Technical Information
Micropilot FMR51, FMR52

Level radar

Level measurement in liquids

Application

Continuous, non-contact level measurement of liquids, pastes and slurries

Features FMR51:
- Level measurement under extreme conditions
- Maximum measuring range: 40 m (131 ft); for version with enhanced dynamics: 70 m (230 ft)
- Process connection: 1½" thread/Tri-Clamp/flange
- Temp. range: −196 to +450 °C (−321 to +842 °F)
- Pressure range: −1 to +160 bar (−14.5 to +2 320 psi)
- Accuracy: ±2 mm

Features FMR52:
- For aggressive media as well as for highest hygiene requirements (ASME BPE, USP Class VI)
- Flush mounted, completely filled PTFE horn antenna
- Maximum measuring range: 40 m (131 ft); for version with enhanced dynamics: 60 m (197 ft)
- Flush mounted with cladded flange; or process connections for hygiene requirements (Tri-Clamp, ...)
- Temp. range: −40 to +200 °C (−40 to +392 °F)
- Pressure range: −1 to +16 bar (−14.5 to +232 psi)
- Accuracy: ±2 mm

Your benefits
- Reliable even under changing product and process conditions
- Integrated data memory (HistoROM) for high availability
- Intuitive operating menu in national languages for easy commissioning
- Exact diagnostic and process information
- International approvals for use in hazardous areas
- 5-point linearity protocol
- WHG and marine approvals
- SIL2 according to IEC 61508, SIL3 in case of homogeneous or heterogeneous redundancy
- System integration via HART/PROFIBUS PA (Profile 3.02)/FOUNDATION Fieldbus

Endress+Hauser
People for Process Automation

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Important document information

Document conventions

Safety symbols

Symbol	Meaning
A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Electrical symbols

Symbol	Meaning
A0011197	**Direct current** A terminal to which DC voltage is applied or through which direct current flows.
A0011198	**Alternating current** A terminal to which alternating voltage is applied or through which alternating current flows.
A0017381	**Direct current and alternating current** ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
A0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
A0011201	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

Symbols for certain types of information

Symbol	Meaning
A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
A0011183	**Preferred** Indicates procedures, processes or actions that are preferred.
A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
A0011193	**Tip** Indicates additional information.
A0011194	**Reference to documentation** Refers to the corresponding device documentation.

Symbol	Meaning
A0011195	**Reference to page** Refers to the corresponding page number.
A0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.

Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
1. , 2. , 3. ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections
A0011187	**Hazardous area** Indicates a hazardous area.
A0011188	**Safe area (non-hazardous area)** Indicates a non-hazardous location.

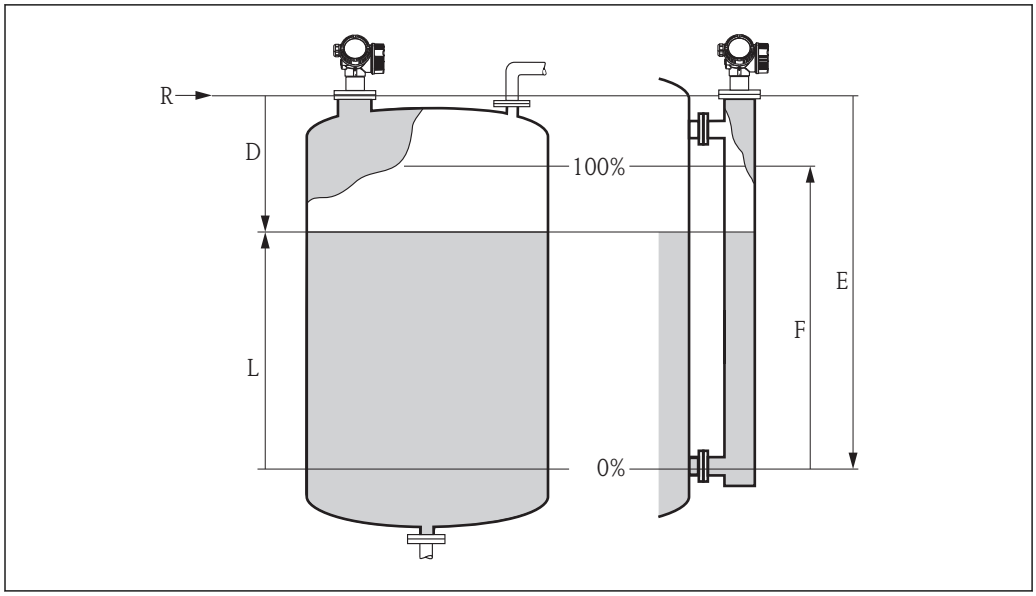
Symbols at the device

Symbol	Meaning
	Safety instructions Observe the safety instructions contained in the associated Operating Instructions.
	Temperature resistance of the connection cables Specifies the minimum value of the temperature resistance of the connection cables.

Function and system design

Measuring principle

The Micropilot is a "downward-looking" measuring system, operating based on the time-of-flight method (ToF). It measures the distance from the reference point (process connection) to the product surface. Radar impulses are emitted by an antenna, reflected off the product surface and received again by the radar system.



1 *Setup parameters of the Micropilot*

R Reference point of the measurement (lower edge of the flange or threaded connection)
E Empty calibration (= zero)
F Full calibration (= span)
D Measured distance
L Level (L = E - D)

Input

The reflected radar impulses are received by the antenna and transmitted into the electronics. A microprocessor evaluates the signal and identifies the level echo caused by the reflection of the radar impulse at the product surface. The unambiguous signal identification is accomplished by the PulseMaster® eXact software together with the Multi-echo tracking algorithms, based on many years of experience with time-of-flight technology.

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

$D = c \cdot t/2$,

with c being the speed of light.

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

$L = E - D$

The reference point R of the measurement is located at the process connection. For details see the dimensional drawing:
- FMR51: (→ 67)
- FMR52: (→ 71)

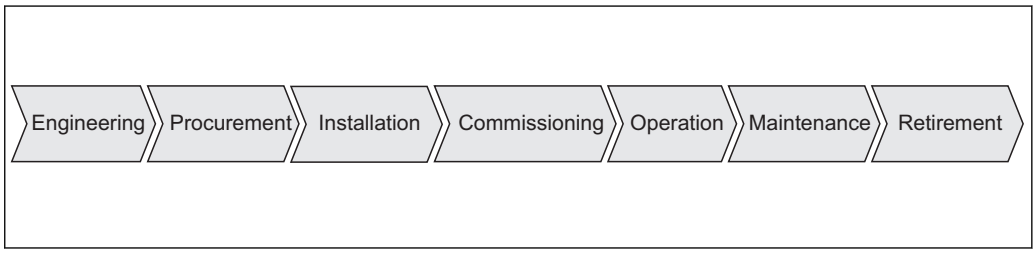
The Micropilot is equipped with functions to suppress interference echoes. The user can activate these functions. Together with the multi-echo tracking algorithms they ensure that interference echoes (i.e. from edges and weld seams) are not interpreted as level echo.

Output

The Micropilot is commissioned by entering an empty distance "E" (=zero), a full distance "F" (=span) and application parameters. The application parameters are automatically adapt into the instrument to the process conditions. For models with a current output, the factory adjustment for zero point "E" and span "F" is 4 mA and 20 mA. For digital outputs and the display module, the factory adjustment for zero point "E" and span "F" is 0 % and 100 %.

A linearization with max. 32 points, based on a table entered either manually or semi-automatically, can be activated locally or remotely. This function provides a measurement in engineering units and a linear output signal for spheres, horizontal cylindrical tanks and vessels with conical outlet.

Life cycle of the product



2 Life cycle

Engineering
- Universal measuring principle
- Measurement unaffected by medium properties
- Hardware and software developed according to SIL IEC 61508

Procurement
- Endress+Hauser being the world market leader in level measurement guarantees asset protection
- Worldwide support and service

Installation
- Special tools are not required
- Reverse polarity protection
- Modern, detachable terminals
- Main electronics protected by a separate connection compartment

Commissioning
- Fast, menu-guided commissioning in only a few steps on site or from the control room
- Plain text display in national languages reduces the risk of error or confusion
- Direct local access of all parameters
- Short instruction manual at the device

Operation
- Multi-echo tracking: Reliable measurement through self-learning echo-search algorithms taking into account the short-term and long-term history in order to check the found echoes for plausibility and to suppress interference echoes.
- Diagnostics in accordance with NAMUR NE107

Maintenance
- HistoROM: Data backup for instrument settings and measured values
- Exact instrument and process diagnosis to assist fast decisions with clear details concerning remedies
- Intuitive, menu-guided operating concept in national languages saves costs for training, maintenance and operation
- Cover of the electronics compartment can be opened in hazardous areas

Retirement
- Order code translation for subsequent models
- RoHS-conforming (Restriction of certain Hazardous Substances), unleaded soldering of electronic components
- Environmentally sound recycling concept

Input

Measured variable

The measured variable is the distance between the reference point and the product surface.

The level is calculated from this distance, taking into account the empty distance "E" entered by the user.

If required, the level can be converted into other variables (volume, mass) by means of a linearization (up to 32 points).

Measuring range

Maximum measuring range

Device	Maximum measuring range
FMR51 - standard version	40 m (131 ft)
FMR51 - with "Advanced dynamics" application package	70 m (230 ft)
FMR52 - standard version	40 m (131 ft)
FMR52 - with "Advanced dynamics" application package	60 m (197 ft)

Usable measuring range

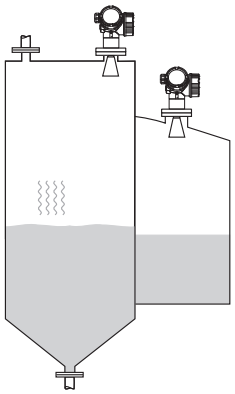
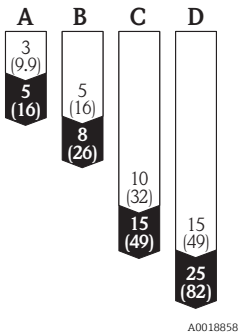
The usable measuring range depends on the size of the antenna, the reflectivity of the medium, the mounting location and eventual interference reflections.

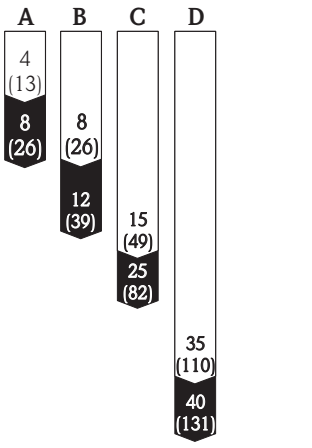
The following tables describe the groups of media as well as the achievable measuring range as a function of application and media group. If the dielectric constant of a medium is unknown, it is recommended to assume media group B to ensure a reliable measurement.

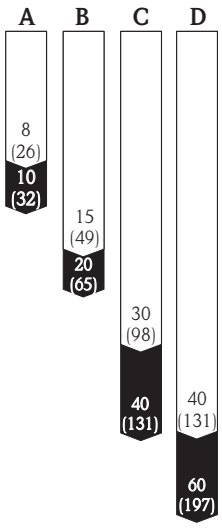
Media groups

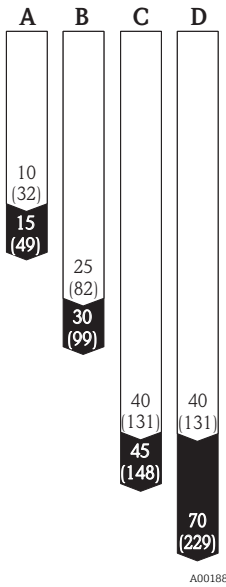
Media groups	DK (ε_r)	Example
A	1.4 to 1.9	non-conducting liquids, e.g. liquefied gas [1]
B	1.9 to 4	non-conducting liquids, e.g. benzene, oil, toluene, ...
C	4 to 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ...
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

1) Treat Ammonia NH_3 as a medium of group A.

<table>
<tr><th>Device</th><th colspan="4">Storage tank</th></tr>
<tr><td rowspan="3"></td><td colspan="4"> 
A0018833
Calm product surface (e.g. intermittent filling, filling from bottom, immersion tubes)</td></tr>
<tr><td colspan="4">Antenna size</td></tr>
<tr><td>FMR51</td><td>40 mm (1½ in)</td><td>50 mm (2 in)</td><td>80 mm (3 in)</td><td>100 mm (4 in)</td></tr>
<tr><td>FMR52</td><td>-</td><td>50 mm (2 in)</td><td>80 mm (3 in)</td><td>-</td></tr>
<tr><td></td><td> 

A0018858</td><td> 

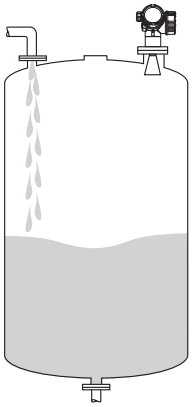
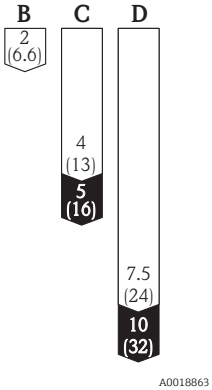
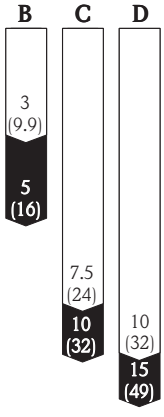
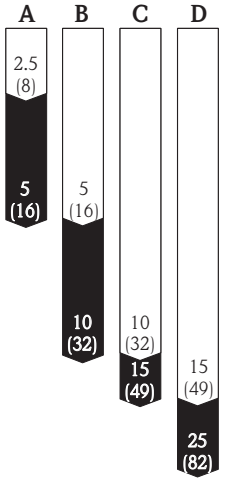
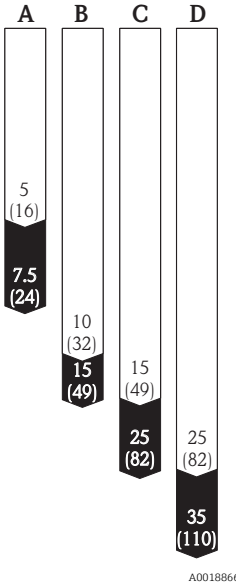
A0018859</td><td> 

A0018860</td><td> 

A0018862</td></tr>
<tr><td colspan="4">Measuring range [m (ft)]</td></tr>
</table>

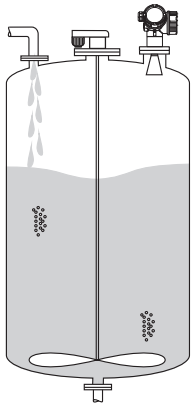
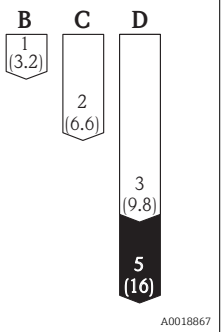
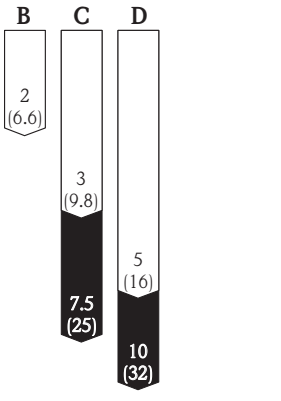
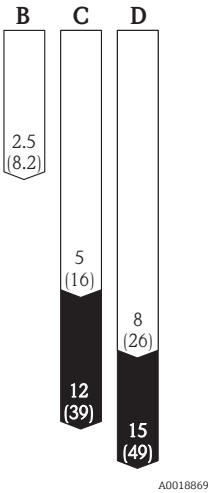
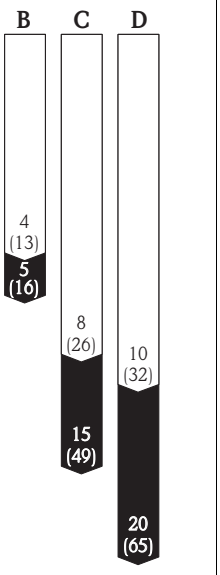
Legend

▯	Measuring range of the standard version
▮	Measuring range for the "Advanced dynamics" application package (product structure: feature 540: "Application Package", Option EM: "Advanced dynamics")

Device	Buffer tank			
	 A0018835 Moving surfaces (e.g. continuous filling, from above, mixing jets)			
	Antenna size			
FMR51	40 mm (1½ in)	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
FMR52	-	50 mm (2 in)	80 mm (3 in)	-
	 A0018863	 A0018864	 A0018865	 A0018866
	Measuring range [m (ft)]			

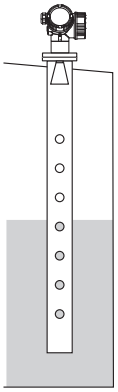
Legend

▯	Measuring range of the standard version
▮	Measuring range for the "Advanced dynamics" application package (product structure: feature 540: "Application Package", Option EM: "Advanced dynamics")

Device	Process tank with agitator			
	 A0018837 Turbulent surface. Single stage agitator (f_{rot} < 1 Hz)			
	Antenna size			
FMR51	40 mm (1½ in)	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
FMR52	-	50 mm (2 in)	80 mm (3 in)	-
	 A0018867	 A0018868	 A0018869	 A0018870
	Measuring range [m (ft)]			

Legend

▯	Measuring range of the standard version
▮	Measuring range for the "Advanced dynamics" application package (product structure: feature 540: "Application Package", Option EM: "Advanced dynamics")

Device	Stilling well	Bypass
	 A0018842	A0018840
	Antenna size	Antenna size
FMR51	40 to 100 mm (1½ ... 4 in)	40 to 100 mm (1½ ... 4 in)
FMR52	50 to 80 mm (2 ... 3 in)	50 to 80 mm (2 ... 3 in)
	A, B, C, D A0018851	**C, D** A0018852
	Measuring range [m (ft)]	

Operating frequency

K-band (~ 26 GHz)

Up to 8 Micropilot transmitters can be installed in the same tank because the transmitter pulses are statistically coded.

Transmitting power

Distance	Average energy density in beam direction	
	Standard version	With "Advanced dynamics" application package [1]
1 m (3.3 ft)	< 12 nW/cm^2	< 64 nW/cm^2
5 m (16 ft)	< 0.4 nW/cm^2	< 2.5 nW/cm^2

1) Product structure, feature 540: "Application package", option EM: "Advanced dynamics"

Output

Output signal

HART

Signal coding	FSK ±0.5 mA over current signal
Data transmission rate	1200 Bit/s
Galvanic isolation	Yes

PROFIBUS PA

Signal coding	Manchester Bus Powered (MBP)
Data transmission rate	31.25 kBit/s, voltage mode
Galvanic isolation	Yes

FOUNDATION Fieldbus

Signal coding	Manchester Bus Powered (MBP)
Data transmission rate	31.25 kBit/s, voltage mode
Galvanic isolation	Yes

Switch output

For HART devices, the switch output is available as an option. See product structure, feature 20: "Power Supply, Output", option B: "2-wire; 4-20mA HART, switch output"

Devices with PROFIBUS PA and FOUNDATION Fieldbus always have a switch output.

Switch output	
Function	Open collector switching output
Switching behavior	Binary (conductive or non-conductive), switches when the programmable switch point is reached
Failure mode	non-conductive
Eectrical connection values	U = 10.4 to 35 V_{DC}, I = 0 to 40 mA
Internal resistance	R_I < 880 Ω The voltage drop at this internal resistance has to be taken into account on planning the configuration. For example, the resulting voltage at a connected relay must be sufficient to switch the relay.
Insulation voltage	floating, Insulation voltage 1350 V_{DC} to power supply aund 500 V_{AC} to ground
Switch point	freely programmable, separately for switch-on and switch-off point
Switching delay	freely programmable from 0 to 100 sec. , separately for switch-on and switch-off point
Number of switching cycles	corresponds to the measuring cycle
Signal source device variables	▪ Level linearized ▪ Distance ▪ Terminal voltage ▪ Electronic temperature ▪ Relative echo amplitude ▪ Diagnostic values, Advanced diagnostics
Number of switching cycles	unlimited

Signal on alarm

Depending on the interface, failure information is displayed as follows:
- Current output (for HART devices)
  - Failsafe mode selectable (in accordance with NAMUR Recommendation NE 43):
    Minimum alarm: 3.6 mA
    Maximum alarm (= factory setting): 22 mA
  - Failsafe mode with user-selectable value: 3.59 to 22.5 mA
- Local display
  - Status signal (in accordance with NAMUR Recommendation NE 107)
  - Plain text display
- Operating tool via digital communication (HART, PROFIBUS PA, FOUNDATION Fieldbus) or service interface (CDI)
  - Status signal (in accordance with NAMUR Recommendation NE 107)
  - Plain text display

Linearization

The linearization function of the device allows the conversion of the measured value into any unit of length or volume. Linearization tables for calculating the volume in cylindrical tanks are pre-programmed. Other tables of up to 32 value pairs can be entered manually or semi-automatically.

Galvanic isolation

All circuits for the outputs are galvanically isolated from each other.

Protocol-specific data

HART

Manufacturer ID	17 (0x11)
Device type ID	41 (0x28)
HART specification	6.0
Device description files (DTM, DD)	Information and files under: ▪ www.endress.com ▪ www.hartcomm.org
HART load	Min. 250 Ω
HART device variables	The measured values can be freely assigned to the device variables. **Measured values for PV (primary variable)** ▪ Level linearized ▪ Distance ▪ Electronic temperature ▪ Relative echo amplitude ▪ Analog output adv. diagnostics **Measured values for SV, TV, FV (second, third and fourth variable)** ▪ Level linearized ▪ Distance ▪ Terminal voltage ▪ Electronic temperature ▪ Absolute echo amplitude ▪ Relative echo amplitude ▪ Area of incoupling
Supported functions	▪ Burst mode ▪ Additional transmitter status

PROFIBUS PA

Manufacturer ID	17 (0x11)
Ident number	0x1559
Profile version	3.02
GSD file	Information and files under: ▪ www.endress.com ▪ www.profibus.org
GSD file version	

Output values	**Analog Input:** ▪ Level linearized ▪ Distance ▪ Terminal voltage ▪ Electronic temperature ▪ Absolute echo amplitude ▪ Relative echo amplitude ▪ Analog output advanced diagnostics 1/2 **Digital Input:** ▪ Advanced diagnostic blocks ▪ Status output switch block
Input values	**Analog Output:** ▪ Analog value from PLC (for sensor block external pressure to compensate gas phase effects) ▪ Analog value from PLC to be indicated on the display **Digital Output:** ▪ Extended diagnostic block ▪ Level limiter ▪ Sensor block measurement on ▪ Sensor block save history on ▪ Status output
Supported functions	▪ Identification & Maintenance Einfachste Geräteidentifizierung seitens des Leitsystems und des Typenschildes ▪ Automatic Ident Number Adoption GSD compatibility mode with respect to the preceding product Micropilot M FMR2xx ▪ Physical Layer Diagnostics Installation check of the PRFIBUS segment and the Micropilot FMR5x via the terminal voltage and telegram surveillance. ▪ PROFIBUS Up-/Download Up to 10 times faster writing and reading of parameters via PROFIBUS up-/download ▪ Condensed Status Simple and self-explanatory diagnostic information by categorization of occurring diagnostic messages.

