# Table of contents

1 **Introduction**.................................................................................................................. 7
1.1 Manufacturer .................................................................................................................. 7
1.2 Completeness .................................................................................................................. 7
1.3 Safekeeping .................................................................................................................... 7
1.4 Notation conventions ...................................................................................................... 7
1.4.1 Hazard communication system .................................................................................. 7
1.4.2 Information system ..................................................................................................... 9
1.4.3 Instruction system ...................................................................................................... 9
1.4.4 Typographic conventions .......................................................................................... 10
2 **Safety**.................................................................................................................................. 11
2.1 Appropriate use ............................................................................................................. 11
2.2 Inappropriate use ........................................................................................................... 12
2.3 Fundamental safety instructions .................................................................................... 12
2.4 Personnel qualification .................................................................................................. 13
2.5 Personal protective equipment ...................................................................................... 14
3 **IT security**...................................................................................................................... 16
4 **Product description**........................................................................................................ 20
4.1 MSENSE® VAM monitoring system versions ............................................................... 20
4.2 Scope of delivery ............................................................................................................ 20
4.3 Function description ...................................................................................................... 21
4.4 Performance features ................................................................................................... 22
4.5 Design ............................................................................................................................ 23
4.5.1 VS 1 sensor assembly ............................................................................................... 24
4.5.2 Control cabinet ......................................................................................................... 24
4.6 Main screen ................................................................................................................... 32
4.6.1 MSENSE® VAM as an integration solution ............................................................... 32
4.6.2 MSENSE® VAM as a standalone version ................................................................. 33
4.7 Operating concept ......................................................................................................... 33
5 **Packaging, transport and storage** .................................................................................. 38
5.1 Packaging ....................................................................................................................... 38
5.1.1 Suitability .................................................................................................................. 38
5.1.2 Markings .................................................................................................................... 39
5.2 Transportation, receipt and handling of shipments ................................................................. 39
5.3 Storage of shipments ............................................................................................................. 40
5.4 Unpacking shipments and checking for transportation damages ........................................ 41

6 Mounting .................................................................................................................................. 43
   6.1 Installing the Cap rail modules / control cabinet ................................................................. 43
      6.1.1 Installing the cap rail modules ...................................................................................... 43
      6.1.2 Integration solution in the ETOS® ED motor-drive unit ................................................ 47
      6.1.3 Fitting the control cabinet to the transformer ................................................................. 47
   6.2 Mounting the vibration sensor ............................................................................................. 50
   6.3 Connecting the assemblies .................................................................................................. 51
      6.3.1 Cable recommendation .................................................................................................. 51
      6.3.2 Information about connecting serial interfaces RS232 and RS485 .................................. 52
      6.3.3 Information about connecting analog sensors ................................................................. 55
      6.3.4 Electromagnetic compatibility ...................................................................................... 57
      6.3.5 Information about laying fiber-optic cable ..................................................................... 60
      6.3.6 Connecting the vibration sensor to the control cabinet ................................................... 61
      6.3.7 Connecting the motor-drive unit controller to the monitoring system ......................... 64
      6.3.8 Connecting the temperature sensor ............................................................................... 64
      6.3.9 Connecting additional leads (optional) ......................................................................... 65
      6.3.10 Connecting the power supply ....................................................................................... 65
   6.4 Checking functional reliability ............................................................................................ 66

7 Commissioning .......................................................................................................................... 67
   7.1 Visualization ........................................................................................................................ 67
   7.2 Commissioning wizard ......................................................................................................... 69
   7.3 Setting the language ............................................................................................................ 70
   7.4 Setting date and time .......................................................................................................... 71
   7.5 Name plate ........................................................................................................................... 71
      7.5.1 Enter the name plate data .............................................................................................. 71
      7.5.2 Displaying the name plate ............................................................................................ 72
   7.6 Setting the control system protocol (optional) ................................................................. 72
   7.7 Performing tests .................................................................................................................. 72
      7.7.1 Checking measured values and status of digital inputs and outputs ............................. 73
      7.7.2 Performing function tests ............................................................................................. 73
      7.7.3 Electrical high-voltage tests on the transformer ............................................................. 73
      7.7.4 Ground test .................................................................................................................. 74
## Table of contents

7.7.5 Dielectric tests on transformer wiring ................................................................. 75

### 8 Operation ........................................................................................................... 76
8.1 Visualization .......................................................................................................... 76
8.2 User administration .............................................................................................. 78
8.2.1 User roles ......................................................................................................... 78
8.2.2 Changing the password ................................................................................ 80
8.2.3 Creating, editing and deleting users ............................................................ 80
8.2.4 Setting access rights to parameters and events ............................................. 82
8.3 Events menu ........................................................................................................ 83
8.4 Information menu ................................................................................................. 87
8.5 Recorder menu .................................................................................................... 91
8.6 Settings menu ...................................................................................................... 94
8.7 Menu Settings > Parameters ............................................................................... 94
8.7.1 Menu Settings > Parameters > General ........................................................ 95
8.7.2 Configuring the network ............................................................................... 97
8.7.3 Time synchronization .................................................................................. 97
8.7.4 Configuring syslog ...................................................................................... 100
8.7.5 Setting the screensaver ................................................................................ 101
8.7.6 Linking digital outputs and control system messages ..................................... 101
8.7.7 Linking functions ......................................................................................... 103
8.7.8 Temperature monitoring ............................................................................. 104
8.7.9 On-load tap-changer > OLTC data .............................................................. 105
8.7.10 Power grid > Tap position monitoring ...................................................... 105
8.7.11 SCADA ...................................................................................................... 106
8.8 Menu Settings > Events .................................................................................... 127
8.9 Menu Settings > DIO configuration (optional) .................................................. 128
8.10 Menu Settings > AIO configuration (optional) ................................................ 130
8.11 Tap position table ............................................................................................. 132
8.12 Menu Settings > Reset VAM ........................................................................... 132
8.13 Menu settings > VAM update rules ................................................................. 133
8.14 Menu Settings > Commissioning wizard ........................................................ 134
8.15 Menu Settings > TPLE ..................................................................................... 134
8.15.1 Function ...................................................................................................... 134
8.15.2 Configuring TPLE ..................................................................................... 147
8.16 Menu Settings > Import .................................................................................. 150
8.17 Menu Settings > Export ................................................................. 152
8.17.1 VAM export ........................................................................... 153
8.18 Menu Settings > Administration ............................................... 155

9 Inspection and maintenance .......................................................... 156
9.1 Care .......................................................................................... 156
9.2 Inspection ................................................................................ 156
9.3 Maintenance ............................................................................ 156

10 Fault elimination .......................................................................... 157
10.1 General faults ......................................................................... 157
10.2 Event messages ...................................................................... 157
10.3 Human-machine interface ....................................................... 158
10.4 Other faults ............................................................................ 158

11 Disassembly ................................................................................ 159

12 Disposal ..................................................................................... 160

13 Technical data ............................................................................ 161
13.1 Control cabinet standalone version ............................................ 161
13.1.1 Connection terminals ......................................................... 162
13.2 Voltage supply ........................................................................ 162
13.3 CPU (central processing unit) II .............................................. 162
13.4 DIO 28-15 digital inputs and outputs ........................................ 164
13.5 AIO 2 analog inputs and outputs .............................................. 166
13.6 VI 4 vibration sensor input module ........................................... 167
13.7 VS 1 vibration sensor .............................................................. 167
13.8 Sensor cable ........................................................................... 168

Glossary ......................................................................................... 169

List of key words ........................................................................... 170
1 Introduction

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

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

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

1.1 Manufacturer

The product is manufactured by:
Maschinenfabrik Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg
Tel.: (+49) 9 41/40 90-0
E-mail: sales@reinhausen.com

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

1.2 Completeness

This technical file is incomplete without the supporting documents.

The following documents are considered supporting documents:
- Operating instructions
- Connection diagrams

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 file. Warnings relating to sections use the following format:

⚠️ WARNING

Type of danger!
Source of the danger and outcome.
► Action
► Action

1.4.1.2 Embedded warning information

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

⚠️ DANGER!
Instruction for avoiding a dangerous situation.

1.4.1.3 Signal words and pictograms

The following signal words are used:

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

Table 1: Signal words in warning notices
1.4.2 Information system

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

Important information.

1.4.3 Instruction system

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

Single-step instructions

Instructions which consist of only a single process step are structured as follows:
Aim of action
✓ Requirements (optional).
► Step 1 of 1.
⇒ Result of step (optional).
⇒ Result of action (optional).

Multi-step instructions
Instructions which consist of several process steps are structured as follows:
Aim of action
✓ Requirements (optional).
1. Step 1.
⇒ Result of step (optional).
2. Step 2.
⇒ Result of step (optional).
⇒ Result of action (optional).

1.4.4 Typographic conventions

<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><strong>Bold</strong></td>
<td>Software operating controls</td>
<td>Press <strong>Continue</strong> button</td>
</tr>
<tr>
<td>…&gt;…&gt;…</td>
<td>Menu paths</td>
<td>Parameter &gt; Control parameter</td>
</tr>
<tr>
<td><em>Italics</em></td>
<td>System messages, error messages,</td>
<td><em>Function monitoring</em> alarm triggered</td>
</tr>
<tr>
<td></td>
<td>signals</td>
<td></td>
</tr>
<tr>
<td>[► Number of pages]</td>
<td>Cross reference</td>
<td>[► Page 41].</td>
</tr>
<tr>
<td>Dotted underscore</td>
<td>Glossary entry, abbreviations,</td>
<td>Glossary entry</td>
</tr>
<tr>
<td></td>
<td>definitions, etc.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Typographic conventions used in this technical file
2 Safety

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

2.1 Appropriate use

The product is a monitoring system for monitoring on-load tap-changers on power transformers/reactors. You can use the product to detect time and amplitude anomalies in the progression of the vibro-acoustic signal sent by the on-load tap-changer and receive event messages when anomalies are detected.

The product is designed solely for use in electrical energy systems and facilities. It may only be used in compliance with the requirements and conditions listed in this technical file as well as the warnings in this technical file and the warnings posted on the product. This applies throughout the service life of the product, from delivery, installation and operation to removal and disposal.

The following is considered appropriate use:
- Only use the product with the on-load tap-changer and the motor-drive unit specified in the order.
- Only use the product for on-load tap-changers that have not already been damaged.
- Operate the product in accordance with this technical file, the agreed-upon delivery conditions and the technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Only use the equipment and special tools included in the scope of delivery for the intended purpose and in accordance with the specifications of this technical file.
- Only use the product on transformers with insulated add-on parts after approval by Maschinenfabrik Reinhausen GmbH (special version required).
- Only operate the product in industrial areas. Observe the notices in this technical file regarding electromagnetic compatibility and the technical data.
2.2 Inappropriate use

- The product is not suitable for extending the permitted service life of the on-load tap-changer specified by the on-load tap-changer manufacturer.

- The product is not a protective device. Do not use it to handle safety-related functions.

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

- The product is not intended for use in environments subject to strong corrosion effects.

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

2.3 Fundamental safety instructions

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

**Personal protective equipment**

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

- Wear appropriate personal protective equipment such as a helmet, work gloves, etc. for the respective activity.

- Never wear damaged personal protective equipment.

- Never wear rings, necklaces, or other jewelry.

- If you have long hair, wear a hairnet.

**Work area**

Untidy and poorly lit work areas can lead to accidents.

- Keep the work area clean and tidy.

- Make sure that the work area is well lit.

- Observe the applicable laws for accident prevention in the relevant country.

**Working during operation**

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

- Regularly check the operational reliability of safety equipment.

- Comply with the inspection work, maintenance work and maintenance intervals described in this technical file.
Securing the motor-drive unit
If you open the motor-drive unit during operation, there is a danger of electric shock due to live components behind the swing frame.

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

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

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

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

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

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

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

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

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

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

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

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

Electrically trained persons

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

Operator

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

Technical Service

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

Authorized personnel

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

2.5 Personal protective equipment

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

- Always wear the personal protective equipment required for the job at hand.
- Never wear damaged personal protective equipment.
- Observe information about personal protective equipment provided in the work area.
<table>
<thead>
<tr>
<th>Personal Protective Equipment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protective clothing</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Safety shoes</strong></td>
<td>To protect against falling heavy objects and slipping on slippery surfaces.</td>
</tr>
<tr>
<td><strong>Safety glasses</strong></td>
<td>To protect the eyes from flying parts and splashing liquids.</td>
</tr>
<tr>
<td><strong>Visor</strong></td>
<td>To protect the face from flying parts and splashing liquids or other dangerous substances.</td>
</tr>
<tr>
<td><strong>Hard hat</strong></td>
<td>To protect against falling and flying parts and materials.</td>
</tr>
<tr>
<td><strong>Hearing protection</strong></td>
<td>To protect against hearing damage.</td>
</tr>
<tr>
<td><strong>Protective gloves</strong></td>
<td>To protect against mechanical, thermal, and electrical hazards.</td>
</tr>
</tbody>
</table>

Table 4: Personal protective equipment
3 IT security

Observe the following recommendations for secure operation of the product.

General

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

Commissioning

Observe the following recommendations for device commissioning:

▪ User IDs must be unique and assignable. Do not use a "Group account" function or the "Auto login" function.
▪ Activate the "Auto logout" function.
▪ Restrict the rights of the individual user groups as much as is feasible; this helps avoid errors during operations. A user with the "Operator" role, for example, should only perform operations and should not be able to change any device settings.
▪ Delete or disable the default "admin" user ID. This requires first creating a new user account with the "Administrator" role. You can then use it to delete or disable the default "admin" account.
▪ Deactivate service user access.
▪ Enable SSL/TLS encryption; access to the device is then only possible using the SSL/TLS protocol. In addition to encrypting communication, this protocol also checks the authenticity of the server.
▪ Use TLS version 1.2 or higher wherever possible.
▪ Integrate the device into a public key infrastructure. Create your own SSL certificates for this if necessary and then import them.
▪ Connect the device to a central log server by using the syslog interface [► Section 8.7.4, Page 100].

Operation

Observe the following recommendations during device operation:

▪ Change the password at regular intervals.
▪ Export the security log at regular intervals.
▪ Check the log files regularly for unauthorized system access and other security-related events.

Interfaces

The device uses the following interfaces for communication:
3 IT security

Figure 1: ETH1.1 interface on the OT1205 assembly

<table>
<thead>
<tr>
<th>Interface</th>
<th>Protocol</th>
<th>Port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETH1.1</td>
<td>TCP</td>
<td>21</td>
<td>FTP service access ¹)</td>
</tr>
<tr>
<td>ETH1.1</td>
<td>TCP</td>
<td>80</td>
<td>Web visualization ¹)</td>
</tr>
<tr>
<td>ETH1.1</td>
<td>TCP</td>
<td>443</td>
<td>SSL-protected web visualization</td>
</tr>
<tr>
<td>ETH1.1</td>
<td>TCP</td>
<td>990</td>
<td>SSL-protected FTP service access</td>
</tr>
<tr>
<td>ETH1.1</td>
<td>TCP</td>
<td>8080</td>
<td>Web visualization (alternative port) ¹)</td>
</tr>
<tr>
<td>ETH1.1</td>
<td>TCP</td>
<td>8081</td>
<td>SSL-protected web visualization (alternative port) ¹)</td>
</tr>
</tbody>
</table>

Table 5: Interfaces and open ports of the OT1205 assembly

¹) Port is closed if you activate the device’s SSL encryption.

Figure 2: Interfaces of the CPU assembly
<table>
<thead>
<tr>
<th>Interface</th>
<th>Protocol</th>
<th>Port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN 1</td>
<td>-</td>
<td>-</td>
<td>Connection of the DIO assembly</td>
</tr>
<tr>
<td>CAN 2</td>
<td>-</td>
<td>-</td>
<td>Communication with other ISM® devices (e.g. parallel operation)</td>
</tr>
<tr>
<td>COM 1</td>
<td>-</td>
<td>-</td>
<td>Internal system interface</td>
</tr>
<tr>
<td>COM 2</td>
<td>-</td>
<td>-</td>
<td>Serial interface (SCADA)</td>
</tr>
<tr>
<td>USB</td>
<td>-</td>
<td>-</td>
<td>Import or export of data</td>
</tr>
<tr>
<td>ETH 1</td>
<td>TCP</td>
<td>80</td>
<td>HTTP for web-based visualization(^1), (^2)</td>
</tr>
<tr>
<td>ETH 1</td>
<td>TCP</td>
<td>443</td>
<td>HTTPS for web-based visualization(^1), (^2)</td>
</tr>
<tr>
<td>ETH 1</td>
<td>TCP</td>
<td>102</td>
<td>IEC 61850</td>
</tr>
<tr>
<td>ETH 1</td>
<td>TCP</td>
<td>502</td>
<td>Modbus(^3)</td>
</tr>
<tr>
<td>ETH 1</td>
<td>TCP</td>
<td>20000</td>
<td>DNP3(^3)</td>
</tr>
<tr>
<td>ETH 2.x</td>
<td>TCP</td>
<td>21</td>
<td>FTP(^1) (only for MR service)</td>
</tr>
<tr>
<td>ETH 2.x</td>
<td>TCP</td>
<td>80</td>
<td>HTTP for web-based visualization(^1)</td>
</tr>
<tr>
<td>ETH 2.x</td>
<td>TCP</td>
<td>443</td>
<td>HTTPS for web-based visualization(^1)</td>
</tr>
<tr>
<td>ETH 2.x</td>
<td>TCP</td>
<td>990</td>
<td>FTPS (only for MR service)</td>
</tr>
<tr>
<td>ETH 2.x</td>
<td>TCP</td>
<td>8080</td>
<td>HTTP for web-based visualization(^1)</td>
</tr>
<tr>
<td>ETH 2.x</td>
<td>TCP</td>
<td>8081</td>
<td>HTTPS for web-based visualization(^1)</td>
</tr>
</tbody>
</table>

Table 6: Interfaces and open ports of the CPU assembly

\(^1\) Port is closed if you activate the device’s SSL encryption.

\(^2\) Depending on the setting of the parameter Visualization release.

\(^3\) Default setting; if you have modified the port for the control system protocol, only the set port is opened.

**Encryption standards**

The device supports the following TLS versions:

- TLS 1.0
- TLS 1.1
- TLS 1.2
The device uses the following cipher suites for a TLS-secured connection:

<table>
<thead>
<tr>
<th>Key exchange</th>
<th>Authentication</th>
<th>Encryption</th>
<th>Key length</th>
<th>Operating mode</th>
<th>Hash function</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS</td>
<td>ECDHE</td>
<td>RSA</td>
<td>WITH AES</td>
<td>128 CBC</td>
<td>SHA 1)</td>
</tr>
<tr>
<td>DHE</td>
<td>RSA</td>
<td></td>
<td></td>
<td></td>
<td>SHA265</td>
</tr>
<tr>
<td>ECDHE</td>
<td>ECDSA</td>
<td></td>
<td></td>
<td></td>
<td>SHA256</td>
</tr>
<tr>
<td>ECDH</td>
<td></td>
<td>RSA 2)</td>
<td></td>
<td></td>
<td>SHA256</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SHA256</td>
</tr>
</tbody>
</table>

1) Not available with TLS version >= 1.2

The device uses the SHA256 hash function to save passwords.
4 Product description

4.1 MSENSE® VAM monitoring system versions

The device is available in the following versions:

- MSENSE® VAM:
  - Standalone version in the control cabinet
- ETOS® ED/TD with MSENSE® VAM function:
  - Integration solution in the motor-drive unit
- ETOS® IM with MSENSE® VAM function:
  - Integration solution in the customer control cabinet (pluggable modules)
- MSENSE® BM with MSENSE® VAM function

4.2 Scope of delivery

Please note the following:

- Check the shipment for completeness using the shipping documents.
- Store the parts in a dry place until installation.

Depending on the product version, the following MSENSE® VAM monitoring system assemblies are included in the scope of supply. Depending on the order, additional ETOS® modules that are not listed in these instructions may also be used. Also observe the corresponding operating instructions.

MSENSE® VAM: Standalone version in the control cabinet

- VI 4 vibration sensor input module
- VAM sensor assembly (including VS 1 vibration sensor, adapter screw and kick guard)
- Sensor cable for VS 1 vibration sensor
- Analog AIO 2 or AIO 4 inputs/outputs
- G1 PULS DIMENSION QS3.241 power supply
- Digital DIO 28-15 or DIO 42-20 inputs/outputs
- CPU II (central processing unit)
- Control cabinet
- Optional: MC 2-2 media converter
- Optional: SW 3-3 media converter with managed switch
- Optional: Display
- Optional: PT100 for OLTC oil temperature (temperature pocket must be available in the on-load tap-changer head cover)\(^1\)
ETOS® ED/TD with MSENSE® VAM option: Integration solution in the motor-drive unit
- VI 4 vibration sensor input module
- VAM sensor assembly (including VS 1 vibration sensor, adapter screw and kick guard)
- Sensor cable for VS 1 vibration sensor
- Optional: MC 2-2 media converter
- Optional: SW 3-3 media converter with managed switch
- Optional: Display
- Optional: PT100 for OLTC oil temperature (temperature pocket must be available in the on-load tap-changer head cover)\(^1\)

ETOS® IM with MSENSE® VAM option: Integration solution in the customer control cabinet (pluggable modules)
- VI 4 vibration sensor input module
- VAM sensor assembly (including VS 1 vibration sensor, adapter screw and kick guard)
- Sensor cable for VS 1 vibration sensor
- Analog AIO 2 or AIO 4 inputs/outputs
- G1 PULS DIMENSION QS3.241 power supply
- Digital DIO 28-15 or DIO 42-20 inputs/outputs
- CPU II (central processing unit)
- Optional: MC 2-2 media converter
- Optional: SW 3-3 media converter with managed switch
- Optional: Display
- Optional: PT100 for OLTC oil temperature (temperature pocket must be available in the on-load tap-changer head cover)\(^1\)

\(^1\) Oil temperature recording is a prerequisite for the self-learning of the yellow limit value curve. As an alternative to recording the OLTC oil temperature, the top-oil temperature can be used.

