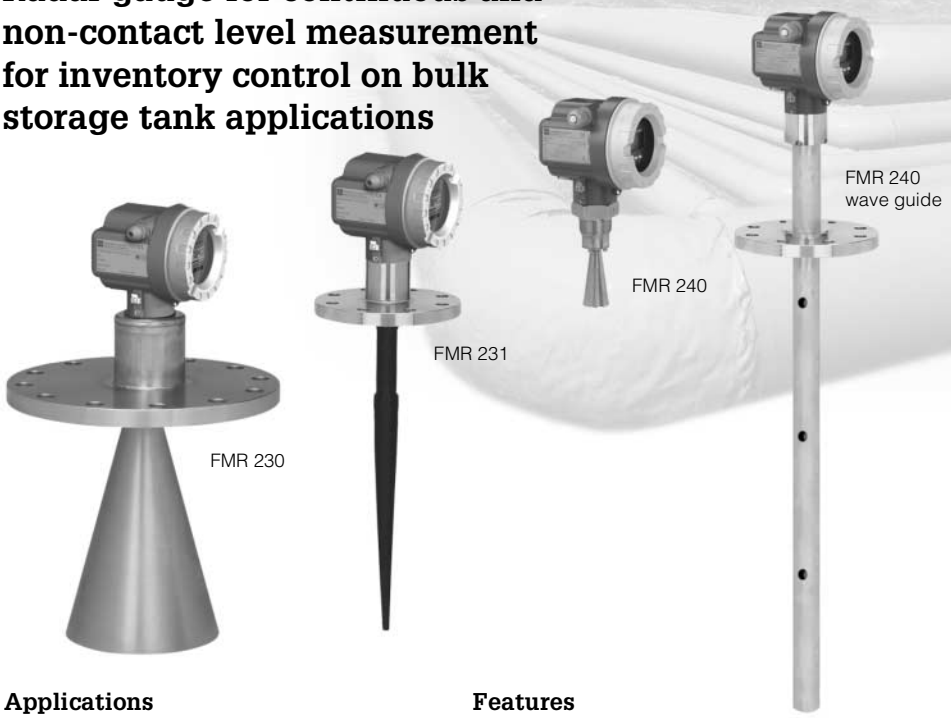
Technical Information
Ti 018G/03/ae

Level-Radar *micropilot M* *FMR 230/231/240*

Radar gauge for continuous and non-contact level measurement for inventory control on bulk storage tank applications



Applications

The Micropilot M is used for continuous, non-contact level measurement of liquids in bulk storage tanks for inventory control applications. Measurement is not affected by changing products, temperature changes, gas blankets or vapors.

- The FMR 230 radar with horn antenna is especially suited for measurement in bulk storage, buffer and process tanks.
- The FMR 231 radar with rod antenna has its strengths wherever high chemical compatibility is required.
- The FMR 240 wave guide, with its own integrated 1½" (38 mm) stilling well, is optimal for bullet tanks and small containers.

Features

- Two-wire technology for integration with all tank sensors via the Tank Side Monitor NRF 590
- Intrinsically safe wiring for all on-tank sensors reduces wiring costs and improves reliability
- Non-contact measurement:
  No moving parts, no product contact and extremely low maintenance
  Independent measurement not influenced by sticky or viscous products
- Easy on-tank operation via menu-driven alphanumeric display
- Easy commissioning and diagnostics
- Two frequency ranges – 6 and 26 GHz:
  No compromises – the right frequency for every application
- Full antenna range:
  Horn for stilling well and free space
  Rod for free space and narrow nozzles, condensation or product build up
  Wave guide for light products stored in small or bullet tanks
- Instrument accuracy for inventory control measurement ±3 to ±6 mm

