turn in
the opposite direction until the indicator is in the mid-position of the area marked in gray on the tap-change indicator. Check the coupling again as described previously.

17. The pointer of the tap-change indicator must be in the mid-position of the area marked in gray once the on-load tap-change operation with the hand crank is complete.

Figure 18: Pointer in the mid-position

18. Once coupling is complete in both directions, check by undertaking several on-load tap-change operations and check that the on-load tap-changer and motor-drive unit are in the same tap position.

5.4 Cable recommendation

Electromagnetic interference on signal lines, which can be expected due to the environment of the transformer, can disrupt the proper operation of the motor-drive unit.

That is why Maschinenfabrik Reinhausen GmbH recommends using shielded signal lines when possible.

**NOTICE**

**Damage to the device!**

Current flow through the shielding of signal lines can lead to the device getting damaged.

► For signal lines between the motor-drive unit and transformer, connect the shielding of the signal line to the motor-drive unit only.

► For all other signal lines, connect the shielding on both sides, as long as there is no potential difference between the two devices. If there is a potential difference, then connect the shielding only on one side for these signal lines, too.

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Function</th>
<th>Cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor circuit</td>
<td>Power supply</td>
<td>Unshielded, separate cable</td>
</tr>
<tr>
<td>Control circuit</td>
<td>Power supply</td>
<td>Unshielded, separate cable</td>
</tr>
<tr>
<td></td>
<td>Tap-change supervisory control</td>
<td>Shielded</td>
</tr>
<tr>
<td></td>
<td>Pulse circuit, raise/lower</td>
<td>Shielded</td>
</tr>
<tr>
<td></td>
<td>Trigger circuit Q1-Off</td>
<td>Shielded</td>
</tr>
</tbody>
</table>
### 5.5 Installing electrics for motor-drive unit

#### Danger of death or severe injury!

An energized transformer and energized on-load tap-changer components could cause death or serious injuries when installing the electrics!

► Adherence to the following safety precautions is mandatory.

The drive may only be connected to circuits that are equipped with an external and all-pole isolating device as close to the drive as possible to ensure that the unit can be fully de-energized if required (service, maintenance etc.).

Furthermore, a drive without its own overcurrent protective device for the control circuit and the heater circuit may only be connected to circuits that are equipped with an external overcurrent protective device. The protective device must ensure protection against indirect touching. The protection recommended by Maschinenfabrik Reinhausen GmbH close to the drive is 1.6 A C (3.0 A C is to be used in a heater circuit with additional heating and supply voltage <127 V AC/DC). This is to be verified after installation by carrying out a measurement.

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC60947-3 (e.g. circuit breaker). When selecting the circuit breaker type, the properties of the relevant circuits (voltage, maximum currents) must be observed. The following should also be noted during installation:

- It must be easy for the operator to access the isolating device
- The isolating device must be labeled for the device and 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

Unless specified otherwise, the connections for the supply circuits must have a conductor cross-section of at least 2.5 mm² (16 AWG). Check applicable standards and directives to ensure that the specified minimum cross-section of the supply line is sufficient.
The voltage supply for the motor-drive unit must be able to provide 5…7 times the nominal operating current of the motor-drive unit for one second.

A maximum voltage tolerance of -20…+10% of the nominal voltage must be observed to avoid damage to the drive.

To electrically connect the motor-drive unit, proceed as follows:

1. Switch off the voltage supply.
2. Secure the voltage supply to prevent an unintentional restart.
3. Ensure that everything is de-energized.
4. Visibly ground and short circuit the motor-drive unit.
5. Cover or cordon off adjacent energized parts.
6. Connect the motor-drive unit in accordance with the connection diagrams provided in the briefcase. Observe the supply voltages (motor circuit, control circuit, heater circuit) and pin assignments stated in the connection diagram.

7. When operating the motor-drive unit, ensure that a current corresponding to that stated in the Technical Data chapter (Load capacity of micro-switches) (Section 13.1, Page 57) flows through the micro-switches in the motor-drive unit at all times to ensure correct functioning of the micro-switches.