FOUNDATION Fieldbus

Manufacturer ID	0x452B48
Device type	0x1028
Device Revision	0x01
DD Revision	Information and files can be found: ▪ www.endress.com ▪ www.fieldbus.org
CFF Revision	
Device Tester Version (ITK Version)	6.0.1
ITK Test Campaign Number	IT085300
Link Master (LAS) capable	yes
Link Master / Basic Device selectable	yes; default: Basic Device
Node address	Default: 247 (0xF7)
Features supported	Following methods are supported: ▪ Restart ▪ ENP Restart ▪ Setup ▪ Linearization ▪ Self Check
Virtual Communication Relationships (VCRs)	
Number of VCRs	44

Number of Link Objects in VFD	50
Permanent entries	1
Client VCRs	0
Server VCRs	10
Source VCRs	43
Sink VCRs	0
Subscriber VCRs	43
Publisher VCRs	43
Device Link Capabilities	
Slot time	4
Min. inter PDU delay	8
Max. response delay	20

Transducer Blocks

Block	Content	Output values
Setup Transducer Block	Contains all parameters for a standard commissioning procedure	▪ Level or volume [1] (Channel 1) ▪ Distance (Channel 2)
Advanced Setup Transducer Block	Contains all parameters for a more detailed configuration of the device	no output values
Display Transducer Block	Contains all parameters for the configuration of the display module	no output values
Diagnostic Transducer Block	Contains diagnostic information	no output values
Advanced Diagnostic Transducer Block	Contains parameters for the Advanced Diagnostic	no output values
Expert Configuration Transducer Block	Contains parameters which require detailed knowledge of the functionalities of the device	no output values
Expert Information Transducer Block	Contains information about the state of the device	no output values
Service Sensor Transducer Block	Contains parameters which can only be operated by Endress+Hauser service personnel	no output values
Service Information Transducer Block	Contains information on the state of device which is relevant for service operations	no output values
Data Transfer Transducer Block	Contains parameters which allow to backup the device configuration in the display module and to restore it into the device. Access to these parameters is restricted to the Endress+Hauser service.	no output values

1) depending on the configuration of the block

Function Blocks

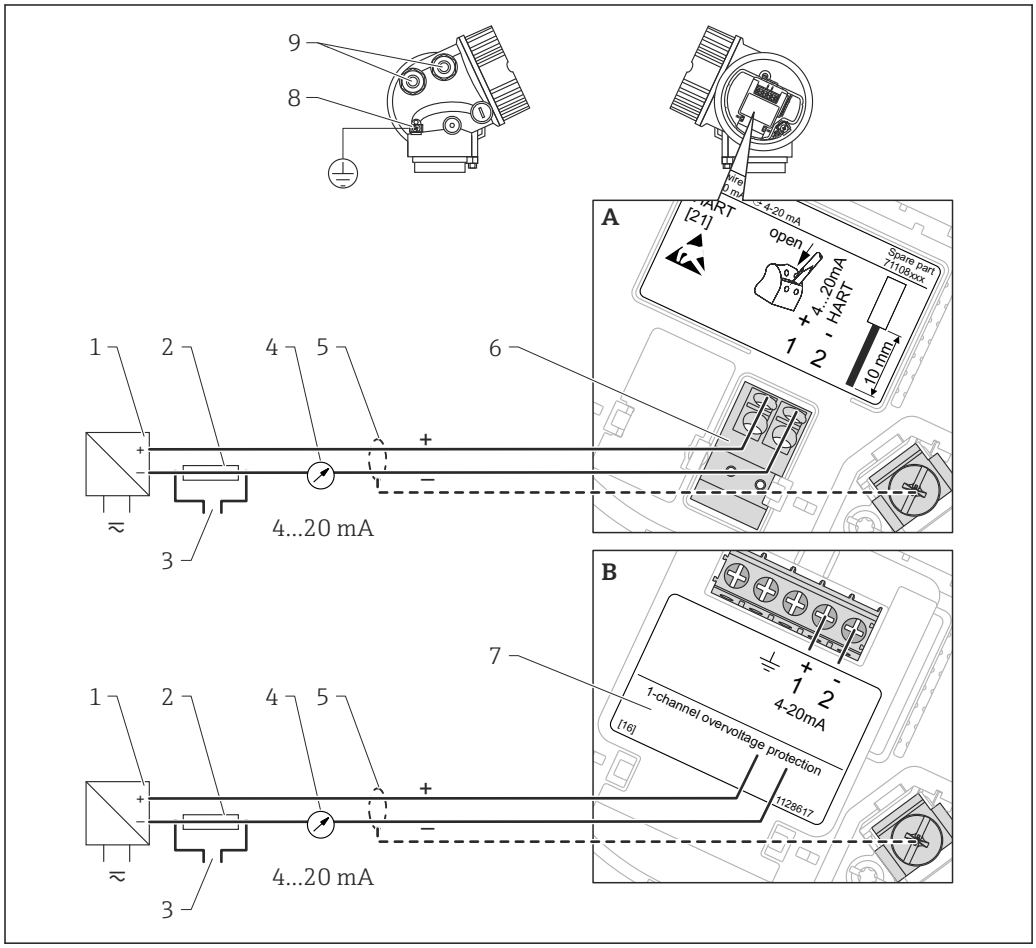
Block	Content	Number of permanent blocks	Number of instantiable blocks	Execution time	Functionality
Resource Block	The Resource Block contains all the data that uniquely identifies the field device. It is an electronic version of a nameplate of the device.	1	0	-	enhanced
Analog Input Block	The AI block takes the manufacturer's input data, selected by channel number, and makes it available to other function blocks at its output.	2	3	25 ms	enhanced
Discrete Input Block	The DI block takes a discrete input value (e.g. indication of an level limit), and makes it available to other function blocks at its output.	1	2	20 ms	standard
Mutiple Analog Output Block	This block is used to transfer analog data from the bus into the device	1	0	20 ms	standard
Mutiple Discrete Output Block	This block is used to transfer discrete data from the bus to the device.	1	0	20 ms	standard
PID Block	The PID block serves as proportional-integralderivative controller and is used almost universally to do closed-loop-control in the field including cascade and feedforward.	1	1	25 ms	standard
Arithmetic Block	This block is designed to permit simple use of popular measurement math functions. The user does not have to know how to write equations. The math algorithm is selected by name, chosen by the user for the function to be done.	1	1	25 ms	standard
Signal Characterizer Block	The signal characterizer block has two sections, each with an output that is a non-linear function of the respective input. The non-linear function is determined by a single look-up table with 21 arbitrary x-y pairs.	1	1	25 ms	standard
Input Selector Block	The input selector block provides selection of up to four inputs and generates an output based on the configured action. This block normally receives its inputs from AI blocks. The block performs maximum, minimum, middle, average and 'first good' signal selection.	1	1	25 ms	standard

Block	Content	Number of permanent blocks	Number of instantiable blocks	Execution time	Functionality
Integrator Block	The Integrator Function Block integrates a variable as a function of the time or accumulates the counts from a Pulse Input block. The block may be used as a totalizer that counts up until reset or as a batch totalizer that has a setpoint, where the integrated or accumulated value is compared to pre-trip and trip settings, generating discrete signals when these settings are reached.	1	1	25 ms	standard
Analog Alarm Block		1	1	25 ms	standard

Up to 20 blocks can be instantiated in the device altogether, including the blocks already instantiated on delivery.

Power supply

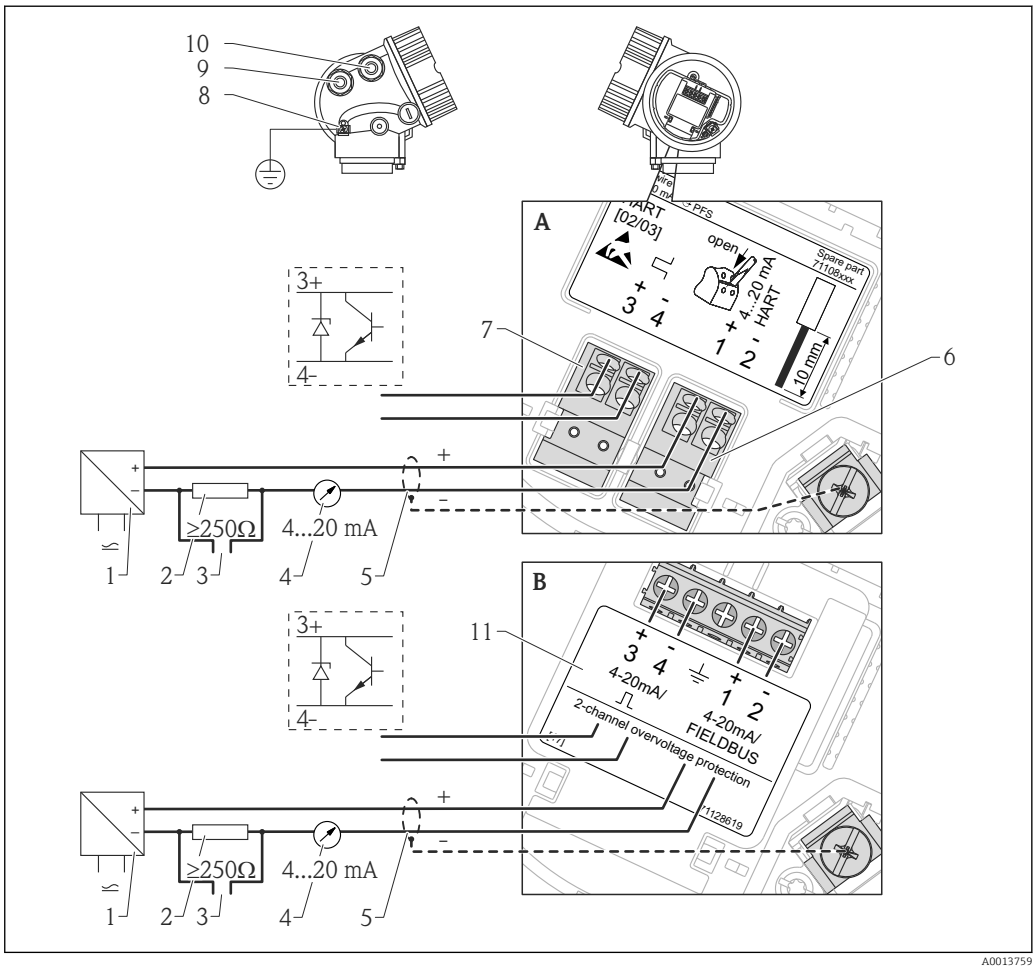
Terminal assignment **2-wire: 4-20mA HART**



3 Terminal assignment 2-wire; 4-20mA HART

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Active barrier with power supply (e.g. RN221N): Observe terminal voltage (→ 28)
2 HART communication resistor (≥250 Ω): Observe maximum load (→ 28)
3 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)
4 Analog display device: Observe maximum load (→ 28)
5 Cable screen; observe cable specification (→ 31)
6 4-20mA HART (passive): Terminals 1 and 2
7 Overvoltage protection module
8 Terminal for potential equalization line
9 Cable entry

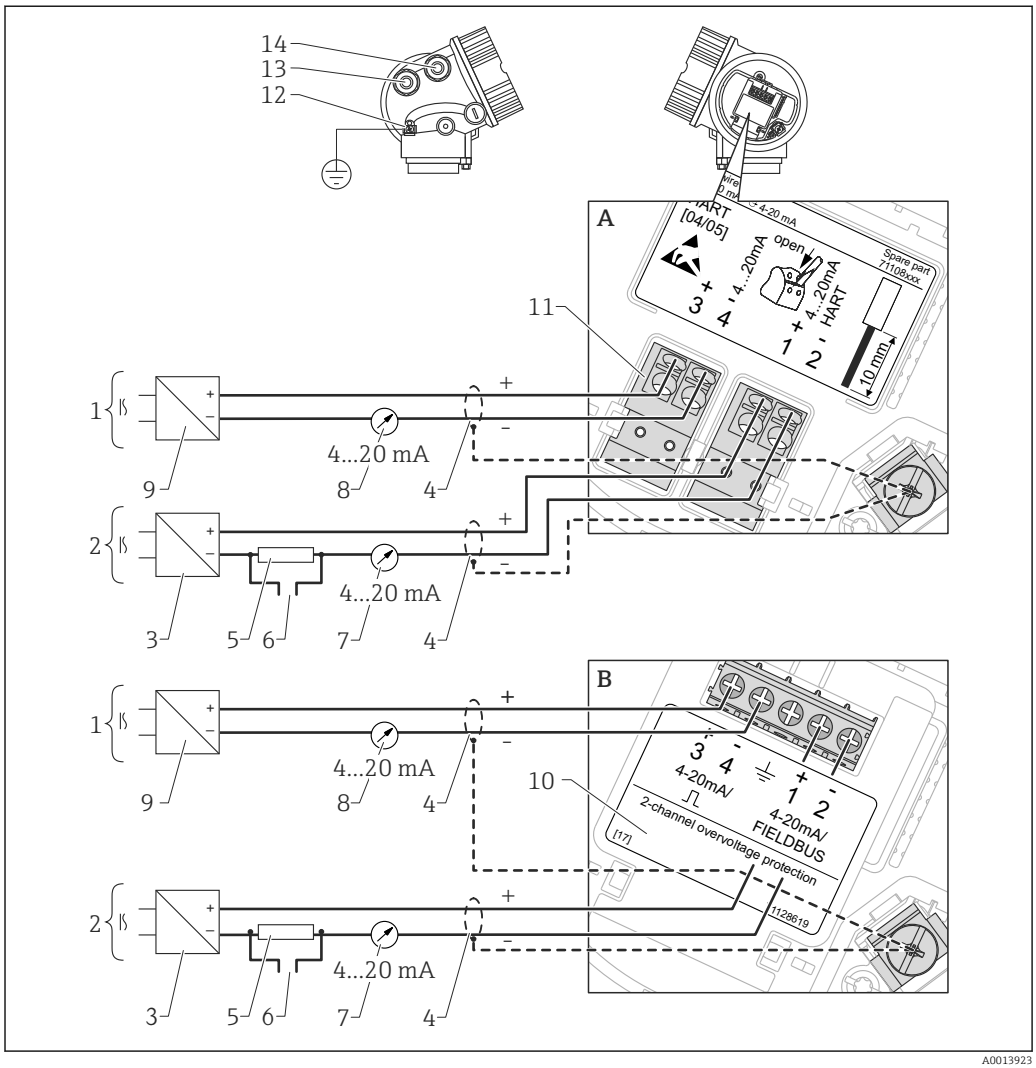
2-wire: 4-20mA HART, switch output



4 *Terminal assignment 2-wire; 4-20mA HART, switch output*

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Active barrier with power supply (e.g. RN221N): Observe terminal voltage (→ 28)
2 HART communication resistor (≥250 Ω): Observe maximum load (→ 28)
3 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)
4 Analog display device: Observe maximum load (→ 28)
5 Cable screen; observe cable specification (→ 31)
6 4-20mA HART (passive): Terminals 1 and 2
7 Switch output (open collector): Terminals 3 and 4
8 Terminal for potential equalization line
9 Cable entry for 4-20mA HART line
10 Cable entry for switch output line
11 Overvoltage protection module

2-wire: 4-20mA HART, 4-20mA

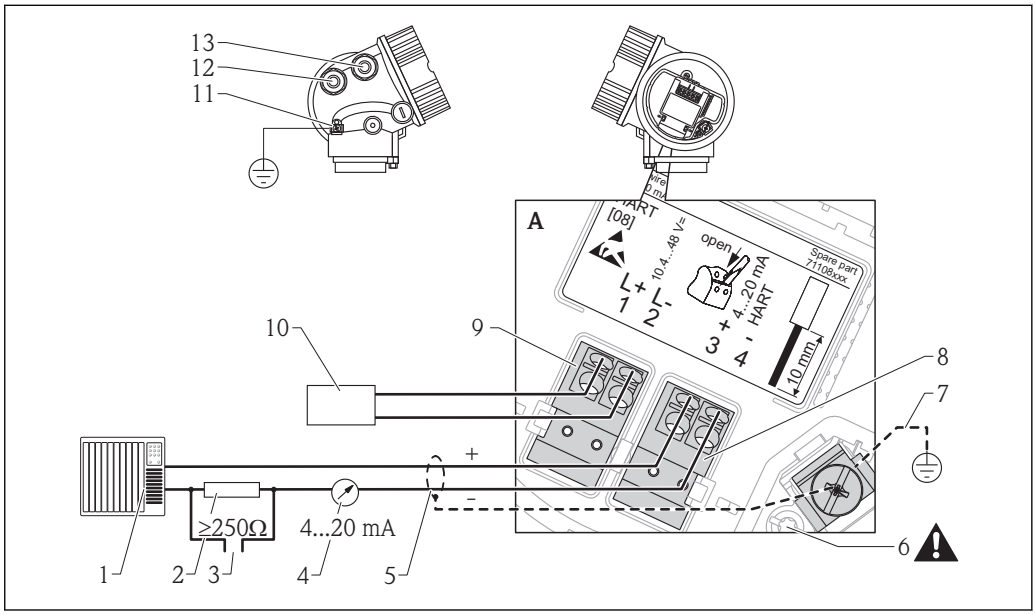


5 Terminal assignment 2-wire, 4-20 mA HART, 4...20mA

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Connection current output 2
2 Connection current output 1
3 Supply voltage for current output 1 (e.g. RN221N); Observe terminal voltage (→ 28)
4 Cable screen; observe cable specification (→ 31)
5 HART communication resistor (≥ 250 Ω): Observe maximum load (→ 28)
6 Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)
7 Analog display device ; observe maximum load (→ 28)
8 Analog display device ; observe maximum load (→ 28)
9 Supply voltage for current output 2 (e.g. RN221N); Obesrve terminal voltage (→ 28)
10 Overvoltage protection module
11 Current output 2: Terminals 3 and 4
12 Terminal for the potential equalization line
13 Cable entry for current output 1
14 Cable entry for current output 2

This version is also suited for single-channel operation. In this case, current output 1 (terminals 1 and 2) must be used.

4-wire: 4-20mA HART (10.4 to 48 V_{DC})



6 *Terminal assignment 4-wire; 4-20mA HART (10.4 to 48 VDC)*

1 *Evaluation unit, e.g. PLC*
2 *HART communication resistor (≥250 Ω): Observe maximum load (→ 30)*
3 *Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)*
4 *Analog display device: Observe maximum load (→ 30)*
5 *Signal cable including screening (if required), observe cable specification (→ 31)*
6 *Protective connection; do not disconnect!*
7 *Protective earth, observe cable specification (→ 31)*
8 *4...20mA HART (active): Terminals 3 and 4*
9 *Supply voltage: Terminals 1 and 2*
10 *Supply voltage: Observe terminal voltage (→ 30), observe cable specification (→ 31)*
11 *Terminal for potential equalization*
12 *Cable entry for signal line*
13 *Cable entry for power supply*

⚠ CAUTION

To ensure electrical safety:

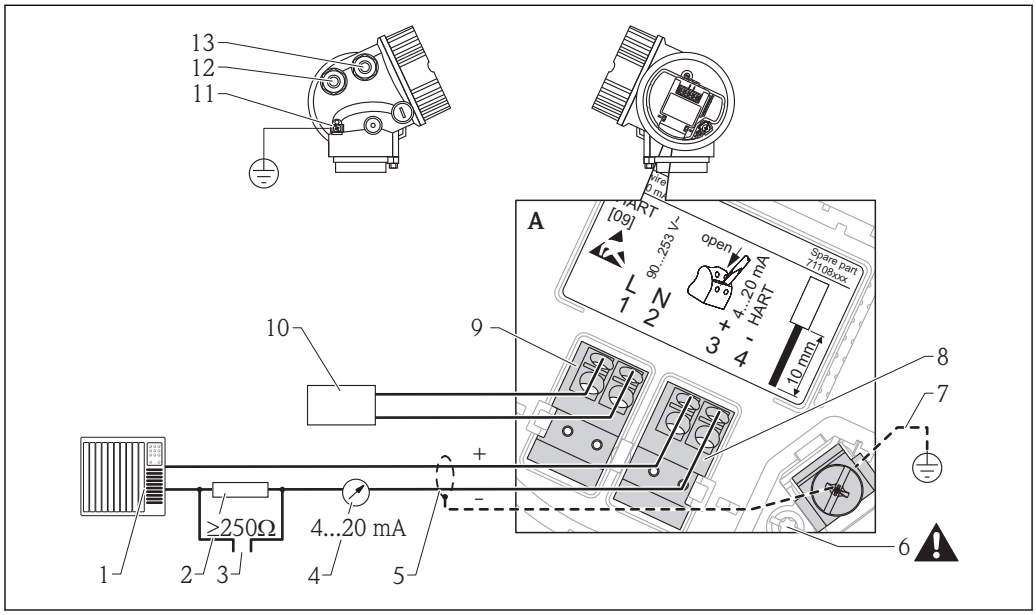
- Do not disconnect the protective connection (7).
- Disconnect the supply voltage before disconnecting the protective earth (8).

Connect protective earth to the internal ground terminal (8) before connecting the supply voltage. If necessary, connect the potential matching line to the external ground terminal (12).

In order to ensure electromagnetic compatibility (EMC): Do not only ground the device via the protective earth conductor of the supply cable. Instead, the functional grounding must also be connected to the process connection (flange or threaded connection) or to the external ground terminal.

An easily accessible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN61010).

4-wire: 4-20mA HART (90 to 253 V_{AC})



7 *Terminal assignment 4-wire; 4-20mA HART (90 to 253 VAC)*

1 *Evaluation unit, e.g. PLC*
2 *HART communication resistor (≥250 Ω): Observe maximum load (→ 30)*
3 *Connection for Commubox FXA195 or FieldXpert SFX100 (via VIATOR Bluetooth modem)*
4 *Analog display device: Observe maximum load (→ 30)*
5 *Signal cable including screening (if required), observe cable specification (→ 31)*
6 *Protective connection; do not disconnect!*
7 *Protective earth, observe cable specification (→ 31)*
8 *4...20mA HART (active): Terminals 3 and 4*
9 *Supply voltage: Terminals 1 and 2*
10 *Supply voltage: Observe terminal voltage (→ 30), observe cable specification (→ 31)*
11 *Terminal for potential equalization*
12 *Cable entry for signal line*
13 *Cable entry for power supply*

⚠ CAUTION

To ensure electrical safety:

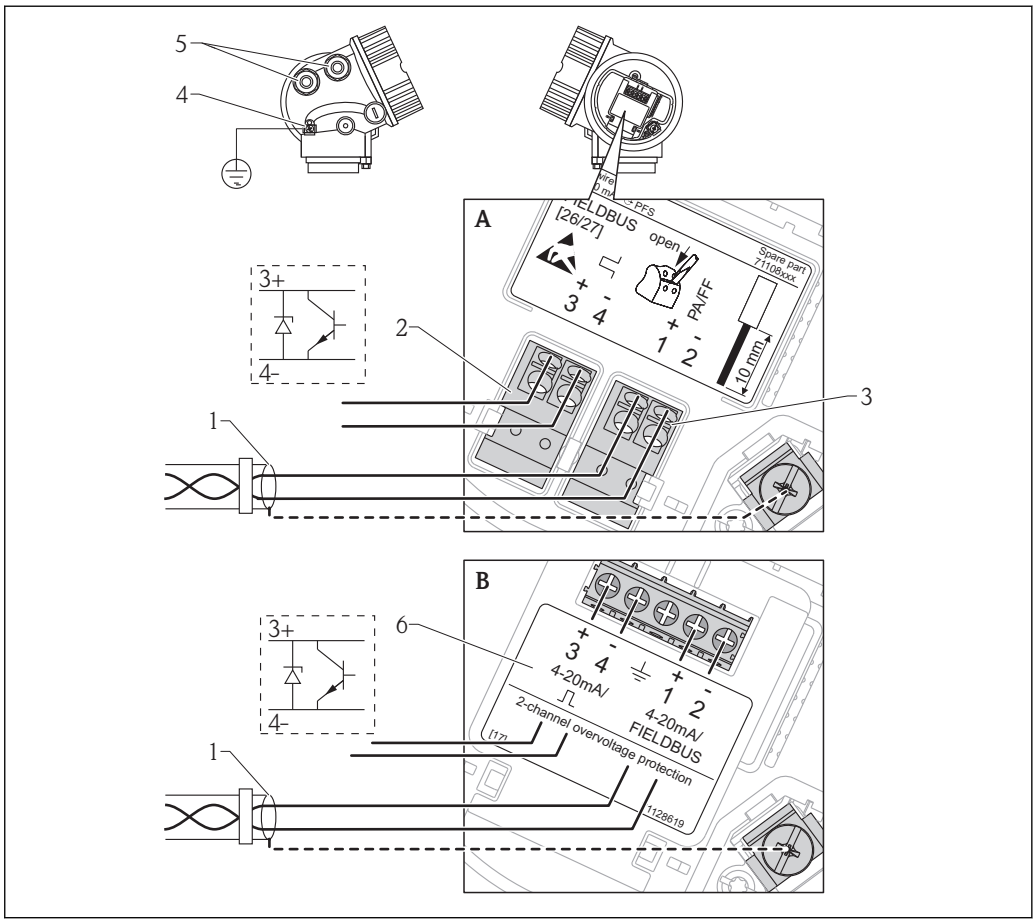
- ▶ Do not disconnect the protective connection (7).
- ▶ Disconnect the supply voltage before disconnecting the protective earth (8).

Connect protective earth to the internal ground terminal (8) before connecting the supply voltage. If necessary, connect the potential matching line to the external ground terminal (12).

In order to ensure electromagnetic compatibility (EMC): Do not only ground the device via the protective earth conductor of the supply cable. Instead, the functional grounding must also be connected to the process connection (flange or threaded connection) or to the external ground terminal.

An easily accessible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN61010).

PROFIBUS PA / FOUNDATION Fieldbus



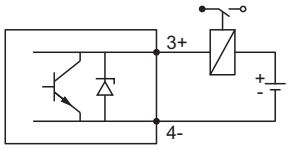
8 Terminal assignment PROFIBUS PA / FOUNDATION Fieldbus

A Without integrated overvoltage protection
B With integrated overvoltage protection
1 Cable screen: Observe cable specifications
2 Switch output (open collector): Terminals 3 and 4
3 PROFIBUS PA / FOUNDATION Fieldbus: Terminals 1 and 2
4 Terminal for potential equalization line
5 Cable entries
6 Overvoltage protection module

Connection examples for the switch output

For HART devices, the switch output is available as an option. See product structure, feature 20: "Power Supply, Output", option B: "2-wire; 4-20mA HART, switch output"

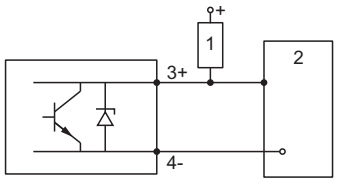
Devices with PROFIBUS PA and FOUNDATION Fieldbus always have a switch output.



A0015909

9 Connection of a relay

Suitable relays (examples):
- Solid-state relay: Phoenix Contact OV-24DC/480AC/5 with mounting rail connector UMK-1 OM-R/AMS
- Electromechanical relay: Phoenix Contact PLC-RSC-12DC/21



A0015910

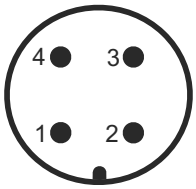
10 Connection of a digital input

1 Pull-up resistor
2 Digital input

Device plug connectors

For the versions with fieldbus plug connector (M12 or 7/8"), the signal line can be connected without opening the housing.

Pin assignment of the M12 plug connector



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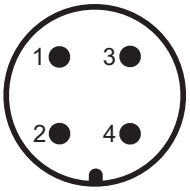
Pin	Meaning
1	Signal +
2	not connected
3	Signal -
4	Ground

Pin assignment of the 7/8" plug connector



A0011176

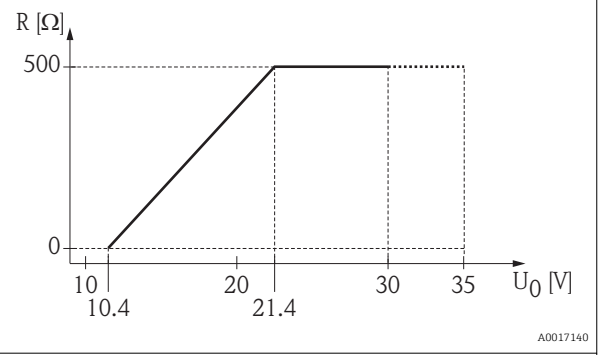
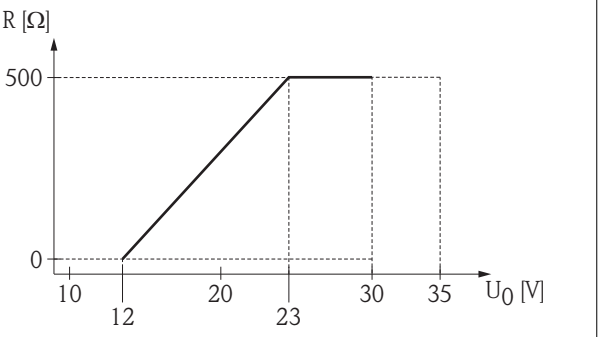
Pin	Meaning
1	Signal -
2	Signal +
3	Screen
4	Not connected

Supply voltage

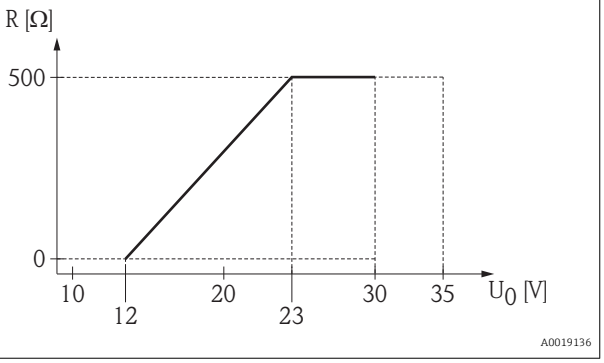
An external power supply is required.

