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71656887
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Technical Information
Micropilot FMR43 HART

Free-space radar



Level measurement in hygienic applications

Application

- Continuous, non-contact level measurement of liquids and solids in hygienic applications
- Process connections: for hygiene applications (e.g.: Tri-Clamp or M24 adapter concept)
- Maximum measuring range: 15 m (49 ft)
- Process temperature:–40 to +150 °C (–40 to +302 °F)
- Pressure: –1 to +20 bar (–14.5 to +290 psi)
- Accuracy: ±1 mm (±0.04 in)

Your benefits

- PTFE or PEEK antenna for hygienic requirements
- Reliable measurement thanks to strong signal focusing, even with multiple internal fixtures
- Easy, guided commissioning with intuitive user interface
- Heartbeat Technology for predictive and preventive maintenance
- *Bluetooth*®wireless technology for commissioning, operation and maintenance
- CIP and SIP capabilities - up to protection class IP69

Endress+Hauser
People for Process Automation

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About this document

Symbols

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.

Communication-specific symbols

Bluetooth®:
Wireless data transmission between devices over a short distance

Symbols for certain types of information

Permitted:

Procedures, processes or actions that are permitted.

Forbidden:

Procedures, processes or actions that are forbidden.

Additional information:

Reference to documentation:

Reference to page:

Series of steps: 1., 2., 3.

Result of an individual step:

Symbols in graphics

Item numbers: 1, 2, 3 ...

Series of steps: 1., 2., 3.

Views: A, B, C, ...

List of abbreviations

PN
Nominal pressure

MWP
Maximum working pressure
The maximum working pressure is indicated on the nameplate.

ToF
Time of Flight

DTM
Device Type Manager

ε_r (Dk value)
Relative dielectric constant

Operating tool

The term "operating tool" is used in place of the following operating software:
- FieldCare / DeviceCare, for operation via HART communication and PC
- SmartBlue app, for operation using an Android or iOS smartphone or tablet

PLC
Programmable logic controller (PLC)

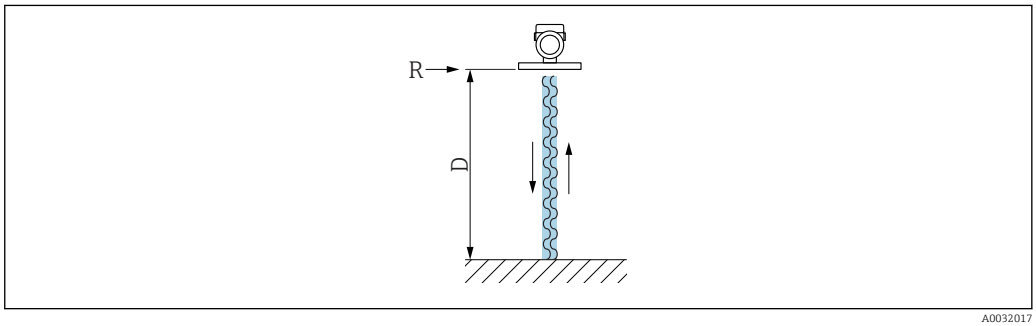
Graphic conventions

- Installation, explosion and electrical connection drawings are presented in simplified format
- Devices, assemblies, components and dimensional drawings are presented in reduced-line format
- Dimensional drawings are not to-scale representations; the dimensions indicated are rounded off to 2 decimal places
- Unless otherwise described, flanges are presented with sealing surface form EN 1092-1; ASME B16.5, RF.

Function and system design

Measuring principle

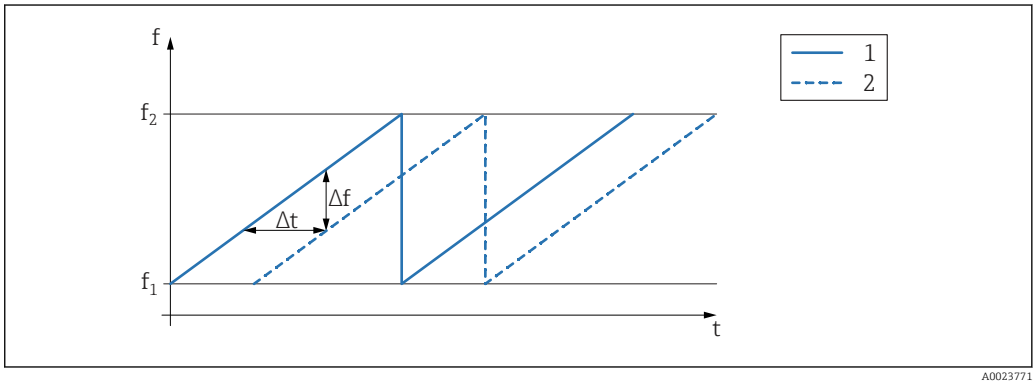
The Micropilot is a "downward-looking" measuring system, operating based on the frequency modulated continuous wave method (FMCW). The antenna emits an electromagnetic wave at a continuously varying frequency. This wave is reflected by the product and received again by the antenna.



1 *FMCW principle: transmission and reflection of the continuous wave*

R Reference point of measurement
D Distance between reference point and product surface

The frequency of this wave is modulated in the form of a sawtooth signal between two limit frequencies f_1 and f_2:



2 *FMCW principle: result of frequency modulation*

1 Transmitted signal
2 Received signal

This results in the following difference frequency at any time between the transmitted signal and the received signal:

$\Delta f = k \Delta t$

where Δt is the run time and k is the specified increase in frequency modulation.

Δt is given by the distance D between the reference point R and the product surface:

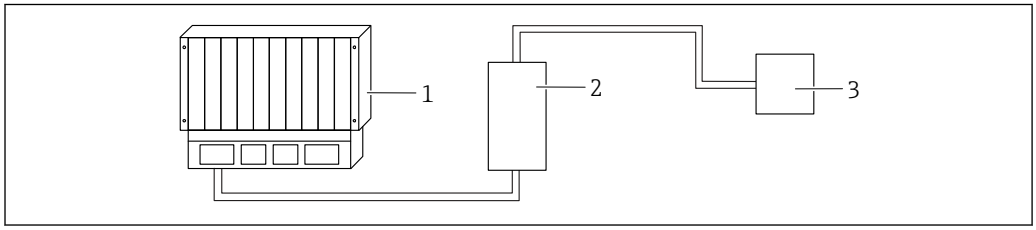
$D = (c \Delta t) / 2$

where c is the velocity of the wave.

In summary, D can be calculated from the measured difference frequency Δf. D is then used to determine the content of the tank or silo.

Measuring system

A complete measuring system comprises:



1 *PLC (programmable logic controller)*
2 *RMA42/RIA45 (if necessary)*
3 *Device*

Communication and data processing

- 4 to 20 mA with superimposed digital communication protocol HART, 2-wire
- Bluetooth (optional)

Reliability

IT security

Our warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

Device-specific IT security

The device offers specific functions to support protective measures by the operator. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. The user role can be changed with an access code (applies to operation via the onsite display, Bluetooth or FieldCare, DeviceCare, Asset Management Tools e.g. AMS, PDM)

Access via Bluetooth® wireless technology

Secure signal transmission via Bluetooth® wireless technology uses an encryption method tested by the Fraunhofer Institute.

- Without the SmartBlue app, the device is not visible via Bluetooth® wireless technology.
- Only one point-to-point connection is established between the device and a smartphone or tablet.
- The Bluetooth® wireless technology interface can be disabled via onsite operation or SmartBlue.

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

The measuring range starts at the point where the beam hits the tank floor. Levels below this point cannot be measured, particularly in the case of spherical bases or conical outlets.

Maximum measuring range

The maximum measuring range depends on the operating frequency and the process connection.

Operating frequency 80 GHz

Process connection	Maximum measuring range
M24	10 m (33 ft)
MNPT/G ¾	10 m (33 ft)
G 1	10 m (33 ft)
MNPT/G 1½	15 m (49 ft)
Tri-Clamp 1½	15 m (49 ft)
Tri-Clamp 2	15 m (49 ft)

Operating frequency 180 GHz

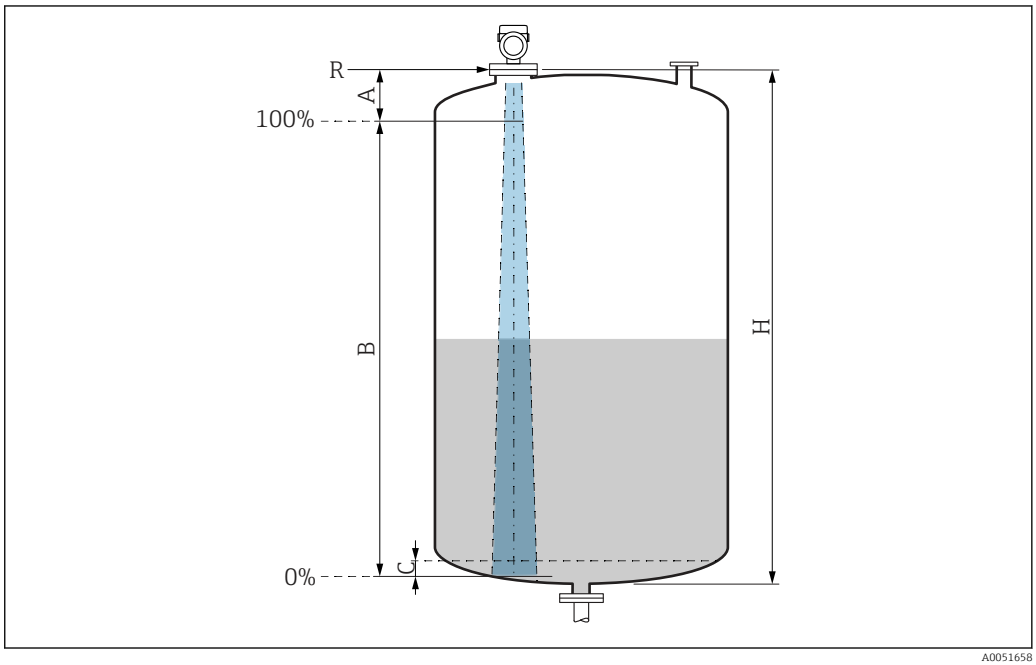
Process connection	Maximum measuring range
MNPT/G ½	10 m (33 ft)
M24	10 m (33 ft)

Usable measuring range

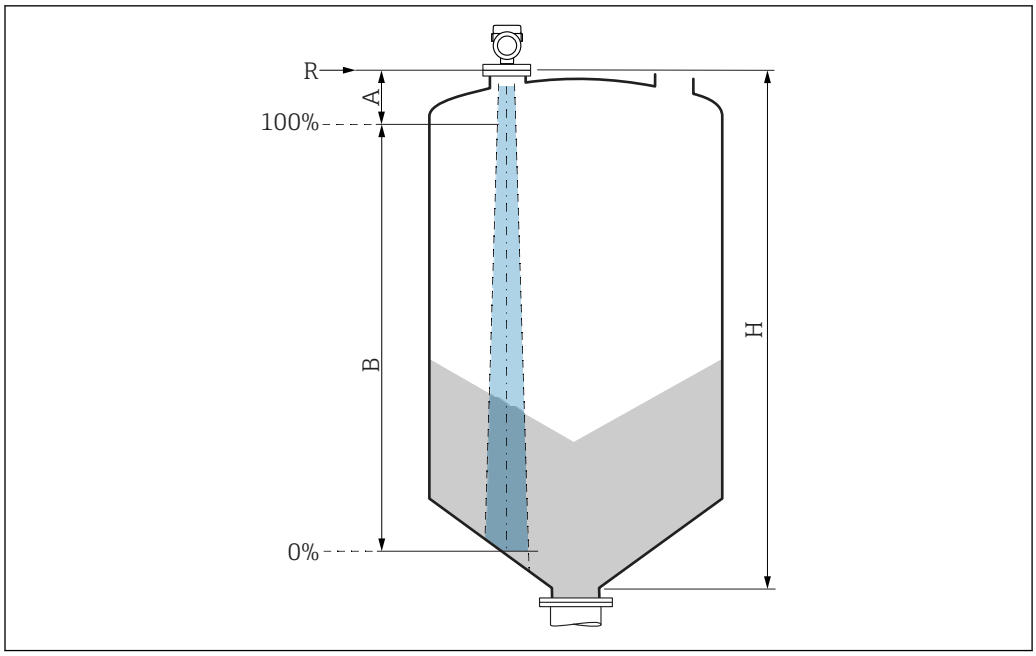
The usable measuring range depends on the antenna size, the medium's reflective properties, the installation position and any possible interference reflections.

In principle, measurement is possible up to the tip of the antenna.

Depending on the position of the product (angle of repose for solids) and to avoid any material damage from corrosive or aggressive media or deposit buildup on the antenna, the end of the measuring range should be selected 10 mm (0.4 in) before the tip of the antenna.



A Antenna tip + 10 mm (0.4 in)
B Usable measuring range
C 50 to 80 mm (1.97 to 3.15 in); Medium ε_r ≤2
H Vessel height
R Reference point of the measurement, varies depending on the antenna system (see section on Mechanical construction)



A Antenna tip + 10 mm (0.4 in)
B Usable measuring range
H Vessel height
R Reference point of the measurement, varies depending on the antenna system (see section on Mechanical construction)

In the case of media with a low dielectric constant ε_r <2, the tank bottom may be visible through the medium when levels are very low (less than level C). Reduced accuracy must be expected in this range. If this is not acceptable, the zero point should be positioned at a distance C above the tank bottom for these applications (see figure).

The media groups for liquids and the possible measuring range as a function of the application and media group are described below. If the dielectric constant of the medium is not known, media group B should be assumed for reliable measurement.

Media groups
- **A** (ε_r 1.4 to 1.9)
  Non-conductive liquids, e.g. liquefied gas
- **B** (ε_r 1.9 to 4)
  Non-conductive liquids, e.g. gasoline, oil, toluene, etc.
- **C** (ε_r 4 to 10)
  e.g. concentrated acid, organic solvents, ester, aniline, etc.
- **D** (ε_r >10)
  Conductive liquids, aqueous solutions, diluted acids, bases and alcohol

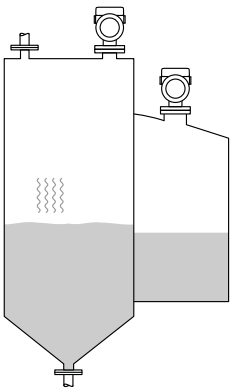
For the dielectric constants (DC values) of many media commonly used in industry, please refer to:
- Dielectric constant (DC value) Compendium CP01076F
- The Endress+Hauser "DC Values app" (available for Android and iOS)

Measurement in storage vessel

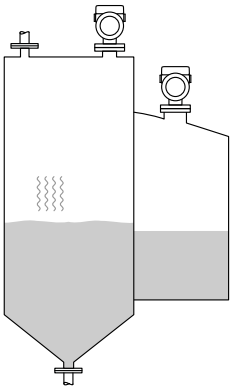
Storage vessel - measuring conditions
Calm medium surface (e.g. bottom filling, filling via immersion tube or rare filling from above)

For Tri-Clamp and 180-GHz connections, the measuring range is always at 15 m (49 ft) or 10 m (33 ft).