4.3 Function description

The product is a monitoring system for monitoring vibro-acoustic signals from on-load tap-changers. You can use the product to detect time and amplitude anomalies in the vibro-acoustic signal progression and receive event messages when anomalies are detected.

The on-load tap-changer is equipped with measuring equipment that records the vibro-acoustic signal in the system throughout the entire tap change sequence and analyses it immediately upon completion. In addition, the system determines the changed tap position and the oil temperature in the on-load tap-changer.
Using the implemented algorithms, the monitoring system can reliably detect any potential anomalies that occur in the vibro-acoustic signal progression, taking the temperature variations of the on-load tap-changer oil into account.

**Status message**

The MSENSE® VAM monitoring system produces a 3-stage status message:

<table>
<thead>
<tr>
<th>Status</th>
<th>Device/visualization display</th>
<th>SCADA/digital output remote signaling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>OK message through blue status message</td>
<td>No remote signaling</td>
</tr>
<tr>
<td>Warning</td>
<td>The first and the second anomalies in an evaluation cluster are indicated via a yellow status message in the VAM analysis (Information menu).</td>
<td>No remote signaling</td>
</tr>
<tr>
<td>Alarm</td>
<td>A third anomaly arising in an evaluation cluster or the third successive anomaly triggers an additional event message (Events menu).</td>
<td>This event message is transmitted to a connected SCADA system. In addition, it can also be sent to a digital output.</td>
</tr>
</tbody>
</table>

**4.4 Performance features**

The MSENSE® VAM monitoring system monitors the vibro-acoustic signals from on-load tap-changers and has the following:

- Monitoring on-load tap-changers/reactors in accordance with the technical specification in the order confirmation
- Suitable for on-load tap-changers with oil-switch and vacuum-switch technology
- Recording of the vibro-acoustic signals during on-load tap-changer operation via automatic triggering
- Evaluation of the vibro-acoustic signal progression with regard to time and amplitude anomalies
- Self-learning limit value at an oil temperature above 15 °C, which moves towards the signal progression with increasing tap-change frequency. Approximately 5 tap-change operations per evaluation cluster (e.g. 5x from step 1 to step 2 in reverse tap-change operation) are necessary before the first limit value curve is displayed. The signals are also evaluated below 15 °C, but the limit value is not adjusted.
- Display and recording of the measured and calculated values
- Status messages via digital outputs
- Web-based visualization
4.5 Design

This chapter contains an overview of the design of the monitoring system:

Figure 3: Design, example of single-column application

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On-load tap-changer head cover</td>
</tr>
<tr>
<td>2</td>
<td>Vibration sensor with kick guard</td>
</tr>
<tr>
<td>3</td>
<td>Control cabinet</td>
</tr>
<tr>
<td>4</td>
<td>Sensor cable</td>
</tr>
<tr>
<td>5</td>
<td>Transformer</td>
</tr>
</tbody>
</table>
4.5.1 VS 1 sensor assembly

Figure 4: VAM sensor assembly

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sensor cable</td>
</tr>
<tr>
<td>2</td>
<td>Kick guard</td>
</tr>
<tr>
<td>3</td>
<td>Vibration sensor</td>
</tr>
<tr>
<td>4</td>
<td>Adapter</td>
</tr>
</tbody>
</table>

4.5.2 Control cabinet

Depending on the order, the electronic assemblies are either already installed in a control cabinet or are supplied as individual components for mounting on a cap rail. The following two figures show a design example for the standalone version.
4.5.2.1 Display elements and operating controls

The control cabinet contains the following display elements and operating controls:

![Diagram of display elements and operating controls](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indicator lamp H1: yellow = &quot;Anomaly detected&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Indicator lamp H2: green = &quot;No anomalies&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Service interface</td>
</tr>
</tbody>
</table>

Figure 5: Display elements and operating controls (example)
4.5.2.2 Control cabinet layout

The following figure shows an example layout in the control cabinet with the most important electronic assemblies for the MSENSE® VAM. The order-specific details can be found in the connection diagram provided.

![Control cabinet layout diagram](image)

**Figure 6: Control cabinet layout (example)**

<table>
<thead>
<tr>
<th>A10</th>
<th>CPU II (central processing unit)</th>
<th>A22</th>
<th>VI 4 vibration sensor input module</th>
</tr>
</thead>
<tbody>
<tr>
<td>A18</td>
<td>Analog AIO 2 or AIO 4 inputs/outputs</td>
<td>G1</td>
<td>Voltage supply</td>
</tr>
<tr>
<td>X19</td>
<td>Plug socket</td>
<td>F13</td>
<td>Miniature circuit breaker for heating</td>
</tr>
<tr>
<td>F14</td>
<td>Miniature circuit breaker for control system</td>
<td>F25</td>
<td>Residual current circuit breaker plug</td>
</tr>
<tr>
<td>A19</td>
<td>Digital inputs/outputs DIO 28-15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 [Section 13, Page 161] section.
4 Product description

4.5.2.2.1 Power supply

The G1 PULS DIMENSION QS3.241 assembly supplies power to the device.

![Figure 7: G1 PULS DIMENSION QS3.241 assembly](image)

4.5.2.2 CPU (central processing unit) II

The CPU II assembly is the central computing unit for the device. It contains the following interfaces:

- Internal system interface RS232 (COM1)
- Serial interface RS232/485 (COM2)
- 3x Ethernet (ETH 1, ETH 2.1, ETH 2.2)
- USB (USB 2.0)
- 2x CAN bus (CAN 1, CAN 2)

![Figure 8: CPU assembly](image)
4.5.2.2.3 DIO 28-15 digital inputs and outputs

The DIO 28-15 assembly makes 28 inputs and 15 outputs (6 N/O contacts, 9 change-over contacts) available.

![Image of DIO 28-15 assembly]

Warning of a danger point. Read the information given in the product operating instructions.

Warning of dangerous electrical voltage.

Table 8: Safety-relevant symbols on the assembly

4.5.2.2.4 Analog inputs and outputs (AIO 2)

The AIO 2 assembly provides 2 channels for analog inputs and outputs. In accordance with the device configuration, the AIO assembly supports one of the following signal types:

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Current</td>
</tr>
<tr>
<td>0 to 10 V</td>
<td>0...20 mA</td>
</tr>
<tr>
<td>4...20 mA</td>
<td></td>
</tr>
</tbody>
</table>

Resistance measurement (e.g. PT100, resistor contact series)

Table 9: Signal types supported by the AIO assembly
4.5.2.2.5 VI 4 vibration sensor input module

The VI 4 assembly records the vibration sensor signals via an IEPE interface. The abbreviation IEPE refers to an industry standard for piezo-electrical sensors (IEPE = Integrated Electronics Piezo Electric).

The measured signals are processed with evaluation algorithms.
4.5.2.2.6 Media converter

The MC 2-2 assembly is a media converter, which converts 2 electrical connections (RJ45) to one fiber-optic cable connection each. Each is converted independently of the other. The following interfaces are available:

- 2x RJ45 (ETH12, ETH22)
- 2x Duplex-LC (SFP module) (ETH11, ETH21)

The media converter is designed to be transparent for the network and does not have its own IP address.

![MC 2-2 assembly](image)

4.5.2.2.7 Media converter with managed switch

The assembly SW 3-3 is a media converter with managed switch. It combines two independent functions and provides you with the following interfaces:

- A media converter converts an electric connection (RJ45) into a fiber-optic cable connection
  - RJ45 (ETH12)
  - Duplex-LC (SFP module) (ETH11)
- Managed switch with redundancy function (PRP or RSTP)
  - 2x RJ45 (ETH23, ETH24), device-internal connection
  - 2x Duplex-LC (SFP module) (ETH21, ETH22), redundancy connection

The following redundancy functions are available to you according to your order:

- PRP (standard setting)
- RSTP
4 Product description

Figure 13: SW 3-3 assembly
4.6 Main screen

The visualization start screen of the MSENSE® VAM monitoring system varies depending on the product version. Their is a difference between the following product versions:

- MSENSE® VAM as an integration solution
- MSENSE® VAM as a standalone product

4.6.1 MSENSE® VAM as an integration solution

Click on the on-load tap-changer in the graphic to enter the overview screen for the vibro-acoustically measured tap-change operations of the on-load tap-changer (OLTC).
4.6.2 MSENSE® VAM as a standalone version

In the standalone version, the last recorded tap-change operation of the on-load tap-changer (OLTC tap-change operation) is displayed directly in the start screen (Home).

![Start screen](image)

Figure 15: Start screen

Further information on the start screen can be found in the "Visualization" [► Section 8.1, Page 76] section.

4.7 Operating concept

You can operate the device using the controls on the front panel or using the web-based ISM™ Intuitive Control Interface visualization on a PC. The scope of function and structure of both options is virtually identical.

User rights and user roles

The device is equipped with a rights system and a roles system. The display and access rights to device settings or events can therefore be controlled at the user level.

You can configure the rights system and roles system to meet your requirements. You will find more information on user rights in the User administration section.

You can only modify the device settings or parameters if you have the necessary user rights.

Logging on, logging off and changing users

The control of access rights to device settings and parameters is user-based. Various users can log in at the same time (e.g. via the visualization) and access the device.
If you want to operate the device via the controls and visualization at the same time, you have to log in on the device and via the visualization.

1. Select the LOGIN or CHANGE button in the status line.
2. Enter your user name and password and select the OK button.
   •  The name of the logged-in user appears in the status line.

To log out as a user, proceed as follows:
► Press the LOGOUT button in the status line.

Navigation

If you are operating the device using the controls on the front panel, you can use the rotary knob to navigate through the entire menu. The menu currently selected has a blue border. To open the highlighted menu, you have to press the ENTER key. Pressing the BACK key returns you to the previous menu level.

If you are operating the device using the web-based visualization, you can navigate by clicking on the appropriate buttons.

Example
1. Go to Settings.
2. Go to Parameters.
3. Go to System.
4. Go to Time synchronization.
5. Select Time.

In these operating instructions, the path for navigating to a parameter is always shown in an abridged form: Go to Settings > Parameters > System > Time synchronization.

Setting parameters

There are various ways to configure the settings, depending on the parameter.
Selecting from a list  To select a list entry, proceed as follows:

1. Use the rotary knob to navigate to the list and press the key.

2. Use the rotary knob to highlight the list entry and press the key.
3. Press the button to save the modified parameter.

Entering a value  To enter a value, proceed as follows:

1. Use the rotary knob to select the value field and press the key.

2. Enter the desired value and confirm with .
3. Press the button to save the modified parameter.
1. Use the rotary knob to select the text box and press the ENTER key. 
   
   If operating via the front panel, the keyboard appears.

2. Enter the desired text and confirm with ✓.
3. Press the Accept button to save the modified parameter.

**Parameter search**

You can use the quick search function in the parameter menu to search for a parameter. Enter the name of the desired parameter in the Search entry field.
Expert mode

The device has an expert mode for entering the parameters. You can enter the parameters directly on the overview screen of the respective menu in this mode.

1. Go to Settings > Parameters.
2. Select the Expert mode checkbox.

Hiding/showing parameters

Depending on how you set the parameters, the device will hide or show additional parameters related to this function.
5 Packaging, transport and storage

5.1 Packaging

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

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

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

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

5.1.1 Suitability

Property damage due to incorrectly stacked crates!

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

► The outer marking on the packaging states if, for example, the on-load tap-changer or selector has been packed upright. Never stack these crates.

► General rule: Do not stack crates above a height of 1.5 m.

► For other crates: Only stack up to 2 equally sized crates on top of one another.

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

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

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

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect against moisture</td>
<td>Protect against moisture</td>
</tr>
<tr>
<td>Top</td>
<td>Top</td>
</tr>
<tr>
<td>Fragile</td>
<td>Fragile</td>
</tr>
<tr>
<td>Attach lifting gear here</td>
<td>Attach lifting gear here</td>
</tr>
<tr>
<td>Center of mass</td>
<td>Center of mass</td>
</tr>
</tbody>
</table>

Table 10: Shipping pictograms

5.2 Transportation, receipt and handling of shipments

**WARNING**

**Danger of death or severe injury!**

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

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

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

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

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

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

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

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

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

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

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

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

5.3 Storage of shipments

Packaged goods dried by Maschinenfabrik Reinhausen

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

Non-dried packaged goods

Non-dried packaged goods but with a functional sealed packaging can be stored outdoors when the following conditions are complied with.
When selecting and setting up the storage location, ensure the following:

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

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

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

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

### 5.4 Unpacking shipments and checking for transportation damages

- **NOTICE!** Transport the packaged crate to the place where the packaged goods are to be installed. Do not open the sealed packaging until just before installation. Otherwise, damage to the packaged goods may occur due to ineffectively sealed packaging.

- **WARNING!** When unpacking, check the condition of the packaged goods. Place the packaged goods in an upright crate and protect it from tipping out. Otherwise, the packaged goods may become damaged and serious injuries may result.

- Check the completeness of the accessories kit using the delivery slip.

**Attachment points for lifting gear**

**WARNING**

Danger of death and damage to property!

Danger of death and damage to property due to tipping or falling load!

- Only trained and authorized persons may select the sling gear and secure the load.
- Do not walk under the suspended load.
- Use means of transport and lifting gear with a sufficient carrying capacity in accordance with the weight stated in the Technical data [Section 13, Page 161] section.
• **WARNING!** Serious injuries and damage to the control cabinet due to falling load. Attach the lifting gear such that the cable angle is always less than 45° in relation to the vertical.

**Figure 21: Maximum permissible cable angle for the lifting-gear limit stop of the control cabinet**

• **WARNING!** Serious injuries due to the control cabinet tipping and damage to the cable gland if the control cabinet is set down, transported or stored upright. Only set down, transport and store the control cabinet on its back.

• Only remove the control cabinet from the crane once it has been fully connected to the transformer.
6 Mounting

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

**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.

**NOTICE**

Damage to the device!

Electrostatic discharge may cause damage to the device.

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

Installing the MSENSE® VAM monitoring system includes the following steps, which are described in the following sections:

1. Depending on the product version selected, install the cap rail modules in the customer control cabinet or in the control cabinet on the transformer. You will find the appropriate description in the "Cap rail module assembly/control cabinet" [► Section 6.1, Page 43] section.
2. Mounting the vibration sensor [► Section 6.2, Page 50]
3. Connecting the assemblies [► Section 6.3, Page 51]
   - Connecting the vibration sensor to the control cabinet
   - Connecting the motor-drive unit controller to the monitoring system
   - Connecting the temperature sensor
   - Connecting additional leads
   - Connecting the power supply

After completing the installation, check the functionality [► Section 6.4, Page 66].

6.1 Installing the Cap rail modules / control cabinet

6.1.1 Installing the cap rail modules

With the MSENSE® VAM product version as an integration solution in the customer control cabinet, the cap rail modules must be installed in a suitable control cabinet, taking the EMC standards into consideration. This section does not apply for other product versions.
6.1.1.1 Minimum distances

**NOTICE**

**Damage to the device!**

Insufficient circulation of ambient air can result in damage to the device due to overheating.

- Keep the ventilation slots clear.
- Ensure sufficient distance to neighboring components.
- Only mount device in horizontal position (ventilation slots are at the top and bottom).

Reliable operation of the device in the permitted temperature range requires that you maintain the following minimum distances to the control cabinet and to neighboring components:

<table>
<thead>
<tr>
<th>Minimum distance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>To the floor of the control cabinet</td>
<td>88.9 mm (3.5 in)</td>
</tr>
<tr>
<td>To the roof of the control cabinet</td>
<td>Corresponds to 2 RU</td>
</tr>
<tr>
<td>Between assemblies on the bus bar and assemblies on the remote cap rail</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: Minimum distances in the control cabinet

![Diagram](image)

Figure 22: Example depiction of the minimum distances in a control cabinet

For other installation types, contact Maschinenfabrik Reinhausen GmbH.

6.1.1.2 Fastening the cap rail

The cap rail is required to mount a bus bar or a device's remote assemblies in a control cabinet. Only use the following types of cap rails in accordance with EN 60715:

- TH 35-7.5
- TH 35-15

The cap rail may not be painted or lacquered.
6 Mounting

**Electric shock!**
Risk of fatal injury due to electrical voltage if the cap rail is not connected to the protective ground.

- Connect the cap rail to the protective ground securely (e.g. with a protective conductor line-up terminal).
- Ensure that the cap rail is connected securely to the protective ground via a ground test after installation.

- Fasten the cap rail to the rear panel of the switch cabinet using screws and contact washers or lock washers. The distance between the screws may be no more than 10 cm (3.94 in).

![Figure 23: Fastening the cap rail](image)

**6.1.1.3 Installing the bus rail on the cap rail**

The bus rail connects assemblies, such as the CPU, DIO and AIO, to each other mechanically and electrically. The bus bar can contain different assemblies according to your order.

- **WARNING!** Mount the bus rail on the cap rail, ensuring that the bus rail engages correctly. Otherwise, it can result in electric shock due to a faulty connection to the protective ground.
6.1.1.4 Installing the assembly at a distance on the cap rail

The assemblies VI 4, CPU II and AIO 2/AIO 4 are delivered pre-mounted on the bus rail. The following optional assemblies must be mounted with an offset on a cap rail:

▪ DIO 28-15 or DIO 42-20
▪ MC 2-2
▪ SW 3-3
▪ G1 (PULS)

✔ Cap rail fastened to the rear panel of the cabinet [► Section 6.1.1.2, Page 44].

➤ **WARNING!** A faulty connection to the protective ground can lead to an electric shock in the event of faults. Hook the assembly onto the cap rail at the specified location, ensuring that the assembly engages correctly.

Figure 24: Hooking the bus rail into position
6.1.2 **Integration solution in the ETOS® ED motor-drive unit**

With this product version, proceed in accordance with the ETOS® ED operating instructions and follow the safety information and warnings they contain when mounting the control cabinet on the transformer. Once mounted, continue in accordance with the section "Mounting the vibration sensor" [► Section 6.2, Page 50] in these instructions.

6.1.3 **Fitting the control cabinet to the transformer**

This section describes how to mount the control cabinet of the stand-alone version to the transformer.

The special design with vibration dampers must be used on transformers where the control cabinet is subject to vibration.
The control cabinet has four fixing attachments on the rear to secure it. To mount the control cabinet on the transformer, proceed as follows:

1. Attach four stud bolts (not supplied by MR) to the transformer tank.

![Figure 26: Fastening the stud bolts](image)

2. Use the fixing attachments to attach the control cabinet to the stud bolts and align it vertically on the transformer tank.

![Figure 27: Attaching the control cabinet](image)
3. **NOTICE!** Secure the control cabinet without subjecting it to mechanical tension. Otherwise, the control cabinet may be damaged.

Figure 28: Fastening the control cabinet

4. Connect the grounding cable to the control cabinet and transformer tank, holding it against the control cabinet using a wrench of size 36.

Figure 29: Connecting the grounding cable to the control cabinet
6.2 Mounting the vibration sensor

When selecting the mounting position, ensure that there is the greatest possible clearance to the drive motor, drive shafts and pipelines to reduce the disruptive effect on the vibro-acoustic recording to a minimum.

To mount the VAM sensor, proceed as follows:

1. Remove one bolt from the on-load tap-changer cover. Reuse the washer that is present.

2. **NOTICE!** Incorrect mounting can destroy the vibration sensor. Only apply a tool with wrench size 17 to the lower hexagon of the adapter to attach the sensor assembly. Place the washer over the open tapped hole and screw in the sensor assembly (vibration sensor with adapter and kick guard) with a torque of 34 Nm.
6.3 Connecting the assemblies

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

**WARNING**

**Electric shock!**

Risk of fatal injury due to connection errors.

► Ground the device using the grounding screw on the housing.

6.3.1 Cable recommendation

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

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

If you want to route Ethernet connections from a control cabinet or building, we recommend the use of fiber-optic cables (in accordance with the IEC 61850-90-4 recommendation).

The sensor cable is included in the scope of delivery and is oil-resistant and UV-resistant.
Use oil-resistant versions for all connection cables outside of control cabinets and versions also with additional UV resistance for those outside of buildings.

<table>
<thead>
<tr>
<th>Cable</th>
<th>Assembly</th>
<th>Cable type</th>
<th>Conductor cross-section</th>
<th>Max. length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal inputs</td>
<td>DIO 28-15,</td>
<td>Shielded</td>
<td>1.5 mm²</td>
<td>400 m (&lt;25 Ω/km)</td>
</tr>
<tr>
<td></td>
<td>DIO 42-20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal outputs*</td>
<td>DIO 28-15,</td>
<td>Shielded</td>
<td>1.5 mm²</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>DIO 42-20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal inputs</td>
<td>AIO 2, AIO 4,</td>
<td>Shielded</td>
<td>1 mm²</td>
<td>400 m (&lt;25 Ω/km)</td>
</tr>
<tr>
<td></td>
<td>AIO 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal outputs</td>
<td>AIO 2, AIO 4,</td>
<td>Shielded</td>
<td>1 mm²</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>AIO 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS232, SUB-D</td>
<td>CPU I, CPU II</td>
<td>Shielded</td>
<td>0.25 mm²</td>
<td>25 m</td>
</tr>
<tr>
<td>RS485; SUB-D</td>
<td>CPU I, CPU II</td>
<td>Shielded</td>
<td>0.25 mm²</td>
<td>140 m</td>
</tr>
<tr>
<td>Ethernet RJ45</td>
<td>CPU I</td>
<td>Min. CAT5, shielded S/FTP</td>
<td>-</td>
<td>100 m</td>
</tr>
<tr>
<td>Ethernet FO</td>
<td>MC 2-2, SW 3-3</td>
<td>Duplex LC</td>
<td>Multimode, OM3, 1310 nm</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 12: Recommendation for connection cables

*) Observe line capacitance, see note above.