Figure 19: Example: Standard terminal block X1
6 Commissioning

6.1 Starting up motor-drive unit

Preparation
1. Make sure that the motor-drive unit is connected as shown in the connection diagram provided.
2. Ensure that all protective conductors are connected correctly.
3. Ensure that the preliminary fuse is selectively configured for the protective devices in the motor-drive unit.
4. Ensure that motor-drive unit and on-load tap-changer are correctly coupled and the operating positions of the motor-drive unit and on-load tap-changer match.
5. Ensure that the hand crank is not inserted in the hand crank aperture.
6. Ensure that all signaling contacts provided in the connection diagram are output and monitored in the control room.
7. Ensure that the motor protective switch and control circuit fuse are disabled.

Commissioning
1. Apply voltage to the motor-drive unit.
2. Measure the voltage and frequency of the motor circuit at terminal X1 and compare with the details on the nameplate. The details must match.
3. As an option with separate control-circuit supply: Measure the voltage and frequency of the control circuit at terminal X1 and compare with the details on the nameplate. The details must match.
4. As an option with separate heating-circuit supply: Measure the voltage of the heater circuit at terminal X1 and compare with the details on the connection diagram. The details must match.
5. As an option with three-phase motor: Ensure that the voltage applied to the connection terminals has a clockwise phase sequence.
6. As an option with DC motor: Ensure that the motor voltage has the right potential connection.
7. Engage the motor protective switch and fuses for the control circuit and heater circuit (if present).
   ⇒ The voltage monitor LED and thermostat LED (if present) on the rear of the swing frame must light up green.
8. Close the motor-drive unit and secure it against unauthorized opening by using a padlock.
   ⇒ Commissioning is complete.

Contact Maschinenfabrik Reinhausen GmbH if anything is not clear or you encounter problems during commissioning.
6.2 Tests on motor-drive unit

**Electric shock!**
Risk of death or severe injury due to electrical voltage!

► Make sure that the motor-drive unit is correctly connected as shown in the connection diagrams provided.

► Make sure that the supply voltage is matched to the technical data of the motor-drive unit.

► Ensure contact safety before performing the checks and tests. The transmission gear cover plate must be fitted and the motor and swing frame closed.

► Ensure that the motor-drive unit and on-load tap-changer/de-energized tap-changer are correctly coupled and that they are in the same tap position for each operating position.

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

### 6.2.1 Checking correct electric switch-off
1. Change over motor-drive unit by moving control switch S3.
2. Check that the pointer of the tap-change indicator stops within the gray field after completing a tap-change operation.
3. Carry out this test in both directions.

### 6.2.2 Checking mechanical and electric end stop of on-load tap-changer/off-circuit tap-changer and motor-drive unit
1. Press the S3 control switch to switch the motor-drive unit to the second-to-last operating position.
2. Open motor-drive unit door and switch off motor protective switch Q1 (position O).

3. Using the hand crank, operate the motor-drive to move it to its last operating position. If the last operating position isn’t reached, check coupling between on-load tap-changer/de-energized tap-changer and motor-drive unit.

4. Continue turning the motor-drive unit in the same direction with the hand crank until the motor-drive unit is mechanically blocked.

5. Turn back motor-drive unit with hand crank to mid-position of tap-change indicator.

6. Remove the hand crank.

7. Switch on motor protective switch Q1 (position I).

8. Check that the motor-drive unit no longer starts up when the S3 switch is turned further in the same operating direction as under item 1.

9. Perform check for both end positions.

6.2.3 Checking tripping of motor protective switch

Proceed as follows to check tripping of the motor protective switch:

1. Close X1:14 - X1:15 Q1 OFF connection to trip the motor protective switch.

   - The motor protective switch is tripped (position O). If the motor protective switch is not tripped, contact Maschinenfabrik Reinhausen GmbH.