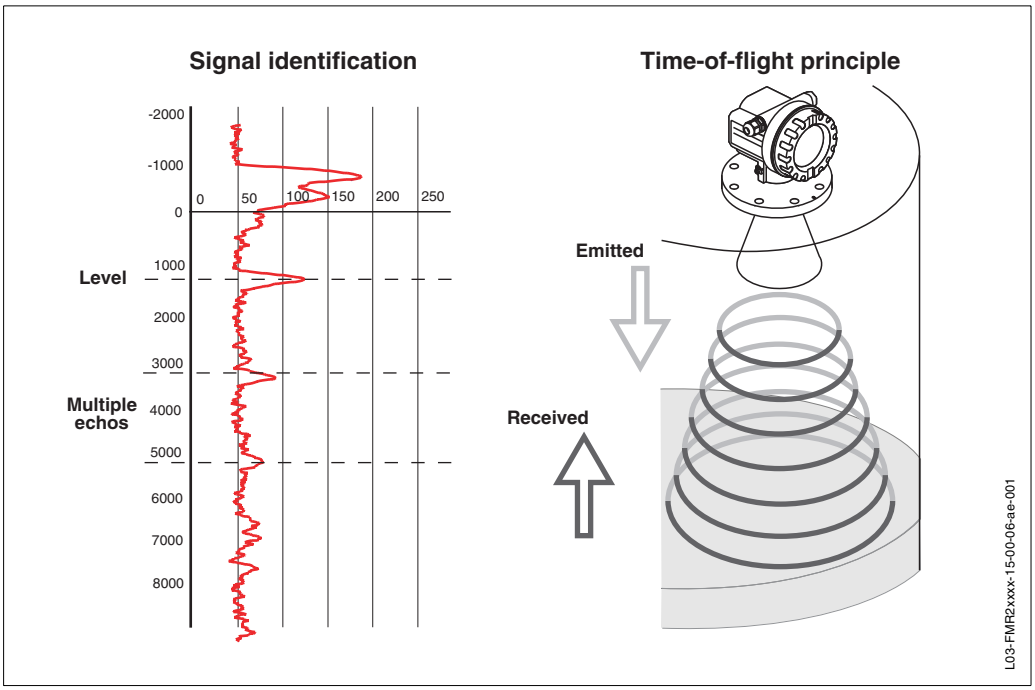
Online
www.systems.endress.com

Endress+Hauser
Systems & Gauging

Function and system design

Measuring principle

The Micropilot is a "downward-looking" measuring system, operating based on the time-of-flight principle. It measures the distance from the reference point (gauge flange) to the product surface (also known as Ullage or Outage). Radar impulses are emitted by an antenna, reflected off the product surface and received again by the radar system.



Signal identification and time-of-flight principle

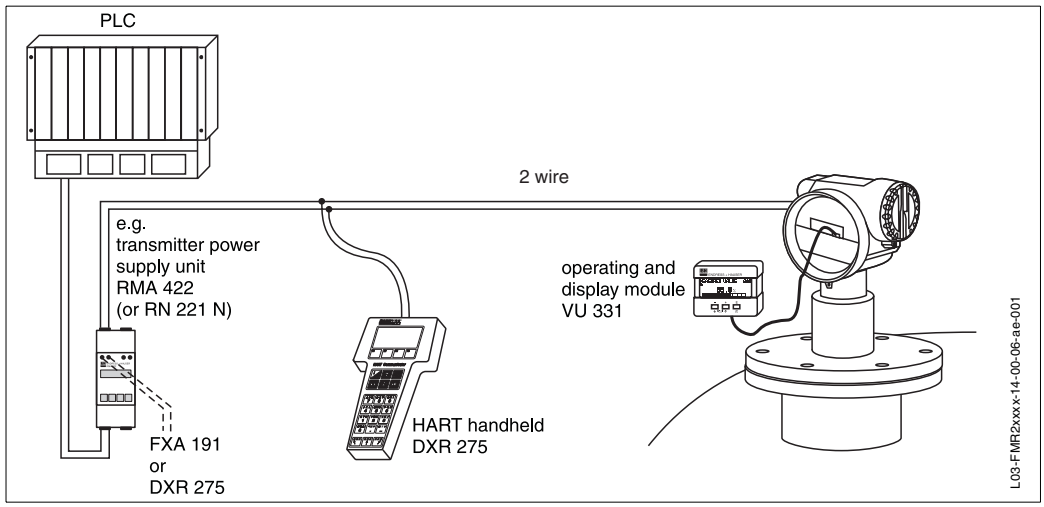
A microprocessor evaluates impulses received and identifies the level echo caused by the reflection of the radar impulse at the product surface. The distance to the product surface is proportional to the time-of-flight of the impulse. The unambiguous signal identification is accomplished by the PulseMaster software, based on many years of experience with time-of-flight technology. The Micropilot is also equipped with functions to suppress interference echoes. The user can activate these functions. They ensure that interference echoes (i.e. from edges and weld seams) are not interpreted as level echo.

