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<td>12.4</td>
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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, 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 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

1.3 Completeness

This technical file is incomplete without the supporting documentation.

1.4 Supporting documents

The following documents apply to this product:
- Operating instructions
- Connection diagrams

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

This technical file and all supporting documents must be kept ready at hand and accessible for future use at all times.

1.6 Notation conventions

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

1.6.1 Hazard communication system

Warnings in this technical file are displayed as follows.

1.6.1.1 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 and source of danger

- Consequences
- Action
- Action

1.6.1.2 Embedded warning

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.

1.6.1.3 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>
<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 1: Signal words in warning notices
Pictograms warn of dangers:

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Triangle with exclamation mark]</td>
<td>Warning of a danger point</td>
</tr>
<tr>
<td>![Triangle with lightning bolt]</td>
<td>Warning of dangerous electrical voltage</td>
</tr>
<tr>
<td>![Triangle with flame]</td>
<td>Warning of combustible substances</td>
</tr>
<tr>
<td>![Triangle with person falling over]</td>
<td>Warning of danger of tipping</td>
</tr>
</tbody>
</table>

Table 2: Pictograms used in warning notices

1.6.2 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.

1.6.3 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 Continue 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>Function monitoring alarm triggered</td>
</tr>
<tr>
<td>Typographic convention</td>
<td>Purpose</td>
<td>Example</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>[► Number of pages].</td>
<td>Cross reference</td>
<td>[► 41].</td>
</tr>
</tbody>
</table>

Table 3: Typographic conventions
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

The product and associated equipment and special tools supplied with it comply with the relevant legislation, regulations and standards, particularly health and safety requirements, applicable at the time of delivery.

If used as intended and in compliance with the specified requirements and conditions in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any hazards 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

▪ The product must be operated in accordance with this technical file and the agreed delivery conditions and technical data
▪ The equipment and special tools supplied must be used solely for the intended purpose and in accordance with the specifications of this technical file

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Appropriate use section.

Maschinenfabrik Reinhausen GmbH does not accept liability for damage resulting from unauthorized or inappropriate changes to the product. Inappropriate changes to the product without consultation with Maschinenfabrik Reinhausen GmbH can lead to personal injury, damage to property and operational disruption.
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.
3 Product description

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

3.1 Scope of delivery

The following items are included in the delivery:
- TAPGUARD® 240
- CD MR-Suite (optional, contains the TAPCON®-trol program)
- Technical files
- Serial cable RS232 (optional)
- USB adapter with installation CD (optional)

Please note the following:
- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation.

3.2 Operating principle

The TAPGUARD® 240 monitoring system monitors the on-load tap-changer and calculates all important maintenance criteria. To do so, it is equipped with measuring devices that record all relevant information.

Using the recorded values, the monitoring system determines when the next maintenance is due. This prognosis is displayed clearly on the operating monitor. The basis for prognoses are data from over 50 years of service experience with our on-load tap-changers.

The monitoring system is the ideal tool for condition-oriented maintenance. It increases operating safety and extends the maintenance intervals of the on-load tap-changer, thereby reducing operating costs.
3.3 Performance features

The monitoring system helps you with condition-oriented maintenance of the on-load tap-changer. To this end, the monitoring system monitors the following maintenance criteria:

- Maintenance of the on-load tap-changer and tap selector and replacement of the diverter switch insert
- Oil change, cleaning and replacing the oil filter (only OILTAP®)
- Taking an oil sample
- Calculation of contact wear (only OILTAP®)
- Operator interval

The monitoring system records all measured values and events. These data can be selected and prepared using the TAPCON®-trol visualization software.
3.4 Hardware

The individual assemblies are fitted in a standardized 19-inch plug-in housing. The front panels of the assemblies are secured to the plug-in housing at the top and bottom. An IEC 60603-2 plug connector provides the electrical connection.

The assemblies are connected to one another via a data bus and direct current (DC) supply. This allows for an upgrade with additional plug-in modules and extension cards at a later date.

Figure 2: Front view

<table>
<thead>
<tr>
<th></th>
<th>Operating panel with display and LEDs</th>
<th></th>
<th>19-inch plug-in housing (in accordance with DIN 41494 Part 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td>Rack for optional expansions</td>
</tr>
</tbody>
</table>
3.4.1 Operating controls

The device has 15 pushbuttons. The illustration below is an overview of all the device's operating controls.

![Operating controls illustration]

**RAISE key**: No function (only for TAPCON® 240).

**LOWER key**: No function (only for TAPCON® 240).

**REMOTE key**: No function (only for TAPCON® 240).

**MANUAL key**: No function (only for TAPCON® 240).

**AUTO key**: No function (only for TAPCON® 240).

**PREV/NEXT key**: By pressing the arrow keys, you can set the display on the main screen. They can also be used to switch between windows in the submenus.

**ENTER key**: Confirm selection and save modified parameters.

**ESC key**: Escape current menu and select previous menu levels.

**MENU key**: Select main menu.

**F1…F5 function keys**: Select functions displayed on the screen.
3.4.2 Display elements

The device has a graphics display and 15 LEDs, which indicate the various operating statuses or events.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operating status LED</td>
<td>9 No function</td>
</tr>
<tr>
<td>2</td>
<td>No function</td>
<td>10 Event display LED 4</td>
</tr>
<tr>
<td>3</td>
<td>No function</td>
<td>11 Graphics display</td>
</tr>
<tr>
<td>4</td>
<td>No function</td>
<td>12 No function</td>
</tr>
<tr>
<td>5</td>
<td>No function</td>
<td>13 No function</td>
</tr>
<tr>
<td>6</td>
<td>No function</td>
<td>14 No function</td>
</tr>
<tr>
<td>7</td>
<td>No function</td>
<td>15 No function</td>
</tr>
<tr>
<td>8</td>
<td>No function</td>
<td>16 No function</td>
</tr>
</tbody>
</table>

Figure 4: Display elements
Display

![Display diagram](image)

Figure 5: Display (example: VACUTAP® on-load tap-changer)

<table>
<thead>
<tr>
<th></th>
<th>Status line</th>
<th>2</th>
<th>Progress bar for the maintenance interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Status line</td>
<td>2</td>
<td>Progress bar for the maintenance interval</td>
</tr>
</tbody>
</table>

**Status line**

Current messages and events are displayed in the status line 1. You can find more information about messages and events in the Messages [► 57] chapter.

### 3.4.3 Serial interface

The parameters for the device can be set using a PC. The COM 1 (RS232) serial interface on the front panel is provided for this purpose. You can use the connection cable supplied to establish a connection to your PC via the RS232 or USB port (using the optional USB adapter).

TAPCON®-trol software is needed for parameterization via the serial interface. The software and the related operating instructions are contained on the CD provided.

![Device connection to a PC](image)

Figure 6: Device connection to a PC
3.4.4 Assemblies

The functions of the device’s individual assemblies are described in the following section. You can find more information about these assemblies in the Technical data [► 62] section.

3.4.4.1 AD card

The analog input card has 1 input or with an extension card 2 inputs that can record the following analog signals:

- 0...10 V
- 0...20 mA
- 4...20 mA
- Resistance measurement (50 Ω...2 kΩ)

3.4.4.2 CIC card

As an option, the device can be equipped with up to 2 CIC cards. The CIC cards are used to communicate using a control system protocol or TAPCON®-trol software (CIC2).

3.4.4.3 CPU card

The CPU card is the device’s central computing unit. All internal device functions and the application functions, such as processing measured values, are controlled and monitored by the CPU card.

The CPU card contains a flash memory (optional measured value memory) as a non-volatile data storage in which the operating data such as measured values or events are stored. An EEPROM for storing parameters and a real-time clock (RTC) for recording time are included on the CPU card.

3.4.4.4 IO card

The IO card contains 10 digital inputs and 8 digital potential-free outputs.

3.4.4.5 MI card

The MI card measures voltage and current.

3.4.4.6 SU card

The wide range power supply (SU card) supplies the device with power.
4 Packaging, transport and storage

4.1 Packaging

4.1.1 Purpose

The packaging is designed to protect the packaged goods during transport, loading and unloading as well as periods of storage in such a way that no (detrimental) changes occur. The packaging must protect the goods against permitted transport stresses such as vibration, knocks and moisture (rain, snow, condensation).

The packaging also prevents the packaged goods from moving impermissibly within the packaging. The packaged goods must be prepared for shipment before actually being packed so that the goods can be transported safely, economically and in accordance with regulations.

4.1.2 Suitability, structure and production

The goods are packaged in a sturdy cardboard box. This ensures that the shipment is secure when in the intended transportation position and that none of its parts touch the loading surface of the means of transport or touch the ground after unloading.

The box is designed for a maximum load of 10 kg.

Inlays inside the box stabilize the goods, preventing impermissible changes of position, and protect them from vibration.

4.1.3 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>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Protect against moisture" /></td>
<td>Protect against moisture</td>
</tr>
<tr>
<td><img src="image" alt="Top" /></td>
<td>Top</td>
</tr>
<tr>
<td><img src="image" alt="Fragile" /></td>
<td>Fragile</td>
</tr>
</tbody>
</table>

Table 4: Shipping pictograms

4.2 Transportation, receipt and handling of shipments

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.
4 Packaging, transport and storage

If a box 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!
- If possible, 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).
- Be absolutely sure to also check the sealed packaging.