Process connections MNPT/G ¾, G 1, M24, 80 GHz in storage vessel

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	2.5 m (8 ft)
	B (ε_r 1.9 to 4)	5 m (16 ft)
	C (ε_r 4 to 10)	8 m (26 ft)
	D (ε_r >10)	10 m (33 ft)

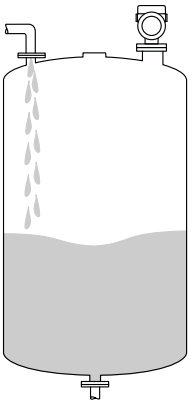
Process connection MNPT/G 1½, NEUMO BioControl D50, 80 GHz in storage vessel

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	6 m (20 ft)
	B (ε_r 1.9 to 4)	11 m (36 ft)
	C (ε_r 4 to 10)	15 m (49 ft)
	D (ε_r >10)	15 m (49 ft)

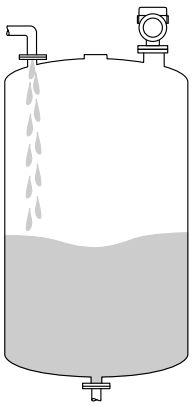
Measurement in buffer vessel

Buffer vessel - measuring conditions
Moving medium surface (e.g. permanent free filling from above, mixing jets)

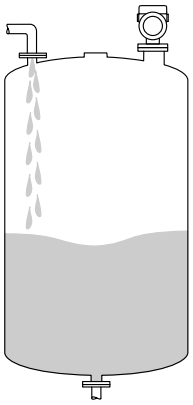
Process connections MNPT/G ¾, G 1, M24, 80 GHz in buffer vessel

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	1.5 m (5 ft)
	B (ε_r 1.9 to 4)	3 m (10 ft)
	C (ε_r 4 to 10)	6 m (20 ft)
	D (ε_r >10)	8 m (26 ft)

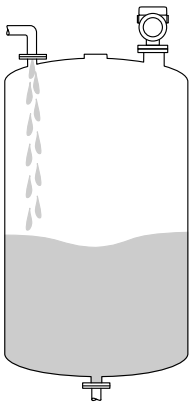
Process connections TriClamp 1½, TriClamp 2, 80 GHz in buffer vessel

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	7 m (23 ft)
	B (ε_r 1.9 to 4)	13 m (43 ft)
	C (ε_r 4 to 10)	15 m (49 ft)
	D (ε_r >10)	15 m (49 ft)

Process connections ½ and M24,180 GHz in buffer vessel

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	7 m (23 ft)
	B (ε_r 1.9 to 4)	10 m (33 ft)
	C (ε_r 4 to 10)	10 m (33 ft)
	D (ε_r >10)	10 m (33 ft)

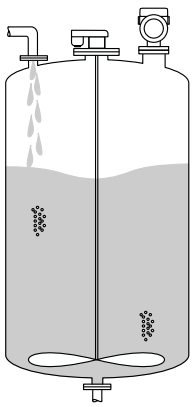
Process connection MNPT/G 1½, NEUMO BioControl D50 in buffer vessel

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	3 m (10 ft)
	B (ε_r 1.9 to 4)	6 m (20 ft)
	C (ε_r 4 to 10)	13 m (43 ft)
	D (ε_r >10)	15 m (49 ft)

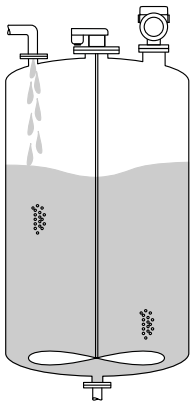
Measurement in vessel with agitator

Vessel with agitator - measuring conditions
Turbulent medium surface (e.g. from filling from above, stirrers and baffles)

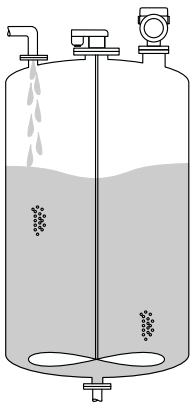
Process connections MNPT/G ¾, G 1, M24, 80 GHz in vessel with agitator

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	1 m (3.3 ft)
	B (ε_r 1.9 to 4)	1.5 m (5 ft)
	C (ε_r 4 to 10)	3 m (10 ft)
	D (ε_r >10)	5 m (16 ft)

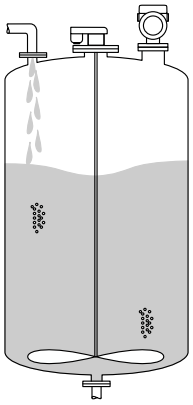
Process connections TriClamp 1½, TriClamp 2, 80 GHz in vessel with agitator

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	4 m (13 ft)
	B (ε_r 1.9 to 4)	7 m (23 ft)
	C (ε_r 4 to 10)	15 m (49 ft)
	D (ε_r >10)	15 m (49 ft)

Process connections ½ and M24, 180 GHz in vessel with agitator

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	4 m (13 ft)
	B (ε_r 1.9 to 4)	7 m (23 ft)
	C (ε_r 4 to 10)	10 m (33 ft)
	D (ε_r >10)	10 m (33 ft)

Process connection MNPT/G 1½, NEUMO BioControl D50 in vessel with agitator

	Media group	Measuring range
	**A** (ε_r 1.4 to 1.9)	1.5 m (5 ft)
	B (ε_r 1.9 to 4)	3 m (10 ft)
	C (ε_r 4 to 10)	7 m (23 ft)
	D (ε_r >10)	11 m (36 ft)

Operating frequency

"Radar technology" depending on the order option:
- 80 GHz
- 180 GHz

Transmission power

- Peak power: <1.5 mW
- Average output power: <70 µW

Output

Output signal

- 4 to 20 mA with superimposed digital communication protocol HART, 2-wire
- The current output offers a choice of three different operating modes:
  - 4 to 20.5 mA
  - NAMUR NE 43: 3.8 to 20.5 mA (factory setting)
  - US mode: 3.9 to 20.5 mA

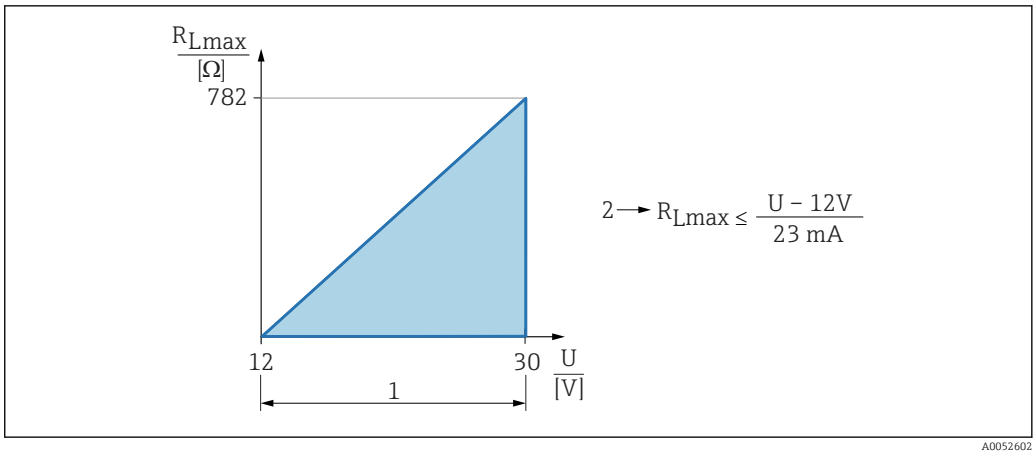
Signal on alarm for devices with current output

Current output
Signal on alarm in accordance with NAMUR recommendation NE 43.
- Max. alarm: can be set from 21.5 to 23 mA
- Min. alarm: < 3.6 mA (factory setting)

Onsite display and operating tool via digital communication
Status signal (according to NAMUR Recommendation NE 107):
Plain text display

Load

In order to guarantee sufficient terminal voltage, a maximum load resistance R_L (including line resistance) must not be exceeded, depending on the supply voltage U of the supply unit.



1 *Power supply 12 to 30 V*
2 *R_{Lmax} maximum load resistance*
U Supply voltage

Operation via handheld terminal or PC with operating program: take minimum communication resistance of 250 Ω into consideration.

Damping

Damping affects all continuous outputs.
Factory setting: 0 s(can be set from 0 to 999 s)

Ex connection data

See the separate technical documentation (Safety Instructions (XA)) on www.endress.com/download.

Linearization

The linearization function of the device allows the conversion of the measured value into any unit of length, weight, flow or volume.

Pre-programmed linearization curves
Linearization tables for calculating the volume in the following vessels are preprogrammed into the device:
- Pyramid bottom
- Conical bottom
- Angled bottom
- Horizontal cylinder
- Sphere

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

Protocol-specific data

Manufacturer ID:
17(0x0011)

Device type ID:
0x11C6

Device revision:
1

HART specification:
7.6

DD version:
1

Device description files (DTM, DD)
Information and files available at:
- www.endress.com
  On the product page for the device: Documents/Software → Device drivers
- www.fieldcommgroup.org

HART load:
Min. 250 Ω

The following measured values are assigned to the device variables at the factory:

Device variable	Measured value
Primary variable (PV) [1]	Level linearized
Secondary variable (SV)	Distance
Tertiary variable (TV)	Absolute echo amplitude
Quaternary variable (QV)	Relative echo amplitude

1) The PV is always applied to the current output.

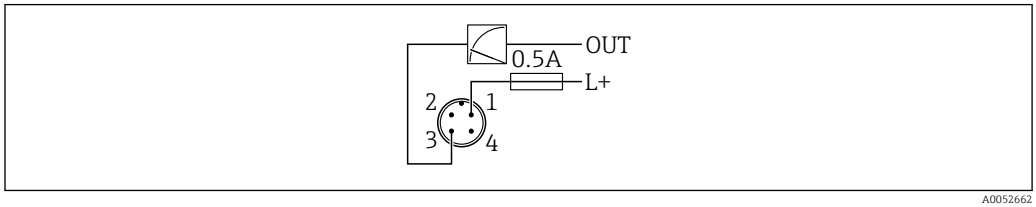
Choice of HART device variables
- Level linearized
- Distance
- Terminal voltage*
- Electronics temperature
- Sensor temperature
- Absolute echo amplitude
- Relative echo amplitude
- Area of incoupling
- Buildup index*
- Buildup detected*
- Foam index*
- Foam detected*
- Percent of range
- Loop current
- Terminal current*
- Not used

Visible depending on the order options or device settings

Power supply

Terminal assignment

2-wire

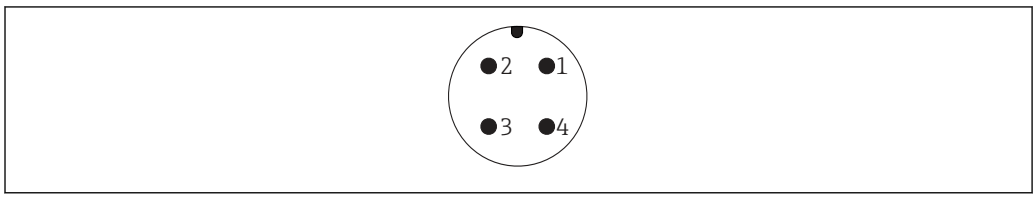


A0052662

1 Supply voltage L+, brown wire (BN)
3 OUT (L-), blue wire (BU)

Available device plugs

M12 plug



A0052661

3 View of the connection on the device

For further information, see the "Device-specific accessories" section

Supply voltage

12 to 30 V_{DC} on a direct current power unit

The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV, Class 2) and must comply with the relevant protocol specifications.

For 4 to 20 mA the same requirements apply as for HART. A galvanically isolated active barrier must be used for devices approved for use in explosion hazardous areas.

A suitable circuit breaker should be provided for the device in accordance with IEC/EN 61010-1.

Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.

Power consumption

- Non-hazardous area: To meet device safety specifications according to the IEC/EN 61010 standard, the installation must ensure that the maximum current is limited to 500 mA.
- Hazardous area: The maximum current is restricted to Ii = 100 mA by the transmitter power supply unit when the measuring instrument is used in an intrinsically safe circuit (Ex ia).

Potential equalization

If necessary, establish potential equalization using the process connection or the grounding clamp supplied by the customer.

Overvoltage protection

The device satisfies the IEC/DIN EN 61326-1 product standard (Table 2 Industrial environment). Depending on the type of connection (DC supply, input/output line) different test levels according to IEC/DIN EN 61326-1 against transient overvoltages are applied (IEC/DIN EN 61000-4-5 Surge): test level for DC power supply lines and input/output lines: 1 000 V line to earth.

Overvoltage protection category

In accordance with IEC/DIN EN 61010-1, the device is intended for use in networks with overvoltage protection category II.

Performance characteristics

Reference conditions

- As per IEC 62828-2
- Ambient temperature T_A = constant, in the range of +21 to +33 °C (+70 to +91 °F)
- Humidity φ = constant, in the range of: 5 to 80 % RH ± 5 %
- Atmospheric pressure p_A = constant, in the range of: 860 to 1 060 mbar (12.47 to 15.37 psi)
- Load with HART: 250 Ω
- Supply voltage: 24 V_{DC} ±3 V_{DC}
- Reflector: metal plate with diameter ≥ 1 m (40 in)
- No major interference reflections inside the signal beam

Response time

- HART: acyclic: min. 330 ms, typically 590 ms (depending on commands and number of preambles)
- HART: Cyclic (burst): min. 160 ms, typically 350 ms (depending on commands and number of preambles)

Resolution

Current output: < 1 µA

Digital: 1 mm (0.04 in)

Maximum measurement error

Reference accuracy

Accuracy

The accuracy is the sum of the non-linearity, non-repeatability and hysteresis.

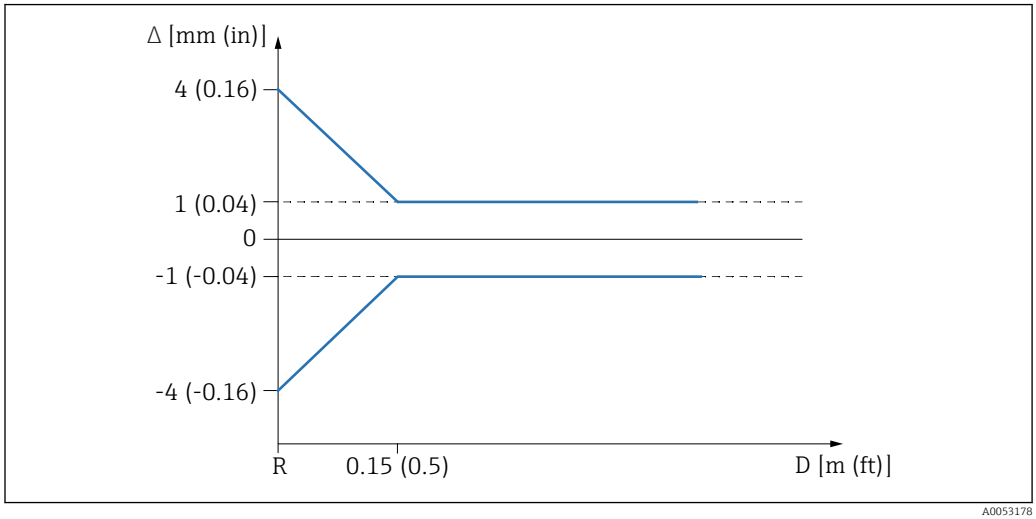
For liquids:
- Measuring distance up to 0.15 m (0.5 ft): max. ±4 mm (±0.16 in)
- Measuring distance > 0.15 m (0.5 ft): ±1 mm (±0.04 in)

For solids:
- Measuring distance up to 0.4 m (1.3 ft): max. ±20 mm (±0.79 in)
- Measuring distance > 0.4 m (1.3 ft): ±3 mm (±0.12 in)

Non-repeatability
Non-repeatability is already included in the accuracy.
≤ 1 mm (0.04 in)

If conditions deviate from the reference operating conditions, the offset/zero point that results from the installation conditions can be up to ±4 mm (±0.16 in). This additional offset/zero point can be eliminated by entering a correction (**Level correction** parameter) during commissioning.