2. Switch on motor protective switch again (position I).

   - The tripping of the motor protective switch is checked.
6 Commissioning

6.3 Tests on the transformer

6.3.1 High-voltage tests on the transformer

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

Note the following points before performing high-voltage tests on the transformer:

▪ Ensure that the oil compartment of the on-load tap-changer is completely filled with insulating fluid.
▪ Ensure that all protective devices for the on-load tap-changer are functioning correctly and are ready for use.
▪ Ensure that the ground connections on the motor-drive protective housing and protective housing fastening are free of paint.
▪ Only perform high voltage test if motor-drive unit door is closed.
▪ Disconnect external connections to electronic components in the motor-drive unit to prevent damage from overvoltage.
▪ When connecting the motor-drive unit's supply voltage, only use the cable bushings in the protective housing base intended for lead insertion.
▪ Guide all ground connecting leads to one central connection point (establishment of suitable reference earth).
▪ Disconnect all electronic components before the high voltage test. Before a dielectric test of the wiring, remove all devices with a withstand voltage of < 1000 V.
▪ Remove leads used for testing before the high voltage test as these function as antennas.
▪ Wherever possible, route the measurement leads and data leads separately to the energy cables.

Contact the manufacturer if you have any questions about possible sources of danger.

6.3.2 Dielectric tests on transformer wiring

Note the following points for dielectric tests on the transformer wiring:

The motor-drive unit is put through dielectric tests before delivery.

► Before the dielectric test for the transformer wiring, disconnect drive from the section to be tested to rule out increased component loading for those components fitted in the motor-drive unit.
6.4 Transporting transformer to the operating site

If the drive must be removed in order to transport the transformer, proceed as follows:

1. Ensure that the drive and the on-load tap-changer / de-energized tap-changer / ARS are in the adjustment position.
2. Remove the drive.
3. Do not actuate the drive while the on-load tap-changer / de-energized tap-changer / ARS is decoupled and do not turn the output shaft.
4. Do not actuate the decoupled on-load tap-changer / de-energized tap-changer / ARS and do not turn its drive shaft.
5. Transport the drive to the installation site in the MR delivery packaging.
6. Fit the drive and drive shaft to the transformer at the installation site in accordance with the respective instructions and check for correct coupling and centering.

6.5 Commissioning the transformer at the operating site

**NOTICE**

**Damage to motor-drive unit!**

Damage to the motor-drive unit due to condensate in protective housing of motor-drive unit.

► Always keep protective housing of the motor-drive unit tightly closed.

► In the event of downtime lasting more than 8 weeks prior to initial commissioning, connect and operate the anti-condensation heater in the motor-drive unit. If this is not possible, place a sufficient amount of desiccant in the protective housing.

**NOTICE**

**Damage to the on-load tap-changer and motor-drive unit!**

Damage to on-load tap-changer and motor-drive unit due to incorrect use of position transmitter equipment.

► Only circuits stated in the chapter Technical data for position transmitter equipment [►Section 13.2, Page 57] may be connected to the position transmitter module connections.

► The switchover point of the position transmitter equipment in the motor-drive unit is not the same as the switchover point of the diverter switch operation. This depends on the type of diverter switch. This fact should be noted when project planning the locking circuits between the motor-drive unit and external equipment (e.g. transformer circuit breaker).

► Therefore, the “Tap changer in operation” position transit contact shown in the connection diagram should be used for external monitoring, locking and control purposes instead of the position transmitter equipment.

1. Commission motor-drive unit [►Section 6.1, Page 39].
2. Ensure correct function of motor-drive unit [►Section 6.2, Page 40].
3. Commission the transformer.
7 Operation

7.1 Operating the motor-drive unit remotely

Operate the motor-drive unit remotely during normal operation.

You can do this with a single control pulse, e.g. using a voltage regulator of the TAPCON® series.

This operation is always completed regardless of any other control pulses emitted 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.

Behavior in the event of a voltage interruption

If the voltage is interrupted during a tap-change operation, the motor-drive unit will complete the started tap-change operation once the voltage supply returns.

7.2 Operating motor-drive unit locally

In special operating cases (such as during maintenance tasks) the motor-drive unit can also be operated electrically on site via control switch S3.

In exceptional cases, the unit can be operated using a hand crank. You will find more information in the following section.
7 Operation

7.3 Operating the motor-drive unit with the hand crank

**WARNING**

Unauthorized operation of the motor-drive unit with the hand crank may result in death or serious injury.