Various supply units can be ordered from Endress+Hauser: see "Accessories" section (→ 92)

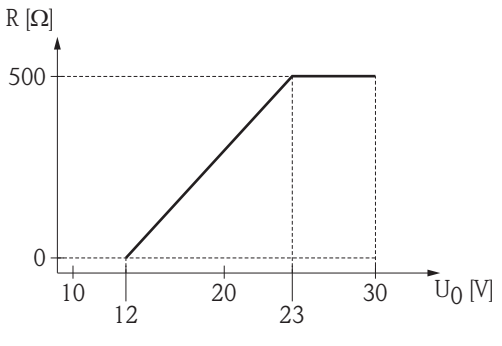
2-wire, 4-20mA HART, passive

"Power Supply, Output" [1]	"Approval" [2]	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U_0 at the supply unit
A: 2-wire; 4-20mA HART	▪ Non-Ex ▪ Ex nA ▪ Ex ic ▪ CSA GP	10.4 to 35 V [3]	
	Ex ia / IS	10.4 to 30 V [3]	
	▪ Ex d(ia) / XP ▪ Ex ic(ia) ▪ Ex nA(ia) ▪ Ex ta / DIP	12 to 35 V [4]	
	Ex ia + Ex d(ia) / IS + XP	12 to 30 V [4]	

1) Feature 020 of the product structure
2) Feature 010 of the product structure
3) For ambient temperatures $T_a \leq$ -20 °C (-4 °F) a minimum voltage of 15 V is required for the sartup of the device at the MIN error current (3,6 mA). The startup current can be parametrized. If the device is operated with a fixed current I ≥ 5,5 mA (HART multidrop mode), a voltage of U ≥ 10,4 V is sufficient throughout the entire range of ambient temperatures.
4) For ambient temperatures $T_a \leq$ -20 °C (-4 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

"Power Supply, Output" [1]	"Approval" [2]	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U_0 at the supply unit
B: 2-wire; 4-20 mA HART, switch output	▪ Non-Ex ▪ Ex nA ▪ Ex nA(ia) ▪ Ex ic ▪ Ex ic(ia) ▪ Ex d(ia) / XP ▪ Ex ta / DIP ▪ CSA GP	12 to 35 V [3]	
	▪ Ex ia / IS ▪ Ex ia + Ex d(ia) / IS + XP	12 to 30 V [3]	

1) Feature 020 of the product structure
2) Feature 010 of the product structure
3) For ambient temperatures $T_a \leq$ -30 °C (-22 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

"Power Supply, Output" [1]	"Approval" [2]	Terminal voltage U at the device	Maximum load R, depending on the supply voltage U_0 at the supply unit
C: 2-wire; 4-20mA HART, 4-20mA	any	12 to 30 V [3]	

1) Feature 020 of the product structure
2) Feature 010 of the product structure
3) For ambient temperatures $T_a \leq$ -30 °C (-22 °F) a minimum voltage of 16 V is required for the startup of the device at the MIN error current (3.6 mA).

Polarity reversal protection	Yes
Admissible residual ripple at f = 0 to 100 Hz	U_{SS} < 1 V
Admissible residual ripple at f = 100 to 10000 Hz	U_{SS} < 10 mV

4-wire, 4-20mA HART, active

"Power supply; Output" [1]	Terminal voltage	Maximum load R_{max}
K: 4-wire 90-253VAC; 4-20mA HART	90 to 253 V_{AC} (50 to 60 Hz), overvoltage category II	500 Ω
L: 4-wire 10,4-48VDC; 4-20mA HART	10.4 to 48 V_{DC}	

1) Feature 020 of the product structure

PROFIBUS PA, FOUNDATION Fieldbus

"Power supply; Output" [1]	"Approval" [2]	Terminal voltage
E: 2-wire; FOUNDATION Fieldbus, switch output **G:** 2-wire; PROFIBUS PA, switch output	▪ Non-Ex ▪ Ex nA ▪ Ex nA(ia) ▪ Ex ic ▪ Ex ic(ia) ▪ Ex d(ia) / XP ▪ Ex ta / DIP ▪ CSA GP	9 to 32 V [3]
	▪ Ex ia / IS ▪ Ex ia + Ex d(ia) / IS + XP	9 to 30 V [3]

1) Feature 020 of the product structure
2) Feature 010 of the product structure
3) Input voltages up to 35 V will not spoil the device.

Polarity sensitive	No
FISCO/FNICO compliant according to IEC 60079-27	Yes

Power consumption

"Power supply; Output" [1]	Power consumption
A: 2-wire; 4-20mA HART	< 0.9 W
B: 2-wire; 4-20mA HART, switch output	< 0.9 W
C: 2-wire; 4-20mA HART, 4-20mA	< 2 x 0.7 W
K: 4-wire 90-253VAC; 4-20mA HART	6 VA
L: 4-wire 10,4-48VDC; 4-20mA HART	1.3 W

1) Feature 020 of the product structure

Current consumption

HART

Nominal current	3.6 to 22 mA, the start-up current for multidrop mode can be parametrized (is set to 3.6 mA on delivery)
Breakdown signal (NAMUR NE43)	adjustable: 3.59 to 22.5 mA

PROFIBUS PA

Nominal current	14 mA
Error current FDE (Fault Disconnection Electronic)	0 mA

FOUNDATION Fieldbus

Device basic current	15 mA
Error current FDE (Fault Disconnection Electronic)	0 mA

FISCO

U_i	17.5 V
I_i	550 mA
P_i	5.5 W
C_i	5 nF
L_i	10 µH

Power supply failure

- Configuration is retained in the HistoROM (EEPROM).
- Error messages (incl. value of operated hours counter) are stored.

Potential equalization

No special measures for potential equalization are required.

If the device is designed for hazardous areas, observe the information in the documentation "Safety Instructions" (XA, ZD).

Terminals

- **Without integrated overvoltage protection**
  Plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- **With integrated overvoltage protection**
  Screw terminals for wire cross-sections 0.2 to 2.5 mm² (24 to 14 AWG)

Cable entries

- Cable gland (not for Ex d):
  - Plastics M20x1.5 for cable Φ5 to 10 mm (0.2 to 0.39 in): non-Ex, ATEX/IECEx/NEPSI Ex ia/ic
  - Metal M20x1.5 for cable Φ7 to 10 mm (0.28 to 0.39 in): dust-Ex, FM IS, CSA IS, CSA GP, Ex nA
- Thread for cable entry:
  - ½" NPT
  - G ½"
  - M20 × 1.5
- Connector (only for non-Ex, Ex ic, Ex ia): M12 or 7/8"

Cable specification

- Minimum cross-section: (→ 31)
- For ambient temperature $T_U \geq 60$ °C (140 °F): use cable for temperature T_U +20 K.

HART

- A normal device cable suffices if only the analog signal is used.
- A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant.
- For 4-wire devices: Standard device cable is sufficient for the power line.

PROFIBUS

Use a twisted, screened two-wire cable, preferably cable type A.

For further information on the cable specifications, see Operating Instructions BA00034S "Guidelines for planning and commissioning PROFIBUS DP/PA", PNO Guideline 2.092 "PROFIBUS PA User and Installation Guideline" and IEC61158-2 (MBP).

FOUNDATION Fieldbus

Endress+Hauser recommends using twisted, shielded two-wire cables.

For further information on the cable specifications, see Operating Instructions BA00013S "FOUNDATION Fieldbus Overview", FOUNDATION Fieldbus Guideline and IEC 61158-2 (MBP).

Overvoltage protection

If the measuring device is used for level measurement in flammable liquids which requires the use of overvoltage protection according to DIN EN 60079-14, standard for test procedures 60060-1 (10 kA, pulse 8/20 µs), overvoltage protection has to be ensured by an integrated or external overvoltage protection module.

Integrated overvoltage protection

An integrated overvoltage protection module is available for 2-wire HART as well as PROFIBUS PA and FOUNDATION Fieldbus devices.

Product structure: Feature 610 "Accessory mounted", option NA "Overvoltage protection".

Technical data	
Resistance per channel	2 * 0.5 Ω max
Threshold DC voltage	400 to 700 V
Threshold impulse voltage	< 800 V
Capacitance at 1 MHz	< 1.5 pF
Nominal arrest impulse voltage ($^{8}/_{20}$ µs)	10 kA

External overvoltage protection

HAW562 or HAW569 from Endress+Hauser are suited as external overvoltage protection.

For detailed information please refer to the following documents:
- HAW562: TI01012K
- HAW569: TI01013K

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 a minimum diameter of 1 m (40 in)
- No major interference reflections inside the signal beam

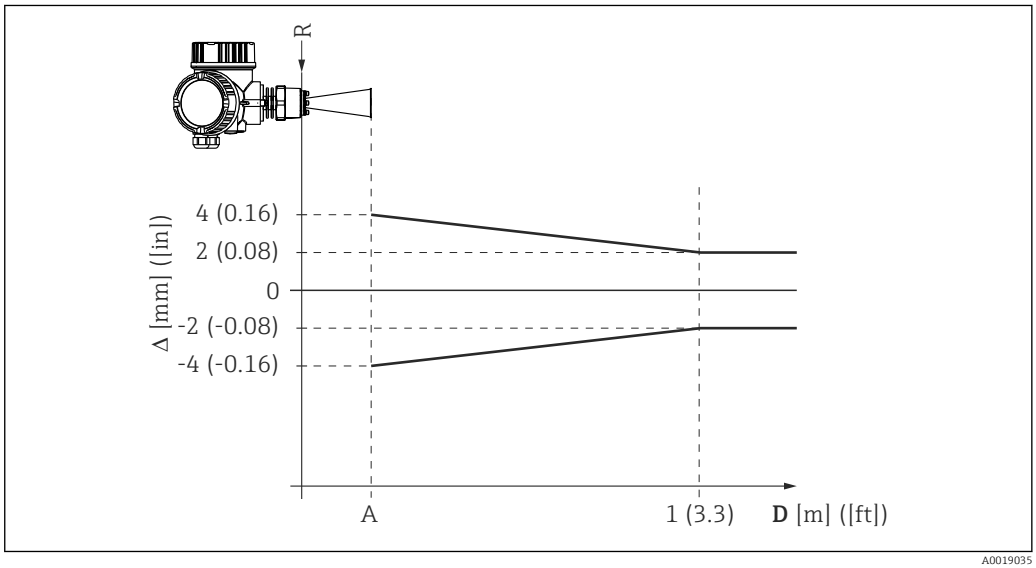
Maximum measured error

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

Device	Value	Output	
		digital	analog [1]
FMR51/FMR52 Standard version	Sum of non-linearity, nonrepeatability and hysteresis	±2 mm (0.08 in)	±0.02 %
	Offset/Zero	±4 mm (0.2 in)	±0.03 %
FMR51/FMR52 Version with application package "Advanced dynamics" [2]	Sum of non-linearity, nonrepeatability and hysteresis	±3 mm (0.12 in)	±0.02 %
	Offset/Zero	±4 mm (0.2 in)	±0.03 %

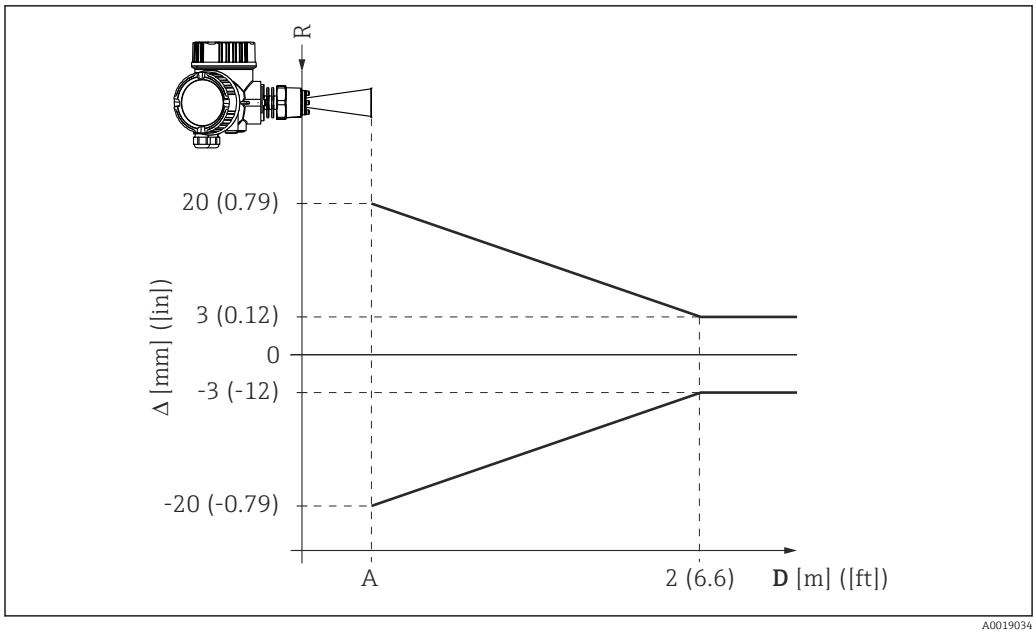
1) Only relevant for 4-20mA current output; add error of the analog value to the digital value.
2) Product structure: Feature 540 "Application Package", Option EM "Advanced dynamics"

Differing values in near-range applications



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

Δ Maximum measured error
A Lower edge of the antenna
D Distance from the lower edge A of the antenna
R Reference point of the distance measurement



12 *Maximum measured error in near-range applications; values for version with the "Advanced dynamics" application package*

Δ Maximum measured error
A Lower edge of the antenna
D Distance from the lower edge A of the antenna
R Reference point of the distance measurement

Measured value resolution

Dead band according to EN61298-2:

- digital: 1 mm
- analog: 1 µA

Reaction time

The reaction time can be parametrized. The following step response times (as per DIN EN 61298-2) [1] are valid if the damping is switched off:

Tank height	Sampling rate	Step response time
<10 m (33 ft)	≥3.6 s^{-1}	< 0.8 s
<70 m (230 ft)	≥2.2 s^{-1}	< 1 s

Influence of ambient temperature

The measurements are carried out in accordance with EN 61298-3

- Digital (HART, PROFIBUS PA, FOUNDATION Fieldbus):
  - Standard version: average T_K = 2 mm/10 K; maximum 5 mm
  - Version with advanced dynamics [2]: average T_K = 5 mm/10 K; maximum 15 mm
- Analog (current output):
  - zero point (4 mA): average T_K = 0.02 %/10 K
  - span (20 mA): average T_K = 0.05 %/10 K

Influence of gas layer

High pressures reduce the propagation velocity of the measuring signals in the gas/vapor above the fluid. This effect depends on the kind of gas/vapor and of its temperature. This results in a systematic measuring error that gets bigger as the distance increases between the reference point of the measurement (flange) and the product surface. The following table illustrates this measured

1) According to DIN EN 61298-2 the response time is the time which passes after a sudden change of the input signal until the output signal for the first time assumes 90% of the steady-state value.
2) Feature 540 "Application Package", option EM

error for a few typical gases/vapors (with regard to distance; a positive value means that too large a distance is being measured):

Gas layer	Temperature		Pressure				
	°C	°F	1 bar (14,5 psi)	10 bar (145 psi)	50 bar (725 psi)	100 bar (1450 psi)	160 bar (2320 psi)
Air/ Nitrogen	20	68	0.00 %	0.22 %	1.2 %	2.4 %	3.89 %
	200	392	–0.01 %	0.13 %	0.74 %	1.5 %	2.42 %
	400	752	–0.02 %	0.08 %	0.52 %	1.1 %	1.70 %
Hydrogen	20	68	–0.01 %	0.10 %	0.61 %	1.2 %	2.00 %
	200	392	–0.02 %	0.05 %	0.37 %	0.76 %	1.23 %
	400	752	–0.02 %	0.03 %	0.25 %	0.53 %	0.86 %
Water (saturated steam)	100	212	0.02 %	-	-	-	-
	180	356	-	2.1 %	-	-	-
	263	505,4	-	-	8.6 %	-	-
	310	590	-	-	-	22 %	-
	364	687	-	-	-	-	41.8 %

When the pressure is known and constant, this measured error can, for example, be compensated by means of a linearization.

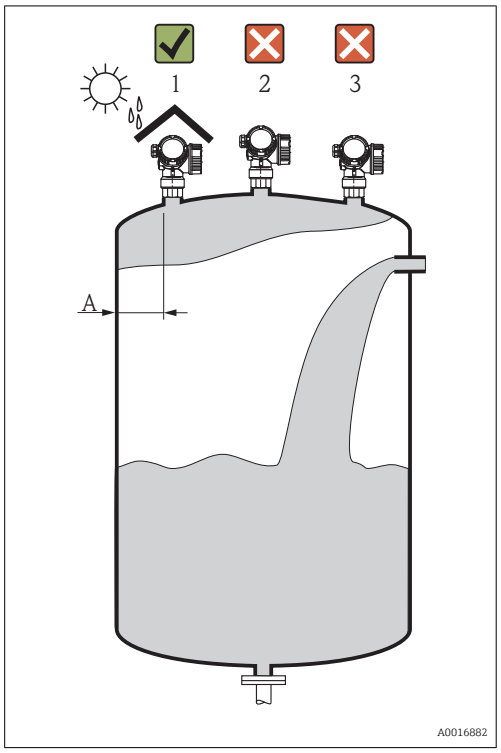
Gas phase compensation with external pressure sensor (PROFIBUS PA, FOUNDATION Fieldbus)

PROFIBUS devices can receive the signal of an external pressure sensor through the bus and use it to perform a pressure dependent time-of-flight correction. In the case of saturated steam in the temperature range from 100 to 350 °C (212 to 662 °f), for example, the measuring error of the distance measurement can be reduced by this method from up to 29 % (without compensation) to less than 3 % (with compensation).

Installation

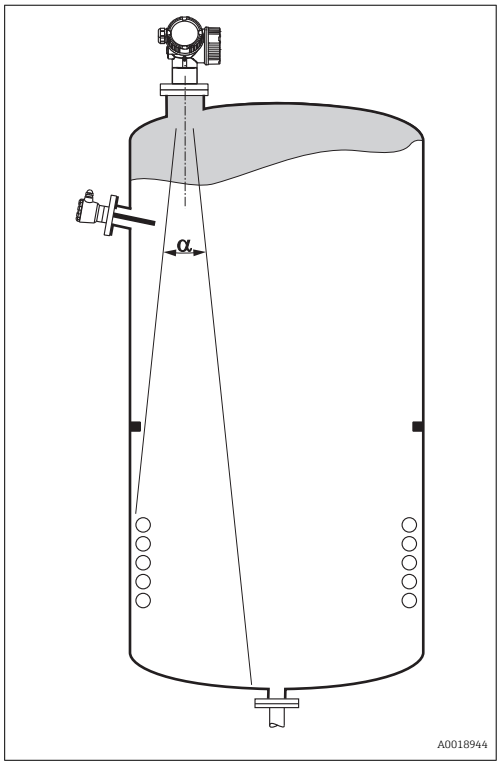
Installation conditions

Mounting position



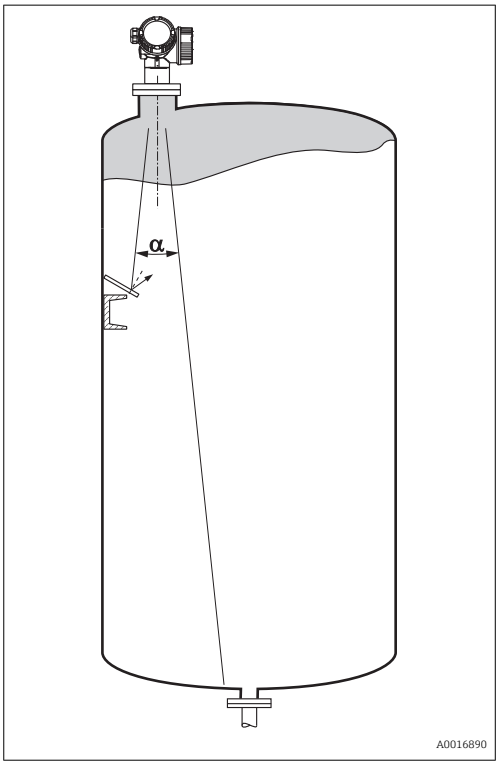
- Recommended distance **A** from wall to outer edge of nozzle: ~ 1/6 of tank diameter. Nevertheless the device should not be installed closer than 15 cm (5.91 in) to the tank wall.
- Not in the center (2), as interference can cause signal loss.
- Not above the fill stream (3).
- It is recommended to us a weather protection cover (1) in order to protect the device from direct sun or rain.

Vessel installations



Avoid any installations (limit switches, temperature sensors, braces, vacuum rings, heating coils, baffles etc.) inside the signal beam. Take into account the beam angle (→ 🖹 39).

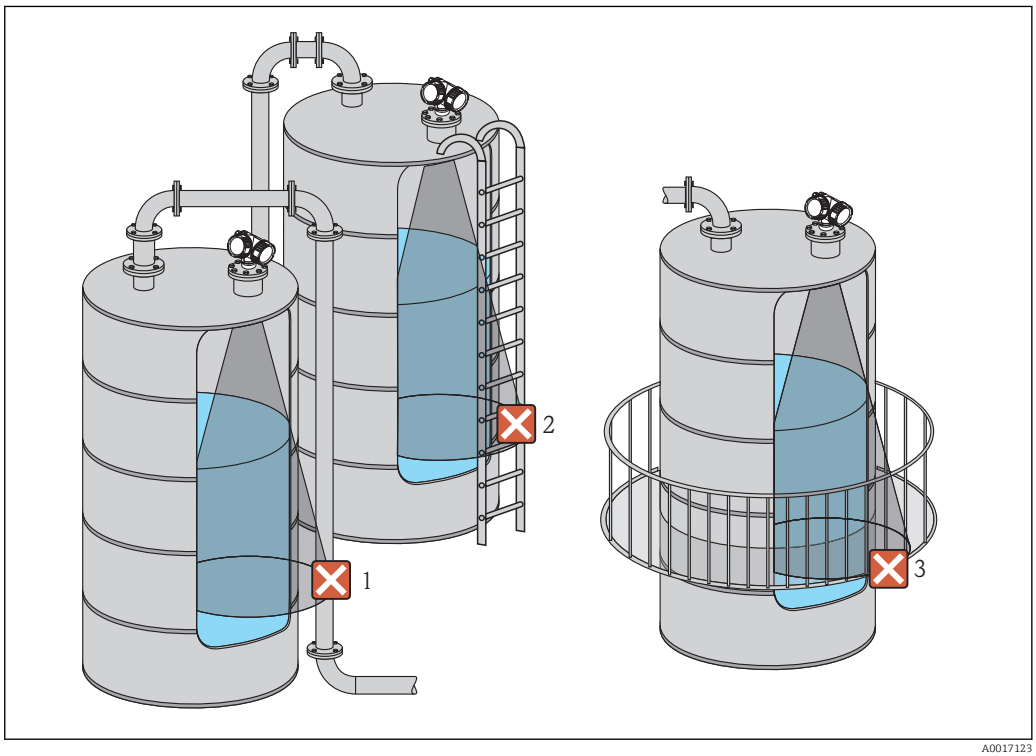
Reduction of interference echoes



Metallic screens mounted at a slope spread the radar signal and can, therefore, reduce interference echoes.

Measurement in a plastic vessel

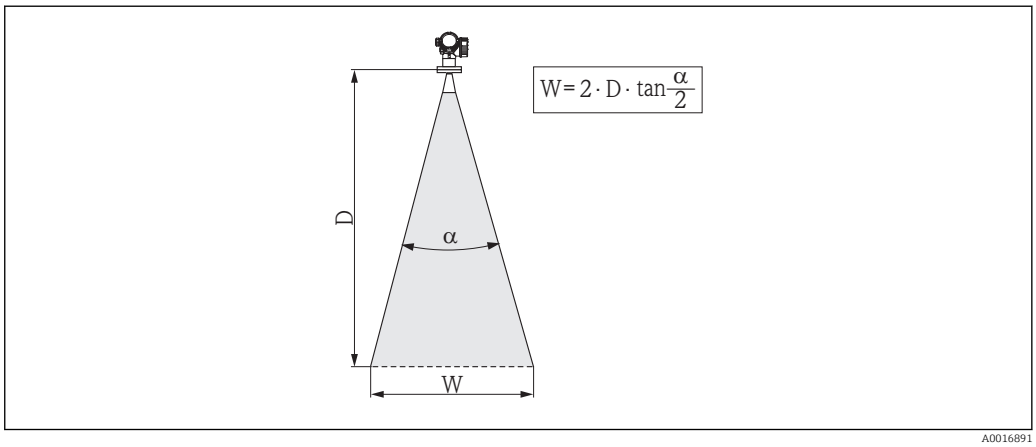
If the outer wall of the vessel is made of a non-conductive material (e.g. GRP), microwaves can also be reflected off interfering installations outside the signal beam (e.g. metallic pipes (1), ladders (2), grates (3), ...). Therefore, there should be no such interfering installations in the signal beam. Please contact Endress+Hauser for further information.



Optimization options

- Antenna size
  The bigger the antenna, the smaller the beam angle α and the fewer interference echoes (→ 🖹 39).
- Mapping
  The measurement can be optimized by means of electronic suppression of interference echoes.
- Antenna alignment
  Take into account the marker on the flange or threaded connection (→ 🖹 43)(→ 🖹 45) .
- Stilling well
  A stilling well can be applied to avoid interferences (→ 🖹 47).
- Metallic screens mounted at a slope
  They spread the radar signals and can, therefore, reduce interference echoes.

