Technical Information

Micropilot FMR20
Modbus RS485
Free space radar

Level measurement for liquids

Application
- Ingress protection: IP66/68 / NEMA 4X/6P
- Measuring range: up to 20 m (66 ft)
- Process temperature: –40 to 80 °C (–40 to 176 °F)
- Process pressure: –1 to 3 bar (–14 to 43 psi)
- Accuracy: up to ± 2 mm (0.08 in)
- International explosion protection certificates

Your benefits
- Level measurement for liquids in storage tanks, open basins, pump shafts and canal systems
- Radar measuring device with Bluetooth® wireless technology and Modbus communication
- Simple, safe and secure wireless remote access – ideal for installation in hazardous areas or places difficult to reach
- Commissioning, operation and maintenance via free iOS / Android app SmartBlue – saves time and reduces costs
- Full PVDF body - for a long sensor lifetime
- Hermetically sealed wiring and fully potted electronics – eliminates water ingress and allows operation under harsh environmental conditions
- Most compact radar due to unique radar chip design – fits in limited space installations
- Best price-performance-ratio radar
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Endress+Hauser
Important document information

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<th>Symbols used</th>
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</thead>
</table>
| ✔️           | Permitted
|              | Procedures, processes or actions that are permitted   |
| ✖️           | Forbidden
|              | Procedures, processes or actions that are forbidden    |
| 🌟           | Tip
|              | Indicates additional information                      |
| 📖           | Reference to documentation                            |
| 📸           | Reference to graphic                                 |
| ⬆️            | Notice or individual step to be observed              |
| 1, 2, 3, ... | Series of steps                                       |
| 1, 2, 3, ... | Result of a step                                      |
| A, B, C, ... | Item numbers                                          |
|              | Views                                                 |
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

$\varepsilon_r$ (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
# Product life cycle

## Engineering
- Proven radar measuring technology
- Level measurement and open channel flow measurement for Ex and non-Ex areas
- Flooding detection
- Wide range of installation possibilities and accessories
- Highest degree of ingress protection
- 2D/3D drawings
- Spec Sheet Producer
- Applicator Selection tool for selecting the perfect measurement solution

**Note:** Device not compatible with transmitters and sensors that use ultrasonic measurement technology (e.g. Prosonic FMU9x, FDU9x)

## Procurement
- Best price-performance-ratio radar
- Global availability
- Order code includes variety of mounting accessories

## Installation
- Rear and front thread for flexible installation
- Slip-on flange for nozzle installation
- Complete measuring point: including mounting accessory and flooding protection tube

## Commissioning
- Quick and easy setup with the SmartBlue app and Modbus
- No additional tools or adapters required
- Local languages (up to 15)

## Operation
- Continuous self-monitoring
- Diagnostics information according to NAMUR NE107 with remedial measures in the form of plain text messages
- Signal curve via SmartBlue (app)
- Encrypted single point-to-point data transmission (tested by Fraunhofer Institute) and password-protected communication via Bluetooth® wireless technology

## Maintenance
- No maintenance required
- Technical experts on-call around the world

## Retirement
- Environmentally responsible recycling concepts
- RoHS compliance (restriction of certain hazardous substances), lead-free soldering of electronic components
Measuring principle

The Micropilot is a 'downward-looking' measuring system, which functions according to the time-of-flight (ToF) method. It measures the distance from the reference point $R$ to the product surface. Radar pulses are emitted by an antenna, reflected off the product surface and received again by the radar system.

The reflected radar pulses are received by the antenna and transmitted to the electronics. A microprocessor evaluates the signals and identifies the level echo caused by the reflection of the radar pulses at the product surface. This clear signal detection system benefits from over 30 years' experience with time-of-flight procedures.

The distance $D$ to the product surface is proportional to the time of flight $t$ of the pulse:

$$D = c \cdot t/2,$$

where $c$ is the speed of light.

Based on the known empty distance $E$, the level $L$ is calculated:

$$L = E - D$$

The device is adjusted by entering the empty distance $E$ (= zero point) and the full distance $F$ (= span).

