THE POWER BEHIND POWER.

Operating instructions
MESSKO® ZT-F2.5. Temperature transmitter

13453033/00 EN

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We reserve the right to change the technical data, design and scope of supply.
Generally the information provided and agreements made when processing the individual quotations and orders are binding.
The product is delivered in accordance with MR's technical specifications, which are based on information provided by the customer. The customer has a duty of care to ensure the compatibility of the specified product with the customer's planned scope of application.
The original operating instructions were written in German.

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1 Introduction

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

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

1.1 Manufacturer

Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg
Deutschland
+49 941 4090-0
sales@reinhausen.com
reinhausen.com

Customer portal

You can find additional information on this product in our customer portal at portal.reinhausen.com.

1.2 Completeness

This technical file is incomplete without the supporting documents:

- Order confirmation

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 Hazard communication system

Warnings in this technical file are displayed as follows.

1.4.1.1 Warning relating to section

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

⚠ WARNING

Type of danger!
Source of the danger and its consequences.

- Action
- Action

1.4.1.2 Embedded warning information

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

⚠ DANGER! Instruction for avoiding a dangerous situation.

1.4.1.3 Signal words

Depending on the product, the following signal words are used:

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

Table 1: Signal words in warning notices

1.4.2 Information system

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

Important information.

1.4.3 Instruction system

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

Single-step instructions

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

Aim of action
✓ Requirements (optional).
1. Step 1 of 1.
   » Result of step (optional).
» Result of action (optional).

Multi-step instructions

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

Aim of action
✓ Requirements (optional).
1. Step 1.
   » Result of step (optional).
2. Step 2.
   » Result of step (optional).
» Result of action (optional).

1.4.4 Typographic conventions

Typographic convention	Purpose	Example
UPPERCASE	Operating controls, switches	ON/OFF
[Brackets]	PC keyboard	[Ctrl] + [Alt]
Bold	Software operating controls	Press **Continue** button
...>...>...	Menu paths	Parameter > Control parameter
Italics	System messages, error messages, signals	*Function monitoring* alarm triggered
[► Number of pages]	Cross reference	[► Page 41].
Dotted underscore	Glossary entry, abbreviations, definitions, etc.	Glossary entry

Table 2: Typographic conventions used in this technical file

1.5 Open source software

This product contains open source software that has been developed by third parties. The respective license conditions are listed in the following.

The open source software is protected by copyright. You are free to use the open source software provided that you comply with the respective license conditions. In the event of a conflict, these license conditions will take precedence over other license conditions.

The open source software is provided free of charge. Insofar as this is provided for by the license conditions of the open source software, you can obtain the source text of the open source software at least for three years from receipt of the product against payment of the corresponding costs from your respective contact person at Reinhausen GmbH.

You will find the license conditions in the "Appendix" [▶Section 13.2, Page 68] section.

2 Safety

Read this technical file through carefully to familiarize yourself with the product. This technical file is a part of the product.
- Read and observe the safety instructions provided in this chapter in particular.
- Observe the warnings in this technical file to avoid function-related dangers.

The product is manufactured based on state-of-the-art technology. Nevertheless, danger to life and limb for the user or impairment of the product and other material assets may arise in the event of improper use.

2.1 Appropriate use

The temperature transmitter maps the hot-spot temperature in the transformer. The temperature transmitter is suitable for use with a MESSKO® MT-ST TRASY2 series pointer thermometer or with a substitute sensor (can be ordered as an accessory from Reinhausen GmbH).

The product is designed solely for use in stationary large-scale systems.

If used as intended and in compliance with the requirements and conditions specified in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any danger to people, property or the environment. This applies throughout the service life of the product, from delivery, installation and operation to removal and disposal.

The following is considered intended use:
- Use the product only with the transformer specified in the order.
- Operate the product in accordance with this technical documentation, the agreed-upon delivery conditions and the technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Use the equipment and special tools supplied solely for the intended purpose and in accordance with the specifications of this technical file.
- Operate the product in electrical energy systems and facilities.

- Only operate the product in industrial areas.
- Observe the notices in this technical document regarding electromagnetic compatibility and the technical data.

2.2 Fundamental Safety Instructions

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:

Personal protective equipment

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

- All necessary devices and personal protective equipment required for the specific task, such as a hard hat, safety footwear, etc. must be worn. Observe the "Personal protective equipment" [▶Section 2.4, Page 16] section.
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces or other jewelry.
- If you have long hair, wear a hairnet.

Work area

Untidy and poorly lit work areas can lead to accidents and malfunctions.

- Keep the work area clean and tidy.
- Make sure that the work area is well lit.
- The device, tools and installation materials must be clean and dry.
- Observe the applicable laws for accident prevention in the relevant country.

Pollution level

Moisture, dust, sweat and other conductive dirt may cause malfunctions in the device. To ensure contamination level II, observe the following information:

- Wear assembly gloves.
- Ensure that no dirt or moisture enters the device when it is open.
- Close up the device after installation.

Explosion protection

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

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

Safety markings

Warning signs and safety information plates are safety markings on the product. They are an important aspect of the safety concept. Safety markings are depicted and described in the chapter "Product description".

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

Ambient conditions

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

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

Modifications and conversions

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

- Only modify the product after consultation with Reinhausen GmbH.

Spare parts

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

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

Working during operation

You must only operate the product when it is in a sound operational condition. Otherwise it poses a danger to life and limb.

- Regularly check the operational reliability of safety equipment.
- Perform the inspection tasks described in this technical document regularly.

2.3 Personnel qualification

The person responsible for assembly, commissioning, operation and inspection must have the following qualifications.

Electrically skilled person

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

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

Technical Service

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

Reinhausen GmbH
Technical Service
Falkensteinstrasse 8
93059 Regensburg
Germany
+49 941 4090-0
service@reinhausen.com
reinhausen.com

2.4 Personal protective equipment

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

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

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

Table 3: Personal protective equipment

3 IT security

Observe the following recommendations to operate the product securely:
- Ensure that only authorized personnel have access to the device.
- Ensure that the device is only operated by trained personnel who are familiar with IT security.
- Only use the device within an ESP (electronic security perimeter).
  - Do not connect the device to the Internet in an unprotected state.
  - Use mechanisms for vertical and horizontal network segmentation and security gateways (firewalls) at the transition points.
- Check regularly whether software updates are available for the device and perform the updates.

Due to the SCADA protocols used, the device does not have its own IT security mechanisms.
- To ensure adequate IT security, an upstream system must be operated with at least the following security measures:
  - Prevention of unauthorized access through the use of individual access.
  - Regularly checking of user accounts for permissions and access.

4 Product description

4.1 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:
- Temperature transmitter with 1x Pt100 measurement resistor
- Technical documents

Optional:
- Type 0TT:
  - Version with 2x Pt100 measurement resistors
- Type 1TT:
  - Version with 1x Pt100 measurement resistor and 1x 4...20 mA analog output
- Type 2TT:
  - Version with up to 2x 4...20 mA analog outputs
- Type 1TTM:
  - Modbus version with 1x Pt100 measurement resistor and 1x 4...20 mA analog output
- Type 2TTM:
  - Modbus version with up to 2x 4...20 mA analog outputs

Please note the following:
- Check the shipment against the shipping documents for completeness
- Store the parts in a dry place until installation
- The product must remain in the packaging and may only be removed immediately before installation

4.2 Function description

The temperature transmitter maps the hot-spot temperature in the transformer. The temperature transmitter is suitable for use with a MESSKO® MT-ST TRASY2 series pointer thermometer or with a substitute sensor (available as an accessory).

The winding temperature is measured indirectly. The temperature transition between the insulating fluid and winding depends on the current in the winding, among other factors. The secondary transformer current is proportional to the current in the winding of the transformer. The secondary transformer current supplies a heating resistor in the temperature transmitter with power, which causes a display increase of the actually measured oil temperature (transition temperature) corresponding to the loading of the transformer.

The winding temperature is simulated in the temperature transmitter. The gradient of the hot-spot temperature for the top-oil temperature at nominal load is set via DIP switches. To display the winding temperature mechanically, either the temperature sensor of a pointer thermometer will be installed or, if a pointer thermometer is not used, a substitute sensor (accessory) will be installed in the temperature transmitter.