6.3.2 Information about connecting serial interfaces RS232 and RS485

**NOTICE**

Damage to the device!

Using the wrong data cable may damage the device.

► Only use data cables which comply with the description below.
RS232 (D-SUB 9-pole)

To connect the device via the RS232 interface (COM2), use a data cable with the following structure:

Figure 32: RS232 data cable (9-pole)
RS485 (D-SUB 9-pole)

To connect the device via the RS485 interface (COM2), use a data cable with the following structure:

Figure 33: RS485 data cable

D-SUB 9-pole plug connection

Only use 9-pole D-SUB plugs with the following characteristics:

- Plug housing is metallic or metal-plated
- Cable shielding is connected with the plug using one of the two following variants:
  - Shielding is screwed down with traction relief.
  - Shielding is soldered with plug housing.
6.3.3 Information about connecting analog sensors

**NOTICE**

**Damage to the device and sensors!**

Incorrectly connected and configured analog inputs/outputs may result in damage to the device and sensor.

► Follow information about connecting analog sensors [► Section 6.3.3, Page 55].

► Configure analog inputs and outputs according to the connected sensors.

The AIO assembly has a separate plug connector for each channel (input or output). The plugs are assigned as follows:

![Plug assignment of the AIO module](image_url)
You can connect the following types of analog sensors:

- 4...20 mA
- PT100/PT1000 (2-wire, 3-wire, 4-wire)

### 4...20 mA sensor

You must connect a 4...20 mA sensor to the pins 2 and 3. You must also connect the supplied bridge to the pins 3, 4, and 5.

![4...20 mA signal source](image)

PT100/PT1000 sensor

Depending on type, you must connect a PT100 sensor or PT1000 sensor as follows:

- 2-wire: pin 1 and 4
- 3-wire: pin 1, 3, and 4
- 4-wire: pin 1, 2, 3, and 4

---

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>11 16</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>12 17</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>13 18</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>14 19</td>
</tr>
<tr>
<td>5</td>
<td>10 15 20</td>
<td>Not used</td>
</tr>
</tbody>
</table>

Table 13: Analog inputs and outputs
6.3.4 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.

6.3.4.1 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.

6.3.4.2 Wiring requirement of operating site

Note the following when wiring the operating site:

- Route the connecting leads in grounded metal cable ducts.
- Do not route lines which cause interference (e.g. power lines) and lines susceptible to interference (e.g. signal lines) in the same cable duct.
- Maintain a distance of more than 100 mm between lines which cause interference and those which are susceptible to interference.

---

Figure 37: Connection example for a PT100/PT1000 sensor
Using single conductors may limit the effectiveness of the shielding. Connect close-fitting shielding to cover all areas.
6.3.4.3 Wiring requirement in control cabinet

Note the following when wiring the control cabinet:

- The control cabinet where the device will be installed 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.
6.3.4.4 Information about screening the cables for analog signals

In order to correctly record the analog signals, you must place the cable screening in the motor-drive unit on the grounding bar. The cable shielding should be removed as late as possible before connecting to keep the section with unshielded cables as short as possible. The shielding must be connected with shielding clips.

![Figure 40: Examples of supporting screening on ground bar (on left: Direct connection to AIO assembly, on right: Connection using line-up terminal)](image)

6.3.5 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. Also observe the information from the manufacturer of the fiber-optic cable and the following instructions:

- 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 because they can damage the fiber-optic cable’s coating during laying or can place mechanical loads on the coating later on.
- Provide a sufficient cable reserve near distributor cabinets. Lay the reserve such that the fiber-optic cable is neither bent nor twisted when tightened.
6.3.6 Connecting the vibration sensor to the control cabinet

Depending on the application, one or more vibration sensors are included in the scope of delivery. Repeat the following steps for a multi-column application.

You must connect the vibration sensor to the control cabinet using the sensor cable provided. Note the following information when routing the sensor cable:

- Route the sensor cable with as much shielding as possible on the transformer (e.g. in the tube or cable duct) and along a conductive grounded surface that runs without interruption.
- Route sensor cables separately from supply lines and do not create any unnecessary loops.
- The vibration sensor cable can also be routed together with the temperature sensor cable in a protective tube.
- On the control cabinet, it is advantageous to have routing parallel to the earthing cable that connects the transformer and the control cabinet together.

To route the sensor cable, proceed as follows:

1. Remove the vibration sensor cover cap.

Figure 41: Vibration sensor cover cap

2. Ensure that the sensor cable plug and the socket on the sensor are dry and free of dirt. If this is not the case, clean and dry them with a cloth.
3. Plug in the sensor cable plug and screw it in by hand.

4. Route the sensor cable on the transformer to the control cabinet with shielding to prevent mechanical damage and interference.
5. Shorten the sensor cable to the desired length. Loops or coil windings of an excessive length are not permitted when routing the cable.

![Sensor cable routing diagram](image)

Figure 43: Sensor cable routing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature sensor cable</td>
</tr>
<tr>
<td>2</td>
<td>Control cabinet</td>
</tr>
<tr>
<td>3</td>
<td>Vibration sensor cable</td>
</tr>
<tr>
<td>4</td>
<td>Transformer</td>
</tr>
<tr>
<td>5</td>
<td>On-load tap-changer head cover</td>
</tr>
</tbody>
</table>

If the control cabinet is farther away, extend the sensor cable with a shielded cable in the motor drive cabinet or in a metal intermediate terminal box. Follow the information in the Cable recommendation [► Section 6.3.1, Page 51] section and implement continuous shielding.
For the control cabinet connection, proceed as follows:

1. Connect the sensor cable shield to the grounding bar in the control cabinet using a shielded clamp. When doing so, only expose the cable shield as much as is necessary for the shielded clamp.

![Sensor cable shield connection](image)

Tighten the cable screw connections on the control cabinet with the following tightening torques: M20: 8 Nm, M32: 20 Nm.

2. Connect the sensor cable in accordance with the connection diagram provided (blue = signal, brown = signal ground, black = ground in control cabinet).

**6.3.7 Connecting the motor-drive unit controller to the monitoring system**

To synchronize the vibro-acoustic signals with the tap position change, it is necessary to measure the diverter switch operation in the motor-drive controller. With the integration solution in the motor-drive unit, this connection is already made at the factory.

With the "standalone" and "integration solution in the customer control cabinet" versions, you must make this connection yourself. To do so, connect the position transmitter module of the motor-drive unit to the DIO assembly of the vibro-acoustic monitoring system in accordance with the connection diagram provided.

**6.3.8 Connecting the temperature sensor**

Depending on the application, one or more temperature sensors are included in the scope of delivery. When making the connection, follow the connection diagram on the associated dimensional drawing. Make the connection to the control cabinet in accordance with the connection diagram provided for the monitoring system.
6.3.9 Connecting additional leads (optional)

Connect additional leads as necessary in accordance with the connection diagram:

- Digital inputs and outputs
- Control system
- Visualization

Routing information for connecting the control system or visualization

When connecting the device to a control system or to your network for accessing the visualization, observe the following recommendation on the cable routing in the control cabinet:

![Figure 45: Recommendation on the cable routing in the control cabinet for the connection of the control system or visualization](image)

6.3.10 Connecting the power supply

You may only connect the control cabinet to circuits with an external overcurrent protection device and an isolating device with all poles disconnected so the equipment can be fully de-energized if required (service, maintenance etc.).
Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC 60947-3 (e.g. circuit breaker). Note the properties of the relevant circuits (voltage, maximum currents) when selecting the circuit breaker type. In addition, observe the following:

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

You must connect the power supply circuit with a conductor cross-section of at least 2.5 mm² (AWG 13) and protect it with a C6A or B6A type miniature circuit breaker.

To connect the voltage supply, proceed as follows:

- Connect the power supply of the control cabinet to terminal X1 in accordance with the connection diagram provided.

### 6.4 Checking functional reliability

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

**NOTICE**

**Damage to device and system periphery!**

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

- Check the entire configuration before commissioning.

To check the functionality, proceed as follows:

- Apply voltage to the control cabinet.

  The device’s control system boots up; after a brief period, the relay switches the operating contact STATUS_OK (DIO 28-15:1B).

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


7 Commissioning

7.1 Visualization

The MSENSE® VAM monitoring system is equipped with web-based visualization. This enables you to configure the device with a computer and to display measured values.

Overview of Ethernet interfaces:

<table>
<thead>
<tr>
<th>MSENSE® VAM product version</th>
<th>ETH 1.1</th>
<th>ETH 2.1</th>
<th>ETH 2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone version in the control cabinet</td>
<td>Yes</td>
<td>No</td>
<td>Optional</td>
</tr>
<tr>
<td>Integration solution in the ETOS® TD motor-drive unit</td>
<td>Yes</td>
<td>No</td>
<td>Optional</td>
</tr>
<tr>
<td>Integration solution in the ETOS® ED motor-drive unit without display</td>
<td>No</td>
<td>Yes</td>
<td>Optional</td>
</tr>
<tr>
<td>Integration solution in the ETOS® ED motor-drive unit with display</td>
<td>Yes</td>
<td>No</td>
<td>Optional</td>
</tr>
<tr>
<td>Integration solution in the customer control cabinet (ETOS® IM, pluggable modules)</td>
<td>No</td>
<td>Yes</td>
<td>Optional</td>
</tr>
</tbody>
</table>

Establishing a connection for visualization via the ETH 1.1 front interface

1. Connect the PC and device using an Ethernet cable (RJ45 plug) via the ETH 1.1 interface. This interface is directly accessible after opening the control cabinet door. Depending on the product version, there are two options:

Figure 46: MSENSE® VAM standalone front interface
2. Assign a unique IP address to the PC in the same subnet as the device (e.g. 192.168.165.100).

3. Enter the visualization’s IP address http://192.168.165.1, or if SSL encryption is active enter https://192.168.165.1, in the browser on the PC.

   The visualization is accessed.

### Establishing a connection for visualization via the ETH 2.1 or ETH 2.2 interface

You can use the ETH 2.1 interface or the optional ETH 2.2 interface of the CPU assembly to establish the connection to the visualization. The interfaces do not use a DHCP server. Therefore, you must assign a static IP address to your PC. To do this, observe the following configuration example:

<table>
<thead>
<tr>
<th>Interface</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>ETH 2.1</td>
</tr>
<tr>
<td></td>
<td>IP address: 192.168.165.1 (not adjustable)</td>
</tr>
<tr>
<td>PC</td>
<td>IP address: 192.168.165.100</td>
</tr>
<tr>
<td></td>
<td>Subnet mask: 255.255.255.0</td>
</tr>
<tr>
<td>Optional</td>
<td>ETH 2.2</td>
</tr>
<tr>
<td></td>
<td>IP address: 192.0.1.230 (factory setting) [► Section 8.7.2, Page 97]</td>
</tr>
<tr>
<td></td>
<td>Subnet mask: 255.255.255.0</td>
</tr>
<tr>
<td>PC</td>
<td>IP address: 192.0.1.100</td>
</tr>
<tr>
<td></td>
<td>Subnet mask: 255.255.255.0</td>
</tr>
</tbody>
</table>

Table 14: Interface configuration example
1. Connect the PC and device using an Ethernet cable (RJ45 plug) via the ETH 2.1 or ETH 2.2 interface.

![CPU interface ETH 2.1 or ETH 2.2](image)

2. Assign a unique IP address to the PC in the same subnet as the device (e.g. ETH 2.1: 192.168.165.100).

3. Enter the IP address of the visualization (e.g. ETH 2.1: http://192.168.165.1; if SSL encryption is active, enter https://192.168.165.1) in the browser on the PC.

   ☑ The visualization is accessed.

### 7.2 Commissioning wizard

If you want the device to help when setting the relevant parameters, you can use the commissioning wizard. The commissioning wizard provides a selection of parameters that you can configure in order.

A detailed description of each of the parameters can be found in the Operation [► Section 8, Page 76] chapter.

To call up the commissioning wizard, you will need the necessary access rights.

When in delivery status, you can log in as the administrator as follows:

- **User name:** admin
- **Password:** admin
To set the parameters with the help of the commissioning wizard, proceed as follows:

1. Log in as a user with the necessary access rights.
2. Go to **Settings > Commissioning wizard**.

![Figure 49: Calling up the commissioning wizard](image)

3. Press the **Next** button to launch the commissioning wizard.
4. Follow the on-screen instructions.

Once you have entered all of the parameters relevant to commissioning, continue with the function test.

### 7.3 Setting the language

You can use this parameter to set the display language for the device. The device comes with a maximum of four languages. The following languages are available:

<table>
<thead>
<tr>
<th>Language</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>Italian*</td>
</tr>
<tr>
<td>German</td>
<td>Portuguese*</td>
</tr>
<tr>
<td>French*</td>
<td>Russian*</td>
</tr>
<tr>
<td>Spanish*</td>
<td>Chinese*</td>
</tr>
<tr>
<td>Korean*</td>
<td>Polish*</td>
</tr>
</tbody>
</table>

*) Language is available as an option (upon request)

To set the language, proceed as follows:

1. Select the **Language** button in the status bar, or as an alternative go to **Settings > General > Language**.

![Figure 50: Setting the language](image)

2. Select the desired language from the list box.
3. Press the **Accept** button to save the modified parameter.
   ⇒ The "Restart device" dialog appears.
4. Restart the device to apply the changed language setting.

### 7.4 Setting date and time

You can set the date and time in the following ways:

- Manually
- Time synchronization via control system (SCADA)
- Time synchronization via SNTP time server

If you are using a control system, the device automatically synchronizes the date and time with the control system. If you would like to use an SNTP time server, you must set the required parameters.

For more information, refer to the information in the section Setting the device time [Section 8.7.3, Page 97].

### 7.5 Name plate

You can enter the data of the nameplates from the transformer, on-load tap-changer and motor-drive unit and display it later.

When operating ETOS® with the MSENSE® VAM option, you must enter the correct serial number for every on-load tap-changer. This entry is necessary to ensure the correct assignment of the vibro-acoustic records in the external database.

#### 7.5.1 Enter the name plate data

You can enter the name plate data for the transformer, the on-load tap-changer and the motor-drive unit.

![Figure 51: Nameplate](image)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Name plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name serial number</td>
<td>-</td>
</tr>
<tr>
<td>Tx year of construction</td>
<td>-</td>
</tr>
<tr>
<td>Tx type</td>
<td>-</td>
</tr>
<tr>
<td>Tx description</td>
<td>-</td>
</tr>
<tr>
<td>Tx manufacturer</td>
<td>-</td>
</tr>
<tr>
<td>Tx standard</td>
<td>-</td>
</tr>
<tr>
<td>Tx phases</td>
<td>-</td>
</tr>
<tr>
<td>Tx insulation medium</td>
<td>-</td>
</tr>
<tr>
<td>Tx rated voltage</td>
<td>-</td>
</tr>
<tr>
<td>Tx frequency</td>
<td>-</td>
</tr>
</tbody>
</table>
1. Go to **Settings > Parameters > System > Nameplate**.
2. Select the desired parameter.
3. Set the parameter.
4. Press the **Accept** button to save the modified parameter.

### 7.5.2 Displaying the name plate

You can display the nameplate data for the transformer, on-load tap-changer, and motor-drive unit.

![Figure 52: Transformer nameplate](image)

**Go to Information > System > Nameplate > Transformer/On-load tap-changer/Motor-drive unit.**

### 7.6 Setting the control system protocol (optional)

If you need a control system protocol, you must set the parameters required for this. More information on this (e.g. data points) is to be found in the provided supplement for the control system protocol.

You do not need to set additional parameters for commissioning.

### 7.7 Performing tests

Please contact Maschinenfabrik Reinhausen GmbH (MR) if any aspect of the tests is not clear.
7.7.1 Checking measured values and status of digital inputs and outputs

Upon commissioning the device, check whether the measured values and status of digital inputs and outputs are plausible. To do so, use an additional measuring device if necessary in order to check the individual measured values.

To display the status of the digital inputs and outputs, proceed as follows:
1. Go to Information > Hardware.
2. Select the individual assemblies one after another and check the individual measured values or the status of digital inputs and outputs.
3. If errors arise, check the measurement path and the wiring.

7.7.2 Performing function tests

To ensure that the monitoring system functions seamlessly, you have to check the communication with the sensor and the automatic triggering function after each installation or maintenance action as follows:
1. Check that the wiring of the sensor and the signal feedback is in accordance with the supplied circuit diagram.
2. Perform a few on-load tap-changes for all positions and in both directions and check the plausibility of the signal progression including the envelope curve in the monitoring system.
3. Check that the signals are being recorded and saved correctly.
4. Optional: Check the control system.
   ⇐ The monitoring system is ready to function.

7.7.3 Electrical high-voltage tests on the transformer

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

Note the following points before performing high voltage tests on the transformer:
- Check that the ground connections on the control cabinet and the control cabinet fixings are free of paint.
- Only perform a high voltage test with the control cabinet door closed.
- Disconnect the sensor cable and other external connections to electronic components in the control cabinet to prevent damage through overvoltage.
- When connecting the control cabinet's supply voltage, only use the bushings in the protective housing base intended for lead insertion.
- Guide all ground connecting leads to one central connection point (establishment of suitable reference earth).
- Disconnect all electronic components before the high voltage test. Before a dielectric test of the wiring, remove all devices with a withstand voltage of < 1000 V.
- Remove leads used for testing before the high voltage test, because these function as antennas.
- Wherever possible, route the measurement leads and data leads separately to the energy cables.

### 7.7.4 Ground test

For commissioning, carry out a ground test (check of the impedance of the protective bonding) in accordance with IEC 61010-1. Note the following information:

- Test current: 2 times the measurement current of the overcurrent protection device of the supply line.
- Test duration: 1 minute for each measurement point.
- The measured voltage between the measurement point and the protective conductor must be smaller than 10 V.

Proceed as follows to carry out the ground test:

1. Feed the test current at the fixing screw of assembly DIO 28-15 or DIO 42-20 using a constant current source and measure the voltage between the measurement point and the protective conductor.
   - The measured voltage must remain less than 10 V over a duration of 1 minute.

![Figure 53: Perform a ground test on the DIO assembly (sample representation of the DIO 28-15 assembly).](image-url)
2. Feed the test current at the grounding terminal of the G1 PULS DIMENSION QS3.241 assembly using a constant current source and measure the voltage between the measurement point and the protective conductor.

⚠️ The measured voltage must remain less than 10 V over a duration of 1 minute.

![Figure 54: Perform a ground test on the G1 PULS DIMENSION QS3.241 assembly](image)

### 7.7.5 Dielectric tests on transformer wiring

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

- The monitoring system has been put through dielectric tests before delivery.
- Before the dielectric test for the transformer wiring, disconnect the monitoring system from the section to be tested to rule out increased component loading for those components fitted in the control cabinet.
8 Operation

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

8.1 Visualization

The integration solution and the standalone version have different start screens. The figure shows the start screen of the integration solution.

![Figure 55: Start screen of the integration solution](image)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Display area</td>
</tr>
<tr>
<td>2</td>
<td>Secondary navigation</td>
</tr>
<tr>
<td>3</td>
<td>Primary navigation</td>
</tr>
<tr>
<td>4</td>
<td>Status bar</td>
</tr>
</tbody>
</table>

**Primary navigation**

The primary navigation on the right edge of the screen is always structured the same way, regardless of the product version. The buttons of the primary navigation have the following functions:

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>Switch to the start screen</td>
</tr>
<tr>
<td>Events</td>
<td>Switch to the display of events detected</td>
</tr>
<tr>
<td>Information</td>
<td>Switch to the display of information on:</td>
</tr>
<tr>
<td></td>
<td>• Installed hardware</td>
</tr>
<tr>
<td></td>
<td>• OLTC</td>
</tr>
<tr>
<td></td>
<td>• Tap-change operation statistics</td>
</tr>
<tr>
<td></td>
<td>• OLTC oil temperature curve</td>
</tr>
<tr>
<td></td>
<td>• VAM analysis</td>
</tr>
</tbody>
</table>
### Button Function

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recorder</td>
<td>Switch to the display of statistics for tap position and oil temperature</td>
</tr>
<tr>
<td>Settings</td>
<td>Switch to the settings menu</td>
</tr>
</tbody>
</table>

With the integration solution, clicking on the on-load tap-changer on the start screen accesses the overview screen for the vibro-acoustically recorded tap-change operations of the on-load tap-changer (OLTC tap-change operations).

### Standalone version start screen

On the start screen of the standalone version, the vibro-acoustic signal progression of the last recorded and evaluated on-load tap-changer operation is shown in blue. Clicking on the **Home** button always returns you to this screen.

Once the recording of a tap-change operation is complete, the calculation and evaluation is performed. With complex switching sequences and a high switching frequency, it may take a few minutes before the latest tap-change operation is displayed.