Beam angle



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

The beam angle is defined as the angle α where the energy density of the radar waves reaches half the value of the maximum energy 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 **α** and measuring distance **D**:

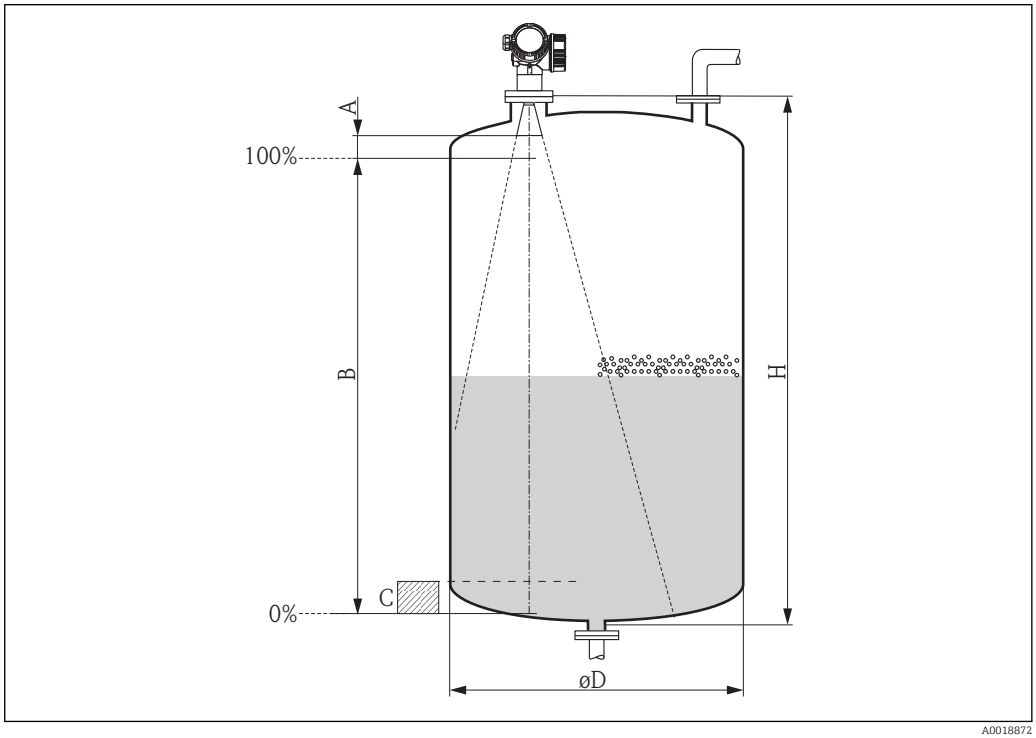
FMR51				
Antenna size	40 mm (1½ in)	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
Beam angle α	23°	18°	10°	8°
Measuring distance (D)	**Beamwidth diameter W**			
3 m (9.8 ft)	1.22 m (4 ft)	0.95 m (3.1 ft)	0.53 m (1.7 ft)	0.42 m (1.4 ft)
6 m (20 ft)	2.44 m (8 ft)	1.9 m (6.2 ft)	1.05 m (3.4 ft)	0.84 m (2.8 ft)
9 m (30 ft)	3.66 m (12 ft)	2.85 m (9.4 ft)	1.58 m (5.2 ft)	1.26 m (4.1 ft)
12 m (39 ft)	4.88 m (16 ft)	3.80 m (12 ft)	2.1 m (6.9 ft)	1.68 m (5.5 ft)
15 m (49 ft)	6.1 m (20 ft)	4.75 m (16 ft)	2.63 m (8.6 ft)	2.10 m (6.9 ft)
20 m (66 ft)	8.14 m (27 ft)	6.34 m (21 ft)	3.50 m (11 ft)	2.80 m (9.2 ft)
25 m (82 ft)	10.17 m (33 ft)	7.92 m (26 ft)	4.37 m (14 ft)	3.50 m (11 ft)
30 m (98 ft)	-	9.50 m (31 ft)	5.25 m (17 ft)	4.20 m (14 ft)
35 m (115 ft)	-	11.09 m (36 ft)	6.12 m (20 ft)	4.89 m (16 ft)
40 m (131 ft)	-	12.67 m (42 ft)	7.00 m (23 ft)	5.59 m (18 ft)
45 m (148 ft)	-	-	7.87 m (26 ft)	6.29 m (21 ft)
60 m (197 ft)	-	-	10.50 m (34 ft)	8.39 m (28 ft)
70 m (230 ft)	-	-	-	9.79 m (32 ft)

FMR52		
Antenna size	50 mm (2 in)	80 mm (3 in)
Beam angle α	18°	10°
Measuring distance (D)	**Beamwidth diameter W**	
3 m (9.8 ft)	0.95 m (3.1 ft)	0.53 m (1.7 ft)
6 m (20 ft)	1.9 m (6.2 ft)	1.05 m (3.4 ft)

9 m (30 ft)	2.85 m (9.4 ft)	1.58 m (5.2 ft)
12 m (39 ft)	3.80 m (12 ft)	2.1 m (6.9 ft)
15 m (49 ft)	4.75 m (16 ft)	2.63 m (8.6 ft)
20 m (66 ft)	6.34 m (21 ft)	3.50 m (11 ft)
25 m (82 ft)	7.92 m (26 ft)	4.37 m (14 ft)
30 m (98 ft)	9.50 m (31 ft)	5.25 m (17 ft)
35 m (115 ft)	11.09 m (36 ft)	6.12 m (20 ft)
40 m (131 ft)	12.67 m (42 ft)	7.00 m (23 ft)
45 m (148 ft)	-	7.87 m (26 ft)
60 m (197 ft)	-	10.50 m (34 ft)

Measuring conditions

- In case of **boiling surfaces**, **bubbling** or tendency for **foaming** use FMR53 or FMR54. Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions. For FMR50, FMR51 and FMR52, the additional option "Advanced dynamics" is recommended in these cases (feature 540: "Application Package", option EM).
- In case of heavy **steam development** or **condensate**, the maximum measuring range of FMR50, FMR51 and FMR52 may decrease depending on density, temperature and composition of the steam → use FMR53 or FMR54.
- For the measurement of absorbing gases such as **ammonia NH_3** or some **fluorocarbons** [3], please use Levelflex or Micropilot FMR54 in a stilling well.
- The measuring range begins, where the beam hits the tank bottom. Particularly with dish bottoms or conical outlets the level cannot be detected below this point.
- For stilling well applications, the zero should be positioned at the end of the tube, as the electromagnetic waves do not propagate completely outside the tube. It must be taken into account that the accuracy may be reduced in the area **C**. In order to guarantee the required accuracy in these cases, it is recommended to position the zero-point at a distance **C** above the end of the tube (see figure).
- In case of media with a low dielectric constant (ε_r = 1.5 to 4) [4] the tank bottom can be visible through the medium at low levels (low height **C**). Reduced accuracy has to be expected in this range. If this is not acceptable, we recommend positioning the zero point at a distance **C** (see figure) above the tank bottom in these applications.
- In principle it is possible to measure up to the tip of the antenna with FMR51, FMR53 and FMR54. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than **A** (see figure) to the tip of the antenna.
- When using FMR54 with planar antenna, especially for media with low dielectric constants, the end of the measuring range should not be closer than 1 m (3.28 ft) to the flange.
- The smallest possible measuring range **B** depends on the antenna version (see figure).
- The tank height should be at least **H** (see table).



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3) Affected compounds are e.g. R134a, R227, Dymel 152a.
4) Dielectric constants of important media commonly used in the industry are summarized in the document SD106F, which can be downloaded from the Endress+Hauser web page (www.endress.com).

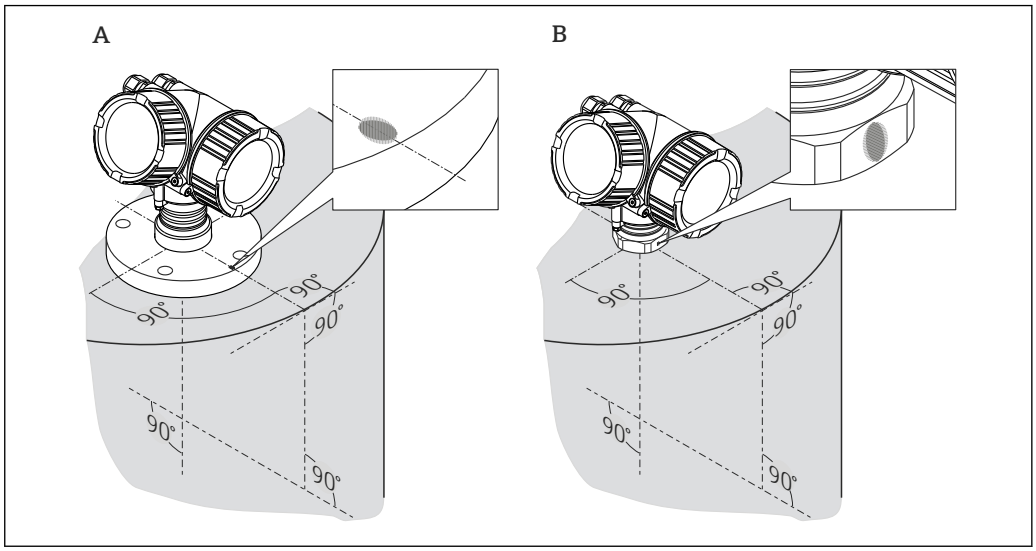
Device	A [mm (in)]	B [m (ft)]	C [mm (in)]	H [m (ft)]
FMR51	50(1.97)	> 0.2 (0.7)	50 to 250 (1.97 to 9.84)	> 0.3 (1.0)
FMR52	200(7.87)			

Installation in vessel (free space)

Horn antenna (FMR51)

Alignment

- Align the antenna vertically to the product surface.
  The maximum range may be reduced if the horn antenna is not vertically aligned.
- A marking at the flange (somewhere between the flange holes) or the boss enables alignment of the antenna. This marking must be aligned towards the tank wall as well as possible.



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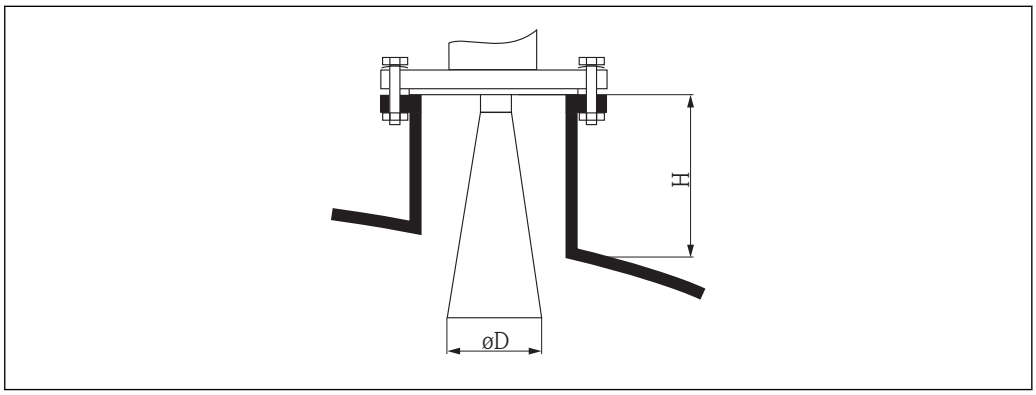
Depending on the device version the marking may be a circle or two short parallel lines.

Nozzle mounting

The horn antenna should extend below the nozzle. Select version with antenna extension up to 500 mm (19.7 in), if necessary [5]. Nozzle heights up to 500 mm (19.7 in) can be accepted if this should not be possible due to mechanical reasons.



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14 *Nozzle height and diameter for horn antenna (FMR51)*

Antenna size	40 mm (1½ in)	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
D	40 mm (1.57 in)	48 mm (1.89 in)	75 mm (2.95 in)	95 mm (3.74 in)
H	< 85 mm (3.35 in)	< 115 mm (4.53 in)	< 210 mm (8.27 in)	< 280 mm (11.0 in)

5) In the product structure: feature 610 "Accessory mounted", options OM, OU, OV.

Please contact Endress+Hauser for applications with higher nozzle.

Threaded connection

- Tighten with the hexagonal nut only.
- Tool : Hexagonal wrench 55 mm
- Maximum permissible torque: 60 Nm (44 lbf ft)

Mesurement from the outside through plastic walls

- If possible, use an antenna 100 mm (4 in).
- The distance from the lower edge of the antenna to the tank ceiling should be about 100 mm (4 in).
- If possible, avoid mounting locations where condensation or build-up might occur.
- In case of outdoor mounting, the space between antenna and vessel has to be protected from the elements.
- Do not mount any potential reflectors (e.g. pipes) outside the tank in the signal beam.

Suitable thickness of the tank ceiling:

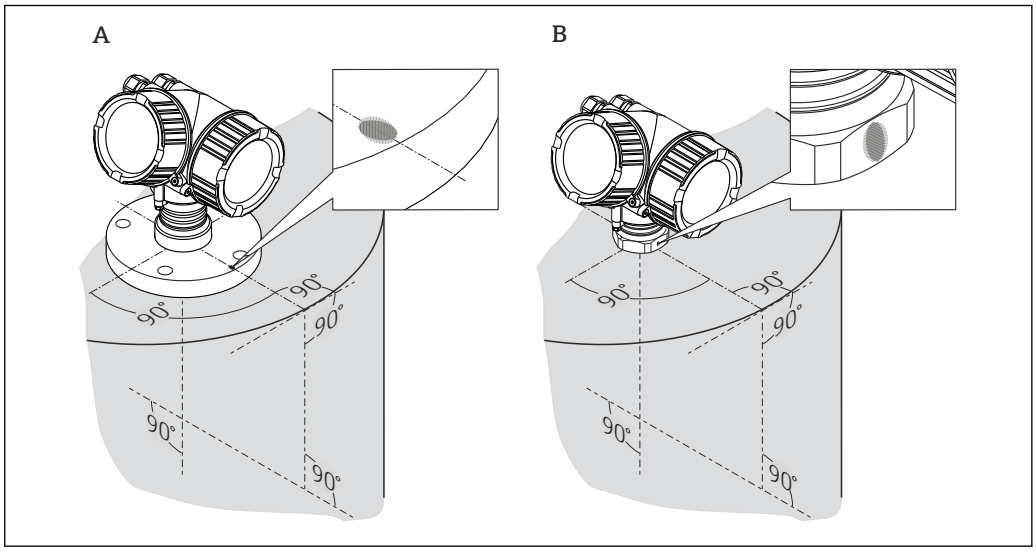
Penetrated material	PE	PTFE	PP	Perspex
DK / ε_r	2.3	2.1	2.3	3.1
Optimum thickness [1)]	3.8 mm (0.15 in)	4.0 mm (0.16 in)	3.8 mm (0.15 in)	3.3 mm (0.13 in)

1) Other possible values for the thickness are multiples of the values listed (e.g. for PE: 7,6 mm (0.3 in), 11,4 mm (0.45 in)

Horn antenna, flush mount (FMR52)

Alignment

- Align the antenna vertically to the product surface.
  The maximum range may be reduced if the horn antenna is not vertically aligned.
- A marking at the flange (somwhere between the flange holes) or the boss enables alignment of the antenna. This marking must be aligned towards the tank wall as well as possible.



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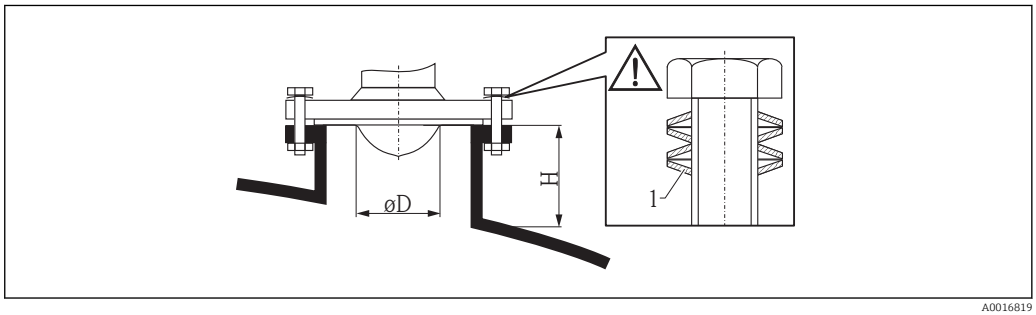
Depending on the device version the marking may be a circle or two short parallel lines.

Nozzle mounting



A0016819

15 *Nozzle height an diameter for horn antenna, flush mount (FMR52)*

1 Spring washers

Antenna size	50 mm (2 in)	80 mm (3 in)
D	44 mm (1.73 in)	75 mm (2.95 in)
H	< 500 mm (19.7 in)	< 500 mm (19.7 in)

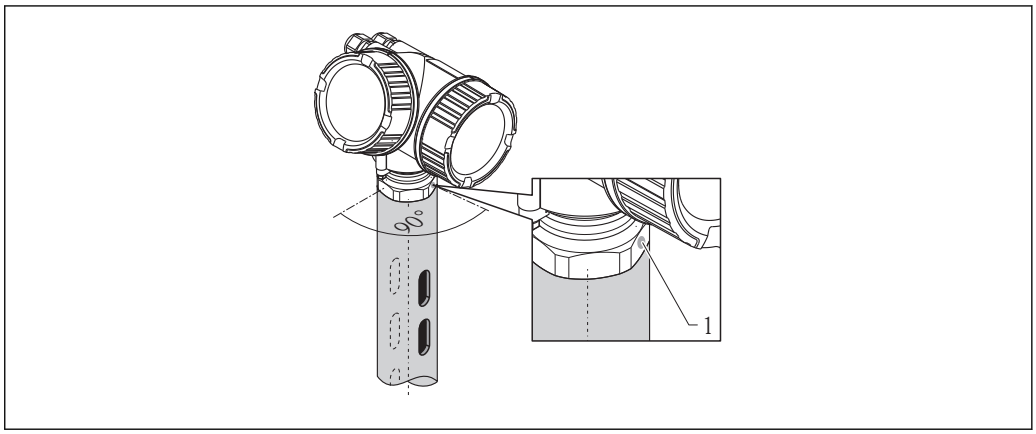
Please contact Endress+Hauser for applications with higher nozzle.

For flanges with PTFE cladding: Use spring washers (see figure) to compensate for the sagging of the cladding.
It is recommended to tighten the the flange bolts periodically, depending on process temperature and pressure.
Recommended torque: 60 to 100 Nm (44.25 to 73.75 lbf ft)

The thickness of the PTFE flange cladding is 4 mm (0.16 in). This corresponds to the maximum adjustment distance of the spring washers.

Usually, the PTFE flange cladding also serves as a seal between the nozzle and the device flange.

Installation in stilling well



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16 Installation in stilling well

1 Marking for antenna alignment

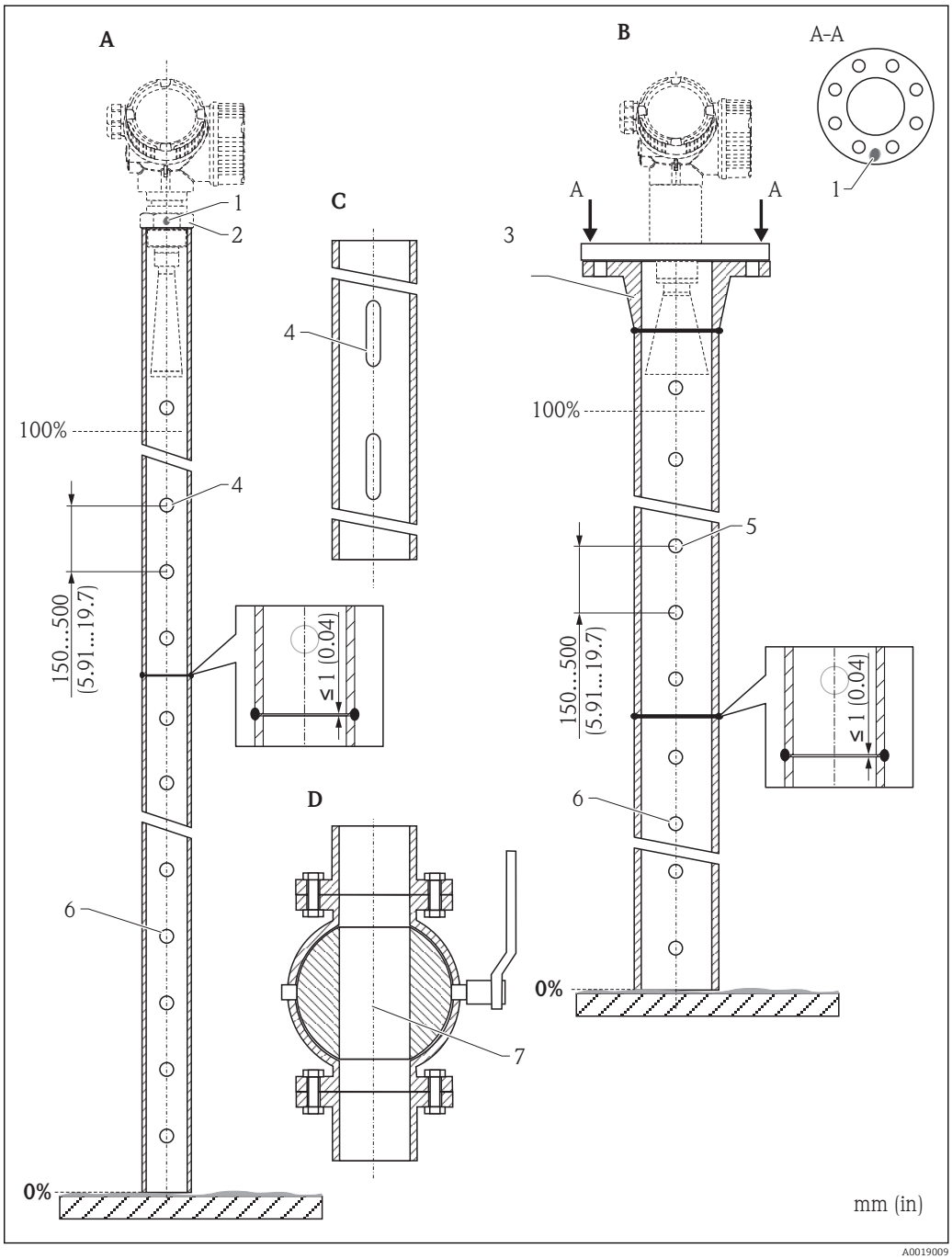
- For horn antenna: Align the marking towards the slots of the stilling well.
- Measurements can be performed through an open full bore ball valve without any problems.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.

Recommendations for the stilling well

- Metal (no enamel coating; plastic on request).
- Constant diameter.
- Diameter of stilling well not larger than antenna diameter.
- Diameter difference between horn antenna and inner diameter of the stilling well as small as possible.
- Weld seam as smooth as possible and on the same axis as the slots.
- Slots offset 180° (not 90°).
- Slot width or diameter of holes max. 1/10 of pipe diameter, de-burred. Length and number do not have any influence on the measurement.
- Select horn antenna as big as possible. For intermedaite sizes (e.g. 180 mm (7 in)) select next larger antenna and adapt it mechanically (for horn antennas)
- At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm (0.04 in).
- The stilling well must be smooth on the inside (average roughness $R_z \leq 6.3$ µm (248 µin)). Use extruded or parallel welded stainless steel pipe. An extension of the pipe is possible with welded flanges or pipe sleeves. Flange and pipe have to be properly aligned at the inside.
- Do not weld through the pipe wall. The inside of the stilling well must remain smooth. In case of unintentional welding through the pipe, the weld seam and any unevenness on the inside need to be carefully removed and smoothened. Otherwise, strong interference echoes will be generated and material build-up will be promoted.
- Particularly on smaller nominal widths it needs to be observed that flanges are welded to the pipe such that they allow for a correct orientation (marker aligned toward slots).

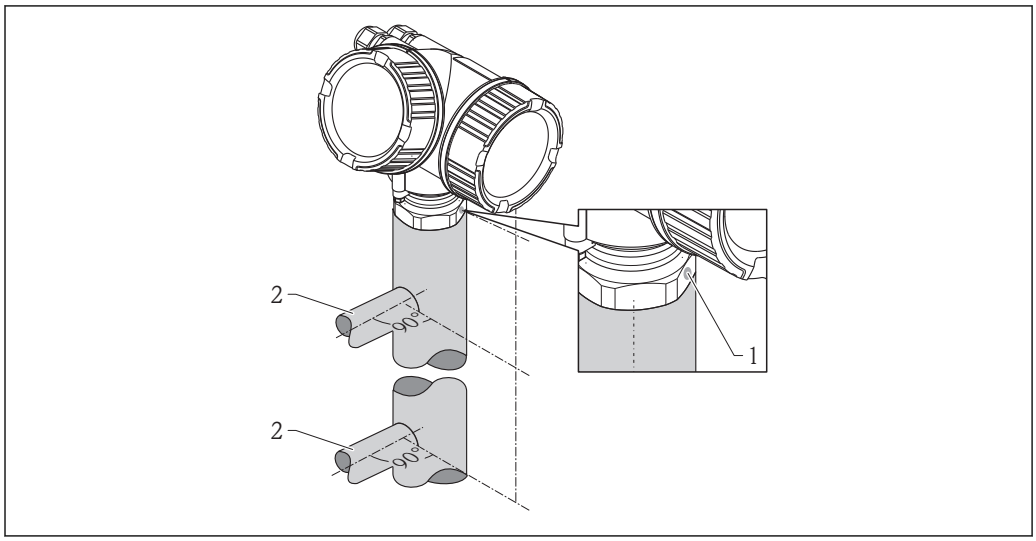
The performance of Micropilot FMR54 with planar antenna is not dependent on the alignment or geometry of standard stilling wells. No special alignment is required. However, make sure that the planar antenna is installed vertically relative to the stilling well axis.

Examples for the construction of stilling wells



A Micropilot FMR50/FMR51: Horn 40mm(1½")
B Micropilot FMR50/FMR51/FMR52/FMR54: Horn 80mm(3")
C Stilling well with slots
D Full bore ball valve
1 Marking for axial alignment
2 Threaded connection
3 e.g. welding neck flange DIN2633
4 Φ hole max. 1/10 Φ stilling well
5 Φ hole max. 1/10 Φ stilling well; single sided or drilled through
6 Inside of holes deburred
7 Diameter of opening of ball valve must always be equivalent to pipe diameter; avoid edges and constrictions.