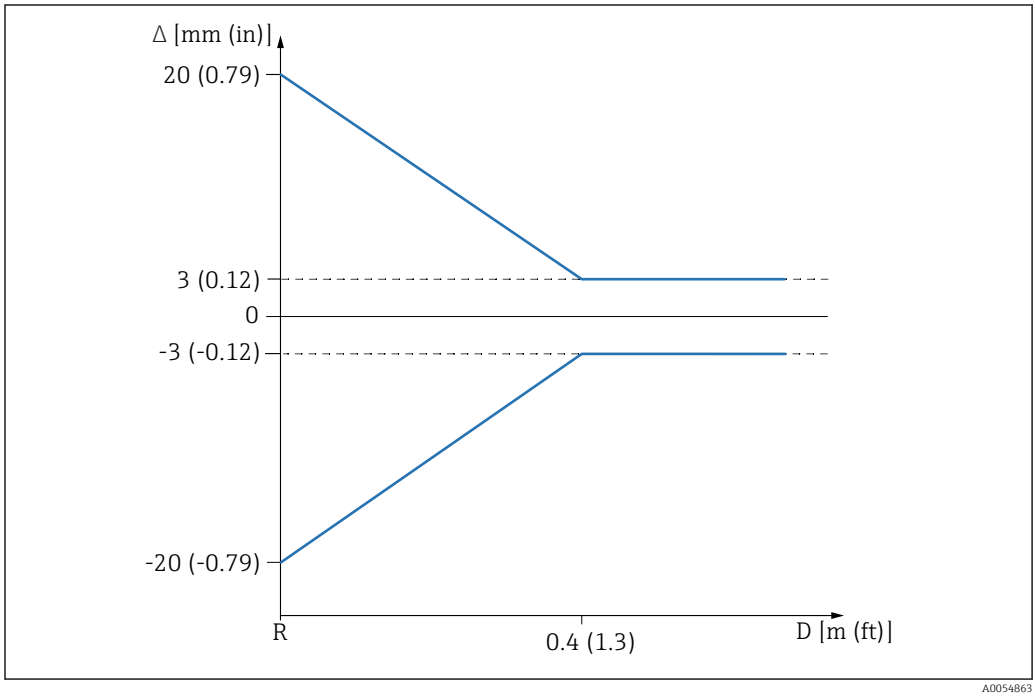
Differing values in near-range applications for liquids



4 *Maximum measurement error in near-range applications*

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

Differing values in near-range applications for solids



5 *Maximum measurement error in near-range applications*

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

Influence of ambient temperature

The output changes due to the effect of the ambient temperature with respect to the reference temperature.

The measurements are performed according to DIN EN IEC 61298-3 / DIN EN IEC 60770-1

Digital output (HART)
Average T_C = 2 mm/10 K

Analog (current output)
- Zero point (4 mA): average T_C = 0.02 %/10 K
- Span (20 mA): average T_C = 0.05 %/10 K

Reaction time

According to DIN EN IEC 61298-2 / DIN EN IEC 60770-1 , 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.

The reaction time can be configured.

The following step response times apply (in accordance with DIN EN IEC 61298-2/DIN EN IEC 60770-1) when damping is switched off:
- Measuring rate ≤ 60 ms at operating voltage 24 V and 16 mA (≤ 200 ms at operating voltage 24 V and 4 mA)
- Step response time < 500 ms

Warm-up time (according to IEC 62828-4)

The warm-up time indicates the time required for the sensor to reach its maximum accuracy or performance after the supply voltage is energized.

Warm-up time: ≤ 30 s

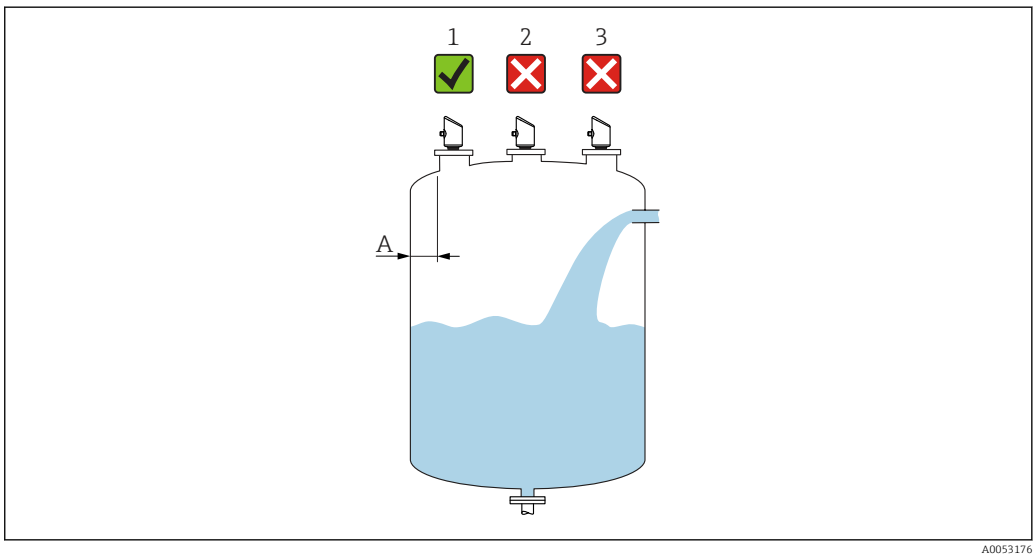
Installation

Mounting instructions

During installation, it is important to ensure that the sealing element used has a permanent operating temperature that corresponds to the maximum temperature of the process.

- Devices with CSA approval are intended for indoor use.
- Devices are suitable for use in wet environments in accordance with IEC/EN 61010-1.

Mounting location

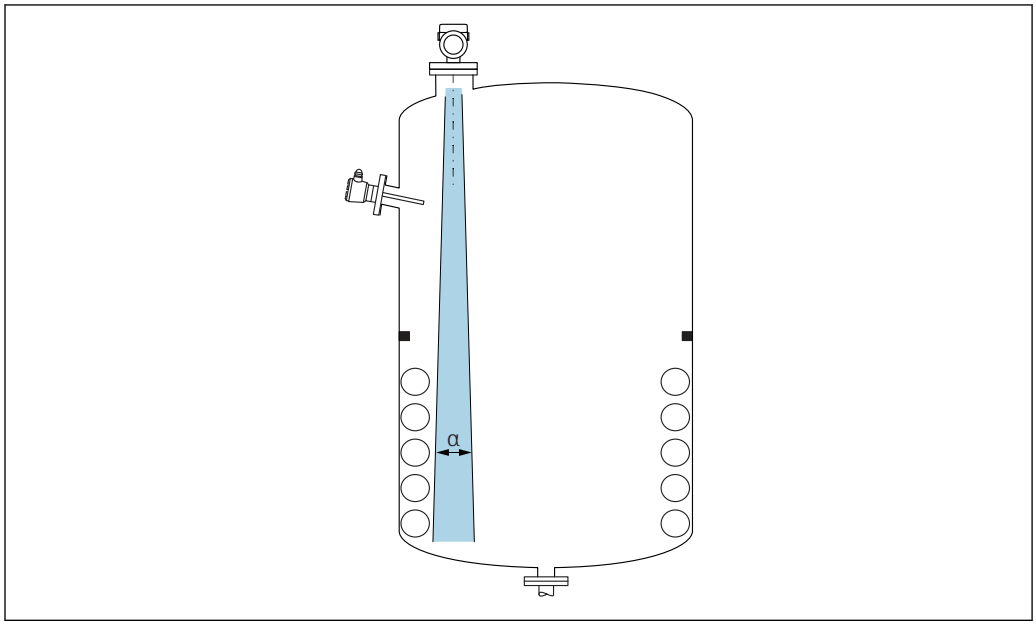


A0053176

A Recommended distance from wall to nozzle outer edge ~ 1/6 of the vessel diameter. However, the device must not under any circumstances be mounted closer than 15 cm (5.91 in) to the vessel wall.
1 Recommended mounting location
2 Installation in the center, interference can cause signal loss
3 Do not install above the filling curtain

Orientation

Internal vessel fittings



Avoid internal fittings (point level switches, temperature sensors, struts, vacuum rings, heating coils, baffles etc.) inside the signal beam. Pay attention to the beam angle **α**.

Vertical alignment of antenna axis

Align the antenna so that it is perpendicular to the product surface.

The maximum reach of the antenna can be reduced, or additional interference signals can occur, if the antenna is not installed perpendicular to the product.

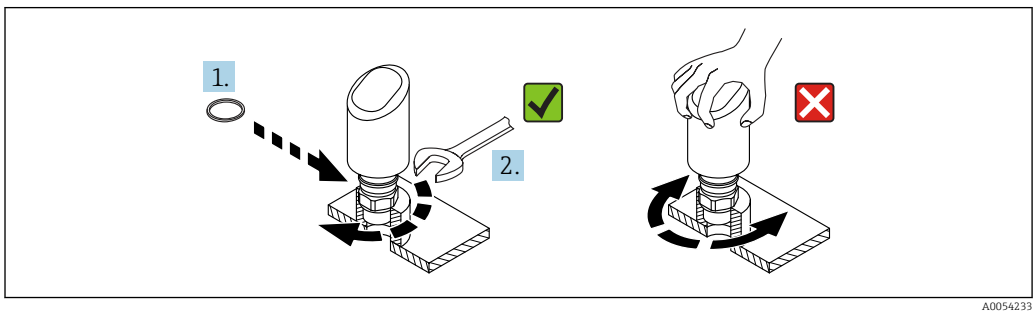
Mounting the device

Screwing in the device

- Turn by the hex bolt only; max. torque 50 Nm (37 lbf ft)
- M24 sensors: Mount with tool only on the parallel spanner flat, max. torque 30 Nm (22 lbf ft)
- Do not turn at the housing!

Open-ended wrench 32 mm

Open-ended wrench 55 mm (for process connections MNPT/G 1½)



6 *Screwing in the device*

Information concerning threaded connections

In the case of longer nozzles, reduced measuring performance must be expected.

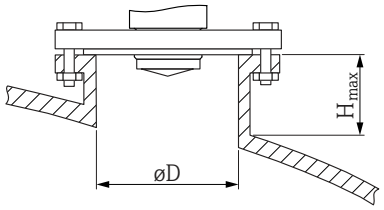
Please note the following:
- The end of the nozzle must be smooth and free from burrs.
- The edge of the nozzle should be rounded.
- Mapping must be performed.
- Please contact the manufacturer's support department for applications with nozzles that are higher than indicated in the table.

Process connections: MNPT/G ¾, G 1, M24, 80 GHz; PEEK

Information about the mounting nozzle

The maximum nozzle length H_{max} depends on the nozzle diameter *D*.

The maximum length of the nozzle H_{max} depends on the nozzle diameter D.

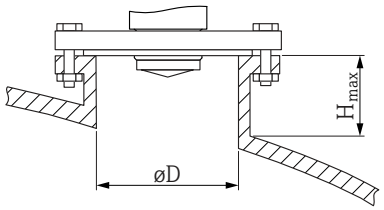
	⌀D	H_{max}
	18 to 40 mm (0.8 to 1.6 in)	30 mm (1.2 in)
	40 to 50 mm (1.6 to 2 in)	220 mm (8.7 in)
	50 to 80 mm (2 to 3.2 in)	300 mm (12 in)
	80 to 100 mm (3.2 to 4 in)	550 mm (21.7 in)
	100 to 150 mm (4 to 6 in)	700 mm (27.6 in)
	≥ 150 mm (6 in)	1 150 mm (45.3 in)

Process connections: MNPT/G 1½, NEUMO BioControl D50 PN16, 80 GHz; PEEK

Information about the mounting nozzle

The maximum nozzle length H_{max} depends on the nozzle diameter *D*.

The maximum length of the nozzle H_{max} depends on the nozzle diameter D.

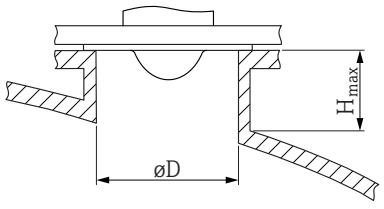
	⌀D	H_{max}
	40 to 50 mm (1.6 to 2 in)	190 mm (7.5 in)
	50 to 80 mm (2 to 3.2 in)	350 mm (13.8 in)
	80 to 100 mm (3.2 to 4 in)	900 mm (35.4 in)
	100 to 150 mm (4 to 6 in)	1 250 mm (49.2 in)
	≥ 150 mm (6 in)	2 100 mm (82.7 in)

Process connection Tri-Clamp NA Connect ISO2852 DN25-38 (1½), 80 GHz; PTFE

Information about the mounting nozzle

The maximum nozzle length H_{max} depends on the nozzle diameter *D*.

The maximum length of the nozzle H_{max} depends on the nozzle diameter D.

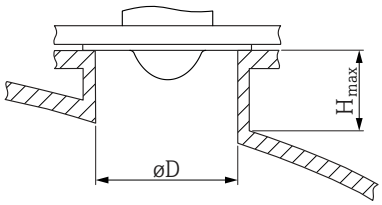
	⌀D	H_{max}
	40 to 50 mm (1.6 to 2 in)	180 mm (7.1 in)
	50 to 80 mm (2 to 3.2 in)	350 mm (13.8 in)
	80 to 100 mm (3.2 to 4 in)	900 mm (35.4 in)
	100 to 150 mm (4 to 6 in)	1 250 mm (49.2 in)
	≥ 150 mm (6 in)	2 200 mm (86.6 in)

Process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2), 80 GHz; PTFE

Information about the mounting nozzle

The maximum nozzle length H_{max} depends on the nozzle diameter *D*.

The maximum length of the nozzle H_{max} depends on the nozzle diameter D.

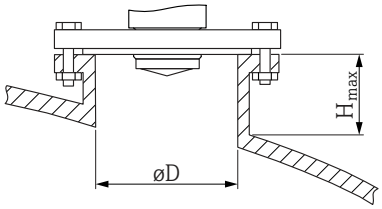
	⌀D	H_{max}
	50 to 80 mm (2 to 3.2 in)	350 mm (13.8 in)
	80 to 100 mm (3.2 to 4 in)	900 mm (35.4 in)
	100 to 150 mm (4 to 6 in)	1 300 mm (51.2 in)
	≥ 150 mm (6 in)	2 300 mm (90.6 in)

Process connections: MNPT/G ½, 180 GHz; PTFE

Information about the mounting nozzle

The maximum nozzle length H_{max} depends on the nozzle diameter *D*.

The maximum length of the nozzle H_{max} depends on the nozzle diameter D.

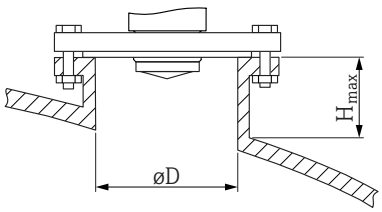
	⌀D	H_{max}
	18 to 40 mm (0.8 to 1.6 in)	90 mm (3.5 in)
	40 to 50 mm (1.6 to 2 in)	450 mm (17.7 in)
	50 to 80 mm (2 to 3.2 in)	600 mm (23.6 in)
	80 to 100 mm (3.2 to 4 in)	1 100 mm (43.3 in)
	100 to 150 mm (4 to 6 in)	1 450 mm (57.1 in)
	≥ 150 mm (6 in)	2 300 mm (90.6 in)

Process M24, 180 GHz; PTFE

Information about the mounting nozzle

The maximum nozzle length H_{max} depends on the nozzle diameter *D*.

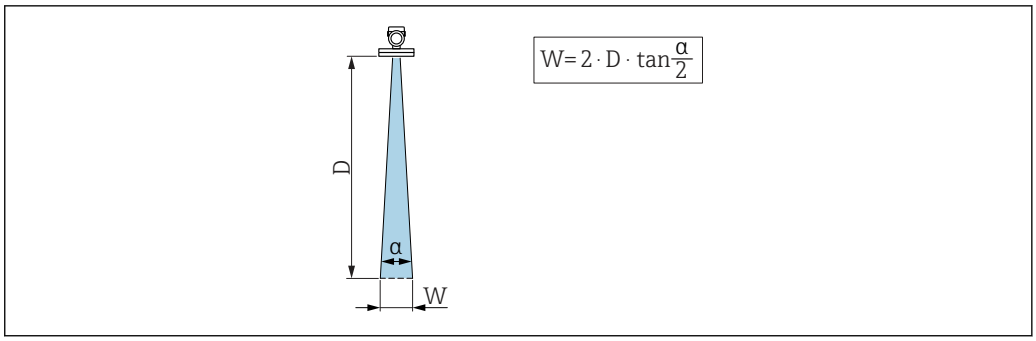
The maximum length of the nozzle H_{max} depends on the nozzle diameter D.

