Operating Instructions

Proservo NMS81

Tank Gauging
Proservo NMS81

1. [QR Code]

2. www.endress.com/deviceviewer

3. [Documents]

Order code:
Ext. ord. cd.:
Ser. no.:

Serial number

Endress+Hauser Operations App

A0023555
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1  About this document

1.1  Document function
These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

1.2  Symbols

1.2.1  Safety symbols

⚠️ **DANGER**
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠️ **WARNING**
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠️ **CAUTION**
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

⚠️ **NOTICE**
This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2  Electrical symbols

∼
Alternating current

∼∼
Direct current and alternating current

——
Direct current

🎵
Ground connection
A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

接地 **Protective earth (PE)**
Ground terminals that must be connected to ground prior to establishing any other connections.
The ground terminals are located on the interior and exterior of the device:
- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

1.2.3  Tool symbols

🛠️ ✂️
Phillips head screwdriver
Flat blade screwdriver

Torx screwdriver

Allen key

Open-ended wrench

1.2.4 Symbols for certain types of information and graphics

- **Permitted**
  Procedures, processes or actions that are permitted

- **Preferred**
  Procedures, processes or actions that are preferred

- **Forbidden**
  Procedures, processes or actions that are forbidden

- **Tip**
  Indicates additional information

- **Reference to documentation**

- **Reference to graphic**

- **Notice or individual step to be observed**

- **Series of steps**

- **Result of a step**

- **Visual inspection**

- **Operation via operating tool**

- **Write-protected parameter**

- **1, 2, 3, ...**
  Item numbers

- **A, B, C, ...**
  Views

- **Safety instructions**
  Observe the safety instructions contained in the associated Operating Instructions

- **Temperature resistance of the connection cables**
  Specifies the minimum value of the temperature resistance of the connection cables
1.3 Documentation

The following documentation types are available in the Downloads area of the Endress +Hauser website (www.endress.com/downloads):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- **Device Viewer** ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from the nameplate
- **Endress+Hauser Operations app**: Enter serial number from nameplate or scan matrix code on nameplate.

1.3.1 Technical Information (TI)

**Planning aid**
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

1.3.2 Brief Operating Instructions (KA)

**Guide that takes you quickly to the 1st measured value**
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

1.3.3 Operating Instructions (BA)

The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

It also contains a detailed explanation of each individual parameter in the operating menu (except the **Expert** menu). The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.

1.3.4 Description of Device Parameters (GP)

The Description of Device Parameters provides a detailed explanation of each individual parameter in the 2nd part of the operating menu: the **Expert** menu. It contains all the device parameters and allows direct access to the parameters by entering a specific code. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.

1.3.5 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

1.3.6 Installation instructions (EA)

Installation Instruction are used to replace a faulty unit with a functioning unit of the same type.

1.4 Registered trademarks

**Modbus®**
Registered trademark of SCHNEIDER AUTOMATION, INC.
2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

2.2 Intended use

Application and measured materials

Depending on the version ordered, the measuring device can also measure potentially explosive, flammable, poisonous and oxidizing media.

Measuring devices for use in hazardous areas, in hygienic applications or in applications where there is an increased risk due to process pressure, are labeled accordingly on the nameplate.

To ensure that the measuring device remains in proper condition for the operation time:

- Only use the measuring device in full compliance with the data on the nameplate and the general conditions listed in the Operating Instructions and supplementary documentation.
- Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area (e.g. explosion protection, pressure vessel safety).
- Use the measuring device only for media against which the process-wetted materials are adequately resistant.
- If the measuring device is not operated at atmospheric temperature, compliance with the relevant basic conditions specified in the associated device documentation is absolutely essential.
- Protect the measuring device permanently against corrosion from environmental influences.
- Observe the limit values in the "Technical Information".

The manufacturer is not liable for damage caused by improper or non-designated use.

Residual risk

During operation the sensor may assume a temperature near the temperature of the measured material.

Danger of burns due to heated surfaces!

- For high process temperatures: Install protection against contact in order to prevent burns.
2.3 Workplace safety

For work on and with the device:

- Wear the required personal protective equipment according to federal/national regulations.

2.4 Operational safety

Risk of injury!

- Operate the device only if it is in proper technical condition, free from errors and faults.
- The operator is responsible for interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:

- If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- Carry out repairs on the device only if they are expressly permitted.
- Observe federal/national regulations pertaining to the repair of an electrical device.
- Use only original spare parts and accessories from the manufacturer.

Hazardous area

To eliminate danger to persons or the facility when the device is used in the hazardous area (e.g. explosion protection):

- Check the nameplate to verify if the device ordered can be put to its intended use in the hazardous area.
- Observe the specifications in the separate supplementary documentation that is an integral part of these instructions.

2.5 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. It meets the general safety standards and legal requirements.

NOTICE

Loss of degree of protection by opening of the device in humid environments

- If the device is opened in a humid environment, the degree of protection indicated on the nameplate is no longer valid. This may also impair the safe operation of the device.

2.5.1 CE mark

The measuring system meets the legal requirements of the applicable EU directives. These are listed in the corresponding EU Declaration of Conformity together with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the CE mark.

2.5.2 EAC conformity

The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity along with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the EAC mark.
3 Product description

3.1 Product design

1 Design of Proservo NMS81

1 Housing
2 Display and operating module (can be operated without opening the cover)
3 Process connection (Flange)
4 Displacer

2 Configuration of NMS81

1 Front cover
2 Display
3 Modules
4 Sensor unit (detector unit and cable)
5 Housing
6 Wire drum
7 Bracket
8 Housing cover
9 Displacer
4 Incoming acceptance and product identification

4.1 Incoming acceptance

Upon receipt of the goods check the following:

- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Do the nameplate data match the ordering information on the delivery note?
- If required (see nameplate): Are the Safety Instructions (XA) enclosed?

If one of these conditions is not satisfied, contact your Endress+Hauser Sales Center.

4.2 Product identification

The following options are available for identification of the device:

- Nameplate specifications
- Enter the serial number from the nameplate in the Device Viewer (www.endress.com/deviceviewer): all the information about the device and an overview of the Technical Documentation supplied with the device are displayed.
- Enter the serial number on the nameplate into the Endress+Hauser Operations App or scan the 2-D matrix code (QR code) on the nameplate with the Endress+Hauser Operations App: all the information about the device and the technical documentation pertaining to the device is displayed.

For an overview of the scope of the associated Technical Documentation, refer to the following:

- Device Viewer (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- Endress+Hauser Operations app: Enter serial number from nameplate or scan matrix code on nameplate.
### 4.2.1 Nameplate

#### 3 Nameplate

1. Manufacturer address
2. Device name
3. Order code
4. Serial number
5. Extended order code
6. Supply voltage
7. Maximum process pressure
8. Maximum process temperature
9. Permitted ambient temperature ($T_a$)
10. Temperature resistance of cable
11. Thread for cable entry
12. Material in contact with process
13. Not used
14. Firmware version
15. Device revision
16. Metrology certification numbers
17. Customized parametrization data
18. Ambient temperature range
19. CE mark / C-tick mark
20. Additional information on the device version
21. Ingress protection
22. Certificate symbol
23. Data concerning the Ex approval
24. General certificate of approval
25. Associated Safety Instructions (XA)
26. Manufacturing date
27. China RoHS mark
28. QR code for the Endress+Hauser Operations App

### 4.2.2 Manufacturer address

Endress+Hauser Yamanashi Co., Ltd.
406-0846
862-1 Mitsukunugi, Sakaigawa-cho, Fuefuki-shi, Yamanashi
4.3  Storage and transport

4.3.1  Storage conditions

- Storage temperature: –50 to +80 °C (–58 to +176 °F)
- Store the device in its original packaging.

4.3.2  Transport

⚠️ **CAUTION**

Risk of injury

- Transport the measuring device to the measuring point in its original packaging.
- Take into account the mass center of the device in order to avoid unintended tilting.
- Comply with the safety instructions, transport conditions for devices over 18 kg (39.6 lb) (IEC 61010).
## 5 Installation

### 5.1 Requirements

#### 5.1.1 Type of tanks

Depending on the type of tank and application, different installation procedures are recommended for NMS8x.

<table>
<thead>
<tr>
<th>Type of tanks</th>
<th>Without guide system</th>
<th>With stilling well</th>
<th>With guide wires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed roof tank</td>
<td><img src="image1" alt="Fixed roof tank" /></td>
<td><img src="image2" alt="Fixed roof tank" /></td>
<td><img src="image3" alt="Fixed roof tank" /></td>
</tr>
<tr>
<td>Floating roof tank</td>
<td><img src="image4" alt="Floating roof tank" /></td>
<td><img src="image5" alt="Floating roof tank" /></td>
<td><img src="image6" alt="Floating roof tank" /></td>
</tr>
<tr>
<td>Covered floating roof tank</td>
<td><img src="image7" alt="Covered floating roof tank" /></td>
<td><img src="image8" alt="Covered floating roof tank" /></td>
<td><img src="image9" alt="Covered floating roof tank" /></td>
</tr>
<tr>
<td>Pressurized or bullet tank</td>
<td><img src="image10" alt="Pressurized or bullet tank" /></td>
<td><img src="image11" alt="Pressurized or bullet tank" /></td>
<td><img src="image12" alt="Pressurized or bullet tank" /></td>
</tr>
<tr>
<td>Tank with agitator or heavy turbulence</td>
<td><img src="image13" alt="Tank with agitator or heavy turbulence" /></td>
<td><img src="image14" alt="Tank with agitator or heavy turbulence" /></td>
<td><img src="image15" alt="Tank with agitator or heavy turbulence" /></td>
</tr>
</tbody>
</table>

- A stilling well is required in a floating roof tank and a covered floating roof tank.
Guide wires cannot be installed in a floating roof tank. When the measuring wire is exposed to free space, it may break due to an external shock.

Installing guide wires is not allowed in pressurized tanks because the wires would prevent closing the valve for replacing the wire, wire drum, or displacer. NMS8x installation position is important for applications without the guide wire system in order to prevent the measuring wire from being broken (refer to Operating Instructions for details).
Typical tank installation

A  Fixed roof tank
B  High pressure tank
C  Floating roof tank with stilling well
1  NMS8x
2  Ball valve
3  Measuring wire
4  Displacer
5  Stilling well
6  Prothermo NMT53x
5.1.2 Displacer selection guide

A wide variety of displacers are available to suit different application. Proper displacer selection ensures optimal performance and longevity. The following guidelines will assist you in selecting the most suitable displacer for your application.

Displacer types

The following NMS8x displacers are available.

<table>
<thead>
<tr>
<th>30 mm (1.18 in)</th>
<th>50 mm (1.97 in)</th>
<th>70 mm (2.76 in)</th>
<th>110 mm (4.33 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>316L/PTFE</td>
<td>316L/AlloyC276/PTFE</td>
<td>316L</td>
<td>316L</td>
</tr>
</tbody>
</table>
**Displacer dimensions**

A. Ø30 mm (1.18 in) 316L cylindrical displacer

B. Ø30 mm (1.18 in) PTFE cylindrical displacer

- **Immersion point**

<table>
<thead>
<tr>
<th>Item</th>
<th>Ø30 mm (1.18 in) 316L cylindrical displacer</th>
<th>Ø30 mm (1.18 in) PTFE cylindrical displacer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>261</td>
<td>250</td>
</tr>
<tr>
<td>Volume (ml)</td>
<td>84.3</td>
<td>118</td>
</tr>
<tr>
<td>Balance volume (ml)</td>
<td>41.7</td>
<td>59</td>
</tr>
</tbody>
</table>

The weight, volume, and balance volume are individually determined by each displacer and also might vary depending on the values stated above.
The weight, volume, and balance volume are individually determined by each displacer and also might vary depending on the values stated above.
A Ø70 mm (2.76 in) 316L conical displacer
B Ø110 mm (4.33 in) 316L conical displacer
a Immersion point

<table>
<thead>
<tr>
<th>Item</th>
<th>Ø70 mm (2.76 in) 316L conical displacer</th>
<th>Ø110 mm (4.33 in) 316L conical displacer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>245</td>
<td>223</td>
</tr>
<tr>
<td>Volume (ml)</td>
<td>124</td>
<td>108</td>
</tr>
<tr>
<td>Balance volume (ml)</td>
<td>52.8</td>
<td>36.3</td>
</tr>
</tbody>
</table>

The weight, volume, and balance volume are individually determined by each displacer and also might vary depending on the values stated above.

**Recommended displacer by application**

<table>
<thead>
<tr>
<th>Application</th>
<th>Product level</th>
<th>Interface level</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscous liquid</td>
<td>50 mm (1.97 in) PTFE</td>
<td>Not Recommended</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>Black oil (e.g. crude oil, heavy oil)</td>
<td>50 mm (1.97 in) 316L</td>
<td>50 mm (1.97 in) 316L</td>
<td>50 mm (1.97 in) 316L</td>
</tr>
<tr>
<td>White oil (e.g. gasoline, diesel, heating oil)</td>
<td>50 mm (1.97 in) or 70 mm (2.76 in) 316L</td>
<td>50 mm (1.97 in) or 70 mm (2.76 in) 316L</td>
<td>50 mm (1.97 in) or 70 mm (2.76 in) 316L</td>
</tr>
<tr>
<td>Liquefied gas, LPG/LNG</td>
<td>50 mm (1.97 in) or 70 mm (2.76 in) 316L</td>
<td>50 mm (1.97 in) or 70 mm (2.76 in) 316L</td>
<td>50 mm (1.97 in) or 70 mm (2.76 in) 316L</td>
</tr>
<tr>
<td>Corrosive liquid</td>
<td>50 mm (1.97 in) AlloyC276</td>
<td>50 mm (1.97 in) AlloyC276</td>
<td>50 mm (1.97 in) AlloyC276</td>
</tr>
</tbody>
</table>
5.1.3 Mounting without a guide system

NMS8x is mounted on a nozzle of the tank roof without a guide system. Sufficient clearance inside the nozzle is necessary to allow the displacer to move without hitting the inner walls (for details of D₁, see 21).

Diagram:

- D₁: Inner diameter of the tank nozzle
- d: Diameter of the displacer
- 1: Displacer
5.1.4 Mounting with a stilling well

The stilling well diameter that is required to protect the measuring wire without disturbing its operation varies depending on the tank height. The stilling well could either be of constant diameter, or narrower at its upper part and wider at its lower part. The following figure shows two examples of the latter case, namely a concentric stilling well and an asymmetric stilling well.

![Diagram](image)

- **A**: Front view
- **B**: Side view
- $L_1$: Length from the center of the calibration window to the upper part of the stilling well
- $L_2$: Length from the center of the calibration window to the bottom of the stilling well
- $L_3$: Length from the center of the calibration window to the bottom of the flange
- $D_1$: Diameter of upper part of stilling well
- $D_2$: Diameter of stilling well
- $d$: Diameter of displacer
- $p$: Longitudinal wire position from the center of the flange
- $r$: Radial direction offset
Mounting with asymmetric stilling well

A  Front view
B  Side view

- **L₁**: Length from the center of the calibration window to the upper part of the stilling well
- **L₂**: Length from the center of the calibration window to the bottom of the stilling well
- **L₃**: Length from the center of the calibration window to the bottom of the flange
- **D₁**: Diameter of upper part of stilling well
- **D₂**: Diameter of stilling well
- **d**: Diameter of displacer
- **p**: Longitudinal wire position from the center of the flange (Lₓ)
- **r**: Radial direction offset

- **L₃**: Length from center of the calibration window to the bottom of the flange built-in NMS8x (77 mm (3.03 in) + flange thickness).
  For JIS 10K 150A RF, the flange thickness is 22 mm (0.87 in).
- When using an asymmetric stilling well, take into account the lateral shift of the displacer and follow the NMS8x mounting direction as shown in the figure.
- To calculate the required stilling well diameters, the formula below should be used. The following tables contain the necessary parameters in order to calculate the dimensions of the stilling well. Be sure to have appropriate dimensions of the stilling well according to each dimension in the table.
- The radial direction offset (r) is required for only the 47 m (154.20 ft) and 55 m (180.45 ft) wire drum. For all other drums, the offset is 0 mm/in.
### Feature: 110

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description (Measuring range; Wire; Diameter)</th>
<th>NMS80</th>
<th>NMS81</th>
<th>NMS83</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>47 m (154.20 ft); 316L; 0.15 mm (0.00591 in)</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>6 mm (0.24 in)</td>
</tr>
<tr>
<td>H1</td>
<td>55 m (180.45 ft); 316L; 0.15 mm (0.00591 in)</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>6 mm (0.24 in)</td>
</tr>
</tbody>
</table>

### Feature: 120

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description (Displacer material; Type)</th>
<th>NMS80</th>
<th>NMS81</th>
<th>NMS83</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1AA</td>
<td>316L; 30 mm (1.18 in) cylindrical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>30 mm (1.18 in)</td>
</tr>
<tr>
<td>1AC</td>
<td>316L; 50 mm (1.97 in) cylindrical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>50 mm (1.97 in)</td>
</tr>
<tr>
<td>1BE</td>
<td>316L; 70 mm (2.76 in) conical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>70 mm (2.76 in)</td>
</tr>
<tr>
<td>1BJ</td>
<td>316L; 110 mm (4.33 in) conical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>110 mm (4.33 in)</td>
</tr>
<tr>
<td>2AA</td>
<td>PTFE; 30 mm (1.18 in) cylindrical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>30 mm (1.18 in)</td>
</tr>
<tr>
<td>2AC</td>
<td>PTFE; 50 mm (1.97 in) cylindrical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>50 mm (1.97 in)</td>
</tr>
<tr>
<td>3AC</td>
<td>AlloyC276; 50 mm (1.97 in) cylindrical</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>50 mm (1.97 in)</td>
</tr>
<tr>
<td>4AC</td>
<td>316L polished; 50 mm (1.97 in) cylindrical</td>
<td></td>
<td></td>
<td></td>
<td>50 mm (1.97 in)</td>
</tr>
<tr>
<td>4AE</td>
<td>316L polished; 70 mm (2.76 in) conical</td>
<td>✔</td>
<td></td>
<td></td>
<td>70 mm (2.76 in)</td>
</tr>
<tr>
<td>5AC</td>
<td>PTFE; 50 mm (1.97 in) cylindrical, hygienic white</td>
<td></td>
<td></td>
<td></td>
<td>50 mm (1.97 in)</td>
</tr>
</tbody>
</table>

### Parameter Description

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>Diameter of displacer</td>
</tr>
<tr>
<td>p(Lx)</td>
<td>Longitudinal wire position from the center of the flange. The value can be determined by using following graph.</td>
</tr>
<tr>
<td>r</td>
<td>Radial direction offset</td>
</tr>
<tr>
<td>s</td>
<td>Safety factor recommended: 5 mm (0.197 in)</td>
</tr>
</tbody>
</table>

The following graph shows the lateral shift of the displacer depending on the measured distance for the different wire drums.
### Lateral shift of displacer according to measurement range

- **a**: 16 m (A3) (NMS80/NMS81/NMS83)
- **b**: 22 m (C2) (NMS80/NMS81/NMS83)
- **c**: 28 m (D1) (NMS80/NMS81)
- **d**: 36 m (F1) (NMS80/NMS81)
- **e**: 47 m (G1) (NMS81)
- **f**: 55 m (H1) (NMS81)

### Upper diameter of stilling well

The dimension of $D_1$ has to be the largest value of the dimensions $D_{1a}$, $D_{1b}$, $D_{1c}$, and $D_{1d}$ according to the following formula.

<table>
<thead>
<tr>
<th>$D_1$ Dimension (Example)</th>
<th>$D_{1a}$ Dimension</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;68.1 mm (2.68 in)</td>
<td>68.1 mm (2.68 in)</td>
<td>$D_{1a}$ dimension when the displacer is at the center of the calibration window</td>
<td>$= 2 \times (</td>
</tr>
<tr>
<td></td>
<td>65.6 mm (2.58 in)</td>
<td>$D_{1b}$ dimension when the displacer is at the upper part of the stilling well</td>
<td>$= 2 \times (</td>
</tr>
</tbody>
</table>
### Concentric pipe

<table>
<thead>
<tr>
<th>D₁ Dimension (Example)</th>
<th>D₁ Dimension Parameter</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.9 mm (2.00 in)</td>
<td>D₁c</td>
<td>D₁ dimension when the displacer is at the bottom of the stilling well</td>
<td>( = 2 \times (</td>
</tr>
<tr>
<td>100.9 mm (3.97 in)</td>
<td>D₁d</td>
<td>D₁ dimension when the radial direction offset is considered. This calculation is used only with the 47 m (154.20 ft) wire drum (G1 in Feature110) and 55 m (180.45 ft) (H1 in feature 110)</td>
<td>( = 2 \times (d/2 + r + s) )</td>
</tr>
</tbody>
</table>

**Example:** \( L₁ = 1000 \text{ mm}, \ L₂ = 20000 \text{ mm}, \ d = 50 \text{ mm}, \ s = 5.0, \ 28 \text{ m drum} \)

**Lower diameter of stilling well**

The dimension of \( D₂ \) has to be the larger value of the dimensions \( D₁ \) and \( D₂b \).

See the table below.

<table>
<thead>
<tr>
<th>D₂ Dimension (Example)</th>
<th>D₂ Dimension Parameter</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;100.9 mm (3.97 in)</td>
<td>D₁</td>
<td>Calculated ( D₁ ) value</td>
<td>( = 2 \times (</td>
</tr>
<tr>
<td>100.9 mm (3.97 in)</td>
<td>D₂b</td>
<td>( D₂ ) dimension when the displacer is in ( L₂ ) length</td>
<td>( = 2 \times (</td>
</tr>
</tbody>
</table>

**Example:** \( L₂ = 20000 \text{ mm}, \ d = 50 \text{ mm}, \ s = 5.0, \ 28 \text{ m drum} \)

### Asymmetric pipe

<table>
<thead>
<tr>
<th>D₂ Dimension (Example)</th>
<th>D₂ Dimension Parameter</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;84.5 mm (3.33 in)</td>
<td>D₁</td>
<td>Calculated ( D₁ ) value</td>
<td>( =</td>
</tr>
<tr>
<td>84.5 mm (3.33 in)</td>
<td>D₂b</td>
<td>( D₂ ) dimension that the displacer can pass through ( \text{nth groove} )</td>
<td>( =</td>
</tr>
</tbody>
</table>

**Example:** \( L₂ = 20000 \text{ mm}, \ d = 50 \text{ mm}, \ s = 5.0, \ 28 \text{ m drum} \)
Recommendations for NMS8x mounting with a stilling well

Follow the recommendations for mounting NMS8x with a stilling well.

- Keep the pipe connection welds smooth.
- When drilling holes into the pipe, keep the interior surface of the holes clear of metal chips and burrs.
- Coat or paint the interior surface of the pipe to prevent corrosion.
- Keep the pipe as vertical as possible. Check using a plumb bob.
- Install the asymmetric pipe under the valve and align the centers of the NMS8x and the valve.
- Set the center of the lower part of the asymmetric pipe in the direction of the lateral motion.
- Observe the recommendations as per API MPMS chapter 3.1B.
- Confirm grounding between NMS8x and the tank nozzle.
5.1.5 Mounting with guide wires

It is also possible to guide the displacer with guide wires to prevent swinging.

![Diagram of Mounting with guide wires]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Maintenance chamber</td>
</tr>
<tr>
<td>B</td>
<td>Spring and sleeve</td>
</tr>
<tr>
<td>C</td>
<td>Guide wire sleeve</td>
</tr>
<tr>
<td>D</td>
<td>Crimp tool</td>
</tr>
<tr>
<td>1</td>
<td>NMS8x</td>
</tr>
<tr>
<td>2</td>
<td>Reducer plate (incl. guide wire option)</td>
</tr>
<tr>
<td>3</td>
<td>Spring, 304 (incl. guide wire option)</td>
</tr>
<tr>
<td>4</td>
<td>Sleeve, 316 (incl. guide wire option)</td>
</tr>
<tr>
<td>5</td>
<td>Maintenance chamber</td>
</tr>
<tr>
<td>6</td>
<td>Tank</td>
</tr>
<tr>
<td>7</td>
<td>Measuring wire</td>
</tr>
<tr>
<td>8</td>
<td>Guide wire, 316 (incl. guide wire option)</td>
</tr>
<tr>
<td>9</td>
<td>Displacer with rings (incl. guide wire option)</td>
</tr>
<tr>
<td>10</td>
<td>Anchor hook plate, 304 (incl. guide wire option)</td>
</tr>
<tr>
<td>11</td>
<td>Welding point</td>
</tr>
<tr>
<td>12</td>
<td>Wire ring, 316L</td>
</tr>
<tr>
<td>13</td>
<td>Flange</td>
</tr>
</tbody>
</table>
Guide wire installation

Guide wire installation procedure

1. Install NMS8x [1] on the reducer plate.
2. Perform calibration steps (→ 86) before the displacer [3] is attached to the guide wires.
   → Make sure that the displacer does not touch the guide wires during calibration. This could be done by mounting the NMS8x to the reducer plate [2] prior to fitting the guide wires [4].

ℹ️ Perform calibration steps so that displacer does not touch the guide wires if the guide wires are already installed to the reducer plate.

3. Secure the guide wires to the hooks of the springs [5].
4. Secure the springs to the reducer plate.
5. Put the guide wires through the displacer guide ring [6] and set the displacer.

This completes the guide wire installation procedure.

A0026887

10 Guide wire installation

1. NMS8x
2. Reducer plate
3. Displacer
4. Guide wires
5. Springs
6. Displacer guide ring
5.1.6 Alignment of NMS8x

Flange

Confirm that the size of the nozzle and the flange is matched prior to mounting NMS8x on the tank. The flange size and the rating of NMS8x vary depending on the customer’s specifications.

- Check the flange size of NMS8x.
- Mount the flange on the top of the tank. The deviation of the flange from the horizontal plane should not exceed ±1 degree.
- When mounting NMS8x on a long nozzle, make sure that the displacer does not touch the inner wall of the nozzle.

![Diagram of Flange Alignment](image)

1. Allowable inclination of mounting flange
   1. Nozzle

When NMS8x is installed without a guide system, follow the recommendations below:

- Confirm the mounting nozzle is in the sector between 45 and 90 degrees (or -45 and -90 degrees) away from the inlet pipe of the tank. This prevents heavy swinging of the displacer caused by waves or turbulence from the inlet liquid.
- Confirm the mounting nozzle is 500 mm (19.69 in) or more away from the tank wall.
- Confirm the minimum measuring level is at 500 mm (19.69 in) or more above the top of the inlet pipe by setting the low stop (for details of low stop setting, → 95). This protects the displacer from direct flow of the inlet liquid.
- If a stilling well cannot be mounted in the tank due to the shape or condition of the tank, attaching a guide system is recommended. Consult E+H services for further information.
Before pouring liquid into the tank, confirm that liquid flowing through the inlet of the pipe will not contact the displacer directly.

- When discharging liquid out of the tank, ensure that the displacer will not get caught in the liquid current and sucked into the outlet pipe.

5.1.7 Electrostatic charge

When liquid measured by NMS8x has a conductivity of 1 uS/m or less, it is quasi-nonconductive. In this case, using a stilling well or guide wire is recommended. This diffuses the electrostatic charge on the liquid surface.
5.2 Mounting of the device

The NMS8x is delivered in two different packing styles depending on the mounting method of the displacer.

- For the all-in-one method, the displacer is mounted on the measuring wire of NMS8x.
- For the displacer shipped separately method, it is necessary to install the displacer on the measuring wire inside NMS8x.

5.2.1 Available installations

The following installation procedures are available for NMS8x.

- Mounting without guide system
- Mounting with stilling well
- Mounting with guide wire

<table>
<thead>
<tr>
<th>Mounting options</th>
<th>Without guide system (Free-space mounting)</th>
<th>With stilling well</th>
<th>With guide wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of tanks</td>
<td><img src="image1" alt="Displacer without guide system" /></td>
<td><img src="image2" alt="Displacer with stilling well" /></td>
<td><img src="image3" alt="Displacer with guide wire" /></td>
</tr>
</tbody>
</table>
| Type of installations | - All-in one  
- Displacer shipped separately  
- Displacer installation through calibration window | - All-in one  
- Displacer shipped separately  
- Displacer installation through calibration window | Displacer shipped separately |
5.2.2 Verification of displacer and wire drum

Prior to installation of NMS8x, confirm that the serial numbers of displacer and the wire drum match with those printed to the label attached on the housing.
### 5.2.3 Tools to be required for installation

The following tools are required when installing NMS8x.

<table>
<thead>
<tr>
<th>Tools</th>
<th>Figures</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Box end wrench               | ![Box end wrench](image1) | Use the following size
  - 24 mm (0.94 in)
  - 26 mm (1 in)
  - 30 mm (1.2 in)
  - 32 mm (1.3 in) |
| Crescent wrench              | ![Crescent wrench](image2) | Use the size of 350 mm (13.78 in)                                    |
| Allen key                    | ![Allen key](image3) | Use the size of 3 mm (0.12 in) or 5 mm (0.17 in)                    |
| Screw driver                 | ![Screw driver](image4) | Cross-head screwdriver
  - Flat-blade screwdriver     |
| Wire cutters or terminal pliers | ![Wire cutters or terminal pliers](image5) |                                                                 |
| Crimp terminal               | ![Crimp terminal](image6) | A:
  - Signal and power supply: 0.2 to 2.5 mm² (24 to 13 AWG)
  - Ground terminal in the terminal compartment: max. 2.5 mm² (13 AWG)
  - Ground terminal at the housing: max. 4 mm² (11 AWG) |
| Water pump pliers            | ![Water pump pliers](image7) |                                                                       |
| Density calibration test weight | ![Density calibration test weight](image8) | This tool is used especially for density measurement application (optional). |
5.2.4 Installation for all-in-one

The device can be delivered by all-in-one method.

Displacer is shipped separately according to the following specifications.

- 47 m (154.2 ft) measuring range
- 55 m (180.5 ft) measuring range
- 316L 30 mm (1.18 in) displacer
- 316L 110 mm (4.33 in) displacer
- PTFE 30 mm (1.18 in) displacer
- PTFE 50 mm (1.97 in) displacer
- Guide wire assembly
- Cleaned from oil + grease option
- Internal FEP coated housing

14 Removing packing materials

1. Tape
2. Fixing band
3. Displacer holder
4. Wire drum stopper
5. Drum housing cover
6. Screws and bolts

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hold the gauge so that</td>
<td>• Perform these steps before mounting NMS8x on the nozzle.</td>
</tr>
<tr>
<td>it stays horizontal</td>
<td>• Do not tilt NMS8x after removing the displacer holder.</td>
</tr>
<tr>
<td>against the flange.</td>
<td></td>
</tr>
<tr>
<td>2. Cut the fixing bands [2].</td>
<td></td>
</tr>
<tr>
<td>3. Remove the displacer</td>
<td>• Make sure that the measuring wire hangs vertically.</td>
</tr>
<tr>
<td>holder [3] and packing</td>
<td>• Confirm that there are no kinks or other defects in the measuring</td>
</tr>
<tr>
<td>material of the displacer.</td>
<td>wire.</td>
</tr>
<tr>
<td>4. Mount NMS8x on the</td>
<td></td>
</tr>
<tr>
<td>nozzle.</td>
<td></td>
</tr>
<tr>
<td>5. Remove screws and M6</td>
<td>Be sure not to lose the O-ring and the fixing bolts for the cover of</td>
</tr>
<tr>
<td>bolts [6] (M10 bolts</td>
<td>the drum housing.</td>
</tr>
<tr>
<td>for stainless steel housing)</td>
<td></td>
</tr>
<tr>
<td>to remove the drum housing</td>
<td></td>
</tr>
<tr>
<td>cover [5].</td>
<td></td>
</tr>
<tr>
<td>6. Loosen two screws and</td>
<td></td>
</tr>
<tr>
<td>remove the wire drum</td>
<td></td>
</tr>
<tr>
<td>stopper [4].</td>
<td></td>
</tr>
</tbody>
</table>
7. Remove the tape [1] from the wire drum carefully.
   • Remove the tape by hands to avoid damaging the wire drum.
   • Make sure that the measuring wire is wound so that it fits correctly in the grooves.

8. Mount the drum housing cover.
   Confirm that the O-ring is in the drum housing cover.

9. Turn on the power of NMS8x.
   ![Sensor, reference, and drum calibration steps are not required because they are all performed prior to delivery.](image)


5.2.5 **Installation for displacer shipped separately method**

It is necessary to remove the wire drum from NMS8x, remove the tape on the wire drum, mount the wire drum in the drum housing, and install the displacer on the measuring wire.

Use blocks or a pedestal to secure NMS8x and provide an environment where electrical power can be supplied to NMS8x.

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Secure NMS8x on the blocks or pedestal.</td>
<td><img src="A0027015" alt="Figures" /></td>
</tr>
<tr>
<td>2. Confirm that there is enough space under NMS8x.</td>
<td>Dimensions mm (in)</td>
</tr>
<tr>
<td>3. Remove screws and M6 bolts [6] (M10 bolts for stainless steel housing).</td>
<td><img src="A0029115" alt="Figures" /></td>
</tr>
<tr>
<td>4. Remove the wire drum cover [5], wire drum stopper [4], and the bracket [2].</td>
<td></td>
</tr>
<tr>
<td>5. Remove the wire drum [1] from the drum housing.</td>
<td></td>
</tr>
<tr>
<td>7. Unwind the measuring wire approximately 250 mm (9.84 in) so that the wire ring is positioned under the flange.</td>
<td></td>
</tr>
<tr>
<td>8. Mount the wire drum on NMS8x.</td>
<td></td>
</tr>
<tr>
<td>9. Mount the bracket.</td>
<td></td>
</tr>
<tr>
<td>• Take special care to not hit the wire drum against the housing due to strong magnet force.</td>
<td></td>
</tr>
<tr>
<td>• Handle the measuring wire with care. It may kink.</td>
<td></td>
</tr>
<tr>
<td>• Be sure that the wire is wound correctly in the grooves.</td>
<td></td>
</tr>
<tr>
<td>• Be sure that the wire is wound correctly in the grooves.</td>
<td></td>
</tr>
<tr>
<td>• If not, remove the displacer and the wire drum, and repeat step 7.</td>
<td></td>
</tr>
</tbody>
</table>
### Procedures

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>11.</strong></td>
<td>Turn on the power of NMS8x.</td>
<td></td>
</tr>
<tr>
<td><strong>12.</strong></td>
<td>Perform sensor calibration</td>
<td></td>
</tr>
<tr>
<td><strong>14.</strong></td>
<td>Install the ground wire [3] of the displacer (for details of displacer ground wire installation → 40).</td>
<td></td>
</tr>
<tr>
<td><strong>15.</strong></td>
<td>Perform reference calibration.</td>
<td></td>
</tr>
<tr>
<td><strong>16.</strong></td>
<td>Turn off the power.</td>
<td></td>
</tr>
<tr>
<td><strong>17.</strong></td>
<td>Mount the wire drum cover [5].</td>
<td></td>
</tr>
<tr>
<td><strong>18.</strong></td>
<td>Mount NMS8x on the tank nozzle [1].</td>
<td></td>
</tr>
<tr>
<td><strong>19.</strong></td>
<td>Confirm that the displacer does not touch the inner wall of the nozzle.</td>
<td></td>
</tr>
<tr>
<td><strong>20.</strong></td>
<td>Turn on the power.</td>
<td></td>
</tr>
<tr>
<td><strong>21.</strong></td>
<td>Perform drum calibration.</td>
<td></td>
</tr>
</tbody>
</table>

- For sensor calibration, → 88
- For reference calibration, → 90.

### Figures

- For drum calibration, → 91
### 5.2.6 Installation through the calibration window

In the case of a 50 mm (1.97 in) diameter displacer, the displacer can be installed through the calibration window.