Installation in bypass



17 Installation in bypass

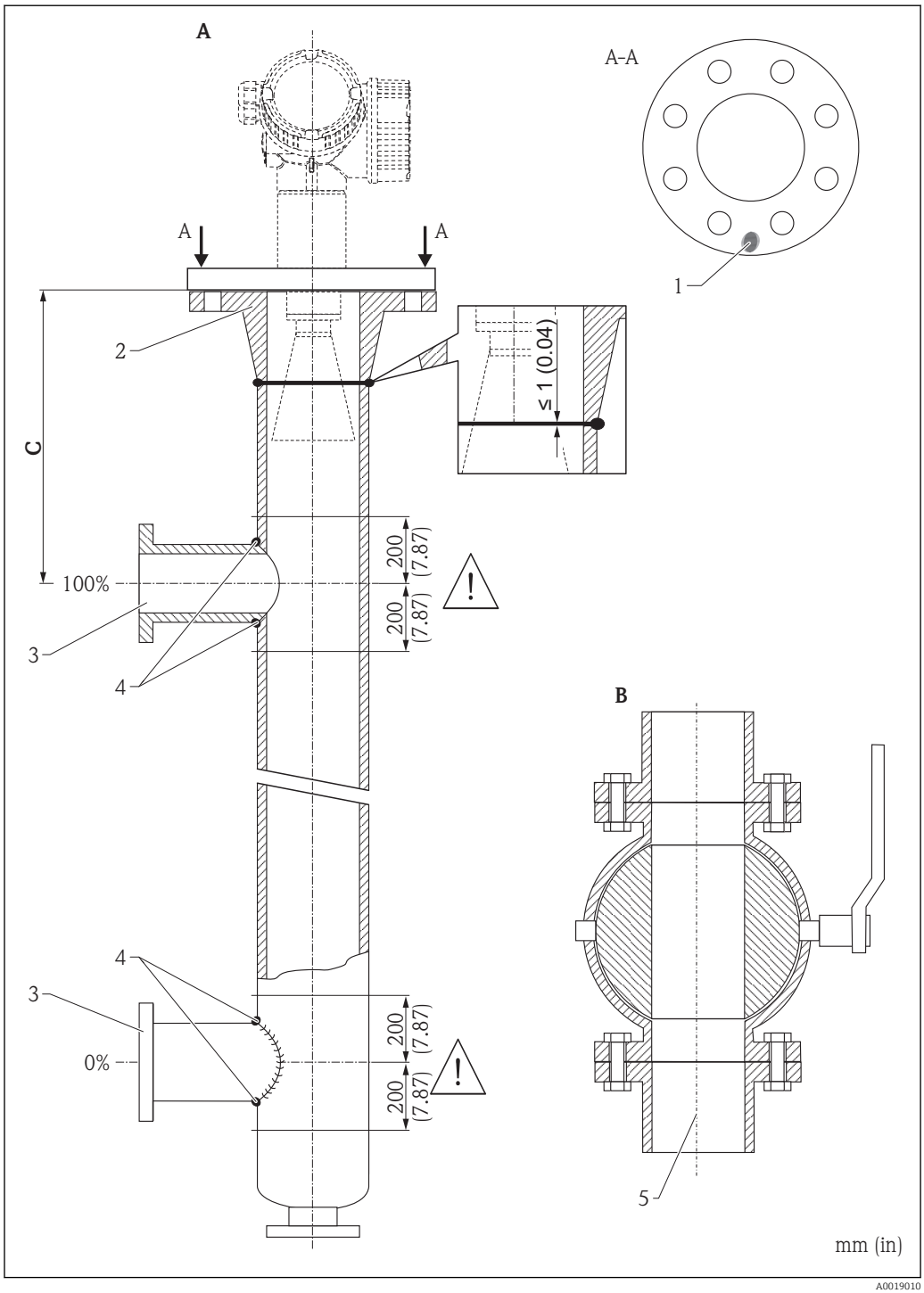
1 Marking for antenna alignment
2 Tank connectors

- Alighn the marker perpendicular (90°) to the tank connectors.
- Measurements can be performed through an open full bore ball valve without any problems.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.

Recommendations for the bypass pipe

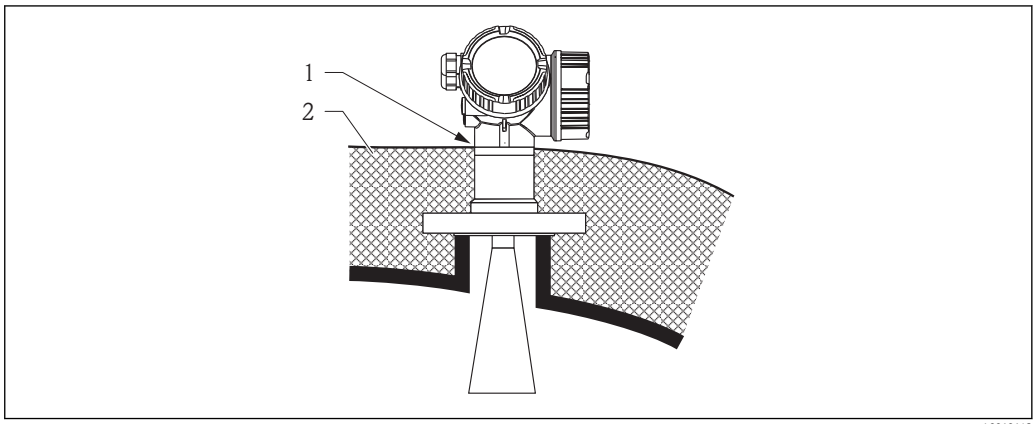
- Metal (no plastic or enamel coating).
- Constant diameter.
- Select horn antenna as big as possible. For intermediate sizes (e.g. 95 mm (3.5 in)) select next larger antenna and adapt it mechanically (for horn antennas).
- Diameter difference between horn antenna and inner diameter of the bypass as small as possible.
- At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm (0.04 in).
- In the area of the tank connections (~±20 cm (7.87 in)) ia reduced accuracy of the measurement has to be expected.

Example for the construction of a bypass



A Micropilot FMR50/FMR51/FMR52/FMR54: Horn 80mm(3")
B Full bore ball valve
C Minimum distance to upper connection pipe: 400 mm (15,7 in)
1 Marking for axial alignment
2 e.g. welding neck flange DIN2633
3 Diameter of the connection pipes as small as possible
4 Do not weld through the pipe wall; the inside of the bypass must remain smooth.
5 Diameter of opening of ball valve must always be equivalent to pipe diameter. Avoid edges and constrictions.

Vessels with heat insulation



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If process temperatures are high, the device must be included in normal tank insulation to prevent the electronics heating up as a result of heat radiation or convection. The insulation may not exceed beyond the neck of the housing.

Environment

Ambient temperature range

Measuring device	−40 to +80 °C (−40 to +176 °F); −50 °C (−58 °F) with manufacturer declaration on request
Local display	−20 to +70 °C (−4 to +158 °F), the readability of the display may be impaired at temperatures outside the temperature range.

When operating the device in the open with strong sunlight:
- Mount the device in a shady position.
- Avoid direct sunlight, especially in warmer regions.
- Use a weather protection cover (see accessories).

Ambient temperature limits

The following diagrams take into account only functional aspects. There may be further restrictions for certified device versions. Please refere to the separate Safety Instructions (→ 93).

With a temperature (T_p) at the process connection the admissible ambient temperature (T_a) is reduced according to the following diagram (temperature derating):

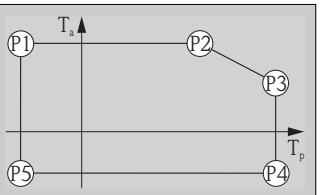
Information concerning the derating tables

Option	Meaning
A	2-wire; 4-20 mA HART
B	2-wire; 4-20 mA HART, switch output
C	2-wire; 4-20 mA HART, 4-20 mA
E	2-wire; FF, switch output
G	2-wire; PA, switch output
K	4-wire 90-253VAC; 4-20 mA HART
L	4-wire 10, 4-48VDC; 4-20 mA HART

FMR51

Seal:
- **Viton GLT, −40 to 150 °C (−40 to 302 °F)**
- **Kalrez, −20 to 150 °C (−4 to 302 °F)**

Housing: GT18 (316 L)
Temperature unit: °C (°F)

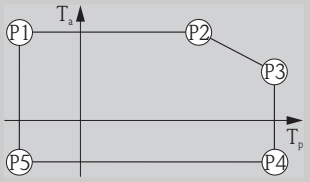


Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	150 (302)	66 (151)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	150 (302)	67 (153)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	150 (302)	61 (142)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	150 (302)	67 (153)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	150 (302)	63 (145)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	150 (302)	68 (154)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

FMR51

Seal:
- **Viton GLT, –40 to 150 °C (–40 to 302 °F)**
- **Kalrez, –20 to 150 °C (–4 to 302 °F)**

Housing: GT18 (316 L)
Temperature unit: °C (°F)



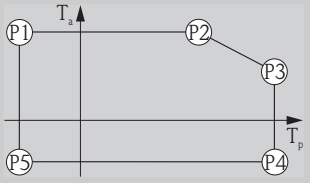
A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	150 (302)	63 (145)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	150 (302)	62 (144)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

FMR51

Seal:
- **Viton GLT, –40 to 150 °C (–40 to 302 °F)**
- **Kalrez, –20 to 150 °C (–4 to 302 °F)**

Housing: GT19 (Plastics PBT)
Temperature unit: °C (°F)



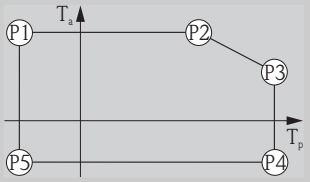
A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	80 (176)	80 (176)	80 (176)	150 (302)	56 (133)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	76 (169)	76 (169)	76 (169)	150 (302)	56 (133)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	60 (140)	60 (140)	60 (140)	150 (302)	38 (100)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	150 (302)	56 (133)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	74 (165)	74 (165)	74 (165)	150 (302)	55 (131)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	79 (174)	79 (174)	79 (174)	150 (302)	56 (133)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	63 (145)	63 (145)	63 (145)	150 (302)	41 (106)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

FMR51

Seal:
- **Viton GLT, –40 to 150 °C (–40 to 302 °F)**
- **Kalrez, –20 to 150 °C (–4 to 302 °F)**

Housing: GT20 (Alu, coated)
Temperature unit: °C (°F)



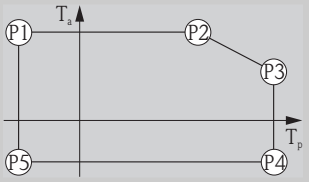
A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	150 (302)	69 (156)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	150 (302)	70 (158)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	150 (302)	64 (147)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

FMR51

Seal:
- **Viton GLT, −40 to 150 °C (−40 to 302 °F)**
- **Kalrez, −20 to 150 °C (−4 to 302 °F)**

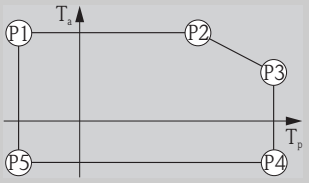
Housing: GT20 (Alu, coated)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	150 (302)	70 (158)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	150 (302)	66 (151)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	150 (302)	71 (160)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	150 (302)	65 (149)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	150 (302)	65 (149)	150 (302)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

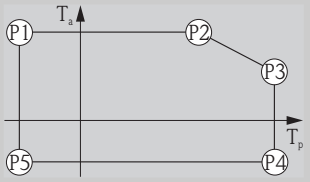
FMR51
Seal: Graphite, −40 to 250 °C (−40 to 482 °F)
Housing: GT18 (316 L)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	250 (482)	63 (145)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	250 (482)	64 (147)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	250 (482)	58 (136)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	250 (482)	64 (147)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	250 (482)	61 (142)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	250 (482)	65 (149)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	250 (482)	60 (140)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	250 (482)	59 (138)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

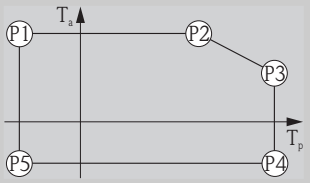
FMR51
Seal: Graphite, −40 to 250 °C (−40 to 482 °F)
Housing: GT19 (Plastics PBT)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	80 (176)	80 (176)	80 (176)	250 (482)	44 (111)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	76 (169)	76 (169)	76 (169)	250 (482)	44 (111)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	60 (140)	60 (140)	60 (140)	250 (482)	32 (90)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	250 (482)	44 (111)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	74 (165)	74 (165)	74 (165)	250 (482)	44 (111)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	79 (174)	79 (174)	79 (174)	250 (482)	44 (111)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	63 (145)	63 (145)	63 (145)	250 (482)	35 (95)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

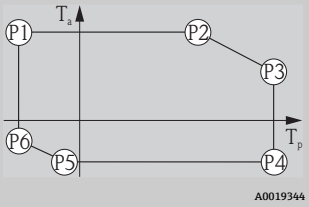
FMR51
Seal: Graphite, −40 to 250 °C (−40 to 482 °F)
Housing: GT20 (Alu, coated)
Temperature unit: °C (°F)



A0019351

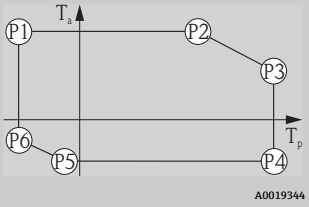
Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	250 (482)	67 (153)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	250 (482)	68 (154)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	250 (482)	62 (144)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	250 (482)	68 (154)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	250 (482)	64 (147)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	250 (482)	69 (156)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	250 (482)	64 (147)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	250 (482)	63 (154)	250 (482)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

FMR51
Seal: Graphite, −196 to 450 °C (−321 to 842 °F)
Housing: GT18 (316 L)
Temperature unit: °C (°F)



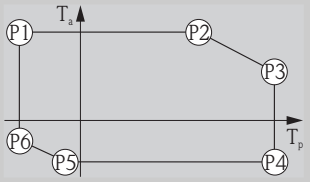
Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-196 (-321)	81 (178)	81 (178)	81 (178)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
B Switch output not used	-196 (-321)	82 (180)	82 (180)	82 (180)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
B Switch output used	-196 (-321)	77 (171)	77 (171)	77 (171)	450 (842)	25 (77)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
C Channel 2 not used	-196 (-321)	82 (180)	82 (180)	82 (180)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
C Channel 2 used	-196 (-321)	79 (174)	79 (174)	79 (174)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
E, G Switch output not used	-196 (-321)	83 (181)	83 (181)	83 (181)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
E, G Switch output used	-196 (-321)	78 (172)	78 (172)	78 (172)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)
K, L	-196 (-321)	77 (171)	77 (171)	77 (171)	450 (842)	26 (79)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-15 (+5)

FMR51
Seal: Graphite, −196 to 450 °C (−321 to 842 °F)
Housing: GT19 (Plastics PBT)
Temperature unit: °C (°F)



Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-196 (-321)	80 (176)	80 (176)	80 (176)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)
B Switch output not used	-196 (-321)	76 (169)	76 (169)	76 (169)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)
B Switch output used	-196 (-321)	60 (140)	60 (140)	60 (140)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)
C Channel 2 not used	-196 (-321)	82 (180)	82 (180)	82 (180)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)
C Channel 2 used	-196 (-321)	74 (165)	74 (165)	74 (165)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)
E, G Switch output not used	-196 (-321)	79 (174)	79 (174)	79 (174)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)
E, G Switch output used	-196 (-321)	63 (145)	63 (145)	63 (145)	450 (842)	-29 (-20)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	9 (48)

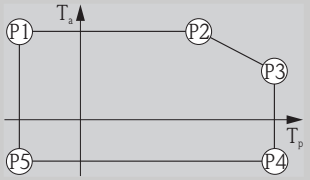
FMR51
Seal: Graphite, −196 to 450 °C (−321 to 842 °F)
Housing: GT20 (Alu, coated)
Temperature unit: °C (°F)



A0019344

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-196 (-321)	81 (178)	81 (178)	81 (178)	450 (842)	39 (102)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
B Switch output not used	-196 (-321)	82 (180)	82 (180)	82 (180)	450 (842)	39 (102)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
B Switch output used	-196 (-321)	77 (171)	77 (171)	77 (171)	450 (842)	36 (97)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
C Channel 2 not used	-196 (-321)	82 (180)	82 (180)	82 (180)	450 (842)	39 (102)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
C Channel 2 used	-196 (-321)	79 (174)	79 (174)	79 (174)	450 (842)	38 (100)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
E, G Switch output not used	-196 (-321)	83 (181)	83 (181)	83 (181)	450 (842)	39 (102)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
E, G Switch output used	-196 (-321)	78 (172)	78 (172)	78 (172)	450 (842)	38 (100)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)
K, L	-196 (-321)	77 (171	77 (171)	77 (171)	450 (842)	37 (99)	450 (842)	-40 (-40)	-40 (-40)	-40 (-40)	-196 (-321)	-20 (-4)

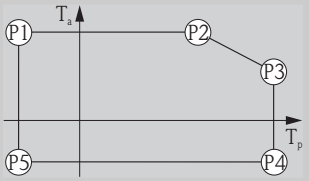
FMR52
Antenna: Horn 50mm/2"
Housing: GT18 (316 L)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	200 (392)	61 (142)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	61 (142)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	55 (131)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	62 (144)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	200 (392)	58 (136)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	200 (392)	62 (144)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	200 (392)	57 (135)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	56 (133)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

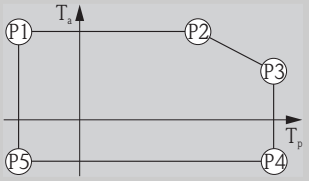
FMR52
Antenna: Horn 50mm/2"
Housing: GT19 (Plastics PBT)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	80 (176)	80 (176)	80 (176)	200 (392)	42 (108)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	76 (169)	76 (169)	76 (169)	200 (392)	42 (108)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	60 (140)	60 (140)	60 (140)	200 (392)	31 (88)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	42 (108)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	74 (165)	74 (165)	74 (165)	200 (392)	42 (108)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	79 (174)	79 (174)	79 (174)	200 (392)	42 (108)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	63 (145)	63 (145)	63 (145)	200 (392)	33 (91)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

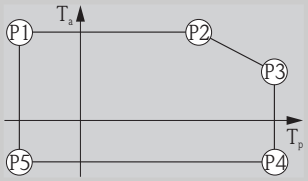
FMR52
Antenna: Horn 50mm/2"
Housing: GT20 (Alu, coated)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	200 (392)	65 (149)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	65 (149	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	59 (138)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	66 (151)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	200 (392)	62 (144)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	200 (392)	66 (1512)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	200 (392)	61 (142)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	60 (140)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

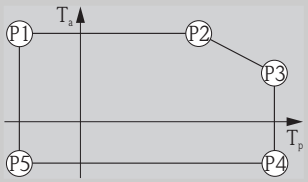
FMR52
Antenna: Horn 80mm/2"
Housing: GT18 (316 L)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	200 (392)	57 (135)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	57 (135)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	51 (124)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	57 (135)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	200 (392)	54 (129)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	200 (392)	57 (135)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	200 (392)	53 (127)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	52 (126)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

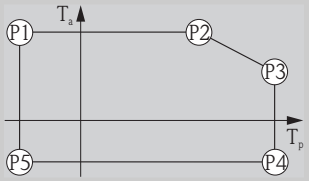
FMR52
Antenna: Horn 80mm/2"
Housing: GT19 (Plastics PBT)
Temperature unit: °C (°F)



A0019351

Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	80 (176)	80 (176)	80 (176)	200 (392)	36 (97)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	76 (169)	76 (169)	76 (169)	200 (392)	36 (97)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	60 (140)	60 (140)	60 (140)	200 (392)	27 (81)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	36 (97)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	74 (165)	74 (165)	74 (165)	200 (392)	36 (97)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	79 (174)	79 (174)	79 (174)	200 (392)	36 (97)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	63 (145)	63 (145)	63 (145)	200 (392)	30 (86)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

FMR52
Antenna: Horn 80mm/2"
Housing: GT20 (Alu, coated)
Temperature unit: °C (°F)



Power Supply; Output (Pos. 2 of the product structure)	P1		P2		P3		P4		P5		P6	
	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a	T_p	T_a
A	-40 (-40)	81 (178)	81 (178)	81 (178)	200 (392)	61 (142)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	62 (144)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
B Switch output used	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	56 (133)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 not used	-40 (-40)	82 (180)	82 (180)	82 (180)	200 (392)	62 (144)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
C Channel 2 used	-40 (-40)	79 (174)	79 (174)	79 (174)	200 (392)	58 (136)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output not used	-40 (-40)	83 (181)	83 (181)	83 (181)	200 (392)	62 (144)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
E, G Switch output used	-40 (-40)	78 (172)	78 (172)	78 (172)	200 (392)	58 (136)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-
K, L	-40 (-40)	77 (171)	77 (171)	77 (171)	200 (392)	57 (135)	200 (392)	-40 (-40)	-40 (-40)	-40 (-40)	-	-

Storage temperature

−40 to +80 °C (−40 to +176 °F)

−50 °C (−58 °F) with manufacturer declaration on request

Climate class

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

Altitude according to IEC61010-1 Ed.3

Up to 2 000 m (6 600 ft) above MSL.

Can be expanded to 3 000 m (9 800 ft) above MSL by application of an overvoltage protection, e.g. HAW562 or HAW569.

Degree of protection

- With closed housing tested according to:
  - IP68, NEMA6P (24 h at 1.83 m under water surface)
  - For plastic housing with transparent cover (display module): IP68 (24 h at 1.00 m under water surface) [6)]
  - IP66, NEMA4X
- With open housing: IP20, NEMA1
- Display module: IP20, NEMA1

Degree of protection IP68 NEMA6P applies for M12 PROFIBUS PA plugs only when the PROFIBUS cable is plugged in and is also rated IP68 NEMA6P.

Vibration resistance

DIN EN 60068-2-64 / IEC 68-2-64: 20 to 2 000 Hz, 1 $(m/s^2)^2/Hz$

Cleaning the antenna

The antenna can get contaminated, depending on the application. The emission and reception of microwaves can thus eventually be hindered. The degree of contamination leading to an error depends on the medium and the reflectivity, mainly determined by the dielectric constant ε_r.

If the medium tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care has to be taken not to damage the antenna in the process of a mechanical or

6) This restriction is valid if the following options of the product structure have been selected at the same time: 030("Display, Operation") = C("SD02") or E("SD03"); 040("Housing") = A("GT19").

hose-down cleaning. The material compatibility has to be considered if cleaning agents are used! The maximum permitted temperature at the flange should not be exceeded.

Electromagnetic compatibility (EMC)

Electromagnetic compatibility to all relevant requirements of the EN 61326- series and NAMUR recommendation EMC (NE21). For details see declaration of conformity. [7)].

If only the analogue signal is used, unshielded interconnection lines are sufficient for the installation. In case of using the digital signal (HART/ PA/ FF) use shielded interconnection lines.

Max. fluctuations during EMC- tests: < 0.5 % of the span. As an exception to this, the maximum fluctuations may amount to 2 % of the span for devices with plastic housing and see-through lid (integrated display SD02 or SD03) if strong electromagnetic interferences in the frequenency range of 1 to 2 GHz are present.

7) Can be downloaded from www.endress.com.

Process

Process temperature range

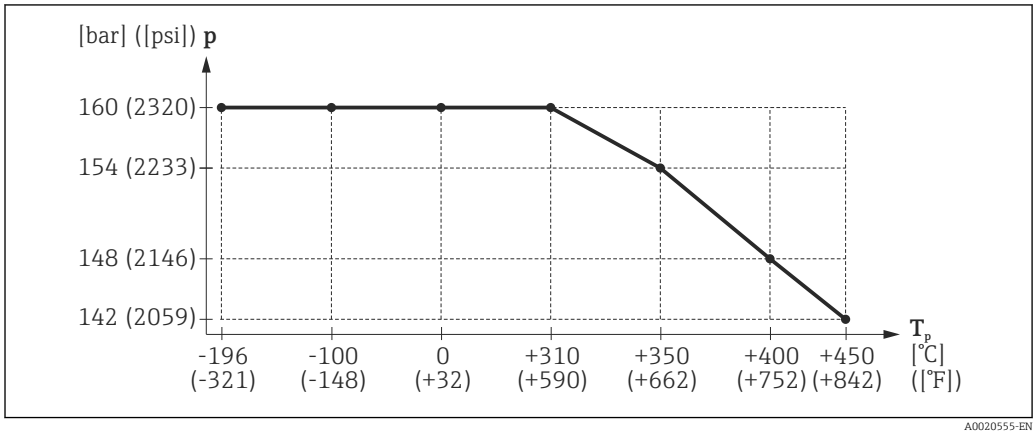
Sensor	Seal [1]	Process temperature range
FMR51	Viton GLT	−40 to +150 °C (−40 to 302 °F)
	Kalrez	−20 to +150 °C (−4 to 302 °F)
	Graphite, -40 ... 250°C / -40 ... 482°F	−40 to +250 °C (−40 to 482 °F)
	Graphite, -196...450°C / -321...842°F	−196 to +450 °C (−321 to 842 °F)
FMR52	-	−40 to +200 °C (−40 to 392 °F)

1) Feature 090 of the product structure

Process pressure range

Sensor	Seal [1]	Process pressure range
FMR51	Viton GLT	p_{rel} = −1 to 40 bar (−14.5 to 580 psi)
	Kalrez	
	Graphite, -40 ... 250°C / -40 ... 482°F	
	Graphite, -196...450°C / -321...842°F	p_{rel} = −1 to 160 bar (−14.5 to 2 320 psi) See the diagram below for temperature dependent restrictions.
FMR52	-	p_{rel} = −1 to 25 bar (−14.5 to 363 psi)

1) Feature 090 of the product structure



18 *FMR51, HT version (Seal "Graphite, -196...450°C / -321...842°F") : Admissible process pressure depending on the process temperature T_p*

This range may be reduced by the selected process connection. The pressure rating (PN) specified on the flanges refers to a reference temperature of 20 °C, for ASME flanges 100 °F. Pay attention to pressure-temperature dependencies.