Depending on the device version, the measured value can be transmitted as follows:

Transmission of measured value	Device version				
	0TT	1TT	2TT	1TTM	2TTM
Pt100 analog output	2x	1x	-	1x	-
4...20 mA analog output	-	1x	2x	1x	2x
Modbus RTU	-	-	-	1x	1x

Table 4: Measured value transmission

4.3 Design

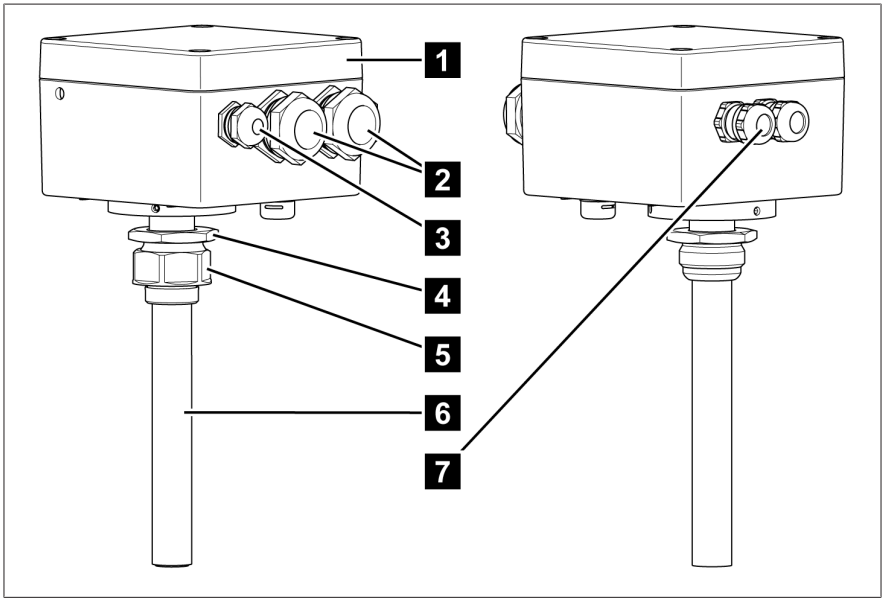


Figure 1: Temperature transmitter

1	Cover	2	2x M25x1.5 EMC cable glands for electrical connection
3	M16x1.5 cable gland for temperature sensor	4	Double screw connection upper nut
5	Double screw connection lower nut	6	Immersion pipe
7	2x EMC M16x1.5 cable glands (type TTM only)		

4.4 Nameplate

The nameplate is on the side of the device.

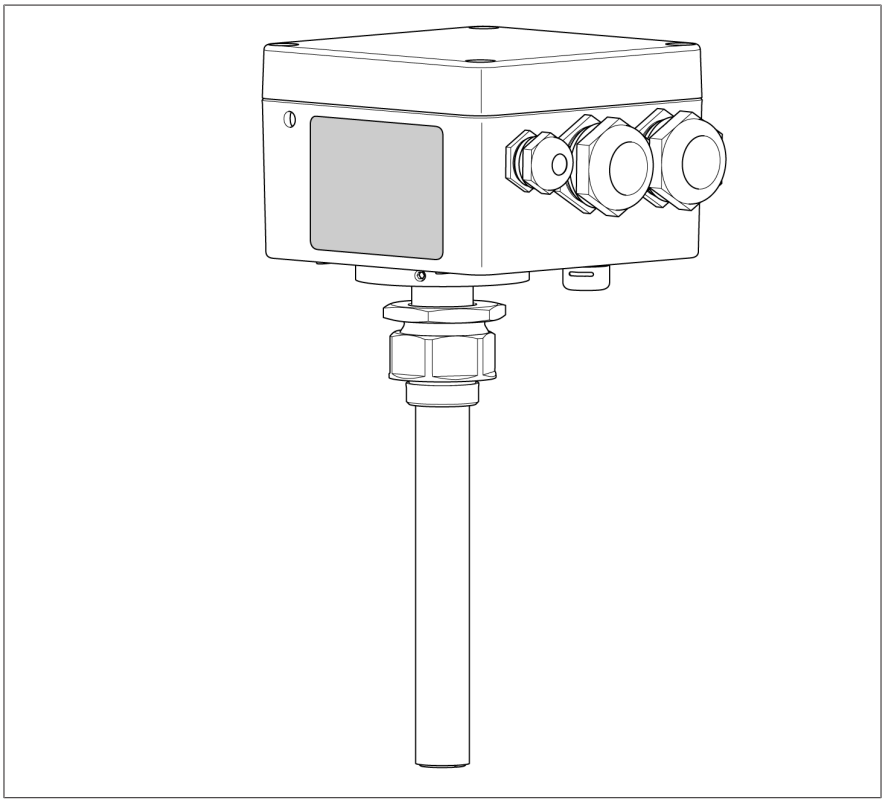


Figure 2: Nameplate

5 Packaging, transport and storage

5.1 Purpose

The packaging is designed to protect the packaged product during transport, loading, unloading and during 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.

5.2 Suitability, structure and production

The goods are packaged in a sturdy cardboard box or solid wooden crate. These ensure 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.

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

5.3 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.

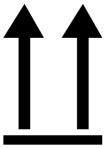
Protect against moisture	 Top	Fragile	Attach lifting gear here	Center of mass

Table 5: Shipping pictograms

5.4 Transportation, receipt and handling of shipments

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

If the packaging tips over or falls, damage is to 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 cartons or transport container can be accessed from all sides.

Visible damage

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

- Immediately record the 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 Reinhausen GmbH and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately on site together with the carrier involved. This is essential for any claim for damages!
- 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 damage is 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 damage can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

5.5 Storage of shipments

When selecting and setting up the storage location, ensure the following:
- Store the product and accessories in the original packaging until installation.
- Protect stored goods against moisture (rain, flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites etc. and against unauthorized access.
- Store crates and boxes on pallets, timber beams or planks as protection against ground moisture and for improved ventilation.
- Ensure that the foundation has sufficient load-bearing capacity.
- Keep entrance paths clear.
- Check the stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow etc.

5.6 Further transport

Use the original product packaging for further transport.

If you transport the product to the final installation site in a mounted state, observe the following information in order to protect the product against mechanical damage due to external influences.

Transport packaging requirements
- Select packaging suitable for the duration of transport or storage, taking the climatic conditions into consideration.
- Ensure that the packaging protects the product against transport stress such as shaking, vibrations and impacts.
- Ensure that the packaging protects the product against moisture such as rain, snow and condensation.
- Ensure that the packaging allows for sufficient air circulation in order to prevent the formation of condensation.

6 Mounting

This chapter describes how to correctly mount and connect the device. Observe the following hazard notices prior to opening the device:

⚠ DANGER

Electric shock!

Risk of fatal injury due to electrical voltage. Always observe the following safety regulations when working in or on electrical equipment.

- Disconnect the equipment.
- Lock the equipment to prevent an unintentional restart.
- Make sure all poles are de-energized.
- Ground and short-circuit.
- Cover or cordon off adjacent energized parts.

⚠ CAUTION

Risk of burns

When a defective device is removed, the immersion pipe may still be hot and cause burns upon contact.

- After de-energizing the device, wait for it to cool down.
- Avoid touching the immersion pipe as much as possible.
- Wear gloves.

NOTICE

Damage to the device!

Electrostatic discharge can lead to damage to the device.

- Take precautionary measures to prevent the build-up of electrostatic charges on work surfaces and personnel.

6.1 Installation conditions

- The temperature transmitter is suitable for installation in the thermometer pocket in accordance with DIN EN 50216-4 type A1. Other fittings are available as an option.
- The thermometer pocket must be installed on the transformer cover in the area of greatest oil flow to ensure good heat exchange between the coolant, thermometer pocket, and the temperature sensors in the temperature transmitter.
- The thermometer pocket must be filled with approximately 50 ml of oil at room temperature to ensure the correct heat transfer (do not use any aluminum foil or similar).
- If the temperature transmitter is to be tested prior to installation, the test setup must replicate similar conditions to those on the transformer (see chapter "Function test").

6.2 Function test

You can perform a function test prior to installing the temperature transmitter. The test setup for the function test must replicate similar conditions to those in the transformer:

✓ The oil bath is regulated and stirred. Use of the MESSKO® MZT1650S calibration bath offered by Reinhausen GmbH is recommended.

✓ The thermometer pocket has been installed in the oil bath.

✓ The thermometer pocket has been filled with approximately 50 ml of oil at room temperature.

✓ The temperature transmitter has been installed in the thermometer pocket.

✓ The Pt100 or 4...20 mA output (depending on option) has been connected (see section Pt100 measurement resistor connection [▶Section 6.6.4, Page 34] and section 4...20 mA analog output connection (optional) [▶Section 6.6.5, Page 37]).

✓ The temperature sensor has been pushed in up to the stop (approx. 215 mm/8.46 in deep).

✓ The temperature of the oil bath may not exceed 30 °C, otherwise the heat radiation via the double screw connection will falsify the conditions.

1. Feed in the desired CT current (2 A AC rms).
2. Set the hotspot gradient via the DIP switches or Modbus in accordance with manufacturer specifications (see section Setting the hotspot gradient).
3. On the device version with Modbus interface, close the terminating resistor.
4. The adjustment to the temperature of the oil bath must be at least 30 minutes.
5. The measurement cycle must be at least 20 minutes until the set gradient is reached.

6.3 Installing the temperature transmitter

✓ Use a suitable thermometer pocket in accordance with DIN EN 50216-4 type A1.