Digital output (HART, SmartBlue): 0 to 15 m (0 to 49 ft) or 0 to 20 m (0 to 66 ft) depending on antenna version.

1) order code 010 (approval) 'GA', 'GB', 'GR': 0 to 10 m (0 to 32.8 ft)
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**

**Maximum measuring range**

- Device with 40 mm (1.5 in) antenna: 15 m (49 ft) \(^2\)
- Device with 80 mm (3 in) antenna: 20 m (66 ft)

**Installation requirements**

- Recommended tank height > 1.5 m (5 ft) for media with low \( \varepsilon_r \) value
- Open channel minimum width 0.5 m (1.6 ft)
- Calm surfaces
- No agitators
- No buildup
- Relative dielectric constant \( \varepsilon_r > 4 \)
  Contact Endress+Hauser for lower \( \varepsilon_r \) values

**Usable measuring range**

The usable measuring range depends on the antenna size, the medium's reflective properties, the installation position and any possible interference reflections.

**Media groups**

- \( \varepsilon_r = 4 \) to 10  
  e.g. concentrated acid, organic solvents, ester, aniline, alcohol, acetone.
- \( \varepsilon_r > 10 \)  
  e.g. conductive liquids, aqueous solutions, diluted acids and bases

Reduction of the maximum possible measuring range by:

- Media with bad reflective properties (= low \( \varepsilon_r \) value)
- Formation of buildup, particularly of moist products
- Strong condensation
- Foam generation
- Freezing of sensor

**Operating frequency**

K-band (~ 26 GHz)

**Transmission power**

**Mean power density in the direction of the beam**

- At a distance of 1 m (3.3 ft): < 12 nW/cm\(^2\)
- At a distance of 5 m (16 ft): < 0.4 nW/cm\(^2\)

Output

**Digital output**

**Modbus®**

Dedicated differential Modbus interface via separate wire pair

**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

---

\(^2\) order code 010 (approval) "GA", "GB", "GR": 10 m (32.8 ft)
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 linearization function of the device allows the conversion of the measured value into any unit of length, weight, flow or volume. When operating via Modbus, linearization tables are pre-programmed for the calculation of the volume in vessels (see the following list).

Pre-programmed linearization curves
- Cylindrical tank
- Spherical tank
- Tank with pyramidal bottom
- Tank with conical bottom
- Tank with flat bottom

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

Protocol-specific data, Modbus

Modbus conformity

Modbus-compliant with restrictions.
The TIA-485 Standard is only met with the following restrictions:

Maximum bus load:
100 Ω
For installations with a bus cable > 100 m, the load should not drop below 200 Ω, or a fieldbus repeater should be used.

Time for connection setup
< 1 s

Addressing
1 to 200

Modbus settings

The following settings can be customized via Bluetooth and Modbus.

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<thead>
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<th>Setting</th>
<th>Options</th>
<th>Default</th>
</tr>
</thead>
<tbody>
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<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>

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.
### Electrical connection

#### Cable assignment

<table>
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<th>Cable assignment</th>
<th>Function</th>
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<td>D0 / A (+)</td>
<td>Modbus D0/A (+), white wire</td>
</tr>
<tr>
<td>D1 / B (-)</td>
<td>Modbus D1/B (-), black wire</td>
</tr>
<tr>
<td>1</td>
<td>Plus, brown wire</td>
</tr>
<tr>
<td>2</td>
<td>Minus, blue wire</td>
</tr>
</tbody>
</table>

#### Supply voltage

5 to 30 $V_{DC}$

An external power supply is necessary.

#### Battery operation

The sensor's Bluetooth® 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.
Power consumption

Data with supply voltage $24 \: V_{DC}$

Maximum input power: 100 mW

Calculation for other supply voltage:

$$P = 39 \: mW + (V_{cc} - 24 \: V_{DC}) \times 0.28$$

Measures to reduce power consumption:

Disabling the Bluetooth® wireless technology interface reduces the power consumption by 1.5 mW.

