Operating Instructions

Micropilot FMR20 MODBUS RS485

Free space radar
For bulk solids
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1 About this document

1.1 Document function
These Operating Instructions provide all of the information that is required in various phases of the life cycle of the device including:
- Product identification
- Incoming acceptance
- Storage
- Installation
- Connection
- Operation
- Commissioning
- Troubleshooting
- Maintenance
- Disposal

1.2 Symbols used

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 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

ℹ️ Tip
Indicates additional information

🔗 Reference to documentation

🔗 Reference to graphic

⚠️ Notice or individual step to be observed

1, 2, 3
Series of steps
Result of a step

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

1.3  Documentation

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

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

- W@M Device Viewer (www.endress.com/deviceviewer): Enter the serial number from nameplate
- Endress+Hauser Operations App: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the 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  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.

ℹ️ The nameplate indicates the Safety Instructions (XA) that are relevant to the device.
1.4 Terms and abbreviations

BA
Document type "Operating Instructions"

KA
Document type "Brief Operating Instructions"

TI
Document type "Technical Information"

SD
Document type "Special Documentation"

XA
Document type "Safety Instructions"

PN
Nominal pressure

MWP
MWP (Maximum working pressure/max. process pressure)
The MWP can also be found on the nameplate.

ToF
Time of Flight

ε_r (Dk value)
Relative dielectric constant

Operating tool
The term "operating tool" is used in place of the following operating software:
SmartBlue (app), for operation using an Android or iOS smartphone or tablet

RTU
Remote Transmit Unit

BD
Blocking Distance; no signals are analyzed within the BD.

PLC
Programmable logic controller (PLC)

CDI
Common Data Interface

1.5 Registered trademarks

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

Apple®
Apple, the Apple logo, iPhone, and iPod touch are trademarks of Apple Inc., registered in
the U.S. and other countries. App Store is a service mark of Apple Inc.

Android®
Android, Google Play and the Google Play logo are trademarks of Google Inc.

Bluetooth®
The Bluetooth® word mark and logos are registered trademarks owned by the Bluetooth
SIG, Inc. and any use of such marks by Endress+Hauser is under license. Other trademarks
and trade names are those of their respective owners.
2 Basic safety instructions

2.1 Requirements for 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.
- Personnel must be authorized by the plant owner/operator.
- Be familiar with federal/national regulations.
- Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:

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

2.2 Intended use

Application and media

The measuring device described in these Operating Instructions is intended for continuous, non-contact level measurement of solids. Because of its operating frequency of approx. 26 GHz, a maximum radiated pulsed power of 5.7 mW and an average power output of 0.015 mW, use outside of closed, metallic vessels is also permitted. If operated outside of closed vessels, the device must be mounted in accordance with the instructions in the "Installation" section. The operation of the devices does not present any health risk.

If the limit values specified in the "Technical data" and the conditions listed in the manual and additional documentation are observed, the measuring device may be used for the following measurements only:

- Measured process variables: distance
- Calculable process variables: volume or mass in any shape of vessel

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

- Use the measuring device only for media to which the process-wetted materials have an adequate level of resistance.
- Observe the limit values (see "Technical data").

Incorrect use

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

Clarification of borderline cases:

- With regard to special media and media used for cleaning, please contact the manufacturer. Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials but does not accept any warranty or liability.

Residual risks

Due to heat transfer from the process as well as power dissipation within the electronics, the temperature of the electronics housing and the assemblies contained therein may rise to 80 °C (176 °F) during operation. When in operation, the sensor can reach a temperature close to the medium temperature.

Danger of burns from contact with surfaces!

- In the event of elevated medium temperatures, ensure protection against contact 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 the risk of danger to persons or the facility when the device is used in the approval-related area (e.g. explosion protection, pressure equipment safety):
› Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area.
› Observe the specifications in the separate supplementary documentation that is an integral part of this manual.

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 general safety standards and legal requirements.

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 along 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 together with the standards applied.
The manufacturer confirms successful testing of the device by affixing to it the EAC mark.
2.6  IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

2.7  Device-specific IT security

2.7.1  Access via Bluetooth® wireless technology

Signal transmission via Bluetooth® wireless technology uses a cryptographic technique tested by Fraunhofer AISEC

- The device is not visible via Bluetooth® wireless technology without the SmartBlue App
- Only one point-to-point connection between one sensor and one smartphone or tablet is established
- The Bluetooth® wireless technology interface can be disabled via SmartBlue
3  Product description

3.1  Product design

1  Overview of materials

80 mm (3 in) antenna
1  Sensor housing; PVDF
2  Seal; EPDM
3  Process connection, rear side; PVDF
4  Cable gland; PA
5  Conduit adapter; CuZn nickel-plated
6  O-ring; EPDM
7  Counter nut; PA6.6
8  Design ring; PBT-PC
9  Process connection, front side; PVDF
4  Incoming acceptance and product identification

4.1  Goods acceptance
Check the following during goods acceptance:
- 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) provided?

If one of these conditions is not met, please contact the manufacturer's sales office.

4.2  Product identification
The following options are available for the identification of the measuring device:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note

▶ Enter the serial number from the nameplates into W@M Device Viewer
  (www.endress.com/deviceviewer)
  All the information about the measuring device and the scope of the associated
  Technical Documentation are displayed.

▶ Enter the serial number from the nameplate into the Endress+Hauser Operations App
  or use the Endress+Hauser Operations App to scan the 2-D matrix code (QR Code)
  provided on the nameplate
  All the information about the measuring device and the scope of the associated
  Technical Documentation are displayed.

4.3  Manufacturer address
Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany
Place of manufacture: See nameplate.
## 4.4 Nameplate

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manufacturer address</td>
</tr>
<tr>
<td>2</td>
<td>Device name</td>
</tr>
<tr>
<td>3</td>
<td>Order code</td>
</tr>
<tr>
<td>4</td>
<td>Serial number (Ser. no.)</td>
</tr>
<tr>
<td>5</td>
<td>Extended order code (Ext. ord. cd.)</td>
</tr>
<tr>
<td>6</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>7</td>
<td>Signal outputs</td>
</tr>
<tr>
<td>8</td>
<td>Process pressure</td>
</tr>
<tr>
<td>9</td>
<td>Permitted ambient temperature ($T_a$)</td>
</tr>
<tr>
<td>10</td>
<td>Maximum process temperature</td>
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<tr>
<td>11</td>
<td>Device ID</td>
</tr>
<tr>
<td>12</td>
<td>Firmware version (FW)</td>
</tr>
<tr>
<td>13</td>
<td>Device revision (Dev.Rev.)</td>
</tr>
<tr>
<td>14</td>
<td>CE mark</td>
</tr>
<tr>
<td>15</td>
<td>Additional information about the device version (certificates, approvals)</td>
</tr>
<tr>
<td>16</td>
<td>RCM</td>
</tr>
<tr>
<td>17</td>
<td>Materials in contact with process</td>
</tr>
<tr>
<td>18</td>
<td>Logo</td>
</tr>
<tr>
<td>19</td>
<td>Degree of protection: e.g. IP, NEMA</td>
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<tr>
<td>20</td>
<td>Certificate symbol</td>
</tr>
<tr>
<td>21</td>
<td>Certificate- and approval-specific data</td>
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<tr>
<td>22</td>
<td>Document number of the Safety Instructions: e.g. XA, ZD, ZE</td>
</tr>
<tr>
<td>23</td>
<td>Modification mark</td>
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<tr>
<td>24</td>
<td>2-D matrix code (QR code)</td>
</tr>
<tr>
<td>25</td>
<td>Date of manufacture: year-month</td>
</tr>
</tbody>
</table>

Up to 33 characters of the extended order code are indicated on the nameplate. If the extended order code contains additional characters, these cannot be displayed.

However, the complete extended order code can also be displayed via the device operating menu: **Extended order code 1 to 3 parameter**
5 Installation

5.1 Installation conditions

5.1.1 Installation types

![Diagram of installation types]

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<td>Wall or ceiling mounting, adjustable</td>
</tr>
<tr>
<td>B</td>
<td>Mounted at rear thread</td>
</tr>
<tr>
<td>C</td>
<td>Horizontal installation in cramped spaces</td>
</tr>
<tr>
<td>D</td>
<td>Ceiling installation with counter nut (included in delivery)</td>
</tr>
<tr>
<td>E</td>
<td>Installation with adjustable flange seal</td>
</tr>
<tr>
<td>F</td>
<td>Installation with FAU40 alignment unit</td>
</tr>
</tbody>
</table>

**Caution!**

- The sensor cables are not designed as supporting cables. Do not use them for suspension purposes.
- Always operate the device in a vertical position in free-space applications.

5.1.2 Nozzle installation

The antenna should project out of the nozzle for optimum measurement. The interior of the nozzle must be smooth and may not contain any edges or welded joints. The edge of the nozzle should be rounded if possible.
The maximum nozzle length $L$ depends on the nozzle diameter $D$. Please note the limits for the diameter and length of the nozzle.

**80 mm (3 in) antenna, installation inside nozzle**
- $D$: min. 120 mm (4.72 in)
- $L$: max. 205 mm (8.07 in) + $D \times 4.5$

**80 mm (3 in) antenna, installation outside nozzle**
- $D$: min. 80 mm (3 in)
- $L$: max. $D \times 4.5$

### 5.1.3 Position for installation on a vessel

- If possible install the sensor so that its lower edge is inside the vessel.
- Recommended distance $A$ wall - nozzle outer edge: $\approx \frac{1}{6}$ of the vessel diameter. Under no circumstances should the device be mounted closer than 15 cm (5.91 in) to the vessel wall.
- Do not install the sensor in the middle of the vessel.
- Avoid measurements through the filling curtain.
- Avoid internal fixtures such as limit switches.
- No signals are evaluated within the Blocking distance (BD). It can therefore be used to suppress interference signals (e.g. the effects of condensate) in the vicinity of the antenna.

An automatic Blocking distance of at least 0.1 m (0.33 ft) is configured as standard. However, this can be overwritten manually (0 m (0 ft) is also permitted).

Automatic calculation:
Blocking distance = Empty calibration - Full calibration - 0.2 m (0.656 ft).
Each time a new entry is made in the Empty calibration parameter or Full calibration parameter, the Blocking distance parameter is recalculated automatically using this formula.
If the result of the calculation is a value <0.1 m (0.33 ft), the Blocking distance of 0.1 m (0.33 ft) will continue to be used.

### 5.1.4 Device alignment for installation on a vessel

- Align the antenna so that it is perpendicular to the product surface
- Align the eyelet with lug towards the vessel wall as well as possible
To avoid disturbance echoes, use metal plates installed at an angle (where necessary)

5.1.5 Beam angle

The beam angle is defined as the angle $\alpha$ at which the power energy of the radar waves reaches half the value of the maximum power density (3dB width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations.

Beam diameter $W$ as a function of beam angle $\alpha$ and distance $D$. 

\[
W = 2 \times D \times \tan \left( \frac{\alpha}{2} \right)
\]
80 mm (3 in) antenna with or without a flooding protection tube, α 12°

\[ W = D \times 0.21 \]

5.1.6 Measurement in plastic vessels

![Diagram showing measurement in a plastic vessel with a metallic, interfering installation outside of the vessel.]

1. Pipe, tubing
2. Ladder
3. Grate, railing

If the outer wall of the vessel is made of a non-conductive material (e.g. GFR), microwaves can also be reflected by interfering installations outside of the vessel.

**Optimization options**
- **Adjustable flange seal:** The device can be aligned with the product surface using the adjustable flange seal.
- **Alignment unit:**
  In the case of devices with an alignment unit, the sensor can be optimally aligned with the conditions at the vessel. The maximum angle \( \beta \) is \( \pm 15° \).
  The purpose of sensor alignment is primarily to:
  - Prevent interference reflections
  - Increase the maximum possible measuring range in conical outlets
  - Please ensure there are no interfering installations made of a conductive material in the signal beam (see the beam angle section for information on calculating the beamwidth diameter).