- It is only possible to install the following displacers through the calibration window: 50 mm 316L, 50 mm AlloyC276, 50 mm PTFE

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remove the calibration window cover [1].</td>
<td><img src="A0027019" alt="Figure" /></td>
</tr>
<tr>
<td>2. Remove M6 bolts and screws [6] (M10 bolts for stainless steel housing).</td>
<td><img src="A0027617" alt="Figure" /></td>
</tr>
<tr>
<td>3. Remove the cover [5], wire drum stopper [4], and the bracket [3].</td>
<td></td>
</tr>
<tr>
<td>4. Remove the wire drum [1] from the drum housing.</td>
<td></td>
</tr>
<tr>
<td>5. Remove the tape [2] that is securing the wire.</td>
<td></td>
</tr>
<tr>
<td>6. Holding the wire drum [1] with one hand, unwind the measuring wire [3] approximately 500 mm (19.69 in).</td>
<td><img src="A0027623" alt="Figure" /></td>
</tr>
<tr>
<td>7. Secure the wire [3] temporarily with the tape [2].</td>
<td></td>
</tr>
<tr>
<td>9. Pull the wire ring out through the calibration window.</td>
<td></td>
</tr>
<tr>
<td>12. Secure the displacer to the measuring wire using the securing wire [2].</td>
<td></td>
</tr>
<tr>
<td>13. Install the ground wire [1] for the displacer (for details of displacer ground wire installation → 40).</td>
<td></td>
</tr>
<tr>
<td>• Take special care to not hit the wire drum against the housing due to strong magnet force.</td>
<td></td>
</tr>
<tr>
<td>• Handle the measuring wire with care. It may kink.</td>
<td></td>
</tr>
</tbody>
</table>
### Procedures

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>Remove the wire drum from the drum housing and unwind the measuring wire approximately 500 mm (19.69 in).</td>
</tr>
<tr>
<td>16.</td>
<td>Hold the displacer at the center of the calibration window.</td>
</tr>
<tr>
<td>17.</td>
<td>Hold the other hand (wire drum) up to add tension to the measuring wire in order not to drop the displacer rapidly.</td>
</tr>
<tr>
<td>18.</td>
<td>Let go of the displacer [2].</td>
</tr>
<tr>
<td>19.</td>
<td>Remove the tape from the wire drum [5].</td>
</tr>
<tr>
<td>20.</td>
<td>Insert the wire drum into the drum housing.</td>
</tr>
<tr>
<td>21.</td>
<td>Mount the bracket [4].</td>
</tr>
<tr>
<td></td>
<td>Be sure that the wire is wound correctly in the grooves.</td>
</tr>
<tr>
<td>22.</td>
<td>Turn on the power of NMS8x and move the displacer up using the Move displacer → 87 until the wire ring can be seen in the calibration window.</td>
</tr>
<tr>
<td></td>
<td>• Confirm that there are no kinks or other defects in the measuring wire.</td>
</tr>
<tr>
<td></td>
<td>• Confirm that the displacer does not touch the inner wall of the nozzle.</td>
</tr>
<tr>
<td>23.</td>
<td>Perform sensor calibration.</td>
</tr>
<tr>
<td></td>
<td>For sensor calibration, → 88</td>
</tr>
<tr>
<td></td>
<td>For reference calibration, → 90.</td>
</tr>
<tr>
<td>25.</td>
<td>Mount the drum housing cover [3] and the calibration window cover [1].</td>
</tr>
<tr>
<td>26.</td>
<td>Perform drum calibration.</td>
</tr>
<tr>
<td></td>
<td>For drum calibration, → 91</td>
</tr>
</tbody>
</table>

### Figures
5.2.7 Displacer ground wire installation

Depending on the application and Ex requirements, electrical grounding of the displacer is required. There are different procedures depending on the displacer type, which are described below.

For details of displacer installation → 31

Standard displacer installation

   If grounding is not required for non-explosion-proof applications, skip this step.
4. Secure the nut [6] with a wrench [7].

This completes the displacer installation procedure.

PTFE displacer installation

3. Remove the PFA covered wire approximately 3.5 to 4.0 mm (0.14 to 0.16 in) for conductivity.
   - PTFE wire: Install the ground wire [6] onto the displacer from the wire insertion slot [3] until the ground wire touches to the wall of the screw hole [5].
   - SUS wire: Install the ground wire [6] onto the displacer from the wire insertion slot [3] until the ground wire touches to the wall of the screw hole [5]. Then install the ground wire 10 mm (0.39 in) farther.
4. Install the ground wire [6] onto the displacer from the wire insertion slot [3] until the ground wire contacts to the wall of the screw hole [5].
5. Tighten the screw [1].
   - Hold the ground wire with finger tips so that the wire does not come out from the slot.
6. Lift the displacer using a screwdriver and confirm that the ground wire does not come out from the slot.

This completes the PTFE displacer installation.

5.3 Post-installation check

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<th>Answer</th>
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<td>Is the device undamaged (visual inspection)?</td>
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<tr>
<td>Does the device conform to the measuring point specifications?</td>
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<td>For example:</td>
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<td>• Process temperature</td>
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<tr>
<td>• Process pressure (refer to the chapter on 'Material load curves' of the &quot;Technical Information&quot; document)</td>
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<tr>
<td>• Ambient temperature range</td>
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<tr>
<td>• Measuring range</td>
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<tr>
<td>Are the measuring point identification and labeling correct (visual inspection)?</td>
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</tr>
<tr>
<td>Is the device adequately protected from precipitation and direct sunlight?</td>
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</tr>
</tbody>
</table>
6 Electrical connection

6.1 Terminal assignment

![Terminal compartment (typical example) and ground terminals](image)

- **Housing thread**
  The threads of the electronics and connection compartment can be coated with an anti-friction coating.
  The following applies for all housing materials:
  - **Do not lubricate the housing threads.**

- **Terminal area A/B/C/D (slots for I/O modules)**
  - Module: Up to four I/O modules, depending on the order code
  - Modules with four terminals can be in any of these slots.
  - Modules with eight terminals can be in slot B or C.
  - The exact assignment of the modules to the slots is dependent on the device version → 45.

- **Terminal area E**
  - Module: HART Ex i/IS interface
  - E1: H+
  - E2: H-

- **Terminal area F**
  - Remote display
  - F1: VCC (connect to terminal 81 of the remote display)
  - F2: Signal B (connect to terminal 84 of the remote display)
  - F3: Signal A (connect to terminal 83 of the remote display)
  - F4: Gnd (connect to terminal 82 of the remote display)

- **Terminal area G (for High voltage AC power supply and Low voltage AC power supply)**
  - G1: N
  - G2: not connected
  - G3: L

- **Terminal area G (for Low voltage DC power supply)**
  - G1: L-
  - G2: not connected
  - G3: L+

- **Terminal area: Protective ground**
  - Module: Protective ground connection (M4 screw)
6.1.1 Power supply

The supply voltage is also indicated on the nameplate.

Supply voltage

High voltage AC power supply:
Operational value:
100 to 240 $V_{AC}$ ($-15\% + 10\%) = 85$ to $264 \, V_{AC}, 50/60 \, Hz$

Low voltage AC power supply:
Operational value:
65 $V_{AC}$ ($-20\% + 15\%) = 52$ to $75 \, V_{AC}, 50/60 \, Hz$

Low voltage DC power supply:
Operational value:
24 to 55 $V_{DC}$ ($-20\% + 15\%) = 19$ to $64 \, V_{DC}$

Power consumption

Maximum power varies depending on the configuration of the modules. The value shows maximum apparent power, select the applicable cables accordingly. The actual consumed effective power is 12 W.

High voltage AC power supply:
28.8 VA

Low voltage AC power supply:
21.6 VA

Low voltage DC power supply:
13.4 W
6.1.2 Remote display and operating module DKX001

![Diagram of electrical connections]

19 Connection of the remote display and operating module DKX001 to the Tank Gauging device (NMR8x, NMS8x or NRF8x)

1 Remote display and operating module
2 Connecting cable
3 Tank Gauging device (NMR8x, NMS8x or NRF8x)

The remote display and operating module DKX001 is available as an accessory. For details refer to SD01763D.

- The measured value is indicated on the DKX001 and on the local display and operating module simultaneously.
- The operating menu cannot be accessed on both modules at the same time. If the operating menu is entered in one of these modules, the other module is automatically locked. This locking remains active until the menu is closed in the first module (back to measured value display).

6.1.3 HART Ex i/IS interface

![Diagram of electrical connections]

E1 H+
E2 H-
3 Orange LED: indicates data communication

This interface always operates as the main HART master for connected HART slave transmitters. The Analog I/O modules, on the other hand, can be configured as a HART master or slave → 58 → 60.
6.1.4 Slots for I/O modules

The terminal compartment contains four slots (A, B, C and D) for I/O modules. Depending on the device version (ordering features 040, 050 and 060) these slots contain different I/O modules. The table below shows which module is located in which slot for a specific device version.

The slot assignment for the device is also indicated on a label attached to the back cover of the display module.

---

List of abbreviations used in table "Primary Output" (040) = "Modbus" (A1)

- **O** - Ordering feature
- **T** - Terminal area
- **040** - Primary Output
- **050** - Secondary IO Analog
- **060** - Secondary IO Digital Ex d/XP
- **M** - Modbus
- **D** - Digital
- **A/XP** - Analog Ex d/XP
- **A/IS** - Analog Ex i/IS
"Primary Output" (040) = "Modbus" (A1)

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List of abbreviations used in table "Primary Output" (040) = "V1" (B1)

- **O** - Ordering feature
- **T** - Terminal area
- **040** - Primary Output
- **050** - Secondary IO Analog
- **060** - Secondary IO Digital Ex d/XP
- **V1** - Sakura V1
- **M** - Modbus
- **W** - Whesooe WM550
- **D** - Digital
- **A/XP** - Analog Ex d/XP
- **A/IS** - Analog Ex i/IS
"Primary Output" (040) = "V1" (B1)

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| B1 | C2 | E1 | V1 | A/IS | A/IS | W |

1) Ordering feature  
2) Terminal area  
3) Primary Output  
4) Secondary IO Analog  
5) Secondary IO Digital Ex d/XP

List of abbreviations used in table "Primary Output" (040) = "V1" (B1)  
- O - Ordering feature  
- T - Terminal area  
- 040 - Primary Output  
- 050 - Secondary IO Analog  
- 060 - Secondary IO Digital Ex d/XP  
- V1 - Sakura V1  
- M - Modbus  
- W - Whessoe WM550  
- D - Digital  
- A/XP - Analog Ex d/XP  
- A/IS - Analog Ex i/IS
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<td>A/XP</td>
<td>W</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>C1</td>
<td>B1</td>
<td>X0</td>
<td>W</td>
<td>A/IS</td>
<td>-</td>
<td>-</td>
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<td>28</td>
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<tr>
<td>C1</td>
<td>B1</td>
<td>A1</td>
<td>W</td>
<td>A/IS</td>
<td>D</td>
<td>29</td>
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<td>B1</td>
<td>A2</td>
<td>W</td>
<td>A/IS</td>
<td>D</td>
<td>30</td>
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<td></td>
</tr>
</tbody>
</table>
### 1) Ordering feature

### 2) Terminal area

### 3) Primary Output

### 4) Secondary I/O Analog

### 5) Secondary I/O Digital Ex d/XP

<table>
<thead>
<tr>
<th></th>
<th>040</th>
<th>050</th>
<th>060</th>
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</thead>
<tbody>
<tr>
<td>C1</td>
<td>B1</td>
<td>B1</td>
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<tr>
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<td>B2</td>
<td>W</td>
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<td>B1</td>
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<td>B1</td>
<td>C2</td>
<td>W</td>
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<td>B2</td>
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<tr>
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<td>X0</td>
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<td>C1</td>
<td>C2</td>
<td>B1</td>
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<tr>
<td>C1</td>
<td>C2</td>
<td>E1</td>
<td>W</td>
</tr>
</tbody>
</table>

### List of abbreviations used in table "Primary Output" (040) = "V1" (B1)

- O - Ordering feature
- T - Terminal area
- 040 - Primary Output
- 050 - Secondary I/O Analog
- 060 - Secondary I/O Digital Ex d/XP
- V1 - Sakura V1
- M - Modbus
- W - Whessoe WM550
- D - Digital
- A/XP - Analog Ex d/XP
- A/IS - Analog Ex i/IS
"Primary Output" (040) = "4-20mA HART Ex d" (E1)

<table>
<thead>
<tr>
<th>040</th>
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</thead>
<tbody>
<tr>
<td>E1</td>
<td>X0</td>
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<td>E1</td>
<td>X0</td>
<td>A3</td>
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<td>E1</td>
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</tr>
<tr>
<td>E1</td>
<td>A1</td>
<td>A2</td>
</tr>
<tr>
<td>E1</td>
<td>A1</td>
<td>B1</td>
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<tr>
<td>E1</td>
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<td>B2</td>
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<td>B1</td>
<td>A2</td>
</tr>
<tr>
<td>E1</td>
<td>B1</td>
<td>B1</td>
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</table>

1) Ordering feature
2) Terminal area
3) Primary Output
4) Secondary IO Analog
5) Secondary IO Digital Ex d/XP

List of abbreviations used in table "Primary Output" (040) = "V1" (B1)
- O - Ordering feature
- T - Terminal area
- 040 - Primary Output
- 050 - Secondary IO Analog
- 060 - Secondary IO Digital Ex d/XP
- V1 - Sakura V1
- M - Modbus
- W - Whessoe WM550
- D - Digital
- A/XP - Analog Ex d/XP
- A/IS - Analog Ex i/IS

"Primary Output" (040) = "4-20mA HART Ex i" (H1)

<table>
<thead>
<tr>
<th>O 1)</th>
<th>T 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>040 3)</td>
<td>050 4)</td>
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<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
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<tbody>
<tr>
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<td>X0</td>
<td>X0</td>
<td>-</td>
<td>A/IS</td>
</tr>
<tr>
<td>H1</td>
<td>X0</td>
<td>A1</td>
<td>-</td>
<td>A/IS</td>
</tr>
<tr>
<td>H1</td>
<td>X0</td>
<td>A2</td>
<td>-</td>
<td>A/IS</td>
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<tr>
<td>H1</td>
<td>X0</td>
<td>A3</td>
<td>D</td>
<td>A/IS</td>
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<tr>
<td>H1</td>
<td>X0</td>
<td>B1</td>
<td>M</td>
<td>A/IS</td>
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<tr>
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<td>B3</td>
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<td>H1</td>
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<td>A/IS</td>
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<td>B1</td>
<td>B2</td>
<td>M</td>
<td>A/IS</td>
</tr>
</tbody>
</table>

1) Ordering feature
2) Terminal area
3) Primary Output
4) Secondary IO Analog
5) Secondary IO Digital Ex d/XP

List of abbreviations used in table "Primary Output" (040) = "V1" (B1)
- O - Ordering feature
- T - Terminal area
- 040 - Primary Output
- 050 - Secondary IO Analog
- 060 - Secondary IO Digital Ex d/XP
- V1 - Sakura V1
- M - Modbus
- W - Whessoe WM550
- D - Digital
- A/XP - Analog Ex d/XP
- A/iS - Analog Ex i/iS
6.1.5 Terminals of the "Modbus" module, "V1" module or "WM550" module

depending on the device version, the "Modbus" and/or "V1" or "WM550" module may be in different slots of the terminal compartment. In the operating menu the "Modbus" and "V1" or "WM550" interfaces are designated by the respective slot and the terminals within this slot: A1-4, B1-4, C1-4, D1-4.

Terminals of the "Modbus" module
Designation of the module in the operating menu: Modbus X1-4; (X = A, B, C or D)

- **X1**
  - Terminal name: S
  - Description: Cable shielding connected via a capacitor to EARTH
- **X2**
  - Terminal name: 0V
  - Description: Common reference
- **X3**
  - Terminal name: B-
  - Description: Non-inverting signal line
- **X4**
  - Terminal name: A+
  - Description: Inverting signal line

1) Here, 'X' stands for one of the slots "A", "B", "C", or "D".
**Terminals of the "V1" and "WM550" module**

Designation of the module in the operating menu: **V1 X1-4** or **WM550 X1-4**; (X = A, B, C or D)

- **X1** 2)
  - Terminal name: S
  - Description: Cable shielding connected via a capacitor to EARTH
- **X2** 1)
  - Terminal name: -
  - Description: not connected
- **X3** 1)
  - Terminal name: B-
  - Description: Protocol loop signal -
- **X4** 1)
  - Terminal name: A+
  - Description: Protocol loop signal +

6.1.6 **Terminals of the "Analog I/O" module (Ex d /XP or Ex i/IS)**

![Diagram of terminals](image)

**Terminal: B1-3**

Function: Analog input or output (configurable)

- Passive usage: → Page 58
- Active usage: → Page 60
- Designation in the operating menu:
  Analog I/O B1-3 (→ Page 221)

**Terminal: C1-3**

Function: Analog input or output (configurable)

- Passive usage: → Page 58
- Active usage: → Page 60
- Designation in the operating menu:
  Analog I/O C1-3 (→ Page 221)

**Terminal: B4-8**

Function: Analog input

- RTD: → Page 61
- Designation in the operating menu:
  Analog IP B4-8 (→ Page 215)

---

2) Here, ‘X’ stands for one of the slots ‘A’, ‘B’, ‘C’, or ‘D’.
Terminal: C4-8
Function: Analog input
- RTD: → 61
- Designation in the operating menu:
  Analog IP C4-8 (→ 215)
6.1.7 Connection of the "Analog I/O" module for passive usage

- In the passive usage the supply voltage for the communication line must be supplied by an external source.
- The wiring must be in accordance with the intended operating mode of the Analog I/O module; see the drawings below.

"Operating mode" = "4..20mA output" or "HART slave +4..20mA output"

- Power supply
- HART signal output
- Analog signal evaluation

"Operating mode" = "4..20mA input" or "HART master+4..20mA input"

- Power supply
- External device with 4..20mA and/or HART signal output
"Operating mode" = "HART master"

23 Passive usage of the Analog I/O module in the HART master mode

- a Power supply
- b Up to 6 external devices with HART signal output
6.1.8 Connection of the "Analog I/O" module for active usage

- In the active usage the supply voltage for the communication line is supplied by the device itself. There is no need of an external power supply.
- The wiring must be in accordance with the intended operating mode of the Analog I/O module; see the drawings below.
- Maximum current consumption of the connected HART devices: 24 mA (i.e. 4 mA per device if 6 devices are connected).
- Output voltage of the Ex-d module: 17.0 V@4 mA to 10.5 V@22 mA
- Output voltage of the Ex-ia module: 18.5 V@4 mA to 12.5 V@22 mA

"Operating mode" = "4..20mA output" or "HART slave +4..20mA output"

"Operating mode" = "4..20mA input" or "HART master+4..20mA input"
"Operating mode" = "HART master"

26. Active usage of the Analog I/O module in the HART master mode

a. Up to 6 external devices with HART signal output

The maximum current consumption for the connected HART devices is 24 mA (i.e. 4 mA per device if 6 devices are connected).

6.1.9 Connection of a RTD

A. 4-wire RTD connection
B. 3-wire RTD connection
C. 2-wire RTD connection
6.1.10 Terminals of the "Digital I/O" module

Each Digital IO Module provides two digital inputs or outputs. In the operating menu each input or output is designated by the respective slot and two terminals within this slot. **A1-2**, for example, denotes terminals 1 and 2 of slot **A**. The same is valid for slots **B**, **C** and **D** if they contain a Digital I/O module.

For each of these pairs of terminals, one of the following operating modes can be selected in the operating menu:

- **Disable**
- **Passive Output**
- **Passive Input**
- **Active Input**
6.2 Connecting requirements

6.2.1 Cable specification

Terminals

Wire cross section 0.2 to 2.5 mm² (24 to 13 AWG)
Use for terminals with function: Signal and power supply
- Spring terminals (NMx8x-xx1...)
- Screw terminals (NMx8x-xx2...)

Wire cross section max. 2.5 mm² (13 AWG)
Use for terminals with function: Ground terminal in the terminal compartment

Wire cross section max. 4 mm² (11 AWG)
Use for terminals with function: Ground terminal at the housing

Power supply line
Standard device cable is sufficient for the power line.

HART communication line
- Standard device cable is sufficient if only the analog signal is used.
- Shielded cable is recommended if using the HART protocol. Observe the grounding concept of the plant.

Modbus communication line
- Observe the cable conditions from the TIA-485-A, Telecommunications Industry Association.
- Additional conditions: Use shielded cable.

V1 communication line
- 2-wire twisted pair, screened or unscreened cable
- Resistance in one cable: ≤ 120 Ω
- Capacitance between lines: ≤ 0.3 µF

WM550 communication line
- 2-wire twisted pair, unscreened cable
- Cross section minimum 0.5 mm² (20 AWG)
- Maximum total cable resistance: ≤ 250 Ω
- Cable with low capacitance
6.3 Ensuring the degree of protection

To guarantee the specified degree of protection, carry out the following steps after the electrical connection:

1. Check that the housing seals are clean and fitted correctly. Dry, clean or replace the seals if necessary.
2. Tighten all housing screws and screw covers.
3. Firmly tighten the cable glands.
4. To ensure that moisture does not enter the cable entry, route the cable so that it loops down before the cable entry (“water trap”).
5. Insert blind plugs appropriate for the safety rating of the device (e.g. Ex d/XP).

6.4 Post-connection check

- Are cables or the device undamaged (visual inspection)?
- Do the cables comply with the requirements?
- Do the cables have adequate strain relief?
- Are all cable glands installed, firmly tightened and correctly sealed?
- Does the supply voltage match the specifications on the transmitter nameplate?
- Is the terminal assignment correct → 4.2?
- If required: Is the protective earth connected correctly?
- If supply voltage is present: Is the device ready for operation and do values appear on the display module?
- Are all housing covers installed and firmly tightened?
- Is the securing clamp tightened correctly?
7 Operability

7.1 Overview of the operation options

The device is operated via an operating menu (→ 66). This menu can be accessed by the following interfaces:

- The display and operating module at the device or the remote display and operating module DKX001 (→ 67).
- FieldCare connected through the service interface in the terminal compartment of the device (→ 79).
- FieldCare connected through Tankvision Tank Scanner NXA820 (remote operation; → 79).
- FieldCare connected through Commubox FXA195 (→ 159) to a HART interface of the device.

Confirm that the servo motor stops before changing parameters for safety use.
## 7.2 Structure and function of the operating menu

<table>
<thead>
<tr>
<th>Menu</th>
<th>Submenu / parameter</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proservo parameters</td>
<td>Contains parameters to operate Proservo (e.g. Gauge command).</td>
</tr>
<tr>
<td></td>
<td>Level</td>
<td>Shows the measured and calculated level values.</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>Shows the measured and calculated temperature values.</td>
</tr>
<tr>
<td></td>
<td>Density</td>
<td>Shows the measured and calculated density values.</td>
</tr>
<tr>
<td></td>
<td>Pressure</td>
<td>Shows the measured and calculated pressure values.</td>
</tr>
<tr>
<td></td>
<td>GP values</td>
<td>Shows the general purpose values.</td>
</tr>
<tr>
<td><strong>Setup</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard parameters</td>
<td>Standard commissioning parameters</td>
</tr>
<tr>
<td>Calibration</td>
<td></td>
<td>Calibration of the measurement</td>
</tr>
</tbody>
</table>
| Advanced setup |                     | Contains further parameters and submenus:  
| | | • to adapt the device to special measuring conditions.  
| | | • to process the measured value.  
| | | • to configure the signal output. |
| **Diagnostics** |                     |         |
|         | Diagnostic parameters | Indicates:  
| | | • The latest diagnostic messages and their timestamps.  
| | | • The operating time (overall time and time since last restart).  
| | | • The time according to the real-time clock. |
| Diagnostic list |                     | Contains up to 5 currently active error messages. |
| Device information |                     | Contains information needed to identify the device. |
| Simulation |                     | Used to simulate measured values or output values. |
| Device check |                     | Contains all parameters needed to check the measurement capability of the device. |
| **Expert** | 1)                   | Contains all parameters of the device (including those which are already contained in one of the other menus). This menu is organized according to the function blocks of the device. The parameter of the Expert menu are described in: GP01077G (NMS81) |
| System |                     | Contains all general device parameters which do not affect the measurement or the communication interface. |
| Sensor |                     | Contains all parameters needed to configure the measurement. |
| Input/output |                     | Contains submenus to configure the analog and discrete I/O modules and connected HART devices. |
| Communication |                     | Contains all parameters needed to configure the digital communication interface. |
| Application |                     | Contains submenus to configure  
| | | • the tank gauging application  
| | | • the tank calculations  
| | | • the alarms. |
Menu | Submenu / parameter | Meaning
--- | --- | ---
Tank values |  | Shows measured and calculated tank values
Diagnostics |  | Contains all parameters needed to detect and analyze operational errors.

1) On entering the "Expert" menu, an access code is always requested. If a customer specific access code has not been defined, "0000" has to be entered.

7.3 Access to the operating menu via the local or remote display and operating module

- Operating via the remote display and operating module DKX001 (→ 44) or the local display and operating module at the device are equivalent.
- The measured value is indicated on the DKX001 and on the local display and operating module simultaneously.
- The operating menu cannot be accessed on both modules at the same time. If the operating menu is entered in one of these modules, the other module is automatically locked. This locking remains active until the menu is closed in the first module (back to measured value display).

7.3.1 Display and operating elements

The device has an illuminated liquid crystal display (LCD) that shows measured and calculated values as well as the device status in the standard view. Other views are used to navigate through the operating menu and to set parameter values.

The device is operated by three optical keys, namely "+", "−" and "E". They are actuated when the appropriate field on the protective glass of the front is lightly touched with the finger ("touch control").
7.3.2 Standard view (measured value display)

![Diagram](image)

29 Typical appearance of the standard view (measured value display)
1 Display module
2 Device tag
3 Status area
4 Display area for measured values
5 Display area for measured value and status symbols
6 Gauge status indication
7 Gauge status symbol
8 Measured value status symbol

Status symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>&quot;Failure&quot; A device error is present. The measured value is no longer valid.</td>
</tr>
<tr>
<td>C</td>
<td>&quot;Function check&quot; The device is in service mode (e.g. during a simulation).</td>
</tr>
</tbody>
</table>
| S      | "Out of specification" The device is operated:  
|        | • Outside of its technical specifications (e.g. during startup or a cleaning)  
|        | • Outside of the configuration carried out by the user (e.g. level outside configured span) |
| M      | "Maintenance required" Maintenance is required. The measured value is still valid. |

Measured value symbols

<table>
<thead>
<tr>
<th>Symbol 1</th>
<th>Symbol 2</th>
<th>Measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Tank level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Measured level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tank level %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water level</td>
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<tr>
<td></td>
<td></td>
<td>Liquid temperature</td>
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<td></td>
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<td>Vapor temperature</td>
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<td></td>
<td></td>
<td>Air temperature</td>
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<td></td>
<td></td>
<td>• Tank ullage</td>
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<td>Symbol 2</td>
<td>Measured value</td>
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<td>----------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>Average profile density</td>
</tr>
<tr>
<td>P</td>
<td>1</td>
<td>P1 (bottom)</td>
</tr>
<tr>
<td>P</td>
<td>2</td>
<td>P2 (middle)</td>
</tr>
<tr>
<td>P</td>
<td>3</td>
<td>P3 (top)</td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>GP 1 value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This is used for an external device.</td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>GP 2 value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This is used for an external device.</td>
</tr>
<tr>
<td>G</td>
<td>3</td>
<td>GP 3 value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This is used for an external device.</td>
</tr>
<tr>
<td>G</td>
<td>4</td>
<td>GP 4 value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This is used for an external device.</td>
</tr>
<tr>
<td>U</td>
<td></td>
<td>Upper I/F level</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td>Lower I/F level</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>Upper density</td>
</tr>
<tr>
<td>M</td>
<td></td>
<td>Middle density</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>Lower density</td>
</tr>
<tr>
<td>U</td>
<td></td>
<td>Bottom level</td>
</tr>
<tr>
<td>Θ</td>
<td></td>
<td>Displacer position</td>
</tr>
</tbody>
</table>

### Gauge command and gauge status symbols

<table>
<thead>
<tr>
<th>Symbol 1</th>
<th>Symbol 2</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>Gauge command</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This shows current command.</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>Gauge status</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Displacer is unbalanced (Level/Interface not found yet).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Displacer is balanced (Level/Interface measurement valid).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Displacer is moving up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Displacer is moving down.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Displacer stopped.</td>
</tr>
</tbody>
</table>
### Measured value status symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Status "Alarm"](image) | Status "Alarm"  
The measurement is interrupted. The output assumes the defined alarm value. A diagnostic message is generated. |
| ![Status "Warning"](image) | Status "Warning"  
The device continues measuring. A diagnostic message is generated. |
| ![Calibration to regulatory standards disturbed](image) | Calibration to regulatory standards disturbed  
Is displayed in the following situations:  
- The write protection switch is OFF. → 🗝️ 77  
- The write protection switch is ON but the level value can currently not be guaranteed because the displacer is not balanced. |

### Locking state symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Display parameter](image) | Display parameter  
Marks display-only parameters which cannot be edited. |
| ![Device locked](image) | Device locked  
- In front of a parameter name: The device is locked via software and/or hardware.  
- In the header of the measured value screen: The device is locked via hardware. |

### Meaning of the keys in the standard view

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Enter key](image) | **Enter key**  
- Pressing the key briefly opens the operating menu.  
- Pressing the key for 2 s opens the context menu:  
  - **Level** (visible if the keylock is inactive): Shows the measured levels.  
  - **Keylock on** (visible if the keylock is inactive): Activates the keylock.  
  - **Keylock off** (visible if the keylock is active): Deactivates the keylock. |
7.3.3 Navigation view

![Navigation view diagram]

- **1** Current submenu or wizard
- **2** Quick access code
- **3** Display area for navigation

**Navigation symbols**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Operation symbol](A0011975) | Operation  
Is displayed:  
• in the main menu next to the selection *Operation*  
• in the header, if you are in the *Operation* menu. |
| ![Setup symbol](A0011974) | Setup  
Is displayed:  
• in the main menu next to the selection *Setup*  
• in the header, if you are in the *Setup* menu |
| ![Expert symbol](A0011976) | Expert  
Is displayed:  
• in the main menu next to the selection *Expert*  
• in the header, if you are in the *Expert* menu |
| ![Diagnostics symbol](A0011977) | Diagnostics  
Is displayed:  
• in the main menu next to the selection *Diagnostics*  
• in the header, if you are in the *Diagnostics* menu |
| ![Submenu symbol](A0011978) | Submenu |
| ![Wizard symbol](A0011979) | Wizard |
| ![Parameter locked symbol](A0011980) | Parameter locked  
When displayed in front of a parameter name, indicates that the parameter is locked. |
Meaning of the keys in the navigation view

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![Minus key](image) | Minus key  
Moves the selection bar upwards in a picklist. |
| ![Plus key](image) | Plus key  
Moves the selection bar downwards in a picklist. |
| ![Enter key](image) | Enter key  
- Pressing the key briefly opens the selected menu, submenu or parameter.  
- For parameters: Pressing the key for 2 s opens the help text for the function of the parameter (if present). |
| ![Escape key combination](image) | Escape key combination (press keys simultaneously)  
- Pressing the key briefly  
  - Exits the current menu level and takes you to the next higher level.  
  - If help text is open, closes the help text of the parameter.  
  - Pressing the keys for 2 s returns you to the measured value display ('standard view'). |

7.3.4  Wizard view

![Wizard view on the display module](image)

1  Current wizard  
2  Display area for navigation

Wizard navigation symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Parameters within a wizard" /></td>
<td>Parameters within a wizard</td>
</tr>
<tr>
<td><img src="image" alt="Switches to the previous parameter" /></td>
<td>Switches to the previous parameter.</td>
</tr>
<tr>
<td><img src="image" alt="Confirms the parameter value and switches to the next parameter" /></td>
<td>Confirms the parameter value and switches to the next parameter.</td>
</tr>
<tr>
<td><img src="image" alt="Opens the editing view of the parameter" /></td>
<td>Opens the editing view of the parameter.</td>
</tr>
</tbody>
</table>

In the wizard view the meaning of the keys is indicated by the navigation symbol directly above the respective key (softkey functionality).
7.3.5 Numeric editor

![Numeric editor on the display module]

1 Display area of the entered value
2 Input mask

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Selection of numbers from 0 to 9.</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>.</td>
<td>Inserts decimal separator at the input position.</td>
</tr>
<tr>
<td>–</td>
<td>Inserts minus sign at the input position.</td>
</tr>
<tr>
<td>✔</td>
<td>Confirms selection.</td>
</tr>
<tr>
<td>←</td>
<td>Moves the input position one position to the left.</td>
</tr>
<tr>
<td>✗</td>
<td>Exits the input without applying the changes.</td>
</tr>
<tr>
<td>C</td>
<td>Clears all entered characters.</td>
</tr>
</tbody>
</table>

**Meaning of the keys in the numeric editor**

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Minus key</strong></td>
</tr>
<tr>
<td></td>
<td>In the input mask, moves the selection bar to the left (backwards).</td>
</tr>
<tr>
<td></td>
<td><strong>Plus key</strong></td>
</tr>
<tr>
<td></td>
<td>In the input mask, moves the selection bar to the right (forwards).</td>
</tr>
<tr>
<td>Enter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressing the key briefly adds the selected number to the current decimal place or carries out the selected action.</td>
</tr>
<tr>
<td></td>
<td>Pressing the key for 2 s confirms the edited parameter value.</td>
</tr>
<tr>
<td>Escape</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closes the text or numeric editor without applying changes.</td>
</tr>
</tbody>
</table>
7.3.6 Text editor

Text editor on the display module
1 Display area of the entered text
2 Input mask

Text editor symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC _</td>
<td>Selection of letters from A to Z</td>
</tr>
<tr>
<td>…</td>
<td>Toggle</td>
</tr>
<tr>
<td>XYZ</td>
<td>Selection of letters from A to Z</td>
</tr>
<tr>
<td>Aa1@</td>
<td>Toggle</td>
</tr>
<tr>
<td>✔️</td>
<td>Confirms selection.</td>
</tr>
<tr>
<td>✖️</td>
<td>Switches to the selection of the correction tools.</td>
</tr>
<tr>
<td>✖️</td>
<td>Exits the input without applying the changes.</td>
</tr>
<tr>
<td>C</td>
<td>Clears all entered characters.</td>
</tr>
</tbody>
</table>

Correction symbols under ✖️

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Clears all entered characters.</td>
</tr>
<tr>
<td>➡️</td>
<td>Moves the input position one position to the right.</td>
</tr>
<tr>
<td>⬅️</td>
<td>Moves the input position one position to the left.</td>
</tr>
<tr>
<td>✖️</td>
<td>Deletes one character immediately to the left of the input position.</td>
</tr>
</tbody>
</table>
### Meaning of the keys in the text editor

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Minus key" /></td>
<td>In the input mask, moves the selection bar to the left (backwards).</td>
</tr>
<tr>
<td><img src="image2.png" alt="Plus key" /></td>
<td>In the input mask, moves the selection bar to the right (forwards).</td>
</tr>
<tr>
<td><img src="image3.png" alt="Enter key" /></td>
<td>• Pressing the key briefly</td>
</tr>
<tr>
<td></td>
<td>• Opens the selected group.</td>
</tr>
<tr>
<td></td>
<td>• Carries out the selected action.</td>
</tr>
<tr>
<td></td>
<td>• Pressing the key for 2 s confirms the edited parameter value.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Escape key combination" /></td>
<td>Closes the text or numeric editor without applying changes.</td>
</tr>
</tbody>
</table>

### 7.3.7 Keypad lock

#### Automatic keypad lock

Operation via the local display is automatically locked:
- after a start-up or restart of the device.
- if the device has not been operated via the display for > 1 minute.

When attempting to access the operating menu while the keylock is enabled, the Keylock on message appears.

#### Disabling the keypad lock

1. The keylock is enabled.
   - Press  for at least 2 seconds.
   - A context menu appears.
2. Select Keylock off from the context menu.
   - The keylock is disabled.

#### Manual activation of the keypad lock

After commissioning of the device the keypad lock can be activated manually.

1. The device is in the measured value display.
   - Press  for at least 2 seconds.
   - A context menu appears.
2. Select Keylock on from the context menu.
   - The keylock is enabled.
7.3.8 Access code and user roles

Meaning of the access code
An access code can be defined in order to distinguish between the following user roles:

<table>
<thead>
<tr>
<th>User role</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>• Knows the access code.</td>
</tr>
<tr>
<td></td>
<td>• Has write access to all parameters (except service parameters).</td>
</tr>
<tr>
<td>Operator</td>
<td>• Doesn't know the access code.</td>
</tr>
<tr>
<td></td>
<td>• Has write access to only a few parameters.</td>
</tr>
</tbody>
</table>

- The description of parameters states which role is needed at least for read and write access to each parameter.
- The current user role is indicated by the Access status display.
- If the access code is "0000", every user is in the Maintenance role. This is the default setting on delivery of the device.

Defining an access code
1. Navigate to: Setup → Advanced setup → Administration → Define access code → Define access code
2. Enter the intended access code (max. 4 digits).
3. Repeat the same code in the Confirm access code.
   - The user is in the Operator role. The -symbol appears in front of all write-protected parameters.

Switching to the "Maintenance" role
If the -symbol appears on the local display in front of a parameter, the parameter is write-protected because the user is in the Operator role. To switch to the Maintenance role, proceed as follows:
1. Press .
   - The input prompt for the access code appears.
2. Enter the access code.
   - The user is in the Maintenance role. The -symbol in front of the parameters disappears; all previously write-protected parameters are now re-enabled.

Switching back to the "Operator" role automatically
The user automatically switches back to the Operator role:
- if no key is pressed for 10 minutes in the navigation and editing mode.
- 60 s after going back from the navigation and editing mode to the standard view (measured value display).
7.3.9 Write protection switch

The operating menu can be locked by a hardware switch in the connection compartment. In this locking state W&M related parameters are read only.

1. The display module can be attached to the edge of the electronics compartment. This makes it easier to access the lock switch.
   1. Loosen the securing clamp.
   2. Unscrew the housing cover.
   3. Pull out the display module with a gentle rotation movement.
   4. Using a flat blade screwdriver or a similar tool, set the write protection switch (WP) into the desired position. **ON:** operating menu is locked; **OFF:** operating menu is unlocked.
   5. Put the display module onto the connection compartment, screw the cover closed and tighten the securing clamp.

To avoid access to the write protection switch, the cover of the connection compartment can be secured by a lead seal.
For LNE approval, bolts at built in flange additionally must be secured by a lead seal.