![Figure 56: Standalone version start screen](image)

The upper curve in yellow indicates the self-learned limit value. In addition, the corresponding properties of the tap-change operation are shown:

- Type of OLTC tap-change operation (e.g. reverse tap-change operation)
- Start and end position of the tap-change
- Date and time of the tap-change operation
- Oil temperature of the on-load tap-changer
- Number of OLTC tap-change operations registered until now
- Status display with the following color code:
8 Operation

<table>
<thead>
<tr>
<th>Color code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>No anomalies: Plausibility criteria met and limit values not exceeded</td>
</tr>
<tr>
<td>Yellow</td>
<td>Limit value was exceeded</td>
</tr>
<tr>
<td>Gray</td>
<td>The evaluation could not be carried out</td>
</tr>
</tbody>
</table>

Remark:

With the integration solution, you will go to the same view if you display the most recent recorded tap-change operations in the Information menu.

8.2 User administration

User administration is based on a system of roles. You must assign a role to every user. You can define access rights to parameters and events for each role.

The access rights depend on the product version [Section 4.1, Page 20] and the associated scope of supply.

8.2.1 User roles

The access rights to device functions and settings are controlled using a hierarchical system of roles. The system has 5 different roles with different access rights. Some of these access rights are fixed, but you can configure the access rights to particular parameters and events. Note the Setting access rights to parameters and events [Section 8.2.4, Page 82] section.

If you are not logged in on the device, you will assume the "Data display" user role.

Upon delivery, the following roles are provided:

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data display</td>
<td>User who can only view data of relevance to operation.</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>User who can view data and log data of relevance to operation.</td>
</tr>
<tr>
<td>Operator</td>
<td>User who can view data of relevance to operation and acknowledge events. The user can perform manual tap-change operations using the device's controls.</td>
</tr>
</tbody>
</table>
### 8 Operation

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter configurator</td>
<td>User who can view and modify data of relevance to operation.</td>
</tr>
<tr>
<td></td>
<td>• Display and modify all parameters</td>
</tr>
<tr>
<td></td>
<td>• Import and export parameters</td>
</tr>
<tr>
<td></td>
<td>• Display, modify, and acknowledge all events</td>
</tr>
<tr>
<td>Administrator</td>
<td>User who can view and modify all data.</td>
</tr>
<tr>
<td></td>
<td>• Read all parameters</td>
</tr>
<tr>
<td></td>
<td>• Display, modify, and acknowledge all events</td>
</tr>
</tbody>
</table>

Table 15: Roles in delivery status

Access to the following areas of the device is linked to the roles:

<table>
<thead>
<tr>
<th>Function</th>
<th>Data display</th>
<th>Diagnostics</th>
<th>Operator</th>
<th>Parameter configurator</th>
<th>Administrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Restart device</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Import</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Export</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Set date and time</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Calling up the commissioning wizard</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Calibrate resistor contact series</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Actuation of the RAISE, LOWER, REMOTE, AVR AUTO, and AVR MANUAL keys</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Setting topology</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Configuring analog inputs and outputs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Configuring digital inputs and outputs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Setting TPLE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Configuring data points</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Calling up the maintenance wizard</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Changing tap position table</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Enabling ECOTAP Modbus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Adding sensors to the MR sensor bus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 16: Access rights permanently linked to the roles
8.2.2 Changing the password

All users can change their passwords provided that the user account is not set up as a group account. You can only change a group account's password if you are logged in as the administrator.

Note that the password must satisfy the following requirements:

▪ At least eight characters
▪ At least three of the four following character types
  – Upper case letters
  – Lower case letters
  – Numbers
  – Special characters

To change the password, proceed as follows:
1. Select the user name in the status line.
2. Enter the new password twice.
3. Press the Accept button to save the changed password.

8.2.3 Creating, editing and deleting users

You can set the following options for all users:

▪ Username and password
▪ Role: You can assign a role to every user. The access rights to parameters and events are linked to the roles.
▪ Group account: With this option, you can declare a user account to be a group account (e.g. for access by different people). Users with a group account cannot change their own password. The password can only be changed by the administrator.
- **Active:** You can activate or deactivate the user. Deactivated users cannot log in. The user data is still stored in the device.

- **Auto login:** You can activate the Auto-login function for a user. This user is automatically logged in when the system is restarted or another user logs out.

![User Management Interface]

Figure 58: Overview of users created

You can only create, edit, and delete users if you are assigned an administrator role.

When in delivery status, you can log in as the administrator as follows:
- **User name:** admin
- **Password:** admin

**Creating users**

To create a new user, proceed as follows:
1. Go to **Settings > Administration > User**.
2. Press the **Create user** button.
3. Enter the **user name** once and the **password** twice.
4. Select the **role** you want.
5. If necessary activate the **Group account**, **Active** or **Auto login** options.
6. Press the **Accept** button to save the user.

**Editing users**

To edit an existing user, proceed as follows:
1. Go to **Settings > Administration > User**.
2. Select the desired user in the list.
3. Make the amendments desired.
4. Press the **Accept** button to save the user.

**Deleting user**

To delete an existing user, proceed as follows:
1. Go to **Settings > Administration > User**.
2. Select the desired user in the list.
3. Press the **Delete user** button.
4. Press the **Accept** button to delete the user.

### 8.2.4 Setting access rights to parameters and events

You can configure access rights to parameters and events for the available roles. The following options are available for this purpose:

- **Read**: Parameter/event may be displayed.
- **Write**: Parameter/event may be modified.
- **Acknowledge**: Event may be acknowledged.

![Figure 59: Setting access rights for an event](image)

You can only change access rights if you are assigned an administrator role.

When in delivery status, you can log in as the administrator as follows:

- **User name**: `admin`
- **Password**: `admin`

To set the access rights to parameters and events, proceed as follows:
1. Go to **Settings > Administration > Parameters/events**.
2. A list of all parameters or events appears.
3. Select the desired entry in the list.
3. Select the options you want.
4. Press the **Accept** button to save the change.

### 8.3 Events menu

The device is equipped with event management, which allows you to detect various device operating statuses and to adapt the behavior of the device. With the MSENSE® VAM monitoring system, only yellow and gray events occur. A list of the events with explanations and handling recommendations can be found in the “Event messages” [► Section 10.2, Page 157] section.

To display the events currently active, proceed as follows:

► **Go to Events.**

 ⇒ A list of currently pending events appears.

![Figure 60: Events menu](image)

The events are numbered consecutively. A short description and a time stamp for each one follows.

**Acknowledging events**

Acknowledgeable events must be acknowledged in the event overview so that they are no longer displayed. All other events are automatically removed once the cause is remedied (e.g. limit value no longer exceeded).

To acknowledge the events, proceed as follows:

► To acknowledge the events, highlight the desired events in the column, then press the **Acknowledge** button.

⇒ The events have been acknowledged.
Displaying event memory

Past events are stored in the event memory. The following information is displayed:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>Consecutive number of events</td>
</tr>
<tr>
<td>No.</td>
<td>Event number for clear identification</td>
</tr>
<tr>
<td>⚠</td>
<td>Event category:</td>
</tr>
<tr>
<td></td>
<td>▪ Warning (yellow)</td>
</tr>
<tr>
<td></td>
<td>▪ Info (gray)</td>
</tr>
<tr>
<td>Event</td>
<td>Event text</td>
</tr>
<tr>
<td>Time</td>
<td>Date and time of event (DD-MM-YYYY, HH:MM:SS/ms)</td>
</tr>
<tr>
<td>✔️</td>
<td>Event coming-going:</td>
</tr>
<tr>
<td></td>
<td>▪ Event coming</td>
</tr>
<tr>
<td></td>
<td>○ Event going</td>
</tr>
</tbody>
</table>

Table 17: Event memory

To call up the event memory, proceed as follows:

1. Go to Events.
2. Press the Log button.

Figure 61: Event history
Detailed description of the events

By double-clicking on an event, you can call up the detailed description and find a handling recommendation to fix the problem.

Figure 62: Event description

You will find the details on the properties of the events and a description of how you can configure this in the chapter "Menu settings > Events" [ ► Section 8.8, Page 127].

Filtering events

To adjust the display, you can define a filter. To do so, proceed as follows:

1. Press the Filter button.
2. Enter the desired time period.
3. Select the checkbox and enter the desired event number.
   ⇒ The event text is displayed.
4. Select the desired event categories and the desired event status.
   ⇒ Press the Search button to display the desired events.
Figure 63: Events list filter function

Exporting events

You can export the event memory entries currently displayed as a csv file. If you first create a filter, only the filtered entries are exported.

To export the events, proceed as follows:

1. First connect using Connect PC or connect a storage medium to the USB port on the CPU I module.
2. Press the Export button.
3. The data is exported.

Figure 64: Export events list
8.4 Information menu

The Information menu has the following selection options:

- **Hardware**: Overview of the available hardware modules and the signals present.
- **Software**: Serial number and versions of the software used.
- **OLTC**: Information on the on-load tap-changer.
- **Tap-change operation statistics**: Information on the frequency of the on-load tap-changer operations.
- **Temperatures**: Temperature of the transformer.
- **VAM analysis**: Analyzed vibro-acoustic measurements of the on-load tap-changer.

**Menu Information > VAM analysis**:

For every tap-change operation listed, you will receive the following information:

- Tap-change operation type
- Start position and end position of the tap-change operation.
- Time of the tap-change operation
- Status
Tap-change operation type

The monitoring system distinguishes between the following types of tap-change operations:

- Change-over selector operation: The change-over selector also changes in this tap-change operation.
- Small tap change: Tap selector operation in which the distance between the stationary selector contacts used for this tap-change operation is small.
- Moderate tap change: Tap selector operation in which the distance between the attached selector contacts used for this tap-change operation is moderate.
- Large tap change: Tap selector operation in which the distance between the attached selector contacts used for this tap-change operation is large.
- Reverse tap-change operation: Tap-change operation in which the tap changes in the opposite direction to the most recent tap-change operation and does not involve actuation of the selector.

Status information

<table>
<thead>
<tr>
<th>Color code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>No anomalies: Plausibility criteria met and limit values not exceeded</td>
</tr>
<tr>
<td>Yellow</td>
<td>Limit value was exceeded</td>
</tr>
<tr>
<td>Gray</td>
<td>The evaluation could not be carried out</td>
</tr>
</tbody>
</table>
Filter options

Using the drop-down menu, you can limit the selection of tap-change operations to those of a specific tap-change operation type or to those involving a specific property.

- Selection according to tap-change operation type:
  - Change-over selector operation
  - Small, medium or large tap change
  - Reverse tap-change operation

- Selection according to property:
  - All
  - Marked
  - Evaluation ok
  - Anomalies
  - Without evaluation

Display of selected tap-change operations

To display individual tap-change operations with the associated VAM signal and the stored limit value as a curve, proceed as follows:

1. Place a check mark in the first column in front of the tap-change operation that is to be displayed as a curve. Up to 100 tap-change operations can be shown in the visualization via web browser. A maximum of 10 tap-change operations can be shown on the device display.

2. Confirm via the Display button.
   
   They will be displayed differently depending on the number of selected tap-change operations.

If more than one tap-change operation is selected, then the limit value curve display will be omitted for clarity purposes:

<table>
<thead>
<tr>
<th>Number of selected tap-change operations</th>
<th>1</th>
<th>2-100</th>
<th>&gt;100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display of VAM signal</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Display of limit value curve</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
The following figure shows an example of the visualization of an individual tap-change operation:

![Image of a tap-change operation](image.jpg)

**Figure 67: Display of a tap-change operation**

The following figure shows an example of how multiple selected tap-change operations are shown at the same time:

![Image of multiple tap-change operations](image.jpg)

**Figure 68: Display of multiple tap-change operations**

If multiple tap-change operations are selected for the visualization, it is possible to hide or show individual tap-change operations by clicking on them in the key.

Using the web-based ISM™ Intuitive Control visualization allows you to zoom into an area of the signal. To do this, hold down the left mouse button and draw a frame around the desired area. To return to the original representation, click on the symbol.
8.5 **Recorder menu**

Use the "Information" [▶ Section 8.4, Page 87] menu to compare the vibro-acoustic signals of several tap-change operations, enabling you to see the changes.

With the standalone version, you can use the measured value recorder function to display the temporal progression of the oil temperature, and with the integration solution, you can use this function to display the temporal progression of additional measured values and signals.

If you call up the measured value recorder directly on the device display, you can select a maximum of 3 measured values. If you access it via the web visualization, you can select a maximum of 10 measured values.

To display the measured value recorder on the device display, proceed as follows:

1. Go to **Recorder**.

   ![Recorder](image)

   Figure 69: Recorder

2. Select the signals to be displayed in the list.
3. If necessary, set the desired **axis** for each signal.
4. Enter the **start time** and the **end time** for the measured value display.
5. Press **Display** to call up the measured value display (data log).

![Image of measured value display]

**Figure 70: Measured value display**

The operation described below is only possible if you access the visualization using a computer.

6. Move the mouse indicator to a **measurement point** for more information.
7. Use the mouse to produce a selection window or turn the mouse wheel to zoom into or out of the diagram. If necessary, you can move an enlarged diagram with the right mouse button.
8. Select the **button to save the displayed measured values as a csv file.**
Trend curves

If you call up the measured value recorder using a PC, you can display a trend curve instead of the measured values. The trend curve can, for example, be a moving average over a configurable time period.

1. Call up the measurement recorder and the desired measured value series.
2. Press the Trend button.
3. Select the desired measured values.
4. Select the desired trend function.
5. Enter the desired time period for the calculation of the trend curve.
6. Press the Accept button to display the trend curves.

The trend curve is displayed. Measured values that are displayed as trend curves are marked with the symbol.

Figure 71: Setting trend curves

Figure 72: Trend curve display
8.6 Settings menu

You have the following selection options in this menu:

- **Parameters**: Functions and settings of the device.
- **Events**: Overview of all available events for the device.
- **Configure DIO**: Configuration of the digital inputs and outputs (DIOs).
- **Configure AIO**: Configuration of the analog inputs and outputs (AIOs).
- **Tap-change operation table**: Reference of the tap-change operation designsations.
- **Reset VAM**: Reset the self-learned statistics of the vibro-acoustic signals.
- **Commissioning wizard**: Support when setting up the relevant parameters. These are separated into three groups: general, time synchronization, IEC 61850.
- **TPLE**: With the TPLE (TAPCON® Personal Logical Editor) function, you can link inputs and outputs with one another via function modules.
- **Import**: Import data via a USB or a PC.
- **Export**: Export data via a USB or a PC.
- **Administration**: You can use this menu to change user administration settings. As an administrator, you can view and adjust the rights of selected users.

8.7 Menu Settings > Parameters

The parameters are divided into four groups. You will find more information directly via the link:

1. System
   - General [► Section 8.7.1, Page 95]
   - Configuring the network [► Section 8.7.2, Page 97]
   - Time synchronization [► Section 8.7.3, Page 97]
   - Syslog [► Section 8.7.4, Page 100]
   - Screensaver [► Section 8.7.5, Page 101]
   - Configuring IEC 61850 (optional) [► Section 8.7.11.1, Page 106]
   - Configuring IEC 60870-5-101 (optional) [► Section 8.7.11.2, Page 108]
   - Configuring IEC 60870-5-103 (optional) [► Section 8.7.11.3, Page 111]
   - Configuring IEC 60870-5-104 (optional) [► Section 8.7.11.4, Page 114]
   - Configuring Modbus (optional) [► Section 8.7.11.5, Page 116]
   - Configuring DNP3 (optional) [► Section 8.7.11.6, Page 118]
   - Configuring data points (optional) [► Section 8.7.11.7, Page 120]
   - Linking digital outputs [► Section 8.7.6, Page 101]
   - Linking messages [► Section 8.7.6, Page 101]
   - Linking functions [► Section 8.7.7, Page 103]
2. Active part
   - Temperature monitoring [▶ Section 8.7.8, Page 104]
3. On-load tap-changer
   - OLTC data [▶ Section 8.7.9, Page 105]
4. Power grid
   - Tap position monitoring [▶ Section 8.7.10, Page 105]

8.7.1 Menu Settings > Parameters > General

In this menu, you can make general settings and prepare the settings for web-based visualization:

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>English</td>
</tr>
<tr>
<td>Commissioning wizard</td>
<td>Yes</td>
</tr>
<tr>
<td>Auto-logout</td>
<td>Off</td>
</tr>
<tr>
<td>Time until auto-logout</td>
<td>15.0 min</td>
</tr>
<tr>
<td>Measured value display</td>
<td>Primary values</td>
</tr>
<tr>
<td>Transformer name</td>
<td>Transformer</td>
</tr>
<tr>
<td>Remote behavior</td>
<td>Hardware and SCADA</td>
</tr>
<tr>
<td>USB interface</td>
<td>Off</td>
</tr>
<tr>
<td>Service user access activation</td>
<td>Activated</td>
</tr>
<tr>
<td>SNMP Agent activation</td>
<td>Off</td>
</tr>
</tbody>
</table>

General settings

- **Language**
  - With this setting, you can specify the device display language.
  - The display language can also be set via the status bar [▶ Section 7.3, Page 70]
- **Commissioning wizard**
  - Information on how to set whether the commissioning wizard starts up once the device is restarted is available here [▶ Page 96].
- **Auto-logout**
  - You can use this to set whether a user is to be logged out automatically in the event of a long period of inactivity.
- **Transformer name**
  - Enter the transformer name for identification.
- **Remote behavior**
  - Information on how to set the remote behavior is available here [▶ Section 8.7.1.1, Page 96].
• USB interface
  – Here, you can activate/deactivate the USB interface [Section 8.7.1.2, Page 96].

**Settings for web-based visualization**

• IP address
• Subnet mask
• Gateway address
• SSL encryption
• TLS version

**Commissioning wizard**

You can use this parameter to set whether the commissioning wizard is to launch automatically when the device is restarted.

### 8.7.1.1 Remote behavior

You can use this parameter to select the behavior of the device in remote operating mode. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware only</td>
<td>The device accepts commands via digital inputs.</td>
</tr>
<tr>
<td>SCADA only</td>
<td>The device accepts commands via SCADA.</td>
</tr>
<tr>
<td>Hardware and SCADA</td>
<td>The device accepts commands via digital inputs and SCADA.</td>
</tr>
</tbody>
</table>

Table 18: Selecting remote behavior

To set the remote behavior, proceed as follows:

1. Go to Settings > Parameters > General > Remote behavior.
2. Select the desired option.
3. Press the Accept button to save the modified parameter.

### 8.7.1.2 Activating/deactivating the USB interface

You can use this parameter to deactivate the USB interface. You can select the following options:

• On: USB interface is activated
• Off: USB interface is deactivated

Proceed as follows to activate/deactivate the USB interface:

1. Go to Settings > Parameters > General > USB interface.
2. Select the desired option.
3. Press the Accept button to save the modified parameter.
8.7.2 Configuring the network

You can configure the ETH 1 and ETH 2.2 network interfaces of the CPU assembly in this menu item.

You can only set the parameters for ETH 1 if the device is equipped with the optional control system connection via Ethernet (TCP/IP):

- IEC 61850
- IEC 60870-5-104
- Modbus (Modbus type TCP active)
- DNP3 (DNP3 transmission type TCP active)

You can only set the parameters for ETH 2.2 if the device is equipped with the optional interface for visualization.

Figure 74: Network settings

1. Go to Settings > Parameters > System > Network settings.
2. Select the desired parameter.
3. Set the parameter.
4. Press the Accept button to save the modified parameter.

8.7.3 Time synchronization

You can set the device time manually or automatically via an SNTP time server. The device must be connected to an SNTP time server via Ethernet for this purpose. You can set the following parameters:

- Time synchronization via SNTP
- Activate second time server (optional)
- SNTP time server (for the first and second SNTP time servers)
- Synchronization interval
- Time zone
8.7.3.1 Activating time synchronization using SNTP

You can use this parameter to activate time synchronization using an SNTP time server.

To activate time synchronization using SNTP, proceed as follows:
1. Go to Settings > Parameters > Time synchronization > Time synchronization via SNTP.
2. Select the option you want.
3. Press the Accept button to save the modified parameter.

Second time server (optional)

As an option, you can use a second time server, e.g. should the first one fail. When you activate the second time server, the device synchronizes the time with the second time server if a connection cannot be established with the first time server. If the device is able to re-establish the connection to the first time server, it automatically synchronizes the time with the first time server again.

You can only use the second time server if you have activated the Time synchronization via SNTP parameter and entered an IP address for the first time server.

To activate the second time server, proceed as follows:
1. Go to Settings > Parameters > Time synchronization > Activate second time server.
2. Select the option you want.
3. Press the **Accept** button to save the modified parameter.

### 8.7.3.2 Entering the time server address

This parameter lets you enter the IP address of a SNTP time server. If you are using a time server, the device uses the time of the time server as the system time.

Be sure to enter a valid time server address that is not 0.0.0.0, otherwise it will not be possible to connect to the device.

To enter the time server address of the SNTP server, proceed as follows:

1. Go to **Settings > Parameters > Time synchronization > SNTP time server**.
2. Enter time server address.
3. Press the **Accept** button to save the modified parameter.

#### Entering time server address of second time server (optional)

You can use this parameter to enter the IP address of the second time server as an option.

To enter the time server address of the second SNTP server, proceed as follows:

1. Go to **Settings > Parameters > Time synchronization > SNTP time server 2**.
2. Enter time server address.
3. Press the **Accept** button to save the modified parameter.

### 8.7.3.3 Setting the time zone

If the time information is conveyed to the device by a network service (SNTP or SCADA), this time is transferred depending on the set reference time. To adjust the device time to your local time, you can use the time shift parameter to set the time shift to UTC.