	⌀D	H_{max}
	18 to 40 mm (0.8 to 1.6 in)	20 mm (0.8 in)
	40 to 50 mm (1.6 to 2 in)	500 mm (19.7 in)
	50 to 80 mm (2 to 3.2 in)	750 mm (29.5 in)
	80 to 100 mm (3.2 to 4 in)	1 450 mm (57.1 in)
	100 to 150 mm (4 to 6 in)	1 900 mm (74.8 in)
	≥ 150 mm (6 in)	3 050 mm (120 in)

Beam angle

Calculation

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

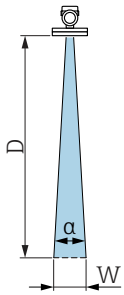


7 *Relationship between beam angle α, distance D and beamwidth diameter W*

The beamwidth diameter **W** depends on the beam angle **α** and the distance **D**.

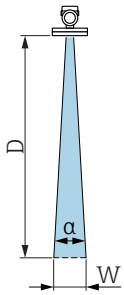
Process connections: MNPT/G ½, 180 GHz, PTFE

Beam angle α = 8 °

W = D × 0.14	D	W
	1 m (3.3 ft)	0.14 m (0.5 ft)
	2 m (6.6 ft)	0.28 m (0.9 ft)
	3 m (9.8 ft)	0.42 m (1.4 ft)
	5 m (16 ft)	0.7 m (2.3 ft)
	8 m (26 ft)	1.12 m (3.7 ft)
	10 m (33 ft)	1.4 m (4.6 ft)

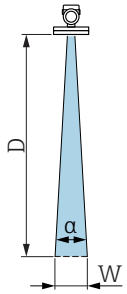
Process connections: MNPT/G 1½, 80 GHz, PEEK; Tri-Clamp NA Connect ISO2852 DN25-38 (1½), 80 GHz, PTFE; NEUMO Bio Control D50 PN16, 80 GHz; PEEK

Beam angle α = 8 °

W = D × 0.14	D	W
	1 m (3.3 ft)	0.14 m (0.5 ft)
	2 m (6.6 ft)	0.28 m (0.9 ft)
	3 m (9.8 ft)	0.42 m (1.4 ft)
	5 m (16 ft)	0.7 m (2.3 ft)
	8 m (26 ft)	1.12 m (3.7 ft)
	10 m (33 ft)	1.4 m (4.6 ft)
	15 m (49 ft)	2.1 m (6.9 ft)

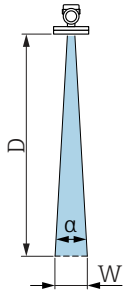
Process connections: MNPT/G ¾, G 1, M24, 80 GHz, PEEK

Beam angle α = 14 °

W = D × 0.26	D	W
	1 m (3.3 ft)	0.25 m (0.8 ft)
	2 m (6.6 ft)	0.5 m (1.6 ft)
	3 m (9.8 ft)	0.74 m (2.4 ft)
	5 m (16 ft)	1.23 m (4 ft)
	8 m (26 ft)	1.97 m (6.5 ft)
	10 m (33 ft)	2.46 m (8.1 ft)

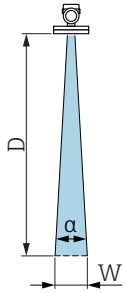
Process connection M24, 180 GHz, PTFE

Beam angle α = 6 °

W = D × 0.10	D	W
	1 m (3.3 ft)	0.1 m (0.3 ft)
	2 m (6.6 ft)	0.21 m (0.7 ft)
	3 m (9.8 ft)	0.31 m (1 ft)
	5 m (16 ft)	0.52 m (1.7 ft)
	8 m (26 ft)	0.84 m (2.8 ft)
	10 m (33 ft)	1.05 m (3.4 ft)

Process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2"), 80 GHz; PTFE

Beam angle α = 7 °

W = D × 0.12	D	W
	1 m (3.3 ft)	0.12 m (0.4 ft)
	2 m (6.6 ft)	0.24 m (0.8 ft)
	3 m (9.8 ft)	0.37 m (1.2 ft)
	5 m (16 ft)	0.61 m (2 ft)
	8 m (26 ft)	0.98 m (3.2 ft)
	10 m (33 ft)	1.22 m (4 ft)
	15 m (49 ft)	1.83 m (6 ft)

Environment

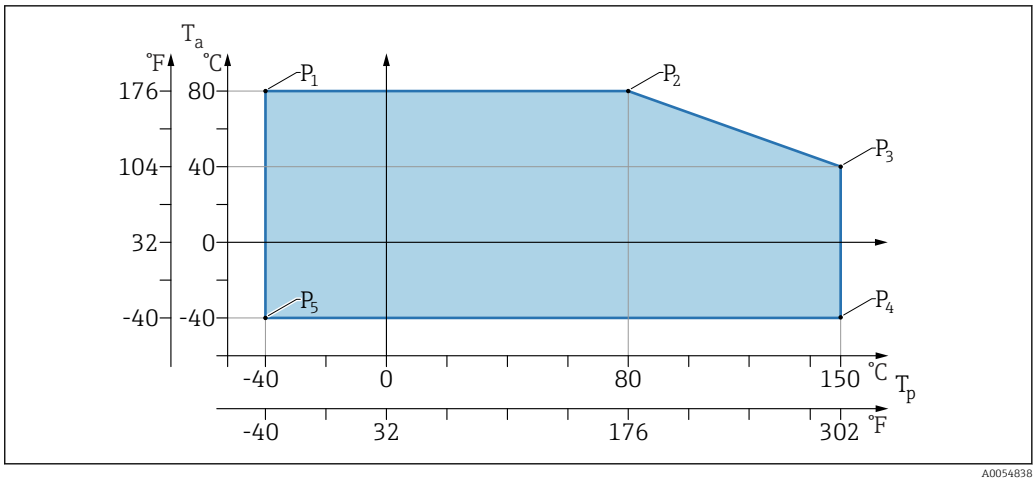
Ambient temperature range

Process connections MNPT/G ½, M24 180 GHz, Tri-Clamp, Neumo Bio Control

−40 to +80 °C (−40 to +176 °F)

The permitted ambient temperature is reduced at higher process temperatures.

The following information only takes into account functional aspects. Additional restrictions may apply for certified device versions.



8 *Ambient temperature T_a depending on the process temperature T_p*

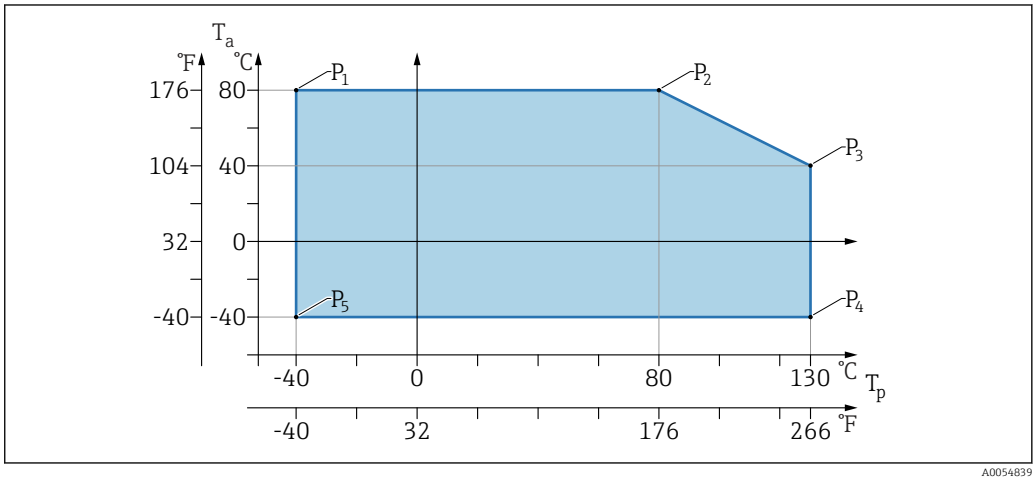
P	T_p	T_a
P1	−40 °C (−40 °F)	+80 °C (+176 °F)
P2	+80 °C (+176 °F)	+80 °C (+176 °F)
P3	+150 °C (+302 °F)	+40 °C (+77 °F)
P4	+150 °C (+302 °F)	−40 °C (−40 °F)
P5	−40 °C (−40 °F)	−40 °C (−40 °F)

Process connections MNPT/G ¾, MNPT/G 1½, G1, M24 80 GHz

−40 to +80 °C (−40 to +176 °F)

The permitted ambient temperature is reduced at higher process temperatures.

The following information only takes into account functional aspects. Additional restrictions may apply for certified device versions.



9 *Ambient temperature T_a depending on the process temperature T_p*

P	T_p	T_a
P1	−40 °C (−40 °F)	+80 °C (+176 °F)
P2	+80 °C (+176 °F)	+80 °C (+176 °F)
P3	+130 °C (+266 °F)	+40 °C (+77 °F)

P	T_p	T_a
P4	+130 °C (+266 °F)	–40 °C (–40 °F)
P5	–40 °C (–40 °F)	–40 °C (–40 °F)

Higher process temperatures are possible for a limited time. For T_a: +40 °C (+77 °F), the following applies:

- T_p: 150 °C (302 °F) for maximum 20 min
- T_p: 140 °C (284 °F) for maximum 30 min
- T_p: 135 °C (275 °F) for maximum 60 min

Storage temperature

–40 to +85 °C (–40 to +185 °F)

Operating height

Up to 5 000 m (16 404 ft) above sea level

Climate class

According to IEC 60068-2-38 test Z/AD (relative humidity 4 to 100 %).

Degree of protection

Test as per IEC 60529 Edition 2.2 2013-08/ DIN EN 60529:2014-09 and NEMA 250-2014

For mounted M12 connecting cable: IP66/68/69, NEMA type 4X/6P

/IP68,: (1.83 mH_2O for 24 h))

Pollution degree

Pollution degree 2 according to IEC/EN 61010-1

Vibration resistance

- Stochastic noise (random sweep) as per DIN EN 60068-2-64 Case 2/ IEC 60068-2-64 Case 2
- Guaranteed for 5 to 2 000 Hz: 1.25 $(m/s^2)^2/Hz$, ~ 5 g

Shock resistance

- Test standard: DIN EN 60068-2-27 Case 2
- Shock resistance: 30 g (18 ms) in all 3 axes

Electromagnetic compatibility (EMC)

- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- Maximum deviation under the effect of disturbance: < 0.5%

For more details refer to the EU Declaration of Conformity.

Process

Pressure range

Pressure specifications

WARNING

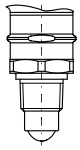
The maximum pressure for the device depends on the lowest-rated component with regard to pressure (components are: process connection, optional mounted parts or accessories).

- ▶ Only operate the device within the specified limits for the components!
- ▶ MWP (maximum working pressure): The maximum working pressure is specified on the nameplate. This value refers to a reference temperature of +20 °C (+68 °F) and may be applied to the device for an unlimited time. Note temperature dependence of maximum working pressure.
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation 'PS' corresponds to the maximum working pressure of the device.
- ▶ Maximum working pressure data that deviate from this are provided in the relevant sections of the Technical Information.

The following tables show the dependencies between the seal material, process temperature (T_P) and process pressure range for each process connection that can be selected for the antenna used.

Process connections MNPT/G ½, 316 L

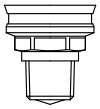
Antenna 180 GHz, PTFE

	Seal	T_p	Process pressure range
 A0053241	FKM	−10 to +150 °C (+14 to +302 °F)	−1 to 20 bar (−14.5 to 290 psi)
	EPDM	−40 to +150 °C (−40 to +302 °F)	−1 to 20 bar (−14.5 to 290 psi)

The pressure range may be further restricted in the event of a CRN approval.

Process connections MNPT/G ¾, MNPT/G 1½, G1, M24, 316 L

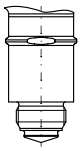
Antenna 80 GHz, PEEK

	Seal	T_p	Pressure range
 A0047832	FKM	−10 to +130 °C (+14 to +266 °F) 150 ° (302 °F) for max. 20 min	−1 to 20 bar (−14.5 to 290 psi)
	EPDM	−40 to +130 °C (−40 to +266 °F) 150 ° (302 °F) for max. 20 min	−1 to 20 bar (−14.5 to 290 psi)

The pressure range may be further restricted in the event of a CRN approval.

Process connection M24, 316L

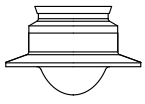
Antenna 180 GHz, PTFE

	Seal	T_p	Pressure range
 A0053243	FKM	−10 to +150 °C (14 to +302 °F)	−1 to 20 bar (−14.5 to 290 psi)
	EPDM	−40 to +150 °C (−40 to +302 °F)	−1 to 20 bar (−14.5 to 290 psi)

The pressure range may be further restricted in the event of a CRN approval.

Process connections: Tri-Clamp NA Connect ISO2852 DN25-38 (1½); Tri-Clamp NA Connect ISO2852 DN40-51 (2)

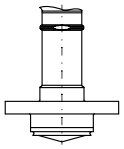
Antenna 80 GHz, PTFE

	Seal	T_p	Process pressure range
 A0047838	PTFE cladding	−40 to +150 °C (−40 to +302 °F)	−1 to 16 bar (−14.5 to 232 psi)

The pressure range may be further restricted in the event of a CRN approval.

Process connection Neumo BioControl D50 PN16, 316L

Antenna 80 GHz, PEEK

	Seal	T_p	Process pressure range
 A0053256	Peek cladding	−40 to +150 °C (−40 to +302 °F)	−1 to 16 bar (−15 to 240 psi)

The pressure range may be further restricted in the event of a CRN approval.

Dielectric constant

For liquids
$\varepsilon_r \geq 1.2$

For bulk solids
$\varepsilon_r \geq 1.6$

For applications with lower dielectric constants than indicated, contact Endress+Hauser.