For more information: contact the Endress+Hauser sales organization.

5.1.7 Weather protection cover

A weather protection cover is recommended for outdoor use.

The weather protection cover can be ordered as an accessory or together with the device via the product structure "Accessory enclosed".
The sensor is not completely covered by the weather protection cover.

5.1.8 Use of flooding protection tube

In free-field installations and/or in applications where there is a risk of flooding, the flooding protection tube must be used.

Optimum results are achieved with coarse-grained material and the use of the flooding protection tube.

The flooding protection tube can be ordered as an accessory or together with the device via the product structure 'Accessory enclosed'.

The tube is screwed directly onto the sensor and seals off the system by means of an O-ring making it air-tight. In the event of flooding, the empty space that develops in the tube
ensures a defined detection of the maximum level directly at the end of the tube. Due to the fact that the Blocking distance is inside the tube, multiple echoes are not analyzed.

Configuration parameters for flooding protection tube

Configuring the blocking distance when using the flooding protection tube

- Navigate to: Main menu → Setup → Advanced setup → Blocking distance
  - Enter 100 mm (4 in).

Perform a mapping after the flooding protection tube has been installed and the blocking distance has been configured

1. Navigate to: Setup → Confirm distance
   - Compare the distance displayed with the actual value in order to start the recording of an interference echo map.

2. Navigate to: Setup → Mapping end point
   - This parameter determines the distance up to which the new mapping is to be recorded.

3. Navigate to: Setup → Present mapping
   - Displays the distance up to which a mapping has already been recorded.

5.1.9  Installation with mounting bracket, adjustable

The mounting bracket can be ordered as an accessory or together with the device via the product structure 'Accessory enclosed'.

- Wall or ceiling installation is possible.
- Using the mounting bracket, position the antenna so that it is perpendicular to the product surface.

**NOTICE**

There is no conductive connection between the mounting bracket and transmitter housing. Electrostatic charging possible.

- Integrate the mounting bracket in the local potential equalization system.

5.1.10  Cantilever installation, with pivot

The cantilever, wall bracket and mounting frame are available as accessories.
5.1.11  **Installation with the horizontal mounting bracket**

The mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".

5.1.12  **Installation with pivotable mounting bracket**

The pivotable mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".
5.1.13 **FAU40 alignment unit**

An angle of inclination of up to 15° in all directions can be set for the antenna axis using the FAU40 alignment unit. The alignment unit is used to optimally direct the radar beam at the bulk solids.

The FAU40 alignment unit is available as an accessory.

![FAU40 alignment unit](image1.jpg)

5.1.14 **Adjustable flange seal**

The radar beam can be optimally directed at the bulk solids using the adjustable flange seal.

The adjustable flange seal can be ordered together with the device via the product structure "Accessory enclosed".

![Adjustable flange seal](image2.jpg)

5.2 **Post-installation check**

- Is the device or cable undamaged (visual inspection)?
- Is the device adequately protected from wet conditions and direct sunlight?
- Is the device properly secured?
6 Electrical connection

6.1 Cable assignment

![Diagram of FMR20 cable assignment, Modbus](image)

1. Plus, brown wire
2. Minus, blue wire
3. Modbus D0/A (+), white wire
4. Modbus D1/B (-), black wire

6.2 Supply voltage

5 to 30 V\textsubscript{DC}

An external power supply is necessary.

Battery operation
The sensor's Bluetooth\textsuperscript{®} wireless technology communication can be disabled to increase the operating life of the battery.

Potential equalization
No special measures for potential equalization are required.

Various power supply units can be ordered as an accessory from Endress+Hauser.

6.3 Connecting the device

6.3.1 Block circuit diagram for Modbus RS485 connection

The RS485 connection meets the requirements of the RS485-IS specification for use in hazardous environments.
Electrical connection

19 Block circuit diagram for Modbus RS485 connection
1 Device with Modbus communication
2 Modbus master/RTU
3 Power supply

Up to 32 users can be connected on the RS485 bus.

The bus cable should be a type-A fieldbus cable with a maximum length of 1200 m (3937 ft).

If the device is installed in a hazardous environment, the cable length may not exceed 1000 m (3281 ft).

A terminating resistor must be connected at both ends of the RS485 bus.

6.3.2 Modbus RS485 bus terminating resistor
The bus terminating resistor should be installed as per the RS485-IS specification.

21 Representation of the bus terminating resistor as per the RS485-IS specification
6.4 Post-connection check

- Is the device or cable undamaged (visual inspection)?
- Do the mounted cables have adequate strain relief?
- Are the cable glands mounted and firmly tightened?
- Does the supply voltage match the specifications on the nameplate?
- No reverse polarity, is terminal assignment correct?
7 Operability

7.1 Operating concept
- Modbus
- SmartBlue (app) via Bluetooth® wireless technology
- Menu guidance with brief explanations of the individual parameter functions in the operating tool

7.2 Operation via Bluetooth® wireless technology

![Diagram of remote operation via Bluetooth® wireless technology]

Possibilities for remote operation via Bluetooth® wireless technology:
1. Transmitter power supply unit
2. Smartphone / tablet with SmartBlue (app)
3. Transmitter with Bluetooth® wireless technology

7.3 Remote operation via Modbus protocol

![Diagram of remote operation via Modbus protocol]

Options for remote operation via Modbus protocol:
1. Computer with Modbus operating tool (customer application, terminal application, etc.)
2. Remote Transmit Unit (RTU) with Modbus (e.g. Fieldgate FXA42)
3. Memograph M RSG45
4. Modbus RS485
5. Smartphone / tablet with SmartBlue (app)
6. Transmitter with Modbus and Bluetooth® wireless technology
8 System integration via Modbus protocol

8.1 Modbus RS485 information

8.1.1 Modbus settings

The following settings can be customized via Bluetooth and Modbus.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Options</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data bits</td>
<td>7,8</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>Even, odd, none</td>
<td>Even</td>
</tr>
<tr>
<td>Stop bits</td>
<td>1,2</td>
<td>1</td>
</tr>
<tr>
<td>Baud rate</td>
<td>1200, 2400, 4800, 9600, 19200</td>
<td>9600</td>
</tr>
<tr>
<td>Protocol</td>
<td>RTU, ASCII</td>
<td>RTU</td>
</tr>
<tr>
<td>Addressing</td>
<td>1 to 200</td>
<td>200</td>
</tr>
<tr>
<td>Minimum polling interval</td>
<td>500 ms</td>
<td></td>
</tr>
</tbody>
</table>

8.1.2 Modbus function codes

<table>
<thead>
<tr>
<th>Function code</th>
<th>Action</th>
<th>Register type</th>
<th>Command type</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 (0x03)</td>
<td>Single / multiple read</td>
<td>Holding Register</td>
<td>Standard</td>
</tr>
<tr>
<td>06 (0x06)</td>
<td>Single write</td>
<td>Holding Register</td>
<td>Standard</td>
</tr>
<tr>
<td>16 (0x10)</td>
<td>Multiple write</td>
<td>Holding Register</td>
<td>Standard</td>
</tr>
</tbody>
</table>

8.1.3 Modbus exceptions

<table>
<thead>
<tr>
<th>Exception</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB_EX_ILLEGAL_FUNCTION</td>
<td>01 (0x01)</td>
<td>Function code is not supported</td>
</tr>
<tr>
<td>MB_EX_ILLEGAL_DATA_ADDRESS</td>
<td>02 (0x02)</td>
<td>Register address is not available</td>
</tr>
<tr>
<td>MB_EX_ILLEGAL_DATA_VALUE</td>
<td>03 (0x03)</td>
<td>Data value is not permitted (e.g. writing of a float32 to a char8 register). Also valid for writing to read-only registers.</td>
</tr>
</tbody>
</table>

8.1.4 Modbus special data types

<table>
<thead>
<tr>
<th>Data type</th>
<th>Registers per parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>float32 (IEEE754)</td>
<td>2</td>
<td>As a float32 consists of four bytes, a parameter with float32 as the data type must be divided into two 16-bit words that are transmitted via Modbus. To read a float32-type parameter, two consecutive Modbus registers therefore must be read.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modbus register [n]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modbus register [n+1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Byte A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Byte B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Byte C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Byte D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>float32 value</td>
</tr>
<tr>
<td>uint32 / int32</td>
<td>2</td>
<td>The same conditions that apply for float32 data types also apply for uint32 / int32 data types.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modbus register [n]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modbus register [n+1]</td>
</tr>
</tbody>
</table>
Data type | Registers per parameter | Description |
---|---|---|
String (char8 array) | 0.5 | As a single character of a character string only needs one byte, two characters are always packed into a Modbus register. Furthermore, the length of a parameter with string as the data type is limited to 60 characters. |

<table>
<thead>
<tr>
<th>Modbus address</th>
<th>Parameter name</th>
<th>Description</th>
<th>SI unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>MODB_PV_VALUE</td>
<td>Level linearized (PV)</td>
<td>Depends on the type of linearization</td>
</tr>
<tr>
<td>5002</td>
<td>MODB_SV_VALUE</td>
<td>Distance (SV)</td>
<td>m</td>
</tr>
<tr>
<td>5004</td>
<td>MODB_TV_VALUE</td>
<td>Relative echo amplitude (TV)</td>
<td>dB</td>
</tr>
<tr>
<td>5006</td>
<td>MODB_QV_VALUE</td>
<td>Temperature (QV)</td>
<td>°C</td>
</tr>
<tr>
<td>5008</td>
<td>MODB_SIGNALQUALITY</td>
<td>Signal quality</td>
<td>-</td>
</tr>
<tr>
<td>5010</td>
<td>MODB_ACTUALDIAGNOSTICS</td>
<td>Current diagnostics number</td>
<td>-</td>
</tr>
<tr>
<td>5012</td>
<td>MODB_LOCATION_LONGITUDE</td>
<td>Longitude coordinate</td>
<td>°</td>
</tr>
<tr>
<td>5014</td>
<td>MODB_LOCATION_LATITUDE</td>
<td>Latitude coordinate</td>
<td>°</td>
</tr>
</tbody>
</table>

8.2 Measured variables via Modbus protocol

The 8 most important process parameters are mapped as burst parameters to the first addresses in the Modbus address range. This means that these parameters can be read out in one measurement transmission. All parameters are available in the Float32 format.

The register address must be incremented by one (register address +1) when using the Memograph M RSG45 or Fieldgate FXA30b Modbus master. This can also apply for other masters.
9 Commissioning and operation

9.1 Installation and function check
Perform the post-installation check and the post-connection check prior to commissioning.

9.1.1 Post-installation check
- Is the device or cable undamaged (visual inspection)?
- Is the device adequately protected from wet conditions and direct sunlight?
- Is the device properly secured?

9.1.2 Post-connection check
- Is the device or cable undamaged (visual inspection)?
- Do the mounted cables have adequate strain relief?
- Are the cable glands mounted and firmly tightened?
- Does the supply voltage match the specifications on the nameplate?
- No reverse polarity, is terminal assignment correct?

9.2 Commissioning via SmartBlue (App)

9.2.1 Device requirements
Commissioning via SmartBlue is only possible if the device has Bluetooth capability (Bluetooth module installed at the factory prior to delivery or retrofitted).

9.2.2 SmartBlue system requirements
SmartBlue is available as a download from the Google Play Store for Android devices and from the iTunes Store for iOS devices.
- Devices with iOS:
  - iPhone 4S or higher from iOS 9; iPad 2 or higher from iOS 9; iPod touch 5th generation or higher from iOS 9
- Devices with Android:
  - From Android 4.4 KitKat and Bluetooth® 4.0

9.2.3 SmartBlue App
1. Scan the QR code or enter "SmartBlue" in the search field of the App Store.
2. Start SmartBlue.
3. Select device from livelist displayed.
4. Enter the login data:
   - User name: admin
   - Password: serial number of the device

5. Tap the icons for more information.

After logging in for the first time, change the password!

9.2.4   Envelope curve display in SmartBlue

Envelope curves can be displayed and recorded in SmartBlue.