1. Fill the thermometer pocket with approximately 50 ml of oil at room temperature.
2. Unscrew the lower nut of the double screw connection and screw into the thermometer pocket.
3. *NOTICE!* Damage to the device! Ensure that the double screw connection is free before aligning or turning the temperature transmitter. Insert the immersion pipe of the temperature transmitter into the thermometer pocket, align it, and screw tight using the upper nut of the double screw connection.

6.4 Installing the temperature sensor of the pointer thermometer

If you are going to use a pointer thermometer for displaying the winding temperature mechanically, first install the pointer thermometer in accordance with the corresponding operating instructions. Then install the temperature sensor of the pointer thermometer in the temperature transmitter:

✓ The temperature sensor of the pointer thermometer used has a diameter of 9.5 mm (0.37 in).

1. Unscrew the cover of the temperature transmitter.
2. Open the M16x1.5 cable gland.
3. *NOTICE!* Damage to the capillary line! The shield contact on the cable gland can make it difficult to withdraw the capillary line or damage the capillary line when it is withdrawn. Remove the shield contact from the cable gland for the temperature sensor.
4. Push the pressure nut and gasket over the temperature sensor and the capillary line.
5. Feed the temperature sensor through the cable gland and feed approximately 50 cm (19.69 in) through.
6. Push the temperature sensor into the temperature sensor well of the temperature transmitter up to the stop (approx. 215 mm/8.46 in deep).
7. Pull out and lay the capillary line without kinks.
8. Close the cable gland.

6.5 Installing the substitute sensor

If you are not going to use a pointer thermometer for displaying the winding temperature mechanically, install a substitute sensor in the temperature transmitter:

1. Unscrew the cover of the temperature transmitter.
2. Push the substitute sensor into the temperature sensor well of the temperature transmitter up to the stop (approx. 215 mm/8.46 in deep).
3. *NOTICE!* To ensure the IP degree of protection of the device, close the unused M16x1.5 cable gland tight.

6.6 Electrical connection

This section describes how to connect the device correctly. Note the connection diagrams provided. Observe the following hazard notices prior to opening the device:

⚠ DANGER

Electric shock!
Risk of fatal injury due to electrical voltage. Always observe the following safety regulations when working in or on electrical equipment.

- Disconnect the equipment.
- Lock the equipment to prevent an unintentional restart.
- Make sure all poles are de-energized.
- Ground and short-circuit.
- Cover or cordon off adjacent energized parts.

⚠ WARNING

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

- Make sure that there are no dangerous electrical voltages on the CT secondary circuit.
- Never operate a current transformer with an open secondary circuit; short-circuit the current transformer to prevent this.
- Ground the current transformer on one side.
- Observe the information in the current-transformer operating instructions.

NOTICE

Damage to the device!
Electrostatic discharge can lead to damage to the device.

- Take precautionary measures to prevent the build-up of electrostatic charges on work surfaces and personnel.

As part of the preparation work, observe the following information for the electrical connection.

6.6.1 Electromagnetic compatibility

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

6.6.1.1 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.

6.6.1.2 Wiring requirement of operating site

Note the following when wiring the operating site:
- Do not route lines which cause interference (e.g. supply lines) and lines susceptible to interference (e.g. signal lines) in the same cable duct.
- Maintain a distance of more than 100 mm (3.94″) between lines which cause interference and those which are susceptible to interference.
- Never connect the device with a multi-wire collective pipe.
- Use shielded cables for signal transmission.

6.6.2 Cable recommendation

Please note the following recommendation from the manufacturer when connecting the device:
- Only use cables that are flame resistant in accordance with IEC 60332-1-2 or in accordance with UL 2556 VW-1.
- Ensure that the low-voltage circuits are separated from the CT circuit with double insulation, both in the connection area and in the cable.

Connection cable[1)]	Terminals	Permissible cross-sections
CT	1: CT, ungrounded wire 2: CT, grounded wire (if the CT is grounded)	– Single-wire or finely-stranded conductor with ferrule without plastic collar: 1.5...4 mm² – Finely-stranded with ferrule with plastic collar: 1.5...4 mm²
Functional ground	⏚	– ≥ all other conductors
TT/TTM versions only: Pt100 measuring resistors and analog outputs	3, 3a, 4, 5, 5a, 6	– Single-wire conductor: 0.2...4 mm² / 24...12 AWG – Finely-stranded conductor: 0.2...4 mm² / 24...12 AWG – Finely-stranded conductor with ferrule with plastic collar: 0.25...2.5 mm² – Finely-stranded conductor with ferrule without plastic collar: 0.25...2.5 mm² – Finely-stranded conductor with twin ferrule: 0.25...1.5 mm² – Stripping length: 9...11 mm / 0.35...0.43 inches
TTM version only: 24 VDC Power supply and Modbus	V+, 0 A, Com, B	– Single-wire conductor: 0.14...1.5 mm² / 28...16 AWG – Finely-stranded conductor: 0.14...1.5 mm² / 28...16 AWG – Finely-stranded conductor with ferrule with plastic collar: 0.25...0.75 mm² – Finely-stranded conductor with ferrule without plastic collar: 0.25...1.5 mm² – Stripping length: 8...9 mm / 0.31...0.35 inches

Table 6: Recommendation for connection cable

[1)] Depending on device version (optional in part)

It must be possible to apply a nominal voltage of at least 300 V to all above-listed connection cables. Rigid and flexible cables can be used.

Analog output and Pt100

We recommend a shielded cable.

Connect the shield in the control cabinet and route it to the device without interruption. We recommend EMC cable glands for shielding the device.

Modbus RTU

We recommend a shielded twisted pair cable. A shielded twisted pair cable is recommended. To optimize the number of cables and the cable glands, it may be advantageous to run Modbus and the 24 V supply in the same cable.

Connect the shield to the Modbus master (e.g. in the control cabinet) and route it to the device without interruption. We recommend EMC cable glands for shielding the device.

6.6.3 Current transformer connection

The secondary current must be 1.5...2 A nominal. With other current strengths, a multi-ballast transformer must be used depending on the desired hotspot gradient.

1. Open one of the M25x1.5 EMC cable glands.

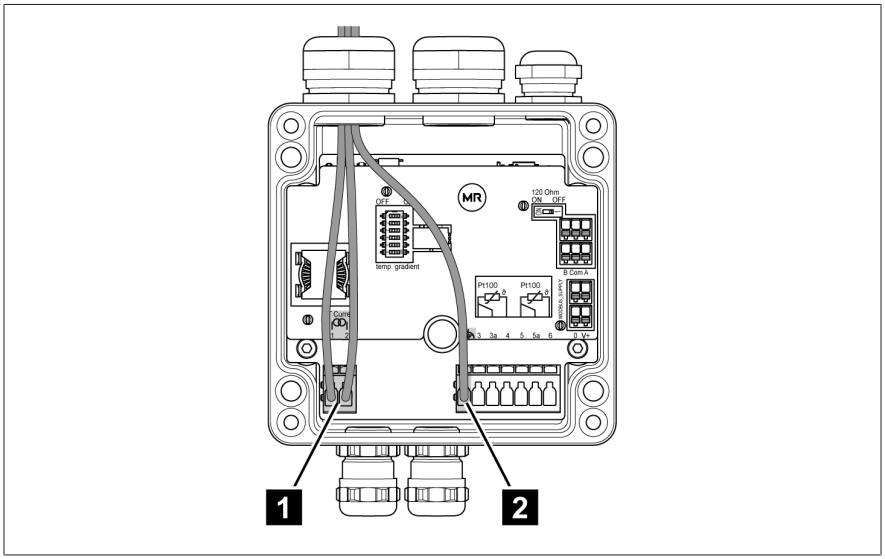


Figure 3: Current transformer and ground connection terminals

1	Terminals 1, 2	2	Functional earth FE

2. Connect the current transformer connection cable as shown. When doing so, connect the grounded connection of the current transformer to terminal 2.
3. Connect the grounding cable via the FE terminal.
4. Close the cable gland.

6.6.4 Pt100 measurement resistor connection

The device is equipped with a Pt100 measurement resistor in accordance with IEC 60751. The device is designed for the connection of a display instrument with 3-conductor technology. The display instrument used can also have a 2-conductor or 4-conductor technology design.

Connection cable length

The length of the connection cables is based on the specifications of the measuring transducer or display device to be connected (e.g. Pt-MU 100 Ω per cable). As a general rule, a cable length of 50 m must not be exceeded with 3-conductor technology. With 3-conductor or 4-conductor technology, it must be ensured that the individual wires are identical (same length and same cross-section). Otherwise, deviations may arise due to incorrect compensation of the conductor resistances.