**Indication of the locking state**

Write protection via locking switch is indicated as follows:
- **Locking status** (→ 206) = Hardware locked
- [ ] appears in the header of the display.
7.4 Access to the operating menu via the service interface and FieldCare

![Diagram](image)

38 Operation via service interface
1 Service interface (CDI = Endress+Hauser Common Data Interface)
2 Commubox FXA291
3 Computer with "FieldCare" operating tool and "CDI Communication FXA291" COM DTM

The "Save/Restore" function
After a device configuration has been saved to a computer and restored to the device using the Save/Restore function of FieldCare, the device must be restarted by the following setting:
Setup → Advanced setup → Administration → Device reset = Restart device.
This ensures correct operation of the device after the restore.

7.5 Access to the operating menu via Tankvision Tank Scanner NXA820 and FieldCare

7.5.1 Wiring scheme

![Diagram](image)

39 Connection of Tank Gauging devices to FieldCare via the Tankvision Tank Scanner NXA820
1 Proservo NMS8x
2 Tankside Monitor NRF81
3 Micropilot NMR8x
4 Field protocol (e.g. Modbus, V1)
5 Tankvision Tank Scanner NXA820
6 Ethernet
7 Computer with FieldCare installed
7.5.2 Establishing the connection between FieldCare and the device

1. Make sure the HART CommDTM NXA is installed and update the DTM catalogue if required.
2. Create a new project in FieldCare.
3. Add a new device: **NXA HART Communication**
4. Open the configuration of the DTM and enter the required data (IP address of the NxA820; "Password" = "hart"; "Tank identification" only with NxA V1.05 or higher)
Select **Create network** from the context menu.

The device is detected and the DTM is assigned.

The device can be configured.

**The “Save/Restore” function**

After a device configuration has been saved to a computer and restored to the device using the **Save/Restore** function of FieldCare, the device must be restarted by the following setting:

**Setup** → **Advanced setup** → **Administration** → **Device reset** = **Restart device**.

This ensures correct operation of the device after the restore.
8 System integration

8.1 Overview of the Device Description files (DTM)

To integrate the device via HART into FieldCare, a Device Description file (DTM) according to the following specification is required:

<table>
<thead>
<tr>
<th>Manufacturer ID</th>
<th>0x11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device type (NMS8x)</td>
<td>0x112D</td>
</tr>
<tr>
<td>HART specification</td>
<td>7.0</td>
</tr>
<tr>
<td>DD files</td>
<td>For information and files see: <a href="http://www.endress.com">www.endress.com</a></td>
</tr>
</tbody>
</table>
9 Commissioning

9.1 Terms related to tank measurement

- Liquid level
- Upper interface
- Lower interface
- Gas phase
- Upper phase
- Middle phase
- Lower phase
- Tank bottom
- Gauge reference height
- Empty
- Datum plate
- Tank ullage
- Tank level
- Tank reference height
- High stop level
- Displacer position
- Standby level
- Upper interface level
- Lower interface level
- Low stop level
- Dipping reference
9.2 Initial settings

Depending on NMS8x specification, some of the initial settings described below may not be required.

9.2.1 Setting the display language

Setting the display language via the display module

1. While in the standard view (→ 68), press ‘E’. If required, select Keylock off from the context menu and press ‘E’ again.
   - The Language appears.
2. Open the Language and select the display language.

Setting the display language via an operating tool (e.g. FieldCare)

1. Navigate to: Setup → Advanced setup → Display → Language
2. Select the display language.

This setting only affects the language on the display module. To set the language in the operating tool use the language setting functionality of FieldCare or DeviceCare, respectively.

9.2.2 Setting the real-time clock

Setting the real-time clock via the display module

1. Navigate to: Setup → Advanced setup → Date / time → Set date
2. Use the following parameters to set the real-time clock to the current date and time: Year, Month, Day, Hour, Minutes.

Setting the real-time clock via an operating tool (e.g. FieldCare)

1. Navigate to: Setup → Advanced setup → Date / time
2. Go to the Set date and select the Start.
3. Use the following parameters to set the date and time: **Year, Month, Day, Hour, Minutes**.

4. Go to the Set date and select the Confirm time.
   - The real-time clock is set to the current date and time.
9.3 Calibration

After installing or replacing NMS8x or its parts (sensor module, detector unit, wire drum, or measuring wire), Perform the following calibrations in this order.

1. Sensor calibration
2. Reference calibration
3. Drum calibration

All calibration steps may not be required, depending on whether the device is being installed, adjusted, or replaced (see the table below).

<table>
<thead>
<tr>
<th>Type of installation/replacement</th>
<th>1. Sensor calibration</th>
<th>2. Reference calibration</th>
<th>3. Drum calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-in one</td>
<td>Not required</td>
<td>Not required</td>
<td>Not required</td>
</tr>
<tr>
<td>Displacer shipped separately</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>Displacer installation through calibration window</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>Replacement/ maintenance</td>
<td>Wire drum</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Displacer</td>
<td>Not required</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Sensor module/ Detector unit</td>
<td>Required</td>
<td>Required</td>
</tr>
</tbody>
</table>

9.3.1 Verification of displacer and wire drum

Prior to installation of NMS8x, confirm that all of the following data of the displacer and the wire drum on the nameplate match with those programmed into the device.

Parameters to be confirmed

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Navigate to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacer diameter</td>
<td>Setup → Advanced setup → Sensor config → Displacer → Displacer diameter</td>
</tr>
<tr>
<td>Displacer weight</td>
<td>Setup → Advanced setup → Sensor config → Displacer → Displacer weight</td>
</tr>
<tr>
<td>Displacer volume</td>
<td>Setup → Advanced setup → Sensor config → Displacer → Displacer volume</td>
</tr>
<tr>
<td>Displacer balance volume</td>
<td>Setup → Advanced setup → Sensor config → Displacer → Displacer balance volume</td>
</tr>
<tr>
<td>Drum circumference</td>
<td>Setup → Advanced setup → Sensor config → Wiredrum</td>
</tr>
<tr>
<td>Wire weight</td>
<td>Expert → Sensor → Sensor config → Wiredrum → Wire weight</td>
</tr>
</tbody>
</table>
Data verification

Data verification procedure

1. Check the displacer diameter, weight, volume, and balance volume for the Displacer diameter, the Displacer weight, the Displacer volume, and the Displacer balance volume.

2. Check the drum circumference and wire weight for the Drum circumference and Wire weight.

This completes the data verification procedure.

9.3.2 Move displacer

The move displacer operation is optional and can be used to change the current position of the displacer in order to perform the calibration steps more easily.

1. Make sure that the wire drum stopper has been removed.
2. Navigate to: Setup → Calibration → Move displacer → Move distance
3. Input the relative moving distance for the Move distance.
4. Select the Move down or the Move up
5. Select the Yes.

This completes move displacer commands procedure.
Sensor calibration adjusts the weight measurement of the detector unit. The calibration consists of three steps as follows.

- ADC zero calibration
- ADC offset calibration
- ADC span calibration

For the ADC offset weight calibration, either 0 g or an offset weight (0 to 100 g) can be used.

Using an offset weight other than 0 g is recommended for density measurement.
Calibration procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Using displacer</th>
<th>Using offset weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><img src="image1.png" alt="Displacer" /></td>
<td><img src="image2.png" alt="Offset Weight" /></td>
<td>• Navigate to: Setup → Calibration → Sensor calibration → Sensor calibration&lt;br&gt;• Input the offset weight for the Offset weight used in step 3 (0.0 g in case of using the displacer only).&lt;br&gt;• Input the value for the Span weight used in step 4 (weight of displacer indicated on nameplate).</td>
</tr>
<tr>
<td>2.</td>
<td><img src="image3.png" alt="Displacer" /></td>
<td><img src="image4.png" alt="Offset Weight" /></td>
<td>• Hold up or remove the displacer.&lt;br&gt;• Select [ ] for next parameter.&lt;br&gt;• Measuring zero weight is shown on the display.&lt;br&gt;• Wait until the Zero calibration shows the Finished and calibration status shows Idle.&lt;br&gt;ℹ️ When the displacer is being held up, do not release it until this step is completed.</td>
</tr>
<tr>
<td>3.</td>
<td><img src="image5.png" alt="Displacer" /></td>
<td><img src="image6.png" alt="Offset Weight" /></td>
<td>• Confirm that the Offset calibration shows the Place offset weight.&lt;br&gt;• Hold up the displacer or attach the offset weight.&lt;br&gt;• Select [ ] for next parameter.&lt;br&gt;• Measuring offset weight is shown on the display.&lt;br&gt;• Wait until the Offset calibration shows the Finished and Calibration status shows Idle.&lt;br&gt;ℹ️ When the displacer is being held up, do not release it until this step is completed.</td>
</tr>
<tr>
<td>4.</td>
<td><img src="image7.png" alt="Displacer" /></td>
<td><img src="image8.png" alt="Offset Weight" /></td>
<td>• Release the displacer or mount it on the measuring ring if an offset weight was used in the previous step.&lt;br&gt;• Select [ ] for next parameter.&lt;br&gt;• Measuring span weight is shown on the display.&lt;br&gt;• Confirm that the Span calibration shows the Finished and Calibration status shows Idle.&lt;br&gt;• Select the Next.&lt;br&gt;• Confirm that the Sensor calibration shows the Finished and Calibration status shows Idle.&lt;br&gt;ℹ️ Do not swing the displacer and keep it in as stable a position as possible.</td>
</tr>
</tbody>
</table>

This completes sensor calibration procedure.
9.3.4 Reference calibration

The reference calibration defines the zero distance position of the displacer from the mechanical stop.

1. Navigate to: Setup → Calibration → Reference calibration → Reference calibration
2. Select the Start
3. Check the reference position (e.g. 70 mm (2.76 in)).
   - The reference position is preset prior to delivery.
4. Confirm that the displacer is correctly attached to the measuring wire.
5. The reference calibration starts automatically.

This completes the reference calibration.

#### Reference calibration sequence

1. Mechanical stop
2. Reference position

![Reference calibration sequence](image-url)
9.3.5 Drum calibration

1. Navigate to: Setup → Calibration → Drum calibration → Drum calibration

2. Ensure a distance of 500 mm (19.69 in) or more from the bottom of the displacer to the liquid level.

3. Confirm that the displacer weight is correct for the Set high weight.

4. Select the Start.
   - The drum calibration starts automatically.
   - The drum calibration records fifty points which will take approximately eleven minutes.

5. Select the No as usual for the Make low table.
   - To make a low table for special applications, select the Yes and use 50 g weight.

This completes drum calibration procedure.

To cancel any calibration, press + simultaneously. If the drum calibration is canceled while making the new table, the old table remains effective. If making a new table fails due to an obstruction, NMS8x will not accept the new table and shows an error message.
9.3.6 Commissioning check

This procedure is to confirm that all calibration steps have been completed appropriately.

The commissioning check starts at the position where the previous drum calibration was performed. Perform drum calibration if the reference position was changed.

When skipping the drum calibration, it is necessary to ensure that there are no obstructions or interfering objects prior to the commissioning check.

The commissioning check has a total of eleven steps as follows.

The check items for the commissioning check should be performed in the following order.

- The displacer weight at the first point is within the threshold (within the specified value: 5 g (0.01 lb)).
- Ten points out of fifty, when the previous drum table was created, are selected and compared with the result of the current weight table and detected weight will be confirmed.
- Confirm the displacer weight is within the threshold (within specified value: 5 g (0.01 lb)) at each point.

If the displacer weight exceeds the threshold in the ten steps, the commissioning check stops and the gauge status changes to Stop.

To continue the level measurement, perform the gauge command.

The following three items are confirmed in the last step.

- The difference of the neighboring two points is within the threshold (within the specified value: 2 g (0.004 lb)).
- Peak-to-peak of the compensation value in the drum table is within 20 g (0.04 lb).
- The maximum compensation value in the drum table is within 40 g (0.09 lb).

Overtension is not confirmed during execution of the commissioning check.

Prior to drum calibration, ensure that there is nothing interfering with where the previous drum calibration was performed.

1. Navigate to: Diagnostics → Device check → Commissioning check → Commissioning check

2. Select the Start.
   
   Executing is shown on the verify drum table.

3. Select the Start.

4. Confirm that the Commissioning check shows the Finished.

5. Confirm that the Result drum check is passed.

This completes the commissioning check procedure.
9.4 Configuring the measuring device

<table>
<thead>
<tr>
<th>Configuration task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuring the level and interface measurement</td>
<td>Setting density → 93</td>
</tr>
<tr>
<td></td>
<td>Setting tank height → 94</td>
</tr>
<tr>
<td></td>
<td>Setting high and low stop → 95</td>
</tr>
<tr>
<td>Level calibration</td>
<td>Setting for open tank with liquid → 96</td>
</tr>
<tr>
<td></td>
<td>Setting for open tank without liquid → 97</td>
</tr>
<tr>
<td></td>
<td>Setting for closed tank → 98</td>
</tr>
<tr>
<td></td>
<td>Setting process condition → 100</td>
</tr>
<tr>
<td>Configuring the density measurement</td>
<td>Setting spot density → 101</td>
</tr>
<tr>
<td></td>
<td>Setting tank profile → 103</td>
</tr>
<tr>
<td></td>
<td>Setting interface profile → 104</td>
</tr>
<tr>
<td></td>
<td>Setting manual profile → 105</td>
</tr>
</tbody>
</table>

9.4.1 Configuring the level and interface measurement

The level measurement is to measure the position where the displacer is balanced (immersion point) in the liquid. When the liquid surface level changes, the displacer continuously follows the position to measure the liquid level. To define the appropriate level measurement, the following settings are required prior to operation.

The interface measurement can determine the interface between different liquids in a tank (e.g. water and oil). Up to two different interfaces can be determined within a maximum of three phases in a tank.

Setting the density of application

Density values for three liquid phases are set as follows prior to delivery.

- Upper density: 800 kg/m³
- Middle density: 1000 kg/m³
- Lower density: 1200 kg/m³

Change the data to reflect the actual density values. For tanks with only one liquid phase, set the upper density. For tanks with two or three phases, set middle and bottom densities as well.

<table>
<thead>
<tr>
<th>Number of phases</th>
<th>Parameters to be set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 phase</td>
<td>Upper density</td>
</tr>
<tr>
<td>2 phases</td>
<td>Upper/middle density</td>
</tr>
<tr>
<td>3 phases</td>
<td>Upper/middle/lower density</td>
</tr>
</tbody>
</table>

When performing an interface measurement, the minimum density difference between phases should be at least 100 kg/m³.

Setting the density

1. Navigate to: Setup → Upper density , Setup → Middle density and Setup → Lower density
2. Input the value to Upper, Middle, and Lower densities accordingly.
Setting the tank height

To measure the tank level correctly, the tank reference height and empty (distance from reference point to datum plate) must be set in advance.

- **Tank reference height**: Set by the customer to represent the height of the tank. Distance between the dipping reference and the datum plate. Used for percentage calculation and as reference for the ullage level.
- **Empty**: Distance between the zero point of device and datum plate. Empty is automatically adjusted by the Set level.
- Refer to Level calibration for details how to determine the empty parameter accurately. → 96

**Setting the tank reference height and empty**

1. Navigate to: Setup → Empty
2. Input the empty value.
3. Navigate to: Setup → Tank reference height
4. Input the value of tank reference height.
Setting the high stop and low stop

The high stop and low stop determine the highest and lowest points of displacer movement. Set these data to the desired actual upper and lower limit values.

If the displacer should be able to determine a tank bottom that is below the datum plate, set the low stop to a negative value. To make sure that the displacer travels up to the reference position, set the high stop to a value greater than or equal to empty.

High stop and low stop setting procedure

1. Navigate to: Setup → High stop level
2. Input the actual value for high stop.
3. Navigate to: Setup → Low stop level
4. Input the actual value for low stop.

This completes upper and lower stop setting procedure.
9.4.2 Level calibration

The following table shows the most likely options for setting the level calibration.

<table>
<thead>
<tr>
<th>Open tank with liquid</th>
<th>Open tank without liquid</th>
<th>Closed tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Open tank with liquid diagram]</td>
<td>![Open tank without liquid diagram]</td>
<td>![Closed tank diagram]</td>
</tr>
</tbody>
</table>

Setting for an open tank with liquid

Level setting procedure

1. Navigate to: Setup → Gauge command
2. Select the Level for the Gauge command.
   - The displacer automatically searches for the point where it balances.
3. Wait until the displacer is balanced on the liquid.
4. Perform dipping to determine the liquid level (L) in the tank.
5. Navigate to: Setup → Set level
6. Input the determined level value for the Set level.

ℹ️ The Set level adjusts the Empty to reflect the new level value.

This completes setting for open tank with liquid procedure.
Setting for an open tank without liquid

If there is no liquid in the tank, the following procedure can be used to set the tank bottom or datum plate to 0 mm for the tank level.

Level setting procedure

1. Navigate to: Operation → Gauge command → Gauge command
2. Select the Bottom level to measure the tank bottom.
3. Navigate to: Operation → One-time command status
4. Wait until the Finished is shown.
5. Navigate to: Operation → Level → Bottom level
6. Read the Bottom level (Bv).
7. Navigate to: Setup → Empty
8. Read the actual empty value (Ea).
9. Calculate the new empty value using following formula.
   \[ En = Ea - Bv - Z0 \]
   Example: \( Ea = 28\text{m}, Bv = 10.5\text{m}, Z0 = 0.5\text{m} \)
   \( En = 28\text{m} - 10.5\text{m} = 17\text{m} \)
10. Input the calculated value for the Empty.

- The parameter \( Z0 \) defines the distance between the desired 0mm level value and the physical tank bottom (if displacer measures the datum plate, \( Z0 = 0 \text{ mm} \) (0 in)).
- Bottom level operation considers the immersion depth of the displacer in the measurement.

This completes the level setting for open tank without liquid procedure.

\[ 49 \quad \text{Open tank without liquid} \]

1. Tank bottom
2. Datum plate
3. Initial empty setting
4. Initial bottom level
5. New empty
6. New empty
7. Distance from tank bottom to datum plate

It is recommended to repeating the level calibration when there is liquid in the tank (→ 96).
**Setting for a closed tank**

For tanks that cannot be hand-dipped, follow the procedure shown below.

**Level setting procedure**

1. Navigate to: Operation → Gauge command → Gauge command
2. Select the Bottom level to measure the tank bottom.
   \[ \text{NMS8x measures the tank bottom and returns to level if the post gauge command is set to level (default).} \]
3. Navigate to: Operation → One-time command status
4. Wait until the Finished is shown.
5. Navigate to: Operation → Level → Bottom level
6. Read the bottom value (Bv).
7. Navigate to: Operation → Level → Tank level (a)
8. Calculate the level value (L) by using following formula.
   \[ \text{L = a - Bv} \]
9. Navigate to: Setup → Set level
10. Input the value L for the Set level.

This completes the level setting procedure.

If the datum plate is not zero (e.g. Z mm), adjust the set level value (L) by subtracting Z from the value L (L= a-Bv-Z).
Setting for a closed tank without datum plate

For tanks that cannot be hand-dipped and have no datum plates, follow the procedure shown below.

Procedure for setting level by empty

In cases where a manual dip cannot be carried out and there are no flat datum plates to reference the bottom, empty can be used instead of set level. In this particular case, empty needs to be adjusted as it is not the gauge reference height but the displacer immersion depth.

Level is automatically calculated by the following formula.

\[ \text{Empty} - \text{Distance} = \text{Level} \]

The absolute value of distance is updated according to the displacer movement and level can be determined.

1. Navigate to: Setup → Empty
2. Set empty to be the displacer immersion depth.
3. Navigate to: Setup → Gauge command
4. Select the Level for the Gauge command parameter.
   - The displacer automatically searches for the point where it balances.
5. Wait until the displacer is balanced on the liquid surface.

This completes the level setting procedure.

51 Level setting in case of empty (NMS80/81)

A. Set empty
B. How level is determined
   a. Gauge reference height
   b. Empty adjusted to the displacer immersion depth = distance 0 mm
   c. Empty
   d. Distance
   e. Level
Selecting the process condition

The process condition is used to adjust the device to the application. By changing this parameter, several balancing parameters are adjusted automatically to make setup easier.

1. Navigate to: Setup → Process condition
2. Select an appropriate condition for the Process condition.

The default setting of the process condition varies depending on your order.

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Process condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter setting</td>
<td>Universal</td>
</tr>
<tr>
<td>Description</td>
<td><img src="image" alt="Universal" /></td>
</tr>
<tr>
<td></td>
<td>Provides reliable results in various applications and for various liquids.</td>
</tr>
</tbody>
</table>

9.4.3 Configuring the density measurement

The density measurement is performed to confirm and maintain the quality of the liquid. The density measurement is largely divided into two methods as shown below.

<table>
<thead>
<tr>
<th>Density methods</th>
<th>Gauge command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot density</td>
<td>Upper density</td>
<td>One spot density measurement for designated layer</td>
</tr>
<tr>
<td></td>
<td>Middle density</td>
<td>• Upper density is for upper layer.</td>
</tr>
<tr>
<td></td>
<td>Lower density</td>
<td>• Middle density is for middle layer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lower density is for lower layer.</td>
</tr>
<tr>
<td>Profile density</td>
<td>Tank profile</td>
<td>Profile between the bottom of the tank and the level position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Normal mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Compensation mode</td>
</tr>
<tr>
<td>Interface profile</td>
<td>Profile between the upper interface (I/F) and the level position</td>
<td></td>
</tr>
<tr>
<td>Manual profile</td>
<td>Profile between the desired start point and the level position</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Normal mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Compensation mode</td>
</tr>
</tbody>
</table>
Spot density measurement

Three different spot density gauge commands are available as shown below.

The submersion depth (a) is set to 150 mm (5.91 in) prior to delivery. To change the submersion depth, perform the following steps.

1. Navigate to: Setup → Advanced setup → Sensor config → Spot density → Submersion depth
2. Input the desired value for the Submersion depth.

Setting the spot density

1. Navigate to: Operation → Gauge command → Gauge command
2. Select the Upper density, the Middle density, or the Lower density for the Gauge command.
3. Verify that the value that was examined in a laboratory and the actual value that was measured in the tank are the same or within an allowable range.
4. Adjust the value if necessary.
   - Navigate to: Setup → Advanced setup → Sensor config → Spot density
     Select the Upper density offset, the Middle density offset, and the Lower density offset and input the desired values for each offset.

This completes the setting spot density procedure.
Profile density measurement

Profile density has three gauge commands as shown below.

NMS8x measures a density profile according to a defined interval of up to 50 points.

Density measurement has two types of modes.

- Normal measure mode: Profile points are measured at exactly configured positions.
- Compensation mode: Profile points are measured at multiples of the wire drum circumference to further improve accuracy.

Select normal mode as usual. However, when selecting compensation mode, NMS8x automatically adjusts the measurement positions to where the density measurement can be the most accurate.
Tank profile measurement

Setting tank profile procedure

The tank profile operation measures a profile starting at the physical tank bottom up to the liquid level.

1. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Profile density offset distance

2. Input the desired value for the Profile density offset distance.
   - The value of the profile density offset distance defines the distance between the start point (datum plate or bottom of the tank) and the first measurement point.

3. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Profile density interval

4. Input the desired value for the Profile density interval.

5. Set Tank profile in the Gauge command to start measurement.

This completes the setting tank profile procedure.

![Tank profile diagram](image)

A 54 Tank profile movement (The numbers show the order of the displacer movement.)

A Profile density interval
B Profile density offset distance
C Datum plate
D Tank profile range
Interface profile measurement

Setting interface profile procedure

The interface profile operation measures a profile starting at the upper interface level up to the liquid level.

1. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Profile density offset distance
2. Input the desired value for the Profile density offset distance.
   - The value of the profile density offset distance defines the distance between the start point (upper interface) and the first measurement point.
3. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Profile density interval
4. Input the desired value for the Profile density interval.
5. Set Interface profile in the Gauge command to start measurement.
This completes the setting interface profile procedure.

![Interface profile movement diagram](image)

- **A** Profile density interval
- **B** Profile density offset distance
- **C** Tank profile range
**Manual profile measurement**

**Setting manual profile procedure**

The manual profile operation measures a profile starting at a manually specified level up to the liquid level.

1. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Manual profile level
2. Input the desired value for the Manual profile level.
3. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Profile density offset distance
   - For the manual profile, the level offset can be set to 0 so that the first point can be measured at the manual profile level.
4. Input the desired value for the Profile density offset distance.
   - The value of the profile density offset distance defines the distance between the start point (manual profile) and the first measurement point.
5. Navigate to: Setup → Advanced setup → Sensor config → Profile density → Profile density interval
6. Input the desired value for the Profile density interval.
7. Set Manual profile in the Gauge command to start measurement.

This completes the setting manual profile.

![Diagram of manual profile measurement](image)

56 Manual profile movement (The numbers show the order of the displacer movement.)

- A Profile density interval
- B Profile density offset distance
- C Manual profile range
- D Manual profile level
## 9.5 Configuring the tank gauging application

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<tr>
<td>4-20mA inputs</td>
<td>→ 111</td>
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<td>RTD input</td>
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<tr>
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<table>
<thead>
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<th>Configuration of the data processing in the device:</th>
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<tr>
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<td>→ 116</td>
</tr>
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<td>Tank calculation: Hybrid Tank Measurement System (HTMS)</td>
<td>→ 117</td>
</tr>
<tr>
<td>Tank calculation: Correction of the Hydrostatic Tank Deformation (HyTD)</td>
<td>→ 118</td>
</tr>
<tr>
<td>Tank calculation: Thermal Tank Shell Correction (CTSh)</td>
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<tr>
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<table>
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<tr>
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<td>→ 125</td>
</tr>
<tr>
<td>Modbus</td>
<td>→ 126</td>
</tr>
<tr>
<td>V1</td>
<td>→ 127</td>
</tr>
<tr>
<td>Digital outputs</td>
<td>→ 128</td>
</tr>
<tr>
<td>WM550</td>
<td>→ 127</td>
</tr>
</tbody>
</table>
9.5.1 Configuration of the HART inputs

Connecting and addressing HART devices

![Diagram](image.png)

57 Possible terminals for HART loops

B Analog I/O module in slot B (availability depending on device version → 45)
C Analog I/O module in slot C (availability depending on device version → 45)
E HART Ex is output (available in all device versions)

HART devices must be configured and given a unique HART address in the range from 1 to 15 via their own user interface before they are connected to the Proservo NMS8x 3). Make sure they are connected as defined by the terminal assignment → 56. Devices with an address larger than 15 are not recognized by the Proservo.

Slot B or C: Setting the operating mode of the Analog I/O module

This section is not relevant for the HART Ex is output (Slot E). This output always functions as a HART master for the connected HART slaves.

If HART devices are connected to an Analog I/O module (slot B or C in the terminal compartment), this module must be configured as follows:

1. Navigate to the submenu of the respective Analog I/O module: Setup → Advanced setup → Input/output → Analog I/O X1-3
2. Go to the Operating mode (→ 221).
3. If only one HART device is connected to this loop:
   Select the HART master+4..20mA input. In this case the 4-20mA signal can be used in addition to the HART signal. For the configuration of the 4-20mA input:
   → 111.
4. If up to 6 HART devices are connected to this loop:
   Select the HART master.

3) The current software does not support HART devices with address 0 (zero).
Defining the type of measured value

- This setting can be skipped for a connected Prothermo NMT53x and NMT8x as the type of measured value is automatically recognized by the Proservo NMS8x in this case.
- The measured values can only be used in the system if the unit of the assigned HART variable fits the type of measured value. The HART variable assigned to Output temperature, for example, has to be in °C or °F.
- A HART variable with unit “%” cannot be used for Output level. Instead, the HART variable must be in mm, m, ft or in.

The type of measured value must be specified for each HART variable (PV, SV, TV and QV). To do so, proceed as follows:

1. Navigate to: Setup → Advanced setup → Input/output → HART devices
   - There is a submenu for each connected HART device.
2. For each device go to the corresponding submenu.
3. If the device measures a pressure:
   Go to the Output pressure (→ 211) and specify which of the four HART variables contains the measured pressure. Only a HART variable with a pressure unit may be selected.
4. If the device measures a density:
   Go to the Output density (→ 211) and specify which of the four HART variables contains the measured density. Only a HART variable with a density unit may be selected.
5. If the device measures a temperature:
   Go to the Output temperature (→ 212) and specify which of the four HART variables contains the measured temperature. Only a HART variable with a temperature unit may be selected.
6. If the device measures the vapor temperature:
   Go to the Output vapor temperature (→ 212) and specify which of the four HART variables contains the measured vapor temperature. Only a HART variable with a temperature unit may be selected.
7. If the device measures a level:
   Go to the Output level (→ 213) and specify which of the four HART variables contains the measured level. Only a HART variable with a level unit (not “%”) may be selected.

Disconnecting HART devices

When a HART device is disconnected from the device, it must also be logically removed as follows:

1. Navigate to Setup → Advanced setup → Input/output → HART devices → Forget device → Forget device
2. Select the HART device to be removed.
3. This procedure is also necessary if a defective device is exchanged.
9.5.2 Configuration of a connected Prothermo temperature transmitter

If a Prothermo NMT532, NMT539 or NMT8x temperature transmitter is connected via HART, it can be configured as follows:

1. Navigate to: Expert → Input/output → HART devices → HART Device(s) → NMT device config; here, **HART Device(s)** is the name of the connected Prothermo.

2. Go to the Configure device? and select **Yes**.

3. To configure a **Prothermo NMT53x**: Go to the Bottom point and enter the position of the bottom temperature element (see picture above).

   The value entered into the Bottom point in the Tank Gauging device is handed over to the Bottom point in the connected Prothermo NMT53x.
To configure a **Prothermo NMT8x**: Go to the Bottom point and enter the distance between the physical end of the probe and the zero level value in the tank (tank bottom or datum plate).

The value entered into the Bottom point in the Tank Gauging device is handed over to the End of probe to zero distance in the connected Prothermo NMT8x.

To check the temperatures measured by the individual elements, go to the following submenu: Operation → Temperature → NMT element values → Element temperature

There is a Element temperature X for each element of the Prothermo.
9.5.3 Configuration of the 4-20mA inputs

For each Analog I/O module to which a 4-20mA device is connected, proceed as follows:

1. Make sure the 4-20mA devices are connected as defined by the terminal assignment → 45.
2. Navigate to the submenu of the respective Analog I/O module: Setup → Advanced setup → Input/output → Analog I/O X1-3
3. Go to the Operating mode (→ 221) and select 4..20mA input or HART master +4..20mA input.
4. Go to the Process value (→ 228) and specify which process variable is transmitted by the connected device.
5. Go to the Analog input 0% value (→ 227) and define which value of the process variable corresponds to an input current of 4 mA (see diagram below).
6. Go to the Analog input 100% value (→ 227) and define which value of the process variable corresponds to an input current of 20 mA (see diagram below).
7. Go to the Process value (→ 228) and check whether the indicated value matches the actual value of the process variable.

The Analog I/O submenu contains additional parameters for a more detailed configuration of the Analog Input. For a description refer to : → 221
9.5.4 Configuration of a connected RTD

1. Make sure the RTD is connected as defined by the terminal assignment → 61.
2. Navigate to the submenu of the respective Analog I/O module: Setup → Advanced setup → Input/output → Analog IP X4-8.
3. Go to the RTD type (→ 215) and specify the type of the connected RTD.
4. Go to the RTD connection type (→ 216) and specify the type of connection of the RTD (2-, 3- or 4-wire).
5. Go to the Input value (→ 218) and check whether the indicated temperature matches the actual temperature.
6. Go to the Minimum probe temperature (→ 218) and specify the minimum approved temperature of the connected RTD.
7. Go to the Maximum probe temperature (→ 219) and specify the maximum approved temperature of the connected RTD.
Go to the Probe position (→ 219) and enter the mounting position of the RTD (measured from the datum plate).

* This parameter, in conjunction with the measured level, determines whether the measured temperature refers to the product or to the gas phase.

**Offset for resistance and/or temperature**

An offset for the resistance or the temperature can be defined in the following submenu: Expert → Input/output → Analog IP X4-8.

- **Ohms offset** is added to the measured resistance before the calculation of the temperature.
- **Temperature offset after conversion** is added to the measured temperature.

1. **Ohms offset**
2. **Temperature offset after conversion**
9.5.5 Configuration of the digital inputs

There is a Digital Xx-x submenu for each digital I/O module of the device. 'X' designates the slot in the terminal compartment, 'x-x' the terminals within this slot. The most important parameters of this submenu are Operating mode and Contact type.

The Operating mode
Setup → Advanced setup → Input/output → Digital Xx-x → Operating mode

Meaning of the options

- **Input passive**
  The DIO module measures the voltage provided by an external source. Depending on the status of the external switch, this voltage is 0 at the input (switch open) or exceeds a certain limit voltage (switch closed). These two states represent the digital signal.

- **Input active**
  The DIO module provides a voltage and uses it to detect whether the external switch is open or closed.

The Contact type
Setup → Advanced setup → Input/output → Digital Xx-x → Contact type
This parameter determines how the state of the external switch is mapped to the internal states of the DIO module:

<table>
<thead>
<tr>
<th>State of the external switch</th>
<th>Internal state of the DIO module</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contact type = Normally open</td>
</tr>
<tr>
<td>Open</td>
<td>Inactive</td>
</tr>
<tr>
<td>Closed</td>
<td>Active</td>
</tr>
</tbody>
</table>

**Behavior in special situations:**
- During start-up: Unknown (Unknown)
- Fault in measurement: Error (Error)

- The internal state of the Digital Input can be transferred to a Digital Output or can be used to control the measurement.
- The **Digital Xx-x** submenu contains additional parameters for a more detailed configuration of the Digital Input. For a description refer to → 231.

### 9.5.6 Linking input values to tank variables

Measured values must be linked to tank variables before they can be used in the Tank Gauging application. This is done by defining the source of each tank variable in the following parameters:

<table>
<thead>
<tr>
<th>Tank variable</th>
<th>Parameter defining the source of this variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product level</td>
<td>• Setup → Level source&lt;br&gt;• Setup → Advanced setup → Application → Tank configuration → Level → Level source</td>
</tr>
<tr>
<td>Bottom water level</td>
<td>Setup → Advanced setup → Application → Tank configuration → Level → Water level source</td>
</tr>
<tr>
<td>Average or spot temperature of the product</td>
<td>• Setup → Liquid temp source&lt;br&gt;• Setup → Advanced setup → Application → Tank configuration → Temperature → Liquid temp source</td>
</tr>
<tr>
<td>Temperature of the air surrounding the tank</td>
<td>Setup → Advanced setup → Application → Tank configuration → Temperature → Air temperature source</td>
</tr>
<tr>
<td>Temperature of the vapor above the product</td>
<td>Setup → Advanced setup → Tank configuration → Temperature → Vapor temp source</td>
</tr>
<tr>
<td>Density of the product</td>
<td>Setup → Advanced setup → Application → Tank configuration → Density → Observed density source</td>
</tr>
<tr>
<td>Bottom pressure (P1)</td>
<td>Setup → Advanced setup → Application → Tank configuration → Pressure → P1 (bottom) source</td>
</tr>
<tr>
<td>Top pressure (P3)</td>
<td>Setup → Advanced setup → Application → Tank configuration → Pressure → P3 (top) source</td>
</tr>
</tbody>
</table>

- Depending on the application not all these parameters will be relevant in a given situation.
9.5.7  Tank calculation: Direct level measurement

If no tank calculation is configured, level and temperature are measured directly.

A  Direct level measurement (without temperature)
B  Direct level and temperature measurement
1  NMS8x
2  To inventory management system
3  Temperature transmitter

1. Navigate to: "Setup → Level source" and specify from which device the level is obtained.
2. If a temperature transmitter is connected:
   Navigate to: "Setup → Liquid temp source" and specify from which device the temperature is obtained.
9.5.8 Tank calculation: Hybrid tank measurement system (HTMS)

HTMS uses level and pressure measurements to calculate the density of the medium.

In non-atmospheric (i.e. pressurized) tanks it is recommended to use the HTMS P1+P3 mode. Two pressure sensors are required in this case. In atmospheric (i.e. unpressurized) tanks the HTMS P1 with only one pressure sensor is sufficient.

![Diagram of HTMS measurement modes]

A The HTMS P1 measurement mode
B The HTMS P1+P3 measurement mode
D1 P1 position
D3 P3 position
1 NMS8x
2 To inventory management system
3 Pressure sensor (bottom)
4 Pressure sensor (top)

1. Navigate to Setup → Advanced setup → Application → Tank configuration → Level
2. Go to Level source (→ 195) and specify from which device the level is obtained.
3. Navigate to Setup → Advanced setup → Application → Tank configuration → Pressure
4. Go to P1 (bottom) source (→ 272) and specify from which device the bottom pressure (P1) is obtained.
5. If a top pressure transmitter (P3) is connected:
   Go to P3 (top) source (→ 274) and specify from which device the top pressure (P3) is obtained.
6. Navigate to: Setup → Advanced setup → Application → Tank calculation → HTMS
7. Go to HTMS mode (→ 289) and specify the HTMS mode.
8. Navigate to Setup → Advanced setup → Application → Tank configuration → Density
9. Go to Observed density source (→ 270) and select HTMS.
10. Use the other parameters of the HTMS to configure the calculation. For a detailed description: → 287
9.5.9 Tank calculation: Hydrostatic Tank Deformation (HyTD)

Hydrostatic Tank Deformation can be used to compensate the vertical movement of the Gauge Reference Height (GRH) due to bulging of the tank shell caused by the hydrostatic pressure exerted by the liquid stored in the tank. The compensation is based on a linear approximation obtained from manual hand dips at several levels divided over the full range of the tank.