In addition to the envelope curve, the following values are displayed:
   - D = Distance
   - L = Level
   - A = Absolute amplitude
   - With screenshots, the displayed section (zoom function) is saved
   - With video sequences, the whole area without zoom function is saved all the time

![Envelope curve display (sample) in SmartBlue for Android](image)

1. Record video
2. Create screenshot
3. Display mapping menu
4. Start/stop video recording
5. Move time on time axis
26 Envelope curve display (sample) in SmartBlue for iOS

1. Record video
2. Create screenshot
3. Display mapping menu
4. Start/stop video recording
5. Move time on time axis

9.3 Configuring level measurement via operating software

27 Configuration parameters for level measurement in bulk solids

- **R** Reference point of measurement
- **D** Distance
- **L** Level
- **E** Empty calibration (= zero point)
- **F** Full calibration (= span)
- **BD** Blocking distance

9.3.1 Via SmartBlue

1. Navigate to: Setup → Distance unit
   - Select unit of length for distance calculation
2. Navigate to: Setup → Empty calibration
   - Specify empty distance E (distance from reference point R to minimum level)
3. Navigate to: Setup → Full calibration
   ➔ Specify full distance F (span: max. level - min. level)

4. Navigate to: Setup → Distance
   ➔ Shows the distance D that is currently measured from the reference point (lower edge of flange / last sensor thread) to the level

5. Navigate to: Setup → Confirm distance
   ➔ Compare the distance displayed with the actual value in order to start the recording of an interference echo map

6. Navigate to: Setup → Mapping end point
   ➔ This parameter determines the distance up to which the new mapping is to be recorded

7. Navigate to: Setup → Present mapping
   ➔ Displays the distance up to which a mapping has already been recorded

8. Setup → Confirm distance

9. Navigate to: Setup → Level
   ➔ Shows the level L measured

10. Navigate to: Setup → Signal quality
    ➔ Displays the signal quality of the analyzed level echo

9.3.2 Via Modbus

1. Navigate to: Modbus Register 5262 (float32) (LE_EMPTY)
   ➔ Write empty distance E

2. Navigate to: Modbus Register 5264 (float32) (LE_FULL)
   ➔ Write full distance F (span: max. level - min. level)

3. Navigate to: Modbus Register 5105 (float32) (LCRS_DISTANCE_VALUE)
   ➔ Shows the distance D that is currently measured from the reference point (lower edge of flange / last sensor thread) to the level

4. If distance is o.k.:
   Navigate to: Distance ok → Modbus Register 5266 (uint16) (LCRS_DISTANCESELECTIONCONTROL)
   ➔ Write distance ok (value: 32859)
   ➔ MAP is recorded

5. If distance is not o.k.:
   Navigate to: Distance ok → Modbus Register 5266 (uint16) (LCRS_DISTANCESELECTIONCONTROL)
   ➔ Start manual recording of MAP (value: 179)

6. Navigate to: Modbus Register 5267 (float32) (LCRS_MAPPING_ENDPOINTCTRL)
   ➔ Write real distance - 0.1m
   ➔ MAP is recorded up to this distance

7. End mapping → Modbus Register 5266 (uint16) (LCRS_DISTANCESELECTIONCONTROL)
   ➔ Write end mapping (value: 32862)

8. Or: do nothing
   ➔ No mapping recorded -> factory settings are used.
9.3.3 Displaying level value as %

A standardized signal which is in proportion to the level, e.g. 0 to 100 % level, can be calculated with Full calibration.

<table>
<thead>
<tr>
<th>X</th>
<th>Level</th>
<th>Y</th>
<th>Output signal as %</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>0.00 m (0.00 ft)</td>
<td>Y1</td>
<td>0 %</td>
</tr>
<tr>
<td>X2</td>
<td>Value F (=Full)</td>
<td>Y2</td>
<td>100 %</td>
</tr>
</tbody>
</table>

Configuration with Modbus

1. Navigate to: Modbus Register 5284 (float32)
   - X1 = Specify level value in m / ft for 0 %
2. Navigate to: Modbus Register 5286 (float32)
   - Enter Y1 = 0 %
3. Navigate to: Modbus Register 5288 (float32)
   - X2 = Specify level value in m / ft for 100 %
4. Navigate to: Modbus Register 5290 (float32)
   - Enter Y2 = 100 %
5. Navigate to: Modbus Register 5282 (uint16) (UIDHPM_LE_CSTLINTYPE_0)
   - Write linearization type table (value: 33171)
6. Navigate to: Modbus Register 5283 (uint16)
   - Select the length unit:

   Selection/input
   - 1095 = [short Ton]
   - 1094 = [lb]
   - 1088 = [kg]
   - 1092 = [Ton]
   - 1048 = [US Gal.]
   - 1049 = [Imp. Gal.]
   - 1043 = [ft³]
   - 1571 = [cm³]
   - 1035 = [dm³]
   - 1034 = [m³]
   - 1038 = [l]
   - 1041 = [hl]
   - 1342 = [%]
   - 1010 = [m]
   - 1012 = [mm]
   - 1018 = [ft]
   - 1019 = [inch]
   - 1351 = [l/s]
   - 1352 = [l/min]
   - 1353 = [l/h]
   - 1347 = [m³/s]
   - 1348 = [m³/min]
   - 1349 = [m³/h]
   - 1356 = [ft³/s]
   - 1357 = [ft³/min]
   - 1358 = [ft³/h]
   - 1362 = [US Gal./s]
   - 1363 = [US Gal./min]
   - 1364 = [US Gal./h]
   - 1367 = [Imp. Gal./s]
1358 = [Imp. Gal./min]
1359 = [Imp. Gal./h]
32815 = [Ml/s]
32816 = [Ml/min]
32817 = [Ml/h]
1355 = [Ml/d]

7. Navigate to: Activate linearization table -> Modbus Register 5415 (uint16) (UIDHPM_LE_CT_ACTTABLE_0)
   ➔ Write activate linearization table (value: 32887)

**Configuration with SmartBlue**

1. Navigate to: Main menu → Setup → Advanced setup → Linearization type
   ➔ Select table as the linearization type
2. Select linearization table
3. X1 = Specify level value in m / ft for 0 %
4. X2 = Specify level value in m / ft for 100 %
5. Activate linearization table

### 9.4 Measuring mode

The following measuring modes are possible:
- The continuous mode (standard mode)
  The device measures continuously once per second.
- The single-shot mode
  The device only performs one measurement and afterwards goes to a mode with reduced power consumption. This can reduce the power consumption of the device.

The measuring mode can be configured as follows:
- Via Modbus
  Modbus Register 5426 (uint16) (MODB_RUNMODE) → write 3494 (single-shot mode)
  or 1380 (continuous mode)
- Via app
  Navigate to: Setup → Communication → Advanced setup → Measurement mode

A measurement can be triggered by the following criteria in the single-shot mode:
- Start-up
  When the device is started, a measurement is taken in the single-shot mode
- By writing the value 32965 to the Modbus Register 5427 (uint16) (MODB_MEASUREMENT_TRIGGER)
9.5 Data access - Security

9.5.1 Software locking via access code in Modbus
The configuration data can be write-protected using an access code (software locking).

- Navigate to: Modbus Register 5272 (uint16) (LCRS_ENTERPRIVATECODE) → Define access code → Modbus Register 5273 (uint16) (LCRS_CONFIRMPRIVATECODE) → Confirm access code

The new access code must differ from the last access code used and may not be "0000".

- The access code is only active if a different (wrong) code is entered or the device is deenergized.
- Once the access code has been defined, write-protected devices can only be switched to maintenance mode if the access code is entered in the Enter access code parameter. If the factory setting is not changed or if "0000" is entered, the device is in maintenance mode and its configuration data are therefore not write-protected and can be changed at any time.

9.5.2 Unlocking via Modbus
- Navigate to: Modbus Register 5271 (uint16) (STD_ACCESSCODE) → Enter access code

9.5.3 Software locking via access code in SmartBlue
The configuration data can be write-protected using an access code (software locking).

- Navigate to: Setup → Advanced setup → Administration → Administration1 → Define access code → Confirm access code

The new access code must differ from the last access code used and may not be "0000".

- The access code is only active if a different (wrong) code is entered or the device is deenergized.
- Once the access code has been defined, write-protected devices can only be switched to maintenance mode if the access code is entered in the Enter access code parameter. If the factory setting is not changed or if "0000" is entered, the device is in maintenance mode and its configuration data are therefore not write-protected and can be changed at any time.

9.5.4 Unlocking via SmartBlue
- Navigate to: Setup → Advanced setup → Access status tooling → Enter access code

9.5.5 Bluetooth® wireless technology
Signal transmission via Bluetooth® wireless technology uses a cryptographic technique tested by the Fraunhofer Institute AISEC
- The device is not visible via Bluetooth® wireless technology without the SmartBlue App
- Only one point-to-point connection between one sensor and one smartphone or tablet is established
- The Bluetooth® wireless technology has a configurable switch-on delay
- The Bluetooth® wireless technology interface can be disabled via SmartBlue and Modbus

Bluetooth® wireless technology start-up delay
It is possible to delay the activation of the Bluetooth interface when the power supply is switched on. If the sensor is only switched on briefly for one measurement and then
switched off again, the Bluetooth interface does not necessarily also have to be enabled. This setting also helps save energy.

The value entered corresponds to the delay in seconds (maximum 600 s) from the time the device is switched on.

**Via app**

Navigate to:

Setup → Communication → Bluetooth configuration → Switch-on delay

وها Entry in seconds

**Via Modbus**

Navigate to:

Modbus Register 5436 (uint16) (MODB_BLUETOOTH_STARTUP_DELAY)

وها Entry in seconds

### Disabling the Bluetooth® wireless technology interface

- Navigate to: Setup → Communication → Bluetooth configuration → Bluetooth mode

  Switch off the Bluetooth® wireless technology interface. "Off" position disables remote access via app

### Re-enabling the Bluetooth® wireless technology interface

If the Bluetooth® wireless technology interface has been disabled, it can be re-enabled via Modbus at any time. The Bluetooth® wireless technology interface is restarted 10 minutes after the device is switched on.

- Navigate to: Modbus Register 5435 (uint8) (LCRS_BLESWITCH)

  Switch on the Bluetooth® wireless technology interface. Writing the value '0x01' enables remote access via the app

### Bluetooth recovery sequence

The Bluetooth® wireless technology interface can be re-enabled after performing the following recovery sequence:

1. Connect device to voltage supply
   - After a waiting time of 10 minutes, a time window of 2 minutes opens

2. You can re-enable the Bluetooth® wireless technology interface of the device using the SmartBlue (app) during this time window

3. Navigate to: Setup → Communication → Bluetooth configuration → Bluetooth mode

   Switch on the Bluetooth® wireless technology interface. "On" position enables remote access via app

![Timeline for Bluetooth wireless technology recovery sequence, time in minutes](image)
10  Diagnostics and troubleshooting

10.1  General errors

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device does not respond</td>
<td>Supply voltage does not match the specification on the nameplate</td>
<td>Apply correct voltage</td>
</tr>
<tr>
<td></td>
<td>The polarity of the supply voltage is wrong</td>
<td>Correct the polarity</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>Modbus communication not working</td>
<td>Modbus signals connected incorrectly</td>
<td>Connect the Modbus signals correctly</td>
</tr>
<tr>
<td></td>
<td>Access code is activated</td>
<td>Enter access code</td>
</tr>
<tr>
<td>Device measures incorrectly</td>
<td>Configuration error</td>
<td>Check and correct the parameter configuration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carry out mapping</td>
</tr>
<tr>
<td>Display values not plausible (linearization)</td>
<td>SmartBlue and Modbus active simultaneously</td>
<td>Log off Modbus and disconnect or Log off SmartBlue and disconnect (connection via SmartBlue has priority)</td>
</tr>
<tr>
<td>Linearized output value not plausible</td>
<td>Linearization error</td>
<td>Check the linearization table</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the vessel selection in the linearization module</td>
</tr>
</tbody>
</table>