3-conductor technology (2 measurement lines, 1 compensation line)

1. Open one of the M25x1.5 EMC cable glands.
2. Pull the connection cable through the cable gland.

3. Connect one measurement line to terminal 3.

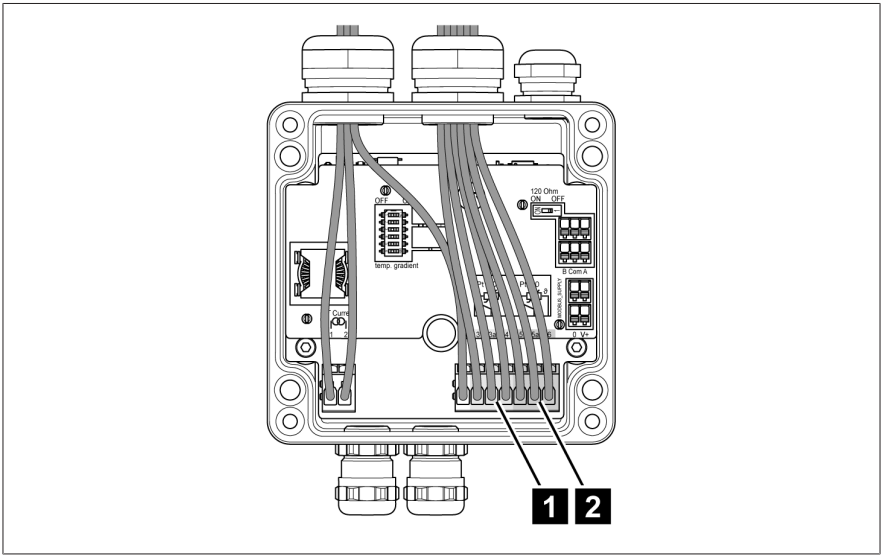


Figure 4: Pt100 measurement resistor connection terminals

1	Terminals 3, 3a and 4	2	Terminals 5, 5a and 6

4. Connect the second measurement line to terminal 4.
5. Connect the compensation line to terminal 3a.
6. Close the cable gland.

2-conductor technology (2 measurement lines)

1. Open one of the M25x1.5 EMC cable glands.
2. Pull the connection cable through the cable gland.
3. Connect one measurement line to terminal 3.
4. Connect the second measurement line to terminal 4.
5. Close the cable gland.

4-conductor technology (2 measurement lines, 2 compensation lines)

1. Open one of the M25x1.5 EMC cable glands.
2. Pull the connection cable through the cable gland.
3. Connect one measurement line to terminal 3.
4. Connect the second measurement line and one compensation line to terminal 4.

5. Connect the second compensation line to terminal 3a.
6. Close the cable gland.

Additional Pt100 measurement resistor (optional)

If the device is equipped with an additional Pt100 measurement resistor, you can connect an additional display instrument to terminals 5, 5a and 6. The device is designed for the connection of a display instrument with 3-conductor technology. The display instrument used can also have a 2-conductor or 4-conductor technology design.

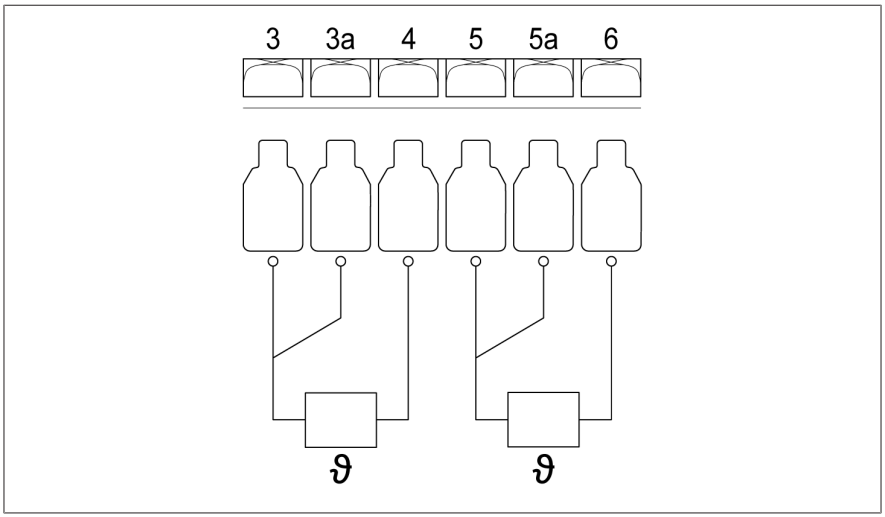


Figure 5: Pt100 measuring resistors

6.6.5 4...20 mA analog output connection (optional)

As an option, the temperature transmitter can be equipped with one analog output or with two analog outputs instead of a Pt100 measurement resistor. The connection is made via 2-conductor technology (R/L max. 750 Ω at 24 V DC).

1. Open one of the M25x1.5 EMC cable glands.
2. Pull the connection cable through the cable gland.

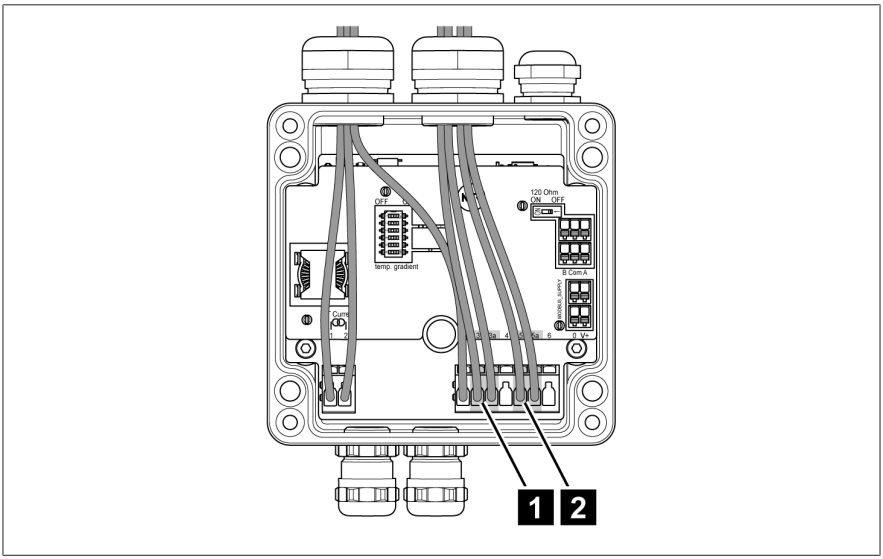


Figure 6: 4...20 mA analog output connection terminals

1	Terminals 3 and 3a	2	Terminals 5 and 5a

3. Connect the signal lines of the analog output to terminals 3 and 3a. Use terminals 5 and 5a for a second analog output.
4. Close the cable gland.

Current loop I_1 as passive analog output

The device acts as a regulated resistor that, with a supply voltage of 18...30 V DC, regulates the current flow of 4...20 mA as a descriptive dimension of the measured temperature.

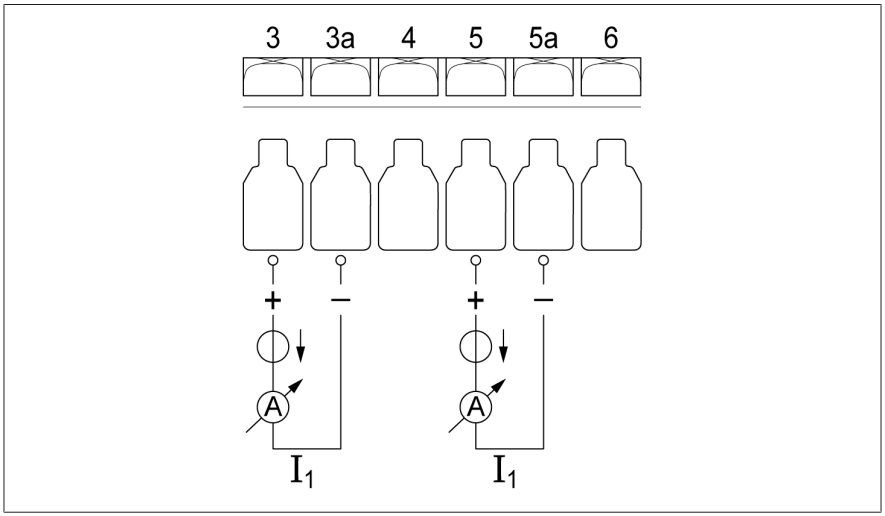


Figure 7: Passive analog output

Combination options

As an option, the device can be equipped with one analog output, with two analog outputs or with one analog output and one Pt100 measurement resistor.

Version examples	Analog output 1 connection terminals	Analog output 2 connection terminals	Pt100 measurement resistor connection terminals
2x 4...20 mA analog outputs	3, 3a	5, 5a	-
1x 4...20 mA analog output and 1x Pt100 measurement resistor	3, 3a	-	5, 5a, 6

Table 7: Connection terminals

6.6.6 Modbus connection (optional)

The type TTM device version is equipped with a double connection for communication via Modbus RTU. This enables Modbus signals and the associated power supply to be looped through (daisy-chained).

If only one of the two EMC cable glands is used, the other must be sealed correctly to ensure protection against moisture and contamination. The matching sealing plugs are available as accessories.