This document is dedicated to bulk storage tank gauging applications. Therefore, gauge versions and options typically required for process control have been excluded. Endress+Hauser has extensive experience in level measurement applications for process control for the food and beverage industry. Please contact Endress+Hauser for detailed advice on this and any other applications.

Equipment architecture

Standalone operation

The radar can be used as a standalone instrument, where additional tank sensors are not required or where no tank gauging system is present. The local radar display provides the operator with precise level and diagnostic information. For these applications, the radar can either be supplied intrinsically safe (i.s.) via a safety barrier or in an explosion proof (Exd) version allowing non-intrinsically safe (non-i.s.) connection. Via the same 2 wires, it is possible to connect to PLC or DCS via either 4...20 mA or using the digital HART protocol.

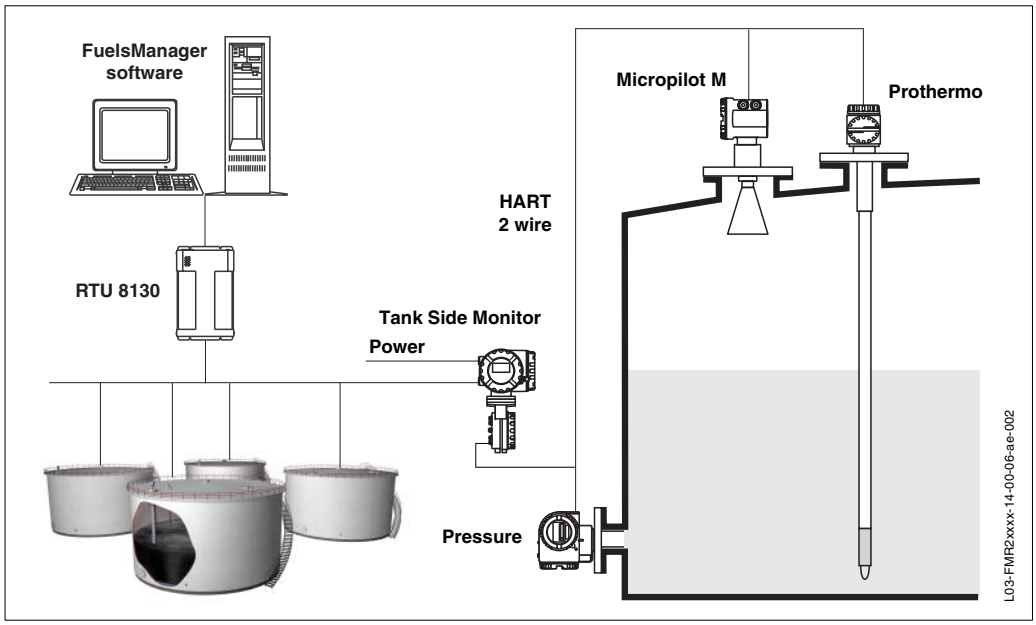


Typical standalone operation

Note!
Fieldbus Foundation and Profibus are also available. Please contact your Endress+Hauser representative for more details.

Integrated on tank gauging system

The Endress+Hauser Tank Side Monitor NRF 590 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.



Typical tank gauging system

Input

Measured variable

The measured variable is the distance between a reference point and a reflective surface (i.e. product surface). The product level (Innage) is calculated based on the gauge reference height entered.