10.2  Error - SmartBlue operation

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device is not visible in the live list</td>
<td>No Bluetooth connection</td>
<td>Enable Bluetooth function on smartphone or tablet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bluetooth function of sensor disabled, perform recovery sequence</td>
</tr>
<tr>
<td>Device is not visible in the live list</td>
<td>The device is already connected with another smartphone/tablet</td>
<td>Only one point-to-point connection is established between a sensor and a smartphone or tablet</td>
</tr>
<tr>
<td>Device is visible in the live list but cannot be accessed via SmartBlue</td>
<td>Android end device</td>
<td>Is the location function permitted for the app, was it approved the first time?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GPS or positioning function must be activated for certain Android versions in conjunction with Bluetooth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Activate GPS - close the app fully and restart - enable the positioning function for the app</td>
</tr>
<tr>
<td>Device is visible in the live list but cannot be accessed via SmartBlue</td>
<td>Apple end device</td>
<td>Log in as standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enter user name 'admin'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enter initial password (device serial number) paying attention to lower/upper case</td>
</tr>
<tr>
<td>Login via SmartBlue not possible</td>
<td>Device is being put into operation for the first time</td>
<td>Enter initial password (device serial number) and change. Pay attention to lower/upper case when entering the serial number.</td>
</tr>
<tr>
<td>Device cannot be operated via SmartBlue</td>
<td>Incorrect password entered</td>
<td>Enter correct password</td>
</tr>
</tbody>
</table>
### 10.3 Diagnostic event

#### 10.3.1 Diagnostic event in the operating tool

If a diagnostic event is present in the device, the status signal appears in the top left status area of the operating tool along with the corresponding symbol for the event level in accordance with NAMUR NE 107:

- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)

**Calling up remedial measures**

- Navigate to the **Diagnostics** menu
- In the **Actual diagnostics** parameter the diagnostic event is shown with event text

#### 10.3.2 List of diagnostic events in the operating tool

<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>270</td>
<td>Main electronic failure</td>
<td>Change main electronic module</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>271</td>
<td>Main electronic failure</td>
<td>1. Restart device 2. If failure remains, exchange device.</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>272</td>
<td>Main electronic failure</td>
<td>1. Restart device 2. Check environment for strong EMC fields 3. If failure remains, exchange device.</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>283</td>
<td>Memory content</td>
<td>1. Transfer data or reset device 2. Contact service</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>410</td>
<td>Data transfer</td>
<td>1. Check connection 2. Retry data transfer</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>435</td>
<td>Linearization</td>
<td>Check linearization table</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>438</td>
<td>Dataset</td>
<td>1. Check data set file 2. Check device configuration 3. Up- and download new configuration</td>
<td>M</td>
<td>Warning</td>
</tr>
<tr>
<td>585</td>
<td>Simulation distance</td>
<td>Deactivate simulation</td>
<td>C</td>
<td>Warning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device cannot be operated via SmartBlue</td>
<td>Password forgotten</td>
<td>Contact the manufacturer's Service Department</td>
</tr>
<tr>
<td>Device cannot be operated via SmartBlue</td>
<td>The sensor temperature is too high</td>
<td>If the ambient temperature results in an elevated sensor temperature of &gt;60 °C (140 °F), Bluetooth communication may be disabled. Shield the device, isolate it and cool it down if necessary.</td>
</tr>
</tbody>
</table>
### 10.3.3 List of Modbus diagnostic codes

<table>
<thead>
<tr>
<th>Diagnostic code</th>
<th>Short text</th>
<th>Remedy</th>
<th>Status signal</th>
<th>Diagnostic behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diagnostics for the electronics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x0100002B4 (16777908)</td>
<td>Main electronics error</td>
<td>1. Restart device 2. Error persists, replace the device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>0x0100002B7 (16777911)</td>
<td>Main electronics error</td>
<td>1. Restart device 2. Check the environment for sources of strong EMC interference. 3. Error persists, replace the device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>0x0100002B5 (16777909)</td>
<td>Main electronics error</td>
<td>1. Restart device 2. Error persists, replace the device</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>0x0100002B6 (16777910)</td>
<td>Memory content</td>
<td>1. Transfer data or reset device 2. Contact Service Department</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td><strong>Diagnostics for the configuration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x010000075 (16777333)</td>
<td>Linearization</td>
<td>Check linearization table</td>
<td>F</td>
<td>Alarm</td>
</tr>
<tr>
<td>0x0200000E0 (33554656)</td>
<td>Simulation distance</td>
<td>Switch off simulation</td>
<td>C</td>
<td>Warning</td>
</tr>
<tr>
<td>0x020000160 (33554784)</td>
<td>Recording mapping</td>
<td>Recording mapping, please wait</td>
<td>C</td>
<td>Warning</td>
</tr>
<tr>
<td><strong>Diagnostics for the process</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x080000061 (134217825)</td>
<td>Energy too low</td>
<td>Increase supply voltage</td>
<td>S</td>
<td>Warning</td>
</tr>
<tr>
<td>0x080000087 (134217863)</td>
<td>Operating temperature</td>
<td>1. Check ambient temperature 2. Check process temperature</td>
<td>S</td>
<td>Warning</td>
</tr>
<tr>
<td>0x080000072 (134217842)</td>
<td>Lost echo</td>
<td>Check DC value setting</td>
<td>S</td>
<td>Warning</td>
</tr>
<tr>
<td>0x010000076 (16777334)</td>
<td>Lost echo</td>
<td>Check DC value setting</td>
<td>F</td>
<td>Alarm</td>
</tr>
</tbody>
</table>
11 Maintenance
No special maintenance work is required.

11.1 Cleaning the antenna
The antenna may become contaminated depending on the application. Emission and reception of microwaves can thus be potentially hindered. The level of contamination leading to an error depends on the medium and on the reflectivity, mainly determined by the dielectric constant $\varepsilon_r$.

If the medium tends to cause contamination and buildup, cleaning on a regular basis is recommended.
- Care must be taken to ensure the device is not damaged in the process of mechanical or hose-down cleaning.
- Material compatibility must be taken into account if cleaning agents are used!
- Do not exceed maximum permitted temperatures.

11.2 Process seals
The process seals of the sensor (at the process connection) should be replaced periodically. The interval between changes depends on the frequency of the cleaning cycles, the cleaning temperature and the medium temperature.

12 Repair

12.1 General information

12.1.1 Repair concept
The Endress+Hauser repair concept is devised in such a way that repairs can only be carried out through device replacement.

12.1.2 Replacing a device
Once the device has been replaced, parameters must be reconfigured and interference echo suppression or linearization may need to be carried out once again.

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

1. Refer to the website for more information:
   http://www.endress.com/support/return-material

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

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 Endress+Hauser for disposal under the applicable conditions.
13 Accessories

13.1 Device-specific accessories

13.1.1 Weather protection cover

The weather protection cover can be ordered together with the device via the product structure "Accessory enclosed".

![Dimensions of weather protection cover, engineering unit: mm (in)](image)

**Material**
PVDF

**Order number**
52025686

*The sensor is not completely covered by the weather protection cover.*
### 13.1.2 Flooding protection tube 80 mm (3 in)

Suitable for use with devices with a 80 mm (3 in) antenna and "Mounting customer side w/o flange" process connection.

The flooding protection tube can be ordered together with the device via the product structure 'Accessory enclosed'.

![Dimensions of flooding protection tube 80 mm (3 in), engineering unit: mm (in)](image)

**Material**
- PBT-PC, metalized

**Order number**
- 71327051
13.1.3 Mounting bracket, adjustable

The mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".

Consists of:
- 1 × mounting bracket, 316L (1.4404)
- 1 × angle bracket, 316L (1.4404)
- 3 × screws, A4
- 3 × securing disks, A4

Order number
71325079
13.1.4 UNI flange 3"/DN80/80, PP

The UNI flange 3"/DN80/80 can be ordered together with the device via the product structure "Accessory enclosed".

![Diagram of UNI flange 3"/DN80/80]

Dimensions of UNI flange 3"/DN80/80, engineering unit: mm (in)

- A: Sensor connection in accordance with product structure "Process connection on rear"

Material

PP

Order number

FAX50-####
13.1.5 UNI flange 4"/DN100/100, PP

The UNI flange 4"/DN100/100 can be ordered together with the device via the product structure "Accessory enclosed".

Sensor connection in accordance with product structure "Process connection on rear"

Material

PP

Order number

FAX50-####
13.1.6 Cantilever, pivotable

Sensor installation

![Sensor installation diagram](image1)

- **Installation type sensor process connection rear side**
  - **A** Installation with cantilever and wall bracket
  - **B** Installation with cantilever and mounting frame
  1. Cantilever
  2. Wall bracket
  3. Mounting frame

Cantilever arm 500 mm, for G 1" or MNPT 1" connections on rear

![Cantilever arm diagram](image2)

- **34 Dimensions. Unit of measurement mm (in)**

**Weight:**
3.0 kg (6.62 lb)

**Material**
316L (1.4404)

**Order number**
71452315

- 35 mm (1.38 in) openings for all G 1" or MNPT 1" connections on rear
- 22 mm (0.87 in) opening can be used for any additional sensor
- Retaining screws are included in delivery
**Cantilever arm 1000 mm, for G 1" or MNPT 1" connections on rear**

*Dimensions. Unit of measurement mm (in)*

**Weight:**
5.4 kg (11.91 lb)

**Material**
316L (1.4404)

**Order number**
71452316

- 35 mm (1.38 in) openings for all G 1" or MNPT 1" connections on rear
- 22 mm (0.87 in) opening can be used for any additional sensor
- Retaining screws are included in delivery

**Frame, 700 mm (27.6 in)**

*Dimensions. Unit of measurement mm (in)*

---

Accessories

Micropilot FMR20 MODBUS RS485

Endress+Hauser
**Weight:**
4.0 kg (8.82 lb)

**Material**
316L (1.4404)

**Order number**
71452327

**Frame, 1400 mm (55.1 in)**

![Diagram of frame dimensions]

**Weight:**
6.0 kg (13.23 lb)

**Material**
316L (1.4404)

**Order number**
71452326
Wall bracket for cantilever with pivot

Dimensions of the wall bracket. Unit of measurement mm (in)

**Weight**
1.21 kg (2.67 lb)

**Material**
316L (1.4404)

**Order number**
71452323
13.1.7 Ceiling mounting bracket

The ceiling mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".

Material

316L (1.4404)

Order number

71093130
13.1.8  Pivotal mounting bracket

The mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".

Material
316L (1.4404)

Order number
71429910
13.1.9 Horizontal mounting bracket

The horizontal mounting bracket is used to install the device in confined spaces. The mounting bracket can be ordered together with the device via the product structure "Accessory enclosed".

![Diagram of horizontal mounting bracket](image)

Dimensions of the horizontal mounting bracket. Unit of measurement mm (in)

Material
316L (1.4404)

Order number
71429905
13.1.10 FAU40 alignment unit

The alignment unit is used to optimally align the sensor with the bulk solids.

![Diagram of FAU40 alignment unit]

**Material**
- Flange: 304
- Pipe: steel, galvanized
- Cable gland: 304 or steel, galvanized

**Order number**
FAU40-##

Can be used for all rear sensor connections G1" or MNPT1, male thread, and connecting cable max. Ø10 mm (0.43 in), minimum length 600 mm (23.6 in).

Technical Information TI00179F
13.1.11 Adjustable flange seal

The adjustable flange seal is used to align the FMR20. The adjustable flange seal can be ordered together with the device via the product structure 'Accessory enclosed'.