![Diagram showing the correction of hydrostatic tank deformation](image)

- **A** "Distance" (tank nearly empty)
- **B** Gauge Reference Height (GRH)
- **C** HyTD correction value
- **D** "Distance" (tank filled)

The Correction of the Hydrostatic Tank Deformation is configured in the HyTD (→ 279)
9.5.10  Tank calculation: Thermal tank shell correction (CTSh)

CTSh (correction for the thermal expansion of the tank shell) compensates for effects on the Gauge Reference Height (GRH) and on the expansion or contraction of the measuring wire due to temperature effects on the tank shell or stilling well. The temperature effects are separated into two parts, respectively affecting the ‘dry’ and ‘wetted’ part of the tank shell or stilling well. The correction function is based on thermal expansion coefficients of steel and insulation factors for both the ‘dry’ and ‘wet’ parts of the wire and the tank shell. The temperatures used for the correction can be selected from on manual or measured values.

This correction is recommended for the following situations:
- if the operating temperature deviates considerably from the temperature during calibration (ΔT > 10 °C (18 °F))
- for extremely high tanks
- for refrigerated, cryogenic or heated applications

As the use of this correction will influence the innage level reading, it is recommended to ensure the manual hand dip and level verification procedures are being conducted correctly before enabling this correction method.

This mode cannot be used in conjunction with HTG because the level is not measured relative to the gauge reference height with HTG.

9.5.11  Configuration of the level reference check (LRC) function

For tanks where a manual dipping cannot be performed the level gauge can be verified by means of the LRC function.

This reference check is recommended for liquefied gas applications.

There are different options for this function:
- LRC with reference level
- LRC with reference switch

LRC with reference level

The radar device compares its own level reading with the level reading of another level gauge (e.g. Proservo NMS8x). Based on a configurable deviation value (Allowed difference parameter), a continuous check is performed.
Application example with Proservo NMS8x

1. Lower limit of deviation value 'a' as configured in radar level gauge
2. Reference value: Measured level as provided by level gauge Proservo NMS8x
3. Upper limit of deviation
4. Proservo NMS8x provides the reference value
5. Level gauges are interconnected via HART interface
6. Radar level gauge with configured deviation value 'a' for 'Allowed difference' parameter
7. The measured level is greater than reference value plus deviation value 'a': Level value is not verified
8. The measured level is within or equal to the limits defined by the deviation value 'a': Level value is verified
9. The measured level is less than reference value minus deviation value 'a': Level value is not verified

Properties
- Frequency: The reference check is performed continuously every 60 seconds.
- Tolerance: Via the Check fail threshold parameter, a configurable number of failures is allowed before the status switches to failed.
- Connection: The level reference device is connected via an optional HART I/O board.

Configuration of LRC with reference level

1. Navigate to Diagnostics → LRC → LRC 1 to 2

2. [Diagram showing LRC configuration parameters]

Go to the LRC Mode parameter and select the Compare with level device option.

3. Go to the Allowed difference parameter and specify the value for the allowed difference between the tank level and the reference.
4. Go to the **Check fail threshold** parameter and set the tolerated amount of failures before an alarm is triggered. As the reference check is performed continuously every 60 seconds, this resembles the number of minutes until an alarm is triggered.

5. Go to the **Reference level source** parameter and define the source for the reference level.

**LRC with reference switch**

A level switch (e.g. Liquiphant FTLx) can be mounted within the tank. The check can be performed continuously, each time the level switch is activated or deactivated. The measured level should remain within a configurable deviation.

![Diagram of LRC with reference switch](image)

6. **Application example with level switch**

- Lower limit of deviation value "a" as configured in radar level gauge
- Reference value: The switching point of an installed level switch represents the reference value for verification
- Upper limit of deviation
- Level switch and level gauge are interconnected via a digital I/O board
- Radar level gauge with configured deviation value "a" for "Allowed difference" parameter
- The measured level is greater than reference value plus deviation value "a": Level value is not verified
- The measured level is within or equal to the limits defined by the deviation value "a": Level value is verified
- The measured level is less than reference value minus deviation value "a": Level value is not verified

**Properties**

- Modes: The device can be set to monitor the switching point while filling or draining the tank.
- Connection: The level switch is connected via a digital I/O board.

**Configuration of LRC with reference switch**

1. Navigate to Diagnostics → LRC → LRC 1 to 2
2. Go to the **LRC Mode** parameter and select the **Compare with level switch** option.

3. Go to the **Allowed difference** parameter and specify the value for the allowed difference between the tank level and the reference.

4. Go to the **Reference switch source** parameter and select the source for the reference switch.

5. Go to the **Reference switch mode** parameter. Select the **Active -> Inactive** option to define the switch direction for the reference check to be executed when the switch status changes from **Active** to **Inactive**. Or select the **Inactive -> Active** option to define the switch direction for the reference check to be executed when the switch status changes from **Inactive** to **Active**.

6. Go to the **Reference switch level** parameter and enter the position of the reference switch by entering a value with a unit of length. This parameter depends on the choice made for the **Distance unit** parameter.

This defines the position of the reference switch as level.
9.5.12  Configuration of the alarms (limit evaluation)

A limit evaluation can be configured for up to 4 tank variables. The limit evaluation issues an alarm if the value exceeds an upper limit or falls below a lower limit, respectively. The limit values can be defined by the user.

![Diagram](image_url)

**68  Principle of the limit evaluation**

A  Alarm mode = On
B  Alarm mode = Latching
1  HH alarm value
2  H alarm value
3  L alarm value
4  LL alarm value
5  HH alarm
6  H alarm
7  L alarm
8  LL alarm
9  "Clear alarm" = "Yes" or power off-on
10  Hysteresis

The limit evaluation is configured in the **Alarm 1 to 4** submenus.

Navigation path: Setup → Advanced setup → Alarm → Alarm 1 to 4

- For **Alarm mode** = Latching all alarms remain active until the user selects **Clear alarm = Yes** or the power is switched off and on.
- Make sure to also configure the parameter **Hysteresis** accordingly, depending on tank variable and unit used.
### 9.5.13 Configuration of the 4-20mA output

Each Analog I/O module of the device can be configured as a 4...20mA analog output. To do so, proceed as follows:

1. Navigate to: Setup → Advanced setup → Input/output → Analog I/O X1-3.
2. Go to the Operating mode and select **4...20mA output** or **HART slave +4...20mA output**.
3. Go to the Analog input source and select the tank variable which is to be transmitted via the 4...20mA output.
4. Go to the 0 % value and enter the value of the selected tank variable which will be mapped to 4 mA.
5. Go to the 100 % value and enter the value of the selected tank variable which will be mapped to 20 mA.

![Diagram of Analog I/O modules](image)

#### 69 Possible locations of the Analog I/O modules, which can be used as a 4-20mA output. The order code of the device determines which of these modules is actually present → 45.

- **Scaling of the tank variable to the output current**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank variable</td>
<td>Output current</td>
</tr>
</tbody>
</table>

After startup of the device, as long as the assigned tank variable is not yet available, the output current assumes the defined error value.

The Analog I/O contains more parameters which can be used for a more detailed configuration of the analog output. For a description see → 221

---

4) "HART slave +4...20mA output" means that the Analog I/O module serves as a HART slave which cyclically sends up to four HART variables to a HART master. For the configuration of the HART output: → 125
9.5.14 Configuration of the HART slave + 4 to 20 mA output

If Operating mode = HART slave + 4..20mA output has been selected for an Analog I/O module, it serves as a HART slave which sends up to four HART variables to a HART master.

The 4 to 20 mA signal can be used in this case, too. For its configuration: → 124

Standard case: PV = 4 to 20 mA signal

By default, the Primary Variable (PV) is identical to the tank variable transmitted by the 4-20mA output. To define the other HART variables and to configure the HART output in more detail, proceed as follows:

1. Navigate to: Setup → Advanced setup → Communication → HART output → Configuration
2. Go to the System polling address and set the HART slave address of the device.
3. Use the following parameters to assign tank variables to the second to fourth HART variable: Assign SV, Assign TV, Assign QV.
   → The four HART variables are transmitted to a connected HART Master.

Special case: PV ≠ 4 to 20 mA signal

In exceptional cases it might be required that the Primary Variable (PV) transmits a different tank variable than the 4-20mA output. This is configured as follows.

1. Navigate to: Setup → Advanced setup → Communication → HART output → Configuration
2. Go to the PV source and select Custom.
   → The following additional parameters appear in the submenu: Assign PV, 0 % value, 100 % value and PV mA selector.
3. Go to the Assign PV and select the tank variable to be transmitted as the Primary Variable (PV).
4. Use the 0 % value and 100 % value parameters to define a range for the PV. The Percent of range indicates the percentage for the actual value of the PV. It is included in the cyclical output to the HART master.

5. Use the PV mA selector to define whether the output current of an Analog I/O module is to be included in the cyclical HART output.
After startup of the device, as long as the assigned tank variable is not yet available, the output current assumes the defined error value.

The PV mA selector does not influence the output current at the terminals of the Analog I/O module. It only defines whether the value of this current is part of the HART output or not.

9.5.15 Configuration of the Modbus output

The Proservo NMS8x acts as a Modbus slave. Measured or calculated tank values are stored in registers which can be requested by a Modbus master.

The following submenu is used to configure the communication between the device and the Modbus master:
Setup → Advanced setup → Communication → Modbus X1-4 → Configuration (→ 242)
9.5.16  Configuration of the V1 output

The following submenus are used to configure the V1 communication between the device and the control system:

- Setup → Advanced setup → Communication → V1 X1-4 → Configuration → 245
- Setup → Advanced setup → Communication → V1 X1-4 → V1 input selector → 248

9.5.17  Configuration of the WM550 output

The following submenus are used to configure the WM550 communication between the device and the control system:

- Setup → Advanced setup → Communication → WM550 X1-4 → Configuration → 241
- Setup → Advanced setup → Communication → WM550 X1-4 → WM550 input selector → 250
9.5.18 Configuration of the digital outputs

Possible locations of the Digital I/O modules (examples); the order code defines the number and location of Digital I/O modules → 45.

Usage of the Digital I/O module as a digital output

There is a Digital Xx-x submenu for each digital I/O module of the device. "X" designates the slot in the terminal compartment, "x-x" the terminals within this slot. The most important parameters of this submenu are Operating mode, Digital input source and Contact type.

A digital output can be used to
- output the state of an alarm (if an alarm has been configured → 123)
- transmit the status of a digital input (if a digital input has been configured → 114)

To configure a digital output, proceed as follows:
1. Navigate to Setup → Advanced setup → Input/output → Digital Xx-x, where Xx-x designates the digital I/O module to be configured.
2. Go to the Operating mode and select the Output passive.
3. Go to the Digital input source and select the alarm or digital input to be transmitted.
4. Go to the Contact type and select how the internal state of the alarm or digital input is to be mapped to the digital output (see table below).
9.6 Advanced settings

For a more detailed configuration of the signal inputs, the tank calculations and the signal outputs refer to the Advanced setup (→ 206).

9.7 Simulation

To check the correct configuration of the device and of the control system, it is possible to simulate different situations (measured values, diagnostic messages etc.). See the Simulation (→ 336) for details.

9.8 Protecting settings from unauthorized access

There are two possibilities to protect the settings from unauthorized access:

- By an access code (→ 76)
  This locks the access via the display and operating module.

- By the protection switch (→ 77)
  This locks the access to W&M-related parameters by any user interface (display and operating module, FieldCare, other configuration tools).

<table>
<thead>
<tr>
<th>State of the alarm</th>
<th>Internal state of the digital input</th>
<th>Switching state of the digital output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Active</td>
<td>Contact type = Normally open</td>
<td>Contact type = Normally closed</td>
</tr>
</tbody>
</table>

For SIL applications, **Contact type** is automatically set to **Normally closed** by the device when starting the SIL confirmation procedure.

- In case of a power supply failure, the switching state is always 'open', irrespective of the selected option.
- The Digital Xx-x contains additional parameters for a more detailed configuration of the Digital Input. For a description refer to → 231.
10 Operation

10.1 Reading off the device locking status

Depending on the locking state of the device some operations may be locked. The current locking status is indicated at: Setup → Advanced setup → Locking status. The following table summarizes the different locking statuses:

<table>
<thead>
<tr>
<th>Locking status</th>
<th>Meaning</th>
<th>Unlocking procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware locked</td>
<td>The device is locked by the write-protection switch in the terminal compartment.</td>
<td>→ 77</td>
</tr>
<tr>
<td>SIL locked</td>
<td>The device is in SIL-locked mode.</td>
<td>Detailed information on this topic see SIL Safety manual</td>
</tr>
<tr>
<td>CT active - all parameters</td>
<td>The custody transfer mode is active.</td>
<td>→ 77</td>
</tr>
<tr>
<td>WHG locked</td>
<td>The device is in WHG-locked mode.</td>
<td>Detailed information on this topic see SIL Safety manual</td>
</tr>
<tr>
<td>Temporarily locked</td>
<td>Write access to the parameters is temporarily lock due to device-internal processing (e.g. data upload/download, reset). Once the internal processing has been completed, the parameters can be changed again.</td>
<td>Wait for completion of the device-internal processing.</td>
</tr>
</tbody>
</table>

A locking is indicated by the write protection symbol in the header of the display:

![Write protection symbol]

20.50

X X

10.2 Reading off measured values

Tank values can be read off in the following submenus:
- Operation → Level
- Operation → Temperature
- Operation → Density
- Operation → Pressure
10.3 Gauge commands

10.3.1 Overview of available device functions

Gauge commands are mainly divided into two categories.

- Continuous gauge command
- One-time gauge command (non-continuous)

One-time gauge commands have a defined end state. After a one-time gauge command is completed, another gauge command is executed which is defined by the Post gauge command. If Post gauge command is set to None, the operation will stop.

The gauge command can be chosen by navigating to Operation → Gauge command. The status of the gauge command execution is shown in the Gauge status. The gauge status is displayed on the home screen by default.

![Diagram of gauge command](image)

- Typical appearance of the standard view (measured value display)

For details of status symbols → 67

When a one-time gauge command is executed, additional information is shown in the One-time command status in the operation menu.
### 10.3.2 Descriptions of gauge commands

The following table shows the available gauge commands and functions of NMS8x.

> The numbers in the figures show the sequence of displacer movement.

<table>
<thead>
<tr>
<th>Gauge command</th>
<th>Descriptions</th>
<th>Post gauge command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>Displacer stops.</td>
<td>Not available</td>
</tr>
<tr>
<td>Level</td>
<td>The displacer searches for the liquid level surface and balances there.</td>
<td>Not available</td>
</tr>
<tr>
<td>Up</td>
<td>The displacer moves up to the reference position.</td>
<td>Not available</td>
</tr>
<tr>
<td>Bottom level</td>
<td>The displacer searches for the tank bottom. After determining the bottom value, the post gauge command is executed.</td>
<td>Customer setting value</td>
</tr>
<tr>
<td>Upper I/F level</td>
<td>The displacer searches for the upper interface level and balances there.</td>
<td>Not available</td>
</tr>
<tr>
<td>Lower I/F level</td>
<td>The displacer searches for the lower interface level and balances there.</td>
<td>Not available</td>
</tr>
<tr>
<td>Upper density</td>
<td>NMS8x performs a spot density measurement in the upper phase of the tank. After completing the measurement, the post gauge command is executed.</td>
<td>Customer setting value</td>
</tr>
</tbody>
</table>

*a Immersion depth*
## Descriptions

<table>
<thead>
<tr>
<th>Gauge command</th>
<th>Descriptions</th>
<th>Post gauge command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle density</td>
<td>NMS8x performs a spot density measurement in the middle phase of the tank. After completing the measurement, the post gauge command is executed.</td>
<td>Customer setting value</td>
</tr>
<tr>
<td>Lower density</td>
<td>NMS8x performs a spot density measurement in the lower phase of the tank. After completing measurement, the post gauge command is executed.</td>
<td>Customer setting value</td>
</tr>
<tr>
<td>Repeatability</td>
<td>The displacer moves upwards from the liquid. After that, the displacer returns to the level measurement. This can be used for a function check. This gauge command should only be executed if the current gauge command is level.</td>
<td>Level</td>
</tr>
<tr>
<td>Water dip</td>
<td>The displacer searches for the upper interface level. After balancing on the liquid, the post gauge command is executed.</td>
<td>Customer setting value</td>
</tr>
<tr>
<td>Release overtension</td>
<td>When the displacer hits any obstacle in the tank and gets stuck (Error message: Overtension) this command will release the tension on the wire by moving down a short distance. During an overtension error, no other gauge command will be executed.</td>
<td>Stop</td>
</tr>
<tr>
<td>Tank profile</td>
<td>Density profile measurement of the tank (tank bottom to level)</td>
<td>Customer setting value</td>
</tr>
<tr>
<td>Interface profile</td>
<td>Density profile measurement of the upper interface (upper I/F level to level)</td>
<td>Customer setting value</td>
</tr>
<tr>
<td>Manual profile</td>
<td>Density profile measurement from a manually set position to level</td>
<td>Customer setting value</td>
</tr>
</tbody>
</table>
### Post gauge command

<table>
<thead>
<tr>
<th>Gauge command</th>
<th>Descriptions</th>
<th>Post gauge command</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level standby</strong></td>
<td>The displacer moves to a set position and stays there until the tank level reaches this position. After that, gauge command is changed back to level. This function can be used when supplying or discharging liquid.</td>
<td><strong>Level</strong></td>
</tr>
<tr>
<td><strong>Offset standby</strong></td>
<td>The displacer moves upwards for the distance which is set from the current position and stays there until the tank level reaches this position. After that, gauge command is changed back to level. This function can be used when supplying or discharging liquid.</td>
<td><strong>Level</strong></td>
</tr>
</tbody>
</table>
10.3.3  Sources for gauge commands

Gauge commands can be sent via various sources.

- Displays or CDI (e.g. FieldCare)
- Digital input (e.g. control switch)
- Fieldbus (Modbus, V1, HART)

The last received gauge command via any sources will be executed as usual.

During calibration, gauge commands are not accepted from any sources.

Gauge command priorities

The priority of the gauge command for NMS8x is very simple. The last received gauge command via any sources will be executed to take of the former gauge command. However the priority varies depending on the devices. When replacing the device with the NMS8x, check the priorities shown below.

**NOTICE**
Undesired gauge command will be executed.

If the setting is not changed, an undesired gauge command will be executed (e.g. Level command via Fieldbus would overwrite Stop command for maintenance.).

- If the system has been automatically or semi-automatically programmed for operation, maintenance or other purposes, the setting should be changed corresponding to use.

Proservo NMS8x

<table>
<thead>
<tr>
<th>Command</th>
<th>Priority</th>
<th>Command</th>
<th>Priority</th>
<th>Command</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>1</td>
<td>Level</td>
<td>1</td>
<td>Level</td>
<td>1</td>
</tr>
<tr>
<td>Interface</td>
<td>1</td>
<td>Interface</td>
<td>1</td>
<td>Interface</td>
<td>1</td>
</tr>
<tr>
<td>Tank bottom</td>
<td>1</td>
<td>Tank bottom</td>
<td>1</td>
<td>Tank bottom</td>
<td>1</td>
</tr>
</tbody>
</table>
### Proservo NMS81

<table>
<thead>
<tr>
<th></th>
<th>By display</th>
<th>From digital input</th>
<th>From Fieldbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot density</td>
<td>1</td>
<td>Spot density</td>
<td>1</td>
</tr>
<tr>
<td>Profile density</td>
<td>1</td>
<td>Profile density</td>
<td>1</td>
</tr>
<tr>
<td>Up</td>
<td>1</td>
<td>Up</td>
<td>1</td>
</tr>
<tr>
<td>Stop</td>
<td>1</td>
<td>Stop</td>
<td>1</td>
</tr>
</tbody>
</table>

### Proservo NMS5/NMS7

<table>
<thead>
<tr>
<th></th>
<th>By display</th>
<th>From NRF560</th>
<th>From digital input</th>
<th>From Fieldbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
<td>Priority</td>
<td>Command</td>
<td>Priority</td>
<td>Command</td>
</tr>
<tr>
<td>Level</td>
<td>4</td>
<td>Level</td>
<td>4</td>
<td>Level</td>
</tr>
<tr>
<td>Interface</td>
<td>2</td>
<td>Interface</td>
<td>3</td>
<td>Interface</td>
</tr>
<tr>
<td>Tank bottom</td>
<td>2</td>
<td>Tank bottom</td>
<td>3</td>
<td>Tank bottom</td>
</tr>
<tr>
<td>Spot density</td>
<td>2</td>
<td>Spot density</td>
<td>3</td>
<td>Spot density</td>
</tr>
<tr>
<td>Profile density</td>
<td>2</td>
<td>Profile density</td>
<td>3</td>
<td>Profile density</td>
</tr>
<tr>
<td>Up</td>
<td>2</td>
<td>Up</td>
<td>3</td>
<td>Up</td>
</tr>
<tr>
<td>Stop</td>
<td>2</td>
<td>Stop</td>
<td>3</td>
<td>Stop</td>
</tr>
</tbody>
</table>

### Servo level gauge TGM5

<table>
<thead>
<tr>
<th></th>
<th>By display</th>
<th>From NRF560</th>
<th>From DRM9700</th>
<th>From digital input</th>
<th>From Fieldbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
<td>Priority</td>
<td>Command</td>
<td>Priority</td>
<td>Command</td>
<td>Command</td>
</tr>
<tr>
<td>Level</td>
<td>4</td>
<td>Level</td>
<td>4</td>
<td>Level</td>
<td>Level</td>
</tr>
<tr>
<td>Interface</td>
<td>2</td>
<td>Interface</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Tank bottom</td>
<td>2</td>
<td>Tank bottom</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spot density</td>
<td>2</td>
<td>Spot density</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Profile density</td>
<td>2</td>
<td>Profile density</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Up</td>
<td>2</td>
<td>Up</td>
<td>3</td>
<td>Up</td>
<td>Up</td>
</tr>
<tr>
<td>Stop</td>
<td>2</td>
<td>Stop</td>
<td>3</td>
<td>N/A</td>
<td>Stop</td>
</tr>
</tbody>
</table>

### Servo level gauge TGM4000

<table>
<thead>
<tr>
<th></th>
<th>By display</th>
<th>From DRM9700</th>
<th>From digital input</th>
<th>From Fieldbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
<td>Priority</td>
<td>Command</td>
<td>Priority</td>
<td>Command</td>
</tr>
<tr>
<td>Level</td>
<td>4</td>
<td>Level</td>
<td>4</td>
<td>Level</td>
</tr>
<tr>
<td>Interface</td>
<td>2</td>
<td>Interface</td>
<td>1</td>
<td>Interface</td>
</tr>
<tr>
<td>Tank bottom</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spot density</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Profile density</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Up</td>
<td>2</td>
<td>Up</td>
<td>1</td>
<td>Up</td>
</tr>
<tr>
<td>Stop</td>
<td>2</td>
<td>Stop</td>
<td>N/A</td>
<td>Stop</td>
</tr>
</tbody>
</table>
11 Diagnostics and troubleshooting

11.1 General trouble shooting

11.1.1 General errors

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedial action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device does not respond.</td>
<td>Supply voltage not connected.</td>
<td>Connect the correct voltage.</td>
</tr>
<tr>
<td></td>
<td>The cables do not contact the terminals properly.</td>
<td>Ensure electrical contact between the cable and the terminal.</td>
</tr>
<tr>
<td>Values on the display invisible</td>
<td>The plug of the display cable is not connected correctly.</td>
<td>Connect the plug correctly.</td>
</tr>
<tr>
<td></td>
<td>Display is defective.</td>
<td>Replace display.</td>
</tr>
<tr>
<td></td>
<td>Display contrast too low.</td>
<td>Set Setup → Advanced setup → Display → Contrast display to a value ≥ 60 %.</td>
</tr>
<tr>
<td>&quot;Communication error&quot; is indicated on the display when starting the device or connecting the display</td>
<td>Electromagnetic interference</td>
<td>Check grounding of the device.</td>
</tr>
<tr>
<td></td>
<td>Broken display cable or display plug.</td>
<td>Exchange display.</td>
</tr>
<tr>
<td>CDI communication does not work.</td>
<td>Wrong setting of the COM port on the computer.</td>
<td>Check the setting of the COM port on the computer (e.g. FieldCare) and change it if necessary.</td>
</tr>
<tr>
<td>Device measures incorrectly.</td>
<td>Parametrization error</td>
<td>Check and adjust parameterization.</td>
</tr>
</tbody>
</table>

11.1.2 Measurement specific errors

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible case</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacer not balancing</td>
<td>No water in the tank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liquid surface unstable</td>
<td>Change Process condition.</td>
</tr>
<tr>
<td></td>
<td>Incorrect density setting</td>
<td>Check density setting.</td>
</tr>
<tr>
<td>Displacer not traveling to reference position</td>
<td>High stop level</td>
<td>Check gauge status.</td>
</tr>
<tr>
<td></td>
<td>Over tension</td>
<td>Check gauge status and gauge command. The function, Release overtension, can only be performed.</td>
</tr>
<tr>
<td>Displacer not measuring the bottom level</td>
<td>Low stop level</td>
<td>Check gauge status.</td>
</tr>
<tr>
<td></td>
<td>Under tension</td>
<td>Check gauge status.</td>
</tr>
<tr>
<td></td>
<td>Bottom detection weight wrong</td>
<td>Check Bottom detection weight in Service mode.</td>
</tr>
<tr>
<td>Gauge status not working under the following levels.</td>
<td>Those setting of Upper, Middle, and Lower density are set to same value.</td>
<td>Upper density &lt; Middle density &lt; Lower density The difference of value 0.2 g/ml or more is required for setting as follows. &lt;e.g&gt;</td>
</tr>
<tr>
<td></td>
<td>• Upper/lower interface</td>
<td>0.8 g/ml</td>
</tr>
<tr>
<td></td>
<td>• Middle/lower density</td>
<td>1.0 g/ml</td>
</tr>
<tr>
<td></td>
<td>• IF (Interface) profile</td>
<td>1.2 g/ml</td>
</tr>
<tr>
<td></td>
<td>• Water dip</td>
<td>After turning on the power, the previous gauge command is not effective.</td>
</tr>
<tr>
<td>Error</td>
<td>Possible case</td>
<td>Remedy</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Invalid level setting</td>
<td>Gauge command of Balanced is not valid when Set level was issued.</td>
<td>Check the gauge command and set level again.</td>
</tr>
<tr>
<td>Invalid liquid temperature</td>
<td>Incorrect liquid temperature source</td>
<td>Check Liquid temp source.</td>
</tr>
<tr>
<td></td>
<td>HART device disconnected</td>
<td>Check HART device</td>
</tr>
<tr>
<td>Invalid vapor temperature</td>
<td>Incorrect liquid temperature source</td>
<td>Check Liquid temp source.</td>
</tr>
<tr>
<td></td>
<td>HART device disconnected</td>
<td>Check HART device</td>
</tr>
<tr>
<td>Invalid liquid level</td>
<td>Incorrect water level source</td>
<td>Check Water level source</td>
</tr>
<tr>
<td></td>
<td>HART device disconnected</td>
<td>Check HART device</td>
</tr>
<tr>
<td>Status is not SIL mode</td>
<td>The status of Gauge command is not on Level.</td>
<td>Check gauge command is on Level.</td>
</tr>
<tr>
<td></td>
<td>Incorrect A1O parameter setting</td>
<td>Check the Operating mode, 4 to 20 mA output</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the Use for SIL is valid.</td>
</tr>
<tr>
<td></td>
<td>Incorrect D1O parameter setting</td>
<td>Check the Operating mode, Output passive.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the Contact type is Normally closed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the Use for SIL is valid.</td>
</tr>
</tbody>
</table>
11.2 Diagnostic information on local display

11.2.1 Diagnostic message

Faults detected by the self-monitoring system of the measuring device are displayed as a diagnostic message in alternation with the measured value display.

<table>
<thead>
<tr>
<th>Measured value display in alarm condition</th>
<th>Diagnostic message</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image of display showing status symbols and measured value]</td>
<td>[Image of diagnostic message]</td>
</tr>
</tbody>
</table>

1 Status signal
2 Status symbol (symbol for event level)
3 Status symbol with diagnostics event
4 Event text
5 Operating elements

Status signals

**F**

"Failure"
A device error is present. The measured value is no longer valid.

**C**

"Function check"
The device is in service mode (e.g. during a simulation or a warning).

**S**

"Out of specification"
The device is operated:
- Outside of its technical specifications (e.g. during startup or a cleaning)
- Outside of the configuration carried out by the user (e.g. level outside configured span)

**M**

"Maintenance required"
Maintenance is required. The measured value is still valid.

Status symbol (symbol for event level)

**X**

"Alarm" status
The measurement is interrupted. The signal outputs take on the defined alarm condition. A diagnostic message is generated.

**A**

"Warning" status
The device continues to measure. A diagnostic message is generated.
Diagnostics and troubleshooting

Diagnostics event and event text

The fault can be identified using the diagnostics event. The event text helps you by providing information about the fault. In addition, the corresponding symbol is displayed before the diagnostics event.

<table>
<thead>
<tr>
<th>Status symbol</th>
<th>Status signal</th>
<th>Event number</th>
<th>Event text</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example**

A0013962
A0013956
441

Curr.output 1
3-digit number

If two or more diagnostic messages are pending simultaneously, only the message with the highest priority is shown. Additional pending diagnostic messages can be shown in Diagnostic list submenu (→ 332).

Operating elements

<table>
<thead>
<tr>
<th>Operating functions in menu, submenu</th>
<th>Plus key</th>
<th>Enter key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plus key</td>
<td>Opens the message about the remedial measures.</td>
<td>Opens the operating menu.</td>
</tr>
</tbody>
</table>
11.2.2 Calling up remedial measures

A diagnostic message appears in the standard view (measured value display).

1. Press \[\text{\textbullet}\] (\[\text{\textbullet}\] symbol).
   - The Diagnostic list submenu opens.
2. Select the desired diagnostic event with \[\text{\textbullet}\] or \[\text{\textbullet}\] and press \[\text{\textbullet}\] .
   - The message for the remedial measures for the selected diagnostic event opens.
3. Press \[\text{\textbullet}\] + \[\text{\textbullet}\] simultaneously.
   - The message for the remedial measures closes.

The user is in the Diagnostics menu at an entry for a diagnostics event, e.g. in the Diagnostic list submenu or in the Previous diagnostics.

1. Press \[\text{\textbullet}\].
   - The message for the remedial measures for the selected diagnostic event opens.
2. Press \[\text{\textbullet}\] + \[\text{\textbullet}\] simultaneously.
   - The message for the remedial measures closes.
11.3 **Diagnostic information in FieldCare**

Any faults detected by the measuring device are displayed on the home page of the operating tool once the connection has been established.

Furthermore, diagnostic events that have occurred can be viewed in the Diagnostic list.

11.3.1 **Status signals**

The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event).

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| ![failure](image) | Failure  
A device error has occurred. The measured value is no longer valid. |
| ![function_check](image) | Function check  
The device is in service mode (e.g. during a simulation or a warning). |
| ![out_of_spec](image) | Out of specification  
The device is operated outside its technical specification limits (e.g. outside the process temperature range) |
| ![maintenance_required](image) | Maintenance required  
Maintenance is required. The measured value is still valid. |

The status signals are categorized in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107.
11.3.2 Calling up remedy information

Remedy information is provided for every diagnostic event to ensure that problems can be rectified quickly:
- On the home page
  Remedy information is displayed in a separate field below the diagnostics information.
- In the Diagnostics menu
  Remedy information can be called up in the working area of the user interface.

The user is in the Diagnostics menu.