Single shot mode switched on/off via RTU

![Diagram 3](image-choice:3,9)

3 Power consumption of single shot mode switched on/off via RTU

- **A** Start-up
- **B** Measurement
- **C** Power save mode
- **D** Switch on power supply
- **E** Switch off power supply

Single shot mode switched on permanently

![Diagram 4](image-choice:4,9)

4 Power consumption of single shot mode switched on permanently

- **B** Measurement
- **C** Power save mode
- **F** Trigger
Continuous measuring mode switched on/off via RTU

![Diagram showing power consumption](image)

5 Power consumption of continuous measuring mode switched on/off via RTU

- **A**: Start-up
- **B**: Measurement
- **C**: Switch on power supply
- **D**: Switch off power supply

**Calculation example**

**Assumed configuration**
- RTU: E+H FXA30B with battery (7.2 V, 14.5 Ah)
- Modbus: single-shot mode switched on/off via RTU
- Switch on power supply every 15 min and leave switched on for 30 s

**Power consumption with Vcc = 7.2 V**
- **Start-up**: 33 mW + (7.2 V - 24 V) × 0.28 = 28.3 mW
- **Measurement**: 39 mW + (7.2 V - 24 V) × 0.28 = 34.3 mW
- **Power save mode**: 30 mW + (7.2 V - 24 V) × 0.28 = 25.3 mW

**Energy of a measurement:**
\[ E = 8 \text{ s} \times 28.3 \text{ mW} + 3 \text{ s} \times 34.3 \text{ mW} + (30 \text{ s} - 8 \text{ s} - 3 \text{ s}) \times 25.3 \text{ mW} = 810 \text{ mWs} \]

**Number of measurements:**
\[ 7.2 \text{ V} \times 14.5 \text{ Ah} \times 3600 / 0.810 \text{ Ws} = \approx 460,000 \text{ measurements} \]

**Operating life:**
\[ 460,000 \times 15 \text{ min} = 4790 \text{ days} = 13 \text{ years} \]

° The energy consumption of the RTU is not taken into consideration!

**Starting time**
- Until the 1st measured value:
  - 11 s (typically)
  - 15 s (maximum)
- Until full accuracy:
  - 15 s (typically)
  - 20 s (maximum)

**Power supply failure**
- The configuration remains stored in the sensor.

**Connecting the device**
- **Block circuit diagram for Modbus RS485 connection**
- The RS485 connection meets the requirements of the RS485-IS specification for use in hazardous environments.
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.

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

- Unshielded cable, wire cross-section 0.22 mm²
- UV- and weather-resistant
- Flame resistance according to IEC 60332-1-2

As per IEC/EN 60079-11 section 10.9, the cable is designed for a tensile strength of 30 N (6.74 lbf) (over a period of 1 h).

The device is supplied with 5 m (16 ft) cable length as standard. Cable lengths 10 m (33 ft) and 20 m (66 ft) are optionally available.

User-defined lengths up to total length of 300 m (980 ft) are possible in increments of one meter or one foot.

Overvoltage protection

The device is equipped with integrated overvoltage protection.

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.

Digital output; Modbus, SmartBlue (app)

- Sum of non-linearity, non-repeatability and hysteresis: ±2 mm (±0.08 in)
- Offset/zero point: ±4 mm (±0.16 in)

Differing values in near-range applications

<table>
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<tr>
<th>R [m (ft)]</th>
<th>∆ [mm (in)]</th>
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<tr>
<td>0.1 (0.33)</td>
<td>0</td>
</tr>
<tr>
<td>0.5 (1.67)</td>
<td>2 (0.08)</td>
</tr>
<tr>
<td>2 (0.79)</td>
<td>10 (0.39)</td>
</tr>
<tr>
<td>0</td>
<td>-2 (-0.08)</td>
</tr>
<tr>
<td>-2 (-0.79)</td>
<td>-10 (-0.39)</td>
</tr>
<tr>
<td>-10 (-0.39)</td>
<td>-20 (-0.79)</td>
</tr>
</tbody>
</table>

Maximum measured error in near-range applications; values for standard version

Δ Maximum measured error
R Reference point of the distance measurement
D Distance from reference point of antenna

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**
  - <20 m (66 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 \( T_C = \pm 3 \text{ mm (±0.12 in)/10 K} \)

