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<td>49</td>
</tr>
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<td>50</td>
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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
Falkensteinaße 8
93059 Regensburg, Germany
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
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 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, guidelines and 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

This section contains an overview of the symbols and textual emphasis used.
### 1.4.1 Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="symbol1.png" alt="Wrench size" /></td>
<td>Wrench size</td>
</tr>
<tr>
<td><img src="symbol2.png" alt="Tightening torque" /></td>
<td>Tightening torque</td>
</tr>
<tr>
<td><img src="symbol3.png" alt="Number and type of fastening material used" /></td>
<td>Number and type of fastening material used</td>
</tr>
<tr>
<td><img src="symbol4.png" alt="Fill with oil" /></td>
<td>Fill with oil</td>
</tr>
<tr>
<td><img src="symbol5.png" alt="Cut open, cut through" /></td>
<td>Cut open, cut through</td>
</tr>
<tr>
<td><img src="symbol6.png" alt="Clean" /></td>
<td>Clean</td>
</tr>
<tr>
<td><img src="symbol7.png" alt="Visual inspection" /></td>
<td>Visual inspection</td>
</tr>
<tr>
<td><img src="symbol8.png" alt="Use your hand" /></td>
<td>Use your hand</td>
</tr>
<tr>
<td><img src="symbol9.png" alt="Adapter ring" /></td>
<td>Adapter ring</td>
</tr>
<tr>
<td><img src="symbol10.png" alt="Apply a coat of paint" /></td>
<td>Apply a coat of paint</td>
</tr>
<tr>
<td><img src="symbol11.png" alt="Use a file" /></td>
<td>Use a file</td>
</tr>
<tr>
<td><img src="symbol12.png" alt="Grease" /></td>
<td>Grease</td>
</tr>
<tr>
<td><img src="symbol13.png" alt="Coupling bolt" /></td>
<td>Coupling bolt</td>
</tr>
<tr>
<td><img src="symbol14.png" alt="Use a ruler" /></td>
<td>Use a ruler</td>
</tr>
<tr>
<td><img src="symbol15.png" alt="Use a saw" /></td>
<td>Use a saw</td>
</tr>
<tr>
<td><img src="symbol16.png" alt="Hose clip" /></td>
<td>Hose clip</td>
</tr>
</tbody>
</table>
1 Introduction

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wire eyelet, safety wire</td>
</tr>
<tr>
<td></td>
<td>Use a screwdriver</td>
</tr>
<tr>
<td></td>
<td>Apply adhesive</td>
</tr>
<tr>
<td></td>
<td>Lock tab</td>
</tr>
</tbody>
</table>

**Table 1: Symbols**

1.4.2 **Hazard communication system**

Warnings in this technical file are displayed as follows.

1.4.2.1 **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 and source of danger**

**Consequences**

- Action
- Action

1.4.2.2 **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.

1.4.2.3 **Signal words and pictograms**

The following signal words are used:

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Meaning</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>
</tbody>
</table>
### 1 Introduction

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<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 injury.</td>
</tr>
<tr>
<td>NOTICE</td>
<td>Indicates measures to be taken to prevent damage to property.</td>
</tr>
</tbody>
</table>

Table 2: Signal words in warning notices

Pictograms warn of dangers:

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Pictogram" /></td>
<td>Warning of a danger point</td>
</tr>
<tr>
<td><img src="image2.png" alt="Pictogram" /></td>
<td>Warning of dangerous electrical voltage</td>
</tr>
<tr>
<td><img src="image3.png" alt="Pictogram" /></td>
<td>Warning of combustible substances</td>
</tr>
<tr>
<td><img src="image4.png" alt="Pictogram" /></td>
<td>Warning of danger of tipping</td>
</tr>
</tbody>
</table>

Table 3: Pictograms used in warning notices

### 1.4.3 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.
2 Safety

2.1 General safety information

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

- Read this technical file through carefully to familiarize yourself with the product.
- Particular attention should be paid to the information given in this chapter.