1. Call up the desired parameter.
2. On the right in the working area, mouse over the parameter.
   ➤ A tool tip with remedy information for the diagnostic event appears.
### 11.4 Overview of the diagnostic messages

<table>
<thead>
<tr>
<th>Diagnostic number</th>
<th>Short text</th>
<th>Remedy instructions</th>
<th>Status signal [from the factory]</th>
<th>Diagnostic behavior [from the factory]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diagnostic of sensor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Sensor incompatible error</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Contact service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>Detector error</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Check electrical connections of detector</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Replace detector unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>Sensor electronic failure</td>
<td>Replace sensor electronic module</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td>Diagnostic of electronic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>242</td>
<td>Software incompatible</td>
<td>1. Check software</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Flash or change main electronic module</td>
<td></td>
<td></td>
</tr>
<tr>
<td>252</td>
<td>Modules incompatible</td>
<td>1. Check if correct electronic module is plugged</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replace electronic module</td>
<td></td>
<td></td>
</tr>
<tr>
<td>261</td>
<td>Electronic modules</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Check electronic modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Change I/O module or main electronics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>262</td>
<td>Module connection</td>
<td>1. Check module connections</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replace electronic modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>270</td>
<td>Main electronics failure</td>
<td>Replace main electronics</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>271</td>
<td>Main electronics failure</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Change main electronic module</td>
<td></td>
<td></td>
</tr>
<tr>
<td>272</td>
<td>Main electronics failure</td>
<td>Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>272</td>
<td></td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Contact service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>273</td>
<td>Main electronics failure</td>
<td>1. Emergency operation via display</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Change main electronics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>I/O module failure</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Change I/O module</td>
<td></td>
<td></td>
</tr>
<tr>
<td>276</td>
<td>I/O module faulty</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Change I/O module</td>
<td></td>
<td></td>
</tr>
<tr>
<td>282</td>
<td>Data storage</td>
<td>1. Restart device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Contact service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>283</td>
<td>Memory content</td>
<td>1. Transfer data or reset device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Contact service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>284</td>
<td>Detector SW update in progress</td>
<td>Firmware update active, please wait!</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>311</td>
<td>Electronics failure</td>
<td>Maintenance required!</td>
<td>M</td>
<td>Warning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Do not perform reset</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Contact service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>333</td>
<td>System recovery required</td>
<td>HW change detected</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System configuration recovery required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>Go to menu on device and perform recovery</td>
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<tr>
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<td>334</td>
<td>System recovery failure</td>
<td>HW changed, system recovery failure. Return to factory</td>
<td>F</td>
<td>Alarm</td>
</tr>
</tbody>
</table>
| 381               | Displacer distance invalid | 1. Calibrate sensor  
2. Restart device  
3. Replace sensor electronics | F | Alarm |
| 382               | Sensor communication | 1. Check connection of sensor electronics  
2. Restart device  
3. Replace sensor electronics | F | Alarm |

### Diagnostic of configuration

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<td>Deactivate simulation AIO output</td>
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<td>401</td>
<td>DIO simulation output</td>
<td>Deactivate simulation DIO output</td>
<td>C</td>
<td>Warning</td>
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</table>
| 403               | Calibration AIO | 1. Restart device  
2. Change I/O module | F | Alarm |
| 404               | Calibration AIP | 1. Restart device  
2. Change I/O module | F | Alarm |
| 405               | COMM timeout DIO 1 to 8 | 1. Check wiring  
2. Change I/O module | F | Alarm |
| 406               | IOM offline | 1. Check wiring  
2. Change I/O module | F | Alarm |
| 407               | COMM timeout AIO 1 to 2 | 1. Check wiring  
2. Change I/O module | F | Alarm |
| 408               | Invalid range AIO 1 to 2 | 1. Check device configuration.  
2. Check wiring. | C | Warning |
| 409               | RTD temp out of range 1 to 2 | 1. Check electronic modules  
2. Change I/O or main electronic module | C | Warning |
| 410               | Data transfer | 1. Retry data transfer  
2. Check connection | F | Alarm |
| 411               | Hart device 1 to 15 has malfunction | 1. Check HART device  
2. Change HART device | F | Alarm |
| 412               | Processing download | Download active, please wait | C | Warning |
| 413               | NMT 1 to 15: element is open or short | 1. Check NMT wiring connection  
2. Replace NMT | C | Warning |
| 415               | Hart device 1 to 15 offline | 1. Check HART device  
2. Change HART device | C | Warning |
| 416               | Warning occurred for HART device 1 to 15 | Check connected HART device | M | Warning |
| 434               | Real time clock defective | Replace main electronics | C | Warning |
| 436               | Date/time incorrect | Check date and time settings. | M | Warning |
| 437               | Configuration incompatible | 1. Restart device  
2. Contact service | F | Alarm |
| 438               | Dataset | 1. Check dataset file  
2. Check device configuration  
3. Up- and download new configuration | M | Warning |
| 441               | AIO 1 to 2 current output alarm | 1. Check process  
2. Check current output settings | F | Alarm |
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<td>484</td>
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<td>AIO C1-3 source no longer valid</td>
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<td>501</td>
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<td>502</td>
<td>GP1 source no longer valid</td>
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<td>503</td>
<td>GP2 source no longer valid</td>
<td>Change input source</td>
<td>C</td>
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<td>504</td>
<td>GP3 source no longer valid</td>
<td>Change input source</td>
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<tr>
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<td>GP4 source no longer valid</td>
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<td>506</td>
<td>Water level source no longer valid</td>
<td>Change input source</td>
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<td>507</td>
<td>Liquid temp source no longer valid</td>
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<tr>
<td>509</td>
<td>Air temperature source no longer valid</td>
<td>Change input source</td>
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<tr>
<td>510</td>
<td>P1 source no longer valid</td>
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<td>511</td>
<td>P2 source no longer valid</td>
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<td>512</td>
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<td>514</td>
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<tr>
<td>515</td>
<td>Lower density source no longer valid</td>
<td>Change input source</td>
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<tr>
<td>516</td>
<td>Gauge command source no longer valid</td>
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<td>517</td>
<td>Gauge status source no longer valid</td>
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<td>518</td>
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<tr>
<td>519</td>
<td>Upper interface source no longer valid</td>
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<td>Warning</td>
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<tr>
<td>520</td>
<td>Lower interface source no longer valid</td>
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<td>521</td>
<td>Bottom level source no longer valid</td>
<td>Change input source</td>
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<td>522</td>
<td>Displacer position source not valid</td>
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<td>523</td>
<td>Distance source no longer valid</td>
<td>Change input source</td>
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<td>524</td>
<td>Balance flag source no longer valid</td>
<td>Change input source</td>
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<tr>
<td>Diagnostic number</td>
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<td>525</td>
<td>One time cmd source no longer valid</td>
<td>Change input source</td>
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<td>526</td>
<td>Alarm 1 to 4 source no longer valid</td>
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<td>527</td>
<td>AIO B1-3 source no longer valid</td>
<td>Change input source</td>
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<td>528</td>
<td>CTSh</td>
<td>1. Check device configuration. 2. Check wiring.</td>
<td>C</td>
<td>Warning</td>
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<td>529</td>
<td>HTG</td>
<td>1. Check device configuration. 2. Check wiring.</td>
<td>C</td>
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<tr>
<td>530</td>
<td>HTMS</td>
<td>1. Check device configuration. 2. Check wiring.</td>
<td>C</td>
<td>Warning</td>
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<td>531</td>
<td>HyTD correction value</td>
<td>1. Check device configuration. 2. Check wiring.</td>
<td>C</td>
<td>Warning</td>
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<tr>
<td>532</td>
<td>HART output: PV source not valid</td>
<td>Change input source</td>
<td>C</td>
<td>Warning</td>
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<tr>
<td>533</td>
<td>HART output: SV source not valid</td>
<td>Change input source</td>
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<tr>
<td>534</td>
<td>HART output: QV source not valid</td>
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<td>537</td>
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<td>538</td>
<td>HART output: PV mA source not valid</td>
<td>Change input source</td>
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<tr>
<td>539</td>
<td>Modbus 1-4 SP source invalid</td>
<td>Set valid SP input selector</td>
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<tr>
<td>540</td>
<td>V1 1-4 SP source invalid</td>
<td>Set valid SP input selector</td>
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<tr>
<td>541</td>
<td>Modbus 1-4 alarm source invalid</td>
<td>Set valid alarm input selector</td>
<td>C</td>
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<td>542</td>
<td>V1 1-4 alarm source invalid</td>
<td>Set valid alarm input selector</td>
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<tr>
<td>543</td>
<td>Modbus 1-4 analog source invalid</td>
<td>Set valid analog input selector</td>
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<tr>
<td>544</td>
<td>V1 1-4 analog source invalid</td>
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<tr>
<td>545</td>
<td>Modbus 1-4 user value source invalid</td>
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<td>546</td>
<td>Modbus 1-4 discrete value source invalid</td>
<td>Set valid user discrete input selector</td>
<td>C</td>
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<tr>
<td>547</td>
<td>V1 1-4 user value source invalid</td>
<td>Set valid user value input selector</td>
<td>C</td>
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<tr>
<td>548</td>
<td>V1 1-4 discrete value source invalid</td>
<td>Set valid user discrete input selector</td>
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<tr>
<td>549</td>
<td>Modbus 1-4 percent source invalid</td>
<td>Set valid percentage input selector</td>
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<tr>
<td>550</td>
<td>V1 1-4 percent source invalid</td>
<td>Set valid percentage input selector</td>
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<td>Diagnostic number</td>
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<td>--------------------------------------------------------------------------------------</td>
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<td>----------------------------------------</td>
</tr>
</tbody>
</table>
| 560               | Calibration mandatory | 1. Carry out weight calibration  
2. Carry out reference calibration  
3. Carry out drum calibration | C                                | Alarm                           |
| 564               | DIO B1-2 source no longer valid | Change input source                  | C                                | Warning                           |
| 565               | DIO B3-4 source not valid | Change input source                  | C                                | Warning                           |
| 566               | DIO C1-2 source no longer valid | Change input source                  | C                                | Warning                           |
| 567               | DIO C3-4 source no longer valid | Change input source                  | C                                | Warning                           |
| 568               | DIO D1-2 source no longer valid | Change input source                  | C                                | Warning                           |
| 569               | DIO D3-4 source no longer valid | Change input source                  | C                                | Warning                           |
| 572               | LRC 1 to 2 not possible | 1. Check device configuration.  
2. Check wiring.                  | C                                | Warning                           |
| 585               | Simulation distance | Deactivate simulation                | C                                | Warning                           |
| 586               | Record map | Recording of mapping please wait        | C                                | Warning                           |
| 598               | DIO A1-2 source no longer valid | Change input source                  | C                                | Warning                           |
| 599               | DIO A3-4 source no longer valid | Change input source                  | C                                | Warning                           |

**Diagnostic of process**

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<td>Energy too low</td>
<td>Increase supply voltage</td>
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</table>
| 803               | Current loop | 1. Check device configuration.  
2. Check wiring.                  | F             | Alarm               |
| 803               | Current loop 1 to 2 | 1. Check device configuration.  
2. Check wiring.                  | M             | Warning             |
| 825               | System temperature | 1. Check ambient temperature  
2. Check process temperature | S             | Warning             |
| 825               | System temperature | 1. Check ambient temperature  
2. Check process temperature | F             | Alarm               |
| 826               | Sensor temperature | 1. Check ambient temperature  
2. Check process temperature | S             | Warning             |
| 844               | Process value out of specification | 1. Check process value  
2. Check application  
3. Check sensor | S             | Warning 1)          |
| 901               | Level held | Normal state while Dip Freeze is turned on, otherwise check configuration | S             | Warning             |
| 903               | Current loop 1 to 2 | 1. Check device configuration.  
2. Check wiring.                  | F             | Alarm               |
| 904               | Digital output 1 to 8 | 1. Check device configuration.  
2. Check wiring.                  | F             | Alarm               |
| 941               | Echo lost | 1. Check process value  
2. Check application  
3. Check sensor | S             | Warning             |
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<td>1. Check level</td>
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<td>3. Reset self holding</td>
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<td>943</td>
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<td>Reduced accuracy</td>
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<td>Check level</td>
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<td>950</td>
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<td>Maintain your diagnostic event</td>
<td>M</td>
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<td>1. Check alarm source</td>
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<td>2. Check configuration settings</td>
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<td>1. Check alarm source</td>
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<td>963</td>
<td>Alarm 1 to 4 Low</td>
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<td>2. Check configuration settings</td>
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<td>964</td>
<td>Alarm 1 to 4 LowLow</td>
<td>1. Check alarm source</td>
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<td>2. Check configuration settings</td>
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<tr>
<td>965</td>
<td>Alarm 1 to 4 HighHigh</td>
<td>1. Check alarm source</td>
<td>F</td>
<td>Alarm</td>
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<td></td>
<td>2. Check configuration settings</td>
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<tr>
<td>966</td>
<td>Alarm 1 to 4 High</td>
<td>1. Check alarm source</td>
<td>F</td>
<td>Alarm</td>
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<tr>
<td></td>
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<td>2. Check configuration settings</td>
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<td>967</td>
<td>Alarm 1 to 4 Low</td>
<td>1. Check alarm source</td>
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<td>Alarm</td>
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<tr>
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<td>2. Check configuration settings</td>
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<td>968</td>
<td>Alarm 1 to 4 LowLow</td>
<td>1. Check alarm source</td>
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<td>2. Check configuration settings</td>
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<td>970</td>
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<td>2. Release overtension</td>
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<td>Check displacer and process</td>
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<td>974</td>
<td>LRC 1 to 2 failed</td>
<td>1. Check process value</td>
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<td>2. Check application</td>
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<td></td>
<td>3. Check sensor</td>
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</tbody>
</table>

1) Diagnostic behavior can be changed.

- The parameters No.941, 942, and 943 are only used for NMR8x and NRF81.
11.5 Diagnostic list
In the Diagnostic list submenu, up to 5 currently pending diagnostic messages can be displayed. If more than 5 messages are pending, the messages with the highest priority are shown on the display.

**Navigation path**
Diagnostics → Diagnostic list

**Calling up and closing the remedial measures**
1. Press 
   ➜ The message for the remedial measures for the selected diagnostic event opens.
2. Press 
   ➜ The message about the remedial measures closes.

11.6 Reset measuring device
To reset the device to a defined state use the Device reset (→ 327).

11.7 Device information
Information on the device (order code, hardware and software version of the individual modules etc.) can be found in the Device information (→ 333).

11.8 Firmware history

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<th>Software version</th>
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<th>Operating Instructions</th>
<th>Description of Parameters</th>
<th>Technical Information</th>
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<tr>
<td>04.2016</td>
<td>01.00.zz</td>
<td>Original software</td>
<td>BA01459G/00/EN/01.16</td>
<td>GP01077G/00/EN/01.16</td>
<td>TI01249G/00/EN/01.16</td>
</tr>
<tr>
<td>12.2016</td>
<td>01.02.zz</td>
<td>Bugfixes and improvements</td>
<td>BA01459G/00/EN/02.17</td>
<td>GP01077G/00/EN/01.17</td>
<td>TI01249G/00/EN/02.17</td>
</tr>
<tr>
<td>07.2018</td>
<td>01.03.zz</td>
<td>Software update</td>
<td>BA01459G/00/EN/04.18</td>
<td>GP01077G/00/EN/02.18</td>
<td>TI01249G/00/EN/04.18</td>
</tr>
<tr>
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<td>01.04.zz</td>
<td>Software update</td>
<td>BA01459G/00/EN/05.20</td>
<td>GP01077G/00/EN/03.18</td>
<td>TI01249G/00/EN/05.20</td>
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</table>
12 Maintenance

12.1 Maintenance tasks
No special maintenance work is required.

12.1.1 Exterior cleaning
When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing or the seals.

12.2 Endress+Hauser services
Endress+Hauser offers a wide variety of services for maintenance such as recalibration, maintenance service or device tests.

Your Endress+Hauser Sales Center can provide detailed information on the services.
13  Repair

13.1  General information on repairs

13.1.1  Repair concept

The Endress+Hauser repair concept assumes that the devices have a modular design and that repairs can be done by the Endress+Hauser service or specially trained customers. Spare parts are contained in suitable kits. They contain the related replacement instructions.

For more information on service and spare parts, contact the Service Department at Endress+Hauser.

13.1.2  Repairs to Ex-approved devices

**WARNING**

Incorrect repair can compromise electrical safety!

Explosion hazard!

- Only specialist personnel or the manufacturer's service team may carry out repairs on Ex-certified devices in accordance with national regulations.
- Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- Only use original spare parts from the manufacturer.
- Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- Carry out repairs according to the instructions.
- Only the manufacturer's service team is permitted to modify a certified device and convert it to another certified version.

13.1.3  Replacement of a device or electronic module

After a complete device or the electronic mainboard has been replaced, the parameters can be downloaded into the instrument again via FieldCare.

Condition: The configuration of the old device has been saved to the computer via FieldCare.

If an electronic module of the sensor or other parts of the sensor have been replaced, the servo calibration must be repeated. Refer to → 86.

**The "Save/Restore" function**

After a device configuration has been saved to a computer and restored to the device using the **Save/Restore** function of FieldCare, the device must be restarted by the following setting:

Setup → Advanced setup → Administration → Device reset = Restart device.

This ensures correct operation of the device after the restore.
13.2 **Spare parts**

Some interchangeable measuring device components are listed on an overview sign in the connection compartment cover.

The spare part overview sign contains the following information:

- A list of the most important spare parts for the measuring device, including their ordering information.
- The URL for the *W@M Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)):
  
  All the spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

13.3 **Endress+Hauser services**

Endress+Hauser offers a wide range of services.

![i]

Your Endress+Hauser Sales Center can provide detailed information on the services.

13.4 **Return**

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information:
   - [http://www.endress.com/support/return-material](http://www.endress.com/support/return-material)
   - Select the region.

2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

13.5 **Disposal**

![x]

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.
14 Accessories

14.1 Device-specific accessories

14.1.1 Weather protection cover

![Weather protection cover diagram]

Materials
- Protection cover and mounting brackets
  Material 316L (1.4404)
- Screws and washers
  Material A4

- The weather protection cover can be ordered together with the device:
  Ordering feature 620 "Accessory Enclosed", option PA "Weather Protection Cover"
- It can also be ordered as an accessory:
  Order code: 71305035 (for NMS8x)
14.1.2 Maintenance chamber

A maintenance chamber is recommended for use with tank level gauges in order to allow maintenance (removing the 70 mm (2.76 in) displacer or larger), while the tank is in service. Contact your Endress+Hauser Sales Center if necessary.

14.1.3 Ball valve

Ball valves are recommended for use with tank level gauges in order to allow maintenance such as removing displacers while tank is in service. Contact your Endress+Hauser Sales Center if necessary.

14.1.4 Control switch

A control switch is used for field mounted tank gauges. This provides additional gauge operation contact switching in order to control the gauge’s operation, such as hoisting up the displacer. Contact your Endress+Hauser Sales Center if necessary.

14.1.5 Relief valve and pressure gauge

![Diagram of relief valve and pressure gauge](image)

80 Mounting position of relief valve and pressure gauge

A Standard version
B 90 °-degree rotation (optional)
1 Pressure gauge
2 Relief valve
Relief valve
A relief valve is used to release pressure inside the housing of NMS8x before maintenance.

Contact your Endress+Hauser Sales Center when applying pressure in an ammonia atmosphere.

Pressure gauge
A pressure gauge is used to check process pressure inside the housing.

The range of the scale for the pressure gauge varies depending on the pressure.
- Low pressure: 0 to 1 MPa
- High pressure: 0 to 4 MPa
14.1.6 Cleaning nozzle and gas purging nozzle

A cleaning nozzle used for washing inside housing is especially recommended for F&B or alcohol applications.

A gas purging nozzle used for purging gas inside the housing is especially recommended for a nitrogen blanket for petrochemical or chemical applications.

14.1.7 Other combinations for relief valve, pressure gauge, cleaning nozzle, and gas purging nozzle

Cleaning nozzle and relief valve

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<th>B</th>
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<td>2</td>
<td>Cleaning nozzle</td>
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A  Standard version
B  90 °-degree rotation (optional)
1  Cleaning nozzle
2  Relief valve
Pressure gauge and gas purging nozzle

1 Pressure gauge
2 Gas purging nozzle
14.2 Communication-specific accessories

**WirelessHART adapter SWA70**
- Is used for the wireless connection of field devices
- The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks

For details, see Operating Instructions BA00061S

**Gauge Emulator, Modbus to BPM**
- Using the protocol converter, it is possible to integrate a field device into a host system even if the field device does not know the communication protocol of the host system. Eliminates vendor lock-in for field devices.
- Field communication protocol (field device): Modbus RS485
- Host communication protocol (host system): Enraf BPM
- 1 measuring device per Gauge Emulator
- Separate power supply: 100 to 240 VAC, 50 to 60 Hz, 0.375 A, 15 W
- Several approvals for the hazardous area

**Gauge Emulator, Modbus to TRL/2**
- Using the protocol converter, it is possible to integrate a field device into a host system even if the field device does not know the communication protocol of the host system. Eliminates vendor lock-in for field devices.
- Field communication protocol (field device): Modbus RS485
- Host communication protocol (host system): Saab TRL/2
- 1 measuring device per Gauge Emulator
- Separate power supply: 100 to 240 VAC, 50 to 60 Hz, 0.375 A, 15 W
- Several approvals for the hazardous area

14.3 Service-specific accessories

**Commubox FXA195 HART**
For intrinsically safe HART communication with FieldCare via the USB interface

For details, see "Technical Information" TI00404F

**Commubox FXA291**
Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop
Order number: 51516983

For details, see "Technical Information" TI00405C

**DeviceCare SFE100**
Configuration tool for HART, PROFIBUS and FOUNDATION Fieldbus field devices
DeviceCare is available for download at www.software-products.endress.com. You need to register in the Endress+Hauser software portal to download the application.

Technical Information TI01134S

**FieldCare SFE500**
FDT-based plant asset management tool
It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.

Technical Information TI00028S
14.4 System components

RIA15
Compact process display unit with very low voltage drop for universal use to display 4 to 20 mA/HART signals

Technical Information TI01043K

Tankvision Tank Scanner NXA820 / Tankvision Data Concentrator NXA821 / Tankvision Host Link NXA822
Inventory Management System with completely integrated software for operation via standard web browser

Technical Information TI00419G
15 Operating menu

- Navigation path for operating module at the device
- Navigation path for operating tool (e.g. FieldCare)
- Parameter can be locked via software locking

15.1 Overview of the operating menu

- This section lists the parameters of the following menus:
  - Operation (→ 173)
  - Setup (→ 191)
  - Diagnostics (→ 329)
- For the Expert menu refer to the 'Description of Device Parameters' (GP) of the respective device.
- Depending on the device version and parametrization some parameters will not be available in a given situation. For details refer to the 'Prerequisite' category in the description of the respective parameter.
- The representation essentially corresponds to the menu in an operating tool (e.g. FieldCare). On the local display there may be minor differences in the menu structure. Details are mentioned in the description of the respective submenu.

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### Operating menu

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- Timestamp

#### Middle density
- Measured
- Timestamp

#### Lower density
- Measured
- Timestamp

#### Profile density
- Profile point
- Average density
- Timestamp

#### Pressure
- P1 (bottom)
- P3 (top)

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- HART output

- Application

  - Tank configuration

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<td>333</td>
</tr>
<tr>
<td>Device tag</td>
<td>333</td>
</tr>
<tr>
<td>Serial number</td>
<td>333</td>
</tr>
<tr>
<td>Firmware version</td>
<td>333</td>
</tr>
<tr>
<td>Firmware CRC</td>
<td>334</td>
</tr>
<tr>
<td>Weight and measures configuration CRC</td>
<td>334</td>
</tr>
<tr>
<td>Device name</td>
<td>334</td>
</tr>
<tr>
<td>Order code</td>
<td>334</td>
</tr>
<tr>
<td>Extended order code 1 to 3</td>
<td>335</td>
</tr>
<tr>
<td>Simulation</td>
<td>336</td>
</tr>
<tr>
<td>Device alarm simulation</td>
<td>336</td>
</tr>
<tr>
<td>Diagnostic event simulation</td>
<td>336</td>
</tr>
<tr>
<td>Simulation distance on</td>
<td>336</td>
</tr>
<tr>
<td>Simulation distance</td>
<td>337</td>
</tr>
<tr>
<td>Current output 1 simulation</td>
<td>337</td>
</tr>
<tr>
<td>Simulation value</td>
<td>337</td>
</tr>
</tbody>
</table>
15.2 "Operation" menu

The Operation menu (→ 173) shows the most important measured values and allows to issue a gauge command.
Gauge command

Navigation  ➔ Operation ➔ Gauge command

Description
Gauge operation command to choose the measurement mode of the device.

Selection
- Stop *
- Level
- Up *
- Bottom level *
- Upper I/F level *
- Lower I/F level *
- Upper density *
- Middle density *
- Lower density *
- Repeatability
- Water dip
- Release overtension *
- Tank profile *
- Interface profile *
- Manual profile *
- Level standby *
- Offset standby *

Factory setting
Stop

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Distance

Navigation  ➔ Operation ➔ Distance

Description
Shows measured distance from reference position.

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
Net weight

Navigation  
Operation → Net weight

Description  
Shows the corrected weight data from the detector, as compensated by the drum table. This weight is used for measurement.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Gauge status

Navigation  
Operation → Gauge status

Description  
Indicates the current status of the device gauge command.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Balance flag

Navigation  
Operation → Balance flag

Description  
Indicates the validity of the Measurement. If balanced, corresponding Value (Liquid Level, Upper Interface, Lower Interface, Tank Bottom) is updated.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Standby level

Navigation  
Operation → Standby level

Description  
Defines the position in the tank where the displacer waits for the liquid level to rise during standby level gauge command.

User entry  
-999 999.9 to 999 999.9 mm

Factory setting  
0 mm

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Endress+Hauser
**Offset standby distance**

**Navigation**

Operation → Offset distance

**Description**

Defines the distance from the current position where the displacer waits for the liquid level to rise during offset standby gauge command.

**User entry**

0 to 999999.9 mm

**Factory setting**

500 mm
### Additional information

![Diagram showing offset standby distance](image)

87 \( a \): Offset standby distance

---

### One-time command status

**Navigation**  
Operation → One-time Cmd

**Description**  
Indicates the status of the last executed one-time gauge command.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

---

**Additional information**  
One-time command is available for all gauge commands, excepting Level, Stop, Up, and Interface.

---

#### 15.2.1 "Level" submenu

**Navigation**  
Operation → Level

---

#### Dip Freeze

**Navigation**  
Operation → Level → Dip Freeze

**Description**  
If activated the level values are frozen and a warning is shown.
Operating menu

Proservo NMS81

Selection
- Off
- On

Factory setting
Off

Additional information
This function can be used when performing a manual dipping in the same stilling well or nozzle where the radar device is mounted.

---

**Tank Level**

**Navigation**
Operation → Level → Tank level

**Description**
Shows the distance from the zero position (tank bottom or datum plate) to the product surface.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

**Tank Level %**

**Navigation**
Operation → Level → Tank Level %

**Description**
Shows the level as a percentage of the full measuring range.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

**Tank ullage**

**Navigation**
Operation → Level → Tank ullage

**Description**
Shows the remaining empty space in the tank.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
Tank ullage %

Navigation  
Operation → Level → Tank ullage %

Description  
Shows the remaining empty space in percentage related to parameter tank reference height.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

Upper interface level

Navigation  
Operation → Level → Upper I/F level

Description  
Shows measured interface level from zero position (tank bottom or datum plate). Value is updated when device generates a valid Interface measurement.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>-</td>
</tr>
</tbody>
</table>

Upper interface level timestamp

Navigation  
Operation → Level → Up I/F timestamp

Description  
Shows timestamp for the last measured upper interface level.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

Lower interface level

Navigation  
Operation → Level → Lower I/F level

Description  
Shows measured interface level from zero position (tank bottom or datum plate). Value is updated when device generates a valid interface measurement.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>-</td>
</tr>
</tbody>
</table>
### Lower interface level timestamp

**Navigation**  
Operation → Level → LowI/F timestamp

**Description**  
Shows timestamp of the last measured lower interface level.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

### Bottom level

**Navigation**  
Operation → Level → Bottom level

**Description**  
Shows the bottom level.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

### Bottom level timestamp

**Navigation**  
Operation → Level → BotLev timestamp

**Description**  
Shows the timestamp for measured bottom level.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

### Water level

**Navigation**  
Operation → Level → Water level

**Description**  
Shows the bottom water level.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
Measured level

Navigation  ➕ ➕ Operation → Level → Measured level

Description  Shows the measured level without any correction from the tank calculations.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

Distance

Navigation  ➕ ➕ Operation → Level → Distance

Description  Shows measured distance from reference position.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

Displacer position

Navigation  ➕ ➕ Operation → Level → Displacer pos

Description  Shows the displacer position.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

15.2.2  "Temperature" submenu

Air temperature

Navigation  ➕ ➕ Operation → Temperature → Air temp.

Description  Shows the air temperature.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
Liquid temperature

**Navigation**

Operation → Temperature → Liquid temp.

**Description**

Shows the average or spot temperature of the measured liquid.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Vapor temperature

**Navigation**

Operation → Temperature → Vapor temp.

**Description**

Shows the measured vapor temperature.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

"NMT element values" submenu

This submenu is only visible if a Prothermo NMT is connected.

**Navigation**

Operation → Temperature → NMT elem. values

"Element temperature" submenu

**Navigation**

Operation → Temperature → NMT elem. values → Element temp.

Element temperature 1 to 24

**Navigation**

Operation → Temperature → NMT elem. values → Element temp. 1 to 24

**Description**

Shows the temperature of an element in the NMT.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
“Element position” submenu

**Navigation**

Operation → Temperature → NMT elem. values → Element position

**Element position 1 to 24**

**Navigation**

Operation → Temperature → NMT elem. values → Element position → Element pos. 1 to 24

**Description**

Shows the position of the selected element in the NMT.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

**15.2.3 "Density" submenu**

**Navigation**

Operation → Density

**Observed density**

**Navigation**

Operation → Density → Observed density

**Description**

Calculated density of the product.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

**This value is calculated from different measured variables depending on the selected calculation method.**

**Observed density temperature**

**Navigation**

Operation → Density → Obs. dens. temp.

**Description**

Corresponding temperature of measured density. Can be used for reference density calculation.

**User interface**

Signed floating-point number

**Factory setting**

0 °C
## Vapor density

**Navigation**  
Operation → Density → Vapor density

**Description**  
Defines the density of the gas phase in the tank.

**User entry**  
0.0 to 500.0 kg/m³

**Factory setting**  
1.2 kg/m³

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

## Air density

**Navigation**  
Operation → Density → Air density

**Description**  
Defines the density of the air surrounding the tank.

**User entry**  
0.0 to 500.0 kg/m³

**Factory setting**  
1.2 kg/m³

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

## Measured upper density

**Navigation**  
Operation → Density → Meas upper dens.

**Description**  
Shows the density of the upper phase.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

## Upper density timestamp

**Navigation**  
Operation → Density → UpDens timestamp

**Description**  
Shows timestamp of the last measured upper density.
### Measured middle density

**Navigation**  
Operation → Density → Meas middle dens

**Description**  
Density of the middle phase.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### Middle Density Timestamp

**Navigation**  
Operation → Density → MidDensTimestamp

**Description**  
Shows the timestamp of the last measured middle density.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### Measured lower density

**Navigation**  
Operation → Density → Meas lower dens.

**Description**  
Density of the lower phase.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
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<tbody>
<tr>
<td>Read access</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### Lower density timestamp

**Navigation**  
Operation → Density → LowerDensTimestamp

**Description**  
Shows timestamp of last measured lower density.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
Profile point

**Navigation**

Proceeds to the Density page and then to the Profile point.

**Description**

Shows the actual number of Density Points measured so far in the current operation, and the total number of Points after the Density Profile Operation is complete.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
<th>Access level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
<td>Read access</td>
</tr>
</tbody>
</table>

Profile average density

**Navigation**

Proceeds to the Density page and then to the Profile avg dens.

**Description**

Shows the average density calculated after a profile density measurement is complete.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
<th>Access level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
<td>Read access</td>
</tr>
</tbody>
</table>

Profile density timestamp

**Navigation**

Proceeds to the Density page and then to the Profil dens time.

**Description**

Shows the timestamp when the last average density profile was finished.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
<th>Access level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
<td>Read access</td>
</tr>
</tbody>
</table>
"Profile density" submenu

Navigation  
Operation → Density → Profile density

Profile density 0 to 49

Navigation  
Operation → Density → Profile density → Profile dens 0 to 49

Description  
Shows the density measurement at the corresponding profile density position.

Additional information

<table>
<thead>
<tr>
<th>Access</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Profile density position 0 to 49

Navigation  
Operation → Density → Profile density → Profile pos 0 to 49

Description  
Shows the position where the corresponding density was measured.

Additional information

<table>
<thead>
<tr>
<th>Access</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

15.2.4  "Pressure" submenu

Navigation  
Operation → Pressure

P1 (bottom)

Navigation  
Operation → Pressure → P1 (bottom)

Description  
Shows the pressure at the tank bottom.

Additional information

<table>
<thead>
<tr>
<th>Access</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
P3 (top)

**Navigation**

Operation → Pressure → P3 (top)

**Description**

Shows the pressure (P3) at the top transmitter.

**Additional information**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
15.2.5  "GP values" submenu

Navigation  
Operation → GP values

GP 1 to 4 name

Navigation  
Operation → GP values → GP 1 name
Description  
Defines the label associated with the respective GP value.
User entry  
Character string comprising numbers, letters and special characters (15)
Factory setting  
GP Value 1
Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

GP Value 1

Navigation  
Operation → GP values → GP Value 1
Description  
Displays the value that will be used as general purpose value.
Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

GP Value 2

Navigation  
Operation → GP values → GP Value 2
Description  
Displays the value that will be used as general purpose value.
Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

GP Value 3

Navigation  
Operation → GP values → GP Value 3
Description  
Displays the value that will be used as general purpose value.
Operating menu

Proservo NMS81

Additional information

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Operator</td>
<td>Operator</td>
</tr>
</tbody>
</table>

GP Value 4

Navigation

Operation → GP values → GP Value 4

Description

Displays the value that will be used as general purpose value.

Additional information

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Operator</td>
<td>Operator</td>
</tr>
</tbody>
</table>
15.3 "Setup" menu

Device tag

**Navigation**

Setup → Device tag

**Description**

Enter a unique name for the measuring point to identify the device quickly within the plant.

**User entry**

Character string comprising numbers, letters and special characters (32)

**Factory setting**

NMS8x

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Units preset

**Navigation**

Setup → Units preset

**Description**

Defines a set of units for length, pressure and temperature.

**Selection**

- mm, bar, °C
- m, bar, °C
- mm, PSI, °C
- ft, PSI, °F
- ft-in-16, PSI, °F
- ft-in-8, PSI, °F
- Customer value

**Factory setting**

mm, bar, °C

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

If the **Customer value** option is selected, the units are defined in the following parameters. In any other case these are read-only parameters used to indicate the respective unit:

- Distance unit (→ 320)
- Pressure unit (→ 321)
- Temperature unit (→ 321)
Operating menu

Proservo NMS81

Upper density

Navigation  
Setup → Upper density

Description  
Sets the density of the upper phase of the liquid.

User entry  
50 to 2,000 kg/m³

Factory setting  
800 kg/m³

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Middle density

Navigation  
Setup → Middle density

Description  
Sets Density of Middle Phase in the Tank if three Phases are available. Otherwise used for the Lower Phase in the Tank if two Phases are available.

User entry  
50 to 2,000 kg/m³

Factory setting  
1,000 kg/m³

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Lower density

Navigation  
Setup → Lower density

Description  
Sets the density of the lower Phase in the tank if three phases are available.

User entry  
50 to 2,000 kg/m³

Factory setting  
1,200 kg/m³

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
Gauge command

Description
Gauge operation command to choose the measurement mode of the device.

Selection
- Stop *
- Level
- Up *
- Bottom level *
- Upper I/F level *
- Lower I/F level *
- Upper density *
- Middle density *
- Lower density *
- Repeatability *
- Water dip *
- Release overtension *
- Tank profile *
- Interface profile *
- Manual profile *
- Level standby *
- Offset standby *

Factory setting
Stop

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Process condition

Description
Select the liquid condition of the tank.

Selection
- Universal
- Calm surface
- Turbulent surface

Factory setting
Universal

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

* Visibility depends on order options or device settings

For W&M, setting to option **Calm surface** is recommended.
### Empty

**Navigation**

Setup → Empty

**Description**
Distance from reference point to zero position (tank bottom or datum plate).

**User entry**
0 to 10 000 000 mm

**Factory setting**
Dependent on the device version

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

- The reference point is the reference line of the calibration window.

### Tank reference height

**Navigation**

Setup → Tank ref height

**Description**
Defines the distance from the dipping reference point to the zero position (tank bottom or datum plate).

**User entry**
0 to 10 000 000 mm

**Factory setting**
Dependent on the device version

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Tank level

**Navigation**

Setup → Tank level

**Description**
Shows the distance from the zero position (tank bottom or datum plate) to the product surface.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
Set level

**Navigation**
Setup → Set level

**Description**
If the level measured by the device does not match the actual level obtained by a manual dip, enter the correct level into this parameter.

**User entry**
0 to 10 000 000 mm

**Factory setting**
0 mm

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

The device adjusts the **Empty** parameter (→ 194) according to the entered value, such that the measured level will match the actual level.

Level source

**Navigation**
Setup → Level source

**Description**
Defines the source of the level value.

**Selection**
- No input value
- HART device 1 ... 15 level
- Level SR*
- Level *
- Displacer position *
- AIO B1-3 value *
- AIO C1-3 value *
- AIP B4-8 value *
- AIP C4-8 value *

**Factory setting**
Dependent on the device version

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

High stop level

**Navigation**
Setup → High stop level

**Description**
Position of the displacer high stop as measured from defined zero position (tank bottom or datum plate).

* Visibility depends on order options or device settings
Operating menu

Proservo NMS81

User entry
-999 999.9 to 999 999.9 mm

Factory setting
20 000 mm

Additional information

Read access | Operator
Write access | Maintenance

Low stop level

Navigation
Setup → Low stop level

Description
Position of the displacer low stop as measured from defined zero position (tank bottom or datum plate).

User entry
-999 999.9 to 999 999.9 mm

Factory setting
0 mm

Additional information

Read access | Operator
Write access | Maintenance

Distance

Navigation
Setup → Distance

Description
Shows measured distance from reference position.

Additional information

Read access | Operator
Write access | -

Liquid temp source

Navigation
Setup → Liq temp source

Description
Defines source from which the liquid temperature is obtained.

Selection
- Manual value
- HART device 1 ... 15 temperature
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

Factory setting
Manual value
### Additional information

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
15.3.1 "Calibration" submenu

<table>
<thead>
<tr>
<th>Read access</th>
<th>Maintenance</th>
</tr>
</thead>
</table>

*Navigation*  
Setup → Calibration

"Move displacer" wizard

| Navigation | Setup → Calibration → Move displacer

Move distance

| Navigation | Setup → Calibration → Move displacer → Move distance
| Description | Up or down movement of displacer in mm.
| User entry | 0 to 999999.9 mm
| Factory setting | 0 mm
| Additional information | Read access: Operator  
Write access: Maintenance

Distance

| Navigation | Setup → Calibration → Move displacer → Distance
| Description | Shows measured distance from reference position.
| Additional information | Read access: Operator  
Write access: -

Move displacer

| Navigation | Setup → Calibration → Move displacer → Move displacer
| Selection | Stop  
Move down  
Move up
| Factory setting | Stop
Proservo NMS81

Operating menu

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Motor status

Navigation

Setup → Calibration → Move displacer → Motor status

Description

Shows the current moving Direction of the Motor.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Move displacer

Navigation

Setup → Calibration → Move displacer → Move displacer

Selection

- No
- Yes

Factory setting

No

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
"Sensor calibration" wizard


Sensor calibration

Description
This sequence calibrates the sensor of the servo.

Additional information
Read access  Operator
Write access  Maintenance

Offset weight


Description
Sets the weight that is used for the lower point sensor calibration. Changing the value will delete the calibration data.

User entry
0 to 150 g

Factory setting
Dependent on the device version

Additional information
Read access  Operator
Write access  Maintenance

For density measurement application, it is recommended to apply 50 g.

Span weight


Description
Sets the weight that is used for the middle point sensor calibration. Changing the value will delete the calibration data.

User entry
10 to 999.9 g

Factory setting
Dependent on the device version

Additional information
Read access  Operator
Write access  Maintenance
Zero calibration

**Navigation**

Setup → Calibration → Sensor cal. → Zero calibration

**Description**

In this step the sensor calibration zero weight will be done.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Calibration status

**Navigation**

Setup → Calibration → Sensor cal. → Status

**Description**

Gives feedback on the latest status of the calibration process.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Offset calibration

**Navigation**


**Description**

In this step the sensor calibration with offset weight will be done.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Span calibration

**Navigation**

Setup → Calibration → Sensor cal. → Span calibration

**Description**

In this step the sensor calibration with span weight will be done.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
"Reference calibration" wizard

Navigation  Setup → Calibration → Reference cal.

Reference calibration


Description  This sequence will move the displacer to the mechanical stop and set the reference position.

Additional information

| Read access | Operator |
| Write access | Maintenance |

Reference position

Navigation  Setup → Calibration → Reference cal. → Ref. position

Description  Defines in mm, during reference calibration, the distance between mechanical stop inside the drum housing and the middle of the wire ring.

User entry  0 to 9999.9 mm

Factory setting  Dependent on the device version

Additional information

| Read access | Operator |
| Write access | Maintenance |

Progress

Navigation  Setup → Calibration → Reference cal. → Progress

Description  Gives feedback on the latest status of the reference calibration process.

Additional information

| Read access | Operator |
| Write access | Maintenance |
Calibration status

Navigation  
Setup → Calibration → Reference cal. → Status

Description  
Gives feedback on the latest status of the calibration process.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
"Drum calibration" wizard

Navigation       Setup → Calibration → Drum cal.

Drum calibration

Description
This sequence will perform a drum calibration.

Additional information
| Read access | Operator |
| Write access | Maintenance |

Set high weight

Navigation       Setup → Calibration → Drum cal. → Set high weight

Description
High weight that is used for a drum calibration (normally it is the displacer weight).

User entry
10 to 999.9 g

Factory setting
Dependent on the device version

Additional information
| Read access | Operator |
| Write access | Maintenance |

Make drum table

Navigation       Setup → Calibration → Drum cal. → Make drum table

Description
This will perform a drum calibration.