**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

Selection and arrangement of the storage location should meet the following requirements:

- Stored goods are protected against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
4 Packaging, transport and storage

- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Carrying capacity of the substrate under the goods is sufficient.
- Entrance and exit paths are kept free.

Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

4.4 Unpacking device

Unpack the device as follows:
1. Remove the lid from the lower part of the cardboard box.
   ⇒ The upper inlay contains the accessories supplied, the separate box labeled "Documentation" contains the device documents.
2. Check scope of supply for accessories.
3. Take the box labeled "Documentation" out of the cardboard box.
4. Remove the upper inlay from the packaging.
   ⇒ The device in the underlying inlay can now be freely accessed.
5. Remove device from the packaging.
   ⇒ The device has been unpacked and can be mounted.

For mounting, proceed as described in the Mounting [► 23] section.
5 Mounting

This chapter describes how to correctly mount and connect the device. Note the connection diagrams provided.

**WARNING**

Electric shock

Danger of death due to electrical voltage.

► De-energize device and system periphery and lock to prevent switching back on again.

5.1 Preparation

The following tools are needed for mounting:

- Screwdriver for the fixing bolts (M6)
- Small screwdriver for connecting the signal lines and supply lines

Depending on installation site and mounting variant, you may need additional tools and corresponding attachment material (screws, nuts, washers) which are not included in the scope of supply.

5.2 Mounting device

Depending on your order, you can mount the device in one of the following variants:

- 19" frame (in accordance with DIN 41494 Part 5)
- 19" flush control panel frame
- ½-19" mounting frame for wall mounting

Below you will find a description of how to mount the device in a 19" frame. For control panel installation or wall mounting, note the technical files supplied.

To mount the device in a 19" frame, proceed as follows:

1. Place cage nuts in the desired locations on the 19" frame, noting the device dimensions [► 67].

2. Place device in 19" frame and screw down.

![Figure 7: Example of device mounting in a 19" frame](image)

5.3 Connecting device

The following section describes how to make the electrical connection to the device.

**WARNING**

**Electric shock**

Danger of death due to connection mistakes

- Ground device using the grounding screw on the housing.
- Pay attention to the phase difference of the secondary terminals for the current transformer and voltage transformer.
- Connect the output relays correctly to the motor-drive unit.

5.3.1 Cable recommendation

Please note the following recommendation from Maschinenfabrik Reinhausen when wiring the device.

Excessive electrical power can prevent the relay contacts from breaking the contact current. In control circuits operated with alternating current, take into account the effect of the line capacitance of long control lines on the function of the relay contacts.

<table>
<thead>
<tr>
<th>Cable</th>
<th>Card</th>
<th>Terminal</th>
<th>Cable type</th>
<th>Conductor cross-section</th>
<th>Max. length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>SU</td>
<td>X1:1/2</td>
<td>Unshielded</td>
<td>1.5 mm²</td>
<td>-</td>
</tr>
<tr>
<td>Voltage measurement</td>
<td>MI/MI1</td>
<td>1/2</td>
<td>Shielded</td>
<td>1.5 mm²</td>
<td>-</td>
</tr>
</tbody>
</table>
### Table 5: Recommendation for connection cable (standard connections)

<table>
<thead>
<tr>
<th>Cable</th>
<th>Card</th>
<th>Terminal</th>
<th>Cable type</th>
<th>Conductor cross-section</th>
<th>Max. length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current measurement</td>
<td>MI/MI1</td>
<td>5/6/9/10</td>
<td>Unshielded</td>
<td>4 mm²</td>
<td>-</td>
</tr>
<tr>
<td>Relay*</td>
<td>IO</td>
<td>X1:1...10 X1:19...26</td>
<td>Unshielded</td>
<td>1.5 mm²</td>
<td>-</td>
</tr>
<tr>
<td>Relay*</td>
<td>UC</td>
<td>X1:1...10</td>
<td>Unshielded</td>
<td>1.5 mm²</td>
<td>-</td>
</tr>
<tr>
<td>Signal inputs</td>
<td>IO</td>
<td>X1:11...17 X1:27...34</td>
<td>Unshielded</td>
<td>1.0 mm²</td>
<td>-</td>
</tr>
<tr>
<td>Signal inputs</td>
<td>UC</td>
<td>X1:11...17 X1:27...34</td>
<td>Unshielded</td>
<td>1.0 mm²</td>
<td>-</td>
</tr>
<tr>
<td>CAN bus</td>
<td>CPU</td>
<td>1...5</td>
<td>Shielded</td>
<td>1.0 mm²</td>
<td>2,000 m</td>
</tr>
</tbody>
</table>

*) Observe line capacitance, see note above.

### Table 6: Recommendation for connection cable (optional connections)

<table>
<thead>
<tr>
<th>Cable</th>
<th>Card</th>
<th>Terminal</th>
<th>Cable type</th>
<th>Conductor cross-section</th>
<th>Max. length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog inputs</td>
<td>AD8</td>
<td>X1:1...3</td>
<td>Shielded</td>
<td>1.5 mm²</td>
<td>400 m (&lt; 25 Ω/km)</td>
</tr>
<tr>
<td>Analog outputs</td>
<td>AN/AN1</td>
<td>X1</td>
<td>Shielded</td>
<td>1mm²</td>
<td>-</td>
</tr>
<tr>
<td>RS-232</td>
<td>CIC</td>
<td>X8</td>
<td>Shielded</td>
<td>0.25 mm²</td>
<td>25 m</td>
</tr>
<tr>
<td>RS-485</td>
<td>CIC</td>
<td>X9</td>
<td>Shielded</td>
<td>0.75 mm²</td>
<td>1,000 m (&lt; 50 Ω/km)</td>
</tr>
<tr>
<td>Ethernet</td>
<td>SID</td>
<td>RJ45</td>
<td>shielded, CAT 7</td>
<td>-</td>
<td>100 m</td>
</tr>
<tr>
<td>Media converter</td>
<td>MC1</td>
<td>X7</td>
<td>Fiber-optic cable with MTRJ-ST duplex patch cable</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Media converter</td>
<td>MC2</td>
<td>-</td>
<td>Fiber-optic cable, connector type: F-ST; fiber type: multi mode/single mode; wavelength: 1310 nm</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
5.3.2 Information about laying fiber-optic cable

To ensure the smooth transfer of data via the fiber-optic cable, you must ensure that mechanical loads are avoided when laying the fiber-optic cable and later on during operation.

Please note the following:
▪ Radii must not fall below the minimum permissible bend radii (do not bend fiber-optic cable).
▪ The fiber-optic cables must not be over-stretched or crushed. Observe the permissible load values.
▪ The fiber-optic cables must not be twisted.
▪ Be aware of sharp edges which could damage the fiber-optic cable’s coating when laying or could place mechanical loading on the coating later on.
▪ Provide a sufficient cable reserve near distributor cabinets for example. Lay the reserve such that the fiber-optic cable is neither bent nor twisted when tightened.

5.3.3 Electromagnetic compatibility

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

5.3.3.1 Wiring requirement of installation site

Note the following when selecting the installation site:
▪ The system's overvoltage protection must be effective.
▪ The system's ground connection must comply with all technical regulations.
▪ Separate system parts must be joined by a potential equalization.
▪ The device and its wiring must be at least 10 m away from circuit-breakers, load disconnectors and busbars.

5.3.3.2 Wiring requirement of operating site

Note the following when wiring the operating site:
▪ The connection cables must be laid in metallic cable ducts with a ground connection.
▪ Do not route lines which cause interference (for example power lines) and lines susceptible to interference (for example signal lines) in the same cable duct.
▪ Maintain a gap of at least 100 mm between lines causing interference and those susceptible to interference.
### Figure 8: Recommended wiring

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cable duct for lines causing interference</td>
</tr>
<tr>
<td>2</td>
<td>Interference-causing line (e.g. power line)</td>
</tr>
<tr>
<td>3</td>
<td>Cable duct for lines susceptible to interference</td>
</tr>
<tr>
<td>4</td>
<td>Line susceptible to interference (e.g. signal line)</td>
</tr>
</tbody>
</table>

- Short-circuit and ground reserve lines.
- The device must never be connected using multi-pin collective cables.
- Signal lines must be routed in a shielded cable.
- The individual conductors (outgoing conductors/return conductors) in the cable core must be twisted in pairs.
- The shield must be fully (360°) connected to the device or a nearby ground rail.

Using "pigtailed" may limit the effectiveness of the shielding. Connect close-fitting shield to cover all areas.
### Wiring requirement in control cabinet

Note the following when wiring the control cabinet:

- The control cabinet for fitting the device must be prepared in accordance with EMC requirements:
  - Functional division of control cabinet (physical separation)
  - Constant potential equalization (all metal parts are joined)
  - Line routing in accordance with EMC requirements (separation of lines which cause interference and those susceptible to interference)
  - Optimum shielding (metal housing)
  - Overvoltage protection (lightning protection)
  - Collective grounding (main grounding rail)
  - Cable bushings in accordance with EMC requirements
  - Any contactor coils present must be interconnected

- The device's connection cables must be laid in close contact with the grounded metal housing or in metallic cable ducts with a ground connection.

- Signal lines and power lines/switching lines must be laid in separate cable ducts.