Installation

### Installation conditions

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<td><strong>A</strong> Wall or ceiling mount, adjustable</td>
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<td><strong>B</strong> Mounted at front thread</td>
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<td><strong>C</strong> Mounted at rear thread</td>
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<tr>
<td><strong>D</strong> Ceiling installation with counter nut (included in delivery)</td>
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<tr>
<td><strong>E</strong> Horizontal installation in cramped spaces (wastewater shaft), 40 mm (1.5 in) antenna with flooding protection tube (accessory) or 80 mm (3 in) antenna recommended</td>
</tr>
<tr>
<td><strong>F</strong> Shaft wall mounting</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.
Position for installation on a vessel

- If possible install the sensor so that its lower edge projects into the vessel.
- Recommended distance A wall - nozzle outer edge: \(~ \frac{1}{6}\) of the vessel diameter D. 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 equipment such as limit switches, temperature sensors, baffles, heating coils etc.
- 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:
Block 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.

Nozzle installation

The antenna should be located 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 length of the nozzle 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 × 4.5

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

**40 mm (1.5 in) antenna, installation outside nozzle**
- D: min. 40 mm (1.5 in)
- L: max. D × 1.5

**40 mm (1.5 in) antenna, installation inside nozzle**
- D: min. 80 mm (3 in)
- L: max. 140 mm (5.5 in) + D × 1.5

**Device alignment for installation on a vessel**
- Align the antenna vertically to the product surface.
- Align the eyelet with lug towards the vessel wall as well as possible.

![Diagram](image1)

**Beam angle**

![Diagram](image2)

The beam angle is defined as the angle \( \alpha \), at which the power density of the radar waves reaches half the value of the maximum power density (3 dB 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 $D$.

40 mm (1.5 in) antenna, $\alpha$ 30 °
$W = D \times 0.54$

40 mm (1.5 in) antenna with flooding protection tube, $\alpha$ 12 °
$W = D \times 0.21$

80 mm (3 in) antenna with or without flooding protection tube, $\alpha$ 12 °
$W = D \times 0.21$

Measurement in plastic vessels

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.

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).

Please contact the manufacturer for further information.

Protective hood

For outdoor use, a protective hood is recommended.

The protective hood 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 protective hood.

**Free-field measurement with flooding protection tube**

The flooding protection tube ensures the sensor measures the maximum level even if it is completely flooded.

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

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

---

1. Air pocket
2. O-ring (EPDM) seal
3. Blocking distance
4. Max. level

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 air pocket that formed in the tube ensures the measurement of the maximum level at the end of the tube. Due to the fact that the Blocking distance is inside the tube, multiple echoes are not analyzed.
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.

Cantilever installation, with pivot

The cantilever, wall bracket and mounting frame are available as accessories.

Installation of horizontal mounting bracket for sewer shafts

The horizontal mounting bracket for sewer shafts is available as an accessory.
Micropilot FMR20 Modbus RS485

Installation of horizontal mounting bracket for sewer shafts

A 40 mm (1.5 in) Antenna, with flooding protection tube (accessory)
B 80 mm (3 in) Antenna, without flooding protection tube

Mounting in a shaft

The pivoted mounting bracket is available as an accessory.

Mounting in a shaft, pivotable and adjustable

A Arm with wall bracket
B Pivotable and adjustable arm (e.g. to align the device with the center of a channel)

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)²/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](http://www.endress.com/downloads)). |
Process

Process temperature, process pressure

![Diagram showing the permitted range for process temperature and process pressure]

22 FMR20: Permitted range for process temperature and process pressure

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

Process pressure range, threaded process connection
- \( p_{\text{rel}} = -1 \) to 3 bar (–14.5 to 43.5 psi)
- \( p_{\text{abs}} < 4 \) bar (58 psi)

Process pressure range, UNI flange process connection
- \( p_{\text{rel}} = -1 \) 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.