2.2 Appropriate use

If used as intended and in compliance with the requirements and conditions specified in this technical document as well as with the warnings in this technical document and attached to the product, then the product does not present any danger to people, property or the environment. This applies throughout the product's entire life, from delivery through installation and operation to disassembly and disposal.

The operational quality-assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

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 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" [► 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" [► 44] chapter.

• Only connect the device to circuits with an external overcurrent protection device and an all-pole isolating device so that the equipment can be fully de-energized if required (for service, maintenance, etc.).

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Appropriate use section. Please also note the following:

• Risk of explosion and fire from highly flammable or explosive gases, vapors, or dusts. Do not operate product in areas at risk of explosion.

• Unauthorized or inappropriate changes to the product may lead to personal injury, material damage, and operational faults. Only modify product following discussion with Maschinenfabrik Reinhausen GmbH.

2.4 Personnel qualification

The product is designed solely for use in electrical energy systems and facilities operated by appropriately trained staff. This staff comprises people who are familiar with the installation, assembly, commissioning and operation of such products.

2.5 Operator’s duty of care

To prevent accidents, disruptions 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:

• All warning and hazard notices are complied with.

• Personnel are instructed regularly in all relevant aspects of operational safety, the operating instructions and particularly the safety instructions contained therein.

• Regulations and operating instructions for safe working as well as the relevant instructions for staff procedures in the case of accidents and fires are kept on hand at all times and are displayed in the workplace where applicable.

• The product is only used when in a sound operational condition and safety equipment in particular is checked regularly for operational reliability.

• Only replacement parts, lubricants and auxiliary materials which are authorized by the manufacturer are used.

• The specified operating conditions and requirements of the installation location are complied with.
• All necessary devices and personal protective equipment for the specific activity are made available.
• The prescribed maintenance intervals and the relevant regulations are complied with.
• Installation, electrical connection and commissioning of the product may only be carried out by qualified and trained personnel in accordance with this technical file.
• The operator must ensure appropriate use of the product.

2.6 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.
• Follow information about personal protective equipment provided in the work area.

<table>
<thead>
<tr>
<th>Always wear</th>
<th>Protective clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Close-fitting work clothing with a low breaking strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>To protect against falling heavy objects and slipping on slippery surfaces.</td>
</tr>
</tbody>
</table>

Table 4: Personal protective equipment to be worn at all times

<table>
<thead>
<tr>
<th>Wear the following in special environments</th>
<th>Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety glasses</td>
<td>To protect the eyes from flying parts and splashing liquids.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hard hat</th>
</tr>
</thead>
<tbody>
<tr>
<td>To protect from falling and flying parts and materials.</td>
</tr>
</tbody>
</table>
Wear the following in special environments

<table>
<thead>
<tr>
<th>Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.</th>
</tr>
</thead>
</table>
| **Hearing protection**  
To protect from hearing damage. |
| **Protective gloves**  
For protection from mechanical, thermal, and electrical hazards. |

Table 5: Personal protective equipment to be worn in special environments

2.7 Protective devices in the motor-drive unit

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

2.8 Drying transformer

2.8.1 Drying transformer in autoclave

Observe the following information when drying the transformer in an autoclave.

**NOTICE**

Damage to drive and on-load tap-changer/off-circuit tap-changer!

If the drive is dried in an autoclave, the drive and on-load tap-changer/off-circuit tap-changer may be damaged.
- Do not dry drive in an autoclave.

2.8.2 Drying transformer in its own tank

If you dry the transformer in its own tank, the drive can remain attached to the transformer during drying.
3 Product description

This chapter contains an overview of the design and function of the product.