► Never operate the motor-drive unit electrically or with the hand crank before the transformer has been disconnected if you think there may be a fault in the transformer or on-load tap-changer / de-energized tap-changer.

► Never use the hand crank to complete a tap-change operation that has begun electrically, but has not been ended completely.

► If the hand crank is difficult to move, you must stop using it.

► When operating the motor-drive unit with the hand crank, never reverse the direction of rotation.

► If there is any doubt about the on-load tap-changer / de-energized tap-changer being in proper working condition or about the cause of a fault in the motor-drive unit, contact the Technical Service department of Maschinenfabrik Reinhausen GmbH immediately.

► To operate the motor-drive unit manually, only use the hand crank mounted in the motor-drive unit.

For information about fault rectification, refer to the "Fault elimination" [►Section 8, Page 47] chapter.

**Normal operation**

During normal operation, there is no need to operate the unit with the hand crank. The hand crank is mainly required during installation and for tests in the transformer plant.

Use of the hand crank for operating the motor-drive unit is permitted if the transformer is disconnected, e.g. for maintenance tasks, if there is no detectable fault on the transformer or on-load tap-changer / de-energized tap-changer and the previous tap-change operation has been completed correctly.

**Emergency operation exception**

An operation is considered an emergency operation if a tap-change operation is absolutely necessary when a transformer is energized, despite a fault in the motor-drive unit. In this case, be sure to observe the warnings listed above.

**Operating the motor-drive unit with the hand crank**

To carry out a tap-change operation with the hand crank, proceed as follows:
1. Open the door of the protective housing for the motor-drive unit.
2. Switch off motor protective switch Q1 (position 0).
3. Insert the hand crank mounted in the motor-drive unit into the hand crank aperture in the upper cover plate.
   ⇒ The built-in hand crank interlock switch interrupts the motor circuit at two poles. The control circuit will not be interrupted.

4. **NOTICE!** Damage to the on-load tap-changer due to tap-change operation not being completed correctly. Turn the hand crank in one direction until the pointer has fully circled the tap-change indicator once and is again in the mid-position of the area marked in gray on the tap-change indicator.
   ⇒ The tap-change operation is complete.

5. Remove the hand crank and return it to the mounting bracket.

6. Switch on motor protective switch Q1 (position I).

7. Close the door of the protective housing for the motor-drive unit.
8 Fault elimination

8.1 Safety instructions

**WARNING**

Danger of death or severe injury from explosive gases in the on-load tap-changer / de-energized tap-changer, in the pipework system, at the dehydrating breather opening and from flying parts and hot oil splashing!

► If a protective device has been tripped or you suspect a fault, first check the transformer, on-load tap-changer / de-energized tap-changer and motor-drive unit. Never operate the motor-drive unit electrically or with the hand crank beforehand as long as the transformer is energized.

► Do not resume operation until the troubleshooting has been completed.

► Make sure that only trained technicians perform the work.

► Use suitable personal protective equipment/clothing.

► 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 all safety equipment for the on-load tap-changer / de-energized tap-changer is ready for use.

► Ensure that the oil compartment of the on-load tap-changer is correctly filled with oil as per the instructions.
8.2 General information

Document each fault, even if it is easy to rectify.

In the event of faults on the on-load tap-changer / de-energized tap-changer or motor-drive unit, which cannot be easily and immediately corrected on site, or if a protective device has been tripped, please inform your authorized MR representative, the transformer manufacturer or contact us directly at:

Maschinenfabrik Reinhausen GmbH

Technical Service

Postfach 12 03 60

93025 Regensburg

Germany

Phone: +49 94140 90-0

Fax: +49 9 41 40 90-7001

E-mail: service@reinhausen.com

Internet: www.reinhausen.com

8.3 Fault in the environment of the motor-drive unit

<table>
<thead>
<tr>
<th>Error pattern</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change in voltage on transformer despite change in position on motor-drive</td>
<td>• Contact MR</td>
</tr>
<tr>
<td>unit</td>
<td></td>
</tr>
<tr>
<td>Noises on drive shaft or motor-drive unit when changing tap position</td>
<td>• Ensure that the motor-drive unit is attached correctly, in accordance</td>
</tr>
<tr>
<td></td>
<td>with the &quot;Assembly&quot; [▶ Section 5, Page 27] chapter.</td>
</tr>
<tr>
<td></td>
<td>• Make sure that the drive shaft including protective cover is assembled</td>
</tr>
<tr>
<td></td>
<td>correctly, in accordance with the operating instructions for the on-</td>
</tr>
<tr>
<td></td>
<td>load tap-changer / de-energized tap-changer.</td>
</tr>
</tbody>
</table>