Additional information
| Read access | Operator |
| Write access | Maintenance |

Drum table point

Navigation       Setup → Calibration → Drum cal. → Drum table point

Description
Shows the currently measured point of the drum calibration. Maximum number of measured points is 50.
**Calibration status**

**Navigation**  
Set → Calibration → Drum cal. → Status

**Description**  
Gives feedback on the latest status of the calibration process.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Make low table**

**Navigation**  
Set → Calibration → Drum cal. → Make low table

**Description**  
For additional accuracy it is possible to perform a second drum calibration with low weight. Choose 'Yes' or 'No' to start/stop calibration.

**Selection**

- No
- Yes

**Factory setting**

No

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Set low weight**

**Navigation**  
Set → Calibration → Drum cal. → Set low weight

**Description**  
Set weight for additional drum calibration sequence.

**User entry**

10 to 999.9 g

**Factory setting**

Dependent on the device version

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
15.3.2 "Advanced setup" submenu

Navigation  ➔ ➔ Setup → Advanced setup → Locking status

Description  Indicates the type of locking.

"Hardware locked" (HW)
The device is locked by the "WP" switch on the main electronics module. To unlock, set the switch into the OFF position.

"WHG locked" (SW)
Unlock the device by entering the appropriate access code in "Enter access code".

"SIL locked" (SW)
Unlock the device by entering the appropriate access code in "Enter access code".

"Temporarily locked" (SW)
The device is temporarily locked by processes in the device (e.g. data upload/download, reset). The device will automatically be unlocked after completion of these processes.

Additional information

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

User role

Navigation  ➔ Setup → Advanced setup → User role

Description  Shows the access authorization to the parameters via the operating tool

Additional information

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

Enter access code

Navigation  ➔ ➔ Setup → Advanced setup → Ent. access code

Description  Enter access code to disable write protection of parameters.

Additional information

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td></td>
<td>Operator</td>
</tr>
</tbody>
</table>
"Input/output" submenu

Navigation ■ Setup → Advanced setup → Input/output

"HART devices" submenu

Navigation ■ Setup → Advanced setup → Input/output → HART devices

Number of devices

Navigation ■ Setup → Advanced setup → Input/output → HART devices → Number devices

Description

Shows the number of devices on the HART bus.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
"HART Device(s)" submenu

There is a **HART Device(s)** submenu for each HART slave device found on the HART loop.

**Navigation**  
Setup → Advanced setup → Input/output → HART devices → HART Device(s)

<table>
<thead>
<tr>
<th>Device name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Shows the name of the transmitter.</td>
</tr>
<tr>
<td><strong>Additional information</strong></td>
</tr>
<tr>
<td>Read access</td>
</tr>
<tr>
<td>Write access</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polling address</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Navigation</strong></td>
</tr>
<tr>
<td>Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Polling address</td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Shows the polling address of the transmitter.</td>
</tr>
<tr>
<td><strong>Additional information</strong></td>
</tr>
<tr>
<td>Read access</td>
</tr>
<tr>
<td>Write access</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Device tag</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Navigation</strong></td>
</tr>
<tr>
<td>Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Device tag</td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Shows the device tag of the transmitter.</td>
</tr>
<tr>
<td><strong>Additional information</strong></td>
</tr>
<tr>
<td>Read access</td>
</tr>
<tr>
<td>Write access</td>
</tr>
</tbody>
</table>
### Operating mode

**Navigation**

Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Operating mode

**Prerequisite**

Not available if the HART device is a Prothermo NMT.

**Description**

Selection of the operation mode PV only or PV,SV,TV,QV. Determines which values are polled from the connected HART Device.

**Selection**

- PV only
- PV,SV,TV & QV
- Level 5)
- Measured level 5)

**Factory setting**

PV,SV,TV & QV

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Communication status**

**Navigation**

Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Comm. status

**Description**

Shows the operating status of the transmitter.

**User interface**

- Operating normally
- Device offline

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td></td>
</tr>
</tbody>
</table>

**Status signal**

**Navigation**

Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Status signal

**Description**

Indicates the current device status in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107.

**User interface**

- OK
- Failure (F)
- Function check (C)
- Out of specification (S)

5) only visible if the connected device is a Micropilot
### #blank# (HART PV - designation dependent on device)

**Navigation**

- Setup → Advanced setup → Input/output → HART devices → HART Device(s)
  → #blank#

**Description**

Shows the first HART variable (PV).

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### #blank# (HART SV - designation dependent on device)

**Navigation**

- Setup → Advanced setup → Input/output → HART devices → HART Device(s)
  → #blank#

**Prerequisite**

For HART devices other than NMT: Operating mode (→ 209) = PV,SV,TV & QV

**Description**

Shows the second HART variable (SV).

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### #blank# (HART TV - designation dependent on device)

**Navigation**

- Setup → Advanced setup → Input/output → HART devices → HART Device(s)
  → #blank#

**Prerequisite**

For HART devices other than NMT: Operating mode (→ 209) = PV,SV,TV & QV

**Description**

Shows the third HART variable (TV).

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
#blank# (HART QV - designation dependent on device)

**Navigation**

- Setup → Advanced setup → Input/output → HART devices → HART Device(s) → #blank#

**Prerequisite**

For HART devices other than NMT: **Operating mode** (→ 209) = PV,SV,TV & QV

**Description**

Shows the fourth HART variable (QV).

**Output pressure**

**Navigation**

- Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Output pressure

**Prerequisite**

Not available for Micropilot S FMR5xx, Prothermo NMT53x and Prothermo NMT8x. In these cases the measured variables are allocated automatically.

**Description**

Defines which HART variable is the pressure.

**Selection**

- No value
- Primary variable (PV)
- Secondary variable (SV)
- Tertiary variable (TV)
- Quaternary variable (QV)

**Factory setting**

No value

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Output density**

**Navigation**

- Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Output density

**Prerequisite**

Not available for Micropilot S FMR5xx, Prothermo NMT53x and Prothermo NMT8x. In these cases the measured variables are allocated automatically.

**Description**

Defines which HART variable is the density.

**Selection**

- No value
- Primary variable (PV)
- Secondary variable (SV)
- Tertiary variable (TV)
- Quaternary variable (QV)
Factory setting: No value

Additional information:
- Read access: Operator
- Write access: Maintenance

Output temperature

Navigation:
Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Output temp.

Prerequisite:
Not available for Micropilot S FMR5xx, Prothermo NMT53x and Prothermo NMT8x. In these cases the measured variables are allocated automatically.

Description:
Defines which HART variable is the temperature.

Selection:
- No value
- Primary variable (PV)
- Secondary variable (SV)
- Tertiary variable (TV)
- Quaternary variable (QV)

Factory setting: No value

Additional information:
- Read access: Operator
- Write access: Maintenance

Output vapor temperature

Navigation:
Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Output vapor tmp

Prerequisite:
Not available for Micropilot S FMR5xx, Prothermo NMT53x and Prothermo NMT8x. In these cases the measured variables are allocated automatically.

Description:
Defines which HART variable is the vapor temperature.

Selection:
- No value
- Primary variable (PV)
- Secondary variable (SV)
- Tertiary variable (TV)
- Quaternary variable (QV)

Factory setting: No value

Additional information:
- Read access: Operator
- Write access: Maintenance
### Output level

#### Navigation

Setup → Advanced setup → Input/output → HART devices → HART Device(s) → Output level

#### Prerequisite

Not available for Micropilot S FMR5xx, Prothermo NMT53x and Prothermo NMT8x. In these cases the measured variables are allocated automatically.

#### Description

Defines which HART variable is the level.

#### Selection

- No value
- Primary variable (PV)
- Secondary variable (SV)
- Tertiary variable (TV)
- Quaternary variable (QV)

#### Factory setting

No value

#### Additional information

<table>
<thead>
<tr>
<th>Access</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
"Forget device" wizard

| Read access | Maintenance |

This submenu is only visible if **Number of devices** → 207 ≥ 1.

**Navigation**

Setup → Advanced setup → Input/output → HART devices → Forget device

**Description**

With this function an offline device can be deleted from the device list.

**Selection**

- HART Device 1 *
- HART Device 2 *
- HART Device 3 *
- HART Device 4 *
- HART Device 5 *
- HART Device 6 *
- HART Device 7 *
- HART Device 8 *
- HART Device 9 *
- HART Device 10 *
- HART Device 11 *
- HART Device 12 *
- HART Device 13 *
- HART Device 14 *
- HART Device 15 *
- None

**Factory setting**

None

**Additional information**

| Read access | Operator |
| Write access | Maintenance |

* Visibility depends on order options or device settings
"Analog IP" submenu

There is a **Analog IP** submenu for each Analog I/O module of the device. This submenu refers to terminals 4 to 8 of this module (the analog input). They are primarily used to connect an RTD. For terminals 1 to 3 (analog input or output) refer to → 221.

![Diagram of Analog IP connections](image)

**Navigation**

Setup → Advanced setup → Input/output → Analog IP

**Operating mode**

**Navigation**

Setup → Advanced setup → Input/output → Analog IP → Operating mode

**Description**

Defines the operating mode of the analog input.

**Selection**

- Disabled
- RTD temperature input
- Gauge power supply

**Factory setting**

Disabled

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**RTD type**

**Navigation**

Setup → Advanced setup → Input/output → Analog IP → RTD type

**Prerequisite**

Operating mode (→ 215) = RTD temperature input

**Description**

Defines the type of the connected RTD.
Selection
- Cu50 (w=1.428, GOST)
- Cu53 (w=1.426, GOST)
- Cu90; 0°C (w=1.4274, GOST)
- Cu100; 25°C (w=1.4274, GOST)
- Cu100; 0°C (w=1.4274, GOST)
- Pt46 (w=1.391, GOST)
- Pt50 (w=1.391, GOST)
- Pt100(385) (a=0.00385, IEC751)
- Pt100(389) (a=0.00389, Canadian)
- Pt100(391) (a=0.003916, JIS1604)
- Pt100 (w=1.391, GOST)
- Pt500(385) (a=0.00385, IEC751)
- Pt1000(385) (a=0.00385, IEC751)
- Ni100(617) (a=0.00617, DIN43760)
- Ni120(672) (a=0.00672, DIN43760)
- Ni1000(617) (a=0.00617, DIN43760)

Factory setting
Pt100(385) (a=0.00385, IEC751)

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Thermocouple type**

**Navigation**
Setup → Advanced setup → Input/output → Analog IP → Thermocouple typ

**Description**
Defines the type of the connected thermocouple.

**Selection**
- N type
- B type
- C type
- D type
- J type
- K type
- L type
- L GOST type
- R type
- S type
- T type
- U type

**Factory setting**
N type

**RTD connection type**

**Navigation**
Setup → Advanced setup → Input/output → Analog IP → RTD connect type

**Prerequisite**
Operating mode (→ 215) = RTD temperature input

**Description**
Defines the connection type of the RTD.
Proservo NMS81

Operating menu

Selection
- 4 wire RTD connection
- 2 wire RTD connection
- 3 wire RTD connection

Factory setting
4 wire RTD connection

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Process value

Navigation
Setup → Advanced setup → Input/output → Analog IP → Process value

Prerequisite
Operating mode (→ 215) ≠ Disabled

Description
Shows the measured value received via the analog input.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Process variable

Navigation
Setup → Advanced setup → Input/output → Analog IP → Process variable

Prerequisite
Operating mode (→ 215) ≠ RTD temperature input

Description
Determines type of measured value.

Selection
- Level linearized
- Temperature
- Pressure
- Density

Factory setting
Level linearized

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

0 % value

Navigation
Setup → Advanced setup → Input/output → Analog IP → 0 % value

Prerequisite
Operating mode (→ 215) = 4..20mA input
Operating menu

Proservo NMS81

Description
Defines the value represented by a current of 4mA.

User entry
Signed floating-point number

Factory setting
0 mm

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

100 % value

Navigation
Setup → Advanced setup → Input/output → Analog IP → 100 % value

Prerequisite
Operating mode (→ 215) = 4..20mA input

Description
Defines the value represented by a current of 20mA.

User entry
Signed floating-point number

Factory setting
0 mm

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Input value

Navigation
Setup → Advanced setup → Input/output → Analog IP → Input value

Prerequisite
Operating mode (→ 215) ≠ Disabled

Description
Shows the value received via the analog input.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Minimum probe temperature

Navigation
Setup → Advanced setup → Input/output → Analog IP → Min. probe temp

Prerequisite
Operating mode (→ 215) = RTD temperature input

Description
Minimum approved temperature of the connected probe. If the temperature falls below this value, the W&M status will be 'invalid'.

Endress+Hauser
**User entry**

-213 to 927 °C

**Factory setting**

-100 °C

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Maximum probe temperature**

**Navigation**

Setup → Advanced setup → Input/output → Analog IP → Max. probe temp

**Prerequisite**

Operating mode (→  215) = RTD temperature input

**Description**

Maximum approved temperature of the connected probe. If the temperature rises above this value, the W&M status will be "invalid".

**User entry**

-213 to 927 °C

**Factory setting**

250 °C

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Probe position**

**Navigation**

Setup → Advanced setup → Input/output → Analog IP → Probe position

**Prerequisite**

Operating mode (→  215) = RTD temperature input

**Description**

Position of the temperature probe, measured from zero position (tank bottom or datum plate). This parameter, in conjunction with the measured level, determines whether the temperature probe is still covered by the product. If this is no longer the case, the status of the temperature value will be "invalid".

**User entry**

-5 000 to 30 000 mm

**Factory setting**

5 000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
## Damping factor

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Input/output → Analog IP → Damping factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite</td>
<td>Operating mode (→ 215) ≠ Disabled</td>
</tr>
<tr>
<td>Description</td>
<td>Defines the damping constant (in seconds).</td>
</tr>
<tr>
<td>User entry</td>
<td>0 to 999.9 s</td>
</tr>
<tr>
<td>Factory setting</td>
<td>0 s</td>
</tr>
<tr>
<td>Additional information</td>
<td>Read access</td>
</tr>
<tr>
<td></td>
<td>Write access</td>
</tr>
</tbody>
</table>

## Gauge current

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Input/output → Analog IP → Gauge current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite</td>
<td>Operating mode (→ 215) = Gauge power supply</td>
</tr>
<tr>
<td>Description</td>
<td>Shows the current on the power supply line for the connected device.</td>
</tr>
<tr>
<td>Additional information</td>
<td>Read access</td>
</tr>
<tr>
<td></td>
<td>Write access</td>
</tr>
</tbody>
</table>
"Analog I/O" submenu

There is a **Analog I/O** submenu for each Analog I/O module of the device. This submenu refers to terminals 1 to 3 of this module (an analog input or output). For terminals 4 to 8 (always an analog input) refer to → § 215.

![Analog I/O diagram]

**Navigation**  
Setup → Advanced setup → Input/output → Analog I/O → Operating mode

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>Direction of signal</th>
<th>Type of signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabled</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4..20mA input</td>
<td>Input from 1 external device</td>
<td>Analog (4...20mA)</td>
</tr>
<tr>
<td>HART master+4..20mA input</td>
<td>Input from 1 external device</td>
<td>HART</td>
</tr>
<tr>
<td>4..20mA output</td>
<td>Input from 6 external devices</td>
<td>-</td>
</tr>
<tr>
<td>HART slave +4..20mA output</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Meaning of the options**

- **Operating mode (**→ § 221**)**
- **Direction of signal**
- **Type of signal**

- Disabled
- 4..20mA input
- HART master+4..20mA input
- HART master
- 4..20mA output
- HART slave +4..20mA output
Operating menu

### Operating mode

<table>
<thead>
<tr>
<th>Operating mode (→ 221)</th>
<th>Direction of signal</th>
<th>Type of signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>4...20mA output</td>
<td>Output to higher-level unit</td>
<td>Analog (4...20mA)</td>
</tr>
<tr>
<td>HART slave +4...20mA output</td>
<td>Output to higher-level unit</td>
<td>Analog (4...20mA), HART</td>
</tr>
</tbody>
</table>

Depending on the terminals used, the Analog I/O module is used in the passive or active mode.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Terminals of the I/O module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive (power supply from external source)</td>
<td>- + not used</td>
</tr>
<tr>
<td>Active (power supplied by the device itself)</td>
<td>not used - +</td>
</tr>
</tbody>
</table>

In the active mode the following conditions must be met:
- Maximum current consumption of the connected HART devices: 24 mA (i.e. 4 mA per device if 6 devices are connected).
- Output voltage of the Ex-d module: 17.0 V@4 mA to 10.5 V@22 mA
- Output voltage of the Ex-ia module: 18.5 V@4 mA to 12.5 V@22 mA

### Current span

**Navigation**

[Setup] → Advanced setup → Input/output → Analog I/O → Current span

**Prerequisite**

Operating mode parameter (→ 221) ≠ Disabled option or HART master option

**Description**

Defines the current range for the measured value transmission.

**Selection**

- 4...20 mA NE (3.8...20.5 mA)
- 4...20 mA US (3.9...20.8 mA)
- 4...20 mA (4...20.5 mA)
- Fixed value *

**Factory setting**

4...20 mA NE (3.8...20.5 mA)

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Meaning of the options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Current range for process variable</th>
<th>Minimum value</th>
<th>Lower alarm signal level</th>
<th>Upper alarm signal level</th>
<th>Maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4...20 mA (4...20.5 mA)</td>
<td>4 to 20.5 mA</td>
<td>3.5 mA</td>
<td>&lt; 3.6 mA</td>
<td>&gt; 21.95 mA</td>
<td>22.6 mA</td>
</tr>
<tr>
<td>4...20 mA NE (3.8...20.5 mA)</td>
<td>3.8 to 20.5 mA</td>
<td>3.5 mA</td>
<td>&lt; 3.6 mA</td>
<td>&gt; 21.95 mA</td>
<td>22.6 mA</td>
</tr>
</tbody>
</table>

* Visibility depends on order options or device settings
### Fixed current

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → Fixed current

**Prerequisite**

Current span (→ 222) = Fixed current

**Description**

Defines the fixed output current.

**User entry**

4 to 22.5 mA

**Factory setting**

4 mA

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Analog input source

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → Analog source

**Prerequisite**

- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output
- Current span (→ 222) = Fixed current

**Description**

Defines the process variable transmitted via the AIO.

**Selection**

- None
- Tank level
- Tank level %
- Tank ullage
- Tank ullage %
- Measured level
- Distance
- Displacer position
- Water level
- Upper interface level
- Lower interface level
- Bottom level
- Tank reference height
- Liquid temperature
- Vapor temperature

---

<table>
<thead>
<tr>
<th>Option</th>
<th>Current range for process variable</th>
<th>Minimum value</th>
<th>Lower alarm signal level</th>
<th>Upper alarm signal level</th>
<th>Maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4...20 mA US (3.9...20.8 mA)</td>
<td>3.9 to 20.8 mA</td>
<td>3.5 mA</td>
<td>&lt; 3.6 mA</td>
<td>&gt; 21.95 mA</td>
<td>22.0 mA</td>
</tr>
</tbody>
</table>

- In the case of an error, the output current assumes the value defined in the **Failure mode** parameter (→ 224).
- Air temperature
- Observed density value
- Average profile density
- Upper density
- Middle density
- Lower density
- P1 (bottom)
- P2 (middle)
- P3 (top)
- GP 1 ... 4 value
- AIO B1-3 value
- AIO B1-3 value mA
- AIO C1-3 value
- AIO C1-3 value mA
- AIP B4-8 value
- AIP C4-8 value
- Element temperature 1 ... 24
- HART device 1 ... 15 PV
- HART device 1 ... 15 PV mA
- HART device 1 ... 15 PV %
- HART device 1 ... 15 SV
- HART device 1 ... 15 TV
- HART device 1 ... 15 QV

**Factory setting**
- Tank level

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Failure mode**

**Navigation**
- Setup → Advanced setup → Input/output → Analog I/O → Failure mode

**Prerequisite**
- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output

**Description**
- Defines the output behavior in case of an error.

**Selection**
- Min.
- Max.
- Last valid value
- Actual value
- Defined value

**Factory setting**
- Max.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

6) Visibility depends on order options or device settings
Error value

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → Error value

**Prerequisite**

Failure mode (→ 224) = Defined value

**Description**

Defines the output value in case of an error.

**User entry**

3.4 to 22.6 mA

**Factory setting**

22 mA

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Input value

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → Input value

**Prerequisite**

- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output
- Current span (→ 222) ≠ Fixed current

**Description**

Shows the input value of the analog I/O module.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

0 % value

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → 0 % value

**Prerequisite**

- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output
- Current span (→ 222) ≠ Fixed current

**Description**

Value corresponding to an output current of 0% (4mA).

**User entry**

Signed floating-point number

**Factory setting**

0 Unitless

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
### 100 % value

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → 100 % value

**Prerequisite**

- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output
- Current span (→ 222) ≠ Fixed current

**Description**

Value corresponding to an output current of 100% (20mA).

**User entry**

Signed floating-point number

**Factory setting**

0 Unitless

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
<td></td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
<td></td>
</tr>
</tbody>
</table>

### Input value %

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → Input value %

**Prerequisite**

- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output
- Current span (→ 222) ≠ Fixed current

**Description**

Shows the output value as a percentage of the complete 4...20mA range.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
<td></td>
</tr>
<tr>
<td>Write access</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

### Output value

**Navigation**

Setup → Advanced setup → Input/output → Analog I/O → Output value

**Prerequisite**

Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output

**Description**

Shows the output value in mA.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
<td></td>
</tr>
<tr>
<td>Write access</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
Process variable

Navigation
Setup → Advanced setup → Input/output → Analog I/O → Process variable

Prerequisite
Operating mode (→ 221) = 4..20mA input or HART master+4..20mA input

Description
Defines the type of measuring variable.

Selection
- Level linearized
- Temperature
- Pressure
- Density

Factory setting
Level linearized

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Analog input 0% value

Navigation
Setup → Advanced setup → Input/output → Analog I/O → AI 0% value

Prerequisite
Operating mode (→ 221) = 4..20mA input or HART master+4..20mA input

Description
Value corresponding to an input current of 0% (4mA).

User entry
Signed floating-point number

Factory setting
0 mm

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Analog input 100% value

Navigation
Setup → Advanced setup → Input/output → Analog I/O → AI 100% value

Prerequisite
Operating mode (→ 221) = 4..20mA input or HART master+4..20mA input

Description
Value corresponding to an input current of 100% (20mA).

User entry
Signed floating-point number

Factory setting
0 mm
### Error event type

**Navigation**
Setup → Advanced setup → Input/output → Analog I/O → Error event type

**Prerequisite**
Operating mode (→ 221) ≠ Disabled or HART master

**Description**
Defines the type of event message (alarm/warning) in case of an error or output out of range in the analog I/O module.

**Selection**
- None
- Warning
- Alarm

**Factory setting**
Warning

**Additional information**
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Process value

**Navigation**
Setup → Advanced setup → Input/output → Analog I/O → Process value

**Prerequisite**
Operating mode (→ 221) = 4..20mA input or HART master+4..20mA input

**Description**
Shows the input value scaled to customer units.

**Additional information**
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### Input value in mA

**Navigation**
Setup → Advanced setup → Input/output → Analog I/O → Input val. in mA

**Prerequisite**
Operating mode (→ 221) = 4..20mA input or HART master+4..20mA input

**Description**
Shows the input value in mA.

**Additional information**
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
## Input value percent

**Navigation**  
Setup → Advanced setup → Input/output → Analog I/O → Input value [%]

**Prerequisite**  
Operating mode (→ 221) = 4..20mA input or HART master+4..20mA input

**Description**  
Shows the input value as a percentage of the complete 4...20mA current range.

### Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

## Damping factor

**Navigation**  
Setup → Advanced setup → Input/output → Analog I/O → Damping factor

**Prerequisite**  
Operating mode (→ 221) ≠ Disabled or HART master

**Description**  
Defines the damping constant (in seconds).

**User entry**  
0 to 999.9 s

**Factory setting**  
0 s

### Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

## Used for SIL/WHG

**Navigation**  
Setup → Advanced setup → Input/output → Analog I/O → Used for SIL/WHG

**Prerequisite**  
- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output  
- The device has a SIL approval.

**Description**  
Determines whether the discrete I/O module is in SIL/WHG mode.

**Selection**  
- Enabled  
- Disabled

**Factory setting**  
Disabled

### Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
Expected SIL/WHG chain

**Navigation**  
 SetUp → Advanced setup → Input/output → Analog I/O → SIL/WHG chain

**Prerequisite**  
- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output  
- The device has a SIL approval.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
"Digital Xx-x" submenu

- In the operating menu, each digital input or output is designated by the respective slot of the terminal compartment and two terminals within this slot. A1-2, for example, denotes terminals 1 and 2 of slot A. The same is valid for slots B, C and D if they contain a Digital IO module.
- In this document, Xx-x designates any of these submenus. The structure of all these submenus is the same.

![Diagram]

**Navigation**
- Setup → Advanced setup → Input/output → Digital Xx-x

**Operating mode**

**Navigation**
- Setup → Advanced setup → Input/output → Digital Xx-x → Operating mode

**Description**
Defines the operating mode of the discrete I/O module.

**Selection**
- Disabled
- Output passive
- Input passive
- Input active

**Factory setting**
Disabled
### Operating menu

#### Additional information

- **A** Input passive
- **B** Input active
- **C** Output passive

#### Digital input source

**Navigation**

- Setup → Advanced setup → Input/output → Digital Xx-x → Digital source

**Prerequisite**

Operating mode (→ 231) = Output passive

**Description**

Defines which device state is indicated by the digital output.

**Selection**

- None
- Balance flag
- Alarm x any
- Alarm x High
- Alarm x HighHigh
- Alarm x High or HighHigh
- Alarm x Low
- Alarm x LowLow
- Alarm x Low or LowLow
- Digital Xx-x
- Primary Modbus x
- Secondary Modbus x

**Factory setting**

None
Additional information

Meaning of the options
- Alarm x any, Alarm x High, Alarm x HighHigh, Alarm x High or HighHigh, Alarm x Low, Alarm x LowLow, Alarm x Low or LowLow
  The digital output indicates if the selected alarm is currently active. The alarms themselves are defined in the Alarm 1 to 4 submenus.
- Digital Xx-x
  The digital signal present at the digital input Xx-x is passed through to the digital output.
- Modbus A1-4 Discrete x
  Modbus B1-4 Discrete x
  Modbus C1-4 Discrete x
  Modbus D1-4 Discrete x
  The digital value written by the Modbus Master device to the Modbus discrete x parameter is passed to the digital output. For details refer to Special Documentation SD02066G.

---

Input value

Navigation

Setup → Advanced setup → Input/output → Digital Xx-x → Input value

Prerequisite

Operating mode (→ 231) = "Input passive" option or "Input active" option

Description

Shows the digital input value.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Contact type

Navigation

Setup → Advanced setup → Input/output → Digital Xx-x → Contact type

Prerequisite

Operating mode (→ 231) = Disabled

Description

Determines the switching behavior of the input or output.

Selection

- Normally open
- Normally closed

Factory setting

Normally open

---

7) Only present if "Operating mode (→ 231)" = "Input passive" or "Input active" for the respective Digital I/O module.
8) Expert → Communication → Modbus Xx-x → Modbus discrete x
### Output simulation

**Navigation**

Setup → Advanced setup → Input/output → Digital Xx-x → Output sim

**Prerequisite**

Operating mode (→ 231) = Output passive

**Description**

Sets the output to a specific simulated value.

**Selection**

- Disable
- Simulating active
- Simulating inactive
- Fault 1
- Fault 2

**Factory setting**

Disable

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

The digital output consists of two relays connected in series:

![Diagram of digital output](image)

92 The two relays of a digital output

1/2 The relays

3/4 The terminals of the digital output

The switching state of these relays is defined by the **Output simulation** parameter as follows:

<table>
<thead>
<tr>
<th>Output simulation</th>
<th>State of relay 1</th>
<th>State of relay 2</th>
<th>Expected result on the terminals of the I/O module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulating active</td>
<td>Closed</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Simulating inactive</td>
<td>Open</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Fault 1</td>
<td>Closed</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Fault 2</td>
<td>Open</td>
<td>Closed</td>
<td>Open</td>
</tr>
</tbody>
</table>

The **Fault 1** and **Fault 2** options can be used to check the correct switching behavior of the two relays.
Output value

**Navigation**
Setup → Advanced setup → Input/output → Digital Xx-x → Output values

**Prerequisite**
Operating mode (→ 231) = Output passive

**Description**
Shows the digital output value.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Readback value

**Navigation**
Setup → Advanced setup → Input/output → Digital Xx-x → Readback value

**Prerequisite**
Operating mode (→ 231) = Output passive

**Description**
Shows the value read back from the output.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Used for SIL/WHG

**Navigation**
Setup → Advanced setup → Input/output → Digital Xx-x → Used for SIL/WHG

**Prerequisite**
• Operating mode (→ 231) = Output passive
  • The device has a SIL certificate.

**Description**
Determines whether the discrete I/O module is in SIL/WHG mode.

**Selection**
• Enabled
  • Disabled

**Factory setting**
Disabled

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
Expected SIL/WHG chain

Navigation

Setup → Advanced setup → Input/output → Digital C3-4 → SIL/WHG chain

Prerequisite

Operating mode (→  231) = Output passive

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
### Digital input mapping submenu

**Navigation**

 SETUP → Advanced setup → Input/output → DI mapping

---

#### Digital input source 1

**Navigation**

 SETUP → Advanced setup → Input/output → DI mapping → Digital source 1

**Description**

Selects the source of digital input #1 (for gauge command).

**Selection**

- None
- Digital A1-2
- Digital A3-4
- Digital B1-2
- Digital B3-4
- Digital C1-2
- Digital C3-4
- Digital D1-2
- Digital D3-4

**Factory setting**

None

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

---

#### Digital input source 2

**Navigation**

 SETUP → Advanced setup → Input/output → DI mapping → Digital source 2

**Description**

Selects the source of digital input #2 (for gauge command).

**Selection**

- None
- Digital A1-2
- Digital A3-4
- Digital B1-2
- Digital B3-4
- Digital C1-2
- Digital C3-4
- Digital D1-2
- Digital D3-4

**Factory setting**

None

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

* Visibility depends on order options or device settings
Gauge command 0

Navigation

Setup → Advanced setup → Input/output → DI mapping → Gauge command 0

Prerequisite

Digital input source 1 (→ 237) ≠ None

Description

Gauge command assigned to digital input combination 0 (DI2=0, DI1=0).

Selection

- Stop *
- Level
- Up *
- Bottom level *
- Upper I/F level *
- Lower I/F level *
- Upper density *
- Middle density *
- Lower density *
- Repeatability *
- Water dip
- Release overtension *
- Tank profile *
- Interface profile *
- Manual profile *
- Level standby *
- Offset standby *

Factory setting

Level

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Gauge command 1

Navigation

Setup → Advanced setup → Input/output → DI mapping → Gauge command 1

Prerequisite

Digital input source 1 (→ 237) ≠ None

Description

Gauge command assigned to digital input combination 1 (DI2=0, DI1=1).

Selection

- Stop *
- Level
- Up *
- Bottom level *
- Upper I/F level *
- Lower I/F level *
- Upper density *
- Middle density *
- Lower density *
- Repeatability *
- Water dip *

* Visibility depends on order options or device settings
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Operating menu

- Release overtension *
- Tank profile *
- Interface profile *
- Manual profile *
- Level standby *
- Offset standby *

Factory setting

Up

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Gauge command 2

Navigation

Setup → Advanced setup → Input/output → DI mapping → Gauge command 2

Prerequisite

- Digital input source 1 (→  237) ≠ None
- Digital input source 2 (→  237) ≠ None

Description

Gauge command assigned to digital Input combination 2 (DI2=1, DI1=0).

Selection

- Stop *
- Level
- Up *
- Bottom level *
- Upper I/F level *
- Lower I/F level *
- Upper density *
- Middle density *
- Lower density *
- Repeatability *
- Water dip
- Release overtension *
- Tank profile
- Interface profile *
- Manual profile *
- Level standby *
- Offset standby *

Factory setting

Stop

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

* Visibility depends on order options or device settings
Operating menu

Gauge command 3

Navigation  ⏩ ⏪ Setup → Advanced setup → Input/output → DI mapping → Gauge command 3

Prerequisite
- Digital input source 1 (→ 237) ≠ None
- Digital input source 2 (→ 237) ≠ None

Description
Gauge command assigned to digital input combination 3 (DI2=1, DI1=1).

Selection
- Stop *
- Level
- Up *
- Bottom level *
- Upper I/F level *
- Lower I/F level *
- Upper density *
- Middle density *
- Lower density *
- Repeatability *
- Water dip
- Release overtension *
- Tank profile *
- Interface profile *
- Manual profile *
- Level standby *
- Offset standby

Factory setting
Upper I/F level

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

* Visibility depends on order options or device settings
"Communication" submenu

This menu contains a submenu for each digital communication interface of the device. The communication interfaces are designated by 'X1-4' where 'X' specifies the slot in the terminal compartment and '1-4' the terminals within this slot.

![Diagram showing communication interfaces]

Designation of the 'Modbus', 'V1' or 'WM550' modules (examples); depending on the device version these modules may also be in slot B or C.

Navigation  Setup → Advanced setup → Communication

'Modbus X1-4', 'V1 X1-4' and 'WM550 X1-4' submenu

This submenu is only present for devices with MODBUS and/or V1 and/or "WM550" option communication interface. There is one submenu of this type for each communication interface.

Navigation  Setup → Advanced setup → Communication → Modbus X1-4

Navigation  Setup → Advanced setup → Communication → V1 X1-4

Navigation  Setup → Advanced setup → Communication → WM550 X1-4

---

**Communication interface protocol**

**Navigation**  Setup → Advanced setup → Communication → Modbus X1-4 / V1 X1-4 / WM550 X1-4 → Commu I/F protoc

**Description**  Shows the type of communication protocol.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
"Configuration" submenu
This submenu is only present for devices with a MODBUS communication interface.

Navigation
Setup → Advanced setup → Communication → Modbus X1-4 → Configuration

### Baudrate

Prerequisite
Communication interface protocol (→ 241) = MODBUS

Description
Defines the baud rate of the communication.

Selection
- 600 BAUD
- 1200 BAUD
- 2400 BAUD
- 4800 BAUD
- 9600 BAUD *
- 19200 BAUD *

Factory setting
9600 BAUD

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Parity

Prerequisite
Communication interface protocol (→ 241) = MODBUS

Description
Defines the parity of the Modbus communication.

Selection
- Odd
- Even
- None / 1 stop bit
- None / 2 stop bits

Factory setting
None / 1 stop bit

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

* Visibility depends on order options or device settings
### Modbus address

**Navigation**
Setup → Advanced setup → Communication → Modbus X1-4 → Configuration → Device ID

**Prerequisite**
Communication interface protocol (→ 241) = MODBUS

**Description**
Defines the Modbus address of the device.

**User entry**
1 to 247

**Factory setting**
1

**Additional information**

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Emission Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Float swap mode

**Navigation**
Setup → Advanced setup → Communication → Modbus X1-4 → Configuration → Float swap mode

**Prerequisite**
Communication interface protocol (→ 241) = MODBUS

**Description**
Sets the format of how the floating point value is transferred on Modbus.

**Selection**
- Normal 3-2-1-0
- Swap 0-1-2-3
- WW Swap 1-0-3-2
- WW Swap 2-3-0-1

**Factory setting**
Swap 0-1-2-3

**Additional information**

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Emission Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Bus termination

**Navigation**
Setup → Advanced setup → Communication → Modbus X1-4 → Configuration → Bus termination

**Prerequisite**
Communication interface protocol (→ 241) = MODBUS

**Description**
Activates or deactivates the bus termination at the device. Should only be activated on the last device in a loop.

**Selection**
- Off
- On
Operating menu

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**Factory setting**

Off

**Additional information**

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Access Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
“Configuration” submenu
This submenu is only present for devices with a V1 communication interface.

Navigation

Setup → Advanced setup → Communication → V1 X1-4 → Configuration

Communication interface protocol variant

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Communication → V1 X1-4 → Configuration → Protocol variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Determines which variant of the V1 protocol is used.</td>
</tr>
</tbody>
</table>
| User interface | None
| | V1 * |
| Factory setting | None |
| Additional information | Read access Operator
Write access Maintenance |

V1 address

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Communication → V1 X1-4 → Configuration → V1 address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite</td>
<td>Communication interface protocol variant (→ 245) = V1</td>
</tr>
<tr>
<td>Description</td>
<td>Identifier of the device for the V1 communication.</td>
</tr>
<tr>
<td>User entry</td>
<td>0 to 99</td>
</tr>
<tr>
<td>Factory setting</td>
<td>1</td>
</tr>
</tbody>
</table>
| Additional information | Read access Operator
Write access Maintenance |

* Visibility depends on order options or device settings
V1 address

Navigation

Setting → Advanced setup → Communication → V1 X1-4 → Configuration → V1 address

Prerequisite

Communication interface protocol variant (→ 245)

Description

Identifier of the previous device for V1 communication.

User entry

0 to 255

Factory setting

1

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Level mapping

Navigation

Setting → Advanced setup → Communication → V1 X1-4 → Configuration → Level mapping

Prerequisite

Communication interface protocol (→ 241) = V1

Description

Determines the transmittable range of levels.