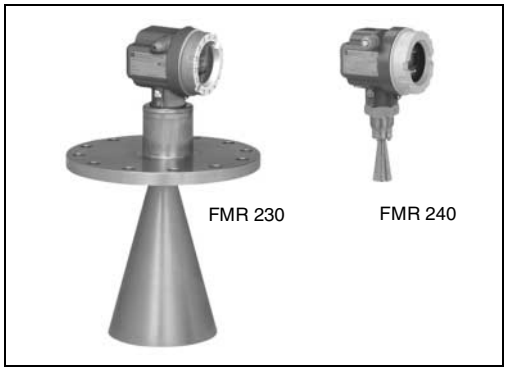
Antenna selection for Micropilot M-series

It is essential for each and every application and installation to evaluate the right antenna type. The antenna selection depends on the following criteria:
- Type of application (i.e. free space vs. stilling well)
- Installation possibilities (size, location and height of nozzle)
- Properties of the product stored in the tank (radar reflectivity, vapor pressure, temperature, etc.)
- Accuracy requirements

The Micropilot M-series radar comes with 3 basic radar antenna forms:
- Horn antenna (used for the FMR 230 and 240)
- Rod antenna (FMR 231)
- Wave guide antenna (FMR 240)

Each of these antennas has specific advantages and limitations and are hence more or less suited for the different applications and installations you might find in refineries, tank terminals, tank farms and process tanks.

Horn antenna



The horn antenna can be both utilized for free space applications, where the radar is directly installed on a nozzle on the tank roof, and stilling well applications, where the radar is installed on the stilling well. For free space applications, it is essential that the horn is bigger than 4" (DN100) and extends below the nozzle (see page 13). For stilling well applications, the diameter of the horn antenna must match the inside diameter of the stilling well. The general rule for diameter selection is "the larger, the better", as a larger aperture of the antenna generates a narrower beam and has a better gain – signal to noise (S/N) ratio. For products with a low radar reflectivity [dielectric constant (εr) < 1.9], a stilling well is always required.

There are 2 models of radar with horn antennas, the FMR 230 and FMR 240. The technical difference between these two radars is the microwave frequency on which they operate. The FMR 230 utilizes 6 GHz, while the FMR 240 uses 26 GHz. 26 GHz allows for the use of smaller aperture antennas, which have a small diameter (narrow) beam and a very good accuracy of $\pm$3 mm, compared to $\pm$10 mm for a typical 6 GHz. Both models provide sufficient level accuracy for inventory control applications. The 26 GHz is not suited for heavy foaming products, but the measuring range is slightly less than a 6 GHz FMR 230 (refer to tables on pages 6 and 7).

Rod antenna

The rod antenna is ideal for tanks where only small diameter nozzles are available and tanks containing condensing products (or heavy water condensation), as the rod is easy to clean and has good "drip-off" properties. The "inactive" length of the antenna should extend below the nozzle (see page 14).

Wave guide antenna
The wave guide antenna acts as an integrated "stilling well". As the maximum length is limited to 12.4 ft (3.8 m), this radar is best suited for horizontal bullet tanks and small tanks (containers). The small diameter [1¼“ (32 mm) only] makes it possible to install 2” (51 mm) nozzles. Application should be limited to light – non-viscous or adhering – products only. The standard wave guide has only flush holes in the bottom and top. For most applications, it is suggested to specify additional flush holes [recommended: every foot (30 cm), one 3 to 5 mm diameter hole].

Measuring range

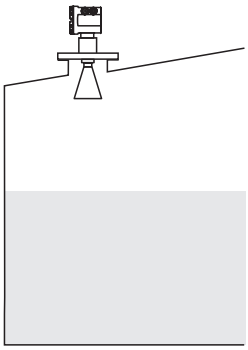
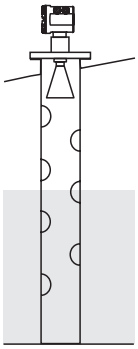
The usable measuring range depends on the size of the antenna, product properties (reflectivity of the product), the mounting location and eventual interference reflections. The following tables describe the groups of products, as well as the achievable measuring range, as a function of application and product group. If the dielectric constant (**Εr**) of a product is unknown, it is recommended to assume product group B to ensure a reliable measurement.