When routing the cables, avoid the hatched area shown in the illustration to prevent the cables from rubbing against the edge of the terminal block and to avoid obstructing the sensor mounting.

1. Open the M16x1.5 cable gland.
2. Pull the connection cable through the cable gland.
3. Connect the Modbus to terminals A, COM and B.
4. Connect the 24 VDC power supply to terminals 0 and V+.
5. Close the cable gland.

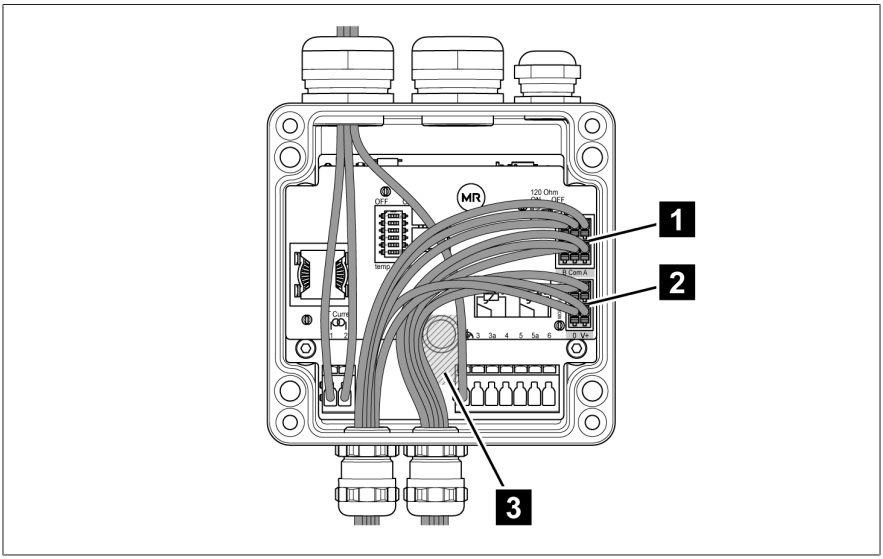


Figure 8: Modbus connection example

1	Modbus A, COM and B	2	24 VDC power supply on 0 and V+
3	Leave area free		

7 Commissioning

7.1 Setting the hotspot gradient

7.1.1 Setting for CT nominal current = 2 A

The nominal-load hotspot gradient can be set via the optional Modbus interface or manually via DIP switches.

Setting via Modbus interface (type TTM)

If the device is equipped with the optional Modbus interface, you can set the hotspot gradient via a Modbus write command. The prerequisite is that all DIP switches are in the OFF position.

Manual setting via DIP switches

You can set the hotspot gradient in 1 K increments from 4 K to 50 K via the DIP switches on the circuit board.

You can use the following table to determine the position of the DIP switches for the desired hotspot gradient at the nominal current of 2 A CT.

Gradient	DIP switches	DIP 1	DIP 2	DIP 3	DIP 4	DIP 5	DIP 6
Type TT: 4 type TTM: Specification via Modbus	000000	OFF	OFF	OFF	OFF	OFF	OFF
4[1]	000001[1]	OFF	OFF	OFF	OFF	OFF	ON
	000010[1]	OFF	OFF	OFF	OFF	ON	OFF
	000011[1]	OFF	OFF	OFF	OFF	ON	ON
4	000100	OFF	OFF	OFF	ON	OFF	OFF
5	000101	OFF	OFF	OFF	ON	OFF	ON
6	000110	OFF	OFF	OFF	ON	ON	OFF

1 If the setting results in a value of 1, 2 or 3, the system uses the hotspot gradient 4.

Gradient	DIP switches	DIP 1	DIP 2	DIP 3	DIP 4	DIP 5	DIP 6
7	000111	OFF	OFF	OFF	ON	ON	ON
8	001000	OFF	OFF	ON	OFF	OFF	OFF
9	001001	OFF	OFF	ON	OFF	OFF	ON
10	001010	OFF	OFF	ON	OFF	ON	OFF
11	001011	OFF	OFF	ON	OFF	ON	ON
12	001100	OFF	OFF	ON	ON	OFF	OFF
13	001101	OFF	OFF	ON	ON	OFF	ON
14	001110	OFF	OFF	ON	ON	ON	OFF
15	001111	OFF	OFF	ON	ON	ON	ON
16	010000	OFF	ON	OFF	OFF	OFF	OFF
17	010001	OFF	ON	OFF	OFF	OFF	ON
18	010010	OFF	ON	OFF	OFF	ON	OFF
19	010011	OFF	ON	OFF	OFF	ON	ON
20	010100	OFF	ON	OFF	ON	OFF	OFF
21	010101	OFF	ON	OFF	ON	OFF	ON
22	010110	OFF	ON	OFF	ON	ON	OFF
23	010111	OFF	ON	OFF	ON	ON	ON
24	011000	OFF	ON	ON	OFF	OFF	OFF
25	011001	OFF	ON	ON	OFF	OFF	ON
26	011010	OFF	ON	ON	OFF	ON	OFF
27	011011	OFF	ON	ON	OFF	ON	ON
28	011100	OFF	ON	ON	ON	OFF	OFF
29	011101	OFF	ON	ON	ON	OFF	ON
30	011110	OFF	ON	ON	ON	ON	OFF
31	011111	OFF	ON	ON	ON	ON	ON
32	100000	ON	OFF	OFF	OFF	OFF	OFF
33	100001	ON	OFF	OFF	OFF	OFF	ON

Gradient	DIP switches	DIP 1	DIP 2	DIP 3	DIP 4	DIP 5	DIP 6
34	100010	ON	OFF	OFF	OFF	ON	OFF
35	100011	ON	OFF	OFF	OFF	ON	ON
36	100100	ON	OFF	OFF	ON	OFF	OFF
37	100101	ON	OFF	OFF	ON	OFF	ON
38	100110	ON	OFF	OFF	ON	ON	OFF
39	100111	ON	OFF	OFF	ON	ON	ON
40	101000	ON	OFF	ON	OFF	OFF	OFF
41	101001	ON	OFF	ON	OFF	OFF	ON
42	101010	ON	OFF	ON	OFF	ON	OFF
43	101011	ON	OFF	ON	OFF	ON	ON
44	101100	ON	OFF	ON	ON	OFF	OFF
45	101101	ON	OFF	ON	ON	OFF	ON
46	101110	ON	OFF	ON	ON	ON	OFF
47	101111	ON	OFF	ON	ON	ON	ON
48	110000	ON	ON	OFF	OFF	OFF	OFF
49	110001	ON	ON	OFF	OFF	OFF	ON
50 [2]	110010 [2]	ON	ON	OFF	OFF	ON	OFF

2 If the setting results in a value >50, the system uses the hotspot gradient of 50.

1. Set DIP switches 1 to 6 on the circuit board in accordance with the table:

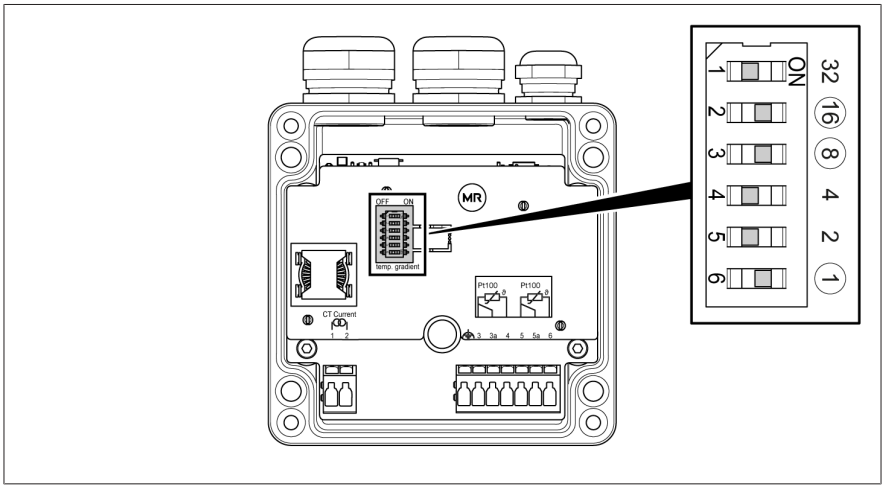


Figure 9: DIP switch settings (example setting for 25 K hotspot gradient)

The switches are read cyclically, so any changes are applied without the device having to be restarted.

7.1.2 Setting for CT nominal current ≠ 2 A

If the CT nominal current is greater or less than 2 A, you can use the following equation to calculate the hotspot gradient to be set:

$Hg[K] = Hg_N \times (2\ A)^2 / CT_N^2$
where N = nominal current

Example:

$Hg_N = 16$ K
$CT_N = 1.6$ A
$Hg[K] = 16\ K \times (2\ A)^2 / (1.6\ A)^2 = 25$ K at 2 A CT nominal current

You can use the table in the previous section Setting for CT nominal current = 2 A [▶Section 7.1.1, Page 41] to determine the position of the DIP switches for the calculated hotspot gradient. Where necessary, round the calculated value to an integer, because the value to be set can only be set in 1 K increments from 4 K to 50 K.