Table 8: Fault in the environment of the motor-drive unit

8.4 Fault in the motor-drive unit when the switching operation has not ended

If the motor-drive unit stops and if the arrow of the tap-change indicator does not point in the area highlighted in gray (see the "Indication field" [▶ Section 3.4.1, Page 18] section, Position 3), then the switching operation has not been ended correctly.
This is a stationary state that is not allowed and must be rectified immediately. If you cannot rectify the fault immediately, switch off the transformer. Contact the Technical Service department at Maschinenfabrik Reinhausen GmbH immediately.

If you notice a fault in the motor-drive unit right away, you should immediately start troubleshooting as described in the following table.

<table>
<thead>
<tr>
<th>Error pattern</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tripping of the motor protective switch Q1</td>
<td>• Hand crank operation is prohibited</td>
</tr>
<tr>
<td></td>
<td>• Switch on Q1 only once</td>
</tr>
<tr>
<td></td>
<td>• If Q1 does not trigger again and if no other fault is present, the motor-drive unit automatically ends the switching operation that was started.</td>
</tr>
<tr>
<td></td>
<td>• If Q1 is tripped again, do not attempt any more switching operations and contact MR.</td>
</tr>
<tr>
<td>Interruption of the supply voltage to the motor-drive unit or motor controller</td>
<td>• Hand crank operation is prohibited</td>
</tr>
<tr>
<td></td>
<td>• Reestablish the voltage supply</td>
</tr>
<tr>
<td></td>
<td>• Once the voltage supply returns, the motor-drive unit automatically ends the switching operation that was started.</td>
</tr>
<tr>
<td>Component defect in the motor-drive unit</td>
<td>• Hand crank operation is prohibited</td>
</tr>
<tr>
<td></td>
<td>• Contact MR</td>
</tr>
</tbody>
</table>

Table 9: Fault in the motor-drive unit when the switching operation has not been ended

8.5 Fault in the motor-drive unit after the switching operation is ended correctly

<table>
<thead>
<tr>
<th>Error pattern</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tripping of the motor protective switch Q1</td>
<td>• Switch on Q1</td>
</tr>
<tr>
<td>Interruption of the supply voltage to the motor-drive unit or motor controller</td>
<td>• Reestablish the voltage supply</td>
</tr>
<tr>
<td>Component defect in the motor-drive unit</td>
<td>• Contact MR</td>
</tr>
</tbody>
</table>

Table 10: Fault in the motor-drive unit after the switching operation is ended correctly

8.6 Hand crank operation in the event of faults

Hand crank operation in the event of faults

An operation is considered an emergency operation if a tap-change operation is absolutely necessary when a transformer is energized, despite a fault in the motor-drive unit.
**Danger of explosion!**

Unauthorized operation of the motor-drive unit with the hand crank may result in death or serious injury.

► Never operate the motor-drive unit electrically or with the hand crank before the transformer has been disconnected if you think there may be a fault in the transformer or on-load tap-changer / de-energized tap-changer.

► Never use the hand crank to complete a tap-change operation that has begun electrically, but has not been ended completely.

► If the hand crank is difficult to move, you must stop using it.

► When operating the motor-drive unit with the hand crank, never reverse the direction of rotation.

► If there is any doubt about the on-load tap-changer / de-energized tap-changer being in proper working condition or about the cause of a fault in the motor-drive unit, contact the Technical Service department of Maschinenfabrik Reinhausen GmbH immediately.

► To operate the motor-drive unit manually, only use the hand crank mounted in the motor-drive unit.