**Example:**

<table>
<thead>
<tr>
<th>Region</th>
<th>Time shift to UTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumbai, India</td>
<td>UTC +5:30 h</td>
</tr>
<tr>
<td>Beijing, China</td>
<td>UTC +8:00 h</td>
</tr>
<tr>
<td>Brasilia, Brazil</td>
<td>UTC -3:00 h</td>
</tr>
</tbody>
</table>

| Table 19: Time shift to UTC (Coordinated Universal Time) |

To set the time zone, proceed as follows:

1. Go to **Settings > Parameters > Time synchronization > Time zone**.
2. Select the option you want.
3. Press the **Accept** button to save the modified parameter.

### 8.7.3.4 Setting synchronization interval

You can use this parameter to set the interval at which the device is to call up the time from the time server.

To set the synchronization interval, proceed as follows:

1. Go to **Settings > Parameters > Time synchronization > Synchronization interval**.
2. Enter synchronization interval.
3. Press the **Accept** button to save the modified parameter.

### 8.7.3.5 Setting the date and time manually

You can use the Time parameter to set the date and time. To do so, proceed as follows:

1. Go to **Settings > Parameters > Time synchronization > Time**.
2. Enter the date and time.
3. Press the **Accept** button to save the modified parameter.

### 8.7.4 Configuring syslog

The device supports the transmission of log messages via the syslog protocol in accordance with the standards RFC 5424 and RFC 3164.

![Syslog](image)

Figure 76: Syslog

1. Go to **Settings > Parameters > System > Syslog**.
2. Select the desired parameter.
3. Set the parameter.
4. Press the **Accept** button to save the modified parameter.
8.7.5 Setting the screensaver

In order to increase the service life of the display on the front panel of the device, you can activate and set a screensaver. The following functions are available for this purpose:

- Switching off the display
- Dimming the brightness of the display

![Figure 77: Setting the screensaver](image)

1. Go to Settings > Parameters > System > Screensaver.
2. Select the desired parameter.
3. Set the desired parameter.
4. Press the Accept button to save the modified parameter.

8.7.6 Linking digital outputs and control system messages

You can link each event with a digital output or a control system message. Depending on your device configuration, the device provides a maximum of 20 digital outputs and 10 SCADA messages for this purpose.

To forward input signals or control system commands, you need to link the digital outputs or control system messages with the Generic digital input or Generic SCADA command events.
Linking digital outputs

When you link a digital output to an event, the device issues a signal to that output if the event occurs. The signal persists until the event stops. A parameter is available for each available digital output.

In order to establish the link, you have to enter the corresponding event number in the desired parameter.

If you enter event number 500, the link is disabled.

To link the digital output, proceed as follows:

- The desired event number is known.

1. Go to Settings > Parameters > Link outputs.
2. Select the desired parameter.
3. Enter the desired event number.
4. Press the Accept button to save the modified parameter.
Linking SCADA messages

When you link a SCADA message to an event, the device sets the data point to "On" when the event occurs. When the event stops, the device sets the data point to "Off". A parameter is available for each available SCADA message.

![Figure 79: Linking SCADA messages](image)

In order to establish the link, you have to enter the corresponding event number in the desired parameter.

If you enter event number 500, the link is disabled.

1. Go to **Settings > Parameters > Link messages**.
2. Select the desired parameter.
3. Enter the desired event number.
4. Press the **Accept** button to save the modified parameter.

8.7.7 Linking functions

You can link the **Generic digital input** or **Generic SCADA command** events with device functions. This allows you to remotely control the device using digital inputs or commands via the control system (SCADA). The following parameters are available for this purpose:
### Table 20: Functions available

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate remote mode</td>
<td>If the assigned event is active, the device activates remote mode.</td>
</tr>
<tr>
<td>Activate local mode</td>
<td>If the assigned event is active, the device activates local mode.</td>
</tr>
</tbody>
</table>

In order to establish the link, you have to enter the corresponding event number in the desired parameter.

Note that you can only enter the event numbers of the *Generic digital input* or *Generic SCADA command* events.

If you enter event number 500, the link is disabled.

To link the function, proceed as follows:

- The desired event number is known.
- 1. Go to *Settings > Parameters > Link functions*.
- 2. Select the desired parameter.
- 3. Enter the desired event number.
- 4. Press the **Accept** button to save the modified parameter.

#### 8.7.8 Temperature monitoring

You can set four limit values for monitoring the temperature. If the measured temperature is greater than limit value > or >>, the device triggers an event message. If the measured temperature is less than limit value < or <<, the device triggers an event message.

You can view the temperature curve under "Information".

![Figure 80: Temperature monitoring](image_url)
To set the temperature monitoring, proceed as follows:
1. Go to **Settings > Parameters > Temperature monitoring**.
2. Select the desired parameter.
3. Set the desired parameter.
4. Press the **Accept** button to save the modified parameter.

8.7.9 **On-load tap-changer > OLTC data**

You can configure the settings for the measurement of and message on the tap positions of the on-load tap-changer (OLTC) in this menu.

**Tap position capture (with standalone version only)**

The current tap position of the on-load tap-changer is transmitted from the motor-drive unit to the device. Here, you can set whether the transmitted tap position should be interpreted as a raw value or according to the tap position table.

**Tap position message (optional)**

Here, you can set whether the message on the tap position uses the raw value or uses the interpretation based on the tap position table.

8.7.10 **Power grid > Tap position monitoring**

You can define two limit values and two delay times to monitor the tap positions:

- **Pos<**: Lower limit
- **Pos>**: Upper limit
- **Pos<**: Delay time
- **Pos>**: Delay time

The "Number of tap-change operations" parameter has no function and therefore no consequences.

**Limit value Pos</Pos>**

The lower limit value is monitored to determine whether the tap position reaches or falls below the limit value. The upper limit value is monitored to determine whether the tap position reaches or exceeds the limit value.

The following function is possible in combination with the voltage regulation:

Once the set delay time has lapsed, the TAPCON® REMOTE sends limit value violations via IEC 61850 to the TAPCON® MASTER to then receive and carry out the corresponding tap change command (raise/lower signal) from the TAPCON® MASTER.
Delay time limit value

You can use this parameter to set the delay time. If a limit value is violated, the device only undertakes the set behavior once the delay time has elapsed. The purpose of the delay time is to allow the device to ignore brief limit value violations.

Number of tap change operations

The device's operations counter is automatically increased with every tap-change operation. You can use this parameter to set the number of tap-change operations, for example for comparison with the operations counter of the motor-drive unit.

To set tap position monitoring or the number of tap position changes, proceed as follows:
1. Go to Settings > Parameters > Tap position monitoring.
2. Select the desired parameter.
3. Set the parameter.
4. Press the Accept button to save the modified parameter.

8.7.11 SCADA

The following section describes how you can configure the device to connect to a control system (SCADA). You can download the data points with the help of the export manager.

8.7.11.1 Configuring IEC 61850 (optional)

If you want to use the IEC 61850 control system protocol, you must set the following parameters. Also refer to the section Configuring the network [Section 8.7.2, Page 97].

Figure 81: IEC 61850
1. Go to Settings > Parameters > System > IEC 61850.
2. Select the desired parameter.
3. Set the parameter.
4. Press the Accept button to save the modified parameter.

**IED name**

You can use this parameter to assign the device an IED name in order for it to be identified in the IEC 61850 network.

The IED name must start with a letter and may contain no more than 11 characters.

**Device ID**

You can use this parameter to assign a device ID to the device in order that it can be identified in the IEC 61850 network.

**Access point**

You can use this parameter to assign a name to the access point in the IEC 61850 network.

**Edition**

You can use this parameter to switch between edition 1 and edition 2 of the IEC 61850 control system protocol.

### 8.7.11.1.1 Downloading an ICD file

You can download the ICD file from the device via the Import/Export Manager. To do this, you have to establish an Ethernet connection between the device and your PC.

For a smooth download with Windows Vista/7/8 operating systems, use Windows Explorer.

### 8.7.11.1.2 Importing CID/SCD file (optional)

Note the following definitions for importing a CID file or SCD file.

Only the following elements may differ between the imported IED and the exported IED from the TEMPLATE.icd.

- DataSet elements can be created in each LN
- ReportControl elements can be created in the LN containing the associated DataSet
- IP address (if this is not present, the preset one is used)
- Subnet mask (if this is not present, the preset one is used)
- Gateway IP address (if this is not present, the preset one is used)
- Name of IED (IED name)
- Name of AccessPoint (AccessPoint attribute name)
- Name of logical device (LDevice attribute inst)

OSI-PSEL, OSI-SSEL, and OSI-TSEL cannot be adjusted.

The SCD file may contain no more than 45 IEDs. It may take several minutes to import a complete SCD file. The SCD file should only contain the IEDs needed.

You can import the CID/SCD file via the Import/Export Manager. To do so, proceed as follows:
1. Go to Settings > Import.
2. Select and import the desired CID/SCD file.

### 8.7.11.2 Configuring IEC 60870-5-101 (optional)

If you want to use the IEC 60870-5-101 control system protocol, you must set the following parameters.

2. Select the desired parameter.
3. Set the parameter.
4. Press the Accept button to save the modified parameter.
8 Operation

Serial interface
You can use this parameter to select the serial interface for data transmission. You can select the following options:
- RS232
- RS485

Baud rate
You can use this parameter to set the serial interface’s baud rate. You can select the following options:
- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

Transmission procedure
You can use this parameter to set the transmission procedure. You can select the following options:
- Unbalanced transmission
- Balanced transmission

Number of link address octets
You can use this parameter to set how many octets are provided for the link address.

Link address
You can use this parameter to set the link address.

Number of ASDU address octets
You can use this parameter to set how many octets are provided for the ASDU address.

ASDU address
You can use this parameter to set the address of the ASDU.

No. of information object address octets
You can use this parameter to set how many octets are provided for the information object address.
Number of cause of transmission octets
You can use this parameter to set how many octets are provided for the cause of transmission.

Number of data bits
You can use this parameter to set the number of databits.

Parity
You can use this parameter to set the parity. You can select the following options:
- None
- Even
- Odd

Number of stop bits
You can use this parameter to set the number of stop bits.

ASDU single character confirmation
You can use this parameter to set whether a confirmation is to be sent as single characters instead of as a complete message. Single character confirmation is only possible for requesting data of class 2 (Class 2 Request).

RES bit test
You can use this parameter to set whether the device is to check the RES bit (Reserved Bit) in the control field. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Messages from the master with RES bit = 1 are declined by the device.</td>
</tr>
<tr>
<td>Off</td>
<td>Messages from the master with RES bit = 1 are accepted by the device.</td>
</tr>
</tbody>
</table>

Table 21: RES bit test

ASDU sequence optimization
With this parameter, you can set which method is to be used for optimizing the ASDU types. The standard enables optimization in order to be able to transfer multiple value changes in a telegram in a sequence of ascending information object addresses. This is displayed by the sequence bit. The selection of ASDU types for which this optimization is allowed is based on the edition of the standard.
You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>The device does not optimize the ASDU types.</td>
</tr>
<tr>
<td>Ed. 1</td>
<td>Optimization in accordance with IEC 60870 Edition 1 (Type 1, 3, 9, 11, 21, 126).</td>
</tr>
<tr>
<td>Ed. 1 Amendment2</td>
<td>Optimization in accordance with IEC 60870 Edition 1, Amendment 2 (Type 1, 3, 9, 11, 13, 15 21, 126).</td>
</tr>
<tr>
<td>Ed. 2</td>
<td>Optimization in accordance with IEC 60870 Edition 2 (Type 1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 126).</td>
</tr>
</tbody>
</table>

Table 22: ASDU sequence optimization

Reference time

You can use this parameter to set which time is to be transmitted by the control system. The device uses this information for time synchronization [► Section 8.7.3, Page 97]. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>The control system transmits the local time. Note: If you use this option, you must deactivate the automatic changeover between daylight saving time and standard time. Otherwise the device will use an incorrect time.</td>
</tr>
<tr>
<td>UTC</td>
<td>The control system transmits the time as UTC. The device calculates the local time from UTC and the set time zone [► Section 8.7.3.3, Page 99].</td>
</tr>
</tbody>
</table>

Table 23: Reference time

8.7.11.3 Configuring IEC 60870-5-103 (optional)

If you want to use the IEC 60870-5-103 control system protocol, you must set the following parameters.
1. Go to Settings > Parameters > System > IEC 60870-5-103.
2. Select the desired parameter.
3. Set the parameter.
4. Press the Accept button to save the modified parameter.

**Serial interface**

You can use this parameter to select the serial interface for data transmission. You can select the following options:
- RS232
- RS485

**Baud rate**

You can use this parameter to set the serial interface's baud rate. You can select the following options:
- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

**ASDU address**

You can use this parameter to set the address of the ASDU.

**Number of data bits**

You can use this parameter to set the number of databits.

**Parity**

You can use this parameter to set the parity. You can select the following options:
- None
- Even
- Odd

**Number of stop bits**

You can use this parameter to set the number of stop bits.
DFC compatibility

You can use this parameter to set how the device is to use the DFC bit (Data Flow Control) in the control field. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>The device sets the DFC bit in each response to a command. The device thus indicates that the master may not send any further commands. The master must react to the ACD bit (Access Demand) and retrieve the response to the command e.g. via a request for data of class 1 from the slave queue.</td>
</tr>
<tr>
<td>Alternative</td>
<td>The device sets the DFC bit in a response if a second command is received without the master having previously sent a request for data of class 1.</td>
</tr>
</tbody>
</table>

Table 24: DFC compatibility

Reference time

You can use this parameter to set which time is to be transmitted by the control system. The device uses this information for time synchronization [▶ Section 8.7.3, Page 97]. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>The control system transmits the local time. Note: If you use this option, you must deactivate the automatic changeover between daylight saving time and standard time. Otherwise the device will use an incorrect time.</td>
</tr>
<tr>
<td>UTC</td>
<td>The control system transmits the time as UTC. The device calculates the local time from UTC and the set time zone [▶ Section 8.7.3.3, Page 99].</td>
</tr>
</tbody>
</table>

Table 25: Reference time
8.7.11.4 Configuring IEC 60870-5-104 (optional)

If you want to use the IEC 60870-5-104 control system protocol, you must set the following parameters. Also refer to the section Configuring the network [► Section 8.7.2, Page 97].

1. Go to Settings > Parameters > System > IEC 60870-5-104.
2. Select the desired parameter.
3. Set the parameter.
4. Press the Accept button to save the modified parameter.

**TCP port**

You can use this parameter to set the TCP port.

**ASDU address**

You can use this parameter to set the address of the ASDU.

**ASDU sequence optimization**

With this parameter, you can set which method is to be used for optimizing the ASDU types. The standard enables optimization in order to be able to transfer multiple value changes in a telegram in a sequence of ascending information object addresses. This is displayed by the sequence bit. The selection of ASDU types for which this optimization is allowed is based on the edition of the standard.
You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>The device does not optimize the ASDU types.</td>
</tr>
<tr>
<td>Ed. 1</td>
<td>Optimization in accordance with IEC 60870 Edition 1 (Type 1, 3, 9, 11, 21, 126).</td>
</tr>
<tr>
<td>Ed. 1 Amendment 2</td>
<td>Optimization in accordance with IEC 60870 Edition 1, Amendment 2 (Type 1, 3, 9, 11, 13, 15, 21, 126).</td>
</tr>
<tr>
<td>Ed. 2</td>
<td>Optimization in accordance with IEC 60870 Edition 2 (Type 1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 126).</td>
</tr>
</tbody>
</table>

Table 26: ASDU sequence optimization

**Reference time**

You can use this parameter to set which time is to be transmitted by the control system. The device uses this information for time synchronization [► Section 8.7.3, Page 97]. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>The control system transmits the local time.</td>
</tr>
<tr>
<td></td>
<td>Note: If you use this option, you must deactivate the automatic changeover between daylight saving time and standard time. Otherwise the device will use an incorrect time.</td>
</tr>
<tr>
<td>UTC</td>
<td>The control system transmits the time as UTC. The device calculates the local time from UTC and the set time zone [► Section 8.7.3.3, Page 99].</td>
</tr>
</tbody>
</table>

Table 27: Reference time
8.7.11.5 Configuring Modbus (optional)

If you want to use the Modbus control system protocol, you must set the corresponding parameters depending on the Modbus type selected. Also refer to the section Configuring the network [► Section 8.7.2, Page 97] if you want to use Modbus TCP.

1. Go to **Settings > Parameters > System > Modbus**.
2. Select the desired parameter.
3. Set the parameter.
4. Press the **Accept** button to save the modified parameter.

**Modbus type**

You can use this parameter to set the Modbus type. You can select the following options:

- RTU
- TCP
- ASCII

**Modbus address**

You can use this parameter to set the Modbus address.

**TCP port**

You can use this parameter to set the TCP port.

**Maximum TCP connections**

You can use this parameter to set the maximum number of TCP connections.
TCP Keepalive
You can use this parameter to activate/deactivate the “TCP Keepalive” function.

Serial interface
You can use this parameter to select the serial interface for data transmission. You can select the following options:
- RS232
- RS485

Baud rate
You can use this parameter to set the serial interface’s baud rate. You can select the following options:
- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

Number of data bits
You can use this parameter to set the number of databits.

Parity
You can use this parameter to set the parity. You can select the following options:
- None
- Even
- Odd

Number of stop bits
You can use this parameter to set the number of stop bits.
8.7.11.6 Configuring DNP3 (optional)

If you would like to use the DNP3 control system protocol, you must set the parameters listed below. Also refer to the section Configuring the network [► Section 8.7.2, Page 97] if you want to use the DNP3 via TCP.

1. Go to **Settings > Parameters > System > DNP3**.
2. Select the desired parameter.
3. Set the parameter.
4. Press the **Accept** button to save the modified parameter.

### 8.7.11.6.1 DNP3 transmission type

You can use this parameter to set the transmission type. You can select the following options:

- TCP
- Serial

#### TCP port

You can use this parameter to set the TCP port.

#### Serial interface

You can use this parameter to select the serial interface for data transmission. You can select the following options:

- RS232
- RS485
8.7.11.6.2 Baud rate
You can use this parameter to set the serial interface’s baud rate. You can select the following options:
- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

8.7.11.6.3 Device address
You can use this parameter to set the device link address.

8.7.11.6.4 Destination address
You can use this parameter to set the destination master link address.

8.7.11.6.5 Unsolicited messages
You can use this parameter to set whether the device is to support unsolicited messages. If you activate unsolicited messages, the device sends a message via the control system every time a value is changed.

8.7.11.6.6 Repetition of unsolicited messages
You can use this parameter to set how often the device is to send an unsolicited message until it receives a response from the DNP3 master.

8.7.11.6.7 Repeat unsolicited messages indefinitely
You can use this parameter to set the device to send an indefinite number of unsolicited messages until it receives a response from the DNP3 master.

8.7.11.6.8 Timeout
You can use this parameter to set the timeout for unsolicited messages.

8.7.11.6.9 Timeout for response confirmation
You can use this parameter to set the timeout for response confirmation for unsolicited messages.

8.7.11.6.9 User ID code
You can use this parameter to set the user ID code.
8 Operation

Reference time

You can use this parameter to set which time is to be transmitted by the control system. The device uses this information for time synchronization [► Section 8.7.3, Page 97]. You can select the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>The control system transmits the local time. Note: If you use this option, you must deactivate the automatic changeover between daylight saving time and standard time. Otherwise the device will use an incorrect time.</td>
</tr>
<tr>
<td>UTC</td>
<td>The control system transmits the time as UTC. The device calculates the local time from UTC and the set time zone [► Section 8.7.3.3, Page 99].</td>
</tr>
</tbody>
</table>

Table 28: Reference time

8.7.11.7 Configure data points (optional)

You can use the optional "Configure data points" function to adjust the control system data points of the device. You can only configure the data points on a PC using the web-based visualization.

8.7.11.7.1 Configuring IEC 60870-5-101 data points

You can adjust the following data point properties for the IEC 60870-5-101 control system protocol:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.</td>
<td>Yes</td>
<td>Active/inactive</td>
</tr>
<tr>
<td>IOA</td>
<td>Data point address. The setting range is based on the setting for the &quot;Octet number of information object address&quot; parameter (octet 2 or 3).</td>
<td>Yes</td>
<td>Octet 2: 1...65,535 Octet 3: 1...16,777,215</td>
</tr>
<tr>
<td>Name</td>
<td>Data point designation.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Type</td>
<td>Data point type.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Group</td>
<td>Data point group or groups. You must enter the group membership as a binary code (5 bits). A maximum of 5 groups is possible. Example:</td>
<td>Yes</td>
<td>00000...11111</td>
</tr>
<tr>
<td></td>
<td>• 00000: belongs to no groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 00001: group 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 01000: group 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 01001: group 1 and group 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTG</td>
<td>The value indicates whether the data point is to be included in a general query (1) or not (0).</td>
<td>Yes</td>
<td>0, 1</td>
</tr>
</tbody>
</table>
### Table 29: Configuring IEC 60870-5-101 data points

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
</table>
| TH     | Threshold value for measured values. The data point is only transferred again if the change of value is greater than the threshold value.  
  - If you enter the value 0, no threshold value is active.  
  - If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either.  
  - Notice: You can only enter a threshold value for data points of type 9, 10, 11, 12, 13, 14, 21, 34, 35 or 36. | Yes | 0...32,768 |
| CT     | Interval in ms for periodic transmission of the data point. If you set 0, the data point is not transmitted periodically. Notice: You can only enter an interval for data points of type 9, 11 or 13. | Yes | 0...10,000 |

Figure 87: Configuring IEC 60870-5-101 data points

Proceed as follows to configure the data points:
1. Go to **Settings > Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.
8.7.11.7.2 Configuring IEC 60870-5-103 data points

You can adjust the following data point properties for the IEC 60870-5-103 control system protocol:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.</td>
<td>Yes</td>
<td>Active/inactive</td>
</tr>
<tr>
<td>TYP</td>
<td>Data point type code.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>FUN</td>
<td>Data point function type.</td>
<td>Yes</td>
<td>0...255</td>
</tr>
<tr>
<td>INF</td>
<td>Data point information number.</td>
<td>Yes</td>
<td>0...255</td>
</tr>
<tr>
<td>GIN</td>
<td>Data point generic identification number.</td>
<td>Yes</td>
<td>0...65,535</td>
</tr>
<tr>
<td>Data Type</td>
<td>Data point data type.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Name</td>
<td>Data point designation.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Interrogation</td>
<td>The value indicates whether the data point is to be included in a general query (1) or not (0).</td>
<td>Yes</td>
<td>0, 1</td>
</tr>
<tr>
<td>Threshold</td>
<td>Threshold value for measured values. The data point is only transferred again if the change of value is greater than the threshold value.</td>
<td>Yes</td>
<td>0...1,000,000,000</td>
</tr>
</tbody>
</table>

- If you enter the value 0, no threshold value is active.
- If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either.