- The device must be grounded at the screw provided using a ground strap (cross-section min. 8 mm²). The device's ground connection is a functional ground and serves to dissipate interfering currents.
5.3.4 Connecting cables to the system periphery

To obtain a better overview when connecting cables, only use as many leads as necessary.

To connect cables to the system periphery, proceed as follows:

- Use only the specified cables for wiring. Note the cable recommendation [► 24].
- Connect the lines to be wired to the device to the system periphery as shown in the connection diagrams supplied.

5.3.5 Wiring device

To obtain a better overview when connecting cables, only use as many leads as necessary.

To wire the device, proceed as follows:

- Use only the specified cables for wiring. Note the cable recommendation [► 24].
- Wire the lines to the system periphery [► 29].
Wire the device according to the connection diagram.

5.3.6 Checking functional reliability

To ensure that the device is wired correctly, check its functional reliability.

Check the following:

- Once you have connected the device to the grid, the screen displays the MR logo and then the operating screen.
- The green *Operating display* LED top left on the device’s front panel lights up.

The device is fully mounted and can be configured. The actions required for this are described in the following chapter.
6 Commissioning

You need to set several parameters and perform function tests before commissioning the device. These are described in the following sections.

**NOTICE**

**Damage to device and system periphery**

An incorrectly connected device can lead to damages in the device and system periphery.

- Check the entire configuration before commissioning.
- Prior to commissioning, be sure to check the actual voltage and operating voltage.

### 6.1 Setting the display contrast

You can adjust the contrast in the display with the help of an adjustment screw on the front of the device. To adjust the contrast, proceed as follows:

- Use a screwdriver to turn the adjustment screw on the front of the device until the contrast is adjusted to the desired setting.

![Figure 11: Setting the display contrast](image)

### 6.2 Setting parameters

To commission the device, you must set the following parameters. For more detailed information about the parameters, refer to the respective sections.
6.2.1 Setting the language

You can use this parameter to set the display language for the device. The following languages are available:

<table>
<thead>
<tr>
<th>English</th>
<th>Italian</th>
</tr>
</thead>
<tbody>
<tr>
<td>German</td>
<td>Portuguese</td>
</tr>
<tr>
<td>French</td>
<td>Russian</td>
</tr>
<tr>
<td>Spanish</td>
<td></td>
</tr>
</tbody>
</table>

To set the language, proceed as follows:

1. **Configuration > F4** Configuration > **F3** General. ➞ Language
2. Press **F1** or **F5** to select the required language.
3. Press ➔ The language is set.

6.2.2 Setting date and time

You must set the system date and system time on the device. You must set the date and time in the following formats:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD.MM.YY</td>
<td>HH:MM:SS</td>
</tr>
</tbody>
</table>

Table 7: Formats

The time does not switch from daylight saving time to standard time and back automatically. You have to change the time manually.

**Time**

To set the time, proceed as follows:

1. **MENU > F4** Configuration > **F5** Continue > **F4** Memory > Press ➔ until the desired display appears. ➞ Time
2. Press **F4** to highlight a digit. ➞ The desired position is highlighted and the value can be changed.
3. Press **F1** to increase the value or **F5** to reduce it.
4. Press ➔ The time is set.
Date

To set the date, proceed as follows:

1. **Configuration > F4** Continue > **F5** Memory > Press **F4** until the desired display appears.
   - **Date**

2. Press **F4** to highlight a digit.
   - The desired position is highlighted and the value can be changed.

3. Press **F1** to increase the value or **F5** to reduce it.

4. Press **F4**
   - The date is set.

6.2.3 Setting further parameters

Set further parameters to commission the device. More detailed information about each of the parameters can be found in the Functions and settings [► 34] chapter.

Setting transformer data

Set the transformer data and phase difference of the current transformer and voltage transformer:

1. Set primary transformer current [► 36].
2. Select current transformer connection [► 36].

Setting tap position capture via analog input (optional)

If you want to capture the tap position via the analog input, you must set the parameters required for this:

► Capture tap positions via analog input [► 37].

Setting control system protocol (optional)

If you need a control system protocol, you must set all important parameters for this. More detailed information about this can be found in the enclosed supplement for the control system protocol description.

Setting operating positions of on-load tap-changer

The operating positions of the on-load tap-changer are preset upon delivery. Check whether the presetting is correct:

► Setting the operating position of the on-load tap-changer [► 40]

All parameters relevant to commissioning are entered. Continue with the function tests.
7 Functions and settings

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

7.1 Key lock

The device is equipped with a key lock to prevent unintentional operation. You can only set or change the parameters when the key lock is deactivated in manual mode.

Activating key lock

To activate the key lock, proceed as follows:

- Press ESC and F5 at the same time.

A confirmation appears in the display for a brief period. The key lock is activated. Parameters can no longer be entered.

Deactivating key lock

To deactivate the key lock, proceed as follows:

- Press ESC and F5 at the same time.

The key lock is deactivated. Parameters can be entered.

7.2 General

You can undertake general settings on the device in the General menu item. You can set the following general parameters:

- Regulator ID
- Baud rate (COM1 setting)
- Display dimming

7.2.1 Setting device ID

You can use the device ID parameter to assign a 4-digit ID to the device. This ID is used to uniquely identify the device in the TAPCON®-trol software.

To set the regulator ID (Controller identification), proceed as follows:

1. M > F4 Configuration > F3 General > Press until the desired parameter is displayed.

Controller identification.

2. Press F1 to change the first digit.

If you wish to enter a multi-digit sequence, proceed to step 3. If you do not wish to enter additional digits, proceed to step 7.

3. Press F1 (digit > 9) until another digit position appears.
4. If necessary, press \texttt{F4} in order to highlight the digit position. 
   $\Rightarrow$ The required digit is highlighted and can be changed.

5. Press \texttt{F1} or \texttt{F5} to change the digit.

6. Repeat steps 3 to 5 until all required digits have been entered.

7. Press $\leftarrow$
   $\Rightarrow$ The regulator ID is set.

### 7.2.2 Setting the baud rate

You can use this parameter to set the COM1 interface's baud rate. You can select the following options:

- 9.6 kilobaud
- 19.2 kilobaud
- 38.4 kilobaud
- 57.6 kilobaud

To set the baud rate, proceed as follows:

1. Press \texttt{MENU} > \texttt{F4} Configuration > \texttt{F3} General > $\leftarrow$ until the desired parameter is displayed.
   $\Rightarrow$ Setting the baud rate.

2. Press \texttt{F1} or \texttt{F5} to select the required baud rate.

3. Press $\leftarrow$
   $\Rightarrow$ The baud rate is set.

### 7.2.3 Dimming display

You can use this parameter to activate or deactivate automatic display dimming. You can select the following options:

- On: The display is automatically dimmed if no key is pressed for 15 minutes. The display returns to full brightness by pressing any key.
- Off: Automatic display dimming is deactivated.

Activating this function extends the display's service life.

To activate/deactivate automatic display dimming, proceed as follows:
7.3 Transformer data

This section describes how to set the transformer data. You have to set the following parameters for the device to function correctly:

- Primary current
- Secondary current (current transformer connection)

The measured values displayed for the device are influenced by the settings for the above parameters.

7.3.1 Setting primary transformer current

This parameter can be used to set the primary transformer current. Proceed as follows:

1. Press \text{MENU} > \text{F4} \text{ Configuration} > \text{F2} \text{ Transformer data} > \text{Press} \rightarrow \text{ until the desired parameter is displayed.}  
   \Rightarrow \text{ Primary current.}

2. Press \text{F4} to highlight the position.  
   \Rightarrow \text{ The desired position is highlighted and the value can be changed.}

3. Press \text{F1} to increase the value or \text{F5} to reduce it.

4. Press \rightarrow.  
   \Rightarrow \text{ The primary transformer current is set.}

7.3.2 Setting the current transformer connection

This parameter can be used to set the current transformer connection. This setting is needed for the device to display the correct secondary current in the info screen.

If you select the "Unknown" option, the percentage of current (with reference to the current transformer connection used) is displayed in the info screen.

- 0.2 A
- 1 A
- 5 A

To set the current transformer connection, proceed as follows:
7 Functions and settings

1. \[\text{MENU} \rightarrow \text{F4} \rightarrow \text{Configuration} \rightarrow \text{F2} \rightarrow \text{Transformer data} \rightarrow \text{Press } \rightarrow \rightarrow \text{until the desired parameter is displayed.}\]
   \[\rightarrow \text{Current transformer connection.}\]

2. \[\text{Press } \rightarrow \text{or } \rightarrow \text{to select the required connection terminal.}\]

3. \[\text{Press } \rightarrow \rightarrow \rightarrow \text{The current transformer connection is set.}\]

7.4 Tap position capture

The current tap position of the on-load tap-changer is transferred from the motor-drive unit to the device. In accordance with your order, the tap position is transferred in one of the following ways:

- Digital signal
  - BCD
  - DUAL
  - AWZ

- Analog signal
  - Injected current (0/4...20 mA)
  - Voltage (0...10 V)
  - Resistor contact series (200 - 2000 ohms)
  - N/O contact series
  - Decade contact series

7.4.1 Digital tap position capture (optional)

There is the option of transferring the tap position as a digital signal from the motor-drive unit to the device. No further settings are needed.