Selection

- +ve
- +ve & -ve

Factory setting

+ve

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

In V1, the level is always represented by a number in the range from 0 to 999999. This number corresponds to a level as follows:

"Level mapping" = "+ve"

<table>
<thead>
<tr>
<th>Number</th>
<th>Corresponding level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0 mm</td>
</tr>
<tr>
<td>999999</td>
<td>999999.9 mm</td>
</tr>
</tbody>
</table>

"Level mapping" = "+ve & -ve"

<table>
<thead>
<tr>
<th>Number</th>
<th>Corresponding level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0 mm</td>
</tr>
<tr>
<td>500000</td>
<td>500000.0 mm</td>
</tr>
</tbody>
</table>
### Line impedance

**Navigation**  
Setup → Advanced setup → Communication → V1 X1-4 → Configuration → Line impedance

**Prerequisite**  
Communication interface protocol (→ 241) = V1

**Description**  
Adjusts the impedance of the communication line.

**User entry**  
0 to 15

**Factory setting**  
15

**Additional information**

<table>
<thead>
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</table>

The line impedance affects the voltage difference between a logical 0 and a logical 1 on the message of the device to the bus. The default setting is suitable for most applications.

### Compatibility mode

**Navigation**  
Setup → Advanced setup → Communication → Modbus Xx-x / V1 Xx-x → Configuration → Comp. mode

**Description**  
Defines the compatibility mode.

**Selection**
- Nxx5xx
- Nxx8x

**Factory setting**  
Nxx8x

**Additional information**

In **NMS5x** mode: Only values which have also existed on NMS5x Gauge status are output on the bus.

In **NMS8x** mode: All Gauge status are available at this parameter.

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</table>
“V1 input selector” submenu
This submenu is only present for devices with a V1 communication interface.

Navigation  Setup → Advanced setup → Communication → V1 X1-4 → V1 input select.

### Alarm 1 input source

**Navigation**  Setup → Advanced setup → Communication → V1 X1-4 → V1 input select. → Alarm1 input src

**Description**  Determines which discrete value will be transmitted as V1 alarm 1 status.

**Selection**

- None
- Alarm 1-4 any
- Alarm 1-4 HighHigh
- Alarm 1-4 High or HighHigh
- Alarm 1-4 High
- Alarm 1-4 Low
- Alarm 1-4 Low or LowLow
- Alarm 1-4 LowLow

**Factory setting**  None

**Additional information**

<table>
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</table>

### Alarm 2 input source

**Navigation**  Setup → Advanced setup → Communication → V1 X1-4 → V1 input select. → Alarm2 input src

**Description**  Determines which discrete value will be transmitted as V1 alarm 2 status.

**Selection**

- None
- Alarm 1-4 any
- Alarm 1-4 HighHigh
- Alarm 1-4 High or HighHigh
- Alarm 1-4 High
- Alarm 1-4 Low
- Alarm 1-4 Low or LowLow
- Alarm 1-4 LowLow

**Factory setting**  None

**Additional information**

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</table>
Value percent selector

**Navigation**
[Setup → Advanced setup → Communication → V1 X1-4 → V1 input select. → Value % select]

**Description**
Selects which value shall be transmitted as a 0..100% value in the V1 Z0/Z1 message.

**Selection**
- None
- Tank level %
- Tank ullage %
- AIO B1-3 value %
- AIO C1-3 value %

**Factory setting**
None

**Additional information**

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</table>

*Configuration' submenu
This submenu is only present for devices with a "WM550" option communication interface.

**Navigation**
[Setup → Advanced setup → Communication → WM550 X1-4 → Configuration → Baudrate]

**Prerequisite**
Communication interface protocol (→ 241) = "WM550" option

**Description**
Defines the baud rate of the WM550 communication.

**Selection**
- 600 BAUD
- 1200 BAUD
- 2400 BAUD
- 4800 BAUD

**Factory setting**
2400 BAUD

**Additional information**

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</table>

* Visibility depends on order options or device settings
WM550 address

**Navigation**

```
Setup → Advanced setup → Communication → WM550 X1-4 → Configuration → WM550 address
```

**Description**

Describes the WM550 address of the device.

**User entry**

0 to 63

**Factory setting**

1

Software ID

**Navigation**

```
Setup → Advanced setup → Communication → WM550 X1-4 → Configuration → Software ID
```

**Prerequisite**

*Communication interface protocol (→ 241) = "WM550" option*

**Description**

Defines content for WM550 Task 32.
Detailed information on content for WM550 Task 32, Special Documentation SD02567G.

**User entry**

0 to 9,999

**Factory setting**

2,000

*"WM550 input selector" submenu*

This submenu is only present for devices with a *"WM550" option* communication interface.

**Navigation**

```
Setup → Advanced setup → Communication → WM550 X1-4 → WM550 inp select
```

Discrete 1 selector

**Navigation**

```
Setup → Advanced setup → Communication → WM550 X1-4 → WM550 inp select → Discrete 1 select
```

**Description**

Determines the input source which is transferred as Alarm bit \[n\] value in the corresponding WM550 tasks.

**Selection**

- None
- **Balance flag** option Visibility depends on order options or device settings
- Alarm 1…4 any
- Alarm 1…4 HighHigh
- Alarm 1...4 High or HighHigh
- Alarm 1...4 High
- Alarm 1...4 Low
- Alarm 1...4 Low or LowLow
- Alarm 1...4 LowLow
- Digital Xx-x

**Factory setting**

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</table>

None
"HART output" submenu

**Navigation**  
Setup → Advanced setup → Communication → HART output

"Configuration" submenu

**Navigation**  
Setup → Advanced setup → Communication → HART output → Configuration

### System polling address

**Navigation**  
Setup → Advanced setup → Communication → HART output → Configuration → Polling address

**Description**  
Device address for HART communication.

**User entry**  
0 to 63

**Factory setting**  
15

**Additional information**

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</table>

### No. of preambles

**Navigation**  
Setup → Advanced setup → Communication → HART output → Configuration → No. of preambles

**Description**  
Defines the number of preambles in the HART telegram.

**User entry**  
5 to 20

**Factory setting**  
5

**Additional information**

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</table>

### PV source

**Navigation**  
Setup → Advanced setup → Communication → HART output → Configuration → PV source

**Description**  
Decides, if the PV configuration is according to an analog output (HART slave) or customized (in case of HART tunneling only).
Assign PV

Selection
- AIO B1-3
- AIO C1-3
- Custom

Factory setting
Custom

Additional information
| Read access | Maintenance |
| Write access | Maintenance |

Navigation
Setup → Advanced setup → Communication → HART output → Configuration → Assign PV

Prerequisite
PV source (→ 252) = Custom

Description
Assign a measured variable to the primary dynamic variable (PV).
Additional information:
The assigned measured variable is also used by the current output.

Selection
- None
- Tank level
- Tank ullage
- Measured level
- Distance
- Displacer position
- Water level
- Upper interface level
- Lower interface level
- Bottom level
- Tank reference height
- Liquid temperature
- Vapor temperature
- Air temperature
- Observed density value
- Average profile density
- Upper density
- Middle density
- Lower density
- P1 (bottom)
- P2 (middle)
- P3 (top)
- GP 1 value
- GP 2 value
- GP 3 value
- GP 4 value

Factory setting
Tank level

* Visibility depends on order options or device settings
Additional information

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</table>

The Measured level option doesn't contain a unit. If a unit is needed, select the Tank level option.

0 % value

Navigation

Setup → Advanced setup → Communication → HART output → Configuration → 0 % value

Prerequisite

PV source = Custom

Description

0% value of the primary variable (PV).

User entry

Signed floating-point number

Factory setting

0 mm

Additional information

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</table>

100 % value

Navigation

Setup → Advanced setup → Communication → HART output → Configuration → 100 % value

Prerequisite

PV source = Custom

Description

100% value of the primary variable (PV).

User entry

Signed floating-point number

Factory setting

0 mm

Additional information

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</table>

PV mA selector

Navigation

Setup → Advanced setup → Communication → HART output → Configuration → PV mA selector

Prerequisite

PV source = Custom
**Assign SV**

**Navigation**

Setup → Advanced setup → Communication → HART output → Configuration → Assign SV

**Description**

Assign a measured variable to the second dynamic variable (SV).

**Selection**

- None
- Tank level
- Tank ullage

*Visibility depends on order options or device settings
- Measured level
- Distance
- Displacer position
- Water level
- Upper interface level
- Lower interface level
- Bottom level
- Tank reference height
- Liquid temperature
- Vapor temperature
- Air temperature
- Observed density value
- Average profile density
- Upper density
- Middle density
- Lower density
- P1 (bottom)
- P2 (middle)
- P3 (top)
- GP 1 value
- GP 2 value
- GP 3 value
- GP 4 value

Factory setting: Liquid temperature

Additional information:

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</tbody>
</table>

The Measured level option doesn't contain a unit. If a unit is needed, select the Tank level option.

Secondary variable (SV)

Navigation: 

- Setup → Advanced setup → Communication → HART output → Configuration → Second.var(SV)

Prerequisite: Assign SV (→ 255) = None

Description: Shows the current measured value of the secondary dynamic variable (SV)

Additional information:

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<td>&quot;</td>
</tr>
</tbody>
</table>
Assign TV

Navigation

Setup → Advanced setup → Communication → HART output → Configuration → Assign TV

Description

Assign a measured variable to the tertiary dynamic variable (TV).

Selection

- None
- Tank level
- Tank ullage
- Measured level
- Distance
- Displacer position
- Water level
- Upper interface level
- Lower interface level
- Bottom level
- Tank reference height
- Liquid temperature
- Vapor temperature
- Air temperature
- Observed density value
- Average profile density
- Upper density
- Middle density
- Lower density
- P1 (bottom)
- P2 (middle)
- P3 (top)
- GP 1 value
- GP 2 value
- GP 3 value
- GP 4 value

Factory setting

Water level

Additional information

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</tbody>
</table>

The Measured level option doesn't contain a unit. If a unit is needed, select the Tank level option.

Tertiary variable (TV)

Navigation

Setup → Advanced setup → Communication → HART output → Configuration → Tertiary var(TV)

Prerequisite

Assign TV (→ 257) ≠ None

Description

Shows the current measured value of the tertiary (third) dynamic variable (TV)
Assign QV

Navigation

Setup → Advanced setup → Communication → HART output → Configuration → Assign QV

Description
Assign a measured variable to the quaternary dynamic variable (QV).

Selection
- None
- Tank level
- Tank ullage
- Measured level
- Distance
- Displacer position
- Water level
- Upper interface level
- Lower interface level
- Bottom level
- Tank reference height
- Liquid temperature
- Vapor temperature
- Air temperature
- Observed density value
- Average profile density
- Upper density
- Middle density
- Lower density
- P1 (bottom)
- P2 (middle)
- P3 (top)
- GP 1 value
- GP 2 value
- GP 3 value
- GP 4 value

Factory setting
Observed density value

Additional information

<table>
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</table>

The Measured level option doesn't contain a unit. If a unit is needed, select the Tank level option.
Quaternary variable (QV)

**Navigation**

Setup → Advanced setup → Communication → HART output → Configuration → Quaterna.var(QV)

**Prerequisite**

Assign QV (→ 258) ≠ None

**Description**

Shows the current measured value of the quaternary (fourth) dynamic variable (QV)

**Additional information**

<p>| | |</p>
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<td>Read access</td>
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</tbody>
</table>

Endress+Hauser
"Information" submenu

**Navigation**
Setup → Advanced setup → Communication → HART output → Information

### HART short tag

**Description**
Defines the short tag for the measuring point.

- Maximum length: 8 characters
- Allowed characters: A-Z, 0-9, certain special characters

**User entry**
Character string comprising numbers, letters and special characters (8)

**Factory setting**
NMS8x

**Additional information**

<table>
<thead>
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</tr>
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</table>

### Device tag

**Description**
Enter a unique name for the measuring point to identify the device quickly within the plant.

**User entry**
Character string comprising numbers, letters and special characters (32)

**Factory setting**
NMS8x

**Additional information**

<table>
<thead>
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</table>

### HART descriptor

**Description**
Enter description for the measuring point

**User entry**
Character string comprising numbers, letters and special characters (16)
**HART message**

**Navigation**  
Setup → Advanced setup → Communication → HART output → Information → HART message

**Description**  
Use this function to define a HART message which is sent via the HART protocol when requested by the master.  
Maximum length: 32 characters  
Allowed characters: A-Z, 0-9, certain special characters

**User entry**  
Character string comprising numbers, letters and special characters (32)

**Factory setting**  
NMS8x

**Additional information**

<table>
<thead>
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</tbody>
</table>

**HART date code**

**Navigation**  
Setup → Advanced setup → Communication → HART output → Information → HART date code

**Description**  
Enter date of the last configuration change. Use this format yyyy-mm-dd

**User entry**  
Character string comprising numbers, letters and special characters (10)

**Factory setting**  
2009-07-20

**Additional information**

<table>
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</table>
"Application" submenu

Navigation  
Setup → Advanced setup → Application

"Tank configuration" submenu

Navigation  
Setup → Advanced setup → Application → Tank config

"Level" submenu

Navigation  
Setup → Advanced setup → Application → Tank config → Level

Level source

Navigation  
Setup → Advanced setup → Application → Tank config → Level → Level source

Description  
Defines the source of the level value.

Selection  
- No input value
- HART device 1 ... 15 level
- Level SR *
- Level *
- Displacer position *
- AIO B1-3 value *
- AIO C1-3 value *
- AIP B4-8 value *
- AIP C4-8 value *

Factory setting  
Dependent on the device version

Additional information

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</table>

Empty

Navigation  
Setup → Advanced setup → Application → Tank config → Level → Empty

Description  
Distance from reference point to zero position (tank bottom or datum plate).

User entry  
0 to 10 000 000 mm

Factory setting  
Dependent on the device version

* Visibility depends on order options or device settings
The reference point is the reference line of the calibration window.

**Tank reference height**

**Navigation**
Setup → Advanced setup → Application → Tank config → Level → Tank ref height

**Description**
Defines the distance from the dipping reference point to the zero position (tank bottom or datum plate).

**User entry**
0 to 10 000 000 mm

**Factory setting**
Dependent on the device version

**Set level**

**Navigation**
Setup → Advanced setup → Application → Tank config → Level → Set level

**Description**
If the level measured by the device does not match the actual level obtained by a manual dip, enter the correct level into this parameter.

**User entry**
0 to 10 000 000 mm

**Factory setting**
0 mm
The device adjusts the **Empty** parameter (→ 204) according to the entered value, such that the measured level will match the actual level.

### Water level source

**Navigation**

Setup → Advanced setup → Application → Tank config → Level → Water level src

**Description**

Defines the source of the bottom water level.

**Selection**

- Manual value
- Bottom level
- HART device 1 ... 15 level
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

**Factory setting**

Manual value

**Additional information**

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</table>

### Manual water level

**Navigation**

Setup → Advanced setup → Application → Tank config → Level → Man. water level

**Prerequisite**

Water level source (→ 204) = Manual value

**Description**

Defines the manual value of the bottom water level.

**User entry**

-2 000 to 5 000 mm

**Factory setting**

0 mm

**Additional information**

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</table>

### Water level

**Navigation**

Setup → Advanced setup → Application → Tank config → Level → Water level

**Description**

Shows the bottom water level.
### Additional information

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</table>
"Temperature" submenu

| Read access | Maintenance |

Navigation
○ ○ Setup → Advanced setup → Application → Tank config → Temperature

Liquid temp source

Navigation
○ ○ Setup → Advanced setup → Application → Tank config → Temperature → Liq temp source

Description
Defines source from which the liquid temperature is obtained.

Selection
- Manual value
- HART device 1 ... 15 temperature
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

Factory setting
Manual value

Additional information

| Read access | Operator |
| Write access | Maintenance |

Manual liquid temperature

Navigation
○ ○ Setup → Advanced setup → Application → Tank config → Temperature → Man. liquid temp

Prerequisite
Liquid temp source (→ 196) = Manual value

Description
Defines the manual value of the liquid temperature.

User entry
-50 to 300 °C

Factory setting
25 °C

Additional information

| Read access | Operator |
| Write access | Maintenance |
Liquid temperature

Navigation
Setup → Advanced setup → Application → Tank config → Temperature → Liquid temp.

Description
Shows the average or spot temperature of the measured liquid.

Additional information
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Air temperature source

Navigation
Setup → Advanced setup → Application → Tank config → Temperature → Air temp. source

Description
Defines source from which the air temperature is obtained.

Selection
- Manual value
- HART device 1 ... 15 temperature
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

Factory setting
Manual value

Additional information
<table>
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Manual air temperature

Navigation
Setup → Advanced setup → Application → Tank config → Temperature → Manual air temp.

Prerequisite
Air temperature source (→ 267) = Manual value

Description
Defines the manual value of the air temperature.

User entry
-50 to 300 °C

Factory setting
25 °C

Additional information
<table>
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</table>
Air temperature

**Navigation**

Setup → Advanced setup → Application → Tank config → Temperature → Air temp.

**Description**

Shows the air temperature.

**Additional information**

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Vapor temp source

**Navigation**

Setup → Advanced setup → Application → Tank config → Temperature → Vapor temp src

**Description**

Defines the source from which the vapor temperature is obtained.

**Selection**

- Manual value
- HART device 1 ... 15 vapor temp
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

**Factory setting**

Manual value

**Additional information**

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</table>

Manual vapor temperature

**Navigation**

Setup → Advanced setup → Application → Tank config → Temperature → Man. vapor temp.

**Prerequisite**

Vapor temp source (→ 268) = Manual value

**Description**

Defines the manual value of the vapor temperature.

**User entry**

-50 to 300 °C

**Factory setting**

25 °C

**Additional information**

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</table>
Vapor temperature

Navigation
Setup → Advanced setup → Application → Tank config → Temperature → Vapor temp.

Description
Shows the measured vapor temperature.

Additional information
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</table>
"Density" submenu

Navigation  
Setup → Advanced setup → Application → Tank config → Density

Observed density source

Navigation  
Setup → Advanced setup → Application → Tank config → Density → Density source

Description
Determines how the density is obtained.

Selection
- HTG *
- HTMS *
- Average profile density *
- Upper density
- Middle density
- Lower density

Factory setting
Dependent on the device version

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Observed density

Navigation  
Setup → Advanced setup → Application → Tank config → Density → Observed density

Description
Shows the measured or calculated density.

Addition information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Air density

Navigation  
Setup → Advanced setup → Application → Tank config → Density → Air density

Description
Defines the density of the air surrounding the tank.

User entry
0.0 to 500.0 kg/m³

Factory setting
1.2 kg/m³

* Visibility depends on order options or device settings
Vapor density

**Navigation**

Setup → Advanced setup → Application → Tank config → Density → Vapor density

**Description**

Defines the density of the gas phase in the tank.

**User entry**

0.0 to 500.0 kg/m³

**Factory setting**

1.2 kg/m³

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
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</tbody>
</table>

---

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
“Pressure” submenu

Navigation

Setup → Advanced setup → Application → Tank config → Pressure

P1 (bottom) source

Navigation

Setup → Advanced setup → Application → Tank config → Pressure → P1 (bot) source

Description
Defines the source of the bottom pressure (P1).

Selection
- Manual value
- HART device 1 ... 15 pressure
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

Factory setting
Manual value

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

P1 (bottom)

Navigation

Setup → Advanced setup → Application → Tank config → Pressure → P1 (bottom)

Description
Shows the pressure at the tank bottom.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

P1 (bottom) manual pressure

Navigation

Setup → Advanced setup → Application → Tank config → Pressure → P1 (bot) manual

Prerequisite
P1 (bottom) source (→ 272) = Manual value

Description
Defines the manual value of the bottom pressure (P1).

User entry
-1.01325 to 25 bar

Factory setting
0 bar
### P1 position

**Navigation**

Setup → Advanced setup → Application → Tank config → Pressure → P1 position

**Description**

Defines the position of the bottom pressure transmitter (P1), measured from zero position (tank bottom or datum plate).

**User entry**

-10000 to 100000 mm

**Factory setting**

5000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### P1 offset

**Navigation**

Setup → Advanced setup → Application → Tank config → Pressure → P1 offset

**Description**

Offset for the bottom pressure (P1). The offset is added to the measured pressure prior to any tank calculation.

**User entry**

-25 to 25 bar

**Factory setting**

0 bar

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### P1 absolute / gauge

**Navigation**

Setup → Advanced setup → Application → Tank config → Pressure → P1 absolute / gauge

**Description**

Defines whether the connected pressure transmitter measures an absolute or a gauge pressure.

**Selection**

- Absolute
- Gauge

**Factory setting**

Gauge
### Operating menu

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**P3 (top) source**

**Navigation**

- Setup → Advanced setup → Application → Tank config → Pressure → P3 (top) source

**Description**

Defines the source of the top pressure (P3).

**Selection**

- Manual value
- HART device 1 ... 15 pressure
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value

**Factory setting**

Manual value

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**P3 (top)**

**Navigation**

- Setup → Advanced setup → Application → Tank config → Pressure → P3 (top)

**Description**

Shows the pressure (P3) at the top transmitter.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

**P3 (top) manual pressure**

**Navigation**

- Setup → Advanced setup → Application → Tank config → Pressure → P3 (top) manual

**Prerequisite**

P3 (top) source (→ 274) = Manual value

**Description**

Defines the manual value of the top pressure (P3).

**User entry**

-1.01325 to 25 bar

**Factory setting**

0 bar
### P3 position

**Navigation**

Setup → Advanced setup → Application → Tank config → Pressure → P3 position

**Description**

Defines the position of the top pressure transmitter (P3), measured from zero position (tank bottom or datum plate).

**User entry**

0 to 100,000 mm

**Factory setting**

20,000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### P3 offset

**Navigation**

Setup → Advanced setup → Application → Tank config → Pressure → P3 offset

**Description**

Offset for the top pressure (P3).
The offset is added to the measured pressure prior to any tank calculation.

**User entry**

–25 to 25 bar

**Factory setting**

0 bar

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### P3 absolute / gauge

**Navigation**

Setup → Advanced setup → Application → Tank config → Pressure → P3 absolut/gauge

**Description**

Defines whether the connected pressure transmitter measures an absolute or a gauge pressure.

**Selection**

- Absolute
- Gauge

**Factory setting**

Gauge
### Ambient pressure

**Navigation**
Setup → Advanced setup → Application → Tank config → Pressure → Ambient pressure

**Description**
Defines the manual value of the ambient pressure.

**User entry**
0 to 2.5 bar

**Factory setting**
1 bar

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
"Tank calculation" submenu

Navigation

Setup → Advanced setup → Application → Tank calculation

"HyTD" submenu

Overview

Hydrostatic Tank Deformation can be used to compensate the vertical movement of the Gauge Reference Height (GRH) due to bulging of the tank shell caused by the hydrostatic pressure exerted by the liquid stored in the tank. The compensation is based on a linear approximation obtained from manual hand dips at several levels distributed over the full range of the tank.

![Diagram of tank with labels A, B, C, D showing correction of hydrostatic tank deformation (HyTD)]

94  Correction of the hydrostatic tank deformation (HyTD)

A  'Distance' (level below $L_0$ → 'HyTD correction value' = 0)
B  Gauge Reference Height (GRH)
C  HyTD correction value
D  'Distance' (level above $L_0$ → 'HyTD correction value' > 0)
Linear approximation of the HyTD correction

The real amount of deformation varies non-linearly with the level due to the construction of the tank. However, as the correction values are typically small compared to the measured level, a simple straight line method can be used with good results.

![Diagram showing linear approximation of HyTD correction](image)

### Calculation of the HyTD correction

1. **Linear correction according to "Deformation factor (→ 280)"**
2. **Real correction**
3. **Starting level (→ 279)**
4. **Measured level (→ 181)**
5. **HyTD correction value (→ 279)**

#### Calculation of the HyTD correction

\[
\begin{align*}
L & \leq L_0 \quad \Rightarrow \quad C_{\text{HyTD}} = 0 \\
L & > L_0 \quad \Rightarrow \quad C_{\text{HyTD}} = -(L - L_0) \times D
\end{align*}
\]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Measured level</td>
</tr>
<tr>
<td>L₀</td>
<td>Starting level</td>
</tr>
<tr>
<td>C_{\text{HyTD}}</td>
<td>HyTD correction value</td>
</tr>
<tr>
<td>D</td>
<td>Deformation factor</td>
</tr>
</tbody>
</table>
Description of parameters

Navigation

Setup → Advanced setup → Application → Tank calculation → HyTD

HyTD correction value

Navigation

Setup → Advanced setup → Application → Tank calculation → HyTD → HyTD corr. value

Description

Shows the correction value from the Hydrostatic Tank Deformation.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

HyTD mode

Navigation

Setup → Advanced setup → Application → Tank calculation → HyTD → HyTD mode

Description

Activates or deactivates the calculation of the Hydrostatic Tank Deformation.

Selection

- No
- Yes

Factory setting

No

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Starting level

Navigation

Setup → Advanced setup → Application → Tank calculation → HyTD → Starting level

Description

Defines the starting level for the Hydrostatic Tank Deformation. Levels below this value are not corrected.

User entry

0 to 5 000 mm

Factory setting

500 mm

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
Deformation factor

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HyTD → Deform factor

**Description**

Defines the deformation factor for the HyTD (change of device position per change of level).

**User entry**

-1.0 to 1.0 %

**Factory setting**

0.2 %

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
** CTSh" submenu

**Overview**

CTSh (correction for the thermal expansion of the tank shell) compensates for effects on the Gauge Reference Height (GRH) and on the expansion or contraction of the measuring wire due to temperature effects on the tank shell or stilling well. The temperature effects are separated into two parts, respectively affecting the 'dry' and 'wetted' part of the tank shell or stilling well. The correction function is based on thermal expansion coefficients of steel and insulation factors for both the 'dry' and 'wet' parts of the wire and the tank shell. The temperatures used for the correction can be selected from on manual or measured values.

This correction is recommended for the following situations:

- if the operating temperature deviates considerably from the temperature during calibration (ΔT > 10 °C (18 °F))
- for extremely high tanks
- for refrigerated, cryogenic or heated applications

As the use of this correction will influence the innage level reading, it is recommended to ensure the manual hand dip and level verification procedures are being conducted correctly before enabling this correction method.

This mode cannot be used in conjunction with HTG because the level is not measured relative to the gauge reference height with HTG.
CTSh: Calculation of the wall temperature

Depending on the parameters Covered tank (→ 284) and Stilling well (→ 285), the temperatures $T_W$ of the wetted and $T_D$ of the dry part of the tank wall are calculated as follows:

<table>
<thead>
<tr>
<th>Covered tank (→ 284)</th>
<th>Stilling well (→ 285)</th>
<th>$T_W$</th>
<th>$T_D$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covered</td>
<td>Yes $^1$</td>
<td>$T_P$</td>
<td>$T_V$</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>$(7/8) T_P + (1/8) T_A$</td>
<td>$(1/2) T_V + (1/2) T_A$</td>
</tr>
<tr>
<td>Open top</td>
<td>Yes</td>
<td>$T_P$</td>
<td>$T_A$</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>$(7/8) T_P + (1/8) T_A$</td>
<td>$T_A$</td>
</tr>
</tbody>
</table>

1) This option is also valid for insulated tanks without a stilling well. This is due to the temperature inside and outside of the tank shell being the same due to the insulation of the tank.
1  Covered tank (→ 284) = Covered; Stilling well (→ 285) = Yes
2  Covered tank (→ 284) = Covered; Stilling well (→ 285) = No
3  Covered tank (→ 284) = Open top; Stilling well (→ 285) = Yes
4  Covered tank (→ 284) = Open top; Stilling well (→ 285) = No
5  Insulated tank: Covered tank (→ 284) = Open top; Stilling well (→ 285) = Yes

CTSh: Calculation of the correction

\[ C_{CTSh} = \alpha_{\text{tank}} (TRH - L)(T_D - T_{\text{cal}}) + \alpha_{\text{tank}} L (T_W - T_{\text{cal}}) - \alpha_{\text{tank}} S_{\text{D}} (T_W - T_{\text{cal}}) \]

TRH  Tank reference height
L  Level
T_D  Temperature of the dry part of the tank shell (calculated from \( T_P \), \( T_V \) and \( T_A \))
T_W  Temperature of the wetted part of the tank shell (calculated from \( T_P \), \( T_V \) and \( T_A \))
T_{cal}  Temperature at which the measurement has been calibrated
\( \alpha_{\text{tank}} \)  Linear expansion coefficient of tank
\( \alpha_{\text{wire}} \)  Linear expansion coefficient of wire
C_{CTSh}  CTSh correction value
Description of parameters

Navigation

Setup → Advanced setup → Application → Tank calculation → CTSh

CTSh correction value

Description

Shows the CTSh correction value.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

CTSh mode

Description

Activates or deactivates the CTSh.

Selection

- No
- Yes
- With wire *
- Only wire *

Factory setting

No

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Covered tank

Description

Determines whether the tank is covered.

Selection

- Open top
- Covered

Factory setting

Open top

* Visibility depends on order options or device settings
The Covered option is only valid for fixed tank roofs. For a floating roof select Open top.

### Stilling well

**Navigation**

Setup → Advanced setup → Application → Tank calculation → CTSh → Stilling well

**Description**

Determines whether the device is mounted on a stilling well.

**Selection**

- No
- Yes

**Factory setting**

No

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

### Calibration temperature

**Navigation**

Setup → Advanced setup → Application → Tank calculation → CTSh → Calibration temp

**Description**

Specify temperature at which the measurement has been calibrated.

**User entry**

−50 to 250 °C

**Factory setting**

25 °C

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
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</thead>
<tbody>
<tr>
<td>Write access</td>
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</tr>
</tbody>
</table>

### Linear expansion coefficient

**Navigation**

Setup → Advanced setup → Application → Tank calculation → CTSh → Linear exp coeff

**Description**

Defines the linear expansion coefficient of the tank shell material.

**User entry**

0 to 100 ppm

**Factory setting**

15 ppm
Operating menu

Proservo NMS81

Additional information

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Write access</td>
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</tr>
</tbody>
</table>

Wire expansion coefficient

- **Navigation**: Setup → Advanced setup → Application → Tank calculation → CTSh → Wire exp coeff
- **Description**: Defines the expansion coefficient of the wire material of the drum. Value is programmed in factory.
- **User entry**: 0 to 100 ppm
- **Factory setting**: 15 ppm
"HTMS" submenu

Overview

The Hybrid Tank Measurement System (HTMS) is a method to calculate the density of a product in a tank based on both a (top mounted) level and at least one (bottom mounted) pressure measurement. An additional pressure sensor can be installed at the top of the tank to provide information about the vapor pressure and to make the density calculation more accurate. The calculation method also takes into account a possible level of water at the bottom of the tank to make density calculations as accurate as possible.

HTMS parameters

![Diagram of HTMS parameters]

### Parameter | Navigation path
--- | ---
P1 (Bottom pressure) | Setup → Advanced setup → Tank configuration → Pressure → P1 (bottom)
Hₚ₁ (Position of P1 transmitter) | Setup → Advanced setup → Tank configuration → Pressure → P1 position
P3 (Top pressure) | Setup → Advanced setup → Tank configuration → Pressure → P3 (top)
Hₚ₃ (Position of P3 transmitter) | Setup → Advanced setup → Tank configuration → Pressure → P3 position
ρₚ (Density of the product ¹) | • Measured value: Setup → Advanced setup → Calculation → HTMS → Density value
• User-defined value: Setup → Advanced setup → Calculation → HTMS → Manual upper density
ρᵥ (Vapor density) | Expert → Application → Tank configuration → Density → Vapor density
ρₐ (Ambient air temperature) | Setup → Advanced setup → Tank configuration → Density → Air density
g (Local gravity) | Expert → Application → Tank Calculation → Local gravity
Lₚ (Level of the product) | Operation → Tank level
Lₚₚ (Bottom water level) | Operation → Water level
V = Lₚₚ - Hₚ₁
Δₚ = Lₚ - Lₚₚ - V - Hₚ₁

¹) Depending on the situation this parameter is measured or a user-defined value is used.
HTMS modes

Two HTMS modes can be selected in the HTMS mode parameter (→ 289). The mode determines whether one or two pressure values are used. Depending on the selected mode a number of additional parameters are required for the calculation of the product density.

The HTMS P1+P3 option must be used in pressurized tanks in order to compensate for the pressure of the vapor phase.

<table>
<thead>
<tr>
<th>HTMS mode (→ 289)</th>
<th>Measured variables</th>
<th>Required additional parameters</th>
<th>Calculated variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTMS P1</td>
<td>P₁, Lₚ</td>
<td>g, Hₚ₁, Lₒ (optional)</td>
<td>ρₚ</td>
</tr>
<tr>
<td>HTMS P1+P3</td>
<td>P₁, P₃, Lₚ</td>
<td>ρᵥ, ρₐ, g, Hₚ₁, Hₚ₃, Lₒ (optional)</td>
<td>ρₚ (more precise calculation for pressurized tanks)</td>
</tr>
</tbody>
</table>

Minimum level

The density of the product can only be calculated if the product has a minimum thickness:

\[
\Delta_P \geq \Delta_{P,\text{min}}
\]

This is equivalent to the following condition for the product level:

\[
L_P - V \geq \Delta_{P,\text{min}} + H_{P₁} = L_{\text{min}}
\]

Lₘᵢᵣᵢᵢ is defined in the Minimum level parameter (→ 290). As can be seen from the formula it always must be bigger than Hₚ₁.

If Lₚ - V falls below this limit, the density is calculated as follows:

- If a previous calculated value is available, this value will be kept as long as no new calculation is possible.
- If no value was previously calculated, the manual value (defined in the Manual upper density parameter) will be used.

Hysteresis

The level of the product in a tank is not constant but slightly varies, due for example to filling disturbances. If the level oscillates around the changeover level (Minimum level (→ 290)), the algorithm will constantly switch between calculating the value and holding the previous result. To avoid this effect a positional hysteresis is defined around the changeover point.
HTMS mode

Navigation  
Setup → Advanced setup → Application → Tank calculation → HTMS → HTMS mode

Description  
Defines the HTMS mode. Depending on the mode one or two pressure transmitters are used.

Selection  
- HTMS P1
- HTMS P1+P3

Factory setting  
HTMS P1

Additional information

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td></td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Meaning of the options  
- HTMS P1  
  Only a bottom pressure transmitter (P1) is used.
- HTMS P1+P3  
  A bottom (P1) and top (P3) pressure transmitter are used. This option should be selected for pressurized tanks.

Manual density

Navigation  
Setup → Advanced setup → Application → Tank calculation → HTMS → Manual density

Description  
Defines the manual density.
**Density value**

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HTMS → Density value

**Description**

Shows the calculated product density.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Minimum level**

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HTMS → Min. level

**Description**

Defines the minimum product level for a HTMS calculation.

If \( L_p - V \) falls below the limit defined in this parameter, the density retains its last value or the manual value is used instead.

**User entry**

0 to 20 000 mm

**Factory setting**

7 000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Minimum pressure**

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HTMS → Minimum pressure

**Description**

Defines the minimum pressure for a HTMS calculation.

If the pressure \( P_1 \) (or the difference \( P_1 - P_3 \)) falls below the limit defined in this parameter, the density retains its last value or the manual value is used instead.

**User entry**

0 to 100 bar

**Factory setting**

0.1 bar
### Safety distance

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HTMS → Safety distance

**Description**
Defines the minimum level which must be present above the bottom pressure sensor before its signal is used for the calculation.

**User entry**
0 to 10 000 mm

**Factory setting**
2 000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
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</tr>
</tbody>
</table>

### Hysteresis

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HTMS → Hysteresis

**Description**
Defines the hysteresis for the HTMS calculation. Prevents constant switching if the level is near the switch-over point.

**User entry**
0 to 2 000 mm

**Factory setting**
50 mm

**Additional information**

<table>
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</table>

### Water density

**Navigation**

Setup → Advanced setup → Application → Tank calculation → HTMS → Water density

**Description**
Density of the water in the tank.

**User entry**
Signed floating-point number

**Factory setting**
1 000 kg/m³
Operating menu

Proservo NMS81

Additional information

<table>
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</table>

"Alarm" submenu

Navigation

Setup → Advanced setup → Application → Alarm

"Alarm" submenu

Navigation

Setup → Advanced setup → Application → Alarm → Alarm

| Alarm mode     | → 293 |
| Error value    | → 294 |
| Alarm value source | → 295 |
| Alarm value    | → 296 |
| HH alarm value | → 296 |
| H alarm value  | → 296 |
| L alarm value  | → 297 |
| LL alarm value | → 297 |
| HH alarm       | → 297 |
| H alarm        | → 298 |
| HH+H alarm     | → 298 |
| L alarm        | → 298 |
| LL alarm       | → 298 |
| LL+L alarm     | → 299 |
| Any error      | → 299 |
| Clear alarm    | → 299 |
Alarm mode

Navigation

Setup → Advanced setup → Application → Alarm → Alarm → Alarm mode

Description

Defines the alarm mode of the selected alarm.

Selection

- Off
- On
- Latching

Factory setting

Off

Additional information

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</table>

**Meaning of the options**

- **Off**
  
  No alarms are generated.

- **On**
  
  An alarm disappears if the alarm condition is no longer present (taking into consideration the hysteresis).