Dielectric constant

For liquids
- \( \varepsilon_r \geq 4 \)
- Contact Endress+Hauser for lower \( \varepsilon_r \) values

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)
Mechanical construction

Dimensions 40 mm (1.5 in) Antenna with G 1-½" or MNPT 1-½" thread

![Diagram of Micropilot FMR20 Modbus RS485 Mechanical construction](image)

23 Dimensions of G 1-½" or MNPT 1-½" process connection thread, engineering unit: mm (in)

- A Cable gland
- B FNPT ½" conduit

40 mm (1.5 in) Antenna with G 2" or MNPT 2" thread

![Diagram of Micropilot FMR20 Modbus RS485 Mechanical construction](image)

24 Dimensions of G 2" or MNPT 2" process connection thread, engineering unit: mm (in)

- A Cable gland
- B FNPT ½" conduit
40 mm (1.5 in) antenna with flooding protection tube

The flooding protection tube, metalized PBT-PC, can be ordered together with the device via the product structure 'Accessory enclosed'.

80 mm (3 in) Antenna

A  Cable gland
B  FNPT ½” conduit
80 mm (3 in) antenna with flooding protection tube

The flooding protection tube, metalized PBT-PC, can be ordered together with the device via the product structure "Accessory enclosed".
80 mm (3 in) antenna with slip-on flange 3\"/DN80

![Diagram of 80 mm (3 in) antenna with slip-on flange 3\"/DN80]

28 Dimensions of 80 mm (3 in) antenna with slip-on flange 3\"/DN80, engineering unit: mm (in)

The slip-on flange 3\"/DN80, PVDF, can be ordered together with the device via the product structure "Accessory enclosed".

80 mm (3 in) antenna with slip-on flange 4\"/DN100

![Diagram of 80 mm (3 in) antenna with slip-on flange 4\"/DN100]

29 Dimensions of 80 mm (3 in) antenna with slip-on flange 4\"/DN100, engineering unit: mm (in)

The slip-on flange 4\"/DN100, PVDF, can be ordered together with the device via the product structure "Accessory enclosed".
80 mm (3 in) antenna with slip-on flange 6"/DN150

The slip-on flange 6"/DN150, PVDF, can be ordered together with the device via the product structure 'Accessory enclosed'.

Counter nut for process connection, rear side

The counter nut with seal (EPDM) is included in the scope of supply.

Material: PA66

Weight

- Device with 40 mm (1.5 in) antenna: approx. 2.5 kg (5.5 lb)
- Device with 80 mm (3 in) antenna: approx. 2.8 kg (6.2 lb)
Materials

32 Overview of materials

A 40 mm (1.5 in) Antenna
B 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

Connecting cable
Available cable length: 5 to 300 m (16 to 980 ft)
Material: PVC

Operability

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

Operation via Bluetooth® wireless technology

33 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
Remote operation via Modbus protocol

1. Computer with Modbus operating tool (client application, terminal application, etc.)
2. Remote Transmit Unit (RTU) with Modbus (e.g. Fieldgate FXA42)
3. Connect Sensor FXA30B
4. Memograph M RSG45
5. Modbus RS485
6. Transmitter with Modbus and Bluetooth® wireless technology
7. Smartphone / tablet with SmartBlue (app)
## Certificates and approvals

The availability of approvals and certificates can be called up daily via the Product Configurator.

### 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.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

### RoHS

The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 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.

Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.

### RCM-Tick marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM-Tick marking on the name plate.

### Approvals

- Non-hazardous area
- ATEX II 1 G Ex ia IIC T4 Ga
- ATEX II 1/2 G Ex ia IIC T4 Ga/Gb
- CSA C/US General Purpose
- CSA C/US CS II Div.1 Gr.A-D, AEx ia / Ex ia T4
- IEC Ex ia IIC T4 Ga/Gb

Additional safety instructions must be followed for use in hazardous areas. Please refer to the separate ‘Safety Instructions’ (XA) document included in the delivery. Reference to the applicable XA can be found on the nameplate.

### Explosion-protected smartphones and tablets

Only mobile end devices with Ex approval may be used in hazardous areas.

### Pressure equipment with allowable pressure ≤ 200 bar (2900 psi)

Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.

**Reasons:**

According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as 'devices with an operational function and having pressure-bearing housings'.

If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.