7.4.2 Analog tap position capture (optional)

For the analog tap position capture, you must assign the lowest tap position to the analog input for the minimum measured value and the highest tap position for the maximum measured value.

The device is configured at the factory according to the order. However, should modifications be necessary, note the following sections.

The analog input card is used to record the tap position of an analog signal transmitter. Depending on device configuration, you can capture the following signals:
7.4.2.1 Setting lower limit value

You can use these parameters to set the lower limit value for the tap position. To do this, you must set the lower value of the signal range and the linked lowest tap position.

You can undertake the settings for each input on the analog input card.

For example: To capture a tap position range of 1...19 via input 1 as 4...20 mA, you must set 20 % for the "Input 1 lower limit" parameter and 1.0 for the "Input 1 lower value" parameter.

<table>
<thead>
<tr>
<th>Analog signal</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injected current: 0...20 mA</td>
<td>0 % (= 0 mA)</td>
</tr>
<tr>
<td>Injected current: 4...20 mA</td>
<td>20 % (= 4 mA)</td>
</tr>
<tr>
<td>Resistor contact series</td>
<td>always 20 %</td>
</tr>
</tbody>
</table>

Table 8: Analog tap position capture

Table 9: Parameter settings

To set the lower limit value of the input, proceed as follows:

1. Configuration > F5 Continue > F3 Analog inputs.
   ⇒ Input 1 lower limit.
2. Press F4 to highlight the position.
   ⇒ The desired position is highlighted and the value can be changed.
3. Press F1 to increase the value or F5 to reduce it.
4. Press 
   ⇒ The lower limit value for the tap position is assigned.

Setting lower value of input signal

To configure the analog input, an absolute value must be assigned to the lower value of the applied signal.

To set the lower value for the input, proceed as follows:
1. Press \textit{F4} Configuration > \textit{F5} Continue > \textit{F3} Analog inputs > Press until the desired parameter is displayed.
\[
\Rightarrow \text{Input 1 lower value.}
\]
2. Press \textit{F1} to increase the value or \textit{F5} to reduce it.
3. Press \textit{F4}.
\[
\Rightarrow \text{The lower value for the tap position is assigned.}
\]

### 7.4.2.2 Setting upper limit value

You can use parameters to set the upper value for the tap position. To do this, you must set the upper value of the signal range and linked highest tap position.

You can undertake the settings for each input on the analog input card.

For example: To capture a tap position range of 1...19 via input 1 as 4...20 mA, you must set 100 % for the "Input 1 upper limit" parameter and 19.0 for the "Input 1 upper value" parameter.

### Setting upper limit value of input signal

To configure the analog input, you must state the upper limit value for the input signal. Use the following settings depending on your analog signal:

<table>
<thead>
<tr>
<th>Analog signal</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injected current: 0/4...20 mA</td>
<td>100 % (= 20 mA)</td>
</tr>
<tr>
<td>Resistor contact series</td>
<td>always 100 %</td>
</tr>
</tbody>
</table>

Table 10: Parameter settings

To set the upper limit value for the input, proceed as follows:

1. Press \textit{F4} Configuration > \textit{F5} Continue > \textit{F3} Analog inputs > Press until the desired parameter is displayed.
\[
\Rightarrow \text{Input 1 upper limit.}
\]
2. Press \textit{F4} to highlight the position.
\[
\Rightarrow \text{The desired position is highlighted and the value can be changed.}
\]
3. Press \textit{F1} to increase the value or \textit{F5} to reduce it.
4. Press \textit{F4}.

### Setting upper value of input signal

To configure the analog input, an absolute value must be assigned to the upper value of the applied signal.

To set the upper value for the input, proceed as follows:
1. Press **F4** Configuration > **F5** Continue > **F3** Analog inputs > Press ‣ until the desired parameter is displayed.
   ⇒ Input 1 upper value.

2. Press **F1** to increase the value or **F5** to reduce it.

3. Press ‣.

7.5 Setting operating positions of on-load tap-changer

You can use these parameters to define the lowest operating position and the highest operating position of the on-load tap-changer.

The device is configured at the factory according to the order. However, should modifications be necessary, note the following description.

To set the lowest and highest operating position, proceed as follows:

1. Press **F4** Configuration > **F5** Continue > **F5** Continue > **F3** OLTC > Press ‣ until the desired display appears.
   ⇒ Lowest operating position or highest operating position.

2. Press **F1** to increase the value or **F5** to reduce it.

3. Press ‣.
   ⇒ The lowest operating position and highest operating position are set.

7.6 Maintenance

The monitoring system monitors the state of the on-load tap-changer and determines when the next maintenance is due.

The monitoring system administers the following maintenances:

- OLTC maintenance
- DSI replacement
- Tap selector maintenance
- OLTC replacement
- Oil change and cleaning
- Oil filter change (only when operating an oil filter unit)
- Contact wear (only with OILTAP® on-load tap-changer types)
- Oil sample
- Operator time interval and tap change operation interval
7.6.1 Displaying the maintenance status

You will find an overview of the current maintenance status in this screen. The different maintenance activities are combined into 5 groups and stored in a progress bar. The progress bar shows the progress in percent of the maintenance interval. The progress bar always refers to the most advanced maintenance.

Depending on the type of on-load tap-changer, the following maintenance criteria are displayed:

<table>
<thead>
<tr>
<th></th>
<th>OILTAP®</th>
<th>VACUTAP®</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>OLTC maintenance</td>
<td>OLTC maintenance</td>
</tr>
<tr>
<td>F2</td>
<td>Oil change + cleaning</td>
<td>Oil change + cleaning</td>
</tr>
<tr>
<td>F3</td>
<td>Contact wear</td>
<td>-</td>
</tr>
<tr>
<td>F4</td>
<td>Oil sample</td>
<td>Oil sample</td>
</tr>
<tr>
<td>F5</td>
<td>Operator interval</td>
<td>Operator interval</td>
</tr>
</tbody>
</table>

Table 11: Maintenance criteria

To request additional information on the maintenance criteria, proceed as follows:

1. Press and hold down the desired function key (F1 ... F5).
   ⇒ The information screen is displayed.
2. If necessary, in addition to the already pressed function key, press to display further maintenance activities.
3. The forecast data indicate when the next maintenance is due. These data are determined depending on condition.

For a correct forecast, at least 200 tap-change operations are required. If this number of tap-change operations is not achieved, the standard values are displayed.

7.6.2 Entering service password

The service password is used to protect the monitoring system from unauthorized access. The following activities cannot be performed until the correct password is entered:

- Setting contact wear
- Resetting maintenance

To enter the service password, proceed as follows:
1. **Configuration > 3x [F5 Continue]** > **Service [F4]**
   - TAPGUARD password.
2. Press **[F4]** to highlight a desired digit.
   - The desired position is highlighted and the value can be changed.
3. Press **[F1]** to increase the value or **[F5]** to reduce it.
4. Press **[←]**.
   - The service password is set.

### 7.6.3 Maintenance events

The monitoring system informs you of an impending maintenance in 2 steps:
- Message of an impending maintenance (e.g. at 90 % of the respective limit value)
- Impending maintenance (at 100 % of the respective limit value)

The announcement of an impending maintenance is signaled by a flashing progress bar. In the case of an impending maintenance, a warning display also appears.

The warning display can be temporarily hidden. To hide warning messages, proceed as follows:

- Press **[←]**.
  - The warning display is temporarily hidden.

The warning display is shown again after each tap-change operation as long as the impending maintenance was not performed and confirmed.

### 7.6.4 Setting the maintenance message

You can use this parameter to set the limit for a maintenance message. If this limit value is achieved, the corresponding progress bar flashes in the maintenance status display.

You can determine these parameters for the following maintenance work separately:

<table>
<thead>
<tr>
<th>Maintenance message</th>
<th>Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLTC maintenance</td>
<td>-</td>
</tr>
<tr>
<td>DSI replacement</td>
<td>1x</td>
</tr>
<tr>
<td>Tap selector maintenance</td>
<td>2x</td>
</tr>
</tbody>
</table>
7 Functions and settings

<table>
<thead>
<tr>
<th>Maintenance message</th>
<th>Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil change and cleaning</td>
<td>3x</td>
</tr>
<tr>
<td>Contact wear</td>
<td>4x</td>
</tr>
<tr>
<td>Oil sample</td>
<td>5x</td>
</tr>
</tbody>
</table>

Table 12: Setting the maintenance message

To set the maintenance message, proceed as follows:

1. 1x Menu > F4 Configuration > 1x F5 Continue > F4 Maintenance
   ➤ Message for OLTC maintenance.

2. Press F4 to highlight a digit.
   ➤ The desired position is highlighted and the value can be changed.

3. Press F1 to increase the value or F5 to reduce it.

4. Press →
   ➤ The maintenance message is set.

7.6.5 Confirming maintenance

If maintenance was performed, this must be confirmed in the monitoring system. Only confirmed maintenance work does not result in new maintenance events. As soon as maintenance work is confirmed, a corresponding note is written in the maintenance history database.

The wear values of the on-load tap-changer contacts measured during maintenance work on the abrasion parts must be entered in the corresponding menu prior to confirming maintenance.

To confirm maintenance, proceed as follows:

1. Enter service password. [► 41]

2. 1x Menu > F4 Configuration > Press F5 until the desired parameter appears > F4 Service > 1x →
   ➤ TAPGUARD password.