Alternatively, you can determine the settings via the hotspot gradients diagram [▶Section 13.1, Page 67]. If the intersection of the CT nominal current and the target hotspot gradient lies between two curves in the diagram, interpolate the required curve or calculate the value to be set using the equation listed above.

7.2 Display check

1. After a warmup period of 30 minutes, compare the pointer thermometer display and the electronic display.

» The displays of both devices should be within the tolerance range.

The following table lists corrective measures to take if the gradient display is too high or too low. If these measurements do not correct the issue, contact MR Service & Complaint.

Gradient display	Measure
Gradient display too high	Check whether there is just oil in the thermometer pocket.
Gradient display on the thermometer too low	Check whether the mechanical temperature sensor has been pushed in up to the stop. Alternatively, check whether the thermometer pocket has been filled with sufficient oil.

Table 8: Gradient display too high or too low

You may be able to change deviations between the displays caused by special operating conditions by changing the DIP switch positions.

7.3 Overvoltage protection

All inputs and outputs have a protective circuit for dissipating residual currents, e.g. lightning strikes and switching events.

During a high-voltage test >300 V AC between the housing and inputs or outputs, residual currents that are greater than the maximum permitted residual current can be dissipated.

7.4 Configuring Modbus (type TTM)

You can change the Modbus configuration settings if the factory settings are not suitable for your application. You will need a configuration tool for this, such as the "MR Modbus Client", which you can download from the MR Download Center.

You will also need a USB-RS485 adapter.

To adjust the Modbus configuration, proceed as follows:

1. Install the MR Modbus Client (admin rights are not needed for this).
2. Connect the device and PC to the RS485 bus.
3. Select the device from the list.
4. Check the communication settings (Modbus address, baud rate etc.) and make changes where necessary to connect to the device. It is also possible to change the Modbus address if several devices with the same address are already connected to the bus (e.g., MTO, MT-ST, BETECH, TFMR).
   - » You can now make the desired configuration settings in accordance with your application.
   - » Changes to the communication settings (Modbus address, baud rate etc.) will become active immediately.
5. If necessary, update the settings in the MR Modbus Client.
6. You can also use the MR Modbus Client to read out further available data, such as the measured values.

For more information (e.g. register content), see section Modbus RTU [▶Section 11.1, Page 60] technical data.

Modbus baud rate setting

The transmission speed (baud rate) of the Modbus interface can be set to the following values: 4800, 9600, 19200, 38400, 57600 and 115200 baud.

Modbus baud rate	
Delivery state (factory setting)	19200 Bd
Maximum value	115200 Bd
Minimum value	4800 Bd

Setting the Modbus address

The following values are available for the Modbus address:

Modbus address	
Delivery state (factory setting)	77
Maximum value	247
Minimum value	1

Issuing the same network addresses twice will lead to malfunctions.

Parity

For data transmission, the parity is determined as follows:

Parity	
Delivery state (factory setting)	EVEN
Optional	ODD/NONE

Ensure that the same Modbus settings are made in your SCADA system.

Terminating resistor

The terminating resistor can be activated if the device is the only device in the Modbus network or it is the last device in the Modbus network.

The terminating resistor can be activated by actuating the DIP switch, as illustrated in the figure below:

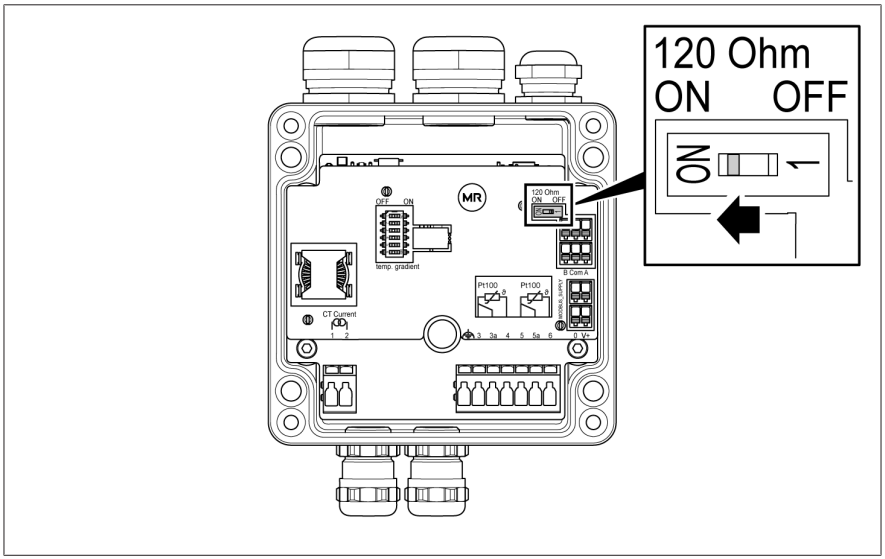


Figure 10: Terminating resistor activation

8 Maintenance, inspection and care

Maintenance

The device is maintenance-free.

Inspection and care

Depending on the conditions of use of the device and the national regulations in the respective country of use, the transformer manufacturers can specify different inspection intervals.

› Observe the inspection intervals defined in CIGRE Publication No. 445 "Guide for Transformer Maintenance" or the inspection intervals specified by the transformer manufacturer.

Check and clean the device as part of each transformer inspection as follows:

1. Use only a damp towel and a mild cleaning agent to clean the housing of the device when needed.
2. Ensure that the ventilation is free of dirt and deposits.
3. Check the device for external damage and contamination.

In the event of questions or irregularities, contact the Technical Service department:

Reinhausen GmbH
Technical Service
Falkensteinstrasse 8
93059 Regensburg
Germany
+49 941 4090-0
service@reinhausen.com
reinhausen.com

8.1 Firmware update

The device firmware can be updated via the following interfaces:

- Modbus interface (RS-485)
- USB interface

The procedure for the update is identical for both interfaces.

The MR Modbus Client software is needed for the firmware update. The MR Modbus Client is available for downloading at https://www.reinhausen.com/downloads. You will find a comprehensive description of the update procedure in the section "Firmware update" in the corresponding user guide.

Only use firmware files from trusted sources, such as the MR customer portal at portal.reinhausen.com.

The device function (monitoring) will be interrupted for the duration of the update.

9 Fault elimination

This section describes how to eliminate operating faults.

If a solution for a fault cannot be found, contact the manufacturer:

Reinhausen GmbH
MR Service & Complaint
Falkensteinstrasse 8
93059 Regensburg
Germany
service@reinhausen.com
complaint@reinhausen.com

Please have the following data ready:
- Serial number
- Software version

Questionnaire for preparation

1. Has there previously been a problem with this device?
2. Have you previously contacted Reinhausen GmbH about this issue? If yes, then who was the contact?
3. When did the error first occur? Is there a correlation with events such as thunderstorms, lightning surge testing in the transformer station, transformer disconnection/reconnection after short circuit or ground fault, etc.?
4. Is the error constant or sporadic? Is there a correlation with other events/conditions, such as extreme ambient temperatures?
5. Is there an error in the transmission of the 4...20 mA analog signal or in the Modbus transmission?

   - Are you using shielded lines?
   - Are you using a twisted pair line?
   - Is the cable shielding attached on both sides?
   - What is the cable length?
   - Which receiver do you use as a receiver?
   - 4...20 mA analog signal: What is the load resistance?

- Modbus: Are there other devices on the Modbus?
- TTM version: Please tell us the value of the status register.

Checking the plausibility of the measured values

If the device is working but not reporting plausible values, check, document and compare the following:

- Measured value via 4...20 mA analog output
- Measured value via Modbus RTU interface
- Measured value via pointer on the scale
- Actual physical measured value (measured or estimated).

Calculating the target current of the 4...20 mA analog output

› I_{target} = 4 mA + 16 mA * [(current measured value scale – $scale_{min}$) / ($scale_{max}$ – $scale_{min}$)]

Calculation example for the oil temperature indicator:

- Scale of -20...+140 °C; the indicator points to 60 °C

  => I_{target}
  = 4 mA + 16 mA * [(60 °C – -20 °C)/(140 °C – -20 °C)]
  = 4 mA + 16 mA * 0.5
  = 12 mA

9.1 General malfunctions (type TT)

You are using a device with passive 4...20 mA analog output.

Characteristic/detail	Cause	Remedy
No function (4...20 mA)	Power supply not present	– Check cables – Check power supply (18... 30 VDC) – Check 4...20 mA receiver (loop into multimeter)

Table 9: General faults

9.2 General malfunctions (type TTM)

You are using a device with Modbus and passive 4...20 mA analog output.