### EN 302729-1/2 radio standard

The devices comply with the LPR (Level Probing Radar) radio standard EN 302729-1/2 and are approved for unrestricted use inside and outside of closed vessels in countries of the EU and EFTA. As a prerequisite, the countries in question must have already implemented this standard.

The following countries are those that have currently implemented the standard:

- Belgium, Bulgaria, Germany, Denmark, Estonia, France, Greece, UK, Ireland, Iceland, Italy, Liechtenstein, Lithuania, Latvia, Malta, The Netherlands, Norway, Austria, Poland, Portugal, Romania, Sweden, Switzerland, Slovakia, Spain, Czech Republic and Cyprus.

Implementation is still underway in all of the countries not listed.
Please note the following for operation of the devices outside of closed vessels:

1. The device must be mounted in accordance with the instructions in the ‘Installation’ section.
2. Installation must be carried out by properly trained, expert staff.
3. The device antenna must be installed in a fixed location pointing vertically downwards.
4. The installation site must be located at a distance of 4 km from the astronomy stations listed below or otherwise approval must be provided by the relevant authority. If the device is installed at a distance of 4 to 40 km from one of the listed stations, it must not be installed at a height of more than 15 m (49 ft) above the ground.

<table>
<thead>
<tr>
<th>Astronomy stations</th>
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<tbody>
<tr>
<td><strong>Country</strong></td>
</tr>
<tr>
<td>Germany</td>
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<td>Finland</td>
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<td>Spain</td>
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<td></td>
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<tr>
<td>Hungary</td>
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</tbody>
</table>

As a general rule, the requirements outlined in EN 302729-1/2 must be observed.

**FCC / Industry Canada**

This device complies with Part 15 of the FCC Rules [and with Industry Canada license-exempt RSS standard(s)]. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes: (1) l’appareil ne doit pas produire de brouillage, et (2) l’utilisateur de l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.
[Any] Changes or modifications made to this equipment not expressly approved by Endress+Hauser may void the FCC authorization to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

The installation of the LPR/TLPR device shall be done by trained installers, in strict compliance with the manufacturer’s instructions.

- The use of this device is on a “no-interference, no-protection” basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, devices found to interfere with primary licensing operations will be required to be removed at the user’s expense.
- Only for usage without the accessory “flooding protection tube”, i.e. NOT in the free-field: This device shall be installed and operated in a completely enclosed container to prevent RF emissions, which can otherwise interfere with aeronautical navigation.

FCC / Industry Canada IDs

Tank level-probing radar
- HVIN: FMR20
  - FCC ID: LCGFMR2XK
  - Industry Canada ID: 2519A-2K
- HVIN: FMR20X
  - FCC ID: LCGFMR2XKT
  - Industry Canada ID: 2519A-2KT

Level-probing radar:
- HVIN: FMR20+R7; FMR20+R8
  - FCC ID: LCGFMR2XKF
  - Industry Canada ID: 2519A-2KF
- HVIN: FMR20+R7X; FMR20+R8X
  - FCC ID: LCGFMR2XKL
  - Industry Canada ID: 2519A-2KL

Mexico

El funcionamiento de este equipo está sujeto a las dos condiciones siguientes:
- (1) Este equipo o aparato no puede causar interferencias perjudiciales.
- (2) Este equipo o aparato debe aceptar todas las interferencias, incluyendo las que puedan causar un funcionamiento indeseado del equipo o aparato.