3. Press F4 to highlight a digit.
   ➤ The desired position is highlighted and the value can be changed.

4. Press F1 to increase the value or F5 to reduce it.

5. Press →
   ➤ The TAPGUARD password is set.

6. Press → until the desired display appears.
7 Functions and settings

- Reset OLTC maintenance.

7. Press [F1] to select the Yes option.

8. Press [←]
   - A security question appears.

   - Maintenance is confirmed.

Each maintenance can be confirmed separately:

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLTC maintenance</td>
<td>1x</td>
</tr>
<tr>
<td>Oil change and cleaning</td>
<td>2x</td>
</tr>
<tr>
<td>DSI replacement</td>
<td>3x</td>
</tr>
<tr>
<td>Tap selector maintenance</td>
<td>4x</td>
</tr>
<tr>
<td>Oil sample</td>
<td>5x</td>
</tr>
<tr>
<td>Number of operator tap-change operations</td>
<td>6x</td>
</tr>
<tr>
<td>Operator time</td>
<td>7x</td>
</tr>
<tr>
<td>Oil filter replacement</td>
<td>8x</td>
</tr>
</tbody>
</table>

Table 13: Confirming maintenance

7.6.6 Contact wear

When monitoring the OILTAP® type on-load tap-changers, the monitoring system calculates the following values after each operation:

- Switching contact wear
- Resistance contact wear
- Oil soot

The monitoring system checks the calculated values with regard to the following limit values:

- Absolute value of the wear
- Difference in wear between main switching contact and transition contact
- Difference in wear between two transition contacts

After maintenance work on the on-load tap-changer, the computed wear thickness of the main switch contacts and the transition contacts have to be entered into the monitoring system. The monitoring system adapts its calculation model automatically using the computed wear thickness. By doing so, future calculations of the wear will be even more precise.
7.6.6.1 Determining contact wear

The thickness of the wear to be entered is the sum of the wear of the movable and the fixed contact part.

![Figure 16: Determining contact wear](image)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fixed contact</td>
<td>(y_1) Thickness of the worn contact coating (fixed contact)</td>
</tr>
<tr>
<td>2</td>
<td>Movable contact</td>
<td>(x_2) Thickness of the contact coating when new (movable contact)</td>
</tr>
<tr>
<td>(x_1)</td>
<td>Thickness of the contact coating when new (fixed contact)</td>
<td>(y_2) Thickness of the worn contact coating (movable contact)</td>
</tr>
</tbody>
</table>

The wear thickness \(z\) to be entered is determined as follows:

\[
z = x_1 - y_1 + x_2 - y_2
\]

If more than one on-load tap-changer is monitored by the monitoring system, the thickest layer of wear has to be entered.

7.6.6.2 Setting contact wear

You have to enter the previously determined contact wear for each main switching contact and transition contact.

- Main switching contact A (SKA)
- Main switching contact B (SKB)
- Transition contact A (WKA or WK1A)
- Transition contact B (WKB or WK1B)
- Transition contact 2A (WK2A)*
- Transition contact 2B (WK2B)*
*) The transition contacts WK2A and WK2B are not available with every on-load tap-changer. If these contacts are not available with your on-load tap-changer, you have to set the value 0.00 mm.

The monitoring system ignores contact wear entries that deviate greatly from the calculated value ($z_{\text{entry}} > 10 \cdot z_{\text{calculated}}$) in order to avoid entry errors. Nevertheless, if you would like to enter a value that deviates greatly, you have to set the contact wear to 0.00 mm beforehand.

To enter the computed wear thickness, proceed as follows:

1. Enter [► 41] service password.
2. Configuration > 2x Continue > Contacts > Press until the desired display appears.
4. Press [F1] to increase the value or [F5] to reduce it.
5. The wear thickness is set.

### 7.6.7 Operator limit values

You can use these parameters to determine your own limit values. These limit values are displayed in the bottom progress bar of the maintenance status. You can set the following limit values:

- Number of tap-change operations
- Time interval

#### 7.6.7.1 Setting the interval for the number of operator tap-change operations

You can use this parameter to define the operator tap-change operation interval. This interval defines the maximum number of tap-change operations. An event message is produced when the tap change operation interval is reached.

The set value has to be multiplied by 1000 to obtain the number-of-operations interval.

To set the tap change operation interval, proceed as follows:
7 Functions and settings

1. **Configuration > 4x** **F5** Continue > **F3** Operator.
   - Tap-change operations interval Operator.

2. Press **F4** to highlight a desired digit.
   - The desired position is highlighted and the value can be changed.

3. Press **F1** to increase the value or **F5** to reduce it.

4. Press **F3**.
   - The tap-change operations interval is set.

### 7.6.7.2 Setting the message for the number of operator tap-change operations

You can use this parameter to set the message limit for the number of operator tap-change operations. If this limit value is achieved, the corresponding progress bar flashes in the maintenance status display.

In order to set the message for the number of operator tap-change operations, proceed as follows:

1. **Configuration > 4x** Continue > **F3** Operator > 1x.
   - Message for operator tap-change operations

2. Press **F4** to highlight a digit.
   - The desired position is highlighted and the value can be changed.

3. Press **F1** to increase the value or **F5** to reduce it.

4. Press **F3**.
   - The message for the number of operator tap-change operations set.

### 7.6.7.3 Setting the operator time interval

You can use this parameter to define a time interval. Together with the "operator date interval" parameter, the time interval is used to calculate the status bar.

To set the time interval, proceed as follows:

1. **Configuration > 4x** Continue > **F3** Operator > 2x.
   - Operator time interval

2. Press **F4** to highlight a digit.
   - The desired position is highlighted and the value can be changed.

3. Press **F1** to increase the value or **F5** to reduce it.

4. Press **F3**.
   - The time interval is set.
7.6.7.4 Setting the date for the operator interval

You can use this parameter to define the final date for the operator interval. If the date is reached, the device triggers an event message.

The date can be set from 01.01.2001 to 29.12.2099 and has the following format:

```
DD:MM:YY
```

The time format can be set using the 24-hour format:

```
HH:MM:SS
```

To set the operator interval date, proceed as follows:

1. Press \(\text{MENU} > F4 \) Configuration > 4x \(F5\) Continue > \(F3\) Operator > 3x \(\rightarrow\) 
   \(\Rightarrow\) Operator date interval.
2. Press \(F4\) to highlight a digit. 
   \(\Rightarrow\) The desired position is highlighted and the value can be changed.
3. Press \(F1\) to increase the value or \(F5\) to reduce it.
4. Press \(\leftarrow\).
   \(\Rightarrow\) The date for the operator interval is set.

7.6.7.5 Setting the operator interval message

You can use this parameter to set the limit for the operator time interval message. If this limit value is achieved, the corresponding progress bar flashes in the display.

To set the operator interval message, proceed as follows:

1. Press \(\text{MENU} > F4 \) Configuration > 4x \(F5\) Continue > \(F3\) Operator > 4x \(\rightarrow\) 
   \(\Rightarrow\) Message for operator time interval
2. Press \(F4\) to highlight a digit. 
   \(\Rightarrow\) The desired position is highlighted and the value can be changed.
3. Press \(F1\) to increase the value or \(F5\) to reduce it.
4. Press \(\leftarrow\).
   \(\Rightarrow\) The operator interval message is set.

7.7 Displaying information about device

The next section describes how you can display information about the device.
7. Functions and settings

7.7.1 Displaying the info screen

Information about the device can be viewed here.

The following information is displayed:

- Device model
- Firmware version number
- Serial number
- RAM
- Additional cards

To display the info screen, proceed as follows:

► **Menu > [F5] Info**

▶ Info.

7.7.2 Displaying measured values

To display the measured values, proceed as follows:

► **Menu > [F5] Info > Press →** until the desired display appears.

▶ Measured values.

7.7.3 Carrying out LED test

You can check whether the LEDs are functioning properly. To do this, press the relevant function key to illuminate an LED:

<table>
<thead>
<tr>
<th>Key</th>
<th>LED no.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F1</strong></td>
<td>LED 1...LED 5</td>
</tr>
<tr>
<td><strong>F5</strong></td>
<td>LED 1...LED 5</td>
</tr>
<tr>
<td><strong>F1</strong> +</td>
<td>LED 6...LED 9</td>
</tr>
<tr>
<td><strong>F5</strong></td>
<td>LED 6...LED 9</td>
</tr>
<tr>
<td><strong>F4</strong></td>
<td>All LEDs</td>
</tr>
<tr>
<td><strong>F5</strong></td>
<td>All LEDs</td>
</tr>
</tbody>
</table>

Table 14: Arrangement of keys for the LED test

This function will only test the functional reliability of the respective LED. The function of the device linked to the LED is not tested.
To carry out the LED test, proceed as follows:

1. Press \([\text{INFO}] \rightarrow \text{F5}\quad \text{Info} \rightarrow \text{Press} \rightarrow\) until the desired measurement parameter is displayed.
   \(\Rightarrow\) LED test.

2. To carry out the function test, press any F key for the LED you want to test.

### 7.7.4 Displaying input/output status

The status of the respective optocoupler inputs is shown in the \textbf{INPUT / OUTPUT-STATUS} display. As soon as a continuous signal is present at the input, it is shown in the display with a 1. 0 indicates no signal at the input.