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>
### Table 6: Type designation

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Description</th>
<th>Variants</th>
</tr>
</thead>
</table>
| ED 100-ST        | Special applications | … = none  
C = Plunger coil design  
T = TAPCON® or TAPGUARD® |
| ED 100-S-ISM     | Special application | ISM = "Integrated Smart Module" for recording, aggregating and interpreting data on the transformer |

### 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.

Figure 1: Motor-drive unit, open

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protective housing cover</td>
</tr>
<tr>
<td>2</td>
<td>Viewing window for indication field</td>
</tr>
<tr>
<td>3</td>
<td>Fixing lug</td>
</tr>
<tr>
<td>4</td>
<td>Ground connection</td>
</tr>
<tr>
<td>5</td>
<td>Output shaft</td>
</tr>
<tr>
<td>6</td>
<td>Hand-crank aperture with hand-crank interlock switch</td>
</tr>
<tr>
<td>7</td>
<td>Hand lamp</td>
</tr>
<tr>
<td>8</td>
<td>Hand crank</td>
</tr>
<tr>
<td>9</td>
<td>S3 control switch</td>
</tr>
<tr>
<td>10</td>
<td>Swing frame/anti-condensation heater</td>
</tr>
<tr>
<td>11</td>
<td>Indication field</td>
</tr>
<tr>
<td>12</td>
<td>Nameplate</td>
</tr>
<tr>
<td>13</td>
<td>Motor protective switch Q1</td>
</tr>
<tr>
<td>14</td>
<td>Document pocket</td>
</tr>
<tr>
<td>15</td>
<td>Transmission-gear cover plate</td>
</tr>
</tbody>
</table>
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.

![Figure 2: Indication field](image)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tap position indicator</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>The two drag hands indicate the regulating range currently used</td>
<td>4</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>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Swing frame</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Position transmitter module</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Terminal bar X1</td>
<td>6</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 [► 56] 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).

- For external monitoring, locking, and control purposes, it is not therefore the position transmitter equipment but the "Tap changer in operation" position transit contact shown in the connection diagram that should be used.

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 [► 17].

For more information about the position transmitter equipment, see Technical data for position transmitter equipment [► 56].

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.

Transmission-gear cover plate
4 Packaging, transport and storage

4.1 Packaging

The products are sometimes supplied with a sealed packaging and sometimes also dried depending on what is required.

A sealed packaging surrounds the packaged goods on all sides with plastic foil. Products that have also been dried are identified by a yellow label on the sealed packaging.

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!

► Only stack up to 2 equally sized crates on top of one another.
► Do not stack crates above a height of 1.5 m.

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

The packaged goods are packed in a stable 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.

A sealed packaging surrounds the packaged goods on all sides with plastic foil. The packaged goods are protected from humidity using a desiccant. The plastic foil is bonded after the drying agent 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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Symbol 1]</td>
<td>Protect against moisture</td>
</tr>
<tr>
<td>![Symbol 2]</td>
<td>Top</td>
</tr>
<tr>
<td>![Symbol 3]</td>
<td>Fragile</td>
</tr>
<tr>
<td>![Symbol 4]</td>
<td>Attach lifting gear here</td>
</tr>
<tr>
<td>![Symbol 5]</td>
<td>Center of mass</td>
</tr>
</tbody>
</table>

Table 7: Shipping pictograms
4.2 Transportation, receipt and handling of shipments

**Danger of death and damage to property!**

- Transport crate only when closed.
- Do not remove the mounting material used in the crate during transport.
- Only trained and appointed persons may select the sling gear and secure the load.
- Do not walk under the hanging 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 and shock 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 experiences 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 detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found 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 sales department at Maschinenfabrik Reinhausen 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 onsite 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!** Be absolutely sure to also check the sealed packaging. If the sealed packaging is damaged, do not under any circumstances install or commission the packaged goods. Either dry the dried packaged goods again as per the operating instructions for the relevant on-load tap-
changer/de-energized tap-changer or contact Maschinenfabrik Reinhausen GmbH to agree on how to proceed with drying. If this is not done, the packaged goods may be damaged.

- Name 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 oil until used if the packaged goods were not supplied in oil.

#### 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 suitable storage space (well ventilated, as dust-free as possible, humidity < 50 % where possible).