Table 30: Configuring IEC 60870-5-103 data points

![Figure 88: Configuring IEC 60870-5-103 data points](image)
Proceed as follows to configure the data points:

1. Go to **Settings > Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

### 8.7.11.7.3 Configuring IEC 60870-5-104 data points

You can adjust the following data point properties for the IEC 60870-5-104 control system protocol:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.</td>
<td>Yes</td>
<td>Active/inactive</td>
</tr>
<tr>
<td>IOA</td>
<td>Data point address.</td>
<td>Yes</td>
<td>1...16,777,215</td>
</tr>
<tr>
<td>Name</td>
<td>Data point designation.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Type</td>
<td>Data point type.</td>
<td>No</td>
<td>-</td>
</tr>
</tbody>
</table>
| Group    | Data point group or groups. You must enter the group membership as a binary code (5 bits). A maximum of 5 groups is possible. Example:  
  - 00000: belongs to no groups  
  - 00001: group 1  
  - 01000: group 4  
  - 01001: group 1 and group 4 | Yes         | 00000...11111               |
| INTG     | The value indicates whether the data point is to be included in a general query (1) or not (0). | Yes         | 0, 1                        |
| TH       | Threshold value for measured values. The data point is only transferred again if the change of value is greater than the threshold value.  
  - If you enter the value 0, no threshold value is active.  
  - If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either.  
  Notice: You can only enter a threshold value for data points of type 9, 10, 11, 12, 13, 14, 21, 34, 35 or 36. | Yes         | 0...32,768                   |
| CT       | Interval in ms for periodic transmission of the data point. If you set 0, the data point is not transmitted periodically.  
  Notice: You can only enter an interval for data points of type 9, 11 or 13. | Yes         | 0...10,000                   |

Table 31: Configuring IEC 60870-5-104 data points
Figure 89: Configuring IEC 60870-5-104 data points

Proceed as follows to configure the data points:
1. Go to **Settings > Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

### 8.7.11.7.4 Configuring Modbus data points

You can adjust the following data point properties for the Modbus control system protocol:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.</td>
<td>Yes</td>
<td>Active/inactive</td>
</tr>
<tr>
<td>Type</td>
<td>Data point type</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Index1</td>
<td>Data point address</td>
<td>Yes</td>
<td>0...65,535</td>
</tr>
<tr>
<td>Index2</td>
<td>Optional second data point address. This is used automatically for data points able to transfer values greater than 16 bits. Please note that the Index2 address always follows on from the Index1 address exactly.</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Name</td>
<td>Data point designation</td>
<td>No</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 32: Configuring Modbus data points
Proceed as follows to configure the data points:

1. Go to **Settings > Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

### 8.7.11.7.5 Configuring DNP3 data points

You can adjust the following data point properties for the DNP3 control system protocol:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.</td>
<td>Yes</td>
<td>Active/inactive</td>
</tr>
<tr>
<td>OBJGROUP</td>
<td>The OBJGROUP column indicates the data point object group:</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>• AI = Analog Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• AO = Analog Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• BI = Binary Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDEXADDR</td>
<td>Data point address.</td>
<td>Yes</td>
<td>0...4,294,967,296</td>
</tr>
<tr>
<td>CLASS</td>
<td>Data point class.</td>
<td>Yes</td>
<td>0...3</td>
</tr>
<tr>
<td></td>
<td>• 0: Static</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 1...3: Event</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notice: You can only set the data point class for data points of object groups AI, BI, and CT.
<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Modifiable</th>
<th>Setting range</th>
</tr>
</thead>
</table>
| PREFSTATICVAR   | For a data point of class 0 (Static), you can define the following variation depending on the object group:  
  ▪ BI: 1, 2  
  ▪ BO: 2  
  ▪ AI: 2, 4  
  ▪ AO: 2  
  ▪ CT: 1, 2, 5, 6 | Yes         | 0...6          |
| PREFEVENTVAR    | For a data point of classes 1...3 (Event), you can define the following variation depending on the object group:  
  ▪ BI: 1, 2, 3  
  ▪ BO: no value  
  ▪ AI: 2, 4  
  ▪ AO: no value  
  ▪ CT: 1, 2, 5, 6 | Yes         | 0...6          |
| NAME            | Data point designation.                                                      | No         | -             |
| Deadband        | Threshold value for analog inputs. The data point is only transferred again if the change of value is greater than the threshold value.  
  ▪ If you enter the value 0, no threshold value is active.  
  ▪ If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either.  
  Notice: The threshold value has the same unit as the data point value. Take note of the list of data points. | Yes         | 0...32,768     |

Table 33: Configuring DNP3 data points

Figure 91: Configuring DNP3 data points
Proceed as follows to configure the data points:
1. Go to **Settings > Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

### 8.7.11.7.6 Resetting the data point configuration to factory settings

If you want to reset the data point configuration to factory settings, proceed as follows:
1. Go to **Settings > Data point configuration**.
2. Press the **Reset** button.
   - The message Reset appears.
3. Press the **Yes** button to reset the data point configuration to the factory settings.
4. Restart the device to activate the modified list of data points.

### 8.7.11.7.7 Exporting and importing the data point configuration

You can export the data point configuration, e.g., to back it up or import it into another device. You will find more information in the Import/Export Manager section.

### 8.8 Menu Settings > Events

The events have the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event status</td>
<td>Active: The event is pending. Inactive: The event is not pending.</td>
</tr>
<tr>
<td>High active</td>
<td>High active: The device generates a signal if the event is pending. Low active: The device generates a signal for as long as the event is not pending. If the event is pending, the signal is reset.</td>
</tr>
<tr>
<td>Can be set multiple times</td>
<td>The event can be triggered several times without having been deactivated in the meantime.</td>
</tr>
<tr>
<td>Acknowledgeable</td>
<td>Acknowledgeable events must be acknowledged in the event overview so that they are no longer displayed. All other events are automatically removed once the cause is remedied (e.g., limit value no longer exceeded).</td>
</tr>
<tr>
<td>Event name</td>
<td>Brief name of event. If you delete all of the text, the standard text is displayed.</td>
</tr>
<tr>
<td>Event description</td>
<td>Description of event. If you delete all of the text, the standard text is displayed.</td>
</tr>
</tbody>
</table>
### Table 34: Properties of events

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event troubleshooting</td>
<td>Instructions for troubleshooting the cause of an event. If you delete all of the text, the standard text is displayed.</td>
</tr>
</tbody>
</table>
| Category             | ▪ Warning (yellow)  
▪ Info (gray)  
This setting affects the color of the Alarm LED and the event symbol in the primary navigation. |
| Message              | If you activate this option, the event is shown on the display and, if configured accordingly, issued via an output and the control system protocol. |
| Storage              | If you enable this option, the event is stored in the event memory.                              |

To configure an event, proceed as follows:
1. Go to **Settings > Events**.
2. Select the event to be changed in the list.
3. Select the desired options.
4. Press the **Accept** button to save the change.

### 8.9 Menu Settings > DIO configuration (optional)

Upon delivery, the configurable digital inputs and outputs of the device are configured as follows:

▪ Input: High active  
▪ Output: Normally open contact (NO)

You can change this configuration if necessary.
Ensure that the configuration of the digital inputs and outputs is suitable for the functions used. Otherwise, malfunctions may occur in the device and the connected periphery.

The following information is displayed in tabular form for configuring the digital inputs and outputs. Grayed out elements cannot be changed.

<table>
<thead>
<tr>
<th>Property</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Function of the digital input (I: ...) or the digital output (O: ...). You can adjust the designation.</td>
</tr>
<tr>
<td>Signal type</td>
<td>Select signal type: Digital input</td>
</tr>
<tr>
<td>Configuration</td>
<td>DI: High active or low active</td>
</tr>
<tr>
<td></td>
<td>DO: N/O contact (NO), N/C contact (NC); Note: If the device is disconnected or in the event of an error, the digital outputs are always open (no bi-stable relay).</td>
</tr>
<tr>
<td>Assembly/channel</td>
<td>Channel of the DIO assembly to which the function is linked. Functions that are not linked with a channel are identified with &quot;-&quot;. Note the connection diagram supplied.</td>
</tr>
</tbody>
</table>

Table 35: Configuration of the digital inputs and outputs

The operation described below is only possible if you access the visualization using a computer. You can only change the configuration of the digital inputs and outputs if you have a Parameter Configurator or Administrator role.

When in delivery status, you can log in as the administrator as follows:

- **User name:** admin
- **Password:** admin
Creating a backup  
You need to create a backup to be able to reset the system in the event that any incorrect configuration settings are made. To do so, proceed as follows:
1. Go to **Settings > Export**.
2. Go to the option **Settings** to export a backup copy of the current settings.
3. Select the desired **Interface** (USB or PC).
4. Press the **Export** button to start the export.

Configuring DIO  
To configure the device’s digital inputs and outputs, proceed as follows:
1. Go to menu item **Settings > DIO configuration**.
2. Where necessary, select the buttons ▲ or ▼ to sort the properties in a column alphabetically.
3. Configure the properties as desired.
4. Press the **Accept** button.
5. Confirm the security prompt with **Yes** to save the changes.

8.10 Menu Settings > AIO configuration (optional)  
You can flexibly configure the device’s analog inputs and outputs and assign device functions.

The device supports analog sensors with linear characteristic curves and only outputs analog signals with linear characteristic curves.

![Figure 94: Example: analog signal with linear characteristic curve](image)

**NOTICE**  
**Damage to the device and sensors!**  
Incorrectly connected and configured analog inputs/outputs may result in damage to the device and sensor.

► Follow information about connecting analog sensors [► Section 6.3.3, Page 55].

► Configure analog inputs and outputs according to the connected sensors.
The following information is displayed in tabular form for configuring the analog inputs and outputs. Grayed out elements cannot be changed.

<table>
<thead>
<tr>
<th>Property</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Function of the analog input (I: ...) or the analog output (O: ...). You can adjust the designation.</td>
</tr>
<tr>
<td>Card/channel</td>
<td>Select the slot and channel of the analog sensor. Note the connection diagram supplied.</td>
</tr>
<tr>
<td>Signal type</td>
<td>Select signal type of analog sensor or deactivate analog output.</td>
</tr>
<tr>
<td></td>
<td>• 4...20 mA</td>
</tr>
<tr>
<td></td>
<td>• PT100-2/3/4, PT1000-2/3/4</td>
</tr>
<tr>
<td>Min/Max&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>Set the minimum and maximum values of the sensor, e.g. with a 4...20 mA signal, the corresponding measured value for 4 mA and the corresponding value for 20 mA.</td>
</tr>
</tbody>
</table>

Table 36: Configuration of the analog inputs and outputs

The operation described below is only possible if you access the visualization using a computer. You can only change the configuration of the analog inputs and outputs if you have a Parameter Configurator or Administrator role.

When in delivery status, you can log in as the administrator as follows:

- User name: admin
- Password: admin

Creating a backup

You need to create a backup to be able to reset the system in the event that any incorrect configuration settings are made. To do so, proceed as follows:
1. Go to Settings > Export.
2. Go to the option Settings to export a backup copy of the current settings.
3. Select the desired Interface (USB or PC).
4. Press the Export button to start the export.
**Configuring AIO**

To configure the device's analog inputs and outputs, proceed as follows:

1. Go to **Settings > AIO configuration**.
2. Configure the properties as desired.
3. Press the **Accept** button.
4. Confirm the security prompt with **Save** to save the changes.

**8.11 Tap position table**

You can enter individual names for the tap positions in this menu.

**8.12 Menu Settings > Reset VAM**

The software in the MSENSE® VAM monitoring system uses a self-learning algorithm which approximates the limit values towards the vibro-acoustic signal progression as the number of tap-change operations increases. The statistics stored for this can be reset in this display window.

**Resetting the counter**

The first and the second anomalies in an evaluation cluster are indicated via a yellow status message in the VAM analysis (Information menu). A third anomaly arising in an evaluation cluster triggers an additional event message. This event message is transmitted to a connected SCADA system.

By selecting "Counters", you reset the counters that are used to trigger the events for the vibro-acoustic evaluation. The self-learned statistics are retained.

**Resetting the statistics**

The stored statistics are used among other things to display the self-learned limit value (yellow curve [Section 4.6.2, Page 33]).

When you select "Statistics", you reset the self-learned statistics and the counters that are used to evaluate the vibro-acoustic signals.
8.13 Menu settings > VAM update rules

Using the update rules, you can define which tap-change operations are recorded and analyzed:

1. Go to **Settings > VAM update rules**.
2. Select the desired tap-change operation and, with multi-column application, the desired on-load tap-changer switching column (A, B or C).
3. Set the parameter.
4. Press the **Accept** button to save the modified parameter.

The following settings are available for selection:

1. "**Evaluation and statistics update**"
   - Standard setting
   - The tap-change operation is recorded, checked for plausibility and evaluated.
   - The statistics update ensures the self-learning of the yellow limit value curve (envelope curve).

2. "**No statistics update**"
   - The tap-change operation is only recorded and checked for plausibility.
   - The evaluation and statistics update are not performed.
   - If a limit value curve has already been learned, limit value violations can nevertheless occur. In the event of doubt, contact the Maschinenfabrik Reinhausen GmbH Technical Service department.

3. "**No evaluation**"
   - The tap-change operation recording will not be analyzed or evaluated.
   - As a consequence, an entry is not made in the menu **Information > VAM analysis** for this tap-change operation.
8.14 Menu Settings > Commissioning wizard

You will find more information on the commissioning wizard in the Commissioning [Section 7, Page 67] chapter.

8.15 Menu Settings > TPLE

You can use the TAPCON® Personal Logic Editor (TPLE) function to program simple logical links via the web-based visualization. You can also link the inputs and outputs available on the device using function modules.

Note that the device does not meet the requirements of a protective device. Therefore, do not use TPLE to produce protective functions.

8.15.1 Function

8.15.1.1 Function groups

There are 10 function groups available that you can use to combine various sub-tasks into one function. In one function group, you can link up to 12 function modules with variables. You can rename function groups and activate or deactivate them individually.

8.15.1.2 Variables

The following types of variables for information processing are available for TPLE:

- Event inputs: You can use all the device's events as inputs for a function.
- Event outputs: 100 generic events are available as outputs for functions.
- Binary inputs: You can use all the device's configured digital inputs and up to 42 generic inputs of the device as inputs for a function.
- Binary outputs: You can use all the device's configured digital outputs and up to 20 generic outputs of the device as outputs for a function. If there is a control system present, 10 generic control system messages are available.
- Analog inputs: You can use all the device's configured analog inputs as inputs for a function.
- Binary flags: You can use up to 100 binary flags as variables to store intermediate values. You can use binary flags as inputs and outputs for a function.
- Analog flags: You can use up to 50 analog flags as variables to store intermediate values. You can use analog flags as inputs and outputs for a function.
- Discrete inputs: You can use all the device's available discrete inputs as inputs for a function.
8.15.1.3 Function modules

TPLE provides various function modules for processing the information.

8.15.1.3.1 AND

<table>
<thead>
<tr>
<th>Description</th>
<th>AND, logical AND link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input 1…4 (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If all configured inputs are TRUE, the output is TRUE, otherwise it is FALSE.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE.</td>
</tr>
<tr>
<td></td>
<td>Non-configured inputs are assumed to be TRUE.</td>
</tr>
<tr>
<td></td>
<td>If no input is configured, the module is not run so it remains in its initial state.</td>
</tr>
</tbody>
</table>

Table 37: AND function module

8.15.1.3.2 NAND

<table>
<thead>
<tr>
<th>Description</th>
<th>NAND, logical NOT-AND link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input 1…4 (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If all configured inputs are TRUE, the output is FALSE, otherwise it is TRUE.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE.</td>
</tr>
<tr>
<td></td>
<td>Non-configured inputs are assumed to be TRUE so they have no impact on the output.</td>
</tr>
<tr>
<td></td>
<td>If no input is configured, the output therefore remains in the initial state of FALSE.</td>
</tr>
</tbody>
</table>

Table 38: NAND function module

8.15.1.3.3 OR

<table>
<thead>
<tr>
<th>Description</th>
<th>OR, logical OR link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input 1…4 (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If one of configured inputs is TRUE, the output is TRUE, otherwise it is FALSE.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE.</td>
</tr>
<tr>
<td></td>
<td>Non-configured inputs are assumed to be FALSE.</td>
</tr>
</tbody>
</table>

Table 39: OR function module
### 8.15.1.3.4 NOR

<table>
<thead>
<tr>
<th>Description</th>
<th>NOR, logical NOT-OR link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input 1…4 (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If all configured inputs are FALSE, the output is TRUE, otherwise it is FALSE.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE. Non-configured inputs are assumed to be FALSE so that they have no impact on the output. If no input is configured, the output remains in the initial state of FALSE anyway.</td>
</tr>
</tbody>
</table>

Table 40: NOR function module

### 8.15.1.3.5 XOR

<table>
<thead>
<tr>
<th>Description</th>
<th>XOR, logical EXCLUSIVE-OR link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input 1…2 (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If an odd number of inputs is TRUE, the output is TRUE, otherwise it is FALSE.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE. Non-configured inputs are assumed to be FALSE so that they have no impact on the output. If no input is configured, the output therefore remains in the initial state of FALSE.</td>
</tr>
</tbody>
</table>

Table 41: XOR function module

### 8.15.1.3.6 NOT

<table>
<thead>
<tr>
<th>Description</th>
<th>NOT, logical NOT link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If the input is TRUE, the output is FALSE, otherwise it is TRUE.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE. If the input is not configured, it is assumed to be TRUE so that the output remains in the initial state of FALSE.</td>
</tr>
</tbody>
</table>

Table 42: NOT function module
8.15.1.3.7 Current impulse relay

<table>
<thead>
<tr>
<th>Description</th>
<th>RS, current impulse relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Trigger (BOOL)</td>
</tr>
<tr>
<td></td>
<td>Set (BOOL)</td>
</tr>
<tr>
<td></td>
<td>Reset (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>None</td>
</tr>
<tr>
<td>Function</td>
<td>If the Reset input is TRUE, Output forcibly becomes FALSE.</td>
</tr>
<tr>
<td></td>
<td>If the Reset input is FALSE and the Set input is TRUE, Output forcibly becomes TRUE.</td>
</tr>
<tr>
<td></td>
<td>If the Reset and Set inputs are FALSE, the status of Output changes when there is a rising edge at the Trigger input. If there is no edge at the Trigger input, Output remains unchanged.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are FALSE.</td>
</tr>
<tr>
<td></td>
<td>Non-configured inputs are assumed to be FALSE so that they have no impact on the output.</td>
</tr>
</tbody>
</table>

Table 43: Current impulse relay function module

Figure 97: Example of RS

<table>
<thead>
<tr>
<th>1 Trigger</th>
<th>2 Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Reset</td>
<td>4 Output</td>
</tr>
</tbody>
</table>

8.15.1.3.8 Switch-on delay

<table>
<thead>
<tr>
<th>Description</th>
<th>TON, switch-on delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>Time ms (UINT32), 1…1,000,000, default = 1,000</td>
</tr>
</tbody>
</table>
8.15.1.3.9 Switch-off delay

Description: TOFF, switch-off delay

Inputs:
- Trigger (BOOL)
- Reset (BOOL)

Outputs: Output (BOOL)

Parameter: Time ms (UINT32), 1...1,000,000, default = 1,000

Function:
- If Input becomes TRUE, Output also instantly becomes TRUE, this condition takes priority.
- When the internal timer has reached or exceeded the parameter value, Output becomes FALSE and the counter stops running.
- If Input is FALSE and the Reset input becomes TRUE, Output instantly and forcibly becomes FALSE and the internal timer is set to the configured desired value.
- If the value of Time_ms is less than the cycle time, the cycle time applies instead.

Initial state: All inputs and outputs are FALSE.

Table 45: Switch-off delay function module

8.15.1.3.10 Pulse

Description: PLSE, pulse

Inputs: Trigger (BOOL)

Outputs: Output (BOOL)

Parameter: Time ms (UINT32), 1...1,000,000, default = 1,000

Table 45: Switch-off delay function module
Function
If there is a rising edge at the Trigger input at any time, the internal timer is set to zero and starts to run, the output becomes TRUE.
If the Trigger input becomes FALSE again during the pulse time, this has no impact on the expiration of the pulse time.
Once the internal timer has expired, the output becomes FALSE.
If the value of Time_ms is less than the cycle time, the cycle time applies instead.

Initial state
All inputs and outputs are FALSE.