### 44 Dimensions

<table>
<thead>
<tr>
<th>Technical data: version DN/JIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order number</td>
</tr>
<tr>
<td>Compatible with</td>
</tr>
<tr>
<td>Recommended screw length</td>
</tr>
<tr>
<td>Recommended screw size</td>
</tr>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Process pressure</td>
</tr>
<tr>
<td>Process temperature</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>d</td>
</tr>
<tr>
<td>h</td>
</tr>
<tr>
<td>h_min</td>
</tr>
<tr>
<td>h_max</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical data: version ASME/JIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order number</td>
</tr>
<tr>
<td>Compatible with</td>
</tr>
<tr>
<td>Recommended screw length</td>
</tr>
<tr>
<td>Recommended screw size</td>
</tr>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Process pressure</td>
</tr>
<tr>
<td>Process temperature</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>d</td>
</tr>
<tr>
<td>h</td>
</tr>
<tr>
<td>h_min</td>
</tr>
<tr>
<td>h_max</td>
</tr>
</tbody>
</table>
13.2 Service-specific accessories

Applicator
Software for selecting and sizing Endress+Hauser measuring devices:
- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results
Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.
Applicator is available:
https://portal.endress.com/webapp/applicator

Configurator
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop
The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

W@M
Life cycle management for your plant
W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.
The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.
W@M is available:
www.endress.com/lifecyclemanagement
14 Technical data

14.1 Input

Measured variable
The measured variable is the distance between the reference point and the product surface.
The level is calculated based on \( E \), the empty distance entered.

Measuring range

<table>
<thead>
<tr>
<th>Measuring range</th>
<th>Maximum measuring range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 m (32.8 ft)</td>
</tr>
</tbody>
</table>

Installation requirements
- No agitators
- No buildup
- Relative dielectric constant \( \varepsilon_r > 2 \)
  Contact Endress+Hauser for lower \( \varepsilon_r \) values

Usable measuring range
The usable measuring range depends on the medium’s reflective properties, the installation position and any possible interference reflections.
Optimum results are achieved with coarse-grained material and the use of the flooding protection tube.
Reduction of the max. possible measuring range by:
- Media with bad reflective properties (\( \approx \) low \( \varepsilon_r \) value)
- Product cone
- Extremely loose surfaces of bulk solids, e.g. bulk solids with low bulk weight in the case of pneumatic filling.
- Formation of buildup, particularly of moist products.

For dielectric constants (DC values) of many media commonly used in various industries refer to:
- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

Operating frequency
K-band (~ 26 GHz)

Transmission power

<table>
<thead>
<tr>
<th>Transmission power</th>
<th>Mean power density in the direction of the beam</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At a distance of 1 m (3.3 ft): &lt; 12 nW/cm²</td>
</tr>
<tr>
<td></td>
<td>At a distance of 5 m (16 ft): &lt; 0.4 nW/cm²</td>
</tr>
</tbody>
</table>

14.2 Output

Digital output

<table>
<thead>
<tr>
<th>Digital output</th>
<th>Modbus®</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dedicated differential Modbus interface via separate wire pair</td>
</tr>
</tbody>
</table>

Bluetooth® wireless technology
The device has a Bluetooth® wireless technology interface and can be operated and configured via this interface using the SmartBlue app.
- The range under reference conditions is 25 m (82 ft)
- Incorrect operation by unauthorized persons is prevented by means of encrypted communication and password encryption
- The Bluetooth® wireless technology interface can be deactivated

Signal on alarm
- Depending on the interface, failure information is displayed as follows:
  - Digital communication (Modbus)
    - Status signal (as per NAMUR Recommendation NE 107)
    - Diagnostic code
  - Operating tool via SmartBlue (app)
    - Status signal (as per NAMUR Recommendation NE 107)
    - Plain text display with remedial action

Linearization
- The device's linearization function allows the user to convert the measured value to any units of length, weight or volume. In the SmartBlue App, there are preprogrammed linearization tables for volume calculation in vessels.

  Preprogrammed linearization curves
  - Horizontal cylindrical tank
  - Spherical tank
  - Tank with pyramid bottom
  - Tank with conical bottom
  - Tank with flat bottom

- Other linearization tables of up to 32 value pairs can be entered manually.

14.3 Performance characteristics

Reference operating conditions
- Temperature = +24 °C (+75 °F) ±5 °C (±9 °F)
- Pressure = 960 mbar abs. (14 psia) ±100 mbar (±1.45 psi)
- Humidity = 60 % ±15 %
- Reflector: metal plate with diameter ≥ 1 m (40 in)
- No major interference reflections inside the signal beam

Maximum measured error
- Typical data under reference operating conditions: DIN EN 61298-2, percentage values in relation to the span.

  Output digital; Modbus, SmartBlue (app)
  - Sum of non-linearity, non-repeatability and hysteresis: ±5 mm (±0.2 in)
  - Offset/zero point: ±4 mm (±0.16 in)
Differing values in near-range applications

![Diagram showing differing values in near-range applications](image)

- Maximum measured error in near-range applications; values for standard version
- Maximum measured error: $\Delta$
- Reference point of the distance measurement: $R$
- Distance from reference point of antenna: $D$

Measured value resolution

Dead band as per EN61298-2:
- Digital: 1 mm (0.04 in)

Response time

The response time can be configured. The following step response times apply (in accordance with DIN EN 61298-2) when damping is switched off:

- **Tank height**
  - $<10$ m (32.8 ft)

- **Sampling rate**
  - $1$ s$^{-1}$

- **Response time**
  - $<3$ s

In accordance with DIN EN 61298-2, the step response time is the time following an abrupt change in the input signal up until the changed output signal has adopted 90% of the steady-state value for the first time.

Influence of ambient temperature

The measurements are carried out in accordance with EN 61298-3.
- Digital (Modbus, Bluetooth® wireless technology):
  - Standard version: average $T_C = \pm 3$ mm (±0.12 in)/10 K

14.4 Environment

Ambient temperature range

Measuring device: $-40$ to $+80$ °C ($-40$ to $+176$ °F)

- It may not be possible to use the Bluetooth connection at ambient temperatures $>60$ °C (140 °F).
Outdoor operation in strong sunlight:
- Mount the device in the shade.
- Avoid direct sunlight, particularly in warm climatic regions.
- Use a weather protection cover.

Storage temperature
-40 to +80 °C (–40 to +176 °F)

Climate class
DIN EN 60068-2-38 (test Z/AD)

Operating altitude as per IEC 61010-1 Ed.3
- Generally up to 2 000 m (6 600 ft) above sea level.

Degree of protection
- Tested acc. to:
  - IP66, NEMA 4X
  - IP68, NEMA 6P (24 h at 1.83 m (6.00 ft) 1.83 m under water)

Vibration resistance
- DIN EN 60068-2-64/IEC 60068-2-64: 20 to 2 000 Hz, 1 (m/s²)/Hz

Electromagnetic compatibility (EMC)
- Electromagnetic compatibility in accordance with all of the relevant requirements outlined in the EN 61000 series and NAMUR Recommendation EMC (NE 21). Details are provided in the Declaration of Conformity (www.endress.com/downloads).

14.5 Process

Process temperature, process pressure

![Graph showing process temperature range from -40 to +80 °C (–40 to +176 °F) and process pressure range from -1 to 3 bar (–14.5 to 43.5 psi) with UNI flange process connection showing -1 to 1 bar (–14.5 to 14.5 psi) and pressure range up to 2 bar (29 psi).]

FMR20: Permitted range for process temperature and process pressure

Process temperature range
-40 to +80 °C (–40 to +176 °F)

Process pressure range
- Process pressure range, threaded process connection
  - $p_{\text{gauge}} = \pm 1$ to 3 bar (–14.5 to 43.5 psi)
  - $p_{\text{abs}} < 4$ bar (58 psi)
- Process pressure range, UNI flange process connection
  - $p_{\text{gauge}} = \pm 1$ to 1 bar (–14.5 to 14.5 psi)
  - $p_{\text{abs}} < 2$ bar (29 psi)

The pressure range may be further restricted in the event of a CRN approval.
<table>
<thead>
<tr>
<th>Dielectric constant</th>
<th>For solids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\varepsilon_r \geq 2$</td>
</tr>
<tr>
<td></td>
<td>Contact Endress+Hauser for lower $\varepsilon_r$ values</td>
</tr>
</tbody>
</table>

For dielectric constants (DC values) of many media commonly used in various industries refer to:

- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)
15 Operating menu

15.1 Overview of Modbus parameters
The following tables provide a complete list of the parameters that can be accessed via Modbus.

The register address must be incremented by one (register address +1) when using the Memograph M RSG45 or Fieldgate FXA30b Modbus master. This can also apply for other masters.

15.1.1 Section: Burst read
The most important parameters to be read-out during a measurement in the float32 format (only used if Burst read is necessary)

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Service</th>
<th>Operator</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>MODB_PV_VALUE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>according to LE_PVUNIT_0</td>
<td>Primary value of measurement (Level linearized)</td>
</tr>
<tr>
<td>5002</td>
<td>MODB_SV_VALUE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>m</td>
<td>Secondary value of measurement (Distance)</td>
</tr>
<tr>
<td>5004</td>
<td>MODB_TV_VALUE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>dB</td>
<td>Tertiary value of measurement (Relative echo amplitude)</td>
</tr>
<tr>
<td>5006</td>
<td>MODB_QV_VALUE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-273.14 to inf</td>
<td>float32</td>
<td>°C</td>
<td>Quaternary value of measurement (Temperature)</td>
</tr>
<tr>
<td>5008</td>
<td>MODB_SIGNALQUALITY</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>strong: 0 medium: 1 weak: 2 no signal: 3</td>
<td>float32</td>
<td>-</td>
<td>Signal Quality</td>
</tr>
<tr>
<td>5010</td>
<td>MODB_ACTUALDIAGNOSTICS</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>see &quot;List of diagnostic events in the operating tool&quot;</td>
<td>float32</td>
<td>-</td>
<td>Current diagnostic number</td>
</tr>
<tr>
<td>5012</td>
<td>MODBLOCATION_LONGITUDE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-180 to 180</td>
<td>float32</td>
<td>°</td>
<td>Configurable GPS longitude coordinate</td>
</tr>
<tr>
<td>5014</td>
<td>MODBLOCATION_LATITUDE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>~90 to 90</td>
<td>float32</td>
<td>°</td>
<td>Configurable GPS latitude coordinate</td>
</tr>
</tbody>
</table>

15.1.2 Section: Measured values

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Service</th>
<th>Operator</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5105</td>
<td>LCRS_DISTANCE_VALUE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>m</td>
<td>Secondary value of measurement (Distance)</td>
</tr>
<tr>
<td>5117</td>
<td>HO_QVVALUE</td>
<td>2</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>-273.14 to inf</td>
<td>float32</td>
<td>°C</td>
<td>Quaternary value of measurement (Temperature)</td>
</tr>
<tr>
<td>5104</td>
<td>LCRS_SIGNALQUALITY</td>
<td>1</td>
<td>•</td>
<td>read only</td>
<td>read only</td>
<td>strong: 0 medium: 1 weak: 2 no signal: 3</td>
<td>enum8</td>
<td>-</td>
<td>Signal Quality</td>
</tr>
<tr>
<td>Address</td>
<td>Name</td>
<td>Number of registers</td>
<td>Access</td>
<td>Range</td>
<td>Data type</td>
<td>SI unit</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
<td>---------------------</td>
<td>--------</td>
<td>-------</td>
<td>-----------</td>
<td>---------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5102</td>
<td>LCRS_PRIMLEVOUT_VALUE</td>
<td>2</td>
<td>● read only ● read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>according to LE_DISTANCEUNIT_0</td>
<td>Primary value of measurement (Level)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5109</td>
<td>LCRS_ABSECHOAMPLITUDE</td>
<td>2</td>
<td>● read only ● read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>dB</td>
<td>Tertiary value of measurement (absolute echo amplitude)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5111</td>
<td>LCRS_SNAPPEDLEVEL</td>
<td>2</td>
<td>● read only ● read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>m</td>
<td>Snapped level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5115</td>
<td>LCRS_SNAPPEDABSOLUTECHOAMPLITUDE</td>
<td>2</td>
<td>● read only ● read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>dB</td>
<td>Snapped absolute echo amplitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5113</td>
<td>LCRS_SNAPPEDDISTANCE</td>
<td>2</td>
<td>● read only ● read only</td>
<td>0 to 21.8</td>
<td>float32</td>
<td>m</td>
<td>Snapped distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5100</td>
<td>HO_PVVALUE</td>
<td>2</td>
<td>● read only ● read only</td>
<td>-inf to inf</td>
<td>float32</td>
<td>according to LE_PVUNIT_0</td>
<td>Primary value of measurement (Level linearized)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5107</td>
<td>HO_TVVALUE</td>
<td>2</td>
<td>● read only ● read only</td>
<td>-60 to 60</td>
<td>float32</td>
<td>dB</td>
<td>Tertiary value of measurement (relative echo amplitude)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 15.1.3 Section: Device status