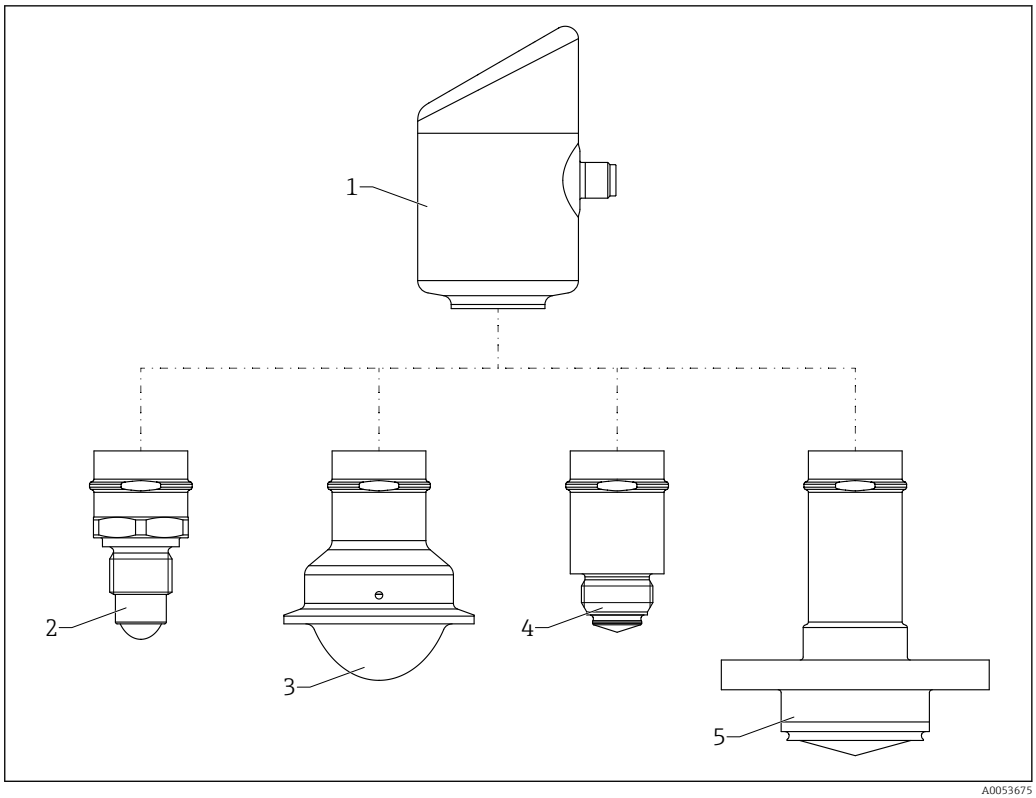
Mechanical construction

Design, dimensions

Device height

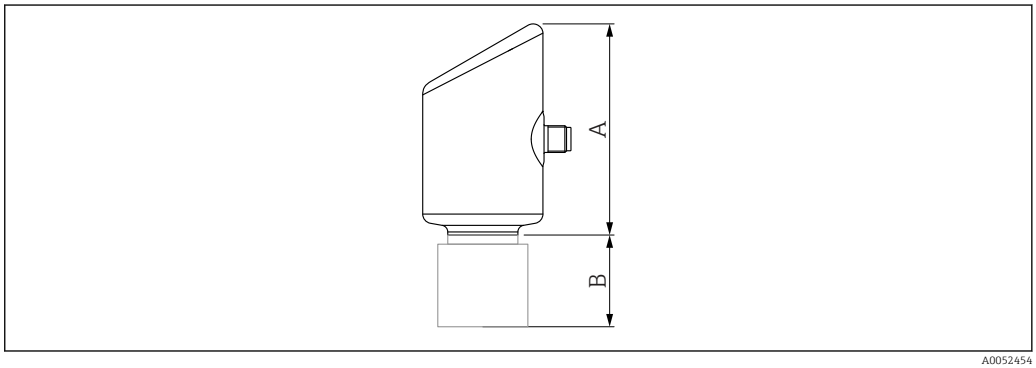
The device height is calculated from
- the height of the housing
- the height of the individual process connection

The individual heights of the components are listed in the following sections. To calculate the device height, add the individual heights of the components. Take account of the installation clearance (space for installing the device).



10 *Product design Micropilot FMR43 with sample process connections*

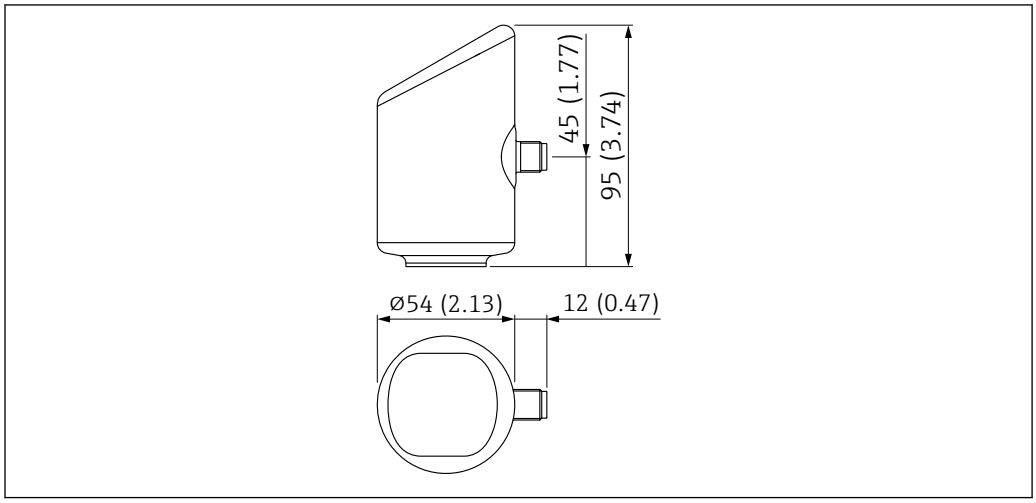
1 *Electronics housing*
2 *Process connection thread ½"*
3 *Process connection Tri-Clamp NA Connect ISO2852*
4 *Process connection M24*
5 *Process connection NEUMO BioControl*



A Height of the housing
B Height of sensor including process connection

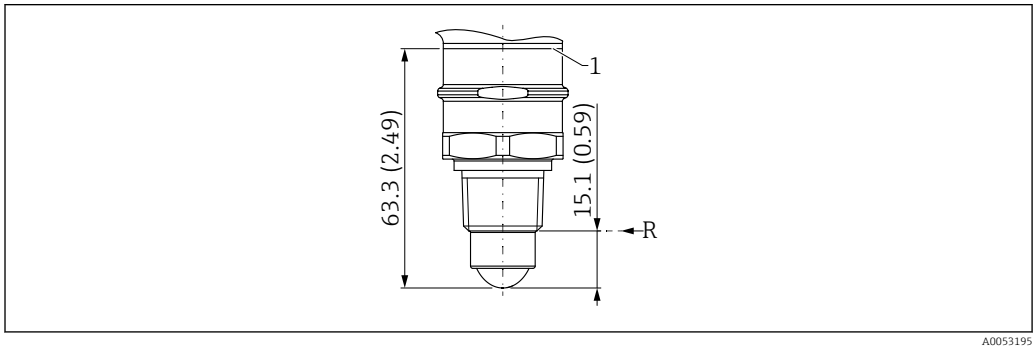
Dimensions

Housing



Unit of measurement mm (in)

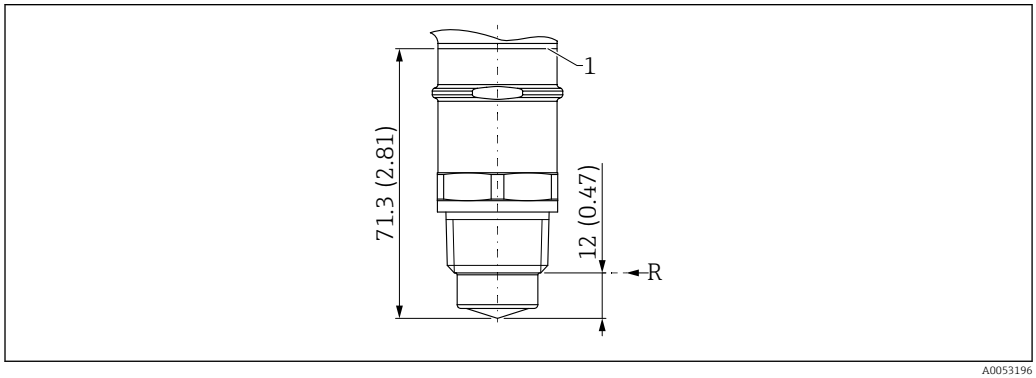
Process connection MNPT ½, 180 GHz; PTFE



11 Dimensions; process connection MNPT ½, 180 GHz; PTFE

1 Bottom edge of housing
R Reference point of measurement

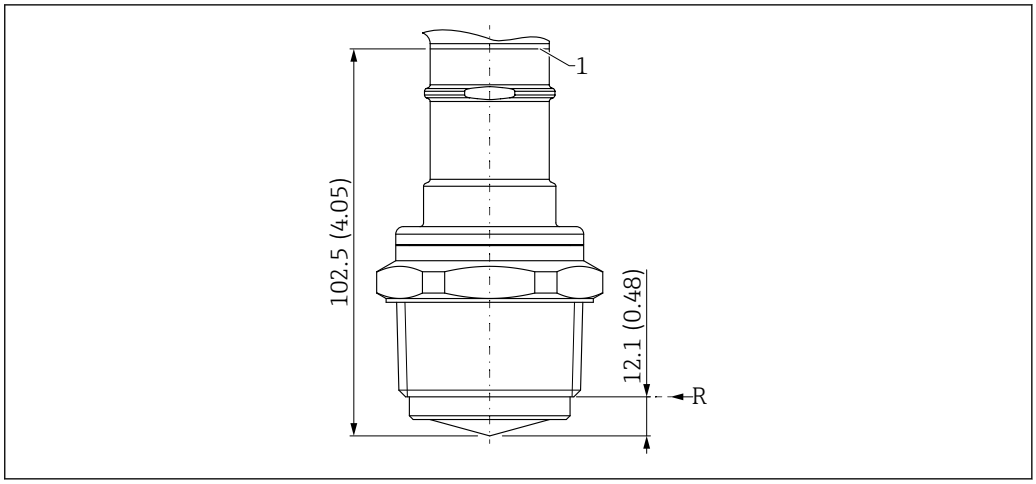
Process connection MNPT ¾, 80 GHz; PEEK



12 Dimensions; process connection MNPT ¾, 80 GHz; PEEK

1 Bottom edge of housing
R Reference point of measurement

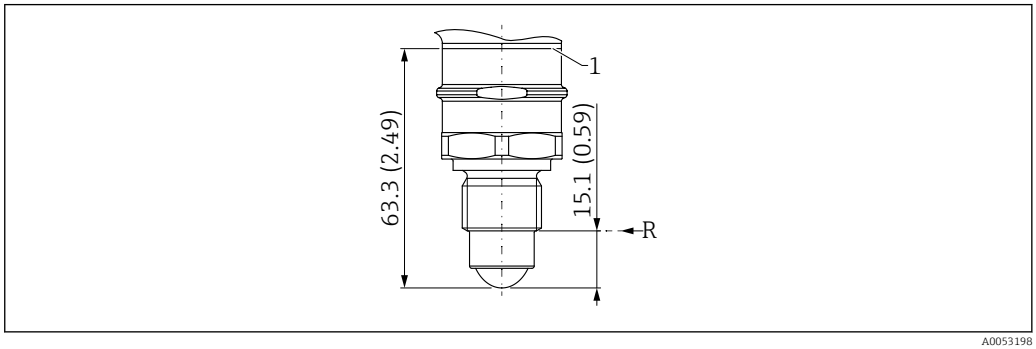
Process connection MNPT 1½, 80 GHz; PEEK