Este producto contiene un módulo inalámbrico

Marca: Endress+Hauser

Modelo: FMR20
Other standards and guidelines

- IEC/EN 61010-1
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures
- IEC/EN 55011
  "EMC Emission, RF Emission for Class B. Industrial, scientific and medical equipment – Electromagnetic disturbance characteristics - Limits and methods of measurement"
- IEC/EN 61000-4-2
  EMC Immunity, ESD (Performance Criteria A). Electromagnetic compatibility (EMC): Testing and measurement techniques - Electrostatic discharge immunity test (ESD)
- IEC/EN 61000-4-3
  EMC Immunity, RF field susceptibility (Performance Criteria A). Electromagnetic compatibility (EMC): Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
- IEC/EN 61000-4-4
  EMC Immunity, bursts (Performance Criteria B). Electromagnetic compatibility (EMC): Testing and measurement techniques - Electrical fast transient/burst immunity test
- IEC/EN 61000-4-5
  EMC Immunity, surge (Performance Criteria B). Electromagnetic compatibility (EMC): Testing and measurement techniques - Surge immunity test
- IEC/EN 61000-4-6
  EMC Immunity, conducted RF (Performance Criteria A). Electromagnetic compatibility (EMC): Testing and measurement techniques - Immunity to conducted disturbances induced by radio-frequency fields
- IEC/EN 61000-4-8
  EMC Immunity, magnetic fields 50 Hz. Electromagnetic compatibility (EMC): Testing and measurement techniques - Power frequency magnetic field immunity test
- EN 61000-6-3
  EMC Emission, conducted RF. EMC: Radiated interference - Residential, commercial and light industry environment
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 107
  Status classification as per NE107
- NAMUR NE 131
  Requirements for field devices for standard applications
- IEEE 802.15.1
  Requirements for the Bluetooth® wireless technology interface

Ordering information

Detailed ordering information is available for your nearest sales organization
www.addresses.endress.com or in the Product Configurator under www.endress.com:

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product 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
**Accessories**

**Device-specific accessories**

**Protective cover**

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

![Diagram of protective cover](image)

⚠️ Dimensions of protective cover, engineering unit: mm (in)

**Material**

PVDF

**Order number**

52025686

The sensor is not completely covered in the case of the 40 mm (1.5 in) antenna or the 80 mm (3 in) antenna.

**Securing nut G 1-1/2"**

Suitable for devices with G 1-1/2" and MNPT 1-1/2" process connection.
36 Dimensions of securing nut, engineering unit: mm (in)

Material
PC

Order number
52014146

Securing nut G 2"
Suitable for devices with G 2" and MNPT 2" process connection on front.

37 Dimensions of securing nut, engineering unit: mm (in)

Material
PC

Order number
52000598
Flooding protection tube 40 mm (1.5 in)
Suitable for use with devices with a 40 mm (1.5 in) antenna and G 1-1/2" process connection on front.

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

![Image of flooding protection tube]

Dimensions of 40 mm (1.5 in) flooding protection tube, engineering unit: mm (in)

**Material**
PBT-PC, metalized

**Order number**
71325090
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 80 mm (3 in) flooding protection tube, engineering unit: mm (in)](image)

**Material**
PBT-PC, metalized

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

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

![Diagram of mounting bracket](image)

**40 Dimensions of mounting bracket, engineering unit: mm (in)**

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

**Order number**

71325079
UNI flange 2"/DN50/50, PP

The UNI flange 2"/DN50/50 can be ordered together with the device via the product structure "Accessory enclosed".

![Diagram of UNI flange 2"/DN50/50, PP](image)

41 Dimensions of UNI flange 2"/DN50/50, engineering unit: mm (in)

A Sensor connection in accordance with product structure 'Process connection on front' or 'Process connection on rear'

Material
PP

Order number
FAX50-####
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](image)

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

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

**Material**
PP

**Order number**
FAX50-****
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".

Dimensions of UNI flange 4"/DN100/100, engineering unit: mm (in)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value (mm)</th>
<th>Value (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>6.89</td>
<td></td>
</tr>
<tr>
<td>190.5</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>228.6</td>
<td>9.0</td>
<td></td>
</tr>
</tbody>
</table>

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

Material
PP

Order number
FAX50-****
Angle bracket for wall mounting

- **Dimensions of angle bracket. Unit of measurement mm (in)**
  - 400 (15.7)
  - 250 (9.84)
  - 120 (4.72)
  - 30 (1.2)
  - $\phi 16$ (0.6)

- **Sensor connection in accordance with product structure "Process connection on front"**

- **Weight**
  - 3.4 kg (7.5 lb)

- **Material**
  - 316L (1.4404)

- **Order number for G 1-1/2" process connection**
  - 71452324
  - Also suitable for MNPT 1-1/2"