![Figure 17: Signals](image)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Signaling status</td>
</tr>
<tr>
<td>2</td>
<td>Control inputs/output relays</td>
</tr>
</tbody>
</table>

To query the status, proceed as follows:

- Press \([\text{INFO}] \rightarrow \text{F5}\quad \text{Info} \rightarrow \text{Press} \rightarrow\) until the desired measurement parameter is displayed.
  \(\Rightarrow\) INPUT/OUTPUT STATUS.

### 7.7.5 Displaying UC card status

The status of the respective optocoupler inputs is shown in this display. As soon as a continuous signal is present at the input, it is shown in the display with a 1. 0 indicates no signal at the input.
To query the status, proceed as follows:

1. Press \( \text{MENU} > \text{F5} \) Info > Press \( \rightarrow \) until the desired measurement parameter is displayed.
2. Press \( \rightarrow \) (UC1 CARD STATUS/UC2 CARD STATUS).

### 7.7.6 Resetting parameters

With this display you can reset your settings to the factory settings.

Resetting the parameters to the factory settings permanently deletes your parameters.

To reset the parameters, proceed as follows:

1. Press \( \text{MENU} > \text{F5} \) Info > \( \rightarrow \) until the desired display appears.
2. Press \( \text{F3} \) and \( \text{F4} \) at the same time to reset all of the parameters to the factory settings.

All parameters have been reset to the factory settings.
7.7.7 Displaying real-time clock

An operations counter is started when the device is first switched on. This continues to run even if the device is switched off. Each of the operations counter's times is overwritten with that of the PC to visualize the measured values.

To display the real-time clock, proceed as follows:

► MENU > F5 Info > Press ➔ until the desired measurement parameter is displayed.
⇒ RTC.

7.7.8 Displaying measured value memory

As an option, the device can be equipped with a long-term memory module. You can display information about the memory in this window.

To display the measured value memory, proceed as follows:

► MENU > F5 Info > Press ➔ until the desired measurement parameter is displayed.
⇒ MEASURED VALUE MEMORY

7.7.9 Displaying peak memory

This display indicates whether the parameter sets are all correctly stored after restarting the device or after transferring a parameter set. The minimum and maximum voltage measured since the last reset and the minimum and maximum on-load tap-changer tap positions are shown here. All values recorded are stored with a time and date.

The minimum and maximum values continue to be stored in an internal fixed value memory even in the event of power failure.
To display the peak memory, proceed as follows:

- **MENU > F5 Info > Press until the desired measurement parameter is displayed.**
- ➡ Peak memory.

### 7.7.10 Displaying upcoming messages

This display shows upcoming messages, such as:

- Undervoltage
- Overvoltage
- Fault in parallel operation
- etc.
To display the upcoming messages, proceed as follows:

► **MENU** > **F5** Info > Press ▶ until the desired measurement parameter is displayed.

⇒ **UPCOMING MESSAGES**

### 7.7.11 Displaying the LOG file

The LOG file documents confirmation of maintenance work undertaken. Once maintenance has been done and the corresponding reset then performed, the name and time are entered automatically.

The LOG file can be displayed and prepared using the TAPCON®-trol visualization software. For more information, please read the operating instructions for the TAPCON®-trol visualization software.

To display the LOG file, proceed as follows:

1. **MENU** > **F5** Info > Insert ▶ until the desired display appears.

⇒ LOG file.

2. Press **F1** or **F5** to scroll slowly (line-by-line), **F2** or **F4** to scroll quickly (page-by-page).
8 Fault elimination

This chapter describes how to eliminate simple operating faults.

8.1 Man Machine Interface

<table>
<thead>
<tr>
<th>Characteristics/detail</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No display.</td>
<td>Contrast incorrectly set.</td>
<td>Set contrast using resistor contact series</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in front panel.</td>
</tr>
<tr>
<td></td>
<td>Voltage supply interrupted.</td>
<td>Check voltage supply.</td>
</tr>
<tr>
<td></td>
<td>Fuse faulty.</td>
<td>Replace fuse.</td>
</tr>
<tr>
<td>Display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Different brightness if there are several monitoring systems.</td>
<td>Display dimming activated/deactivated.</td>
<td>Check &quot;Display dimming&quot; setting.</td>
</tr>
<tr>
<td>COM1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cannot be connected to PC using TAPCONtrol.</td>
<td>Different baud rates set.</td>
<td>Check &quot;Baud rate&quot; parameter (monitoring system and TAPCON®-trol). Correct if necessary.</td>
</tr>
</tbody>
</table>

Table 15: Troubleshooting: Man Machine Interface

8.2 Digital inputs

<table>
<thead>
<tr>
<th>Characteristics/detail</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal discontinuous.</td>
<td>Pulsating signal voltage</td>
<td>Check signal voltage source</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check signaling device</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check wiring. Connect as shown in connection diagram.</td>
</tr>
</tbody>
</table>

Table 16: Incorrect signals on digital inputs

8.3 General faults

<table>
<thead>
<tr>
<th>Characteristics/detail</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No function</td>
<td>Fuse tripped.</td>
<td>Check all fuses.</td>
</tr>
<tr>
<td>• Supply voltage.</td>
<td></td>
<td>Replace if necessary.</td>
</tr>
<tr>
<td>Relays chatter</td>
<td>Supply voltage too low.</td>
<td>Check supply voltage.</td>
</tr>
</tbody>
</table>

Table 17: General faults

8.4 Other faults

If you cannot resolve a problem, please contact Maschinenfabrik Reinhausen. Please have the following data to hand:

• Serial number

This can be found:
8 Fault elimination

- Outer right side when viewed from the front
- Info screen (MENU > F5 Info)

Please provide answers to the following questions:
- Has a firmware update been carried out?
- Has there previously been a problem with this device?
- Have you previously contacted Maschinenfabrik Reinhausen about this issue? If yes, then who was the contact?
9 Messages

This chapter contains an overview of the device's messages.

9.1 Signal inputs

<table>
<thead>
<tr>
<th>Input</th>
<th>Inscription</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO-X1:33</td>
<td>MOTOR-DRIVE UNIT IN OPERATION</td>
<td>Motor-drive unit is in operation</td>
</tr>
<tr>
<td>IO-X1:11...17, IO-X1:27...30</td>
<td>BCD1...BCD10</td>
<td>BCD tap input signal</td>
</tr>
</tbody>
</table>

Table 18: Signal inputs

9.2 Signal outputs

<table>
<thead>
<tr>
<th>Relay</th>
<th>Inscription</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO-X1:01...03</td>
<td>STATUS</td>
<td>Status</td>
</tr>
<tr>
<td>IO-X1:21</td>
<td>MR SIGNAL YELLOW</td>
<td>Signal for when limit value for &quot;Mainte-</td>
</tr>
<tr>
<td></td>
<td>RED</td>
<td>nance message&quot; is reached.</td>
</tr>
<tr>
<td>IO-X1:23</td>
<td>OPERATOR SIGNAL</td>
<td>Signal for when limit value for &quot;Operato-</td>
</tr>
<tr>
<td></td>
<td>YELLOW</td>
<td>tor interval message&quot; is reached.</td>
</tr>
<tr>
<td>IO-X1:18</td>
<td>OPERATOR SIGNAL</td>
<td>Signal for when operator interval is</td>
</tr>
<tr>
<td></td>
<td>RED</td>
<td>reached.</td>
</tr>
</tbody>
</table>

Table 19: Signal outputs

9.3 Event messages

<table>
<thead>
<tr>
<th>Event message</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor protection device</td>
<td>Event message appears if motor protective switch triggers (only with corresponding device configuration and wiring).</td>
</tr>
<tr>
<td>No OLTC position</td>
<td>Event message appears if no OLTC position is detected.</td>
</tr>
<tr>
<td>Tap-change detection error</td>
<td>Event message appears if an on-load tap-change operation has not been detected correctly.</td>
</tr>
</tbody>
</table>

Table 20: Event messages
10 Disposal

The device was produced in accordance with European Community Directive 2002/95/EC (RoHS) and must be disposed of accordingly. If the device is not operated within the European Union, the national disposal requirements applicable in the country of use should be observed.
## 11 Overview of parameters