For a detailed description of operation using the hand crank, refer to the "Operation" [►Section 7, Page 44] chapter.
9 Inspection and maintenance

This chapter contains information about inspecting and maintaining the product.

9.1 Care

You can clean the outside of the motor-drive unit’s protective housing with a damp cloth. You can clean the inside of the protective housing with a dry cloth.

9.2 Inspection

Carry out the following inspections on the motor-drive unit within the specified intervals:

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
<th>Detail</th>
</tr>
</thead>
</table>
| For checking operations on the transformer | Visual checks | • Check the gaskets of the protective housing of the motor-drive unit.  
• Check the function of the electrical heater in the protective housing of the motor-drive unit.  
Contact Maschinenfabrik Reinhausen GmbH if the gaskets or heater are not in perfect condition. |
| Annually                        | Checking the motor protective switch | ✓ The motor protective switch Q1 is switched on (position I).  
1. Trip the motor protective switch from the control room.  
   ⊳ The motor protective switch is tripped (position O). If the motor protective switch is not tripped, check the switch's connection to the control room and if necessary contact Maschinenfabrik Reinhausen GmbH.  
2. Switch on the motor protective switch again (position I).  
   ⊳ The tripping of the motor protective switch from the control room is checked. |

Table 11: Inspection plan

9.3 Maintenance

Maintenance of the motor-drive unit is not required. The condition of the motor-drive unit and its correct function must, however, be checked in accordance with the section “Tests on the motor-drive unit” each time the on-load tap-changer / de-energized tap-changer/ motor-drive unit is maintained.

Furthermore, certain components of the motor-drive unit (e.g. cam switches, relays, contactors) have to be replaced every 1 million tap-change operations. Contact the Technical Service department of Maschinenfabrik Reinhausen GmbH for information regarding this.
We strongly recommend having on-load tap-changer maintenance and motor-drive unit checks carried out by our Technical Service department. This ensures, in addition to the correct performance of all work, that certain components will be upgraded to the latest state of technology and manufacturing status.

If the maintenance and checks are not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained by MR or are otherwise suitably qualified to carry out the work. In such cases, we would ask you to forward to us a report on the maintenance performed so we can update our maintenance files. For inquiries about spare parts, please provide the serial number (see nameplates on the on-load tap-changer and motor-drive unit) and the number of tap-change operations.

Technical Service
Maschinenfabrik Reinhausen GmbH
Technical Service
Postfach 12 03 60
93025 Regensburg
Germany
Phone: +49 94140 90-0
Fax: +49 9 41 40 90-7001
E-mail: service@reinhausen.com
Internet: www.reinhausen.com
10 Disassembly

The safe disassembly of the motor-drive unit is described below.

**WARNING**

Danger of death or severe injury!

An energized transformer and energized on-load tap-changer/de-energized tap-changer/ARS and motor-drive unit components can cause death or serious injuries during disassembly!

► Switch off the voltage supply.
► Secure the voltage supply to prevent an unintentional restart.
► Ensure that everything is de-energized.
► Cover or cordon off adjacent energized parts.

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

1. Remove the vertical drive shaft and protective tube between bevel gear and motor-drive unit.

2. Connect lifting gear to fixing lugs on motor-drive unit.

3. Remove the nuts for fastening the motor-drive unit.
4. **CAUTION!** Injuries and damage to the motor-drive unit due to the lifting gear cable angle being too low! Remove and lower the motor-drive unit using the lifting gear. While doing so, ensure that the lifting gear cable angle does not fall below 45° relative to the horizontal.