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5124</td>
<td>LCRS_CURRENTEVENTCATEGORY</td>
<td>1</td>
<td>● read only ● read only</td>
<td>ok: 0 failure: 1 check: 2 maintenance: 4 out of spec: 8 offline: 16</td>
<td>enum8</td>
<td>-</td>
<td>Device status</td>
</tr>
<tr>
<td>5119</td>
<td>LCRS_ACTUALDIAGNOSTICS</td>
<td>2</td>
<td>● read only ● read only</td>
<td>see &quot;List of Modbus diagnostic codes&quot;</td>
<td>uint32</td>
<td>-</td>
<td>Current diagnostic code</td>
</tr>
<tr>
<td>5121</td>
<td>LCRS_PREVIOUSDIAGNOSTICS</td>
<td>2</td>
<td>● read only ● read only</td>
<td>see &quot;List of Modbus diagnostic codes&quot;</td>
<td>uint32</td>
<td>-</td>
<td>Last diagnostic code</td>
</tr>
<tr>
<td>5123</td>
<td>LCRS_DELETEPREVIOUSDIAGNOSTICS</td>
<td>1</td>
<td>● read/write ● read only</td>
<td>no: 0 yes: 1</td>
<td>enum8</td>
<td>-</td>
<td>Delete previous diagnostic code</td>
</tr>
<tr>
<td>5125</td>
<td>STD_LOCKINGSTATE</td>
<td>1</td>
<td>● read only ● read only</td>
<td>0 to 65535</td>
<td>uint16</td>
<td>-</td>
<td>Locking state</td>
</tr>
</tbody>
</table>

### 15.1.4 Section: Device information

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5126</td>
<td>STD_ENPDEVICESERIALNUMBER</td>
<td>6</td>
<td>● read/write ● read only</td>
<td>-</td>
<td>string</td>
<td>-</td>
<td>Device serial number</td>
</tr>
<tr>
<td>5132</td>
<td>STD_ENPDEVICEORDERIDENT</td>
<td>10</td>
<td>● read/write ● read only</td>
<td>-</td>
<td>string</td>
<td>-</td>
<td>Order code</td>
</tr>
<tr>
<td>5142</td>
<td>STD_ENPDEVICEFIRMWAREREVISION</td>
<td>4</td>
<td>● read only ● read only</td>
<td>-</td>
<td>string</td>
<td>-</td>
<td>Firmware version</td>
</tr>
<tr>
<td>5146</td>
<td>STD_ENPDEVICENAME</td>
<td>8</td>
<td>● read/write ● read only</td>
<td>-</td>
<td>string</td>
<td>-</td>
<td>Device name</td>
</tr>
</tbody>
</table>
### 15.1.5 Section: Installation

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5264</td>
<td>LE_Full</td>
<td>2</td>
<td>read/write • read only</td>
<td>0 to 20</td>
<td>float32</td>
<td>m</td>
<td>Full calibration</td>
</tr>
<tr>
<td>5262</td>
<td>LE_Empty</td>
<td>2</td>
<td>read/write • read only</td>
<td>0 to 20</td>
<td>float32</td>
<td>m</td>
<td>Empty calibration</td>
</tr>
<tr>
<td>5266</td>
<td>LCRS_DISTANCESELECTIONCONTROL</td>
<td>1</td>
<td>read/write • read only</td>
<td>distance ok: 32859</td>
<td>enum16</td>
<td>-</td>
<td>Customer map selection</td>
</tr>
<tr>
<td>5267</td>
<td>LCRS_MAPPING_ENDPOINTCTRL</td>
<td>2</td>
<td>read/write • read only</td>
<td>0 to 20</td>
<td>float32</td>
<td>m</td>
<td>Customer map distance</td>
</tr>
</tbody>
</table>

### 15.1.6 Section: Maintenance

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5269</td>
<td>STD_RESETLEVEL</td>
<td>1</td>
<td>read/write • read only</td>
<td>to factory defaults: 33053</td>
<td>enum16</td>
<td>-</td>
<td>Device parameter reset</td>
</tr>
<tr>
<td>5270</td>
<td>STD_USERLEVEL</td>
<td>1</td>
<td>read only • read only</td>
<td>maintenance: 32959, user: 33014</td>
<td>enum16</td>
<td>-</td>
<td>Access level</td>
</tr>
<tr>
<td>5271</td>
<td>STD_ACCESSCODE</td>
<td>1</td>
<td>read/write • read/write</td>
<td>0 to 9999</td>
<td>uint16</td>
<td>-</td>
<td>Register to enter the access code</td>
</tr>
<tr>
<td>5272</td>
<td>LCRS_ENTERPRIVATECODE</td>
<td>1</td>
<td>read/write • read only</td>
<td>0 to 9999</td>
<td>uint16</td>
<td>-</td>
<td>Register to change the Maintenance access code</td>
</tr>
</tbody>
</table>
## 15.1.7 Section: Measurement configuration

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Number of registers</th>
<th>Access</th>
<th>Range</th>
<th>Data type</th>
<th>Sl unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5278</td>
<td>LE_DISTANCEUNIT</td>
<td>1</td>
<td>read/write, read only</td>
<td>m: 1010, ft: 1018</td>
<td>enum16</td>
<td>-</td>
<td>Distance unit for LCRS_PRIMLEVELOUT_VALUE_0</td>
</tr>
<tr>
<td>5277</td>
<td>LCRS_FIRSTECHOSENSIVITYCTRL</td>
<td>1</td>
<td>read/write, read only</td>
<td>low: 0, medium: 1, high: 2</td>
<td>enum8</td>
<td>-</td>
<td>First echo sensitivity</td>
</tr>
<tr>
<td>5279</td>
<td>LCRS_ECHOLOSTDELAY</td>
<td>1</td>
<td>read/write, read only</td>
<td>0 to 600</td>
<td>uint16</td>
<td>s</td>
<td>Echo lost delay (time between alarm and echo lost)</td>
</tr>
<tr>
<td>5280</td>
<td>LCRS_ADJUSTEVENECHOLOST</td>
<td>1</td>
<td>read/write, read only</td>
<td>warning: 0, alarm: 1</td>
<td>enum8</td>
<td>-</td>
<td>Defines the lost echo status</td>
</tr>
<tr>
<td>5281</td>
<td>LCRS_CHANGINGVELOCITY</td>
<td>1</td>
<td>read/write, read only</td>
<td>&gt;1m/min: 0, &lt;1m/min: 1, &lt;10cm/min: 2, no Filter/Test:3</td>
<td>enum8</td>
<td>-</td>
<td>Defines maximum change velocity of an echo change</td>
</tr>
<tr>
<td>5282</td>
<td>LE_CSTLINETYPE</td>
<td>1</td>
<td>read/write, read only</td>
<td>not active: 32989, active: 33171</td>
<td>enum16</td>
<td>-</td>
<td>Is linearization table is used</td>
</tr>
<tr>
<td>5283</td>
<td>LE_CUSTOMUNIT</td>
<td>1</td>
<td>read/write, read only</td>
<td>see Unit after linearization parameter</td>
<td>enum16</td>
<td>-</td>
<td>Customer level unit</td>
</tr>
<tr>
<td>5412</td>
<td>LCRS_EVALUATIONSENSITIVITY</td>
<td>1</td>
<td>read/write, read only</td>
<td>low: 0, medium: 1, high: 2</td>
<td>enum8</td>
<td>-</td>
<td>Sensitivity of the echo detection</td>
</tr>
<tr>
<td>5413</td>
<td>LE_LEVCORROFFS</td>
<td>2</td>
<td>read/write, read only</td>
<td>-25 to 25</td>
<td>float32</td>
<td>-</td>
<td>Level correction</td>
</tr>
<tr>
<td>5415</td>
<td>LE_CT_ACTTABLE</td>
<td>1</td>
<td>read/write, read only</td>
<td>disable: 32852, enable: 32887</td>
<td>enum16</td>
<td>-</td>
<td>States if linearization table is active</td>
</tr>
<tr>
<td>5416</td>
<td>LE_OUTPUTMODE</td>
<td>1</td>
<td>read/write, read only</td>
<td>level: 32949, empty: 33197</td>
<td>enum16</td>
<td>-</td>
<td>States the output mode</td>
</tr>
<tr>
<td>5417</td>
<td>LE_CT_EDITMODE</td>
<td>1</td>
<td>read/write, read only</td>
<td>edit manual: 32890, delete table: 32889</td>
<td>enum16</td>
<td>-</td>
<td>Edit mode of the linearization table</td>
</tr>
<tr>
<td>5418</td>
<td>LCRS_EVALUATIONDISTANCE</td>
<td>2</td>
<td>read/write, read only</td>
<td>0 to 21.8</td>
<td>float32</td>
<td>m</td>
<td>Max distance which will be evaluated</td>
</tr>
<tr>
<td>Address</td>
<td>Name</td>
<td>Number of registers</td>
<td>Access</td>
<td>Range</td>
<td>Data type</td>
<td>SI unit</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>---------</td>
<td>------------------------</td>
<td>------------</td>
<td>---------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>5420</td>
<td>LCRS_FREEFIELDMOD</td>
<td>1</td>
<td>• read/write • read only</td>
<td>off: 33004 on: 33006</td>
<td>enum16</td>
<td>-</td>
<td>Switch to free field parameters</td>
</tr>
<tr>
<td>5421</td>
<td>LCRS_HIGBLOCKDISTANCE</td>
<td>2</td>
<td>• read/write • read only</td>
<td>0 to 20</td>
<td>float32</td>
<td>m</td>
<td>Blocking distance (distance from sensor which is not evaluated)</td>
</tr>
<tr>
<td>5423</td>
<td>LCRS_MAP_ENDX</td>
<td>2</td>
<td>• read/write • read only</td>
<td>0 to 21.8</td>
<td>float32</td>
<td>m</td>
<td>End-point of overlay map (factory map + custom map)</td>
</tr>
<tr>
<td>5425</td>
<td>LE_PVUNIT</td>
<td>1</td>
<td>• read/write • read only</td>
<td>see Unit after linearization parameter</td>
<td>enum16</td>
<td>-</td>
<td>Level unit</td>
</tr>
<tr>
<td>5426</td>
<td>MODB_RUNMODE</td>
<td>1</td>
<td>• read/write • read only</td>
<td>stopped: 3493 continuous: 1380 single-shot: 3494</td>
<td>enum8</td>
<td>-</td>
<td>Run-Mode</td>
</tr>
<tr>
<td>5427</td>
<td>MODB_MEASUREMENT_TRIGGER</td>
<td>1</td>
<td>• read/write • read/write</td>
<td>idle: 33296 measure: 32965</td>
<td>enum8</td>
<td>-</td>
<td>Measurement-Trigger (only used if MODB_RUNMODE is either stopped or single-shot)</td>
</tr>
<tr>
<td>5284</td>
<td>FMR_LIN_TABLE</td>
<td>64</td>
<td>• read/write • read only</td>
<td>-inf to inf</td>
<td>float32Point</td>
<td>m → m³</td>
<td>Lower half of linearization table (X1, Y1, X2, Y2, ...)</td>
</tr>
<tr>
<td>5348</td>
<td>FMR_LIN_TABLE_2</td>
<td>64</td>
<td>• read/write • read only</td>
<td>-inf to inf</td>
<td>float32Point</td>
<td>m → m³</td>
<td>Upper half of linearization table (X17, Y17, X18, Y18, ...)</td>
</tr>
</tbody>
</table>