13 *Dimensions; process connection MNPT 1½, 80 GHz; PEEK*

1 Bottom edge of housing
R Reference point of measurement

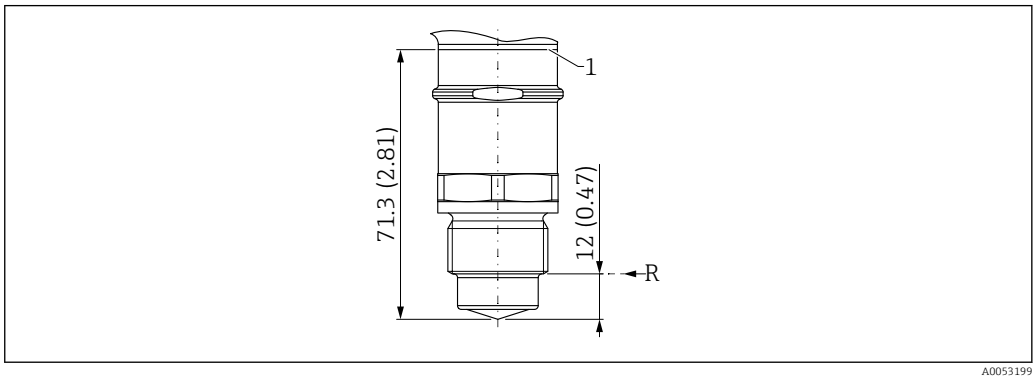
Process connnection G ½, 180 GHz, PTFE



14 *Dimensions; process connection G ½, 180 GHz, PTFE*

1 Bottom edge of housing
R Reference point of measurement

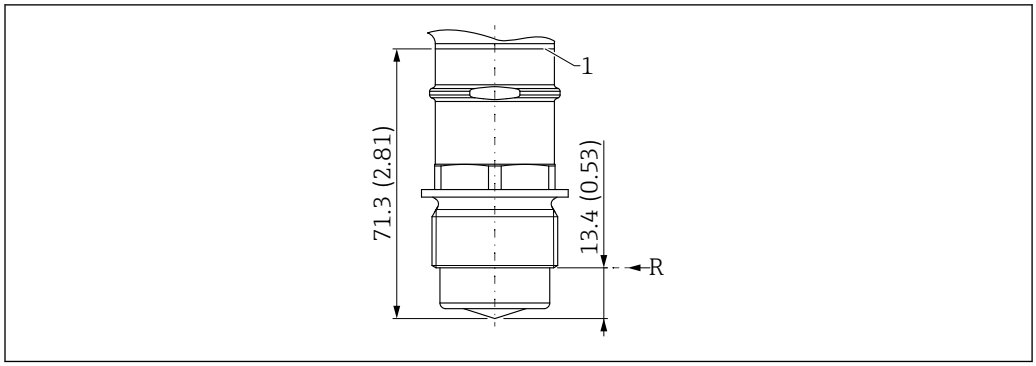
Process connection G ¾, 80 GHz, PEEK



15 *Dimensions; process connection G ¾, 80 GHz, PEEK*

1 Bottom edge of housing
R Reference point of measurement

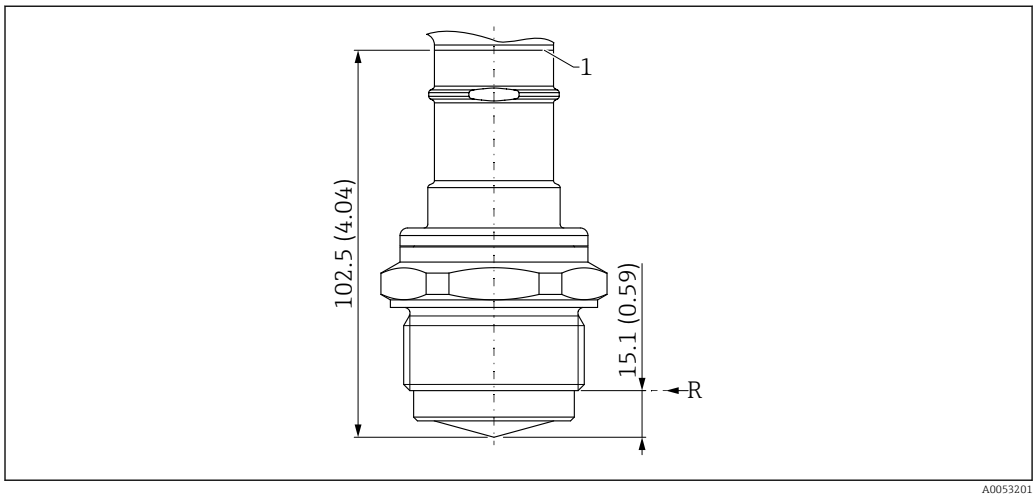
Process connection G 1, 80 GHz, PEEK



16 Dimensions; process connection G 1, 80 GHz, PEEK

1 Bottom edge of housing
R Reference point of measurement

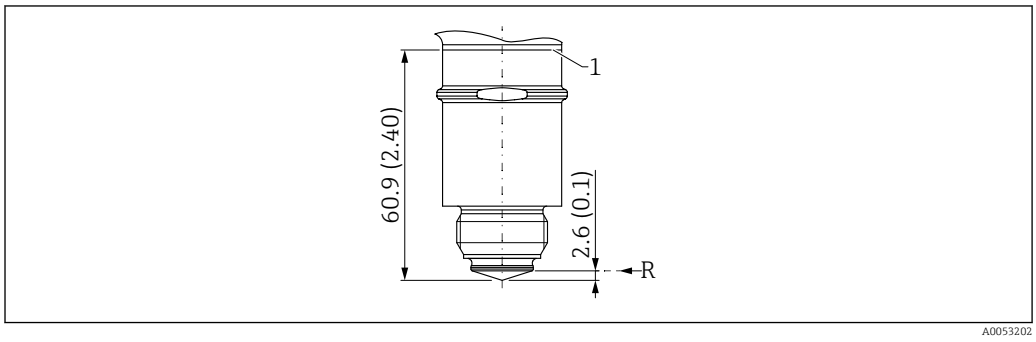
Process connection G 1½, 80 GHz; PEEK



17 Dimensions; process connection G 1½, 80 GHz; PEEK

1 Bottom edge of housing
R Reference point of measurement

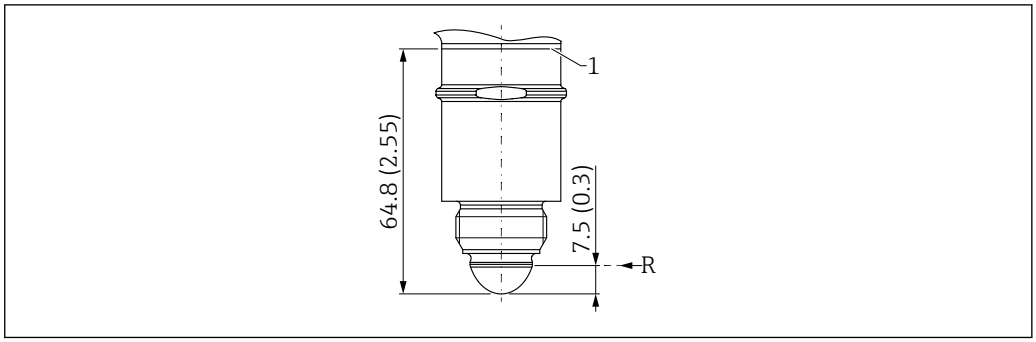
Process connection M24, 80 GHz; PEEK



18 Dimensions; process connection M24, 80 GHz; PEEK

1 Bottom edge of housing
R Reference point of measurement

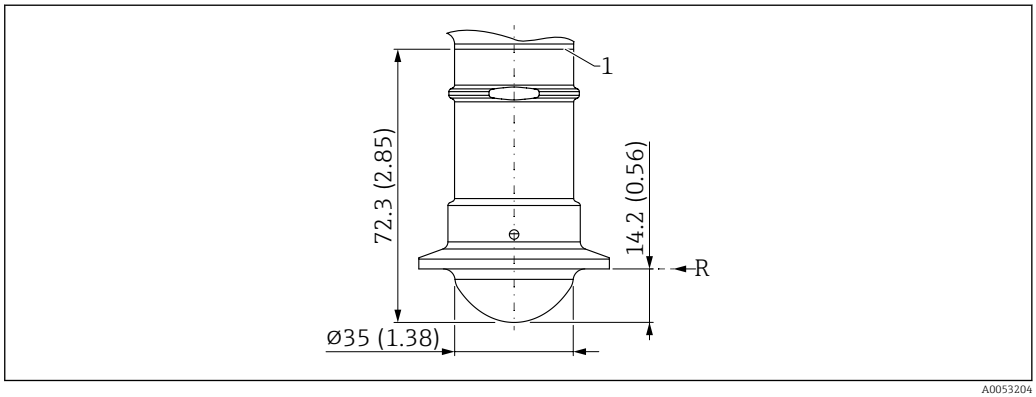
Process connection M24, 180 GHz, PTFE



19 *Dimensions; process connection M24, 180 GHz, PTFE*

1 Bottom edge of housing
R Reference point of measurement

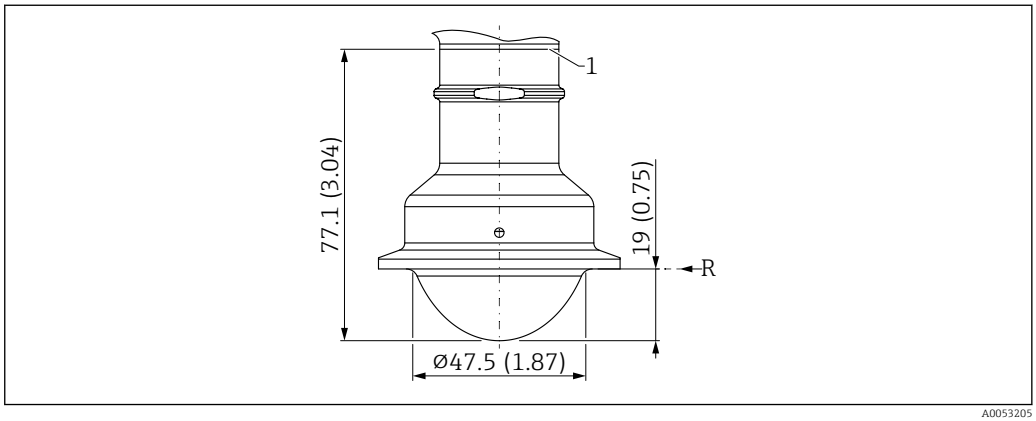
Process connection Tri-Clamp NA Connect ISO2852 DN25-38 (1½), 80 GHz; PTFE



20 *Dimensions; process connection Tri-Clamp NA Connect ISO2852 DN25-38 (1½), 80 GHz; PTFE*

1 Bottom edge of housing
R Reference point of measurement

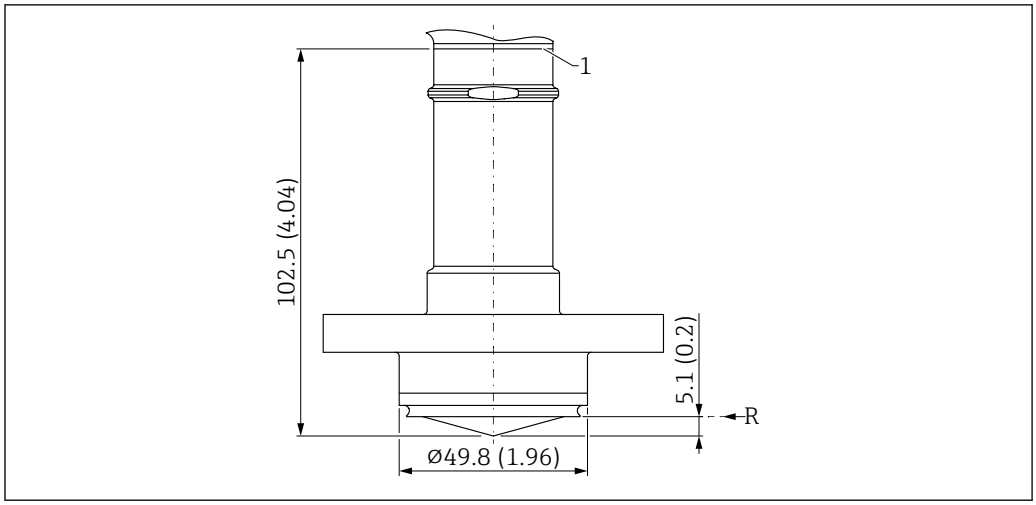
Process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2), 80 GHz; PTFE



21 *Dimensions; process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2), 80 GHz; PTFE*

1 Bottom edge of housing
R Reference point of measurement

Process connection NEUMO BioControl D50 PN16, 80 GHz; PEEK



22 *Dimensions; process connection NEUMO BioControl D50 PN16, 80 GHz; PEEK*

1 Bottom edge of housing
R Reference point of measurement

Weight

The weights of the individual components must be added together for the total weight.

Housing weight including electronics and onsite display: 0.2 kg (0.44 lb)

Process connection and antenna:

Process connection MNPT/G ½, antenna180 GHz; PTFE
0.140 kg (0.31 lb)

Process connection MNPT/G ¾, antenna 80 GHz; PEEK
0.195 kg (0.43 lb)

Process connection MNPT/G 1½, antenna 80 GHz; PEEK
0.675 kg (1.49 lb)

Process connection G 1, antenna 80 GHz, PEEK
0.260 kg (0.57 lb)

Process connection M24, antenna 80 GHz; PEEK
0.155 kg (0.34 lb)

Process connection M24, antenna 180 GHz, PTFE
0.180 kg (0.40 lb)

Process connection Tri-Clamp NA Connect ISO2852 DN25-38 (1½), antenna 80 GHz; PTFE
0.320 kg (0.71 lb)

Process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2), antenna 80 GHz; PTFE
0.450 kg (0.99 lb)

Process connection NEUMO BioControl D50 PN16, antenna 80 GHz; PEEK
0.890 kg (1.96 lb)

Materials

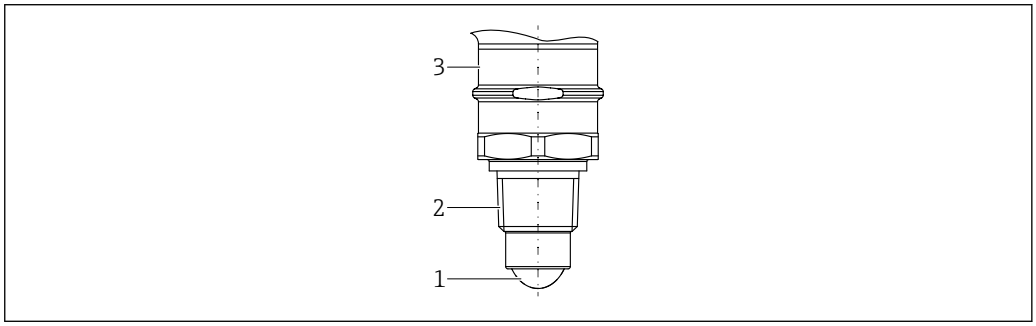
Materials in contact with process

Delta-ferrite content

The following process connections do not have any wetted metal parts and therefore do not contain any delta ferrite:
- M24, 316L install > accessory, process adapter
- Tri-Clamp NA Connect ISO2852 DN25-38 (1½), PTFE>316L
- Tri-Clamp NA Connect ISO2852 DN51 (2), PTFE>316L
- NEUMO BioControl D50 PN16, PEEK>316L

The metal wetted parts of the following weld-in adapters and process adapters have a delta-ferrite content ≤ 1%:
- Weld-in adapter M24, d=65, 316L
- Process adapter M24>clamp 1½, 316L
- Process adapter M24>clamp 2, 316L
- Process adapter M24, NEUMO BioControl D25, 316L
- Process adapter M24, NEUMO BioControl D50, 316L
- Process adapter M24, NEUMO BioControl D80, 316L