### 4.4 Unpacking shipments and checking for transportation damages

- **NOTICE!** Transport the packaged crate to the place where installation will take place. Do not open the sealed packaging until just before installation. If this is not done, damage to the packaged goods may occur due to ineffectively sealed packaging.

- **WARNING!** When unpacking, check the condition of the packaged goods. Secure packaged goods in an upright crate from tipping out. If this is not done, the packaged goods may be damaged and serious injuries may result.

- Check completeness of supplementary parts on the basis of the delivery slip.
5 Mounting

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

**WARNING**

Risk of severe injury or death!

An energized transformer and energized on-load tap-changer components can cause death or serious injuries when installing the motor-drive unit!

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

5.1 Fitting motor-drive unit on transformer

1. Fit 4 stud bolts (not supplied by MR) to transformer tank. The arrangement and diameter of the fixing lugs can be found in the drawings in the Annex [► 58].

![Figure 4: Stud bolt](image)

2. **NOTICE!** Fit the drive vertically to the transformer tank so that its output shaft is exactly aligned with the vertical shaft of the bevel gear. If this is not done, the drive may be damaged.

The assembly holes for this purpose are located externally on the protective housing’s fixing lugs.
3. **NOTICE!** Secure drive without warping or deforming. If this is not done, the drive and drive shaft may be damaged and a lot of noise may be produced.

4. Vibration dampers (MR special design) must be used for transformers where the motor-drive unit is subject to vibration.
5. Connect the grounding screw of the motor-drive protective housing to the transformer tank. It is essential that a CUPAL washer is placed between the cable shoe and connecting lug. The aluminum side of the CUPAL washer must be facing the connecting lug.

![Figure 7: Grounding screw](image)

6. Connect main protective conductor to protective conductor terminal on terminal bar X1 (minimum connection cross-section 2.5 mm$^2$).

![Figure 8: Main protective conductor](image)
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.

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 on-load tap-changer and motor-drive unit do not apply to the DEETAP® DU and COMTAP® ARS. The process for centering 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 on-load tap-changer/de-energized tap-changer and the motor-drive unit into adjustment position before commencing any adjustment work. Ensure that tap position indicators for the motor-drive unit and 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
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 the hand crank clockwise 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 until the diverter switch operation begins](image)
4. Once the diverter switch operation begins, turn the hand crank in the same direction while counting the 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 diverter switch operation](image)
6. Turn the hand crank counter-clockwise until the diverter switch operation begins.

![Figure 14: Turning hand crank in the opposite direction](image)

7. Once the diverter switch operation begins, turn the hand crank in the same direction while counting the 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).

![Figure 15: Counting tap-change indicator sections needed to reach the mid-position](image)

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.

Figure 16: Completing diverter switch operation

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 section, no further actions are required. Refer to point 18 for how to proceed next.

11. Use hand crank to perform one on-load tap-change operation up to the diverter switch action in the direction with the higher value A or B (example: counter-clockwise because \( B > A \)).

12. After the diverter switch action, continue turning another 8 hand crank revolutions in the same direction to correctly complete the tap-change operation.
13. Uncouple motor-drive unit and vertical drive shaft by removing coupling brackets. After uncoupling, don't turn drive shaft any further.

![Uncoupling motor-drive unit and drive shaft](image)

Figure 17: Uncoupling motor-drive unit and drive shaft

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

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

16. Continue to turn in the same direction while counting the 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 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: Indicator in 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 device may only be connected to circuits with an external overcurrent protection device and an all-pole isolating device so the equipment can be fully de-energized if required (service, maintenance etc.).

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 must not be part of the power line
- The isolating device must not interrupt the main protective conductor

Unless specified otherwise, the connections for the supply circuits must have a conductor cross-section of at least 1.5 mm² (16 AWG).

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

Proceed as follows to electrically connect the motor-drive unit:

1. Switch off voltage supply.
2. Lock voltage supply to prevent unintentional restart.
3. Make sure everything is de-energized.
4. Visibly ground and short circuit motor-drive unit.
5. Cover or cordon off adjacent energized parts.
6. Connect motor-drive unit in accordance with connection diagrams provided in the document pocket. Observe the supply voltages (motor circuit, control circuit, heating circuit) and connection assignments stated in the connection diagram.