The following sections give an overview of the relevant menus and parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting range</th>
<th>Factory setting</th>
<th>Current setting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration &gt; Transformer data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary current</td>
<td>0…9,999 A</td>
<td>0 A</td>
<td></td>
</tr>
<tr>
<td>Current transformer connection</td>
<td>0.2 A; 1 A; 5 A</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; General</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>see [► 32]</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Regulator ID</td>
<td>-</td>
<td>0000</td>
<td></td>
</tr>
<tr>
<td>COM1 setting</td>
<td>9.6 kilobaud; 19.2 kilobaud; 38.4 kilobaud; 57.6 kilobaud</td>
<td>57.6 kilobaud</td>
<td></td>
</tr>
<tr>
<td>Display dark</td>
<td>On/Off</td>
<td>On</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; Analog inputs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input 1 lower limit</td>
<td>0…100 %</td>
<td>0 %</td>
<td></td>
</tr>
<tr>
<td>Input 1 upper limit</td>
<td>0…100 %</td>
<td>100 %</td>
<td></td>
</tr>
<tr>
<td>Input 1 lower value</td>
<td>-999.9…999.9</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Input 1 upper value</td>
<td>-999.9…999.9</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; Memory</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>see [► 32]</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>see [► 32]</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OLTC maintenance message</td>
<td>0…100 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>DSI replacement message</td>
<td>0…100 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>Tap selector maintenance message</td>
<td>0…100 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>Oil change and cleaning message</td>
<td>0…100 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>Wear reached message</td>
<td>0…100 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>Oil sample message</td>
<td>0…100 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; OLTC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-load tap-changer type</td>
<td>Parameter is pre-set and may only be changed by MR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-load tap-changer serial number</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower operating position</td>
<td>-55…54</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Top operating position</td>
<td>-55…54</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Average step voltage</td>
<td>Parameter is pre-set and may only be changed by MR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 11 Overview of parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting range</th>
<th>Factory setting</th>
<th>Current setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor &quot;s&quot; of current splitting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel sectors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; Contacts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKA</td>
<td>0…14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>SKB</td>
<td>0…14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>WKA / WK1A</td>
<td>0…14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>WKB / WK1B</td>
<td>0…14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>WK2A</td>
<td>0…14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>WK2B</td>
<td>0…14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; Operator</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator tap-change operation interval</td>
<td>0…1,000*</td>
<td>0</td>
<td>(*) The set value has to be multiplied by 1,000 to obtain the number-of-operations interval.</td>
</tr>
<tr>
<td>Number of operator tap-change operations message</td>
<td>0.0…100.0 %</td>
<td>90 %</td>
<td></td>
</tr>
<tr>
<td>Operator time interval</td>
<td>0.00…50.00 years</td>
<td>0.00 years</td>
<td></td>
</tr>
<tr>
<td>Operator date interval</td>
<td>-</td>
<td>2000-03-01 00:00:00</td>
<td></td>
</tr>
<tr>
<td>Operator time interval message</td>
<td>0…100 %</td>
<td>90.0 %</td>
<td></td>
</tr>
<tr>
<td><strong>Configuration &gt; Service</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAPGUARD password</td>
<td>0000…9,999</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Reset abrasion parts</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset oil change + cleaning</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset DSI replacement</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset tap selector inspection</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset oil sample</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset number of operator tap-change operations</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset operator time</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reset oil filter change</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td><strong>Info</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Info</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input/output status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC1 card status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data on CAN bus</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 11 Overview of parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting range</th>
<th>Factory setting</th>
<th>Current setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value memory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak memory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upcoming messages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOG file</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 21: Overview of parameters
12 Technical data

12.1 Indicator elements

<table>
<thead>
<tr>
<th>Display</th>
<th>LCD, monochrome, graphics-capable 128 x 128 pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEDs</td>
<td>15 LEDs for operation display and messages</td>
</tr>
</tbody>
</table>

Table 22: Indicator elements

12.2 Assemblies

12.2.1 AD card

![AD card diagram]

Figure 20: AD card

12.2.2 CIC card

<table>
<thead>
<tr>
<th></th>
<th>9-pin SUB-D socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS232</td>
<td>Pin 2: TxD</td>
</tr>
<tr>
<td></td>
<td>Pin 3: RxD</td>
</tr>
<tr>
<td></td>
<td>Pin 5: GND</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>3-pin female connector from Phoenix (MC1.5/3 GF 3.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485</td>
<td>Pin 1: GND (100 Ω ground resistance)</td>
</tr>
<tr>
<td></td>
<td>Pin 2: B (inverting)</td>
</tr>
<tr>
<td></td>
<td>Pin 3: A (non-inverting)</td>
</tr>
<tr>
<td></td>
<td>Polarity:</td>
</tr>
<tr>
<td></td>
<td>A &gt; B by 200 mV corresponds to 1.</td>
</tr>
<tr>
<td></td>
<td>A &lt; B by 200 mV corresponds to 0.</td>
</tr>
<tr>
<td></td>
<td>An open communication line corresponds to 1.</td>
</tr>
<tr>
<td></td>
<td>The start bit has the designation 0.</td>
</tr>
<tr>
<td></td>
<td>Recommended terminating resistor 120 Ω.</td>
</tr>
</tbody>
</table>
12 Technical data

| RJ45 (Ethernet) | Pin1: Tx+  
|                 | Pin2: Tx-  
|                 | Pin3: Rx+  
|                 | Pin6: Rx-  |
| Fiber-optic cable (optional) | F-ST (850 nm or 660 nm)  
|                             | F-SMA (850 nm or 660 nm) |

Table 23: Interfaces available

![CIC card](image)

Figure 21: CIC card

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS232</td>
<td>6</td>
<td>TxD LED for transmit signal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RS485</td>
<td>7</td>
<td>RxD LED for receive signal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RJ45 (Ethernet)</td>
<td>8</td>
<td>Clk LED for operating mode (flashes for 2 seconds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Fiber-optic cable</td>
<td>9</td>
<td>Clip for connecting cable shield with functional ground</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Reset key</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12 Technical data

12.2.3 CPU card

Figure 22: CPU card

1 CAN bus interface

12.2.4 IO card

<table>
<thead>
<tr>
<th>Input</th>
<th>Terminal</th>
<th>Output</th>
<th>Contact type*</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>IO-X1:11-15</td>
<td>A1</td>
<td>NO</td>
<td>IO-X1:25-26</td>
</tr>
<tr>
<td>E2</td>
<td>IO-X1:12-15</td>
<td>A2</td>
<td>NO</td>
<td>IO-X1:23-24</td>
</tr>
<tr>
<td>E4</td>
<td>IO-X1:14-15</td>
<td>A4</td>
<td>NO</td>
<td>IO-X1:18-20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IO-X1:18-19</td>
<td></td>
</tr>
<tr>
<td>E5</td>
<td>IO-X1:16-27</td>
<td>A5</td>
<td>NO</td>
<td>IO-X1:8-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NC</td>
<td>IO-X1:8-9</td>
</tr>
<tr>
<td>E6</td>
<td>IO-X1:17-27</td>
<td>A6</td>
<td>NO</td>
<td>IO-X1:6-7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NC</td>
<td>IO-X1:4-5</td>
</tr>
<tr>
<td>E7</td>
<td>IO-X1:28-30</td>
<td>A7</td>
<td>NO</td>
<td>IO-X1:1-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NC</td>
<td>IO-X1:1-2</td>
</tr>
<tr>
<td>E8</td>
<td>IO-X1:29-30</td>
<td>A8</td>
<td>NO</td>
<td>IO-X1:25-26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NC</td>
<td>IO-X1:23-24</td>
</tr>
<tr>
<td>E9</td>
<td>IO-X1:31-32</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 24: Inputs and outputs of IO card

*) NO = Normally open (N/O contact), NC = normally closed (N/C contact)
12 Technical data

12.2.5 MI card

12.2.6 SU card

<table>
<thead>
<tr>
<th>Standard model</th>
<th>Input</th>
<th>Voltage range</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 / + DC</td>
<td>88...350 V DC</td>
<td>SU-X1:01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>88...265 V AC*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N / -DC</td>
<td>88...350 V DC</td>
<td>SU-X1:02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>88...265 V AC*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 25: SU card inputs (standard model)

*) Permissible frequency range: 45...65 Hz

<table>
<thead>
<tr>
<th>Special model</th>
<th>Input</th>
<th>Voltage range</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ DC</td>
<td>18...36 V DC</td>
<td>SU-X1:01</td>
<td></td>
</tr>
<tr>
<td>-DC</td>
<td>18...36 V DC</td>
<td>SU-X1:02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ DC</td>
<td>36...72 V DC</td>
<td>SU-X1:01</td>
<td></td>
</tr>
</tbody>
</table>
12.2 Input

<table>
<thead>
<tr>
<th>Input</th>
<th>Voltage range</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>- DC</td>
<td>36...72 V DC</td>
<td>SU-X1:02</td>
</tr>
</tbody>
</table>

Table 26: Inputs for the SU card come in a 18...36 V DC version or a 36...72 V DC version

![SU card diagram](image)

Figure 25: SU card

12.3 Electrical data

<table>
<thead>
<tr>
<th>Power supply</th>
<th>88...350 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>88...265 V AC*</td>
</tr>
<tr>
<td>Optional: 36...72 V DC or 18...36 V DC</td>
<td></td>
</tr>
</tbody>
</table>

| Power consumption  | 25 VA |

Table 27: Electrical data

*) Permissible frequency range: 45…65 Hz

12.4 Digital inputs and outputs

<table>
<thead>
<tr>
<th>Control voltage of inputs</th>
<th>40...250 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With pulsating DC voltage, the voltage minimum must always exceed 40 V.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contact loadability of outputs</th>
<th>Min. 12 V/100 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. AC</td>
<td>250 V/5 A</td>
</tr>
<tr>
<td>Max. DC</td>
<td>See diagram</td>
</tr>
</tbody>
</table>