Please refer to the following standards for the pressure values permitted for higher temperatures:

- EN 1092-1: 2001 Tab. 18
  With regard to their temperature stability properties, the materials 1.4435 and 1.4404 are grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

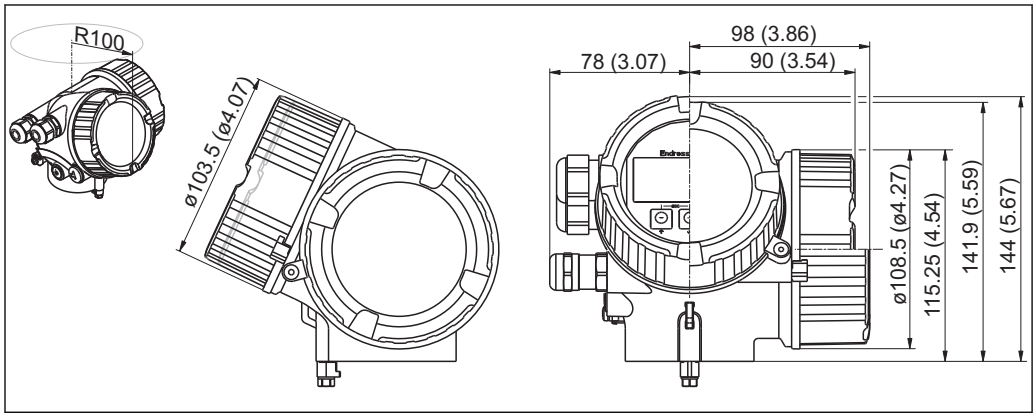
Dielectric constant

- **For liquids**
  - $\varepsilon_r \geq 1.9$ in free-field applications
  - $\varepsilon_r \geq 1.4$ in stilling well
- **For bulk solids**
  $\varepsilon_r \geq 1.6$

Mechanical construction

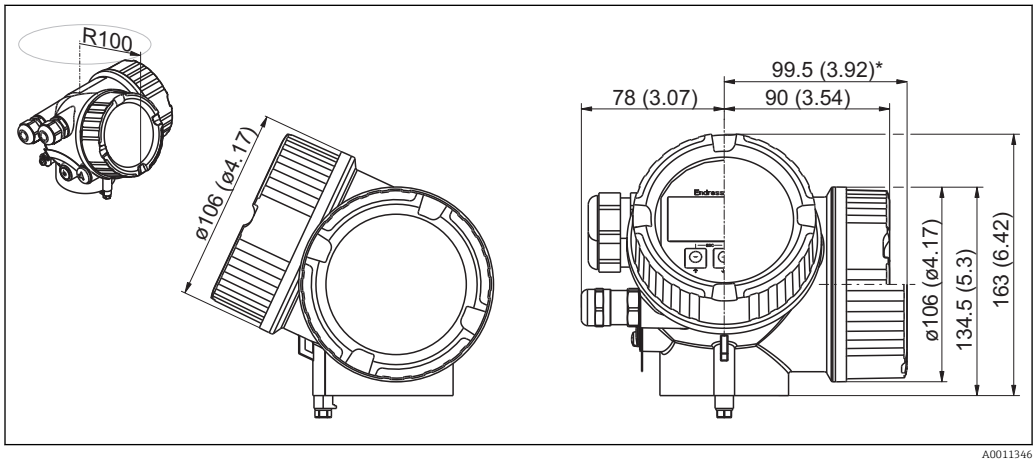
Dimensions

Dimensions of the electronics housing



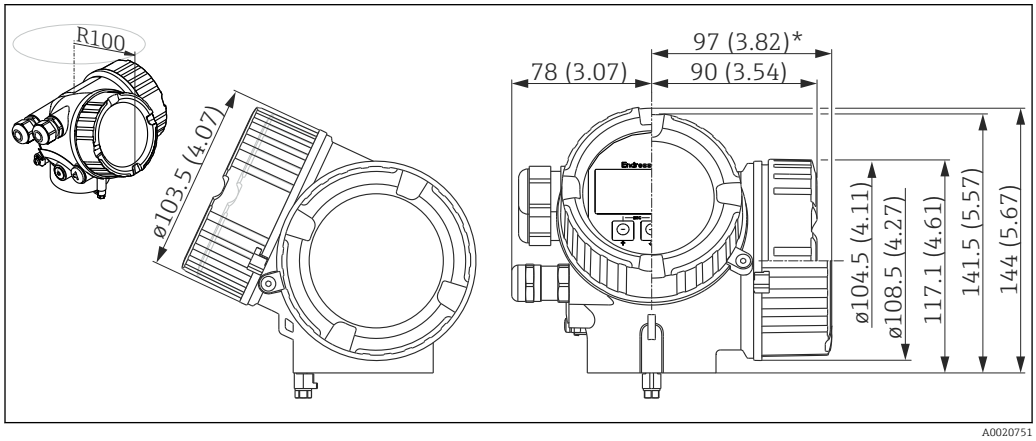
19 *Housing GT18 (316L); Dimensions in mm (in)*

**This measure is valid for devices with integrated overvoltage protection.*



20 *Housing GT19 (Plastics PBT); Dimensions in mm (in)*

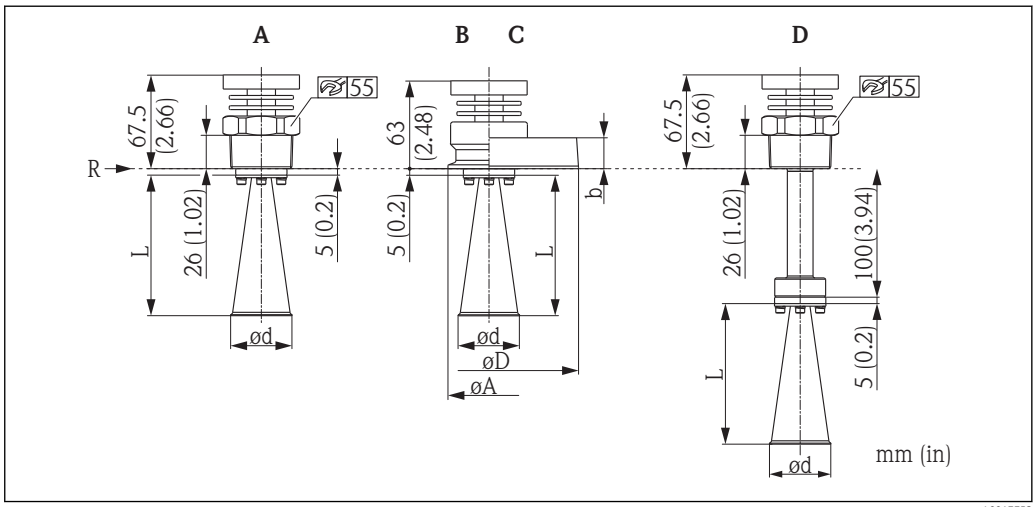
**This measure is valid for devices with integrated overvoltage protection.*



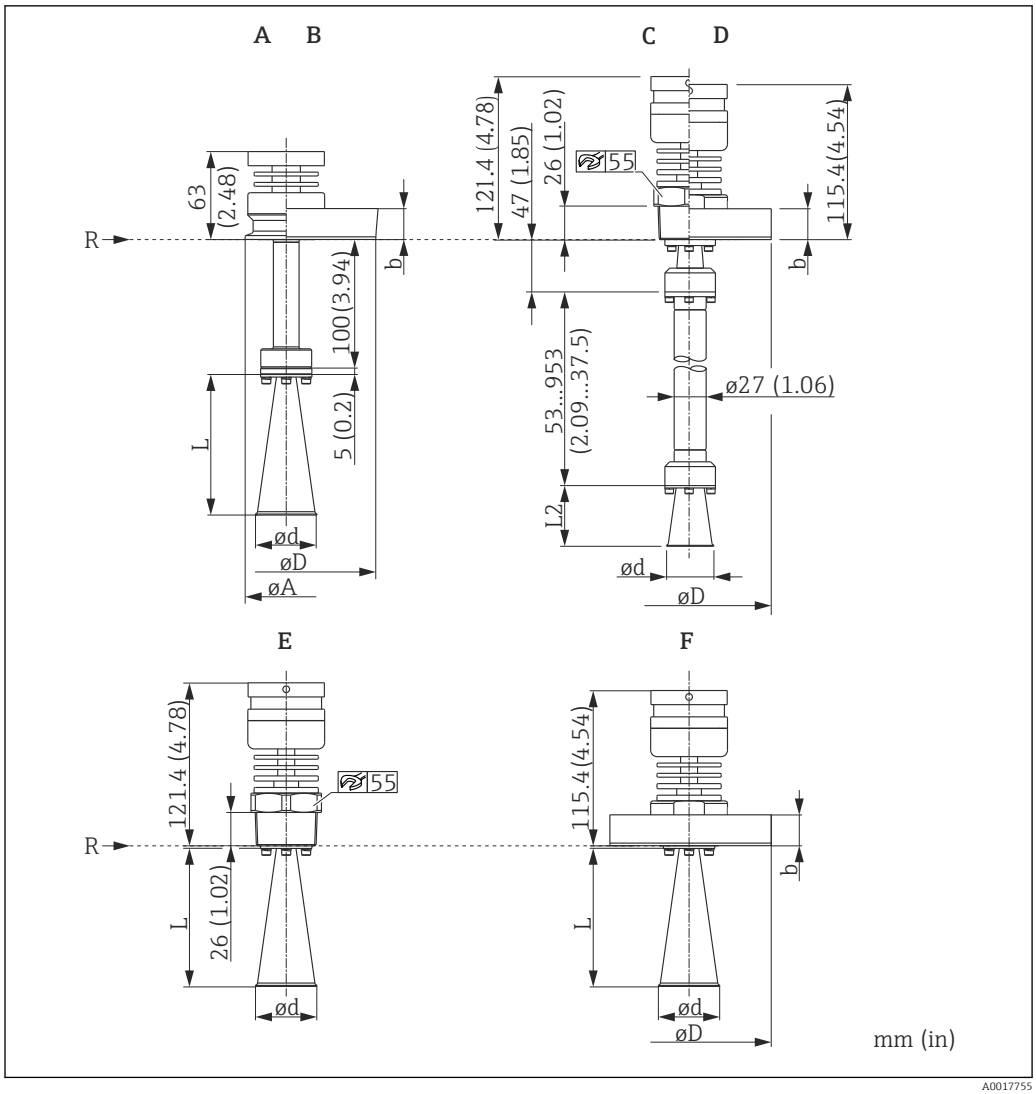
21 *Housing GT20 (Alu coated); Dimensions in mm (in)*

**This measure is valid for devices with integrated overvoltage protection.*

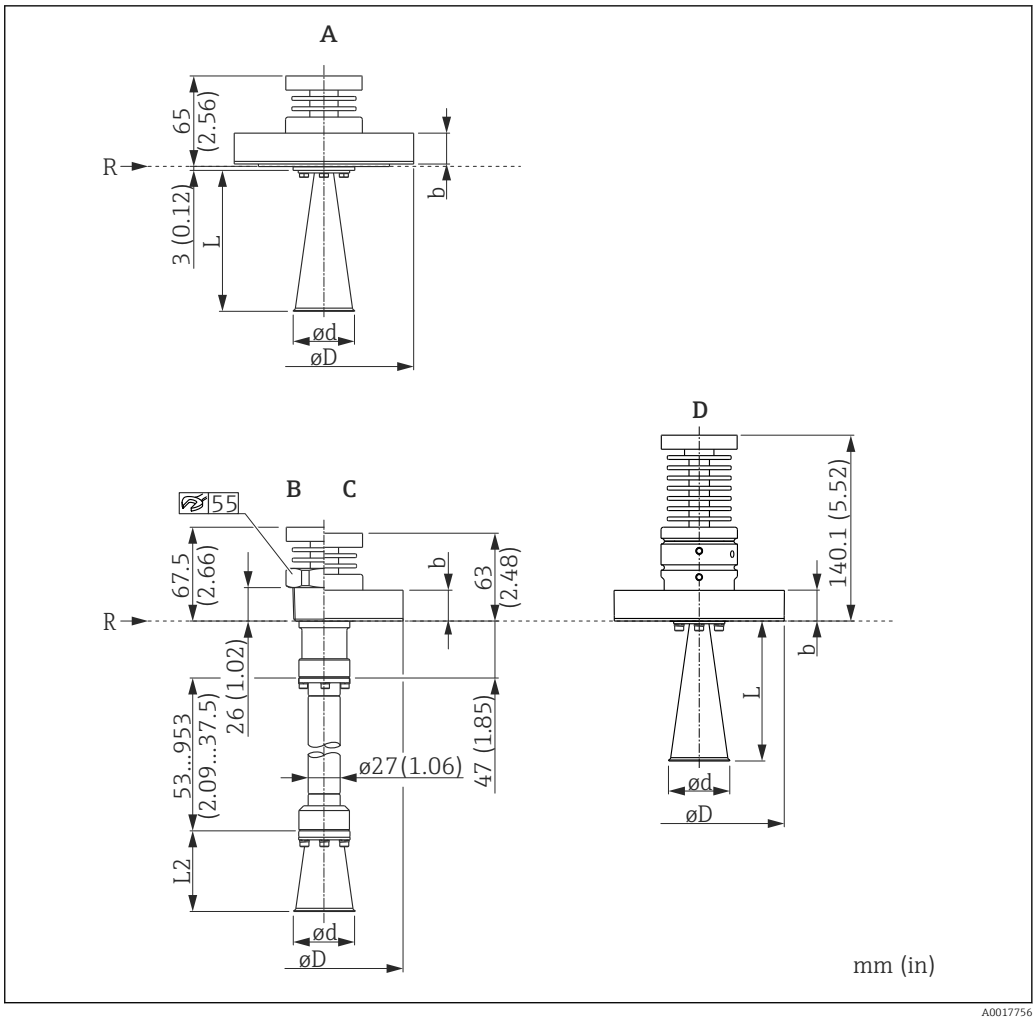
Dimensions FMR51 (process connection/antenna)



A Threaded connection
B Clamp adapter 2"/3"
C Flange version
D Threaded connection with antenna extension 100 mm (3.94 in)
R Reference point of the measurement



A Clamp adapter 2"/3" with antenna extension 100 mm (3.94 in)
B Flange version with antenna extension 100 mm (3.94 in)
C Version XT 250°C (482 °F) with threaded connection and antenna extension 100 mm to 1000 mm (3.94 in to 39.4 in)
D Version XT 250°C (482 °F) with flange and antenna extension 100 mm to 1000 mm (3.94 in to 39.4 in)
E Version XT 250°C (482 °F) with threaded connection
F Version XT 250°C (482 °F) with flange
R Reference point of the measurement



A Flange version, coated
B Version flange with antenna extension 100 mm to 1000 mm (3.94 in to 39.4 in)
C Version threaded connection with antenna extension 100 mm to 1000 mm (3.94 in to 39.4 in)
D Version HT 450 °C (842 °F) with flange
R Reference point of the measurement

Horn antenna

Dimension	40 mm (1")	50 mm (2")	80 mm (3")	100 mm (4")
L	86 mm (3.39 in)	115 mm (4.53 in)	211 mm (8.31 in)	282 mm (11.1 in)
Φd	Φ40 mm (1.57 in)	Φ48 mm (1.89 in)	Φ75 mm (2.95 in)	Φ95 mm (3.74 in)
L2	51 mm (2.01 in)	80 mm (3.15 in)	176 mm (6.93 in)	247 mm (9.72 in)
Φd	Φ40 mm (1.57 in)	Φ48 mm (1.89 in)	Φ75 mm (2.95 in)	Φ95 mm (3.74 in)

Flanges according to EN1092-1 (suitable for DIN2527)

Dimension	Version	DN50	DN80	DN100	DN150
b	PN16	18 mm (0.71 in)	20 mm (0.79 in)	20 mm (0.79 in)	22 mm (0.87 in)
ΦD		Φ165 mm (6.5 in)	Φ200 mm (7.87 in)	Φ220 mm (8.66 in)	Φ285 mm (11.2 in)
b	PN40	20 mm (0.79 in)	24 mm (0.94 in)	24 mm (0.94 in)	-
ΦD		Φ165 mm (6.5 in)	Φ200 mm (7.87 in)	Φ235 mm (9.25 in)	-
b	PN63	-	-	30 mm (1.18 in)	-
ΦD		-	-	Φ250 mm (9.84 in)	-

Dimension	Version	DN50	DN80	DN100	DN150
b	PN100	-	-	36 mm (1.42 in)	-
ΦD		-	-	Φ265 mm (10.4 in)	-

Flanges according to JIS B2220

Dimension	Version	DN50	DN80	DN100	DN150
b	10 K	16 mm (0.63 in)	18 mm (0.71 in)	18 mm (0.71 in)	22 mm (0.87 in)
ΦD		Φ155 mm (6.1 in)	Φ185 mm (7.28 in)	Φ210 mm (8.27 in)	Φ280 mm (11 in)
b	63 K	-	-	44 mm (1.73 in)	-
ΦD		-	-	Φ270 mm (10.6 in)	-

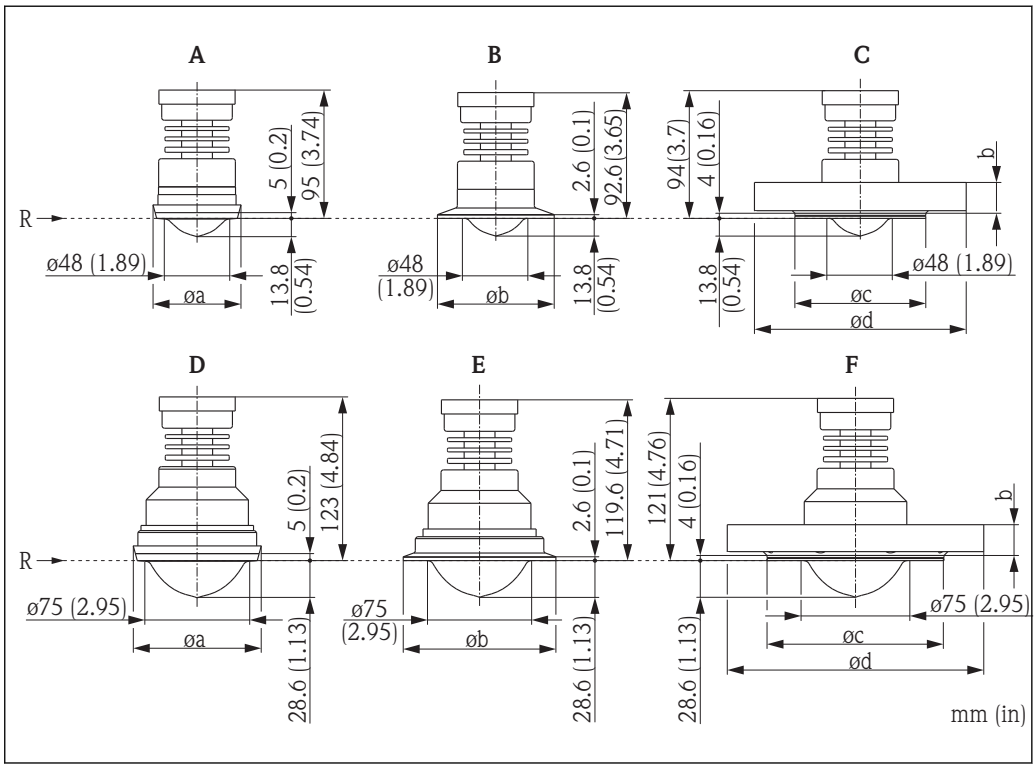
Flanges according to ANSI B16.5

Dimension	Version	2"	3"	4"	6"
b	150 lbs	19.1 mm (0.75 in)	23.9 mm (0.94 in)	23.9 mm (0.94 in)	25.4 mm (1 in)
ΦD		Φ152.4 mm (6 in)	Φ190.5 mm (7.5 in)	Φ228.6 mm (9 in)	Φ279.4 mm (11 in)
b	300 lbs	22.4 mm (0.88 in)	28.4 mm (1.12 in)	31.8 mm (1.25 in)	25.4 mm (1 in)
ΦD		Φ165.1 mm (6.5 in)	Φ209.5 mm (8.25 in)	Φ254 mm (10 in)	Φ279.4 mm (11 in)

Tri-Clamp according to ISO 2852

Dimension	2"	3"
A	64 mm (2.52 in)	91 mm (3.58 in)

Dimensions FMR52 (process connection/antenna)



A0017748

A Dairy coupling adapter DN50
B Clamp adapter DN50
C Version DN50 with flange
D Dairy coupling adapter DN80
E Clamp adapter DN80
F Version DN80 with flange
R Reference point of the measurement

Dairy coupling according to DIN 11851

Dimension	DN50	DN80
Φa	Φ68.5 mm (2.7 in)	Φ100 mm (3.94 in)

Tri-Clamp according to ISO 2852

Dimension	2"	3"	4"
Φb	Φ64 mm (2.52 in)	Φ91 mm (3.58 in)	Φ119 mm (4.69 in)

Flanges according to EN1092-1 (suitable for DIN2527)

Dimension	Version	DN50	DN80	DN100	DN150
b	PN16	20 mm (0.79 in)	20 mm (0.79 in)	20 mm (0.79 in)	22 mm (0.87 in)
Φc		Φ102 mm (4.02 in)	Φ138 mm (5.43 in)	Φ158 mm (6.22 in)	Φ212 mm (8.35 in)
Φd		Φ165 mm (6.5 in)	Φ200 mm (7.87 in)	Φ220 mm (8.66 in)	Φ285 mm (11.2 in)

Flanges according to ANSI B16.5

Dimension	Version	2"	3"	4"	6"
b	150 lbs	19.1 mm (0.75 in)	23.9 mm (0.94 in)	23.9 mm (0.94 in)	25.4 mm (1 in)
Φc		Φ92 mm (3.62 in)	Φ127 mm (5 in)	Φ158 mm (6.22 in)	Φ212 mm (8.35 in)
Φd		Φ152.4 mm (6 in)	Φ190.5 mm (7.5 in)	Φ228.6 mm (9 in)	Φ279.4 mm (11 in)

Flanges according to JIS B2220

Dimension	Version	DN50	DN80	DN100	DN150
b	10 K	16 mm (0.63 in)	18 mm (0.71 in)	18 mm (0.71 in)	22 mm (0.87 in)
Φc		Φ96 mm (3.78 in)	Φ127 mm (5 in)	Φ151 mm (5.94 in)	Φ212 mm (8.35 in)
Φd		Φ155 mm (6.1 in)	Φ185 mm (7.28 in)	Φ210 mm (8.27 in)	Φ280 mm (11 in)

Weight

Housing

Part	Weight
Housing GT18 - stainless steel	approx. 4.5 kg (9.9 lbs)
Housing GT19 - plastic	approx. 1.2 kg (2.7 lbs)
Housing GT20 - aluminium	approx. 1.9 kg (4.2 lbs)

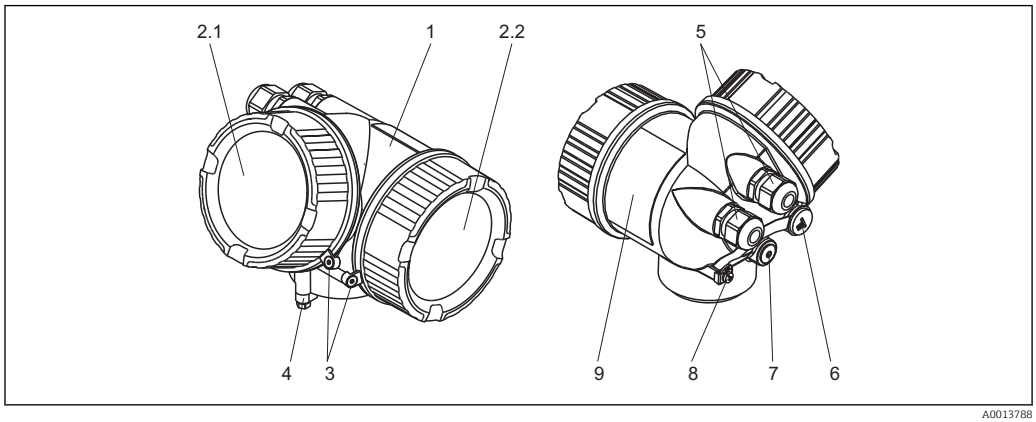
Antenna and process connection

Device	Weight of antenna and process connection
FMR51	max. 3.0 kg (6.6 lbs) + weight of flange [1)]
FMR52	max. 4 kg (8.8 lbs) + weight of flange [1)]

1) For the weight of the flange refer to Technical Information TI00426F.

Materials

Materials: Housing



A0013788

Housing GT18 - stainless steel, corrosion-resistant			
No.	Part: material	No.	Part: material
1	Housing: 316L (CF-3M, 1.4404)	5	Cable entry ▪ Sealing: EMPB ▪ Cable gland: 316L (1.4404) ▪ Adapter: 316L (1.4435)
2.1	Cover of the electronics compartment ▪ Cover: 316L (CF-3M, 1.4404) ▪ Window: glass ▪ Cover seal: EPDM		
2.2	Cover of the terminal compartment ▪ Cover: 316L (CF-3M, 1.4404)	6	Dummy plug: 316L (1.4404)

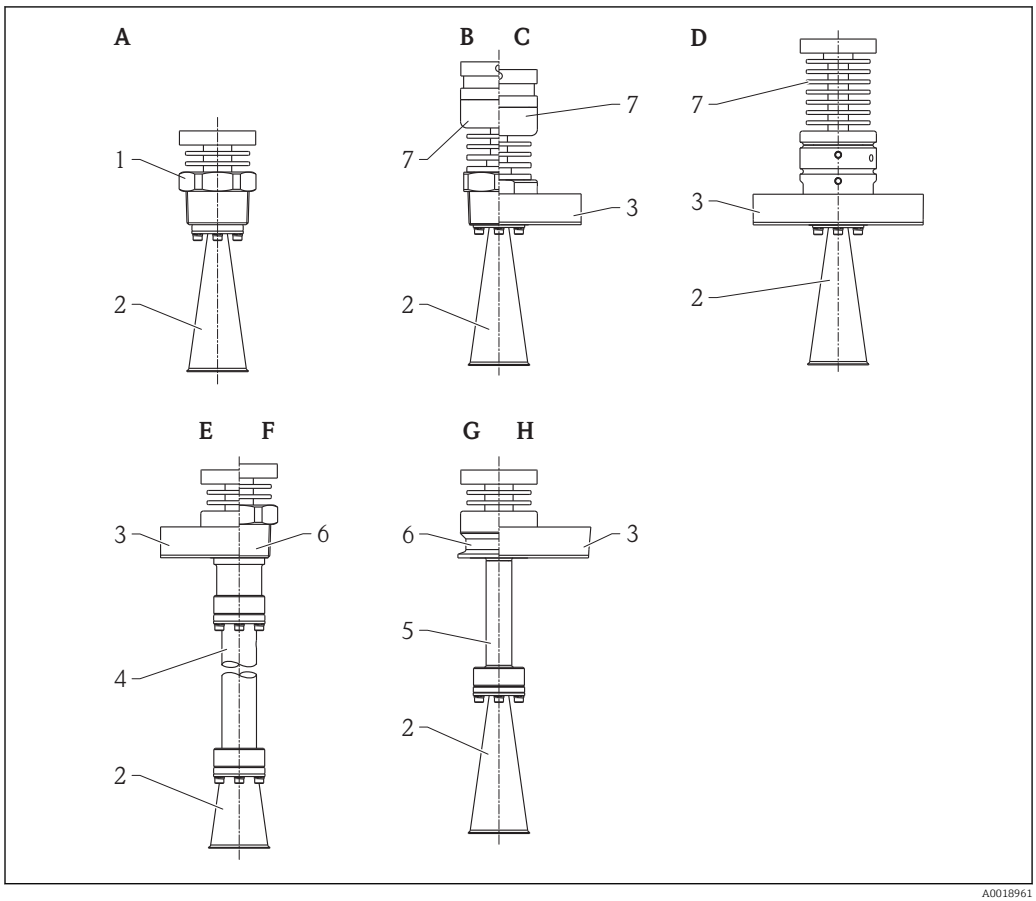
Housing GT18 - stainless steel, corrosion-resistant			
No.	**Part: material**	**No.**	**Part: material**
	▪ Cover seal: EPDM	7	Pressure relief stopper: 316L (1.4404)
3	Cover lock ▪ Screw: A4 ▪ Clamp: 316L (1.4404)	8	Ground terminal ▪ Screw: A4 ▪ Spring washer: A4 ▪ Clamp: 316L (1.4404) ▪ Holder: 316L (1.4404)
4	Turn housing ▪ Screw: A4-70 ▪ Clamp: 316L (1.4404)	9	Identification ▪ Nameplate: 316L (1.4404) ▪ Groove pin: A4 (1.4571)