Product class	Εr	Examples
A	1.4 … 1.9	non-conducting liquids, e.g. liquefied gas [1]
B	1.9 … 4	non-conducting liquids, e.g. benzene, oil, toluene, …
C	4 … 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 NH3 as a product of group A, i.e. always use a stilling well.

Measuring range depending on vessel type, conditions and product for Micropilot M FMR 230 and FMR 231:

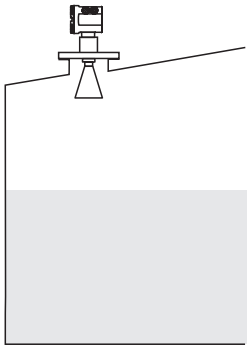
Product considerations for FMR 230 and 231

Product	Product class		Storage tank (scarce draining/filling)		Stilling well
	FMR 230  FMR 231 				
			Measuring range		Measuring range
	FMR 230:		6" DN150	8" / 10" DN200/250	3"…10" DN80…250
	FMR 231:		Rod antenna	—	—
LPG	**A**	ε_r=1.4…1.9	On stilling well only		67 ft (20 m)
White products Black products Crudes Bitumen/Asphalts	**B**	ε_r=1.9…2.5	33 ft (10 m)	50 ft (15 m)	
Chemicals	**B**	ε_r=2.5...4			
	C	ε_r=4…10	50 ft (15 m)	67 ft (20 m)	
	D	ε_r>10	67 ft (20 m)		

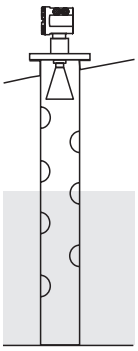
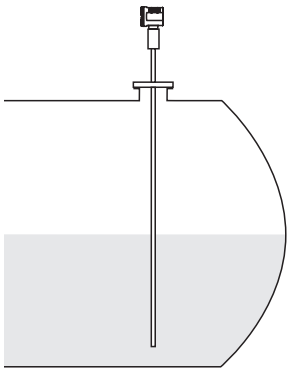
Note!
ε_r is the dielectric constant of product.

Measuring range depending on vessel type, conditions and product for Micropilot M FMR 240:

Product considerations for FMR 240 (horn)

Product	Product class		Storage tank (scarce draining/filling)			
	FMR 240 (horn) 					
			Measuring range			
	FMR 240:		1½" (40 mm)	2" DN50	3" DN80	4" DN100
LPG	**A**	εr=1.4…1.9	On stilling well only (20 m / 67 ft)			
White products **Black products** **Crudes** **Bitumen/Asphalts**	**B**	εr=1.9…2.5	10 ft (3 m)	16 ft (5 m)	33 ft (10 m)	50 ft (15 m)
Chemicals	**B**	εr=2.5...4				
	C	εr=4…10	20 ft (6 m)	10 ft (3 m)	50 ft (15 m)	67 ft (20 m)
	D	εr>10	30 ft (9 m)	50 ft (15 m)	67 ft (20 m)	

Product considerations for FMR 240 (horn) and 240 (wave guide)

Product	Product class		Stilling well	Wave guide antenna
	FMR 240 (horn)  FMR 240 (wave guide) 			
			Measuring range	Measuring range
	FMR 240:		1½" (40mm) … DN100 1½"(40mm)..4"	Wave guide antenna
LPG	**A**	εr=1.4…1.9	67 ft (20 m)	depending on wave guide length, max. 9.2 ft (2.8 m)
White products	**B**	εr=1.9…2.5		
Black products **Crudes** **Bitumen/Asphalts**				—
Chemicals	**B**	εr=2.5...4		depending on wave guide length, max. 9.2 ft (2.8 m)
	C	εr=4…10		
	D	εr>10		

Measuring conditions

Note!