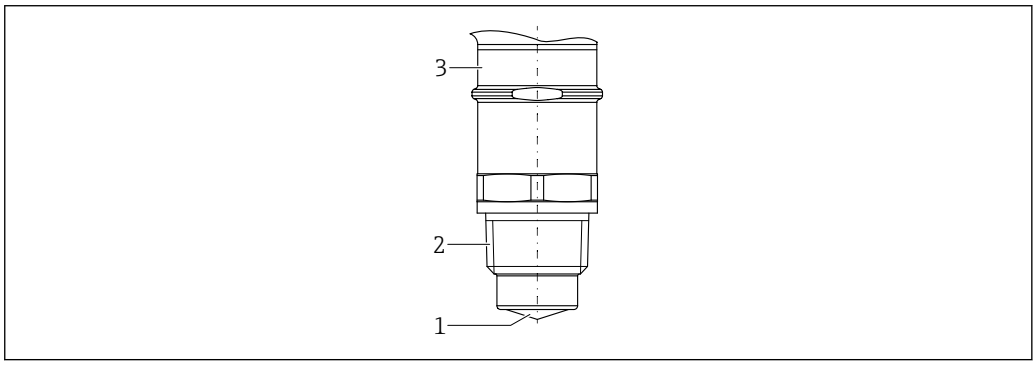
Process connection MNPT½, 180 GHz; PTFE



23 Material; process connection MNPT½, 180 GHz; PTFE

1 Antenna: PTFE, seal material: FKM or EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

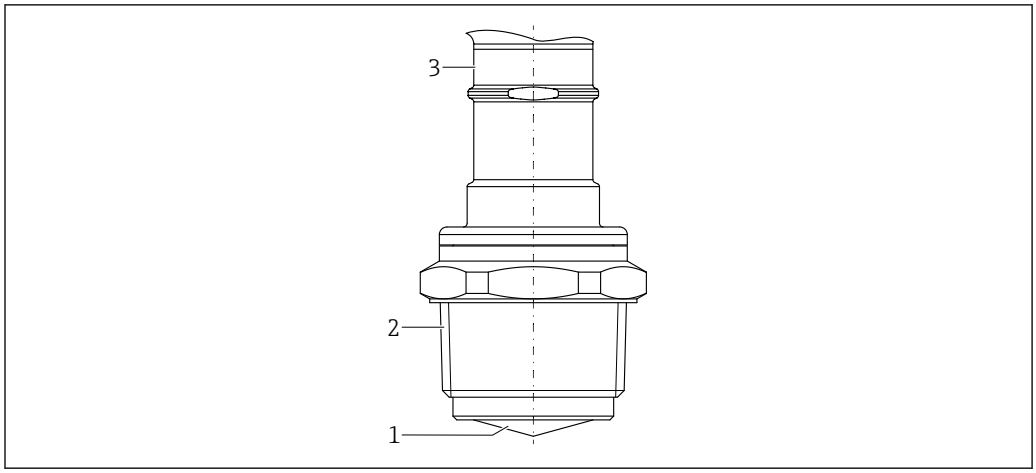
Process connection MNPT¾, 80 GHz; PEEK



24 Material; process connection MNPT¾, 80 GHz; PEEK

1 Antenna: PEEK, seal material: FKM oder EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

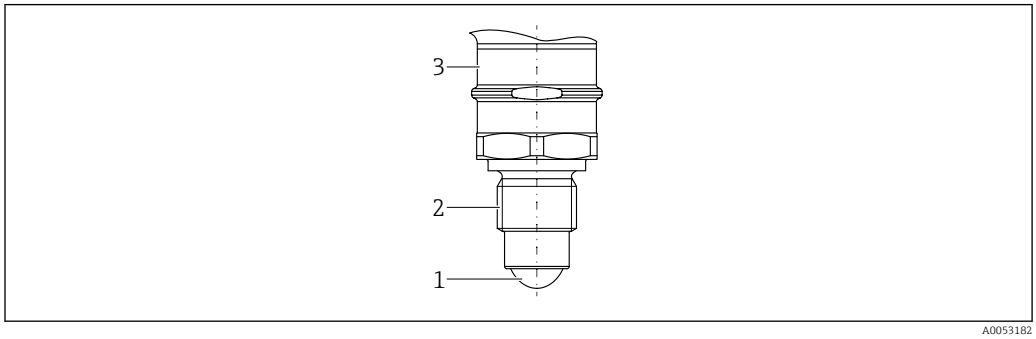
Process connection MNPT1½, 80 GHz; PEEK



25 Material; process connection MNPT1½, 80 GHz; PEEK

1 Antenna: PEEK, seal material: FKM oder EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

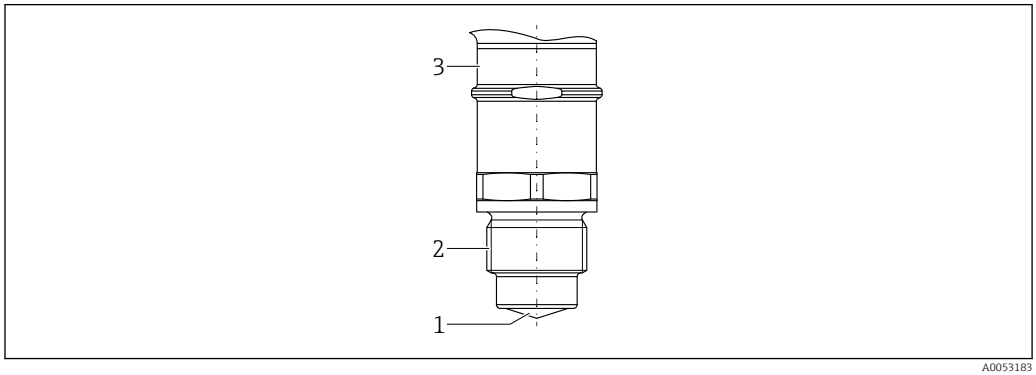
Process connection G½, 180 GHz, PTFE



26 Material; process connection G½, 180 GHz, PTFE

1 Antenna: PTFE, seal material: FKM or EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

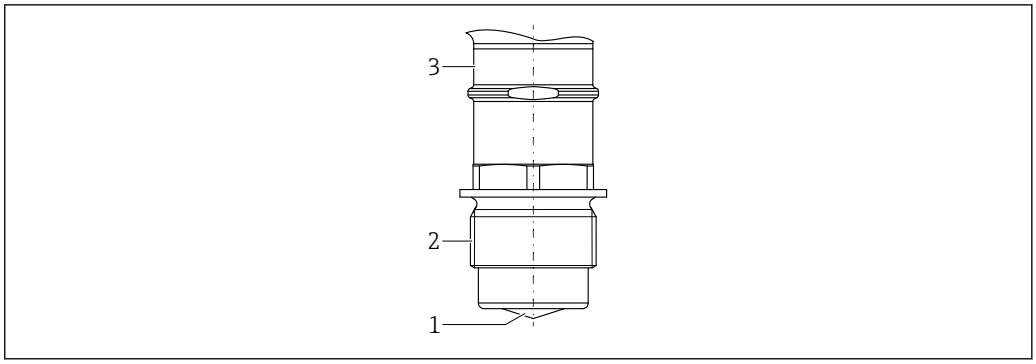
Process connection G¾, 80 GHz, PEEK



27 Material; process connection G¾, 80 GHz, PEEK

1 Antenna: PEEK, , seal material: FKM or EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

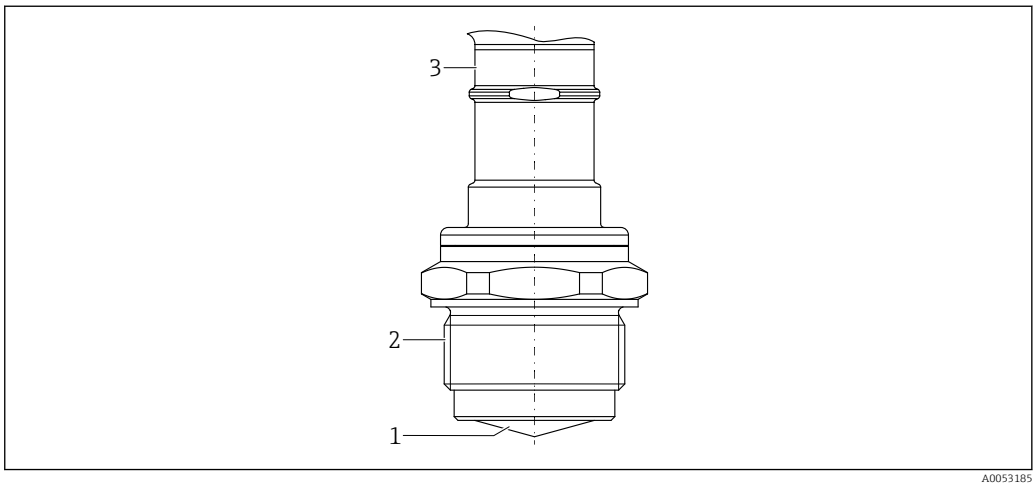
Process connection G1, 80 GHz, PEEK



28 Material; process connection G1, 80 GHz, PEEK

1 Antenna: PEEK, , seal material: FKM or EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

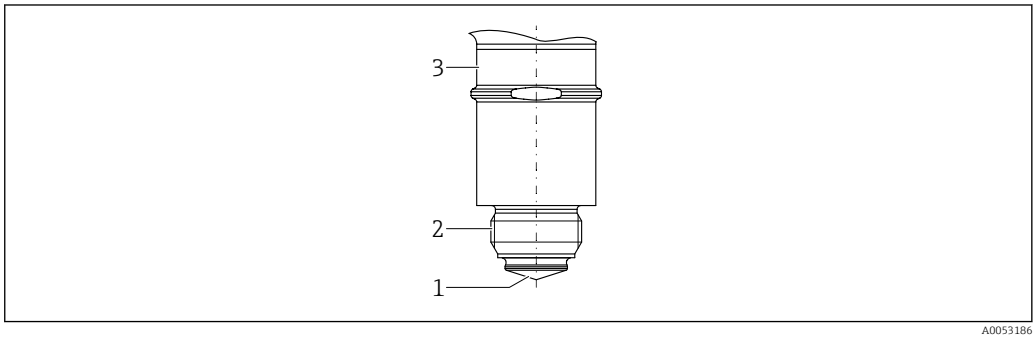
Process connection G1½, 80 GHz; PEEK



29 Material; process connection G1½, 80 GHz; PEEK

1 Antenna: PEEK, , seal material: FKM or EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

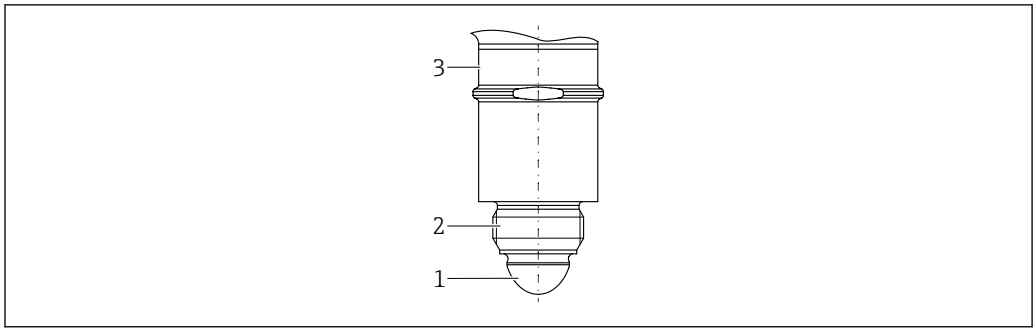
Process connection M24, 80 GHz; PEEK



30 Material; process connection M24, 80 GHz; PEEK

1 Antenna: PEEK, seal material: FKM oder EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

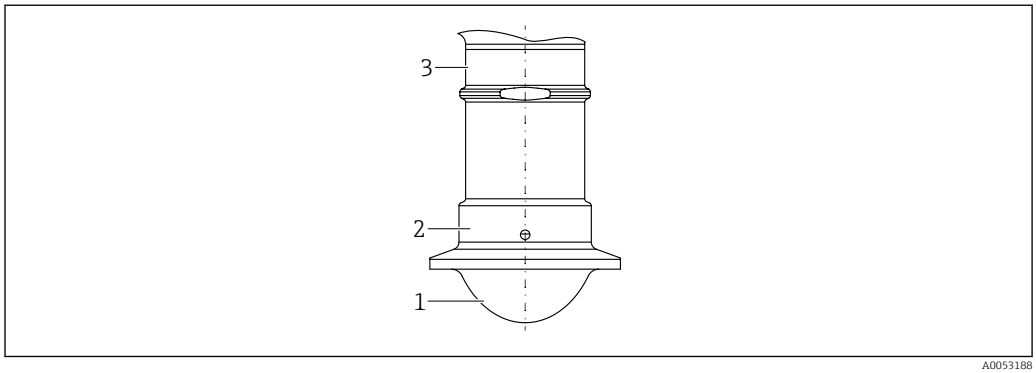
Process connection M24, 180 GHz, PTFE



31 Material; process connection M24, 180 GHz, PTFE

1 Antenna: PTFE, seal material: FKM or EPDM
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

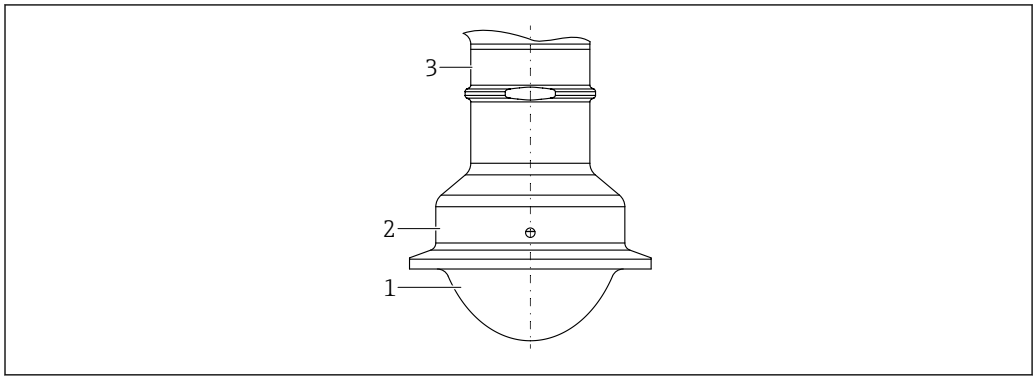
Process connection Tri-Clamp NA Connect ISO2852 DN25-38 (1½), 80 GHz; PTFE



32 Material; process connection Tri-Clamp NA Connect ISO2852 DN25-38 (1½), 80 GHz; PTFE

1 Antenna: PTFE, seal material: PTFE cladding
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

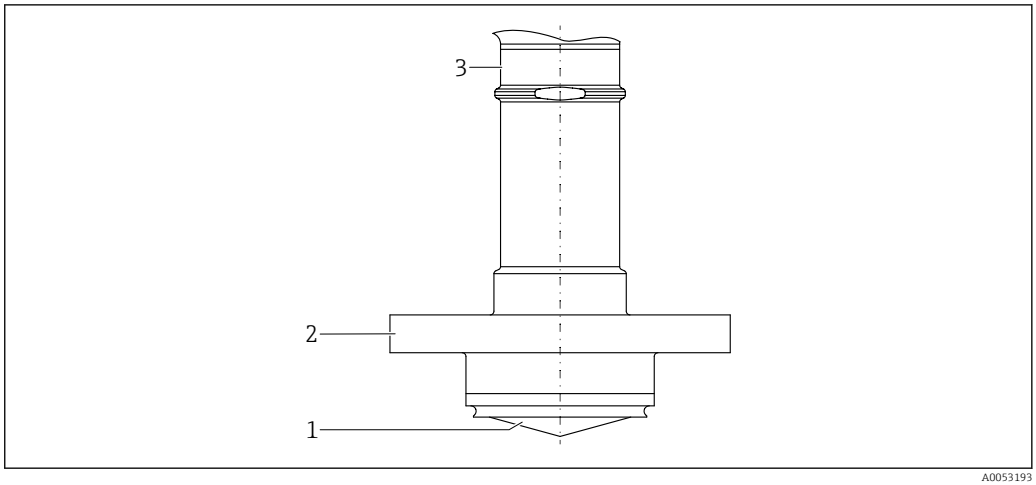
Process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2), 80 GHz; PTFE



33 Material; process connection Tri-Clamp NA Connect ISO2852 DN40-51 (2), 80 GHz; PTFE

1 Antenna: PTFE, seal material: PTFE cladding
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

Process connection NEUMO BioControl D50 PN25, 80 GHz; PEEK



34 *Material; process connection NEUMO BioControl D50 PN25, 80 GHz, PEEK*

1 Antenna: PEEK, seal material: PEEK cladding
2 Process connection: 316L / 1.4404
3 Housing adapter: 316L / 1.4404

Materials not in contact with process

- Housing: 316L (1.4404)
- Display: Polycarbonate
- Device plug: For more information, see section on "Power supply".

Surface roughness

- Housing: Ra <1.6 µm (63 µin), electropolished
- Sensor:
  - PTFE: Ra < 0.76 µm (29.9 µin)
  - PEEK:
    MNPT/G: Ra < 1.6 µm (63 µin)
    M24: Ra < 0.76 µm (29.9 µin)
- Weld-in/process adapter made of stainless steel (1.4435, 316 L):
  - NEUMO BioControl: Ra < 0.38 µm (15 µin), electropolished
  - Other [1]: Ra < 0.76 µm (29.9 µin)

Display and user interface

Operation concept

Operator-oriented menu structure for user-specific tasks
- User navigation
- Diagnosis
- Application
- System

Quick and safe commissioning
- Interactive wizard with graphical interface for guided commissioning in FieldCare/DeviceCare or SmartBlue app
- Menu guidance with brief descriptions of the individual parameter functions
- Standardized operation at the device and in the operating tools

Integrated data memory
Up to 100 event messages recorded in the device

Efficient diagnostics increase measurement reliability
- Remedial measures are integrated in plain text
- Diverse simulation options

1) Ra < 0.38 µm (15 µin), electropolished, on request

Bluetooth (optional)
- Quick and easy setup with the SmartBlue app or FieldXpert SMT70/SMT77
- No additional tools or adapters needed
- Encrypted single point-to-point data transmission (tested by Fraunhofer Institute) and password-protected communication via *Bluetooth*® wireless technology
- The LED display can be retrofitted with Bluetooth.

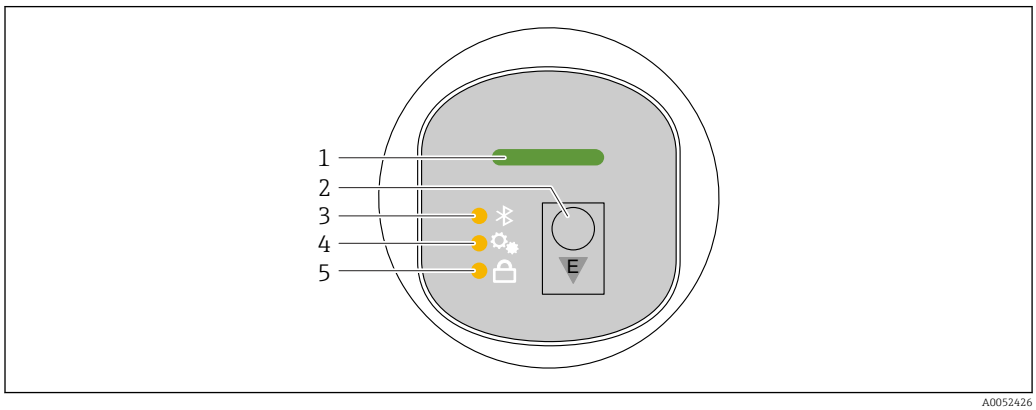
Languages

The following languages are available on the onsite display.

Operating languages
- English (English is set at the factory if no other language is ordered)
- Deutsch
- Français
- Español
- Italiano
- Nederlands
- Portuguesa
- Polski
- русский язык (Russian)
- Türkçe
- 中文 (Chinese)
- 日本語 (Japanese)
- 한국어 (Korean)
- tiếng Việt (Vietnamese)
- čeština (Czech)
- Svenska

LED indicator

Functions:
- Display of the operating status (operation or fault)
- Display of Bluetooth connection, locking status and function
- Easy setup of the following functions with one button:
  - Bluetooth On/Off
  - Locking On/Off
  - Single-key commissioning



A0052426

1 Operating status LED
2 Operating key "E"
3 Bluetooth LED
4 Single-key commissioning LED
5 Keypad lock LED

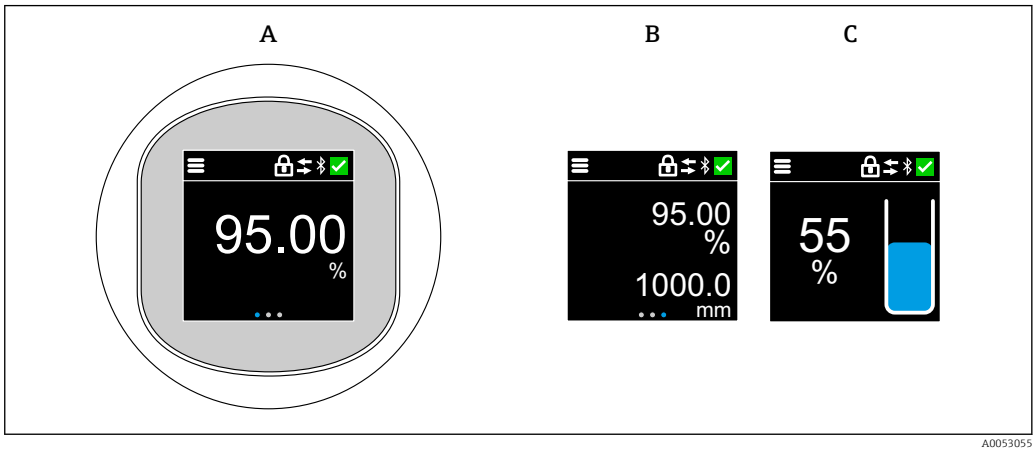
Onsite display

Functions:
- Display measured values, also fault and notice messages
- Display a symbol in the event of an error
- Electronically adjustable onsite display (automatic and manual adjustment of measured value display in 90° steps)
  The measured value display rotates automatically depending on the orientation when the device is started.
- Basic settings via the onsite display with touch control [2)]
  - Select the operating language
  - Start the Heartbeat Verification with passed/failed feedback message on the onsite display
  - Locking On/Off
  - Bluetooth On/Off
  - Commissioning wizard for basic settings
  - Read the device information, such as the name, serial number and firmware version
  - Active diagnosis and status
  - Device reset
  - Invert colors for bright lighting conditions

The backlighting adjusts automatically depending on the terminal voltage.