Housing GT19 - plastic			
No.	**Part: material**	**No.**	**Part: material**
1	Housing: PBT	5	Cable entry ▪ Sealing: EMPB ▪ Cable gland: polyamide (PA), nickel-plated brass (CuZn) ▪ Adapter: 316L (1.4435)
2.1	Cover of the electronics compartment ▪ Cover: – PA (see-through cover) – PBT (non-transparent cover) ▪ Cover seal: EPDM		
2.2	Cover of the terminal compartment ▪ Cover: PBT ▪ Cover seal: EPDM	6	Dummy plug: nickel-plated brass (CuZn)
		7	Pressure relief stopper: nickel-plated brass (CuZn)
4	Turn housing ▪ Screw: A4-70 ▪ Clamp: 316L (1.4404)	8	Ground terminal ▪ Screw: A2 ▪ Spring washer: A4 ▪ Clamp: 304 (1.4301) ▪ Holder: 304 (1.4301)
		9	Identification Nameplate: sticker

Housing GT20 - die-cast aluminum, powder-coated, seawater-resistant			
No.	**Part: material**	**No.**	**Part: material**
1	Housing: AlSi10Mg(<0.1% Cu) Coating: polyester	5	Cable entry ▪ Sealing: EMPB ▪ Cable gland: polyamide (PA), nickel-plated brass (CuZn) ▪ Adapter: 316L (1.4435)
2.1	Cover of the electronics compartment ▪ Cover: AlSi10Mg(<0.1% Cu) ▪ Window: glass ▪ Cover seal: EPDM		
2.2	Cover of the terminal compartment ▪ Cover: AlSi10Mg(<0.1% Cu) ▪ Cover seal: EPDM	6	Dummy plug: nickel-plated brass (CuZn)
		7	Pressure relief stopper: nickel-plated brass (CuZn)
3	Cover lock ▪ Screw: A4 ▪ Clamp: 316L (1.4404)	8	Ground terminal ▪ Screw: A2 ▪ Spring washer: A2 ▪ Clamp: 304 (1.4301) ▪ Holder: 304 (1.4301)
4	Turn housing ▪ Screw: A4-70 ▪ Clamp: 316L (1.4404)	9	Identification Nameplate: sticker

Materials: Antenna and process connection

FMR51

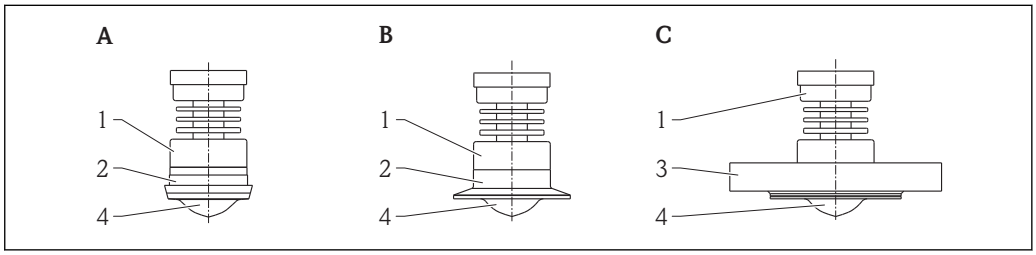


A Version with screw-in adapter
B XT version with threaded connection
C XT version with flange
D HT version with flange
E Version with flange and antenna extension > 100 mm (3.94 in) to 500 mm (19.7 in)
F Version with threaded connection and antenna extension > 100 mm (3.94 in) to 500 mm (19.7 in)
G Version with clamp adapter and antenna extension 100 mm (3.94 in)
H Version with flange and antenna extension 100 mm (3.94 in)

Pos.	Part	Material		
1	Process adapter	316L (1.4404)		
	Locking washer			
2	Horn	316L (1.4404)		Hastelloy C22
	Screws	A4		Hastelloy C22
	Spring-lock washer (compact version)	A4		
	Nordlock washer (extension >100 mm, XT und HT version)	A4		
	Process separation cone	Standard: PTFE	XT: PEEK	HT: Al_2O_3
	Seal	Standard: FKM/FFKM	XT: Graphite	HT: Graphite
3	Flange	316L (1.4404/1.4435) optionally Hastelloy C22 clad		
4	Tube extension + adapter	316L (1.4404)		

Pos.	Part	Material
5	Extension process adapter	316L (1.4404)
	Locking washer	
6	Process adapter	316L (1.4404)
7	Housing adapter	316L (1.4404)
	Temperature reduction (XT)	316L (1.4404)
	Intermediate adapter (HT)	316L (1.4404)
	Process adapter	316L (1.4404)

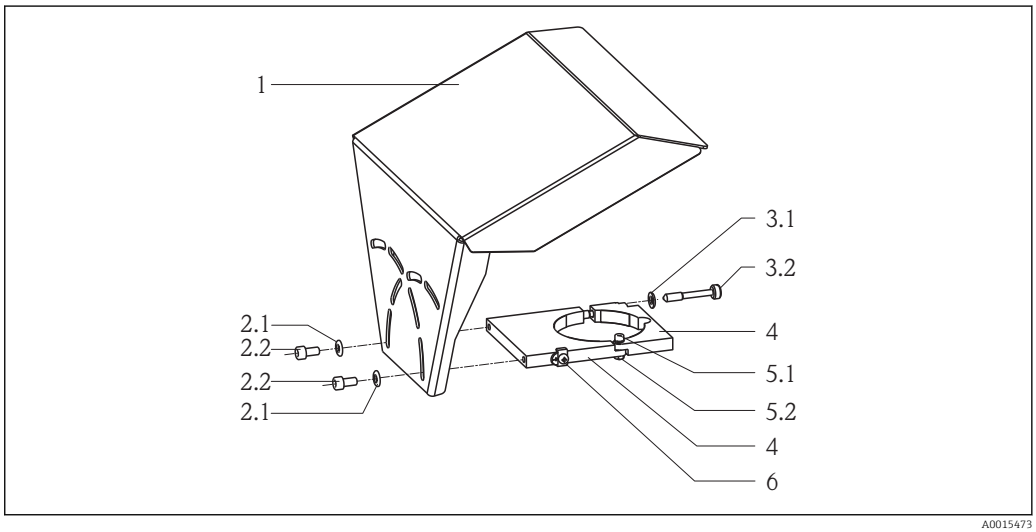
FMR52



A Dairy coupling
B Clamp adapter
C Flange version

Pos.	Part	Material
1	Adapter	304 (1.4301)
2	Process connection	316L (1.4435)
3	Flange	316L (1.4404/1.4435)
4	Cladding	PTFE (in accordance with FDA 21 CFR 177.1550 and USP <88> Class VI)

Materials: Weather protection cover



Weather protection cover			
Nr.	**Part: material**	**Nr.**	**Part: material**
1	Protection cover: 304 (1.4301)	4	Bracket: 304 (1.4301)
2.1	Washer: A2	5.1	Cheese head screw: A2-70
2.2	Cheese head screw: A4-70	5.2	Nut: A2
3.1	Washer: A2	6	Ground terminal ▪ Screw: A4 ▪ Spring washer: A4 ▪ Clamp: 316L (1.4404) ▪ Holder: 316L (1.4404)
3.2	Tightening screw: 304 (1.4301)		

Operability

Operating concept

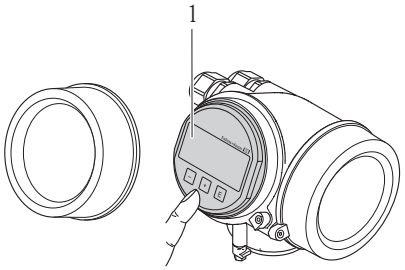
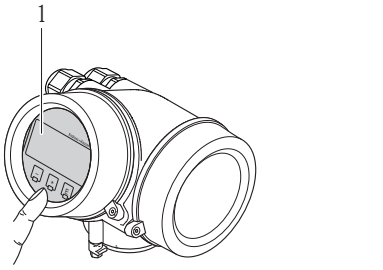
Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Quick and safe commissioning
- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief explanations of the individual parameter functions

Reliable operation
- Local operation in different languages (see product structure, feature "Additional Operation Language")
- Standardized operation at the device and in the operating tools
- Data storage device (HistoROM) for process and measuring device data with event logbook available at all times - even if electronics modules are replaced

Efficient diagnostics increase measurement reliability
- Remedy information is integrated in plain text
- Diverse simulation options and line recorder functions

Local operation

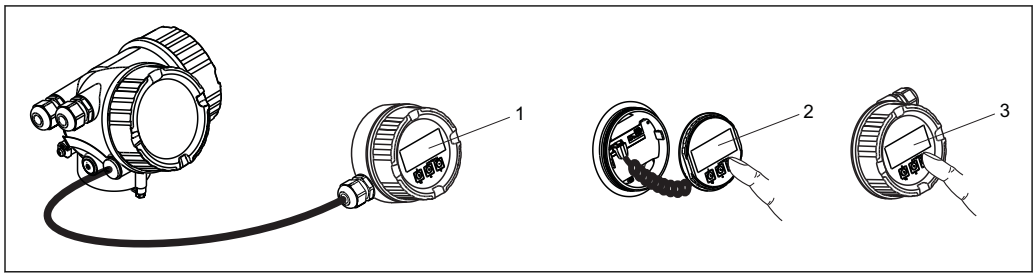
Order code for "Display; Operation", option **C** "SD02"	Order code for "Display; Operation", option **E** "SD03" (in preparation)
	
1 Operation with pushbuttons	*1 Operation with touch control*

Display elements
- 4-line display
- In the case of order code for "Display; Operation", option **E**: white background lighting; switches to red in event of device errors (in preparation)
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: –20 to +70 °C (–4 to +158 °F)
  The readability of the display may be impaired at temperatures outside the temperature range.

Operating elements
- In the case of order code "Display; Operation", Option **C**: local operation with 3 push buttons (⊕, ⊖, Ⓔ)
- In the case of order code for "Display; Operation", option **E**: external operation via touch control; 3 optical keys: ⊕, ⊖, Ⓔ (in preparation)
- Operating elements also accessible in various hazardous areas

Additional functionality
- Data backup function
  The device configuration can be saved in the display module.
- Data comparison function
  The device configuration saved in the display module can be compared to the current device configuration.
- Data transfer function
  The transmitter configuration can be transmitted to another device using the display module.

Operation with remote display and operating module FHX50

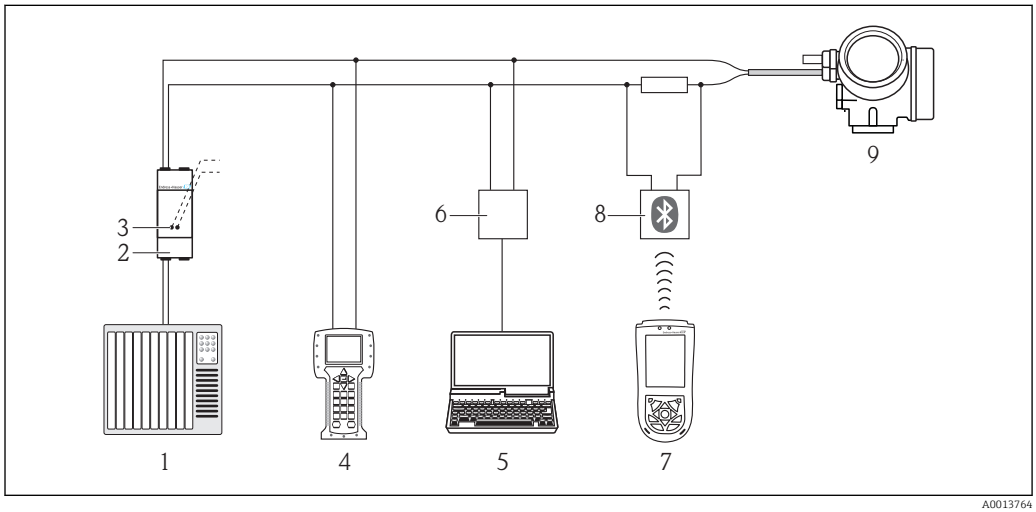


22 FHX50 operating options

1 Housing of the remote display and operating module FHX50
2 Display and operating module SD02, push buttons; cover must be removed
3 Display and operating module SD03, optical keys; can be operated through the glass of the cover (in preparation)

Remote operation

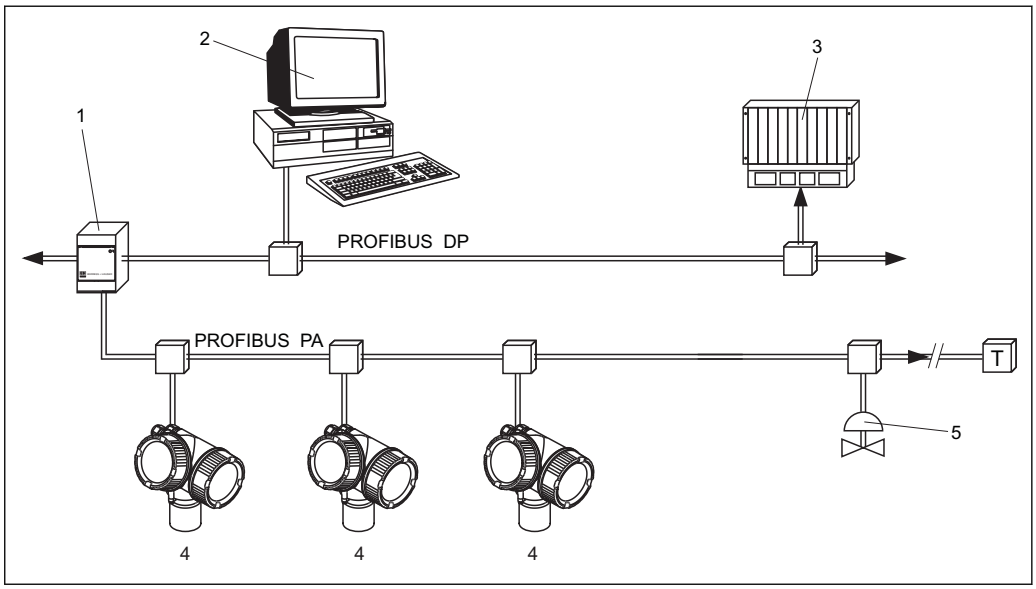
Via HART protocol



23 Options for remote operation via HART protocol

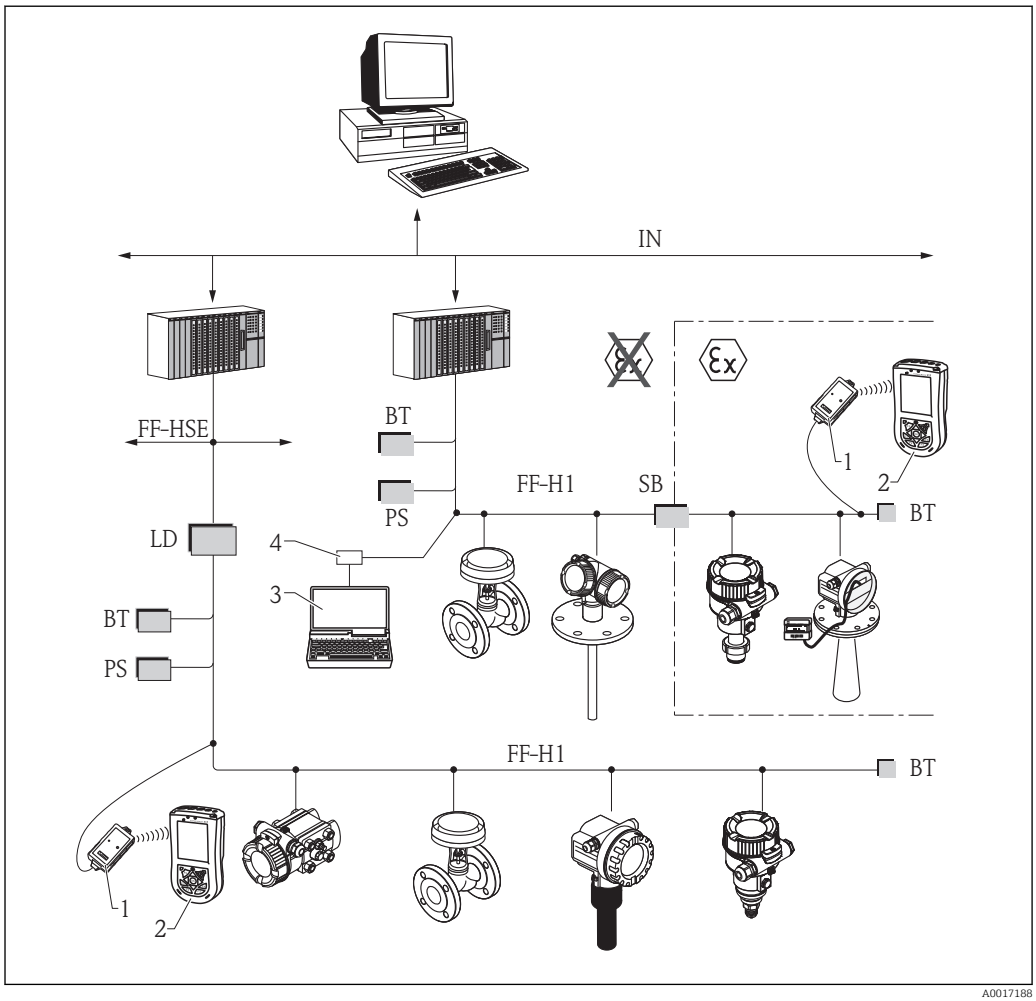
1 PLC (programmable logic controller)
2 Transmitter power supply unit, e.g. RN221N (with communication resistor)
3 Connection for Commubox FXA191, FXA195 and Field Communicator 375, 475
4 Field Communicator 375, 475
5 Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)
6 Commubox FXA191 (RS232) or FXA195 (USB)
7 Field Xpert SFX100
8 VIATOR Bluetooth modem with connecting cable
9 Transmitter

Via PROFIBUS PA protocol



1 Segment coupler
2 Computer with Profiboard/Proficard and operating tool (e.g. FieldCare)
3 PLC (Progrommable Logic Controller)
4 Transmitter
5 Additional functions (valves etc.)

Via FOUNDATION Fieldbus

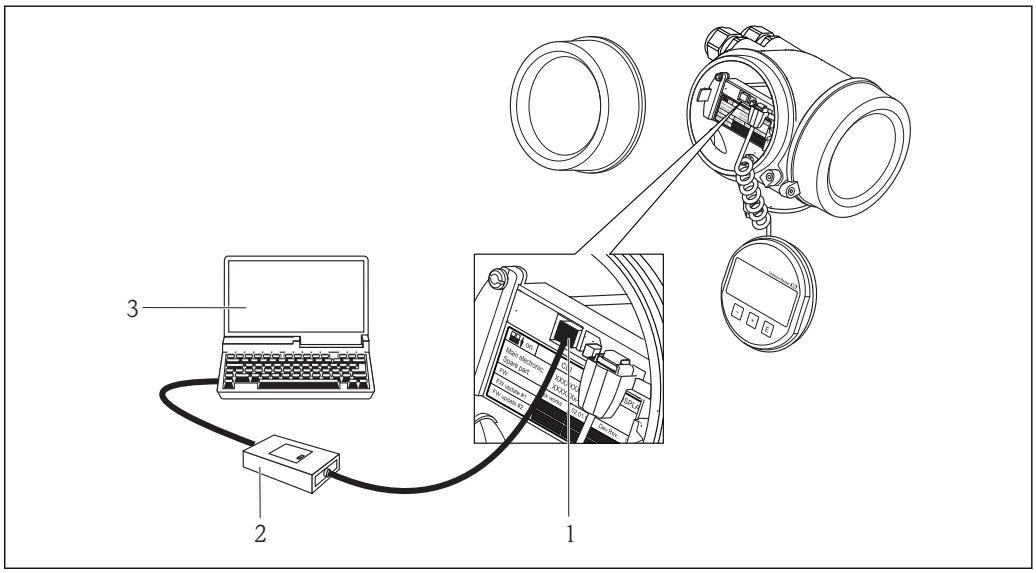


24 FOUNDATION Fieldbus system architecture with associated components

1 FFblue Bluetooth modem
2 Field Xpert SFX100
3 FieldCare
4 NI-FF interface card

IN	Industrial network
FF-HSE	High Speed Ethernet
FF-H1	FOUNDATION Fieldbus-H1
LD	Linking Device FF-HSE/FF-H1
PS	Bus Power Supply
SB	Safety Barrier
BT	Bus Terminator

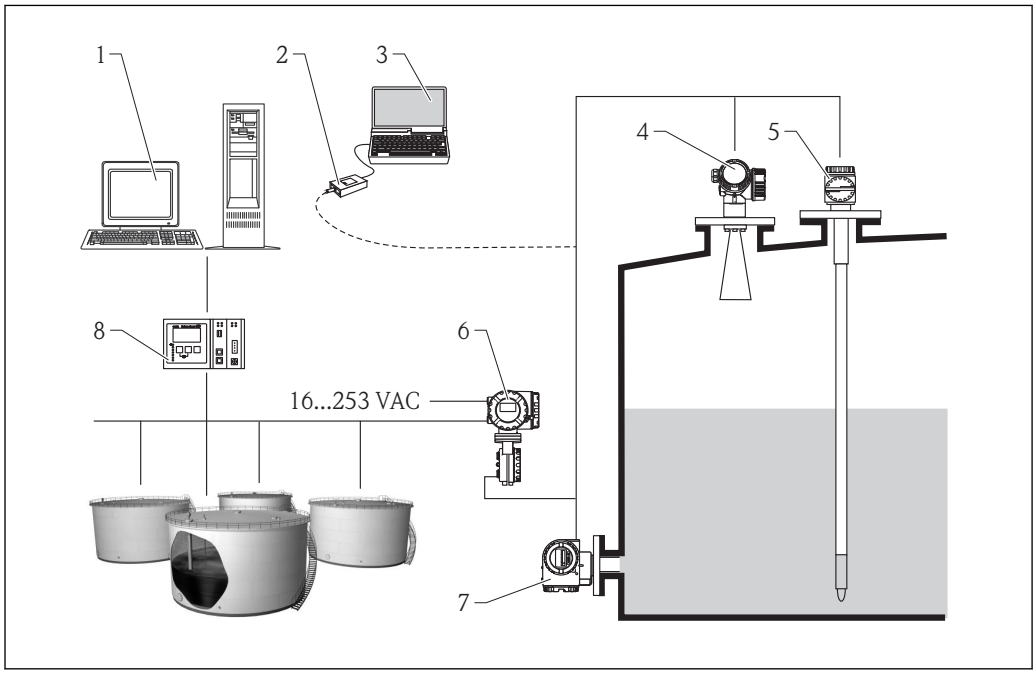
Via service interface (CDI)



1 Service interface (CDI) of the measuring device (= Endress+Hauser Common Data Interface)
2 Commubox FXA291
3 Computer with "FieldCare" operating tool

Integration in tank gauging system

The Endress+Hauser Tank Side Monitor NRF590 provides integrated communications for sites with multiple tanks, each with one or more sensors on the tank, such as radar, spot or average temperature, capacitive probe for water detection and/or pressure sensors. Multiple protocols out of the Tank Side Monitor guarantee connectivity to nearly any of the existing industry standard tank gauging protocols. Optional connectivity of analog 4...20 mA sensors, digital I/O and analog output simplify full tank sensor integration. Use of the proven concept of the intrinsically safe HART bus for all on-tank sensors yields extremely low wiring costs, while at the same time providing maximum safety, reliability and data availability.



25 The complete measuring system consists of:

1 Tankvision workstation
2 Commubox FXA195 (USB) - optional
3 Computer with operating tool (ControlCare) - optional
4 Level measuring device
5 Temperature measuring device
6 Tank Side Monitor NRF590
7 Pressure measuring device
8 Tankvision Tank Scanner NXA820

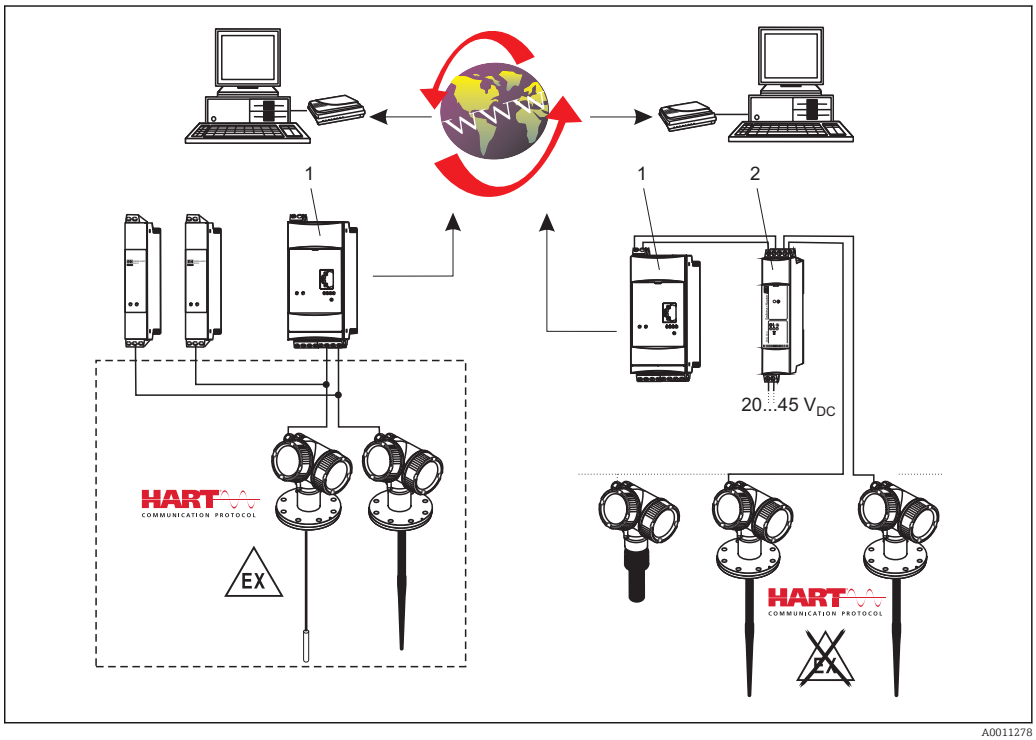
System integration via Fieldgate

Vendor Managed Inventory

By using Fieldgates to interrogate tank or silo levels remotely, suppliers of raw materials can provide their regular customers with information about the current supplies at any time and, for example, account for them in their own production planning. For their part, the Fieldgates monitor the configured level limits and, if required, automatically activate the next supply. The spectrum of options here ranges from a simple purchasing requisition via e-mail through to fully automatic order administration by coupling XML data into the planning systems on both sides.

Remote maintenance of measuring equipment

Fieldgates not only transfer the current measured values, they also alert the responsible standby personnel, if required, via e-mail or SMS. In the event of an alarm or also when performing routine checks, service technicians can diagnose and configure connected HART devices remotely. All that is required for this is the corresponding HART operating tool (e.g. FieldCare, ...) for the connected device. Fieldgate passes on the information transparently, so that all options for the respective operating software are available remotely. Some on-site service operations can be avoided by using remote diagnosis and remote configuration and all others can at least be better planned and prepared.