Characteristic/detail	Cause	Remedy
No function (4...20 mA)	Power supply not present	– Check cables – Check power supply (18... 30 VDC) – Check 4...20 mA receiver (loop into multimeter) – Check the Modbus receiver (supply, configuration)
No function (Modbus)		

Table 10: General faults

9.3 4...20 mA analog signal malfunctions (type TT and type TTM)

Characteristic/detail	Cause	Remedy
Loop current is approx. 3 mA	– Device signals detected error	– At 3 mA: The self-diagnosis has detected an error that does not allow a reliable indication of the measurement. – Type TTM: For possible causes/remedies, see section Self-diagnostic/device status (TTM version) [▶ Section 9.5, Page 55]
The receiver does not measure any 4...20 mA loop current	– Conductor break, open terminal point – Short circuit – Power supply not present – Device defective	– Loop in multimeter and measure – Check cables – Check device supply (18... 30 VDC)
The receiver measures a 20 mA loop current that is too low	– A part of the current is running through a parallel path – Load resistance too high – Supply voltage too low – Device defective	– Loop in multimeter and measure – Check cables – Check receiver (load resistance)
The receiver measures a 4...20 mA loop current that is too high	– Device defective	– Loop in multimeter and measure

Table 11: 4...20 mA analog signal malfunctions

9.4 Modbus communication malfunctions (type TTM)

Characteristic/detail	Cause	Remedy
No communication possible (continuous)	Power supply not present	– Check cables – Check device supply (18... 30 VDC)
	– RS485 lines A, B not connected or interrupted – Short-circuit A, B – Ground fault A and/or B – RS485 connections swapped	Info: A = D0 = D+; B = D1 = D- – Check wiring – Take a voltage measurement with a multimeter if necessary (A against B; A against Com; B against Com) – Reconnect A, B if necessary
	– Modbus address incorrect – Modbus address assigned multiple times – Baud rate – Parity	Info: For factory settings, see chapter Modbus RTU [▶ Section 11.1, Page 60] – Check parameters (device and master) – Change parameters if necessary; see chapter Modbus RTU [▶ Section 11.1, Page 60]
	– Device defective	-
No communication possible (sporadic)	– Modbus address assigned multiple times	– Check parameters (device and master) – Change parameters if necessary; see chapter Modbus RTU [▶ Section 11.1, Page 60]
	– Device defective	-

Table 12: Modbus communication malfunction

9.5 Self-diagnostic/device status (TTM version)

The device checks its own functionality cyclically (self-diagnostic).

In the Modbus input register at address 0 (data type: UINT16), the device reports the corresponding status via status bits. Multiple bits can also be set at the same time.

Status "0" means that the device has not detected any error.

All errors will reset once the error is no longer occurring. An acknowledgement is not needed.

Status bit value/characteristic/detail	Cause	Remedy
0: no error detected	-	-
1: Invalid DIP switch position	– **Invalid DIP switch position**	– **Set the DIP switch to the correct position**
2: Pt100 error	– Pt100 returning implausible values	– Contact MR
All other status bit values: internal error	– Device defective	– Contact MR

Table 13: Status codes

10 Disposal

Observe the national disposal regulations in the country of use.

10.1 SVHC information in accordance with the REACH regulation

This product complies with the provisions of European Regulation 1907/2006/EC dated December 18, 2006 on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

The following components of the product contain > 0.1% [w/w] of the SVHC substance lead (CAS no. 7439-92-1):

- Brass alloy
- Standard parts with a low property class

11 Technical data

Permissible ambient conditions	
Location of use	Indoors and outdoors, tropic-proof
Ambient air temperature	-50...+85 °C
Storage temperature	-50...+80 °C
Operating temperature	-40...+80 °C
Thermometer measuring range	In accordance with the thermometer used
Installation	Thermometer pocket in accordance with DIN EN 50216-4 type A1 or similar
Installation position	Any
Degree of protection	IP66 in accordance with IEC 60529

Basic materials	
Housing / terminal box	Aluminum Coating with corrosion-protection class C4H, optional C5H, in accordance with DIN EN ISO 12944-9 RAL 7033 or RAL 7038
Offshore version option	Stainless steel cable glands Coating CX in accordance with DIN EN ISO 12944-9
Double screw connection	G1B double screw connection, bare brass Optional double screw connection M27x2; M27x1.5; G3/4B
Flange	Teflon

Passive 4...20 mA analog output (type TT, TTM)	
Feed-in voltage of the passive current loop	18...30 VDC unregulated, max. 10% residual ripple, protected against polarity reversal
Output signal	4...20 mA; passive; 2-conductor wiring Approx. 3 mA: Device diagnoses error
Max. current consumption	60 mA

Passive 4...20 mA analog output (type TT, TTM)	
Max. load resistance	750 Ω at U_b= 24 VDC
Rated insulation voltage	500 VDC/1 min, signal to ground 1,000 VDC/1 min, CT to ground
Accuracy	±2% from the end value of the measuring range

RS485 interface for Modbus RTU (TTM version)	
Supply voltage	24 VDC unregulated, max. 10% residual ripple, protected against polarity reversal
Standard	EIA/TIA-485
Protocol	Modbus RTU
Wiring	2-wire; half-duplex
Terminal designation	Polarity: A = D+; B = D-; COM=common ground Expected voltage between A and B in the idle state: >+200 mV
Rated insulation voltage	500 VDC/1 min; terminals to ground

Terminal box	
Cable glands	– 1x M16x1.5 WADI cable gland for temperature sensors – 2x M25x1.5 WADI EMC cable glands for electrical connection – Type TTM only: 2x M16x1.5 EMC cable glands for Modbus
Terminal strip assignment	See section "Installation"
Connection terminals	See section Cable recommendation [▶Section 6.6.2, Page 31]
Ventilation	Via pressure equalization element

Specifications		
CT nominal current	2 A from transformer	
Overload resistance	Continuous max. 3 A 12 A for 30 seconds	
Gradient setting	– Via DIP switches (see section Setting the hotspot gradient) – Via Modbus (set all DIP switches to "0" for this)	
Heating	Integrated into the temperature sensor well	
CT power Maximum power of the CT current source	$P [VA] = I^2_{CT} \times 4.5\ \Omega$	
Rated insulation voltages	CT to ground:	1000 V DC/1 min
	Analog to ground:	500 V DC/1 min
	Modbus connection to ground:	500 V DC/1 min
	24 V DC connection to ground:	500 V DC/1 min
Analog output signal	– Up to 2x Pt100 or – 2x 4...20 mA	

Dimensions and weight	
Dimensions	See dimensional drawings
Weight	1.7 kg

11.1 Modbus RTU

Factory settings

Device version	Modbus address	Baud rate	Parity
MESSKO® ZT-F2.5	77	19,200	EVEN

Table 14: Modbus RTU factory settings

Input register

Function code "04" to read the information.

> Validity of the measured value stored in the input register addresses 1...3:
> Discrete input register address 0 (boolean) indicates whether the measured value is invalid (0) or valid (1). We recommend evaluating this register address alongside the measured value query.
> Device status:
> The input register address 0 indicates the device status (0: the device self-diagnostic has confirmed that the device is running without errors). We recommend querying the device status either parallel to the measured values or when needed (e.g. during troubleshooting, fault elimination).
> For details, see section “Fault elimination”.

Address	Data type	Designation
0	UINT16	Device status
1, 2	FLOAT32	Measured value (temperature in °C) with decimal places
3	SINT16	Measured value (temperature in °C) as an integer
4	UINT16	Hotspot gradient set via Modbus Address 1 of the discrete input register can be used to read whether the hotspot gradient was activated via Modbus or via DIP switch.
5	UINT16	Hotspot gradient set via DIP switch Address 1 of the discrete input register can be used to read whether the hotspot gradient was activated via Modbus or via DIP switch.
6	UINT16	Hotspot gradient used for controlling the heater
7...16	-	Reserved for future use
17	UINT16	Firmware version major
18	UINT16	Firmware version minor
19	UINT16	Firmware version patch

Table 15: Input register

With FLOAT parameters, the MSB (Most Significant Bit) is stored in the lower address and the LSB (Least Significant Bit) in the higher address.

Configuration via holding register

> Each address must be unique in the BUS system. Therefore, for example, when using two identical devices (same default address!), configure them to different addresses before commissioning!

Use function code "03" to read the information and function code "06/16" to write the information.

Address	Data type	Designation	Setting option
0	UINT16	Modbus address	1...247 77[1] MESSKO® ZT-F2.5
1	UINT16	Modbus baud rate	0: 4800 1: 9600 2: 19200[1] 3: 38400 4: 57600 5: 115200
2	UINT16	Modbus parity	0: NONE 1: EVEN[1] 2: ODD
3	UINT16	Modbus number of stop bits	1: One stop bit[2] Can only be read.
4	UINT16	Hotspot gradient specification	4–50 Kelvins Will be used when the DIP switches are set to 000000. Address 1 of the discrete input register can be used to read whether the hotspot gradient was activated via Modbus or via DIP switch.
5...72	-	Reserved	-
73...79[2]	STRING	Serial number	7-digit, 1 number per register in ASCII-format[2]

Address	Data type	Designation	Setting option
100...109	STRING	Serial number	7-digit, 2 ASCII characters per register, little-endian[2)]
110...119	STRING	Date of manufacture	2 ASCII characters per register, little-endian[2)]
120...129	STRING	Firmware version	
130...139	STRING	Sensor manufacturer	
140...149	STRING	Sensor designation	

Table 16: Holding register

[1)] Delivery condition/default settings
[2)] Cannot be overwritten by the user.