- **Please use FMR 230/231 for boiling surfaces or where the product has a tendency to foam.**
- **The maximum measuring range of the FMR 240 may decrease in case of heavy steam development, depending on density, temperature and composition of the steam (-> please use FMR 230/231).**
- **Please use FMR 230 in a stilling well for the measurement of ammonia NH_3.**

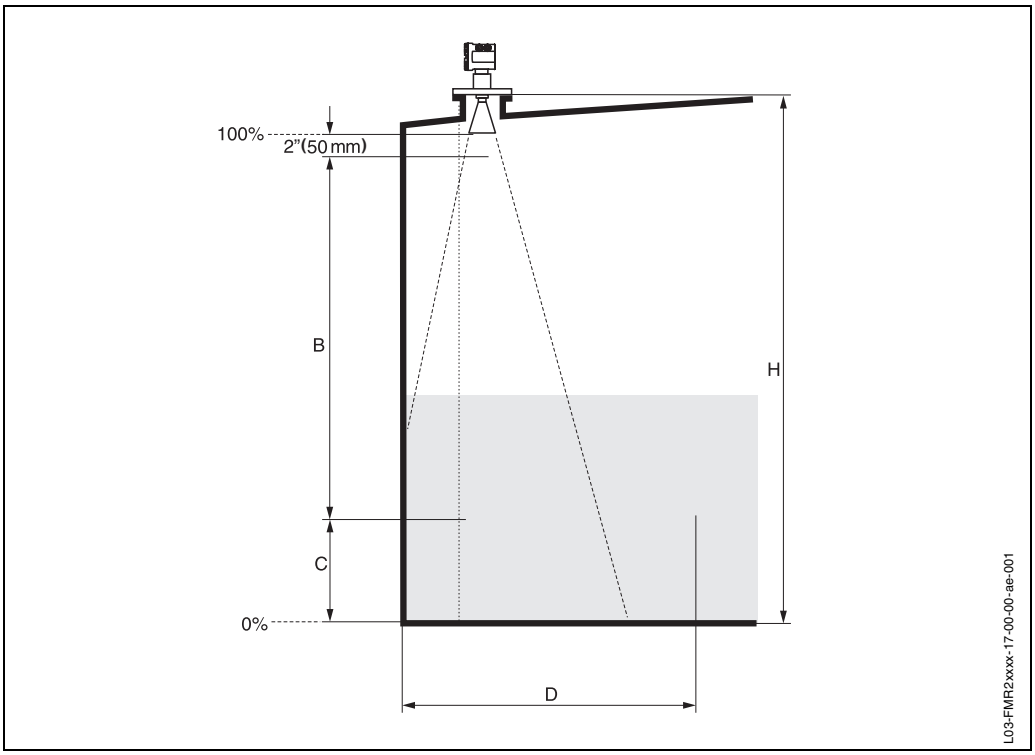


Illustration of measuring conditions

	B [inch / m]	C [inch / mm]	D [inch / m]	H [ft / m]
FMR 230 / 231	> 20 / > 0.5	6…12 / 150…300	> 40 / > 1	> 5 / > 1.5
FMR 240	> 8 / > 0.2	2…6 / 50…150	> 8 / > 0.2	> 1 / > 0.3

- The measuring range begins where the radar beam hits the tank bottom. With cone shaped bottoms or sump wells, the level cannot be detected below this point.
- In case of product with a low dielectric constant (groups A and B), the tank bottom can be visible through the medium at low levels. In order to guarantee the required accuracy in these cases, it is recommended to position the zero-point at a distance **(C)** above the tank bottom.
- In principle, it is possible to measure up to the tip of the antenna. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than 2" (50 mm) to the tip of the antenna.
- The smallest possible measuring range **(B)** depends on the antenna version.
- The tank diameter should be greater than **(D)**, the tank height at least **(H)**.
- Depending on consistence, microwaves can be either absorbed or reflected off the surface of foam. However, measurement is possible under certain conditions.

Output

Output signal

- All models provide a 4…20 mA output with HART protocol for connection to the Tank Side Monitor.