Figure 19: Example: Standard terminal block X1

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, see page [► 56]) flows across the micro-switches in the motor-drive unit at all times to ensure correct functioning of the switches.
6 Commissioning

6.1 Starting up motor-drive unit

Proceed as follows to electrically start up the 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 the motor protective switch and control circuit fuse are disabled.

Commissioning
1. Apply voltage to motor-drive unit.
2. Measure voltage and frequency of motor circuit at terminal X1 and compare with details on nameplate. The details must match.
3. As an option with separate control-circuit supply: Measure voltage and frequency of control circuit at terminal X1 and compare with details on nameplate. The details must match.
4. As an option with separate heating-circuit supply: Measure voltage of heating circuit at terminal X1 and compare with details on connection diagram. The details must match.
5. As an option with three-phase motor: Make sure that voltage applied to the connection terminals has a clockwise phase sequence.
6. As an option with DC motor: Make sure that the motor voltage has the right polarity.
7. Engage motor protective switch and fuses for control circuit and heating circuit (if present).
   • LED of voltage monitor and LED of thermostat (if present) on rear of swing frame must light up green.

If you have successfully completed the above steps, you can undertake the following tests on the motor-drive unit and transformer. Please 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 severe injury or death due to electrical voltage!

► The relevant safety instructions must be observed.
► 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.
► Provide protection against accidental contact before energizing the drive. 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.

![Figure 20: S3 control switch](image)

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:

- The motor protective switch Q1 is switched on (position I).

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.
6.3 Tests on the transformer

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

6.3.1 High-voltage tests on the transformer

**WARNING**

Danger of death or severe injury!

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

- 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 oil compartment of the on-load tap-changer is completely filled with oil.
- Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.
- Ensure that all protective devices for the on-load tap-changer are 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.

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.

Note the following points **before** undertaking high voltage tests on the transformer:

- 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 wiring dielectric test, remove all devices with a withstand voltage of < 1,000 V.
• Remove leads used for testing before the high voltage test as these function as antennas.
• Wherever possible, route the measurement and data leads separately from 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 you have to remove the drive to transport the transformer, proceed as follows:

1. Ensure that the drive and the on-load tap-changer/de-energized tap-changer are in the adjustment position.
2. Remove the drive (see page [► 53]).
3. Do not actuate the drive while the on-load tap-changer/de-energized tap-changer is not coupled and do not turn the output shaft.
4. Do not actuate an on-load tap-changer/de-energized tap-changer which is not coupled 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 the on-load tap-changer and motor-drive unit!**

Damage to on-load tap-changer and 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 downtimes prior to initial commissioning of more than 8 weeks or operation interruptions of more than 2 weeks, connect and operate the anti-condensation heater in the motor-drive unit. If this is not possible (e.g. during transportation), place a sufficient amount of dehydrating agent 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 [► 56] 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).
- For external monitoring, locking, and control purposes, it is not therefore the position transmitter equipment but the "Tap changer in operation" position transit contact shown in the connection diagram that should be used.

1. Before commissioning the transformer, start up the motor-drive unit (see page [► 38]).
2. **WARNING!** Before commissioning the transformer, repeat the tests on the motor-drive unit. Only start up transformer once you have performed all the tests (see page [► 39]). Otherwise, there is the risk of fatal injury.
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.
7.3 Actuating motor-drive unit with hand crank

**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 information about fault rectification, refer to the "Troubleshooting" [► 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 or 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 ended 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 motor-drive unit with hand crank**

To carry out a tap-change operation with the hand crank, proceed as follows:

1. Open door of protective housing of 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!** Turn in one direction with the hand crank 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. Otherwise the tap-change operation is not completed correctly, which may result in damage to the on-load tap-changer and transformer.
   ⇨ The tap-change operation is complete.