Table 46: Pulse function module

8.15.1.3.11 Symmetrical pulse generator

Description
CLCK, symmetrical pulse generator

Inputs
Enable (BOOL)

Outputs
Output (BOOL)

Parameter
Time ms (UINT32), 1...1,000,000, default = 1,000

Function
The internal timer runs for as long as Enable is TRUE. When the internal timer has reached or exceeded the configured time value, the status of the output changes and the timer is restarted. The configured time therefore corresponds to half the period duration of the resulting signal. If the Enable input becomes FALSE, the output also instantly becomes FALSE and the internal timer is reset.
If the value of Time_ms is less than the cycle time, the cycle time applies instead.

Initial state
All inputs and outputs are FALSE.

Table 47: Symmetrical pulse generator function module

8.15.1.3.12 Counter (forwards/backwards)

Description
COUNT, incremental counter

Inputs
Trigger (BOOL)
Direction (BOOL)
Reset (BOOL)
Lock (BOOL)

Outputs
SINT32 (SINT32)
REAL32 (REAL32)

Parameter
Reset value (SINT32), -10,000,000… +10,000,000, default = 0

Table 48: Counter (forwards/backwards) function module
Function

If there is a rising edge at Reset, the output value is set to the value of the Reset value parameter. A rising edge at Reset takes priority over all other inputs.

For as long as Lock is TRUE, the pulse signal is not evaluated and the counter reading is retained. If no input is assigned, the default value FALSE is assumed.

When Direction input = FALSE, the output value is incremented by one with every rising edge at the Trigger input.

When Direction input = TRUE, the output value is decremented by one with every rising edge at the Trigger input.

Initial state

All inputs and outputs are zero or FALSE.

Table 48: Counter (forwards/backwards) function module

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trigger</td>
</tr>
<tr>
<td>2</td>
<td>Direction</td>
</tr>
<tr>
<td>3</td>
<td>Reset</td>
</tr>
<tr>
<td>4</td>
<td>Lock</td>
</tr>
<tr>
<td>5</td>
<td>Output</td>
</tr>
</tbody>
</table>

Figure 98: Example of COUNT

8.15.1.3.13 Analog threshold value switch with hysteresis

<table>
<thead>
<tr>
<th>Designation</th>
<th>THRES, threshold value switch with hysteresis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input (REAL32)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (BOOL) Error (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>On Limit (REAL32), -10,000,000… +10,000,000, default = 10,000,000</td>
</tr>
<tr>
<td></td>
<td>Off Limit (REAL32), -10,000,000… +10,000,000, default = -10,000,000</td>
</tr>
</tbody>
</table>
Function

On Limit ≥ Off Limit setting:
- If the value of Input is greater than On Limit, Output becomes TRUE.
- If the value of Input is less than or equal to Off Limit, Output becomes FALSE.

On Limit < Off Limit setting:
- If the value of Input is greater than On Limit and at the same time less than Off Limit, Output becomes TRUE. Otherwise, the Output is FALSE.

Initial state
All inputs and outputs are zero or FALSE.

Table 49: Analog threshold value switch with hysteresis function module

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALSE</td>
<td>TRUE</td>
</tr>
<tr>
<td>FALSE</td>
<td>FALSE</td>
</tr>
</tbody>
</table>

Figure 99: Analog threshold value switch with the On Limit > Off Limit setting

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALSE</td>
<td>TRUE</td>
</tr>
<tr>
<td>TRUE</td>
<td>FALSE</td>
</tr>
<tr>
<td>FALSE</td>
<td>FALSE</td>
</tr>
<tr>
<td>TRUE</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

Figure 100: Analog threshold value switch with the On Limit < Off Limit setting
### 8.15.1.3.14 Analog multiplication

<table>
<thead>
<tr>
<th>Description</th>
<th>MUL, analog multiplication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
</tr>
<tr>
<td>Value (REAL32)</td>
<td></td>
</tr>
<tr>
<td>Multiplier (REAL32)</td>
<td></td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
</tr>
<tr>
<td>Result (REAL32)</td>
<td></td>
</tr>
<tr>
<td>Overflow (BOOL)</td>
<td></td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
<td></td>
</tr>
<tr>
<td>Constant multiplier (REAL32), -1,000,000...+1,000,000; default = 1</td>
<td></td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td></td>
</tr>
<tr>
<td>Result = Value * Multiplier * Constant multiplier</td>
<td>If the REAL32 range of numbers is exceeded, the Overflow output becomes TRUE.</td>
</tr>
<tr>
<td><strong>Initial state</strong></td>
<td></td>
</tr>
<tr>
<td>All inputs and outputs are zero or FALSE.</td>
<td></td>
</tr>
</tbody>
</table>

Table 50: Analog multiplication function module

### 8.15.1.3.15 Analog division

<table>
<thead>
<tr>
<th>Description</th>
<th>DIV, analog division</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
</tr>
<tr>
<td>Dividend (REAL32)</td>
<td></td>
</tr>
<tr>
<td>Divisor (REAL32)</td>
<td></td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
</tr>
<tr>
<td>Result (REAL32)</td>
<td></td>
</tr>
<tr>
<td>DivByZero (BOOL)</td>
<td></td>
</tr>
<tr>
<td>Overflow (BOOL)</td>
<td></td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
<td></td>
</tr>
<tr>
<td>Constant divisor (REAL32), -1,000,000...+1,000,000; default = 1</td>
<td></td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td></td>
</tr>
<tr>
<td>Result = Dividend / Divisor / Constant Divisor</td>
<td>If dividing by zero, the DivByZero output becomes TRUE and Result is set to zero. If the REAL32 range of numbers is exceeded, the Overflow output becomes TRUE and Result is set to zero.</td>
</tr>
<tr>
<td><strong>Initial state</strong></td>
<td></td>
</tr>
<tr>
<td>All inputs and outputs are zero or FALSE.</td>
<td></td>
</tr>
</tbody>
</table>

Table 51: Analog division function module

### 8.15.1.3.16 Analog addition

<table>
<thead>
<tr>
<th>Description</th>
<th>ADD, analog addition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
</tr>
<tr>
<td>Input 1 (REAL32)</td>
<td></td>
</tr>
<tr>
<td>Input 2 (REAL32)</td>
<td></td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
</tr>
<tr>
<td>Result (REAL32)</td>
<td></td>
</tr>
<tr>
<td>Overflow (BOOL)</td>
<td></td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
<td></td>
</tr>
<tr>
<td>Offset (REAL32), -1,000,000...+1,000,000; default = 0</td>
<td></td>
</tr>
</tbody>
</table>

Table: Analog addition function module
Function | Result = Input 1 + Input 2 + Offset  
If the REAL32 range of numbers is exceeded, the Overflow output becomes TRUE.

Initial state | All inputs and outputs are zero or FALSE.

Table 52: Analog addition function module

8.15.1.3.17 Analog subtraction

Description | SUB, analog subtraction

Inputs | Input 1 (REAL32)  
Input 2 (REAL32)

Outputs | Result (REAL32)  
Overflow (BOOL)

Parameter | Offset (REAL32), -1,000,000...+1,000,000; default = 0

Function | Result = Input 1 - Input 2 – Offset  
If the REAL32 range of numbers is exceeded, the Overflow output becomes TRUE.

Initial state | All inputs and outputs are zero or FALSE.

Table 53: Analog subtraction function module

8.15.1.3.18 Rising edge

Description | RTRG, rising edge trigger

Inputs | Input (BOOL)

Outputs | Output (BOOL)

Parameter | -

Function | When the input changes from FALSE to TRUE, the output becomes TRUE for one cycle of the function group and then changes back to FALSE.

Initial state | All inputs and outputs are FALSE.

Table 54: Rising edge function module

8.15.1.3.19 Falling edge

Description | FTRG, falling edge trigger

Inputs | Input (BOOL)

Outputs | Output (BOOL)

Parameter | -

Function | When the input changes from TRUE to FALSE, the output becomes TRUE for one cycle of the function group and then changes back to FALSE.

Initial state | All inputs and outputs are FALSE.

Table 55: Falling edge function module
## 8.15.1.3.20 Average value

### Description

AVRG, average value

### Inputs

- Input (REAL32)
- Enable (BOOL)
- Reset (BOOL)
- Autorepeat (BOOL)

### Outputs

- Average (REAL32)
- Done (BOOL)
- Started (BOOL)
- SampleCount (UINT32)

### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time ms (UINT32): 1...2,000,000,000, default = 10,000</td>
<td>Average starts with a rising edge of Enable. This does not affect averaging which is already underway. Any output value remaining from earlier is retained. The Done output becomes FALSE, the Started output becomes TRUE. Active averaging is interrupted with a rising edge of Reset. Average is set to zero, Done and Started become FALSE. If Enable is also TRUE during the rising Reset edge, a new averaging process is started. Done becomes TRUE and Started becomes FALSE once averaging is complete. Done remains TRUE until a Reset is detected or new averaging is triggered by a rising edge of Enable. If AutoRepeat and Enable are TRUE, a new averaging process is automatically started each time averaging is completed. Done is set for one cycle each time averaging is completed. The SampleCount output states how many samples have already been recorded. Sample time ms is the desired sample time in milliseconds. It is rounded up to the next whole multiple of the task cycle time and has a lower limit of at least one task cycle time. Time ms is the time period desired for averaging. It is internally rounded up to the next whole multiple of the sample time and has a lower limit of at least one sample time.</td>
</tr>
<tr>
<td>Sample time ms (UINT32): 1...10,000,000, default = 1,000</td>
<td>Initial state</td>
</tr>
</tbody>
</table>

**Table 56: Average value function module**
Figure 101: AVRG

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input</td>
<td>2</td>
<td>Enable</td>
<td>3</td>
<td>Reset</td>
<td>4</td>
<td>AutoRepeat</td>
</tr>
<tr>
<td>5</td>
<td>Average</td>
<td>6</td>
<td>Done</td>
<td>7</td>
<td>Started</td>
<td>8</td>
<td>SampleCount</td>
</tr>
</tbody>
</table>

### 8.15.1.3.21 Scaling

<table>
<thead>
<tr>
<th>Description</th>
<th>SCAL, scaling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Input (REAL32)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output (REAL32)</td>
</tr>
<tr>
<td></td>
<td>Error (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>Min In (REAL32): -10,000,000...+10,000,000, default = -10,000,000</td>
</tr>
<tr>
<td></td>
<td>Max In (REAL32): -10,000,000...+10,000,000, default = +10,000,000</td>
</tr>
<tr>
<td></td>
<td>Min Out (REAL32): -10,000,000...+10,000,000, default = -10,000,000</td>
</tr>
<tr>
<td></td>
<td>Max Out (REAL32): -10,000,000...+10,000,000, default = +10,000,000</td>
</tr>
</tbody>
</table>
Function is calculated using the following formula:
\[
\text{Output} = \text{Min Out} + (\text{Max Out} - \text{Min Out}) \times \frac{(\text{Input} - \text{Min In})}{(\text{Max In} - \text{Min In})}
\]

Output is set to 0 and Error = TRUE when:
- Input is not within the parameters Min In and Max In
- Min In is greater than Max In
- Min Out is greater than Max Out
- Max In is the same size as Min In (division by zero)

Initial state: All inputs and outputs are FALSE.

Table 57: Scaling function module

<table>
<thead>
<tr>
<th>8.15.1.3.22</th>
<th>Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation</td>
<td>BRDG, Bridge</td>
</tr>
<tr>
<td>Inputs</td>
<td>Analog Input (REAL32) \n Digital Input (BOOL)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Analog Output (REAL32) \n Digital Output (BOOL)</td>
</tr>
<tr>
<td>Parameter</td>
<td>-</td>
</tr>
<tr>
<td>Function</td>
<td>Copies the value of Analog Input to Analog Output and Digital Input to Digital Output.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are zero or FALSE.</td>
</tr>
</tbody>
</table>

Table 58: Bridge function module

<table>
<thead>
<tr>
<th>8.15.1.3.23</th>
<th>RTOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>RTOI, Real-to-Integer conversion</td>
</tr>
<tr>
<td>Inputs</td>
<td>Analog Input (REAL32)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Analog Output (SINT32)</td>
</tr>
<tr>
<td>Parameter</td>
<td>-</td>
</tr>
<tr>
<td>Function</td>
<td>Copies the value of Analog Input to Analog Output and converts REAL32 to SINT32.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are zero.</td>
</tr>
</tbody>
</table>

Table 59: RTOI function module

<table>
<thead>
<tr>
<th>8.15.1.3.24</th>
<th>ITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>ITOR, Integer-to-real conversion</td>
</tr>
<tr>
<td>Inputs</td>
<td>UINT32 (UINT32) \n SINT32 (SINT32)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Output U (REAL32) \n Output S (REAL32)</td>
</tr>
</tbody>
</table>
8 Operation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>The value of UINT32 is output converted to Output U, the value of SINT32 is output converted to Output S.</td>
</tr>
<tr>
<td>Initial state</td>
<td>All inputs and outputs are zero.</td>
</tr>
</tbody>
</table>

Table 60: NAND function module

8.15.2 Configuring TPLE

You can configure TPLE on a PC using the web-based visualization. Only a live view is available on the device’s display. To configure TPLE, you have to hold the role of Administrator or Parameterizer.

When in delivery status, you can log in as the administrator as follows:

- User name: admin
- Password: admin

8.15.2.1 Editing variables

You can adapt the name and description of the following variables:

- Binary inputs
- Binary outputs
- Analog inputs
- Binary flags
- Analog flags
- Discrete inputs

The names and descriptions of the generic events can also be adapted like all other device events. Note the Event management section.

The permissible number of characters is limited:

- Name: Maximum of 20 characters
- Description: Maximum of 80 characters
To edit the variable, proceed as follows:
1. Go to Settings > TPLE > Variables.
2. Select the variable you want.
3. Enter the name and description.
4. Press the Accept button to save the modified variable.

8.15.2.2 Creating functions

Within one function group, you can create up to 12 function modules to depict one function. To create, edit or delete a function, you have to call up the function group you want. To do so, proceed as follows:
1. Go to Settings > TPLE > Function group.
2. Select the function group you want.
Creating function modules
To create a function module, proceed as follows:
► Press the + button to create a new function module.

Deleting function modules
To delete a function module, proceed as follows:
► Drag the desired function module to the trash can using drag & drop.

Sorting function modules
To sort a function module, proceed as follows:
► Drag the desired function module to the desired position using drag & drop.

Editing function module
To edit a function module, proceed as follows:
1. Select the desired function module.
2. Press the Edit button.
3. Select the inputs and outputs you want and set the parameters.
4. Press the Accept button to save the change to the function module.

8.15.2.3 Renaming function group
If necessary, you can rename the function group in order to better assign it.
To rename a function group, proceed as follows:
1. Go to Settings > TPLE > Function group.
2. Select the function group you want.
3. Select the text field with the **name of the function group** and enter the name you want.

4. Press [Enter] to accept the change.

### 8.15.2.4 Activating/deactivating function group

You can fully activate or deactivate a function group. When you deactivate a function group, none of the function group's function modules are processed.

To activate/deactivate a function group, proceed as follows:

1. Go to **Settings > TPLE > Function group**.
2. Select the **function group** you want.
3. Press the **Inactive** button.

   - Red X: Function group is inactive; gray X: Function group is active.

### 8.16 Menu Settings > Import

The device is equipped with an import/export manager, which can be used to export and import various data.

To transfer the data, the following options are available:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB</td>
<td>Data transfer via USB port on rear of CPU I assembly.</td>
</tr>
<tr>
<td>PC</td>
<td>Data transfer via PC using web-based visualization.</td>
</tr>
</tbody>
</table>

Table 61: Data transfer options
You can import the following data:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System image</td>
<td>Complete image of the system (software and configuration), with or without history.</td>
</tr>
<tr>
<td>Settings</td>
<td>All device settings:</td>
</tr>
<tr>
<td></td>
<td>• Parameter settings</td>
</tr>
<tr>
<td></td>
<td>• Event settings</td>
</tr>
<tr>
<td></td>
<td>• Administrative settings (users, access rights) The settings can also be imported from another device.</td>
</tr>
<tr>
<td>Language</td>
<td>Import of additional languages. You can install a maximum of five different languages on the device. If five languages are already installed, you will be asked to delete one during the import process.</td>
</tr>
<tr>
<td>SSL certificate</td>
<td>Import of an SSL certificate with associated key:</td>
</tr>
<tr>
<td></td>
<td>• Server certificate (.crt + .pem)</td>
</tr>
<tr>
<td></td>
<td>• Client certificate (.crt + .pem)</td>
</tr>
<tr>
<td></td>
<td>• Client CA (.crt)</td>
</tr>
<tr>
<td></td>
<td>For the import, you will have to compress the certificate (<em>.crt) and key (</em>.pem) in a zip file. You can import certificates with the following key authentication:</td>
</tr>
<tr>
<td></td>
<td>• RSA with 1024 bits</td>
</tr>
<tr>
<td></td>
<td>• ECDSA with 256 bits (&quot;secp256r1&quot; or &quot;prime256v1&quot; curve).</td>
</tr>
<tr>
<td>Data point config-</td>
<td>Data point configuration import</td>
</tr>
<tr>
<td>uration</td>
<td></td>
</tr>
<tr>
<td>SCD import</td>
<td>Control system configuration import</td>
</tr>
<tr>
<td>TPLE</td>
<td>Customer program import (TPLE).</td>
</tr>
</tbody>
</table>

Table 62: Importing data

**NOTICE**

Damage to the file system!

The file system can become damaged due to an incorrect data transmission process. A damaged file system can lead to the device no longer being functional.

► Do not disconnect the device from the power supply during the import.

► During the import, do not remove the USB stick or disconnect the network connection.

To import data, proceed as follows:

1. Go to **Settings > Import**.
2. Select the desired option for data transmission (PC or USB).
3. Select the file to be imported.
   ➔ The file is checked.
4. Press the **Import** button.

   ⇦ The data is imported, then the device is restarted.

### 8.17 Menu Settings > Export

The device is equipped with an import/export manager, which can be used to export and import various data.

To transfer the data, the following options are available:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB</td>
<td>Data transfer via USB port on rear of CPU I assembly.</td>
</tr>
<tr>
<td>PC</td>
<td>Data transfer via PC using web-based visualization.</td>
</tr>
</tbody>
</table>

**Table 63: Data transfer options**

The device stops logging the measured value recorder data for the duration of the export. The screen will only update again once the export is complete. The regulation functions and monitoring functions of the device, however, remain available.

You can export the following data from the device, depending on your device configuration:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System image</td>
<td>Complete image of the system (software and configuration). If you are using the option &quot;with history&quot;, all of the event memory entries are also exported.</td>
</tr>
<tr>
<td>System configuration</td>
<td>System configuration</td>
</tr>
<tr>
<td>Customer program</td>
<td>Customer program export (TPL).</td>
</tr>
<tr>
<td>Event memory</td>
<td>All event memory entries.</td>
</tr>
<tr>
<td>Recorder</td>
<td>Measured value memory export.</td>
</tr>
<tr>
<td>Parameter list</td>
<td>Parameter list with descriptive text and values (min, max, current).</td>
</tr>
<tr>
<td>Event list</td>
<td>Complete list of all possible events.</td>
</tr>
<tr>
<td>SCADA configuration</td>
<td>Control system configuration (e.g. ICD file for IEC 61850).</td>
</tr>
<tr>
<td>Operating Instructions</td>
<td>Operating instructions, protocol specifications.</td>
</tr>
<tr>
<td>Settings</td>
<td>Configuration of parameters and events.</td>
</tr>
</tbody>
</table>
### Option Description

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security log</td>
<td>Logbook of all instances of access and changes relating to security.</td>
</tr>
<tr>
<td>VAM export</td>
<td>Enables the vibro-acoustic recordings to be exported.</td>
</tr>
<tr>
<td></td>
<td>As an alternative to a full export, you can export selected/filtered data.</td>
</tr>
<tr>
<td></td>
<td>Exporting via FTP access is also possible, as long as you have set up an FTP client.</td>
</tr>
</tbody>
</table>

Table 64: Exporting data

Only remove the USB stick once the data transfer is complete. Otherwise data may be lost.

To export data, proceed as follows:

1. Go to **Settings > Export**.
2. Select the desired option for the export.

#### 8.17.1 VAM export

You can export the vibro-acoustic records as a zip file.

![Figure 106: VAM export](image)

Figure 106: VAM export

- Go to **VAM export (.zip)**.
Two options will be presented for selection: Complete export or User-defined export.

![Complete VAM export](image)

Figure 107: VAM export selection

Depending on the file format and the data volume, the complete VAM export will take longer.

There are 3 options available:

![Complete VAM export](image)

Figure 108: Complete VAM export

By selecting **100 points** and **TDMS format**, the data necessary for the standard online report will be exported. The **WAVE format** is necessary in addition for the extended online report. Contact Maschinenfabrik Reinhausen GmbH for the online report.

The latest information about your product and the description of the data exchange can be found on the customer portal: https://portal.reinhausen.com/mydevices/.
With the user-defined VAM export option, you can filter data or select data from the list. The number of signals is limited to 100. All three formats will be exported (100 points, TDMS format and WAVE format).

8.18 Menu Settings > Administration

With this menu, you can change user administration settings. As an administrator, you can view and adjust the rights of selected users.

You will find additional details in the "User administration" [Section 8.2, Page 78] chapter.


9 Inspection and maintenance

This chapter contains information about inspecting and maintaining the product.

9.1 Care

You can clean the VAM sensor, the VAM sensor adapter and the housing of the control cabinet with a dry cloth. You can clean the inside of the control cabinet with a dry cloth.

9.2 Inspection

Inspect the functionality of the signal lamp in the control cabinet once per year.