![Diagram showing lifting gear cable angle](Figure 22: Lifting gear)

The motor-drive unit is disassembled.
11 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.
## 12 Special motor-drive unit models

The standard design of the motor-drive unit can be modified to accommodate specific operating requirements.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Special equipment in motor-drive unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VACUTAP® VT</td>
<td>Recovery time delay (60 s)</td>
</tr>
<tr>
<td>On-load tap-changer with change-over selector for star-delta change-over operation</td>
<td>Star-delta monitoring</td>
</tr>
<tr>
<td>Furnace and electrolysis operation</td>
<td>Additional input terminals for &quot;operation without step-by-step switch&quot;</td>
</tr>
<tr>
<td>Thermostat for on-load tap-changers</td>
<td>Temperature monitoring with break contact for the control circuit</td>
</tr>
<tr>
<td>Higher maximum number of operating positions</td>
<td>Control gear + on-load tap-change position indicator for 70 operating positions</td>
</tr>
<tr>
<td>Special on-load tap-changer arrangement: ABC arrangement</td>
<td>Control gear for ABC arrangement</td>
</tr>
<tr>
<td>Ambient temperature:</td>
<td></td>
</tr>
<tr>
<td>-40 to -25°C</td>
<td>Externally located control elements</td>
</tr>
<tr>
<td></td>
<td>Main switch for disconnecting all circuits except the heating circuit</td>
</tr>
<tr>
<td></td>
<td>Thermostatically controlled additional heater</td>
</tr>
<tr>
<td></td>
<td>Temperature monitoring depending on oil used</td>
</tr>
<tr>
<td>Ambient temperature:</td>
<td></td>
</tr>
<tr>
<td>-60 to -40°C</td>
<td>Externally located control elements</td>
</tr>
<tr>
<td>• For up to 1000 tap-change operations</td>
<td>Main switch for disconnecting all circuits except the heating circuit</td>
</tr>
<tr>
<td>• For type ED 100</td>
<td>Thermostatically controlled additional heater</td>
</tr>
<tr>
<td></td>
<td>Temperature monitoring depending on oil used</td>
</tr>
<tr>
<td></td>
<td>Additional heating for transmission gear</td>
</tr>
<tr>
<td>Ambient temperature:</td>
<td></td>
</tr>
<tr>
<td>+50 to +60°C</td>
<td>Modified heater control system</td>
</tr>
<tr>
<td></td>
<td>Sunroof</td>
</tr>
<tr>
<td></td>
<td>Additional special options available upon request</td>
</tr>
<tr>
<td>Delay of the on-load tap-change operation (switching delay function)</td>
<td>Delay of the on-load tap-change operation for switching on the transformer</td>
</tr>
</tbody>
</table>

Table 12: Special designs
13 Technical data

13.1 Technical data for TAPMOTION® ED

The technical data applies to the standard design and may vary depending on the design delivered. Subject to change without prior notice.

<table>
<thead>
<tr>
<th>Motor-drive unit</th>
<th>ED 100-S/L</th>
<th>ED 200-S/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor power</td>
<td>0.75 kW</td>
<td>2.0 kW</td>
</tr>
<tr>
<td>Motor circuit power supply</td>
<td>3 AC/N 230/400 V</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>approx. 1.9 A</td>
<td>approx. 5.2 A</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
<td></td>
</tr>
<tr>
<td>Synchronous speed</td>
<td>1,500 rpm</td>
<td></td>
</tr>
<tr>
<td>Rotations of the drive shaft per tap-change operation</td>
<td>16.5</td>
<td></td>
</tr>
<tr>
<td>Duration of the tap-change operation</td>
<td>approx. 5.4 s</td>
<td></td>
</tr>
<tr>
<td>Rated torque on the drive shaft</td>
<td>45 Nm</td>
<td>90 Nm</td>
</tr>
<tr>
<td>Rotations of the hand crank per tap-change operation</td>
<td>33</td>
<td>54</td>
</tr>
<tr>
<td>Maximum number of operating positions</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Voltage supply for control circuit and heater circuit</td>
<td>AC 230 V</td>
<td></td>
</tr>
<tr>
<td>Power consumption of the control circuit (control/operation)</td>
<td>100 VA/25 VA</td>
<td></td>
</tr>
<tr>
<td>Heating power</td>
<td>50 W for ED 100/200 S</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 W for ED 100/200 L</td>
<td></td>
</tr>
<tr>
<td>Load capacity of micro-switches</td>
<td>Switching capacity: 100 W</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AC voltage/current: 250 V AC 100 mA…4 A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DC voltage/current: 220 V DC 10 mA…250 mA</td>
<td></td>
</tr>
<tr>
<td>Protection against foreign objects and water</td>
<td>IP 66 in accordance with DIN EN 60529</td>
<td></td>
</tr>
<tr>
<td>Test voltage to ground</td>
<td>2 kV/60 s</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>maximum 130 kg</td>
<td></td>
</tr>
</tbody>
</table>