The standard display can be permanently set via the operating menu.

The following figure is an example. The display depends on the settings of the onsite display.

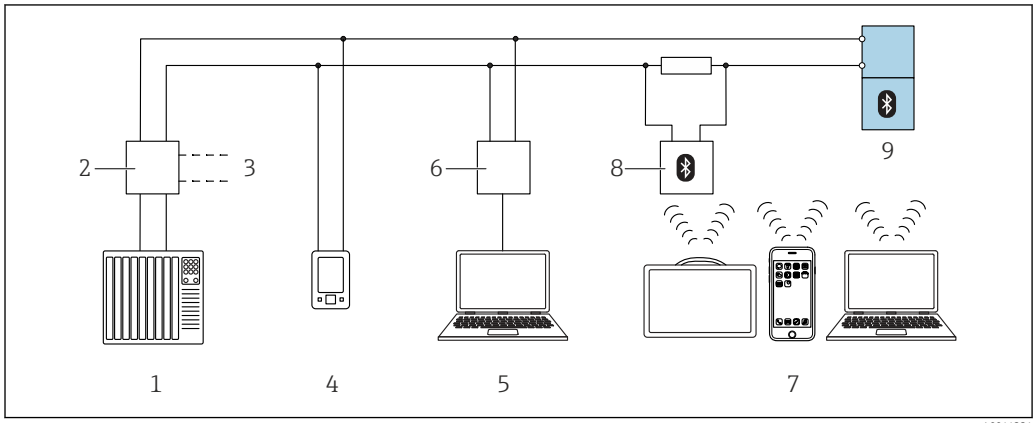


A Standard display: 1 measured value with unit (adjustable)
B 2 measured values, each with unit (adjustable)
C Graphic measured value display in %, level indicator in proportion to the measured value

2) For devices without touch control, settings can be made using operating tools (FieldCare, DeviceCare, SmartBlue).

Remote operation

Via HART protocol or Bluetooth



35 *Options for remote operation via HART protocol*

1 *PLC (programmable logic controller)*
2 *Transmitter power supply unit, e. g. RN42 (with communication resistor)*
3 *Connection for Commubox FXA195 and AMS Trex™ device communicator*
4 *AMS Trex™ device communicator*
5 *Computer with operating tool (e.g. DeviceCare/FieldCare , AMS Device View, SIMATIC PDM)*
6 *Commubox FXA195 (USB)*
7 *Field Xpert SMT70/SMT77, smartphone or computer with operating tool (e.g. DeviceCare/FieldCare , AMS Device View, SIMATIC PDM)*
8 *Bluetooth modem with connecting cable (e.g. VIATOR)*
9 *Transmitter*

Operation via Bluetooth® wireless technology (optional)

Prerequisite
- Device with Bluetooth order option
- Smartphone or tablet with Endress+Hauser SmartBlue app or PC with DeviceCare from version 1.07.07 or FieldXpert SMT70/SMT77

The connection has a range of up to 25 m (82 ft). The range can vary depending on environmental conditions such as attachments, walls or ceilings.

The operating keys on the display are locked as soon as the device is connected via Bluetooth.

Supported operating tools

Smartphone or tablet with Endress+Hauser SmartBlue app, DeviceCare from version 1.07.07, FieldCare, AMS and PDM

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Other certificates and approvals for the product are available under https://www.endress.com-> Downloads.

Hygienic design requirements

- Notes on installation and certification in accordance with 3-A and EHEDG:
  SD02503F document "Hygienic approvals"
- Information on 3-A and EHEDG-certified adapters:
  TI00426F document "Weld-in adapters, process adapters and flanges"
- 3-A and EHEDG-certified versions of the sensor are suitable for Cleaning-in-Place (CIP) and Sterilization-in-Place (SIP) without removing them from the plant. This means that the sensor does not need to be removed during cleaning. The maximum permitted pressure and temperature values for sensor and adapter must not be exceeded (see notes in this TI).
- ASME BPE

Compliance with requirements derived from cGMP

cGMP is suitable for wetted parts:
- The certificate is only available in English
- Materials of construction
- ADI-free based upon EMA/410/01 Rev.3 (TSE/BSE compliant)
- Polishing and surface finish
- Material/compound compliance table: USP, FDA

TSE (BSE) compliance (ADI free - Animal Derived Ingredients)

As the manufacturer, Endress+Hauser states:
- That the parts of this product in contact with the process are not made from materials derived from animals **or**
- at least comply with the requirements of guidelines outlined in EMA/410/01 rev. 3 (TSE (BSE) compliance).

EN 302372 radio standard

The devices with 80 GHz operating frequency comply with the TLPR (Tanks Level Probing Radar) radio standard EN 302372 and are permitted for use in closed vessels. Points a to f in Annex E of EN 302372 must be observed for the installation.

FCC

This device complies with Part 15 of the FCC rules. 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The devices are compliant with the FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205, 15.207, 15.209.

The Model FMR43L is a submodel of the FMR43. "L" indicates devices with 180 GHz working frequency that fullfill the requirements for use as LPR (Level Probe Radar). The Model FMR43T is a submodel of the FMR43. "T" indicates devices with 80 GHz working frequency that fullfill the requirements for use as TLPR (Tank Level Probe Radar) inside metallic enclosures. In addition, the FMR43L devices are compliant with Section 15.258. The installation of the LPR/TLPR device shall be done by trained installers, in strict compliance with the manufacturer's instructions.

Industry Canada

Canada CNR-Gen Section 7.1.3

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

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 not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

- 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.
- This device shall be installed and operated in a completely enclosed container to prevent RF emissions, which can otherwise interfere with aeronautical navigation.
- The installer/user of this device shall ensure that it is at least 10 km from the Dominion Astrophysical Radio Observatory (DRAO) near Penticton, British Columbia. The coordinates of the DRAO are latitude 49°19′15″ N and longitude 119°37′12″ W. For devices not meeting this 10 km separation (e.g., those in the Okanagan Valley, British Columbia,) the installer/user must coordinate with, and obtain the written concurrence of, the Director of the DRAO before the equipment can be installed or operated. The Director of the DRAO may be contacted at 250-497-2300 (tel.) or 250-497-2355 (fax). (Alternatively, the Manager, Regulatory Standards Industry Canada, may be contacted.)

- The Model FMR43L is a submodel of the FMR43. "L" indicates devices with 180 GHz working frequency that fullfill the requirements for use as LPR (Level Probe Radar).
- The Model FMR43T is a submodel of the FMR43. "T" indicates devices with 80 GHz working frequency that fullfill the requirements for use as TLPR (Tank Level Probe Radar).

ASME BPE

The measuring system meets the requirements of the ASME BPE standard (Bioprocessing Equipment).

Order information

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

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

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

Identification

Measuring point (TAG)

The device can be ordered with a tag name.

Location of tag name
Select in the additional specification:
- Stainless steel wired-on tag plate
- Paper adhesive label
- Tag provided by the customer
- Nameplate
- IEC 61406 stainless steel tag
- IEC 61406 stainless steel + NFC tag
- IEC 61406 stainless steel, stainless steel tag
- IEC 61406 stainless steel + NFC, stainless steel
- IEC 61406 stainless steel tag, plate provided
- IEC 61406 stainless steel + NFC, plate provided

Definition of tag name
Specify in the additional specification:
3 lines of maximum 18 characters each
The specified tag name appears on the selected plate.

Visualization in SmartBlue app
The first 32 characters of the tag name
The tag name can always be changed specifically for the measuring point via Bluetooth.

Display on the nameplate
The first 16 characters of the tag name

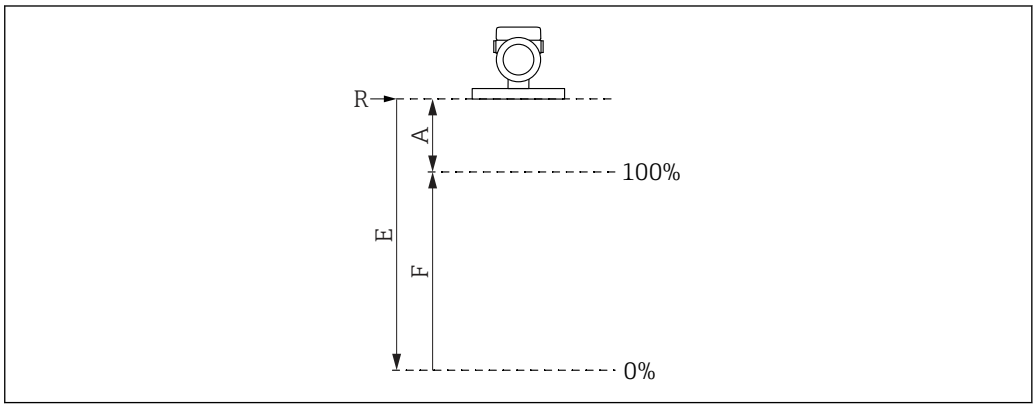
Display in electronic nameplate (ENP)
The first 32 characters of the tag name

For details, see document SD03128P

Calibration

Factory calibration certificate

The calibration points are evenly distributed over the measuring range (0 to 100 %). To define the measuring range, Empty calibration **E** and Full calibration **F** must be specified. If this information is missing, antenna-dependent default values are used instead.



A0032643

R Reference point of measurement
A Minimum distance between reference point and 100% mark
E Empty calibration
F Full calibration

Measuring range restrictions
The following restrictions must be considered when selecting**E** and **F**:
- Distance from the reference point R to the first measuring point
  A = Antenna-dependent between 90 mm (3.54 in) and 140 mm (5.51 in)
- Minimum span
  F ≥ 45 mm (1.77 in)
- Maximum value for **Empty calibration** parameter
  E = maximum 15 m (49 ft)

- Calibration takes place under reference conditions .
- The selected values for Empty calibration and Full calibration are only used to create the factory calibration certificate. Afterwards, the values are reset to the default values specific for the antenna. If values other than the default values are required, they must be ordered as a customized empty/full calibration.
  Product Configurator → Optional → Service → **Customized empty/full calibration**

Factory verification certificate

The verification points (3 points) are defined at the following distances from the reference point (approximate values):
- 2 m
- 4 m
- 6 m

Verification takes place under reference conditions.

Service

The following services, among others, can be selected using the Product Configurator.

- Cleaned of oil+grease (wetted)
- Set damping
- Set HART Burst Mode PV
- Set max. alarm current
- Bluetooth communication is disabled on delivery
- Customized empty/full calibration
- Product documentation on paper
  As an option, test reports, declarations and material test certificates can be ordered as a paper printout using the feature **Service**, format**Product documentation on paper**. The required documents can be selected under the feature **Test, certificate, declaration** and are then included with the device on delivery.

Application packages

The application package can be ordered together with the device or can be activated subsequently with an activation code. Detailed information on the relevant order code is available from the website www.endress.com or from the Endress +Hauser Sales Center.

Heartbeat Technology

Heartbeat Technology offers diagnostic functionality through continuous self-monitoring, the transmission of additional measured variables to an external Condition Monitoring system and the in situ verification of devices in the application.

Heartbeat Diagnostics

Continuous self-monitoring of the device.

Diagnostic messages output to:
- the onsite display
- an asset management system (e.g. FieldCare or DeviceCare)
- an automation system (e.g. PLC)

Heartbeat Verification

- Monitoring of the installed device without interrupting the process, including a verification report
- Clear measuring point assessment (pass/fail) with high total test coverage as part of the manufacturer's specification
- Can be used to document normative requirements
- Meets the requirements for measurement traceability in accordance with ISO 9001 (ISO 9001:2015 Section 7.1.5.2)

The verification report can be generated via Bluetooth and HART.

Heartbeat Monitoring

- Continuously provides device and/or process data for an external system. Analysis of this data provides a basis for process optimization and predictive maintenance.
- **Loop diagnostics** wizard: Detection of elevated measuring circuit resistance values or declining power supply
- **Foam detection** wizard: This wizard configures automatic foam detection.
- **Build-up detection** wizard: Reliable detection of buildup on the antenna
- **Safety mode** wizard: This wizard can be used to write-protect the device via software. The safety-relevant parameters must be confirmed in the wizard.

Detailed description

See Special Documentation for SD Heartbeat Technology.

Accessories

Accessories currently available for the product can be selected via the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.

2. Open the product page.
3. Select **Spare parts & Accessories**.

Device-specific accessories

M12 socket

M12 socket, straight
- Material:
  Body: PA; union nut: stainless steel; seal: EPDM
- Degree of protection (fully locked): IP69
- Order number: 71638191

M12 socket, elbowed
- Material:
  Body: PA; union nut: stainless steel; seal: EPDM
- Degree of protection (fully locked): IP69
- Order number: 71638253

Cables

Cable 4 x 0.34 mm² (20 AWG) with M12 socket, elbowed, screw plug, length 5 m (16 ft)
- Material: body: TPU; union nut: nickel-plated die-cast zinc; cable: PVC
- Degree of protection (fully locked): IP68/69
- Order number: 52010285
- Wire colors
  - 1 = BN = brown
  - 2 = WT = white
  - 3 = BU = blue
  - 4 = BK = black

Welding neck, process adapter and flange

For details, refer to TI00426F/00/EN "Weld-in adapters, process adapters and flanges".

DeviceCare SFE100

Configuration tool for IO-Link, HART, PROFIBUS and FOUNDATION Fieldbusfield devices
DeviceCare is available for download free of charge at www.software-products.endress.com. You need to register in the Endress+Hauser software portal to download the application.

Technical Information TI01134S

FieldCare SFE500

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

Technical Information TI00028S

Device Viewer

All the spare parts for the device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer).

Field Xpert SMT70

Universal, high-performance tablet PC for device configuration in Ex Zone 2 and non-Ex areas

For details, see "Technical Information" TI01342S

Field Xpert SMT77

Universal, high-performance tablet PC for device configuration in Ex Zone 1 areas

For details, see "Technical Information" TI01418S

SmartBlue app

Mobile app for easy configuration of devices on site via Bluetooth wireless technology

Documentation

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

Standard documentation

Document type: Operating Instructions (BA)
Installation and initial commissioning – contains all the functions in the operating menu that are needed for a routine measuring task. Functions beyond this scope are not included.

Document type: Description of Device Parameters (GP)
The document is part of the Operating Instructions and serves as a reference for parameters, providing a detailed explanation of each individual parameter of the operating menu.

Document type: Brief Operating Instructions (KA)
Quick guide to the first measured value – includes all essential information from incoming acceptance to electrical connection.

Document type: Safety Instructions, certificates
Depending on the approval, safety instructions are supplied with the device, e.g. XA. This documentation is an integral part of the Operating Instructions.
Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.

Supplementary device-dependent documentation

Additional documents are supplied depending on the device version ordered: Always comply strictly with the instructions in the supplementary documentation. The supplementary documentation is an integral part of the device documentation.

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