9.3 Maintenance

Maintenance of the monitoring system is not required. However, check the state and functionality of the monitoring system as part of maintenance work on the transformer.

Technical Service

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

This chapter describes how to rectify simple operating faults.

### 10.1 General faults

<table>
<thead>
<tr>
<th>Characteristics/details</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No function</td>
<td>No voltage supply</td>
<td>Check the voltage supply</td>
</tr>
<tr>
<td>• Device not starting</td>
<td>Fuse tripped</td>
<td>Contact Maschinenfabrik Reinhausen GmbH</td>
</tr>
</tbody>
</table>
| No function             | Rotary switch of CPU assembly moved | Correct position of rotary switch:  
| • ERR LED of the CPU assembly lights up |                         | • 0 position  
|                         |                              | • RUN position                                  |
| Relays chatter          | High EMC load                | Use shielded cables or external filters          |
|                         | Poor grounding               | Check the functional ground                     |

Table 65: General faults

### 10.2 Event messages

<table>
<thead>
<tr>
<th>Event</th>
<th>Color code</th>
<th>Definition</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAM: Recording running</td>
<td>Gray</td>
<td>The recording starts at the beginning of the tap-change operation and ends when the vibro-acoustic data record is stored.</td>
<td>Wait until the recording is complete.</td>
</tr>
<tr>
<td>VAM: Recording not possible</td>
<td>Yellow</td>
<td>Recording is not possible if the tap-change operation is invalid or there is a sensor error.</td>
<td>Check the function and wiring of the sensor, the tap position capture, the K1/K2 response contacts and the device configuration.</td>
</tr>
<tr>
<td>VAM: Recording being analyzed</td>
<td>Gray</td>
<td>Recordings are being analyzed. Recordings are being analyzed. Results will be available after the analysis.</td>
<td>Wait until the analysis is finished.</td>
</tr>
<tr>
<td>VAM: Sensor signal invalid</td>
<td>Yellow</td>
<td>Sensor data invalid.</td>
<td>Check the function and wiring of the sensor.</td>
</tr>
<tr>
<td>VAM: Anomalies in the switching pattern</td>
<td>Yellow</td>
<td>A switching pattern anomaly was detected by the monitoring system when evaluating the vibro-acoustic signals.</td>
<td>Check the error details and evaluation and send them to MR Service.</td>
</tr>
<tr>
<td>VAM: Evaluation not possible</td>
<td>Yellow</td>
<td>The vibro-acoustic signals cannot be analyzed due to additional influences.</td>
<td>Verify that the sensor is positioned correctly and avoid signal interruptions. Export the error details and evaluation and send them to MR Service.</td>
</tr>
</tbody>
</table>

Table 66: Event messages
10.3 Human-machine interface

<table>
<thead>
<tr>
<th>Characteristics/details</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No display/screen is loaded</td>
<td>Power supply interrupted.</td>
<td>Check the voltage supply.</td>
</tr>
<tr>
<td>Error when loading the current screen in the browser.</td>
<td>Press [F5] key to update the screen.</td>
<td></td>
</tr>
<tr>
<td>Fuse faulty</td>
<td>Contact Maschinenfabrik Reinhausen.</td>
<td></td>
</tr>
<tr>
<td>Connection cannot be established with visualization</td>
<td>Connection cable defective.</td>
<td>Check connection cable.</td>
</tr>
<tr>
<td>IP addresses of visualization and SCADA are in the same subnet.</td>
<td>Check the setting of the IP addresses of the device and correct where necessary.</td>
<td></td>
</tr>
<tr>
<td>PC not in same subnet as visualization.</td>
<td>Check the setting of the IP addresses of the device and PC and correct where necessary.</td>
<td></td>
</tr>
<tr>
<td>Browser displays an SSL warning when establishing a connection to the visualization.</td>
<td>The browser does not accept an SSL connection with a signed certificate that is non-public (this is the default status of the device).</td>
<td>Import signed SSL certificate or adjust browser settings.</td>
</tr>
<tr>
<td></td>
<td>The device SSL certificate has expired.</td>
<td>Import SSL certificate.</td>
</tr>
<tr>
<td></td>
<td>The device date/time is set incorrectly.</td>
<td>Set the date and time.</td>
</tr>
<tr>
<td></td>
<td>When using time synchronization via SNTP:</td>
<td>When using time synchronization via SNTP:</td>
</tr>
<tr>
<td></td>
<td>check SNTP server.</td>
<td>check SNTP server.</td>
</tr>
<tr>
<td></td>
<td>IP address of interface ETH2.2 has changed.</td>
<td>Import SSL certificate with new IP address (&quot;Alternative applicant name&quot;).</td>
</tr>
</tbody>
</table>

**Table 67: Human-machine interface**

10.4 Other faults

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

- Serial number
  - Name plate (can be found on CPU assembly)
- Software version

Please provide answers to the following questions:

- Has the software been updated?
- 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?
11 Disassembly

**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.

The following describes how to remove the control cabinet safely.

1. Disconnect the control cabinet from the supply voltage.

2. **WARNING!** Electric shock! Depending on the product version, there can also be dangerous residual voltages present in the control cabinet even after the supply voltage has been shut off which could lead to serious injuries. Wait at least five minutes and ensure that the control cabinet is de-energized.

3. Disconnect all connection lines (sensor cable, control cable to the motor-drive unit, customer cables, grounds etc.) in the control cabinet.

4. Close the control cabinet door.

5. **WARNING!** Attach the lifting gear to the control cabinet lifting eyes and ensure that the lifting gear cable angle does not fall below 45° relative to the horizontal. Otherwise, the control cabinet may become damaged and serious injuries may result.

![Figure 110: Removing the control cabinet](image)

6. **WARNING!** Remove and lower the control cabinet using the lifting gear. While doing so, ensure that the lifting gear cable angle does not fall below 45° relative to the horizontal. Otherwise, the control cabinet may become damaged and serious injuries may result.

- The control cabinet is removed.
12 Disposal

Observe the national requirements applicable in the country of use.
13 Technical data

13.1 Control cabinet standalone version

Figure 111: Dimensions of the control cabinet (MSENSE® VAM)
### Control cabinet MSENSE® VAM

<table>
<thead>
<tr>
<th>Dimension (width x height x depth)</th>
<th>616 x 848 x 420 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>Max. 11.3 A</td>
</tr>
<tr>
<td>Voltage supply</td>
<td>220...240 V AC</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Heating power</td>
<td>130 W (controlled)</td>
</tr>
<tr>
<td>Plug socket</td>
<td>220...240 V AC, max. 10 A</td>
</tr>
<tr>
<td>Permitted ambient temperature</td>
<td>-25 °C...+50 °C</td>
</tr>
<tr>
<td>Degree of protection (DIN EN 60529)</td>
<td>IP 66</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 53 kg</td>
</tr>
</tbody>
</table>

Table 68: Technical data for the control cabinet

#### 13.1.1 Connection terminals

<table>
<thead>
<tr>
<th>Terminal block</th>
<th>Maximum permitted operating voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>Max. 250 VAC</td>
</tr>
<tr>
<td>X10</td>
<td>Max. 150 VAC</td>
</tr>
</tbody>
</table>

Table 69: Maximum permitted operating voltage of the connection terminals for external circuits

#### 13.2 Voltage supply

<table>
<thead>
<tr>
<th>G1 PULS QS3.241</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible voltage range</td>
</tr>
<tr>
<td>85 to 276 V AC</td>
</tr>
<tr>
<td>88 to 375 V DC</td>
</tr>
<tr>
<td>V_N: 100 to 240 V AC</td>
</tr>
<tr>
<td>U_N: 110 to 300 V DC</td>
</tr>
<tr>
<td>Permissible frequency range</td>
</tr>
<tr>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Nominal power consumption</td>
</tr>
<tr>
<td>55 W</td>
</tr>
<tr>
<td>Maximum power consumption (continuous)</td>
</tr>
<tr>
<td>70 W</td>
</tr>
</tbody>
</table>

Table 70: Voltage supply

#### 13.3 CPU (central processing unit) II

<table>
<thead>
<tr>
<th>CPU II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
</tr>
<tr>
<td>433 MHz</td>
</tr>
<tr>
<td>RAM</td>
</tr>
<tr>
<td>256 MB</td>
</tr>
<tr>
<td>Interfaces</td>
</tr>
<tr>
<td>1x serial RS232/485 (electrically isolated)</td>
</tr>
<tr>
<td>3x Ethernet 10/100 Mbit</td>
</tr>
<tr>
<td>1x USB 2.0</td>
</tr>
<tr>
<td>1x CAN (electrically isolated)</td>
</tr>
<tr>
<td>1x CAN</td>
</tr>
</tbody>
</table>
**13 Technical data**

<table>
<thead>
<tr>
<th><strong>CPU II</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NVRAM (SRAM with battery backup) 512 kB</td>
</tr>
<tr>
<td>Application memory Max. 4 GB</td>
</tr>
<tr>
<td>Power supply +24 VDC (18...36 VDC)</td>
</tr>
<tr>
<td>Power consumption Max. 22 W</td>
</tr>
</tbody>
</table>

Table 71: Technical data for the CPU II assembly

**Interfaces**

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>RXD (RS232)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>TXD (RS232)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>GND (RS232, RS485)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>RXD+/TXD+ (RS485)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>RXD-/TXD- (RS485)</td>
<td></td>
</tr>
</tbody>
</table>

Table 72: COM2 (RS232, RS485)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>D-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>D+</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>

Table 73: USB 2.0

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TxD+</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TxD-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RxD+</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>RxD-</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>NC-</td>
<td></td>
</tr>
</tbody>
</table>

Table 74: ETH1, ETH 2.1, ETH 2.2 (RJ45)
### 13 Technical data

#### Interface

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>CAN-L</td>
</tr>
<tr>
<td>3</td>
<td>CAN-GND</td>
</tr>
<tr>
<td>7</td>
<td>CAN-H</td>
</tr>
</tbody>
</table>

Table 75: CAN1, CAN2

#### Optional accessories

**CAN bus**
- Terminating resistor
  - D-SUB plug connector (9-pole)
  - $R = 120 \, \Omega$
- Connector with terminal strip for directly connecting CAN lines

**Media converter for COM2 interface (only RS232)**
- Adapter from D-SUB (9-pole) to fiber-optic cable:
  - ACF660/ST: F-ST, 660 nm, range max. 60 m at 40 kBd
  - ACF660/SMA: F-SMA, 660 nm, range max. 60 m at 40 kBd
  - ACF850/ST: F-ST, 850 nm, range max. 1,000 m at 40 kBd
  - ACF850/SMA: F-SMA, 850 nm, range max. 1,000 m at 40 kBd

Table 76: Optional accessories

#### 13.4 DIO 28-15 digital inputs and outputs

<table>
<thead>
<tr>
<th>DIO 28-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs (plug-based electrical isolation)</td>
</tr>
<tr>
<td>Quantity</td>
</tr>
<tr>
<td>Logical 0</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Logical 1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Input current</td>
</tr>
<tr>
<td>Simultaneity factor (at 70 °C ambient temperature and input voltage $\geq 230 , \text{V}$)</td>
</tr>
</tbody>
</table>
## Technical data

<table>
<thead>
<tr>
<th>Outputs (floating relay outputs)</th>
<th>Number (number of change-over contacts in parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 (9)</td>
</tr>
</tbody>
</table>

**Contact rating**

<table>
<thead>
<tr>
<th>Alternating current mode:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_N$: 230 V AC; $I_N$: 5 A</td>
</tr>
</tbody>
</table>

**Direct current mode:** See diagram

**Simultaneity factor**

- Up to 60°C: 100%
- > 60°C: -5%/K

(if output is loaded with 5 A)

Table 77: Technical data for the DIO 28-15 assembly

![Graph of contact rating DIO](image)

**Electric shock!**

The inputs of the DIO assembly have plug-based electrical isolation. A mixture of voltage ranges (e.g. extra low voltage and low voltage) or various phases within a plug can lower the protection against electric shock.

- Use the same voltage ranges within a plug.
- Use the same phase within a plug.

**CAUTION**
## 13 Technical data

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 78: Digital inputs

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A</td>
<td>6 A</td>
<td>11 A</td>
</tr>
<tr>
<td>1C</td>
<td>6C</td>
<td>11C</td>
</tr>
<tr>
<td>1B</td>
<td>6B</td>
<td>11B</td>
</tr>
<tr>
<td>2 A</td>
<td>7 A</td>
<td>12 A</td>
</tr>
<tr>
<td>2C</td>
<td>7C</td>
<td>12C</td>
</tr>
<tr>
<td>2B</td>
<td>7B</td>
<td>12B</td>
</tr>
<tr>
<td>3 A</td>
<td>8 A</td>
<td>13 A</td>
</tr>
<tr>
<td>3C</td>
<td>8C</td>
<td>13C</td>
</tr>
<tr>
<td>3B</td>
<td>8B</td>
<td>13B</td>
</tr>
<tr>
<td>4C</td>
<td>9C</td>
<td>14C</td>
</tr>
<tr>
<td>4B</td>
<td>9B</td>
<td>14B</td>
</tr>
<tr>
<td>5C</td>
<td>10C</td>
<td>15C</td>
</tr>
<tr>
<td>5B</td>
<td>10B</td>
<td>15B</td>
</tr>
</tbody>
</table>

Table 79: Digital outputs

### 13.5 AIO 2 analog inputs and outputs

<table>
<thead>
<tr>
<th>Channels (input or output)</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td></td>
</tr>
<tr>
<td>Measuring range</td>
<td></td>
</tr>
<tr>
<td>0...10 V</td>
<td></td>
</tr>
<tr>
<td>0...20 mA</td>
<td></td>
</tr>
<tr>
<td>4...20 mA</td>
<td></td>
</tr>
<tr>
<td>Load resistance (0/4...20 mA)</td>
<td>Max. 300 Ω</td>
</tr>
</tbody>
</table>
13 Technical data

### Outputs

| Signal range | 0...10 V  
|             | 0...20 mA  
|             | 4...20 mA  |

| Load resistance (0/4...20 mA) | Max. 500 Ω  

| Resistor contact series | Maximum resistance 100 Ω...10 kΩ, max. 35 tap positions  

Table 80: Technical data for the AIO 2 assembly

<table>
<thead>
<tr>
<th>Interface</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1         | 6   | I OUT (+): Current output +  
| 2         | 7   | I/U IN (+) U OUT (+): Voltage input +, current input +, voltage output +  
| 3         | 8   | I/U IN (-): Voltage input -, current input -  
| 4         | 9   | I/U OUT (-): Voltage output -, current output -  
| 5         | 10  | Not used  

Table 81: Analog inputs and outputs

### VI 4 vibration sensor input module

| VI 4  
| Analog inputs | For vibration sensors based on the IEPE standard  
| Input voltage | 24 V DC  
| Power consumption | Max. 200 mA  
| Operating temperature | -25 °C...+70 °C  
| Relative humidity operation | 5...95% non-condensing  
| Storage temperature | -40 °C...+85 °C  
| Relative humidity storage | 5...95% condensing  

Table 82: VI 4 vibration sensor input module

### VS 1 vibration sensor

| VS 1  
| Sensor type | Piezo vibration sensor  
| Housing | Hermetically sealed  
| Working temperature | -50°C...+125°C  
| Protection class | IP67 in accordance with IEC 60529  
| Resistance to corrosion | 316L, stainless steel  

Table 83: VS 1 vibration sensor
## 13.8 Sensor cable

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready for use on one side</td>
<td>Plug in an angled design with 5-pole M12 socket for connection to the VS 1 sensor</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>When screwed on: IP68 in accordance with IEC 60529</td>
</tr>
<tr>
<td>Permissible operating temperature range, fixed routing</td>
<td>-40°C…+105°C</td>
</tr>
<tr>
<td>Permissible operating temperature range, flexible routing</td>
<td>-20°C…+105°C</td>
</tr>
<tr>
<td>Properties</td>
<td>Halogen-free, silicon-free, oil-resistant, UV-resistant</td>
</tr>
<tr>
<td>Flame resistance</td>
<td>In accordance with UL 758/1581 FT2</td>
</tr>
<tr>
<td>Shielding</td>
<td>Drain wire and shielding connected to union nut</td>
</tr>
</tbody>
</table>

Table 84: Sensor cable
<table>
<thead>
<tr>
<th>Glossary</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMC</strong></td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td><strong>ICD</strong></td>
<td>IED Capability Description</td>
</tr>
<tr>
<td><strong>PRP</strong></td>
<td>Redundancy protocol in accordance with IEC 62439-3 (Parallel Redundancy Protocol)</td>
</tr>
<tr>
<td><strong>RSTP</strong></td>
<td>Redundancy protocol in accordance with IEEE 802.1D-2004 (Rapid Spanning Tree Protocol)</td>
</tr>
<tr>
<td><strong>SCADA</strong></td>
<td>Technical processes are monitored and controlled using a computer system (Supervisory Control and Data Acquisition)</td>
</tr>
<tr>
<td><strong>SNTP</strong></td>
<td>NTP (Network Time Protocol) is a standard for synchronizing clocks in computer systems using packet-based communication networks. SNTP (Simple Network Time Protocol) is the simplified version of NTP.</td>
</tr>
<tr>
<td><strong>TPLE</strong></td>
<td>TAPCON® Personal Logic Editor</td>
</tr>
</tbody>
</table>
# List of key words

<table>
<thead>
<tr>
<th>A</th>
<th>D</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access point</td>
<td>Data</td>
<td>ICD file</td>
</tr>
<tr>
<td>Access rights</td>
<td>Import/export</td>
<td>IEC 60870-5-101</td>
</tr>
<tr>
<td>AIO 2</td>
<td>Databits</td>
<td>IEC 60870-5-103</td>
</tr>
<tr>
<td>Analog inputs and outputs</td>
<td>Date</td>
<td>IEC 60870-5-104</td>
</tr>
<tr>
<td>ASDU address</td>
<td>110, 112, 114</td>
<td>IEC 61850</td>
</tr>
<tr>
<td>ASDU sequence optimization</td>
<td>110, 114</td>
<td>IED name</td>
</tr>
<tr>
<td>ASDU single character confirmation</td>
<td>110</td>
<td>Import</td>
</tr>
<tr>
<td>Assembly</td>
<td>Assembly</td>
<td>150, 152</td>
</tr>
<tr>
<td>AIO</td>
<td></td>
<td>Analog</td>
</tr>
<tr>
<td>CPU II</td>
<td></td>
<td>Digital</td>
</tr>
<tr>
<td>DIO</td>
<td></td>
<td>Inspection</td>
</tr>
<tr>
<td>G1</td>
<td></td>
<td>Isolating device</td>
</tr>
<tr>
<td>MC 2-2</td>
<td>30</td>
<td>66</td>
</tr>
<tr>
<td>QS3</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>SW</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baud rate</td>
<td>109, 112, 117, 119</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable recommendation</td>
<td>51</td>
<td>Language</td>
</tr>
<tr>
<td>Changing users</td>
<td>33</td>
<td>Lifting gear</td>
</tr>
<tr>
<td>Channel (AIO)</td>
<td>55</td>
<td>Attachment points</td>
</tr>
<tr>
<td>Commissioning wizard</td>
<td>69, 96</td>
<td>Link address</td>
</tr>
<tr>
<td>Configure data points</td>
<td>120</td>
<td>Logging off</td>
</tr>
<tr>
<td>Connection</td>
<td>51</td>
<td>Logging on</td>
</tr>
<tr>
<td>Control cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mounting the</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Control system</td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>CPU II</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Fiber-optic cable</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Information about laying</td>
<td></td>
</tr>
<tr>
<td>Edition</td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>Electrical high voltage test</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Electromagnetic compatibility</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Event memory</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Acknowledge</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Configure</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Exporting</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Filtering</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Expert mode</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>150, 152</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>27</td>
<td>Name plate</td>
</tr>
<tr>
<td>General</td>
<td>95</td>
<td>Nameplate</td>
</tr>
<tr>
<td>Remote behavior</td>
<td>96</td>
<td>Display</td>
</tr>
<tr>
<td>ground test</td>
<td>74</td>
<td>Navigation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Network settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. of information object address octets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of ASDU address octets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of cause of transmission octets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of link address octets</td>
</tr>
</tbody>
</table>
List of key words

**O**
- Outputs
  - Analog 130
  - Digital 128

**P**
- Parity 110, 112, 117
- Password 80
- Performance features 22
- Power supply 66
- Power supply circuit 66

**Q**
- QS3 27
- Quick search 36

**R**
- Recorder 91
- Rectifying faults 157
- Reference time 111, 113, 115, 120
- Remote behavior 96
- Repeat unsolicited messages indefinitely 119
- Repetition of unsolicited messages indefinitely 119
- RES bit test 110
- RFC 3164 100
- RFC 5424 100

**S**
- SCADA 106
- Screensaver 101
- Second time server 98
- Serial interface 109, 112, 117, 118
- SNTP 97, 98
- SNTP time server 99
- SNTP time server 2 99
- Stop bits 110, 112, 117
- SW 3-3 30
- Synchronization interval 100
- Syslog 100

**T**
- Tap position monitoring 105
- TCP connections 116
- TCP Keepalive 117
- TCP port 114, 116, 118
- Temperature Monitoring 104
- Time 71, 100
- Time server address 99
- Time shift 99
- Time synchronization 97
- Activate 98
- Reference time 111, 113, 115, 120
- Time zone 99
- Timeout 119
- Timeout for response confirmation 119
- TPUE 134
- Transmission procedure 109

**U**
- Unsolicited messages 119
- USB interface
  - Activating/Deactivating 96
- User administration 78
- User ID code 119
- User role 78

**V**
- Visualization 67

**W**
- Web access 67