5. Take off hand crank and return to bracket.

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

7. Close door of protective housing of motor-drive unit.

7.4 Checking motor-drive unit

Checking the motor-drive unit is limited to occasional visual checks. For efficiency reasons these visual checks can be combined with the usual checks on the transformer.

Check the following:

- Gaskets of protective housing of motor-drive unit
- Correct functioning of the installed electrical heater in the protective housing of the motor-drive unit

Contact Maschinenfabrik Reinhausen GmbH if the gaskets or heating are not in perfect condition.
8 Fault elimination

8.1 Safety instructions

**WARNING**

Danger of death or severe injury!

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:

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93025 Regensburg
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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 unit</td>
<td>• Contact MR</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 with the &quot;Assembly&quot; [► 25] chapter.</td>
</tr>
<tr>
<td></td>
<td>• Make sure that the drive shaft including protective cover is assembled correctly, in accordance with the operating instructions for the on-load tap-changer / de-energized tap-changer.</td>
</tr>
</tbody>
</table>

Table 9: 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" [► 17] 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>
</table>
| Tripping of the motor protective switch Q1              | • Hand crank operation is prohibited  
• Switch on Q1 only once  
• 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.  
• If Q1 is tripped again, do not attempt any more switching operations and contact MR. |
| Interruption of the supply voltage to the motor-drive unit or motor controller | • Hand crank operation is prohibited  
• Reestablish the voltage supply  
• Once the voltage supply returns, the motor-drive unit automatically ends the switching operation that was started. |
| Component defect in the motor-drive unit                | • Hand crank operation is prohibited  
• Contact MR |

Table 10: 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 11: 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.

**WARNING**

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" [► 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

Check the tripping of the motor protective switch from the control room at least once a year.

Proceed as follows:

- The motor protective switch Q1 is switched on (position I).
- 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.
- Switch on motor protective switch again (position I).
  - The tripping of the motor protective switch from the control room is checked.

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 “Checks on the motor-drive unit” (see page [► 39]) each time the on-load tap-changer is maintained.

Furthermore, certain components of the motor-drive unit (e.g. cam switch, relay, contactor) have to be replaced every 1 million tap-change operations. Contact the Technical Service department of Maschinenfabrik Reinhausen GmbH for this.

We strongly recommend having on-load tap-changer maintenance and motor-drive unit checks carried out by our Technical Service department. If this route is taken, in addition to the correct performance of all work, 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 name plate on on-load tap-changer and motor-drive unit) and the number of tap-change operations.

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E-mail: service@reinhausen.com
Internet: www.reinhausen.com
10 Disassembly

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

**WARNING**

Risk of severe injury or death!
An energized transformer and energized on-load tap-changer and motor-drive unit components can cause death or serious injuries during disassembly!

► Switch off voltage supply.
► Lock voltage supply to prevent unintentional restart.
► Make sure everything is de-energized.
► Cover or cordon off adjacent energized parts.

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

1. Remove horizontal 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. **WARNING!** Disassemble 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° in relation to the horizontal. If this is not done, the motor-drive unit may be damaged and serious injuries may result.

- The motor-drive unit is disassembled.
11 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 “operation without step-by step switch”</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></td>
<td>Control gear + on-load tap-change position indicator for 105 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>Temperature range: - 40 °C 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>Temperature range: + 50 °C 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>
</tbody>
</table>

Table 12: Special designs
12 Technical data

12.1 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>Power supply of motor circuit</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></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 intensity: 250 V AC 100 mA…4 A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DC voltage/current intensity: 220 V DC 10 mA…250 mA</td>
<td></td>
</tr>
<tr>
<td>Temperature range (ambient temperature)</td>
<td>- 25 °C to + 50 °C</td>
<td></td>
</tr>
<tr>
<td>Protection from 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

12.2 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 Appendix

13.1 TAPMOTION® ED-L, protective housing (898802)
13.2 TAPMOTION® ED-S, protective housing (898801)
MR worldwide

Australia
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