- **Order number for G 2" process connection**
  - 71452325
  - Also suitable for MNPT 2"
Cantilever with pivot

Installation type sensor process connection rear side

45 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 (short) with pivot, sensor process connection on rear

46 Dimensions of cantilever (short) with pivot for sensor process connection on rear. Unit of measurement mm (in)

Weight:
2.1 kg (4.63 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 an additional sensor
- Retaining screws are included in delivery
Cantilever (long) with pivot, sensor process connection on rear

| A0037807 | Dimensions of cantilever (long) with pivot for sensor process connection on rear. Unit of measurement mm (in) |

- Weight: 4.5 kg (9.92 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 an additional sensor
- Retaining screws are included in delivery

Installation type sensor process connection front side

A Installation with cantilever and wall bracket
B Installation with cantilever and mounting frame
1 Cantilever
2 Wall bracket
3 Mounting frame
Cantilever (short) with pivot, G 1-½” sensor process connection on front

- 50 mm (2.17 in) openings for all G 1-½” (MNPT 1-½”) connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Weight:
1.9 kg (4.19 lb)

Material
316L (1.4404)

Order number
71452318

Cantilever (long) with pivot, G 1-½” sensor process connection on front

- 75 (2.9) 75 (2.9) 100 (3.9) 750 (29.5) openings for all G 1-½” (MNPT 1-½”) connections on front
- 20 (0.8) 3 (0.12) 6.5 (0.3) 15 (0.6) openings can be used for an additional sensor
- Retaining screws are included in delivery
Weight:
4.4 kg (9.7 lb)

Material
316L (1.4404)

Order number
571452319

- 50 mm (2.17 in) openings for all G 1-½ (MNPT 1-½") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Cantilever (short) with pivot, G 2" sensor process connection on front

Weight:
1.9 kg (4.19 lb)

Material
316L (1.4404)

Order number
71452321

- 62 mm (2.44 in) openings for all G 2" (MNPT 2") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery
Cantilever (long) with pivot, G 2" sensor process connection on front

- Dimensions of cantilever (long) with pivot for G 2" sensor process connection on front. Unit of measurement mm (in)

Weight:
4.4 kg (9.7 lb)

Material
316L (1.4404)

Order number
71452322

- 62 mm (2.44 in) openings for all G 2" (MNPT 2") connections on front
- 22 mm (0.87 in) opening can be used for an additional sensor
- Retaining screws are included in delivery

Mounting frame (short) for cantilever with pivot

- Dimensions of mounting frame (short). Unit of measurement mm (in)
Micropilot FMR20 Modbus RS485

**Weight:**
3.2 kg (7.06 lb)

**Material**
316L (1.4404)

**Order number**
71452327

*Mounting frame (long) for cantilever with pivot*

![Dimensions of mounting frame (long). Unit of measurement mm (in)](image)

**Weight:**
4.9 kg (10.08 lb)

**Material**
316L (1.4404)

**Order number**
71452326

*Wall bracket for cantilever with pivot*

![Dimensions of the wall bracket. Unit of measurement mm (in)](image)
**Weight**
1.4 kg (3.09 lb)

**Material**
316L (1.4404)

**Order number**
71452323
Ceiling mounting bracket

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

*Dimensions of ceiling mounting bracket. Unit of measurement mm (in)*

**Material**

316L (1.4404)

**Order number**

71093130
Pivoted mounting bracket for sewer channel

The pivoted mounting bracket is used to install the device in a manhole over a sewer channel. The mounting bracket can be ordered together with the device via the "Accessory enclosed" section of the product order structure.

57 Dimensions of pivotable mounting bracket. Unit of measurement mm (in)

Material
316L (1.4404)

Order number
71429910
**Horizontal mounting bracket for sewer shafts**

The horizontal mounting bracket for sewer shafts is used to install the device in confined spaces. The mounting bracket can be ordered together with the device via the 'Accessory enclosed' section of the product order structure.

![Diagram of horizontal mounting bracket for sewer shafts. Unit of measurement mm (in)](image)

- **Material:** 316L (1.4404)
- **Order number:** 71429905
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

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

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

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.

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

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

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