Table 13: Technical data for TAPMOTION® ED

13.2 Technical data for position transmitter equipment

Resistance-type position transmitter module

Standard resistance: 10.0 Ω (0.6 W, +/-1 %) per tap position

The number of desired operating positions determines the number of loaded resistors.
The decisive power loss of the position transmitter module is 0.6 W because in the worst-case scenario only one resistor is energized. The supply voltage should not exceed DC 220 V. If your setup is more demanding, please contact Maschinenfabrik Reinhausen.

**Position transmitter module with N/O contact range (break-before-make contact)**

AC: 250 V, 0.5 A (resistive loading)

DC: 220 V, 0.2 A (resistive loading)

Minimum voltage level for signal and data processing: 24 V

**Position transmitter module with N/O contact range, (make-before-break-type)**

AC, DC: 250 V, 0.02 A (resistive loading)

AC, DC: 24 V, 0.20 A (resistive loading)

Minimum voltage level for signal and data processing: 24 V

**Position transmitter module with N/O contact range, 10 A (make-before-break-type) for controlling current matching transformer in industrial applications.**

AC, DC: 250 V, 10 A (resistive loading)

**Position transmitter module, diode matrix**

DC: 220 V, 0.2 A (resistive loading)

Minimum voltage level for signal and data processing: 24 V

### 13.3 Permissible ambient conditions

<table>
<thead>
<tr>
<th>Motor-drive unit version</th>
<th>Operating temperature</th>
<th>Storage temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>-25 to +50°C</td>
<td>-50 to +70°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The heater must be in constant operation in the temperature range of -50 to -40°C</td>
</tr>
<tr>
<td>Standard with ISM</td>
<td>-25 to +50°C</td>
<td>-25 to +70°C</td>
</tr>
<tr>
<td>Arctic with thermostat-controlled additional heating</td>
<td>-40 to +50°C</td>
<td>-60 to +70°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All heaters must be in constant operation in the temperature range of -60 to -40°C</td>
</tr>
<tr>
<td>Arctic with thermostat-controlled additional heating with ISM</td>
<td>-40 to +50°C</td>
<td>-40 to +70°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All heaters must be in constant operation in the temperature range of -40 to -25°C</td>
</tr>
<tr>
<td>Arctic with thermostat-controlled additional heating for transmission gear</td>
<td>-60 to +50°C</td>
<td>-60 to +70°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All heaters must be in constant operation in the temperature range of -60 to -40°C</td>
</tr>
</tbody>
</table>
### 13 Technical data

#### Table 14: Permissible ambient conditions

<table>
<thead>
<tr>
<th>Motor-drive unit version</th>
<th>Operating temperature</th>
<th>Storage temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>HiTemp</td>
<td>-25 to +60°C</td>
<td>-40 to +70°C</td>
</tr>
<tr>
<td>HiTemp with ISM</td>
<td>-25 to +55°C</td>
<td>-25 to +70°C</td>
</tr>
</tbody>
</table>
Appendix
APERTURE IN PROTECTIVE HOUSING FOR CABLES
( VIEWED FROM BELOW )

ARRANGEMENT OF FIXING HOLES ON PROTECTIVE HOUSING
( VIEWED FROM BEHIND )

THE COVER CAN BE OPENED TO THE LEFT OR TO THE RIGHT DEPENDING ON THE ARRANGEMENT OF THE PINS.

APPROX. 690 IF OPENED 130°
APPROX. 864 IF OPENED 180°

ATTACHMENT OF PROTECTIVE HOUSING

SHIM

WALL OF TRANSFORMER TANK

3 DUMMY PLATES FOR PACKING GLANDS
SPECIAL DESIGN WITH OLTC MONITORING REQUIRED

MOTOR DRIVE UNIT ED – S
PROTECTIVE HOUSING

SED 1040041 000 05
8988013E