Signal on alarm

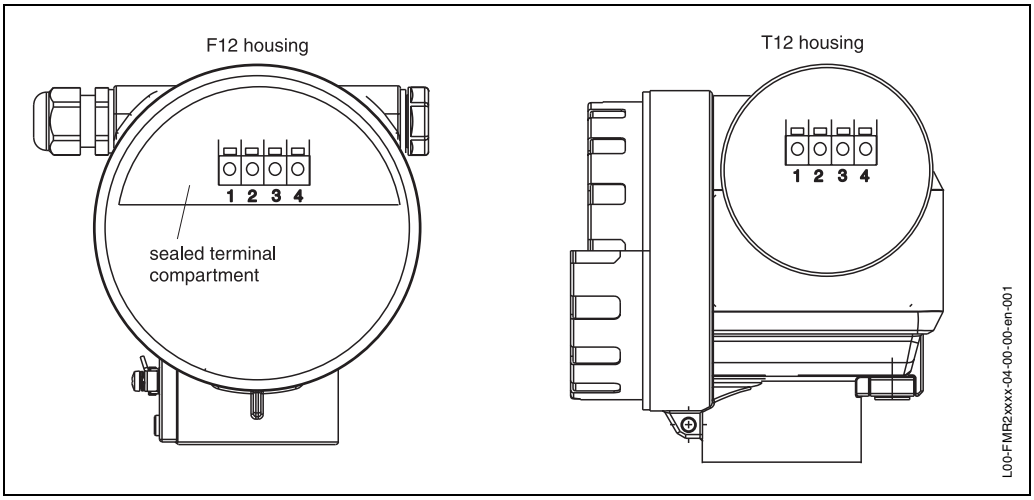
Error information can be accessed via the following interfaces:
- Local display:
  - Error symbol (see page 24)
  - Plain text display
- Current output
- Digital interface

Auxiliary energy

Electrical connection

Terminal compartment
Two housings are available:
- Housing F12 with additionally sealed terminal compartment for standard or EEx ia
- Housing T12 with separate terminal compartment for standard, EEx e or EEx d

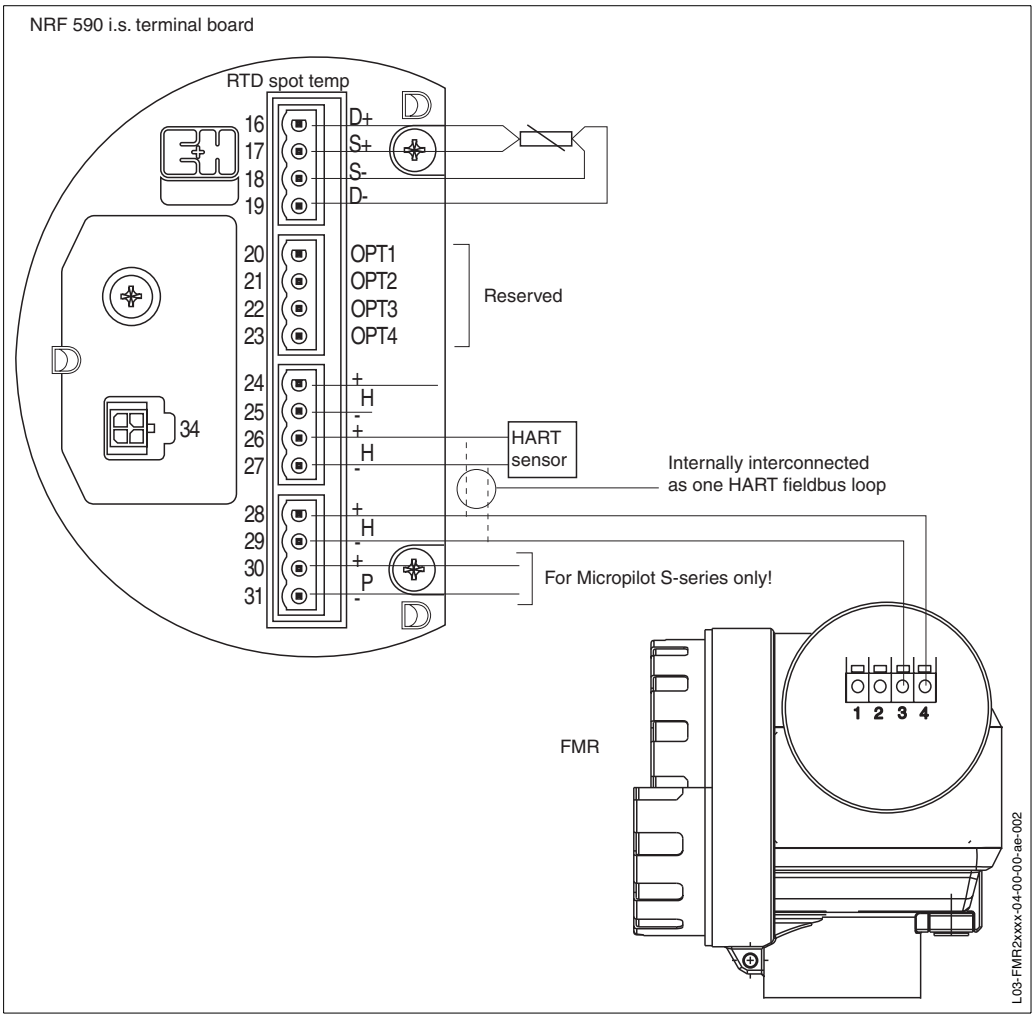
Note!
The F12 housing is ideal for installations where intrinsic safety (for example, in combination with the Tank Side Monitor NRF 590) is required. For installations where no intrinsically safe supply via a safety barrier is available or required, the T12 housing is the correct choice.