15.1.8 Section: Communication

<table>
<thead>
<tr>
<th>Address</th>
<th>Name</th>
<th>Register</th>
<th>Access</th>
<th>Range</th>
<th>Data type</th>
<th>SI unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5428</td>
<td>MODB_PROTOCOL</td>
<td>1</td>
<td>• read/write • read only</td>
<td>RTU: 974 ASCII: 973</td>
<td>enum8</td>
<td>-</td>
<td>Modbus protocol</td>
</tr>
<tr>
<td>5429</td>
<td>MODB_PARITY_AND_DATABITS</td>
<td>1</td>
<td>• read/write • read only</td>
<td>8N: 3498 80: 3499 8E: 3500 70: 3501 7E: 3502</td>
<td>enum8</td>
<td>-</td>
<td>Modbus transmission</td>
</tr>
<tr>
<td>5430</td>
<td>MODB_STOPBIT</td>
<td>1</td>
<td>• read/write • read only</td>
<td>1 Stop Bit: 3503 2 Stop Bit: 3504</td>
<td>enum8</td>
<td>-</td>
<td>Modbus transmission</td>
</tr>
<tr>
<td>5431</td>
<td>MODB_BAUDRATE</td>
<td>1</td>
<td>• read/write • read only</td>
<td>1200: 975 2400: 976 4800: 977 9600: 978 19200: 979</td>
<td>enum16</td>
<td>-</td>
<td>Modbus baud rate</td>
</tr>
<tr>
<td>5432</td>
<td>MODB_ADDRESS</td>
<td>1</td>
<td>• read/write • read only</td>
<td>1 to 200</td>
<td>uint8</td>
<td>-</td>
<td>Modbus slave address</td>
</tr>
<tr>
<td>Address</td>
<td>Name</td>
<td>Register</td>
<td>Access</td>
<td>Service</td>
<td>Operator</td>
<td>Range</td>
<td>Data type</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------</td>
<td>----------</td>
<td>----------</td>
<td>---------</td>
<td>----------</td>
<td>----------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>5433</td>
<td>MODB_FLOAT32_SWAP_ORDER</td>
<td>1</td>
<td>read/write • read/write • read only</td>
<td></td>
<td></td>
<td>ABCD: 991 BADC: 993 CDAB: 994 DCBA: 992</td>
<td>enum8</td>
</tr>
<tr>
<td>5434</td>
<td>MODB_INT32_SWAP_ORDER</td>
<td>1</td>
<td>read/write • read/write • read only</td>
<td></td>
<td></td>
<td>ABCD: 991 BADC: 993 CDAB: 994 DCBA: 992</td>
<td>enum8</td>
</tr>
<tr>
<td>5435</td>
<td>LCRS_BLESWITCH</td>
<td>1</td>
<td>read/write • read/write • read only</td>
<td></td>
<td></td>
<td>enable: 1 disable: 0</td>
<td>enum8</td>
</tr>
<tr>
<td>5436</td>
<td>MODB_BLUETOOTH_STARTUP_DELAY</td>
<td>1</td>
<td>read/write • read/write • read only</td>
<td></td>
<td></td>
<td>0 to 600</td>
<td>uint16</td>
</tr>
<tr>
<td>5437</td>
<td>MODB_BLE_CONNECTION_STATE</td>
<td>1</td>
<td>read only • read only • read only</td>
<td></td>
<td></td>
<td>connection active: 2333 no connection active: 3495</td>
<td>enum8</td>
</tr>
</tbody>
</table>
15.2 Overview of the operating tool (SmartBlue)

Navigation ➤ Operating menu

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<th>Main menu</th>
<th>➤ Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance unit</td>
<td></td>
</tr>
<tr>
<td>Empty calibration</td>
<td></td>
</tr>
<tr>
<td>Full calibration</td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td></td>
</tr>
<tr>
<td>Signal quality</td>
<td></td>
</tr>
<tr>
<td>➤ Advanced setup</td>
<td></td>
</tr>
<tr>
<td>Access status tooling</td>
<td></td>
</tr>
<tr>
<td>Enter access code</td>
<td></td>
</tr>
<tr>
<td>Evaluation sensitivity</td>
<td></td>
</tr>
<tr>
<td>Changing velocity</td>
<td></td>
</tr>
<tr>
<td>First Echo sensitivity</td>
<td></td>
</tr>
<tr>
<td>Output mode</td>
<td></td>
</tr>
<tr>
<td>Blocking distance</td>
<td></td>
</tr>
<tr>
<td>Level correction</td>
<td></td>
</tr>
<tr>
<td>Evaluation distance</td>
<td></td>
</tr>
<tr>
<td>➤ Safety settings</td>
<td></td>
</tr>
<tr>
<td>Delay time echo lost</td>
<td></td>
</tr>
<tr>
<td>Diagnostics echo lost</td>
<td></td>
</tr>
<tr>
<td>Linearization type</td>
<td></td>
</tr>
</tbody>
</table>
### Level linearized

<table>
<thead>
<tr>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define access code</td>
</tr>
<tr>
<td>Confirm access code</td>
</tr>
<tr>
<td>Device reset</td>
</tr>
<tr>
<td>Free field special</td>
</tr>
</tbody>
</table>

### Communication

<table>
<thead>
<tr>
<th>Modbus configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transfer mode</td>
</tr>
<tr>
<td>Bus address</td>
</tr>
<tr>
<td>Baudrate</td>
</tr>
<tr>
<td>Parity and databits setting</td>
</tr>
<tr>
<td>Stop bits</td>
</tr>
</tbody>
</table>

### Diagnostics

<table>
<thead>
<tr>
<th>Bluetooth configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetooth mode</td>
</tr>
</tbody>
</table>

### Device information

<table>
<thead>
<tr>
<th>Device name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

### Extended order code

<table>
<thead>
<tr>
<th>Extended order code 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extended order code 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
### Operating menu

<table>
<thead>
<tr>
<th>Extended order code 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order code</td>
</tr>
<tr>
<td>Serial number</td>
</tr>
<tr>
<td>ENP version</td>
</tr>
</tbody>
</table>

**Simulation**

<table>
<thead>
<tr>
<th>Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process variable value</td>
</tr>
</tbody>
</table>
15.3 "Setup" menu

- Indicates navigation to the parameter via operating tools
- Indicates parameters that can be locked via the access code

**Navigation**
- Setup

---

### Distance unit

**Navigation**
- Setup → Distance unit

**Description**
Used for the basic calibration (Empty / Full).

**Selection**
- **SI units**
  - m
- **US units**
  - ft

---

### Empty calibration

**Navigation**
- Setup → Empty calibr.

**Description**
Distance between process connection and minimum level (0%).

**User entry**
0.0 to 20 m

**Factory setting**
Depends on the antenna version

---

### Full calibration

**Navigation**
- Setup → Full calibr.

**Description**
Distance between minimum level (0%) and maximum level (100%).

**User entry**
0.0 to 20 m

**Factory setting**
Depends on the antenna version

---

### Distance

**Navigation**
- Setup → Distance

**Description**
Shows the distance D that is currently measured from the reference point (lower edge of flange / last thread of sensor) to the level.
Operating menu

Micropilot FMR20 MODBUS RS485

User interface

Level

Navigation

Setup → Level

Description
Displays the measured level L (before linearization).
The unit is defined in the Distance unit parameter (factory setting = m).

User interface
0.0 to 20 m

Signal quality

Navigation

Setup → Signal quality

Description
Displays the signal quality of the level echo.

Meaning of the display options
- Strong:
The evaluated echo exceeds the threshold by at least 10 dB.
- Medium:
The evaluated echo exceeds the threshold by at least 5 dB.
- Weak:
The evaluated echo exceeds the threshold by less than 5 dB.
- No signal:
The device does not find a usable echo.

The signal quality indicated in this parameter always refers to the currently evaluated echo, either the level echo or the tank bottom echo.

In case of a lost echo (Signal quality = No signal) the device generates the following error message:
Diagnostic echo lost = Warning (factory setting) or Alarm, if the other option has been selected in Diagnostic echo lost.

User interface
- Strong
- Medium
- Weak
- No signal

Endress+Hauser
15.3.1 "Advanced setup" submenu

Navigation       Setup → Advanced setup

Access status tooling

Navigation       Setup → Advanced setup → Access stat.tool

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

Enter access code

Navigation       Setup → Advanced setup → Ent. access code

Description      The customer-specific access code, which has been defined in the Define access code parameter, must be entered to change from the Operator to the Maintenance mode. The device remains in the Operator mode if an incorrect access code is entered. If you lose the access code, please contact your Endress+Hauser sales center.

User entry       0 to 9999

Evaluation sensitivity


Description      Selection of the evaluation sensitivity

Options to select from:
- Low
  Interferers but also small level signals are not recognized. The weighting curve is located high.
- Medium
  The weighting curve is in a medium region.
- High
  Small level signals but also interferers can be reliably detected. The weighting curve is located low.

Selection        Low
                  Medium
                  High
### Changing velocity

**Navigation**
- Setup → Advanced setup → Changing vel.

**Description**
Selection of the expected draining or filling speed of the measured level.

**Selection**
- Slow \(<10\) cm \((0,4\) in)/min
- Standard \(<1\) m \((40\) in)/min
- Fast \(>1\) m \((40\) in)/min
- No filter / test

### First Echo sensitivity

**Navigation**
- Setup → Advanced setup → First Echo sens.

**Description**
This parameter describes the band for First Echo evaluation. Is measured / calculated down from the peak of the current level echo.

Options to select from:
- Low
  The band for the first echo evaluation is very narrow. The evaluation stays longer at the found echo respectively does not jump to the next Echo or distortion signal.
- Medium
  The band for the first echo evaluation has an average width.
- High
  The band for the first echo evaluation is broad. The evaluation jumps earlier to the next echo or distortion signal.

**Selection**
- Low
- Medium
- High

### Output mode

**Navigation**
- Setup → Advanced setup → Output mode

**Description**
Select output mode between:
- Ullage
  The remaining space in the tank or silo is indicated.

  or

- Level linearized
  The level is indicated (more precisely: the linearized value if a linearization has been activated).

**Selection**
- Ullage
- Level linearized
### Blocking distance

**Navigation**

Setup → Advanced setup → Blocking dist.

**Description**

Specify blocking distance (BD).

No signals are evaluated within the blocking distance. Therefore, BD can be used to suppress interference signals in the vicinity of the antenna.

**Note:**
The measuring range should not overlap with the blocking distance.

**User entry**

0.0 to 20 m

**Factory setting**

An automatic Blocking distance (→ 75) of at least 0.1 m (0.33 ft) is configured as standard. However, this can be overwritten manually (0 m (0 ft) is also permitted).

Automatic calculation of the Blocking distance = Empty calibration - Full calibration - 0.2 m (0.656 ft).

Each time a new entry is made in the Empty calibration parameter or Full calibration parameter, the Blocking distance parameter is recalculated automatically using this formula.

If the result of the calculation is a value <0.1 m (0.33 ft), the Blocking distance of 0.1 m (0.33 ft) continues to be used.

### Level correction

**Navigation**

Setup → Advanced setup → Level correction

**Description**

The measured level is corrected by this value to compensate for a constant level error.

Level correction > 0:
The level is increased by this value.

Level correction < 0:
The level is decreased by this value.

**User entry**

–25 to 25 m

### Evaluation distance

**Navigation**

Setup → Advanced setup → Evaluation dist.

**Description**

Extended signal search area.

Is generally greater than the empty distance.

If the signal is found below the empty distance, '0' (empty) is indicated as measured value.

Only for signals, detected below the Evaluation distance, the error 'Echo Lost' is issued.

e.g. flow measurement in overflow weirs

**User entry**

0.0 to 21.8 m
### Linearization type

**Navigation**

Setup → Advanced setup → Lineariz. type

**Description**

**Linearization types**

Meaning of the options:

- **None:**
  The level is output in the level unit without being converted (linearized) beforehand.