Validity of the measured value via discrete input register

Use function code "02" to read the information from the discrete input registers.

Address	Data type	Designation
0	BOOL	Validity of the measured value (input register addresses 1...3): 0: Invalid 1: Valid
1	BOOL	Modbus hotspot gradient active 0: DIP switches active 1: Modbus active

12 Drawings

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

	Date	Name	Document no.		Projection method
Dftr.	23.06.2026	STOPPEL	SED 13392745 000 00		
Chkd.	23.06.2026	REHNELT	Change no.	Scale	
Stand.	24.06.2026	WANNINGER	1145891	1:2	

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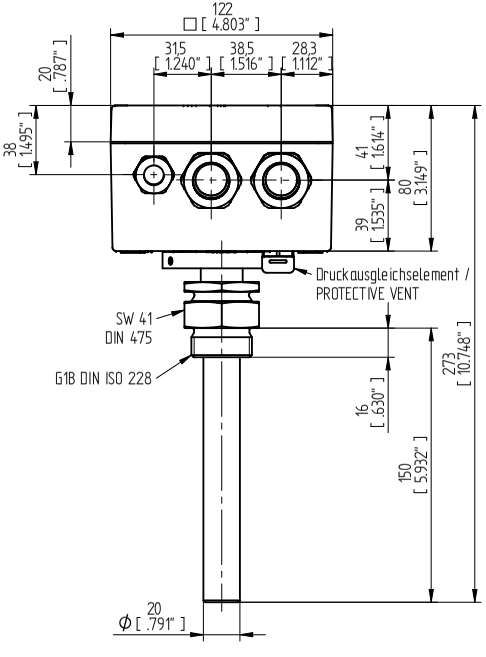
Dimension in mm, except as noted

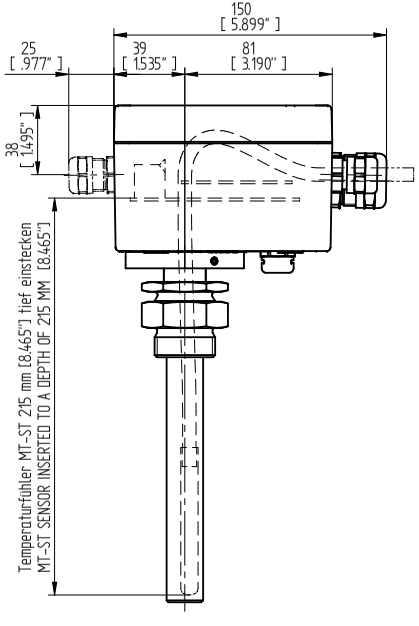
TRANSFORMER ACCESSORIES
MESSKO® ZT-F2.5
Maßzeichnung/DIMENSION DRAWING

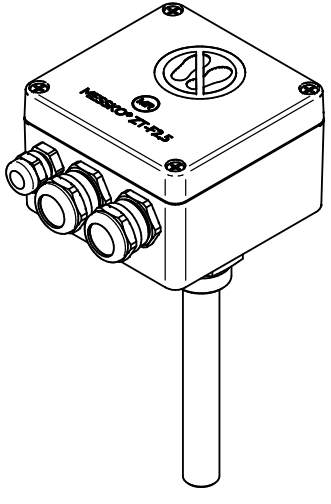
Material number 10197349OM

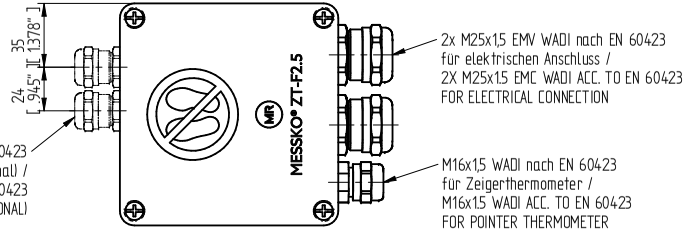
Serial number

Sheet 1 / 1









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Gez.	08.07.2026	KAFFENBERGER	SED 10839027 000 01	
Gepr.	08.07.2026	THIELEK	Änderungsnummer	Maßstab
Norm.	09.07.2026	KLEYN	1146225	2:1

Maßangaben in mm, soweit nicht anders angegeben

Zubehör Transformator / ACC
MESSKO® ZT-F2.x
Maßzeichnung/DIMENSION DRAWING

Serialnummer
–

Materialnummer 101894880M

Blatt 1 / 1

A3

13 Appendix

13.1 Hotspot gradients diagram

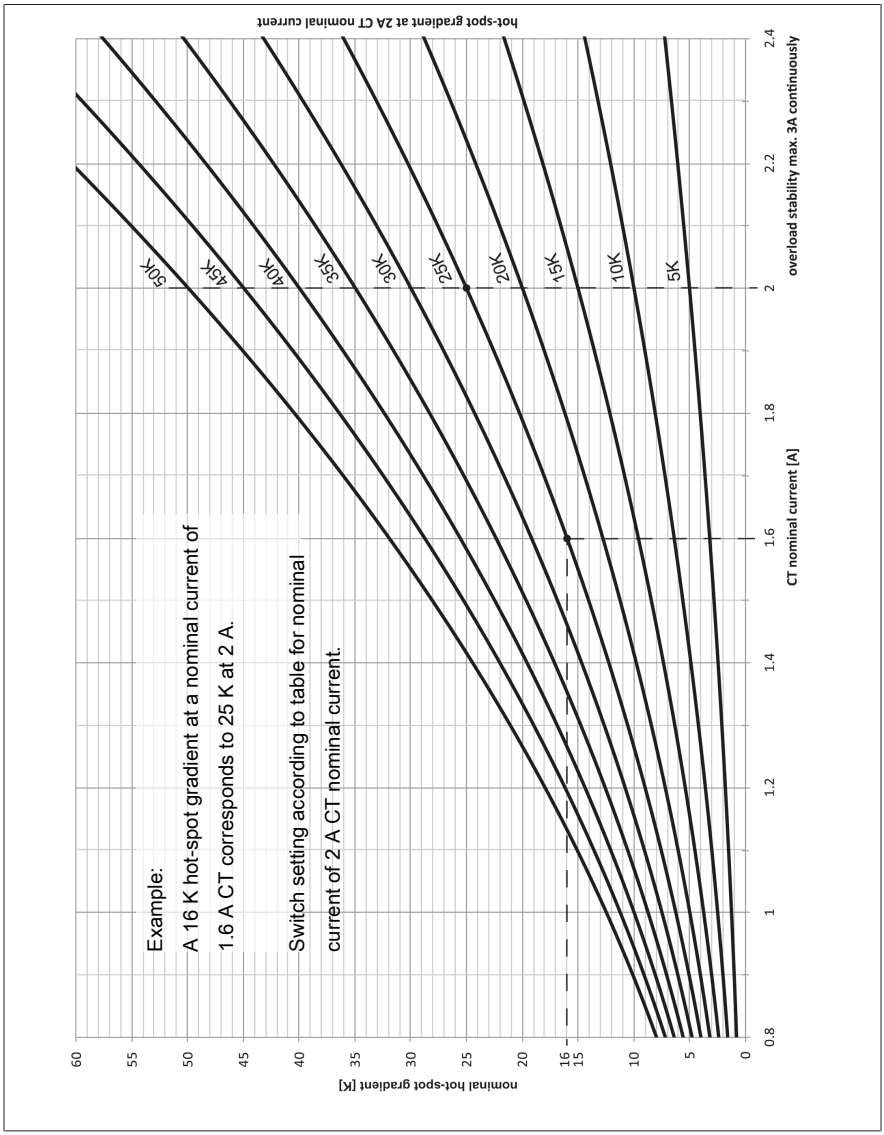

Figure 11: Hotspot gradients diagram

13.2 Open source software license conditions

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Intel-Hex-Parser

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Modbus-Stack

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Glossary

Ambient air temperature
Permissible temperature of the air in the surroundings of the equipment in operation on which the device is installed.

EMC
Electromagnetic compatibility

Operating temperature
Permissible temperature in the immediate surroundings of the device during operation taking ambient influences, for example due to the equipment and installation location, into consideration.

Storage temperature
Permissible temperature for storing the device in an unmounted state or in a mounted state so long as the device is not in operation.

Reinhausen GmbH
Falkensteinstrasse 8
93059 Regensburg
Germany
+49 941 4090-0
info@reinhausen.com
reinhausen.com

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