Table 28: Digital inputs and outputs
12.5 Dimensions and weight

| Housing (W x H x D) | 19-inch plug-in housing in accordance with DIN 41494 Part 5  
| 483 x 133 x 178 mm (19 x 5.2 x 7 in) |

| Weight | 5.0 kg (11 lb) |

Table 29: Dimensions and weight

Figure 26: Maximum contact loadability of outputs with direct current

1 Ohmic load
12 Technical data

12.6 Voltage measurement and current measurement

<table>
<thead>
<tr>
<th>Voltage measuring input</th>
<th>Measuring range: 49...140 V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective value: 45...65 Hz</td>
</tr>
<tr>
<td></td>
<td>Intrinsic consumption: &lt; 1 VA</td>
</tr>
</tbody>
</table>
12 Technical data

<table>
<thead>
<tr>
<th>Current measuring input</th>
<th>0.2 / 1 / 5 A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effective value: 45...65 Hz</td>
</tr>
<tr>
<td></td>
<td>Intrinsic consumption: &lt; 1 VA</td>
</tr>
<tr>
<td></td>
<td>Overload capacity: 2 x ( I_N ) (continuously), 40 x ( I_N / 1 ) s</td>
</tr>
<tr>
<td>Measuring error</td>
<td>Voltage measurement: &lt; 0.3 % ± 40 ppm/°C</td>
</tr>
<tr>
<td></td>
<td>Current measurement: &lt; 0.5 % ± 40 ppm/°C</td>
</tr>
</tbody>
</table>

Table 30: Voltage measurement and current measurement

12.7 Ambient conditions

<table>
<thead>
<tr>
<th>Operating temperature</th>
<th>-25°C...+70°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>-30°C...+85°C</td>
</tr>
</tbody>
</table>

Table 31: Permissible ambient conditions

12.8 Tests

12.8.1 Electrical safety

<table>
<thead>
<tr>
<th>EN 61010-1</th>
<th>Safety requirements for electrical measurement and control and regulation equipment and laboratory instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61131-2</td>
<td>Dielectric test with operating frequency 2.5 kV / 1 min</td>
</tr>
<tr>
<td>IEC 60255</td>
<td>Dielectric test with impulse voltage 5 kV, 1.2/50 μs</td>
</tr>
<tr>
<td>IEC 60 644-1</td>
<td>Level of contamination 2, overvoltage category III</td>
</tr>
</tbody>
</table>

Table 32: Electrical safety

12.8.2 EMC tests

<table>
<thead>
<tr>
<th>IEC 61000-4-2</th>
<th>Electrostatic discharges (ESD) 6 kV/8 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61000-4-3</td>
<td>Electromagnetic fields (HF) 20 V/m 80...3000 MHz</td>
</tr>
<tr>
<td>IEC 61000-4-4</td>
<td>Fast transients (burst) 2 kV</td>
</tr>
<tr>
<td>IEC 61000-4-5</td>
<td>Surge transient immunity 4 kV/2 kV/1 kV</td>
</tr>
<tr>
<td>IEC 61000-4-6</td>
<td>HF interference immunity (lines) 10 V, 150 kHz...80 MHz</td>
</tr>
<tr>
<td>IEC 61000-4-8</td>
<td>Power frequency magnetic field immunity 30 A/m, 50 Hz, continuous</td>
</tr>
<tr>
<td>IEC 61000-4-11</td>
<td>Voltage dips, short interruptions and voltage variations immunity tests</td>
</tr>
<tr>
<td>IEC 61000-4-29</td>
<td>Voltage dips, short interruptions and voltage variations on DC input power port immunity tests</td>
</tr>
<tr>
<td>IEC 61000-6-2</td>
<td>Immunity requirements for industrial environments</td>
</tr>
<tr>
<td>IEC 61000-6-4</td>
<td>Emission standard for industrial environments</td>
</tr>
</tbody>
</table>
Table 33: EMC tests

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN 55011,</td>
<td>Emission &quot;RFI&quot;</td>
</tr>
<tr>
<td>DIN EN 55022</td>
<td></td>
</tr>
</tbody>
</table>

12.8.3 Environmental durability tests

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN 60529</td>
<td>Degree of protection IP20</td>
</tr>
<tr>
<td>IEC 60068-2-1</td>
<td>Dry cold - 25 °C / 96 hours</td>
</tr>
<tr>
<td>IEC 60068-2-2</td>
<td>Dry heat + 70 °C / 96 hours</td>
</tr>
<tr>
<td>IEC 60068-2-3</td>
<td>Constant moist heat</td>
</tr>
<tr>
<td></td>
<td>+ 40 °C / 93 % / 4 days, no dew</td>
</tr>
<tr>
<td>IEC 60068-2-30</td>
<td>Cyclic moist heat</td>
</tr>
<tr>
<td></td>
<td>+ 55 °C / 93 % / 6 cycles</td>
</tr>
</tbody>
</table>

Table 34: Environmental durability tests
Glossary

DIN
Abbreviation for “Deutsches Institut für Normung”

DSI
Abbreviation for diverter switch insert

EN
Abbreviation for “European Norm”

IEC
Abbreviation for "International Electrotechnical Commission"

MR
Abbreviation for "Maschinenfabrik Reinhausen GmbH"

RTC
Abbreviation for "Real Time Clock"

SKA
Abbreviation for main switching contact A

SKB
Abbreviation for main switching contact B

WKA
Abbreviation for transition contact A

WKB
Abbreviation for transition contact B
<table>
<thead>
<tr>
<th>A</th>
<th>I</th>
<th>R</th>
</tr>
</thead>
<tbody>
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MR worldwide

Australia
Reinhausen Australia Pty. Ltd.
17/20-22 St Albans Road
Kingsgrove NSW 2208
Phone: +61 2 9502 2202
Fax: +61 2 9502 2224
E-Mail: sales@au.reinhausen.com

Brazil
MR do Brasil Indústria Mecânica Ltda.
Av. Elias Yazbek, 465
CEP: 06803-000
Embu - SP, São Paulo
Phone: +55 11 4785 2150
Fax: +55 11 4785 2185
E-Mail: vendas@reinhausen.com.br

Canada
Reinhausen Canada Inc.
3755, rue Java, Suite 180
Brossard, Québec J4Y 0E4
Phone: +1 514 370 5377
Fax: +1 450 659 3092
E-Mail: m.foata@ca.reinhausen.com

India
Easun-MR Tap Changers Ltd.
612, CTH Road
Tiruninravur, Chennai 602 024
Phone: +91 44 26300883
Fax: +91 44 26390881
E-Mail: easunmr@vsnl.com

Indonesia
Pt. Reinhausen Indonesia
German Center, Suite 6310,
BSD City, Tangerang
Phone: +62 21 5315-3183
Fax: +62 21 5315-3184
E-Mail: c.haering@id.reinhausen.com

Iran
Iran Transfo After Sales Services Co.
Zanjian, Industrial Township No. 1 (Alibad)
Corner of Morad Str.
Postal Code 4533144551
E-Mail: ias@gmail.com

Italy
Reinhausen Italia S.r.l.
Via Alserio, 16
20159 Milano
Phone: +39 02 6943471
Fax: +39 02 69434766
E-Mail: sales@it.reinhausen.com

Japan
MR Japan Corporation
German Industry Park
1-18-2 Hakusan, Midori-ku
Yokohama 226-0006
Phone: +81 45 929 5728
Fax: +81 45 929 5741

Luxembourg
Reinhausen Luxembourg S.A.
72, Rue de Prés
L-7333 Steinsei
Phone: +352 27 3347 1
Fax: +352 27 3347 99
E-Mail: sales@lu.reinhausen.com

Malaysia
Reinhausen Asia-Pacific Sdn. Bhd
Level 11 Chulan Tower
No. 3 Jalan Conlay
50450 Kuala Lumpur
Phone: +60 3 2142 6481
Fax: +60 3 2142 6422
E-Mail: mr_rap@my.reinhausen.com

P.R.C. (China)
MR China Ltd. (MRT)
开德贸易（上海）有限公司
中国上海浦东新区浦东路360号
新上海国际大厦4楼E座
邮编：200120
电话：+86 21 61634588
传真：+86 21 61634592
邮箱：mr-sales@cn.reinhausen.com
mr-service@cn.reinhausen.com

Russian Federation
OOO MR
Naberezhnaya Akademika Tupoleva
15, Bid. 2 ("Tupolev Plaza")
105005 Moscow
Phone: +7 495 980 89 67
Fax: +7 495 980 89 87
E-Mail: mrr@reinhausen.ru

South Africa
Reinhausen South Africa (Pty) Ltd.
No. 15, Third Street, Booyens Reserve
Johannesburg
Phone: +27 11 8352077
Fax: +27 11 8353806
E-Mail: support@za.reinhausen.com

South Korea
Reinhausen Korea Ltd.
21st floor, Standard Chartered Bank Bldg.,
47, Chongno, Chongno-gu,
Seoul 110-702
Phone: +82 2 767 4909
Fax: +82 2 736 0049
E-Mail: you-mi.jang@kr.reinhausen.com

U.S.A.
Reinhausen Manufacturing Inc.
2549 North 9th Avenue
Humboldt, TN 38343
Phone: +1 731 784 7681
Fax: +1 731 784 7682
E-Mail: sales@reinhausen.com

United Arab Emirates
Reinhausen Middle East FZE
Dubai Airport Freezone, Building Phase 6
3rd floor, Office No. 6E6, 341 Dubai
Phone: +971 4 2368 451
Fax: +971 4 2368 225
Email: service@ae.reinhausen.com