- **Table:**
  The relationship between the measured level \( L \) and the output value (volume/flow/weight) is defined by a linearization table. This table consists of up to 32 value pairs, i.e. "level - volume" or "level - flow" or "level - weight".

**Selection**

- None
- Table

### Level linearized

**Navigation**

Setup → Advanced setup → Level linearized

**Description**

Currently measured level

**User interface**

Signed floating-point number

### Distance unit

**Navigation**

Setup → Advanced setup → Distance unit

**Description**

Used for the basic calibration (Empty / Full).

**Selection**

- **SI units**
  - m
- **US units**
  - ft

### Unit after linearization

**Navigation**

Setup → Advanced setup → Unit lineariz.

**Prerequisite**

Linearization type (→ 76) ≠ None

**Description**

Select the unit for the linearized value.

**Selection**

Selection/input (uint16)

- 1095 = [short Ton]
- 1094 = [lb]
- 1088 = [kg]
- 1092 = [Ton]
The selected unit is only used for display purposes. The measured value is **not** converted on the basis of the selected unit.

**Distance-to-distance linearization** is also possible, i.e. a linearization from the level unit to another length unit. Select the **Linear** linearization mode for this purpose. To specify the new level unit, select the **Free text** option in the **Unit after linearization** parameter and enter the unit in the **Free text** parameter.
Operating menu

Additional information

Meaning of the options
- Disable
  No linearization is calculated.
  If, at the same time, Linearization type (→ 76) = Table, then the device displays the error message F435.
- Enable
  The measured value is linearized according to the table entered.

When the table is edited, the Activate table parameter is automatically reset to Disable and then has to be set to Enable again afterwards.

Table mode

Navigation
- Setup → Advanced setup → Table mode

Prerequisite
- Linearization type (→ 76) = Table

Description
Select the entry mode for the linearization table.

Selection
- Manual
- Clear table

Additional information

Meaning of the options
- Manual
  The level and the associated linearized value are manually entered for each point in the table.
- Semiautomatic
  The level is measured by the device for each point in the table. The associated linearized value is entered manually.
- Clear table
  The existing linearization table is cleared.
- Sort table
  The points in the table are sorted in ascending order.

Linearization table conditions
- The table can consist of up to 32 "level - linearized value" pairs.
- The table must be monotonic (decreasing or increasing).
- The first value in the table must correspond to the minimum level.
- The last value in the table must correspond to the maximum level.

Before you create a linearization table, first select the correct values for Empty calibration (→ 71) and Full calibration (→ 71).

If the full/empty calibration is subsequently changed and should individual values then be changed in the linearization table, an existing table in the device first needs to be cleared and a new one created for the linearization to be performed correctly. For this purpose, first clear the table (Table mode (→ 78) = Clear table). Then enter the new table.
**Entering the table**
Via the local display
Call up the graphic table editor with the **Edit table** submenu. The table then appears on the display screen and can be edited line by line.

ℹ️ The factory setting for the level unit is "%". If the linearization table is to be entered in physical units, another suitable unit first needs to be selected in the **Level unit** parameter.

<table>
<thead>
<tr>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Navigation</strong></td>
</tr>
<tr>
<td><strong>User entry</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Navigation</strong></td>
</tr>
<tr>
<td><strong>User entry</strong></td>
</tr>
</tbody>
</table>
"Safety settings" submenu

*Navigation*  
Setup → Advanced setup → Safety sett.

### Delay time echo lost

**Navigation**  
Setup → Advanced setup → Safety sett. → Delay echo lost

**Description**  
Define the delay time in the case of an echo loss.

After an echo loss, the device waits for the time specified in this parameter before reacting as specified in the Diagnostic echo lost parameter. This helps to avoid interruptions of the measurement by short-term interferences.

**User entry**  
0 to 600 s

### Diagnostics echo lost

**Navigation**  
Setup → Advanced setup → Safety sett. → Diagn. echo lost

**Description**  
At this parameter it can be set if in case of a lost echo a warning or an alarm is issued.

**Selection**  
- Warning
- Alarm
"Administration" submenu

**Navigation**  
Setup → Advanced setup → Administration

**Description**  
Define release code for changing device operation mode.

If the factory setting is not changed or 0000 is defined as the access code, the device works in maintenance mode without write-protection and the configuration data of the device can then always be modified.

Once the access code has been defined, write-protected devices can only be changed to maintenance mode if the access code is entered in the Enter access code parameter. The new access code is only valid after it has been confirmed in the Confirm access code parameter.

Please contact your Endress+Hauser Sales Center if you lose your access code.

**User entry**  
0 to 9999

**Confirm access code**

**Navigation**  
Setup → Advanced setup → Administration → Confirm code

**Description**  
Re-enter the entered access code to confirm.

**User entry**  
0 to 9999

**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
Free field special

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Setup → Advanced setup → Administration → Free field spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Switch the free field option on or off.</td>
</tr>
<tr>
<td></td>
<td>This parameter can be switched on for free field applications (e.g. below bridges).</td>
</tr>
<tr>
<td></td>
<td>Caution:</td>
</tr>
<tr>
<td></td>
<td>The customer map (if one exists) is reset to the factory map!</td>
</tr>
<tr>
<td>Selection</td>
<td>• Off</td>
</tr>
<tr>
<td></td>
<td>• On</td>
</tr>
</tbody>
</table>
15.3.2  "Communication" submenu

Navigation  ➤ Setup → Communication

"Modbus configuration" submenu

Navigation  ➤ Setup → Communication → Modbus config.

Data transfer mode

Navigation  ➤ Setup → Communication → Modbus config. → Data trans. mode

Description  Use this function to select the data transmission mode.

Selection

• ASCII
  Transmission of data in the form of readable ASCII characters. Error protection via LRC.
• RTU
  Transmission of data in binary form. Error protection via CRC16.

Bus address

Navigation  ➤ Setup → Communication → Modbus config. → Bus address

Description  For entering the device address.

User entry  1 to 200

Factory setting  200

Baudrate

Navigation  ➤ Setup → Communication → Modbus config. → Baudrate

Description  Use this function to select a transmission rate.

Selection

• 1200 BAUD
• 2400 BAUD
• 4800 BAUD
• 9600 BAUD
• 19200 BAUD

Factory setting  9600 BAUD
Parity and databits setting

Navigation
Setup → Communication → Modbus config. → Parity& databits

Selection
- 8, None
- 8, Odd
- 8, Even
- 7, Odd
- 7, Even

Factory setting
8, Even

Stop bits

Navigation
Setup → Communication → Modbus config. → Stop bits

Selection
- 1 stop bits
- 2 stop bits

"Bluetooth configuration" submenu

Navigation
Setup → Communication → Bluetooth conf.

Bluetooth mode

Navigation
Setup → Communication → Bluetooth conf. → Bluetooth mode

Description
Enable or disable Bluetooth function..

Remark:
Switching to position 'Off will disable remote access via the app with immediate effect. To re-establish a Bluetooth connection via the app: Please follow the advices in the manual.

Selection
- Off
- On
15.4 "Diagnostics" menu

**Navigation**

Diagnostics → Actual diagnos.

**Description**

Displays current diagnostic message.
If several messages are active at the same time, the messages with the highest priority is displayed.

**Previous diagnostics**

**Navigation**

Diagnostics → Prev.diagnostics

**Description**

Displays the last diagnostic message, with its diagnostic information, which has been active before the current message.
The condition displayed may still apply.

**Delete previous diagnostic**

**Navigation**

Diagnostics → Del. prev. diag.

**Description**

Delete previous diagnostic message?
It is possible that the diagnostic message remains valid.

**Selection**

- No
- Yes
Signal quality

Navigation

Diagnostics → Signal quality

Description

Displays the signal quality of the level echo.

Meaning of the display options
- Strong:
The evaluated echo exceeds the threshold by at least 10 dB.
- Medium:
The evaluated echo exceeds the threshold by at least 5 dB.
- Weak:
The evaluated echo exceeds the threshold by less than 5 dB.
- No signal:
The device does not find a usable echo.

The signal quality indicated in this parameter always refers to the currently evaluated echo, either the level echo or the tank bottom echo.

In case of a lost echo (Signal quality = No signal) the device generates the following error message:
Diagnostic echo lost = Warning (factory setting) or Alarm, if the other option has been selected in Diagnostic echo lost.

User interface

- Strong
- Medium
- Weak
- No signal
15.4.1  "Device information" submenu

**Navigation**

Diagnostics → Device info

**Description**

Shows the name of the transmitter.

**User interface**

Character string comprising numbers, letters and special characters (#16)

---

**Firmware version**

**Navigation**

Diagnostics → Device info → Firmware version

**Description**

Shows the device firmware version installed.

**User interface**

Character string comprising numbers, letters and special characters (#8)

---

**Extended order code 1**

**Navigation**

Diagnostics → Device info → Ext. order cd. 1

**Description**

Shows the 1st part of the extended order code.

**User interface**

Character string comprising numbers, letters and special characters (#20)

---

**Extended order code 2**

**Navigation**

Diagnostics → Device info → Ext. order cd. 2

**Description**

Shows the 2nd part of the extended order code.

**User interface**

Character string comprising numbers, letters and special characters (#20)
### Extended order code 3

**Navigation**  
Diagnostics → Device info → Ext. order cd. 3

**Description**  
Shows the 3rd part of the extended order code.

**User interface**  
Character string comprising numbers, letters and special characters (#20)

---

### Order code

**Navigation**  
Diagnostics → Device info → Order code

**Description**  
Shows the device order code.

**User interface**  
Character string comprising numbers, letters and special characters (#20)

---

### Serial number

**Navigation**  
Diagnostics → Device info → Serial number

**Description**  
Shows the serial number of the measuring device.

**User interface**  
Character string comprising numbers, letters and special characters (#11)

---

### ENP version

**Navigation**  
Diagnostics → Device info → ENP version

**Description**  
Shows the version of the electronic nameplate (ENP).

**User interface**  
Character string comprising numbers, letters and special characters (#16)
## 15.4.2 "Device information" submenu

*Navigation*  
[Diagnostics]  
Device info

### Device name

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Diagnostics → Device info → Device name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Shows the name of the transmitter.</td>
</tr>
<tr>
<td><strong>User interface</strong></td>
<td>Character string comprising numbers, letters and special characters (#16)</td>
</tr>
</tbody>
</table>

### Firmware version

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Diagnostics → Device info → Firmware version</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Shows the device firmware version installed.</td>
</tr>
<tr>
<td><strong>User interface</strong></td>
<td>Character string comprising numbers, letters and special characters (#8)</td>
</tr>
</tbody>
</table>

### Extended order code 1

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Diagnostics → Device info → Ext. order cd. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Shows the 1st part of the extended order code.</td>
</tr>
<tr>
<td><strong>User interface</strong></td>
<td>Character string comprising numbers, letters and special characters (#20)</td>
</tr>
</tbody>
</table>

### Extended order code 2

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Diagnostics → Device info → Ext. order cd. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Shows the 2nd part of the extended order code.</td>
</tr>
<tr>
<td><strong>User interface</strong></td>
<td>Character string comprising numbers, letters and special characters (#20)</td>
</tr>
</tbody>
</table>
### Extended order code 3

**Navigation**
- Diagnostics → Device info → Ext. order cd. 3

**Description**
Shows the 3rd part of the extended order code.

**User interface**
Character string comprising numbers, letters and special characters (#20)

### Order code

**Navigation**
- Diagnostics → Device info → Order code

**Description**
Shows the device order code.

**User interface**
Character string comprising numbers, letters and special characters (#20)

### Serial number

**Navigation**
- Diagnostics → Device info → Serial number

**Description**
Shows the serial number of the measuring device.

**User interface**
Character string comprising numbers, letters and special characters (#11)

### ENP version

**Navigation**
- Diagnostics → Device info → ENP version

**Description**
Shows the version of the electronic nameplate (ENP).

**User interface**
Character string comprising numbers, letters and special characters (#16)
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