- **Latching**
  
  All alarms remain active until the user selects **Clear alarm (→ 299) = Yes** or the power is switched off and on.
Principle of the limit evaluation

A  Alarm mode (→ 293) = On
B  Alarm mode (→ 293) = Latching
1  HH alarm value (→ 296)
2  H alarm value (→ 296)
3  L alarm value (→ 297)
4  LL alarm value (→ 297)
5  HH alarm (→ 297)
6  H alarm (→ 298)
7  L alarm (→ 298)
8  LL alarm (→ 298)
9  "Clear alarm (→ 299)" = "Yes" or power off-on
10 Hysteresis (→ 300)

Error value

Navigation  
Setup → Advanced setup → Application → Alarm → Alarm → Error value

Prerequisite  
Alarm mode (→ 293) ≠ Off

Description  
Defines the alarm to be issued if the input value is invalid.

Selection  
- No alarm
- HH+H alarm
- H alarm
- L alarm
- LL+L alarm
- All alarms

Factory setting  
All alarms

Additional information  
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</table>
Alarm value source

Navigation  
Setup → Advanced setup → Application → Alarm → Alarm → Alarm source

Prerequisite  
Alarm mode (→ 293) = Off

Description  
Determines the process variable to be monitored.

Selection  
- Tank level
- Liquid temperature
- Vapor temperature
- Water level
- P1 (bottom)
- P2 (middle)
- P3 (top)
- Observed density value
- Volume
- Flow velocity
- Volume flow
- Vapor density
- Middle density
- Upper density
- Correction
- Tank level %
- GP 1...4 value
- Measured level
- P3 position
- Tank reference height
- Local gravity
- P1 position
- Manual density
- Tank ullage
- Average profile density
- Lower density
- Upper interface level
- Lower interface level
- Bottom level
- Displacer position
- HART device 1...15 PV
- HART device 1...15 SV
- HART device 1...15 TV
- HART device 1...15 QV
- HART device 1...15 PV mA
- HART device 1...15 PV %
- Element temperature 1...24
- AIO B1-3 value
- AIO C1-3 value
- AIP B4-8 value
- AIP C4-8 value
- None

Factory setting  
None

Additional information  
<table>
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</table>
## Alarm value

### Navigation
[Setup → Advanced setup → Application → Alarm → Alarm → Alarm value]

### Prerequisite
Alarm mode (→ 293) ≠ Off

### Description
Shows the current value of the process variable being monitored.

### User interface
Signed floating-point number

### Factory setting
0 None

### Additional information

<table>
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<tbody>
<tr>
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</table>

## HH alarm value

### Navigation
[Setup → Advanced setup → Application → Alarm → Alarm → HH alarm value]

### Prerequisite
Alarm mode (→ 293) ≠ Off

### Description
Defines the high-high(HH) limit value.

### User entry
Signed floating-point number

### Factory setting
0 None

### Additional information

<table>
<thead>
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<tbody>
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</table>

## H alarm value

### Navigation
[Setup → Advanced setup → Application → Alarm → Alarm → H alarm value]

### Prerequisite
Alarm mode (→ 293) ≠ Off

### Description
Defines the high(H) limit value.

### User entry
Signed floating-point number

### Factory setting
0 None

### Additional information

<table>
<thead>
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<tbody>
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</table>
### L alarm value

**Navigation**

Setup → Advanced setup → Application → Alarm → Alarm → L alarm value

**Prerequisite**

Alarm mode (→ 293) ≠ Off

**Description**

Defines the low limit value.

**User entry**

Signed floating-point number

**Factory setting**

0 None

**Additional information**

<table>
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</table>

### LL alarm value

**Navigation**

Setup → Advanced setup → Application → Alarm → Alarm → LL alarm value

**Prerequisite**

Alarm mode (→ 293) ≠ Off

**Description**

Defines the low-low(LL) limit value.

**User entry**

Signed floating-point number

**Factory setting**

0 None

**Additional information**

<table>
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</table>

### HH alarm

**Navigation**

Setup → Advanced setup → Application → Alarm → Alarm → HH alarm

**Prerequisite**

Alarm mode (→ 293) ≠ Off

**Description**

Shows whether an HH alarm is currently active.

**Additional information**

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</table>
H alarm

Navigation

Setup → Advanced setup → Application → Alarm → Alarm → H alarm

Prerequisite

Alarm mode (→ 293) ≠ Off

Description

Shows whether an H alarm is currently active.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
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</table>

HH+H alarm

Navigation

Setup → Advanced setup → Application → Alarm → Alarm → HH+H alarm

Prerequisite

Alarm mode (→ 293) ≠ Off

Description

Shows whether an HH or H alarm is currently active.

Additional information

<table>
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<tr>
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</tbody>
</table>

L alarm

Navigation

Setup → Advanced setup → Application → Alarm → Alarm → L alarm

Prerequisite

Alarm mode (→ 293) ≠ Off

Description

Shows whether an L alarm is currently active.

Additional information

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</tbody>
</table>

LL alarm

Navigation

Setup → Advanced setup → Application → Alarm → Alarm → LL alarm

Prerequisite

Alarm mode (→ 293) ≠ Off

Description

Shows whether an LL alarm is currently active.
Additional information

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</table>

**LL+L alarm**

**Navigation**

Setup → Advanced setup → Application → Alarm → Alarm → LL+L alarm

**Prerequisite**

Alarm mode (→ 293) ≠ Off

**Description**

Shows whether an LL or L alarm is currently active.

**Additional information**

<table>
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</table>

**Any error**

**Navigation**

Setup → Advanced setup → Application → Alarm → Alarm → Any error

**Prerequisite**

Alarm mode (→ 293) ≠ Off

**Description**

Show whether any alarm is currently active.

**User interface**

- Unknown
- Inactive
- Active
- Error

**Factory setting**

Unknown

**Additional information**

<table>
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</table>

**Clear alarm**

**Navigation**

Setup → Advanced setup → Application → Alarm → Alarm → Clear alarm

**Prerequisite**

Alarm mode (→ 293) = Latching

**Description**

Deletes an alarm which is still active although the alarm condition is no longer present.

**Selection**

- No
- Yes

**Factory setting**

No
### Alarm hysteresis

**Navigation**
- Setup → Advanced setup → Application → Alarm → Alarm → Alarm hysteresis

**Prerequisite**
- Alarm mode (→ 293) ≠ Off

**Description**
Defines the hysteresis for the limit values. The hysteresis prevents constant changes of the alarm state if the level is near one of the limit values.

**User entry**
Signed floating-point number

**Factory setting**
0.001

**Additional information**

<table>
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</tbody>
</table>

### Damping factor

**Navigation**
- Setup → Advanced setup → Application → Alarm → Alarm → Damping factor

**Description**
Defines the damping constant (in seconds).

**User entry**
0 to 999.9 s

**Factory setting**
0 s

**Additional information**

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</table>
"Safety settings" submenu

*Navigation*: Setup → Advanced setup → Safety settings

**Output out of range**

**Navigation**  
Setup → Advanced setup → Safety settings → Output out range

**Description**  
Selection of behavior between Alarm or Last valid value when displacer reached HighStopLevel, LowStopLevel or ReferencePosition.

**Selection**  
- Last valid value
- Alarm
- None

**Factory setting**  
Last valid value

**Additional information**

<table>
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</table>

**Output out of range**

**Navigation**  
Setup → Advanced setup → Safety settings → Output out range

**Description**  
Selection of behavior when displacer reached HighStopLevel (→ 195), Low stop level or Reference position.

**Selection**  
- Last valid value
- Alarm
- None

**Factory setting**  
Last valid value

**Additional information**

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</table>

**High stop level**

**Navigation**  
Setup → Advanced setup → Safety settings → High stop level

**Description**  
Position of the displacer high stop as measured from defined zero position (tank bottom or datum plate).

**User entry**  
-999 999.9 to 999 999.9 mm
Factory setting | Dependent on the device version
---|---

**Addional information**

| Read access | Operator |
| Write access | Maintenance |

---

**Low stop level**

**Navigation**
 Setup → Advanced setup → Safety settings → Low stop level

**Description**
Position of the displacer low stop as measured from defined zero position (tank bottom or datum plate).

**User entry**
-999 999.9 to 999 999.9 mm

**Factory setting**
0 mm

**Addional information**

| Read access | Operator |
| Write access | Maintenance |

---

**Slow hoist zone**

**Navigation**
 Setup → Advanced setup → Safety settings → Slow hoist zone

**Description**
Defines the interval in millimeters, measured down from the Reference Position, in which the Displacer reduces moving speed.

**User entry**
10 to 999 999.9 mm

**Factory setting**
70 mm

**Addional information**

| Read access | Operator |
| Write access | Maintenance |

---

**Overtension weight**

**Navigation**
 Setup → Advanced setup → Safety settings → Overtension wgt

**Description**
Sets the minimum Weight in grams when Overtension Alarm will be set.

**User entry**
100 to 999.9 g

**Factory setting**
350 g
<table>
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<tr>
<th>Additional information</th>
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</table>

### Undertension weight

**Navigation**

Setup → Advanced setup → Safety settings → Undertension wgt

**Description**

Defines the undertension error weight. Untertension error will be issued if displacer weight is below this value longer than 7 seconds.

**User entry**

0 to 300 g

**Factory setting**

10 g

<table>
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</table>
"Sensor config" submenu

Navigation

Setup → Advanced setup → Sensor config

Post gauge command

Navigation

Setup → Advanced setup → Sensor config → Post gauge cmd

Description

Defines the gauge command that will be executed after a one-time gauge command has finished.

Selection

- Stop
- Level
- Up
- Upper I/F level
- Lower I/F level
- None

Factory setting

Level

Additional information

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</table>
Displacer type

- **Navigation**: Setup → Advanced setup → Sensor config → Displacer → Displacer type
- **Description**: Chooses the type of displacer used.
- **Selection**:
  - Custom diameter
  - Diameter 30 mm
  - Diameter 50 mm
  - Diameter 70 mm
  - Diameter 110 mm
- **Factory setting**: Dependent on the device version
- **Additional information**:
  | Read access | Operator |
  | Write access | Maintenance |

Displacer diameter

- **Navigation**: Setup → Advanced setup → Sensor config → Displacer → Displacer diameter
- **Prerequisite**: Displacer type (→ 305) = Custom diameter
- **Description**: Sets the diameter of the cylindrical part of displacer.
- **User entry**: 0 to 999.9 mm
- **Factory setting**: See label on the device.
- **Additional information**:
  | Read access | Operator |
  | Write access | Maintenance |

Displacer weight

- **Navigation**: Setup → Advanced setup → Sensor config → Displacer → Displacer weight
- **Description**: Set the weight of the displacer in air. Indicated on the displacer in grams.
- **User entry**: 10 to 999.9 g
- **Factory setting**: See label on the device.
Additional information

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</table>

Displacer volume

Navigation

Setup → Advanced setup → Sensor config → Displacer → Displacer volume

Description

Displacer volume indicated on displacer in milliliter.

User entry

10 to 999.9 ml

Factory setting

See label on the device.

Additional information

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</table>

Displacer balance volume

Navigation

Setup → Advanced setup → Sensor config → Displacer → Balance volume

Description

Defines the balance volume of the displacer as the lower part of displacer immersed in liquid. Units in milliliters. Indicated on displacer.

User entry

10 to 999.9 ml

Factory setting

See label on the device.

Additional information

<table>
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</table>

Displacer height

Navigation

Setup → Advanced setup → Sensor config → Displacer → Displacer height

Description

Sets the displacer height in mm. Used for density measurement as minimum distance between last profile point and liquid level.

User entry

10 to 300 mm

Factory setting

Dependent on the device version

Additional information

<table>
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</table>
### Immersion depth

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Sensor config → Displacer → Immersion depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Defines distance (mm) from displacer bottom to balancing line defined by balanced volume. Value is needed for correct bottom level measurement.</td>
</tr>
<tr>
<td>User entry</td>
<td>0 to 99.9 mm</td>
</tr>
<tr>
<td>Factory setting</td>
<td>Dependent on the device version</td>
</tr>
<tr>
<td>Additional information</td>
<td>Read access</td>
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</tbody>
</table>
"Wiredrum" submenu

Navigation

Setup → Advanced setup → Sensor config → Wiredrum

Drum circumference

Description
Sets the circumference of the wire drum. Indicated in Label.

User entry
100 to 999.9 mm

Factory setting
See label on the device.

Additional information

<table>
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</table>

Wire weight

Description
Defines the weight of the measuring wire in g/10m. Indicated on Label.

User entry
0 to 999.9 g

Factory setting
See label on the device.

Additional information

<table>
<thead>
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</table>
“Spot density” submenu

Navigation ➔ Setup → Advanced setup → Sensor config → Spot density

### Upper density offset

**Navigation** ➔ Setup → Advanced setup → Sensor config → Spot density → Up dens. offset

**Description**
Defines an offset value which is added to the measured upper density value.

**User entry**
−999.99 to 999.99 kg/m³

**Factory setting**
0 kg/m³

**Additional information**

<table>
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</table>

### Middle density offset

**Navigation** ➔ Setup → Advanced setup → Sensor config → Spot density → Mid dens. offset

**Description**
Defines an offset value which is added to the measured middle density value.

**User entry**
−999.99 to 999.99 kg/m³

**Factory setting**
0 kg/m³

**Additional information**

<table>
<thead>
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</table>

### Lower density offset

**Navigation** ➔ Setup → Advanced setup → Sensor config → Spot density → Low dens. offset

**Description**
Defines an offset value which is added to the measured lower density value.

**User entry**
−999.99 to 999.99 kg/m³

**Factory setting**
0 kg/m³

**Additional information**

<table>
<thead>
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</table>
Submersion depth

Navigation
Setup → Advanced setup → Sensor config → Spot density → Submersion depth

Description
Sets the displacer submersion depth (mm) for spot density operations.

User entry
50 to 99999.9 mm

Factory setting
150 mm

Additional information

<table>
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</table>
Density measurement mode

**Navigation**

Setup → Advanced setup → Sensor config → Profile density → Density mode

**Description**

In normal measure mode, measures at specified positions. In compensation mode measures using next integer value of drum turns to improve accuracy.

**Selection**

- Normal measure mode
- Compensation mode

**Factory setting**

Normal measure mode

**Additional information**

<table>
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<th>Role</th>
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</table>

In normal mode, measures spot densities at requested positions. In compensations mode the Proservo measures the spot densities at multiples of the wiredrum circumference (e.g. every ~ 150 mm (5.91 in))

Manual profile level

**Navigation**

Setup → Advanced setup → Sensor config → Profile density → Man profile lvl

**Description**

Sets the level position in the tank where the manual profile density operation starts.

**User entry**

-999 999.9 to 999 999.9 mm

**Factory setting**

1 000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>Operator</td>
</tr>
<tr>
<td>Write</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Profile density offset distance

**Navigation**

Setup → Advanced setup → Sensor config → Profile density → Dens offset dist

**Description**

Profile density offset distance [mm] is the distance between start point and first measurement point.

**User entry**

0 to 999 999.9 mm
Operating menu

**Profile density interval**

**Navigation**
Setup → Advanced setup → Sensor config → Profile density → Density interval

**Description**
Sets the interval between two measurement points in profile density operation.

**User entry**
1 to 100,000 mm

**Factory setting**
1,000 mm

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Profile density offset**

**Navigation**
Setup → Advanced setup → Sensor config → Profile density → Prof dens offset

**Description**
Defines an offset value which is added to the measured profile density value.

**User entry**
–999.99 to 999.99 kg/m³

**Factory setting**
0 kg/m³

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
“Display” submenu

This menu is only visible if the device has a local display.

Navigation  ➔ Setup  ➔ Advanced setup  ➔ Display

Language

Navigation  ➔ Setup  ➔ Advanced setup  ➔ Display  ➔ Language

Prerequisite  The device has a local display.

Description  Set display language.

Selection

- English
- Deutsch
- русский язык (Russian)
- 日本語 (Japanese)
- Español
- 中文 (Chinese)

Factory setting  English

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Operator</td>
</tr>
</tbody>
</table>

Format display

Navigation  ➔ Setup  ➔ Advanced setup  ➔ Display  ➔ Format display

Prerequisite  The device has a local display.

Description  Select how measured values are shown on the display.

Selection

- 1 value, max. size
- 1 bargraph + 1 value
- 2 values
- 1 value large + 2 values
- 4 values

Factory setting  2 values

Additional information

4841.000

4841.000

mm

100  "Format display" = "1 value, max. size"
101 "Format display" = "1 bargraph + 1 value"

102 "Format display" = "2 values"

103 "Format display" = "1 value large + 2 values"

104 "Format display" = "4 values"

Read access
Operator

Write access
Operator

- The Value 1 to 4 display (→ 314) parameters specify which measured values are shown on the display and in which order.
- If more measured values are specified than the current display mode permits, the values alternate on the device display. The display time until the next change is configured in the Display interval parameter (→ 317).

Value 1 to 4 display

Navigation
Setup → Advanced setup → Display → Value 1 display

Prerequisite
The device has a local display.
**Description**
Select the measured value that is shown on the local display.

**Selection**
- None
- Tank level
- Measured level
- Level linearized
- Tank level %
- Water level
- Liquid temperature
- Vapor temperature
- Air temperature
- Tank ullage
- Tank ullage %
- Observed density value
- P1 (bottom)
- P2 (middle)
- P3 (top)
- GP 1 value
- GP 2 value
- GP 3 value
- GP 4 value
- Gauge command
- Gauge status
- A1O B1-3 value
- A1O B1-3 value mA
- A1O B1-3 value %
- A1O C1-3 value
- A1O C1-3 value mA
- A1O C1-3 value %
- AIP B4-8 value
- AIP B4-8 value mA
- AIP B4-8 value %
- AIP C4-8 value
- AIP C4-8 value mA
- AIP C4-8 value %

**Factory setting**
Depending on device version

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Decimal places 1 to 4**

**Navigation**
Setup → Advanced setup → Display → Decimal places 1

**Prerequisite**
The device has a local display.

**Description**
This selection does not affect the measurement and calculation accuracy of the device.

---

9) not available for the Value 1 display parameter
Selection

- x
- x.x
- x.xx
- x.xxx
- x.xxxx

Factory setting

x.x

Additional information

The setting does not affect the measuring or computational accuracy of the device.

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Separator

Navigation

Setup → Advanced setup → Display → Separator

Prerequisite

The device has a local display.

Description

Select decimal separator for displaying numerical values.

Selection

- .
- ,

Factory setting

.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Number format

Navigation

Setup → Advanced setup → Display → Number format

Prerequisite

The device has a local display.

Description

Choose number format for the display.

Selection

- Decimal
- ft-in-1/16''

Factory setting

Decimal

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

The ft-in-1/16'' option is only valid for distance values.
Header

Navigation  Setup → Advanced setup → Display → Header

**Prerequisite**  The device has a local display.

**Description**  Select header contents on local display.

**Selection**
- Device tag
- Free text

**Factory setting**  Device tag

**Additional information**

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

**Meaning of the options**
- **Device tag**
  The header contents is defined in the Device tag parameter (→ 191).
- **Free text**
  The header contents is defined in the Header text parameter (→ 317).

Header text

Navigation  Setup → Advanced setup → Display → Header text

**Prerequisite**  Header (→ 317) = Free text

**Description**  Enter display header text.

**User entry**  Character string comprising numbers, letters and special characters (11)

**Factory setting**  TG-Platform

**Additional information**

<table>
<thead>
<tr>
<th></th>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operator</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Display interval

Navigation  Setup → Advanced setup → Display → Display interval

**Description**  Set time measured values are shown on display if display alternates between values.

**User entry**  1 to 10 s

**Factory setting**  5 s
Additional information

This parameter is only relevant if the number of selected measuring values exceeds the number of values the selected display format can display simultaneously.

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Operator</td>
</tr>
</tbody>
</table>

Display damping

Navigation

Setup → Advanced setup → Display → Display damping

Prerequisite

The device has a local display.

Description

Set display reaction time to fluctuations in the measured value.

User entry

0.0 to 999.9 s

Factory setting

0.0 s

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Backlight

Navigation

Setup → Advanced setup → Display → Backlight

Prerequisite

The device has a local display.

Description

Switch the local display backlight on and off.

Selection

- Disable
- Enable

Factory setting

Enable

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Operator</td>
</tr>
</tbody>
</table>

Contrast display

Navigation

Setup → Advanced setup → Display → Contrast display

Prerequisite

The device has a local display.

Description

Adjust local display contrast setting to ambient conditions (e.g. lighting or reading angle)
**User entry**

20 to 80 %

**Factory setting**

30 %

**Additional information**

<table>
<thead>
<tr>
<th>Access Type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Operator</td>
</tr>
</tbody>
</table>
"System units" submenu

Navigation  ➤ Setup → Advanced setup → System units → Units preset

Description
Defines a set of units for length, pressure and temperature.

Selection
- mm, bar, °C
- m, bar, °C
- mm, PSI, °C
- ft, PSI, °F
- ft-in-16, PSI, °F
- ft-in-8, PSI, °F
- Customer value

Factory setting
mm, bar, °C

Additional information

| Read access | Operator |
| Write access | Maintenance |

If the Customer value option is selected, the units are defined in the following parameters. In any other case these are read-only parameters used to indicate the respective unit:
- Distance unit (➔ 320)
- Pressure unit (➔ 321)
- Temperature unit (➔ 321)

Distance unit

Navigation  ➤ Setup → Advanced setup → System units → Distance unit

Description
Select distance unit.

Selection
- SI units
  - m
  - mm
  - cm
- US units
  - ft
  - in
  - ft-in-16
  - ft-in-8

Factory setting
mm

Additional information

| Read access | Operator |
| Write access | Maintenance (if Units preset (➔ 191) = Customer value) |
Pressure unit

Navigation
Setup → Advanced setup → System units → Pressure unit

Selection
- SI units
  - bar
  - Pa
  - kPa
  - MPa
  - mbar
- US units
  - psi
- Other units
  - inH2O
  - inH2O (68°F)
  - ftH2O (68°F)
  - mmH2O
  - mmHg

Factory setting
bar

Additional information
Read access
Operator
Write access
Maintenance (if Units preset (→ 191) = Customer value)

Temperature unit

Navigation
Setup → Advanced setup → System units → Temperature unit

Description
Select temperature unit.

Selection
- SI units
  - °C
  - K
- US units
  - °F
  - °R

Factory setting
°C

Additional information
Read access
Operator
Write access
Maintenance (if Units preset (→ 191) = Customer value)

Density unit

Navigation
Setup → Advanced setup → System units → Density unit

Description
Select density unit.

Selection
- SI units
  - g/cm³
  - g/ml
  - g/l
  - kg/l
  - kg/dm³
  - kg/m³
- US units
  - lb/ft³
  - lb/gal (us)
  - lb/in³
  - STon/yd³
- Other units
  - °API
  - SGU

Factory setting
kg/m³
### Additional information

<table>
<thead>
<tr>
<th>Access Type</th>
<th>Access Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance (if Units preset → 191 = Customer value)</td>
</tr>
</tbody>
</table>
"Date / time" submenu

Navigation

Setup → Advanced setup → Date / time

Date/time

Navigation

Setup → Advanced setup → Date / time → Date/time

Description
Displays the device internal real time clock.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Set date

Navigation

Setup → Advanced setup → Date / time → Set date

Description
Controls the setting of the real-time clock.

Selection
- Please select
- Abort
- Start
- Confirm time

Factory setting
Please select

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Meaning of the options
- Please select
  Prompts the user to select an action.
- Abort
  Discards the entered date and time.
- Start
  Starts the setting of the real time clock.
- Confirm time
  Sets the real-time clock to the entered date and time.

Year

Navigation

Setup → Advanced setup → Date / time → Year

Prerequisite
Set date (→ 323) = Start
Description
Enter the current year.

User entry
2016 to 2079

Factory setting
2016

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Month

Navigation
Setup → Advanced setup → Date / time → Month

Prerequisite
Set date (→ 323) = Start

Description
Enter the current month.

User entry
1 to 12

Factory setting
1

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Day

Navigation
Setup → Advanced setup → Date / time → Day

Prerequisite
Set date (→ 323) = Start

Description
Enter the current day.

User entry
1 to 31

Factory setting
1

Additional information
<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Hour

Navigation
Setup → Advanced setup → Date / time → Hour

Prerequisite
Set date (→ 323) = Start
**Description**
Enter the current hour.

**User entry**
0 to 23

**Factory setting**
0

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

---

**Minute**

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Date / time → Minute</th>
</tr>
</thead>
</table>

**Prerequisite**
Set date (→ 323) = Start

**Description**
Enter the current minute.

**User entry**
0 to 59

**Factory setting**
0

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
“SIL confirmation” wizard

- The **SIL confirmation** wizard is only available for devices with SIL or WHG approval (Feature 590: "Additional Approval", option LA: "SIL" or LC: "WHG overfill prevention") which are currently **not** in the SIL- or WHG-locked state.
- The **SIL confirmation** wizard is required to lock the device according to SIL or WHG. For details refer to the "Functional Safety Manual" of the respective device, which describes the locking procedure and the parameters of this wizard.

**Navigation**

Setup → Advanced setup → SIL confirmation

"Deactivate SIL/WHG" wizard

- The **Deactivate SIL/WHG** wizard is only available for devices with SIL or WHG approval (Feature 590: "Additional Approval", option LA: "SIL" or LC: "WHG overfill prevention") which are currently in the SIL- or WHG-locked state.
- The **Deactivate SIL/WHG** wizard is required to undo the locking of the device according to SIL or WHG. For details refer to the "Functional Safety Manual" of the respective device, which describes the locking procedure and the parameters of this wizard.

**Navigation**

Setup → Advanced setup → Deactiv. SIL/WHG
"Administration" submenu

Navigation
Setup → Advanced setup → Administration

Define access code

Description
Define release code for write access to parameters.

User entry
0 to 9999

Factory setting
0

Additional information

If the factory setting is not changed or 0 is defined as the access code, the parameters are not write-protected and the configuration data of the device can then always be modified. The user is logged on in the Maintenance role.

The write protection affects all parameters marked with the symbol in this document.

Once the access code has been defined, write-protected parameters can only be modified if the access code is entered in the Enter access code parameter (→ 206).

Device reset

Navigation
Setup → Advanced setup → Administration → Device reset

Description
Reset the device configuration - either entirely or in part - to a defined state

Selection
- Cancel
- To factory defaults
- Restart device

Factory setting
Cancel

Additional information

 Meaning of the options
- Cancel
  No action
- To factory defaults
  All parameters are reset to the order-code specific factory setting.
- Restart device
  The restart resets every parameter which is stored in the volatile memory (RAM) to the factory setting (e.g. measured value data). The device configuration remains unchanged.
<table>
<thead>
<tr>
<th>Access Type</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>
15.4  "Diagnostics" menu

**Navigation**  
Diagonstics → Actual diagnos.

**Description**  
Displays the currently active diagnostic message.
If there is more than one pending diagnostic event, the message for the diagnostic event with the highest priority is displayed.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

If several messages are active at the same time, the messages with the highest priority is displayed.

Information on what is causing the message, and remedy measures, can be viewed via the symbol on the display.

**Timestamp**

**Navigation**  
Diagonstics → Timestamp

**Description**  
Displays the timestamp for the currently active diagnostic message.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

**Previous diagnostics**

**Navigation**  
Diagonstics → Prev.diagnostics

**Description**  
Displays the diagnostic message for the last diagnostic event that has ended.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

If several messages are active at the same time, the messages with the highest priority is displayed.

Information on what is causing the message, and remedy measures, can be viewed via the symbol on the display.

### Timestamp

**Navigation**

Diagnostics → Timestamp

**Description**

Displays the timestamp of the diagnostic message generated for the last diagnostic event that has ended.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### Operating time from restart

**Navigation**

Diagnostics → Time fr. restart

**Description**

Indicates how long the device has been in operation since the last time the device was restarted.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

### Operating time

**Navigation**

Diagnostics → Operating time

**Description**

Indicates how long the device has been in operation.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
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</thead>
<tbody>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>
Date/time

Navigation

Diagnosics → Date/time

Description
Displays the device internal real time clock.

Additional information

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
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</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
15.4.1  "Diagnostic list" submenu

Navigation
Diagnostics → Diagnostic list

Description
Displays the currently active diagnostic message with the highest priority.

Additional information
The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

Timestamp 1 to 5

Navigation
Diagnostics → Diagnostic list → Timestamp 1 to 5

Description
Timestamp of the diagnostic message.
15.4.2  "Device information" submenu

Navigation  Diagnostics → Device info

Device tag

Description  Shows the device tag.
User interface  Character string comprising numbers, letters and special characters
Factory setting  None
Additional information  
<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

Serial number

Description  The serial number is a unique alphanumerical code identifying the device. It is printed on the nameplate. In combination with the Operations app it allows to access all device related documentation.
Additional information  
<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

Firmware version

Description  Displays the device firmware version installed.
Additional information  
<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>
## Firmware CRC

**Navigation**
```
Diagnoses → Device info → Firmware CRC
```

**Description**
Result of the cyclic redundancy check of the firmware.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

## Weight and measures configuration CRC

**Navigation**
```
Diagnoses → Device info → W&M config CRC
```

**Description**
Result of the cyclic redundancy check of the weights and measure relevant parameters.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

## Device name

**Navigation**
```
Diagnoses → Device info → Device name
```

**Description**
Use this function to display the device name. It can also be found on the nameplate.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>-</td>
</tr>
</tbody>
</table>

## Order code

**Navigation**
```
Diagnoses → Device info → Order code
```

**Description**
Shows the device order code.

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>Service</td>
</tr>
</tbody>
</table>
Extended order code 1 to 3

Navigation
Diagnostics → Device info → Ext. order cd. 1

Description
Display the three parts of the extended order code.

User interface
Character string comprising numbers, letters and special characters

Additional information

<table>
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</thead>
<tbody>
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</tr>
<tr>
<td>Write access</td>
<td>Service</td>
</tr>
</tbody>
</table>

The extended order code indicates the selected option of all ordering features and thus uniquely identifies the device.
15.4.3  "Simulation" submenu

<table>
<thead>
<tr>
<th>Read access</th>
<th>Maintenance</th>
</tr>
</thead>
</table>

**Device alarm simulation**

**Navigation**

.Diagnostics → Simulation → Dev. alarm sim.

**Description**

Switch the device alarm on and off.

**Selection**

- Off
- On

**Factory setting**

Off

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

To terminate the simulation, select Off.

**Diagnostic event simulation**

**Navigation**

.Diagnostics → Simulation → Diagnostic event

**Description**

Select a diagnostic event to simulate this event.

**Selection**

The diagnostic events of the device

**Factory setting**

Off

**Additional information**

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Write access</td>
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</tr>
</tbody>
</table>

**Simulation distance on**

**Navigation**

.Diagnostics → Simulation → Sim distance on

**Description**

Switches the distance simulation on or off.

**Selection**

- Off
- On
### Factory setting

**Off**

### Additional information

<table>
<thead>
<tr>
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<td>Read</td>
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</tr>
<tr>
<td>Write</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

### Simulation distance

**Navigation**  
Diagnostics → Simulation → Sim distance

**Prerequisite**  
Simulation distance on (→ 336) = On

**Description**  
Defines the distance value to be simulated.

**User entry**  
Signed floating-point number

**Factory setting**  
0 mm

### Current output N simulation

**Navigation**  
Diagnostics → Simulation → Curr.outp N sim.

**Prerequisite**  
- The device has an Anlog I/O module.
- Operating mode (→ 221) = 4..20mA output or HART slave +4..20mA output

**Description**  
Switches the simulation of the current on or off.

**Selection**  
- Off
- On

**Factory setting**  
Off

### Simulation value

**Navigation**  
Diagnostics → Simulation → Simulation value

**Prerequisite**  
Current output simulation (→ 337) = On

**Description**  
Defines the current to be simulated.
Operating menu

Proservo NMS81

**User entry** 3.4 to 23 mA

**Factory setting** The current at the time the simulation was started.

**Additional information**

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<tr>
<th>Access</th>
<th>Role</th>
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<tbody>
<tr>
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<td>Write access</td>
<td>Maintenance</td>
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</tbody>
</table>
15.4.4 "Device check" submenu

Navigation

Diagnostics → Device check

Result drum check

Description

Gives feedback on the latest status of the commissioning check.

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<th>Permission</th>
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</thead>
<tbody>
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<td>Operator</td>
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<td>Write access</td>
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</tbody>
</table>
"Commissioning check" wizard

Navigation ➔ Diagnostics → Device check → Commission check

Comissioning check

**Navigation**

Diagnostics → Device check → Commission check → Commission check

**Description**

This sequence supports checking of the hardware on sensor side and correct installation of the sensor.

**Additional information**

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<thead>
<tr>
<th>Access</th>
<th>Role</th>
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</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

Result drum check

**Navigation**

Diagnostics → Device check → Commission check → Result drum chk

**Description**

Gives feedback on the latest status of the commissioning check.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read access</td>
<td>Operator</td>
</tr>
<tr>
<td>Write access</td>
<td>-</td>
</tr>
</tbody>
</table>

Step X / 11

**Navigation**

Diagnostics → Device check → Commission check → Step X / 11

**Description**

Indicates which step of the commissioning check is currently running.

**Additional information**

<table>
<thead>
<tr>
<th>Access</th>
<th>Role</th>
</tr>
</thead>
<tbody>
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<tr>
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</tbody>
</table>
15.4.5 "LRC 1 to 2" submenu

Configuration of the level reference check (LRC) function → 119

Navigation  Diagnostics → LRC → LRC 1 to 2

### LRC Mode

**Navigation**  Diagnostics → LRC → LRC 1 to 2 → LRC Mode

**Description** Activates or deactivates one of the level reference check (LRC) modes.

**Selection**
- Off
- Compare with level device
- Compare with level switch
- Measure reference point *

**Factory setting** Off

**Additional information**

<table>
<thead>
<tr>
<th>Read access</th>
<th>Write access</th>
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</thead>
<tbody>
<tr>
<td>Operator</td>
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</tbody>
</table>

**Additional information** The option of the Measure reference point is not available for NMS8x.

### Allowed difference

**Navigation**  Diagnostics → LRC → LRC 1 to 2 → Allowed diff.

**Description** Defines the allowed difference between the tank level and the reference.

**User entry** 1 to 1 000 mm

**Factory setting** 10 mm

**Additional information**

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<tbody>
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</table>

* Visibility depends on order options or device settings
Check fail threshold

**Navigation**
Diagnostics → LRC → LRC 1 to 2 → Fail threshold

**Description**
Defines how many minutes the comparison has to fail before the check is failed. Note: Only for mode "Compare with level device".

**User entry**
1 to 60

**Factory setting**
3

**Additional information**

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<tr>
<td>Write access</td>
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</table>

Reference level source

**Navigation**
Diagnostics → LRC → LRC 1 to 2 → Reference source

**Description**
Defines the source for the reference level. Note: Only for mode "Compare with level device".

**Selection**
- No input value
- HART device 1 level *
- HART device 2 level *
- HART device 3 level *
- HART device 4 level *
- HART device 5 level *
- HART device 6 level *
- HART device 7 level *
- HART device 8 level *
- HART device 9 level *
- HART device 10 level *
- HART device 11 level *
- HART device 12 level *
- HART device 13 level *
- HART device 14 level *
- HART device 15 level *

**Factory setting**
No input value

**Additional information**

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* Visibility depends on order options or device settings
Reference switch source

**Navigation**
Diagnostics → LRC → LRC 1 to 2 → Reference source

**Description**
Defines the source for the reference switch. Note: Only for mode "Compare with level switch".

**Selection**
- None
- Digital A1-2
- Digital A3-4
- Digital B1-2
- Digital B3-4
- Digital C1-2
- Digital C3-4
- Digital D1-2
- Digital D3-4

**Factory setting**
None

**Additional information**

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Reference switch mode

**Navigation**
Diagnostics → LRC → LRC 1 to 2 → Ref. switch mode

**Description**
Defines the switch direction for which the reference check is executed. Note: Only for mode "Compare with level switch".

**Selection**
- Active -> Inactive
- Inactive -> Active

**Factory setting**
Active -> Inactive

**Additional information**

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Reference level

**Navigation**
Diagnostics → LRC → LRC 1 to 2 → Reference level

**Description**
Shows the current reference level. Note: Only for mode "Compare with level device".

**User interface**
Signed floating-point number

**Factory setting**
0 mm
Additional information

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Reference switch level

Navigation

Diagnostics → LRC → LRC 1 to 2 → Reference level

Description

Defines the position of the reference switch as level. Note: Only for mode “Compare with level switch”.

User entry

0 to 10000.00 mm

Factory setting

0 mm

Additional information

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Reference switch state

Navigation

Diagnostics → LRC → LRC 1 to 2 → Ref.switch state

Description

Shows the current state of the reference switch (e.g. "active"). Note: Only for mode “Compare with level switch”.

User interface

- Unknown
- Inactive
- Active
- Error

Factory setting

Unknown

Additional information

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Check level

Navigation

Diagnostics → LRC → LRC 1 to 2 → Check level

Description

Shows the tank level at which the reference check has been executed.

User interface

Signed floating-point number

Factory setting

0 mm
### Check status

**Navigation**

Diagnotics → LRC → LRC 1 to 2 → Check status

**Description**

Shows the status of the reference check execution (e.g. "passed").

**User interface**

- not executed
- Passed
- Failed
- Not possible

**Factory setting**

not executed

**Additional information**

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</table>

### Check timestamp

**Navigation**

Diagnotics → LRC → LRC 1 to 2 → Check timestamp

**Description**

Shows the timestamp at which the reference check has been executed.

**User interface**

Character string comprising numbers, letters and special characters

**Factory setting**

**Additional information**

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