26 *The complete measuring system consists of devices and:*

1 *Fieldgate FXA520*
2 *Multidrop Connector FXN520*

The number of instruments which can be connected in mutidrop mode can be calculated by the "FieldNetCalc" program. A description of this program can be found in Technical Information TI 400F (Multidrop Conncector FXN520). The program is available form your Endress+Hauser sales organisation or in the internet at: www.de.endress.com/Download (text search = "Fieldnetcalc").

Certificates and approvals

CE mark

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

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

C-Tick symbol

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

- ATEX
- IEC Ex
- CSA (in Vorbereitung)
- FM (in Vorbereitung)
- NEPSI (in Vorbereitung)
- TIIS (in Vorbereitung)

Additional safety instructions must be observed for applications in hazardous areas. They are contained in the separate "Safety Instructions" (XA) document, which is included in the scope of delivery. Reference is made to the XA on the nameplate of the device.

Details on the available certificats as well as the associated XAs can be found in the **Associated documentation** chapter in the **Safety instructions** section: (→ 93).

Dual seal according to ANSI/ISA 12.27.01

The devices Micropilot FMR5x have been designed according to ANSI/ISA 12.27.01 as dual seal devices, allowing the user to waive the use and save the cost of installing external secondary process seals in the conduit as required by the process sealing sections of ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These instruments comply with the North-American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids.

Further information can be found in the control drawings of the relevant devices.

Functional Safety

Used for level monitoring (MIN, MAX, range) up to SIL 3 (homogeneous or inhomogeneous redundancy), independently assessed by TÜV Rhineland as per IEC 61508. Other information see documentation SD01087F: "Functional Safety Manual".

WHG

in preparation

Sanitary compatibility

FMR52 with flange cladding made of PTFE conforms to FDA 21 CFR 177.1550 and USP <88> Class VI

3A and EHEDG approval with Tri-Clamp process connection.

The leak-tight connections can be cleaned with the cleaning methods usually used in this industry without leaving residues.

The 316L housing (GT18), option B in the order attribute 40, is not suitable for applications which need a 3A approval.

AD2000

The pressure retaining material 316L (1.4435/1.4404) corresponds to AD2000 - W2/W10.

Pressure Equipment Directive

The Micropilot is not subject to the scope of the Pressure Equipment Directive 97/23/EC, as it does not have a pressure-bearing housing according to article 1, section 2.1.4 of the directive.

Marine certificate (in preparation)

in preparation

Radio standard EN302729-1/2

The devices Micropilot FMR50, FMR51, FMR52, FMR56 and FMR57 are conform with the LPR (Level Probing Radar) standard EN302729-1/2. The devices are allowed to be used inside or outside of closed bins or tanks in countries of th EU and the EFTA. Precondition is that the country itself already has implemented the directive.

At present, the following countries have already implemented the directive:

Belgium, Bulgaria, Germany, Denmark, Estonia, France, Greece, Great Britain, Ireland, Iceland, Italy, Liechtenstein, Lithuania, Latvia, Malta, Netherland, Norway, Austria, Poland, Romania, Sweden, Switzerland, Slovakia, Spain, Czech Republic and Cyprus.

All countries not mentioned above are at present in the implementation phase.

For the use of the devices outside of closed bins or tanks, the following has to be observed:

1. The installation has to be done by trained personnel.
2. The antenna of the device has to be mounted on a fixed place and vertically to the bottom.
3. The mounting place has to be in a distance of at least 4 km to the mentioned astronomical stations or an appropriate permission has to be issued by the national authority. If the device is mounted at a distance of 4 to 40 km from the stations mentioned, the maximum mounting height is restricted to 15 m (49 ft).

Astronomical stations

Country	Name of the station	Geographical latitude	Geographical longitude
Germany	Effelsberg	50°31'32" N	06°53'00" E
Finland	Metsähovi	60°13'04" N	24°23'37" E
	Tuorla	60°24'56" N	24°26'31" E
France	Plateau de Bure	44°38'01" N	05°54'26" E
	Floirac	44°50'10" N	00°31'37" W
United Kingdom	Cambridge	52°09'59" N	00°02'20" E
	Damhall	53°09'22" N	02°32'03" W
	Jodrell Bank	53°14'10" N	02°18'26" W
	Knockin	52°47'24" N	02°59'45" W
	Pickmere	53°17'18" N	02°26'38" W
Italy	Medicina	44°31'14" N	11°38'49" E
	Noto	36°52'34" N	14°59'21" E
	Sardinia	39°29'50" N	09°14'40" E
Poland	Krakow Fort Skala	50°03'18" N	19°49'36" E
Russia	Dmitrov	56°26'00" N	37°27'00" E
	Kalyazin	57°13'22" N	37°54'01" E
	Pushchino	54°49'00" N	37°40'00" E
	Zelenchukskaya	43°49'53" N	41°35'32" E
Sweden	Onsala	57°23'45" N	11°55'35" E
Switzerland	Bleien	47°20'26" N	08°06'44" E
Spain	Yebes	40°31'27" N	03°05'22" W
	Robledo	40°25'38" N	04°14'57" W
Hungary	Penc	47°47'22" N	19°16'53" E

In general the requirements of EN 302729-1/2 has to be taken in consideration.

Radio standard EN302372-1/2

The devices Micropilot FMR50, FMR51, FMR52, FMR53, FMR54, FMR56 and FMR57 are conform with the TLPR (Tanks Level Probing Radar) standard EN302372-1/2 and can always be used in closed tanks or bins. For installation, points a to f in Annex B of EN302372-1 have to be taken into account.

FCC / Industry Canada

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.

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.

Japanes radio approval

The devices FMR50, FMR51, FMR52, FMR54 and FMR57 comply with the Japanese Radio Law, Article 6, Section 1(1).

CRN approval

in preparation

Track record

FMR5x is the upgrade model of the corresponding FMR2xx series.

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code)
- EN 61010-1
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.
- IEC/EN 61326
  "Emission in accordance with Class A requirements". Electromagnetic compatibility (EMC requirements)
- 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 53
  Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 107
  Status classification as per NE107
- NAMUR NE 131
  Requirements for field devices for standard applications
- IEC61508
  Functional safety of electrical/electronic/programmable electronic safety-related systems

Ordering information

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

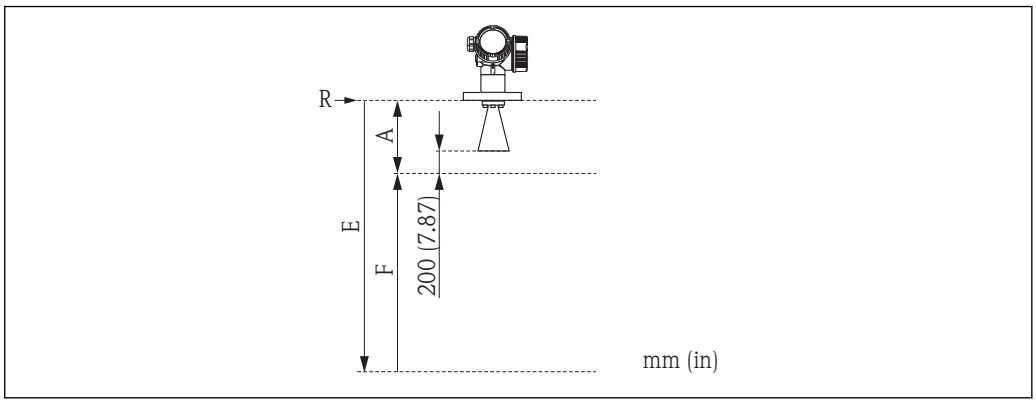
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

5-point linearity protocol

The following notes must be taken into account if option F4 ("5 point linearity protocol") has been selected in feature 550 ("Calibration").

The five points of the linearity protocol are evenly distributetd across the measuring range (0% to 100%). In order to define the measuring range, **Empty calibration** (E) and **Full calibration** (F) have to be specified [8].

The following restrictions have to be taken into account when defining E and F:



A0017983

Minimum distance between reference point (R) and 100% level	Minimum span	Maximum value for "empty calibration"
A ≥ Length of antenna + 200 mm (8 in) Minimum value: 400 mm (16 in)	F ≥400 mm (16 in)	E ≤24 m (79 ft)

The linearity is checked under reference conditions.

The selected values of **Empty calibration** and **Full calibration** are only used to record the linearity protocol and are reset to their antenna specific default values thereafter. If values different from the default are required, they must be ordered as a customized parametrization .

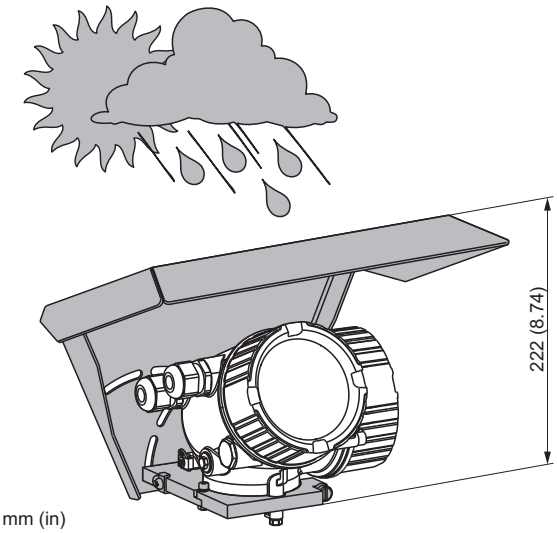
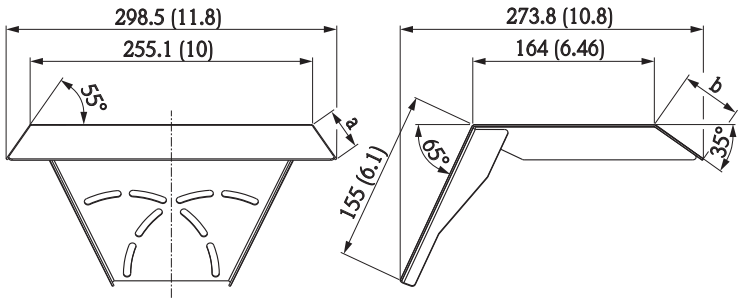
8) If E and F are not specified, antenna dependent default values will be used instead.

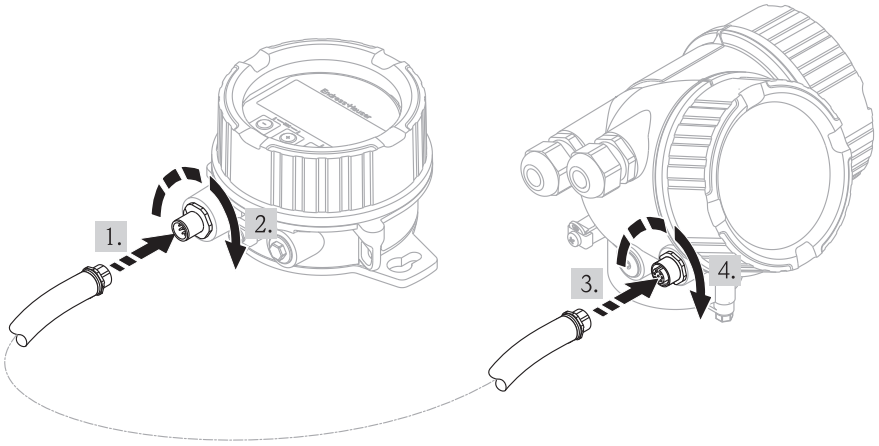
Customized parametrization

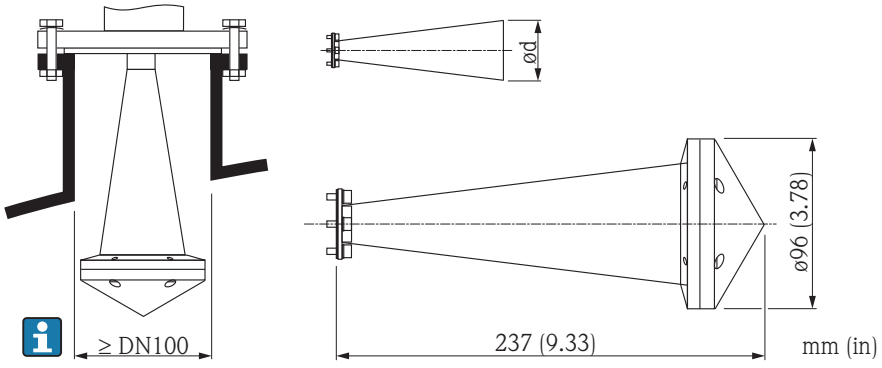
If the option IJ "Customized parametrization HART", IK "Customized parametrization PA" or IL "Customized parametrization FF" has been selected in feature 570 "Service", customer specific presettings can be selected for the following parameters:

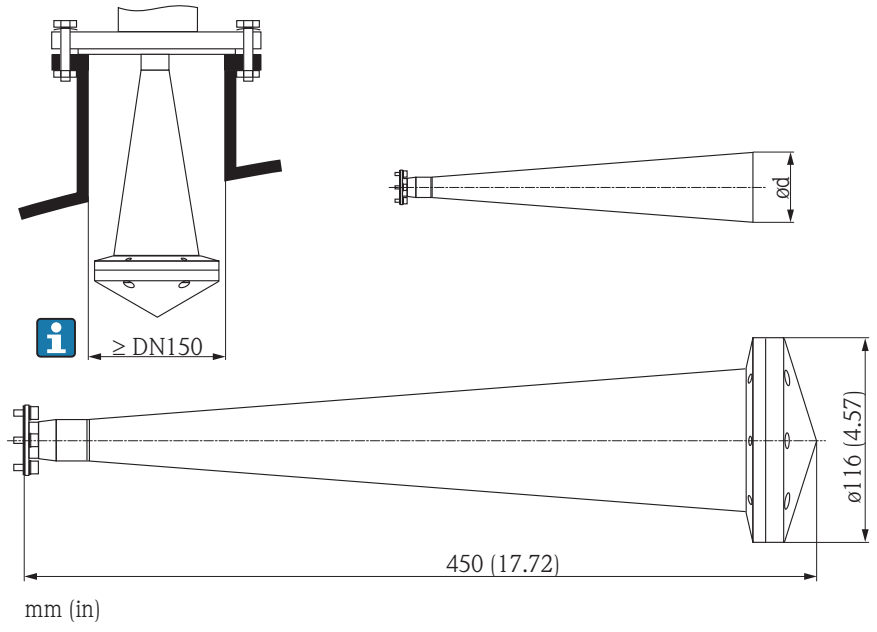
Parameter	Communication	Selection list / range of values
Setup → Distance unit	▪ HART ▪ PA ▪ FF	▪ in ▪ mm
Setup → Empty calibration	▪ HART ▪ PA ▪ FF	0 to 70 m (0 to 230 ft)
Setup → Full calibration	▪ HART ▪ PA ▪ FF	0 to 70 m (0 to 230 ft)
Setup → Adv. Setup → Current output 1/2 → Damping	HART	0 to 999,9 s
Setup → Adv. Setup → Current output 1/2 → Failure mode	HART	▪ Min ▪ Max ▪ Last valid value
Expert → Comm. → HART config. → Burst mode	HART	▪ Off ▪ On

Accessories

Accessory	Description
Weather protection cover	 mm (in) A0015466  mm (in) A0015472 *a* *37.8 mm (1.49 in)* *b* *54 mm (2.13 in)* The weather protection cover can be ordered together with the device (product structure, feature 620 "Accessory Enclosed", option PB "Weather Protection Cover"). Alternatively, it can be separately ordered as an accessory; order code 71132889.

Accessory	Description
Remote display FHX50	 A0019128 ▪ Material: – Plastics PBT – 316L (in preparation) ▪ Suitable for the display modules: – SD02 (push buttons) – SD03 (touch control) (in preparation) ▪ Connection cable: – Cable with M12 plug; supplied with the FHX50; up to 30 m (98 ft) – Customer supplied standard cable; up to 60 m (196 ft) ▪ If the remote display is to be used, the Micropilot must be ordered in the version "Prepared for display FHX50" (feature 030, option L or M). For the FHX50, on the other hand, the option A: "Prepared for display FHX50" has to be selected in feature 050: "Option Measurement Device". ▪ If a Micropilot has not been ordered in the version "Prepared for display FHX50", but is nevertheless to be equipped with an FHX50, it is essential to select the option B: "Not prepared for display FHX50" in feature 050: "Option Measurement Device" of the FHX50. In this case, a retrofit kit, needed to prepare the Micropilot for the remote display, is supplied together with the FHX50. For details refer to the document SD01007F.

Accessory	Description
Horn protection for 80 mm (3 in) horn antenna	 A0019143 For details please refer to the Mounting Instructions SD01084F. **Process conditions** ▪ Maximum vessel pressure: 0.5 bar (7.252 psi) ▪ Maximum process temperature: 130 °C (266 °F) Danger of explosion Avoid electrostatic charging of the horn protection.

Accessory	Description
Horn protection for 100 mm (4 in) horn antenna	 For details please refer to the Mounting Instructions SD01084F. **Process conditions** ▪ Maximum vessel pressure: 0.5 bar (7.252 psi) ▪ Maximum process temperature: 130 °C (266 °F) Danger of explosion Avoid electrostatic charging of the horn protection.

Communication-specific accessories

Accessory	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details refer to Technical Information TI00404F

Accessory	Description
Commubox FXA291	Connects Endress+Hauser field devices with CDI interface (= Endress+Hauser Common Data Interface) to the USB interface of a computer. For details refer to Technical Information TI00405C

Accessory	Description
HART Loop Converter HMX50	Evaluates the dynamic HART variables and converts them to analog current signals or limit values. For details refer to Technical Information TI00429F and Operating Instructions BA00371F

Accessory	Description
WirelessHART Adapter SWA70	Connects field devices to a WirelessHART network. The WirelessHART adapter can be mounted directly at a HART device and is easly integrated into an existing HART network. It ensures safe data transmission and can be operated in parallel with other wireless networks. For details refer to Operating Instructions BA00061S

Accessory	Description
Fieldgate FXA320	Gateway for remote monitoring of connected 4-20mA measuring devices via web browser. For details refer to Technical Information TI00025S and Operating Instructions BA00053S

Accessory	Description
Fieldgate FXA520	Gateway for remote diagnosis and parametrization of connected HART measuring devices via web browser. For details refer to Technical Information TI00025S and Operating Instructions BA00051S

Accessory	Description
Field Xpert SFX100	Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART output or via FOUNDATION Fieldbus . For details refer to Operating Instructions BA00060S

Service-specific accessories

Accessory	Description
FieldCare	Endress+Hauser's FDT-based Plant Asset Management tool. Helps to configure and maintain all field devices of your plant. By supplying status information it also supports the diagnosis of the devices. For details refer to Operating Instructions BA00027S and BA00059S.

System components

Accessory	Description
Graphic Data Manager Memograph M	The graphic data manager Memograph M provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on an SD card or USB stick. For details refer to Technical Information TI00133R and Operating Instructions BA00247R
RN221N	Active barrier with power supply for safe separation of 4 to 20 mA current circuits. Provides bi-directional HART transmission. For details refer to Technical Information TI00073R and Operating Instructions BA00202R
RNS221	Transmitter supply for 2-wire sensors or transmitters exclusively for non-Ex areas. Provides bi-directional communication using the HART communication sockets. For details refer to Technical Information TI00081R and Operating Instructions KA00110R

Documentation

The following document types are available:
- On the CD supplied with the device
- In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

Standard documentation

Micropilot FMR51, FMR52

Correlation of documentations to the device:

Device	Power supply, output	Communikation	Document type	Document code
FMR51 FMR52	A, B, C, K, L	HART	Operating Instructions	BA01049F/00/EN
			Brief Operating Instructions	KA01100F/00/EN
			Description of Device Parameters	GP01014F/00/EN
	G	PROFIBUS PA	Operating Instructions	BA01125F/00/EN
			Brief Operating Instructions	KA01129F/00/EN
			Description of Device Parameters	GP01018F/00/EN
	E	FOUNDATION Fieldbus	Operating Instructions	BA01121F/00/EN
			Brief Operating Instructions	KA01125F/00/EN
			Description of Device Parameters	GP01017F/00/EN

Supplementary documentation

Device	Document type	Document code
Fieldgate FXA520	Technical Information	TI369F/00/EN
Tank Side Monitor NRF590	Technical Information	TI402F/00/EN
	Operating Instructions	BA256F/00/EN
	Description of Device Parameters	BA257F/00/EN

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.

Feature 010	Approval	Available for	Safety Instructions HART	Safety Instructions PROFIBUS FOUNDATION Fieldbus
BA	ATEX: II 1 G Ex ia IIC T6 Ga	▪ FMR51 ▪ FMR52	XA00677F	XA00685F
BB	ATEX: II 1/2 G Ex ia IIC T6-T1 Ga/Gb	▪ FMR51 ▪ FMR52	XA00677F	XA00685F
BC	ATEX: II 1/2 G Ex d [ia] IIC T6-T1 Ga/Gb	▪ FMR51 ▪ FMR52	XA00680F	XA00688F
BD	ATEX: II 1/2/3 G Ex ic [ia Ga] IIC T6-T1 Ga/Gb/Gc	▪ FMR51 ▪ FMR52	XA00678F	XA00686F
BG	ATEX: II 3 G Ex nA IIC T6-T1 Gc	▪ FMR51 ▪ FMR52	XA00679F	XA00687F
BH	ATEX: II 3 G Ex ic IIC T6-T1 Gc	▪ FMR51 ▪ FMR52	XA00679F	XA00687F
BL	ATEX: II 1/2/3 G Ex nA [ia Ga] IIC T6-T1 Ga/Gb/Gc	▪ FMR51 ▪ FMR52	XA00678F	XA00686F
B2	ATEX: II 1/2 G Ex ia IIC T6-T1 Ga/Gb ATEX: II 1/2 D Ex ia IIIC Txx°C Da/Db	▪ FMR51 ▪ FMR52	XA00683F	XA00691F

Feature 010	Approval	Available for	Safety Instructions HART	Safety Instructions PROFIBUS FOUNDATION Fieldbus
B3	ATEX: II 1/2 G Ex d [ia] IIC T6-T1 Ga/Gb ATEX: II 1/2 D Ex ta IIIC Txx°C Da/Db	▪ FMR51 ▪ FMR52	XA00684F	XA00692F
B4	ATEX:II 1/2 G Ex ia IIC T6-T1 Ga/Gb ATEX: II 1/2 G Ex d [ia] IIC T6-T1 Ga/Gb	▪ FMR51 ▪ FMR52	XA00681F	XA00689F
IA	IECEx: Ex ia IIC T6-T1 Ga	▪ FMR51 ▪ FMR52	XA00677F	XA00685F
IB	IECEx: Ex ia IIC T6-T1 Ga/Gb	▪ FMR51 ▪ FMR52	XA00677F	XA00685F
IC	IECEx: Ex d [ia] IIC T6-T1 Ga/Gb	▪ FMR51 ▪ FMR52	XA00680F	XA00688F
ID	IECEx: Ex ic [ia Ga] IIC T6-T1 Ga/Gb/Gc	▪ FMR51 ▪ FMR52	XA00678F	XA00686F
IG	IECEx: Ex nA IIC T6-T1 Gc	▪ FMR51 ▪ FMR52	XA00679F	XA00687F
IH	IECEx: Ex ic IIC T6-T1 Gc	▪ FMR51 ▪ FMR52	XA00679F	XA00687F
IL	IECEx: Ex nA [ia Ga] IIC T6-T1 Ga/Gb/Gc	▪ FMR51 ▪ FMR52	XA00678F	XA00686F
I2	IECEx: Ex ia IIC T6-T1 Ga/Gb IECEx: Ex ia IIIC Txx°C Da/Db	▪ FMR51 ▪ FMR52	XA00683F	XA00691F
I3	IECEx: Ex d [ia] IIC T6-T1 Ga/Gb IEXEx: Ex ta IIIC Txx°C Da/Db	▪ FMR51 ▪ FMR52	XA00684F	XA00692F
I4	IECEx: Ex ia IIC T6-T1 Ga/Gb IECEx: Ex d [ia] IIC T6-T1 Ga/Gb	▪ FMR51 ▪ FMR52	XA00681F	XA00689F

For certified devices the relevant Safety Instructions (XA) are indicated on the nameplate.

If the device is prepared for the remote display FHX50 (product structure: feature 030: Display, Operation", option L or M), the Ex marking of some certificates changes according to the following table [9]:

Feature 010 ("Approval")	Feature 030 ("Display, Operation")	Ex marking
BE	L oder M	ATEX II 1D Ex ta [ia] IIIC T_{500} xx°C Da
BF	L oder M	ATEX II 1/2 D Ex ta [ia Db] IIIC Txx°C Da/Db
BG	L oder M	ATEX II 3G Ex nA [ia Ga] IIC T6 Gc
BH	L oder M	ATEX II 3G Ex ic [ia Ga] IIC T6 Gc
B3	L oder M	ATEX II 1/2G Ex d [ia] IIC T6 Ga/Gb, ATEX II 1/2D Ex ta [ia Db] IIIC Txx°C Da/Db
IE	L oder M	IECEx Ex ta [ia] IIIC T500 xx°C Da
IF	L oder M	IECEx ta [ia Db] IIIC Txx°C Da/Db
IG	L oder M	IECEx Ex nA [ia Ga] IIC T6 Gc
IH	L oder M	IECEx Ex ic [ia Ga] IIC T6 Gc
I3	L oder M	IECEx Ex d [ia] IIC T6 Ga/Gb, IECEx Ex ta [ia Db] IIIC Txx°C Da/Db

9) The marking of certificates not mentioned in this table are not affected by the FHX50.

Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

FOUNDATION™ Fieldbus
Registered trademark of the Fieldbus Foundation, Austin, Texas, USA

KALREZ®, VITON®
Registered trademark of DuPont Performance Elastomers L.L.C., Wilmington, USA

TEFLON®
Registered trademark of E.I. DuPont de Nemours & Co., Wilmington, USA

TRI CLAMP®
Registered trademark of Alfa Laval Inc., Kenosha, USA

Patents

This product may be protected by at least one of the following patents.

Further patents are pending.

US Patents	EP Patents
5.948.979	882 957
6.087.978	955 527
6.140.940	-
6.155.112	834 722
-	882 955
6.266.022	1 083 413
6.295.874	210 567
6.512.358	1 301 914
6.606.904	-
6.640.628	-
6.679.115	1 360 523
-	1 389 337
6.779.397	-
7.201.050	-
7.412.337	-
7.552.634	-
7.730.760	-
7.819.002	-
-	1 774 616
7.966.141	-
8.040.274	-
8.049.371	-

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