Micropilot M terminal housings

Connecting to the Tank Side Monitor NRF 590

The 2-wire cable connected to the screw terminals [wire diameter 24...10 AWG (0.5…2.5 mm)] is in the terminal compartment. Use 2-wire twisted pair cable with screen for the connection. Protective circuitry against reverse polarity, RFI and over-voltage peaks is built into the device.



Micropilot M and Tank Side Monitor terminal connections

Load HART

Minimum load for HART communication: 250 Ω

Cable entry

Cable gland: M20x1.5 or Pg13.5
Cable entry: G ½ or ½ NPT

Supply voltage[2]

The following values are the voltages across the terminals directly at the instrument:

Communication		Current consumption	Terminal voltage	
			minimal	maximal
HART	standard	4 mA	16 V	36 V
		20 mA	7.5 V	36 V
	EEx ia	4 mA	16 V	30 V
		20 mA	7.5 V	30 V
	EEx em EEx d	4 mA	16 V	30 V
		20 mA	11 V	30 V
Fixed current (measured value transferred at HART)	standard	11 mA	10 V	36 V
	EEx ia	11 mA	10 V	30 V

Power consumption[2]

Normal operation: min. 60 mW, max. 900 mW

Current consumption[2]

Communication	Current consumption
HART	3.6…22 mA

Performance characteristics

Reference operating conditions

- Temperature = +68 °F (20 °C) ±9 °F (5 °C)
- Pressure = 14.7 psia (1013 mbar abs.) ±0.3 psi (20 mbar)
- Relative humidity (air) = 65 % ±20%
- Ideal reflector
- No major interference reflections inside the signal beam

Maximum measured error

Typical statements for reference conditions include linearity, repeatability and hysteresis:

Type of device	≤ 33 ft (10 m)	≥ 33 ft (10 m)
FMR 230	±0.4" (10 mm)	±0.1% of measuring range
FMR 231	±0.4" (10 mm)	±0.1% of measuring range
FMR 240	0.12" (±3 mm)	±0.03% of measuring range

Resolution

Digital / analog in % 4…20 mA

- FMR 230: 1mm / 0.1 % of measuring range
- FMR 231: 1mm / 0.1 % of measuring range
- FMR 240: 1mm / 0.1 % of measuring range

Reaction time

The reaction time depends on the parameter settings (min. 1 s). In case of fast level changes, the instrument needs the reaction time to indicate the new value.

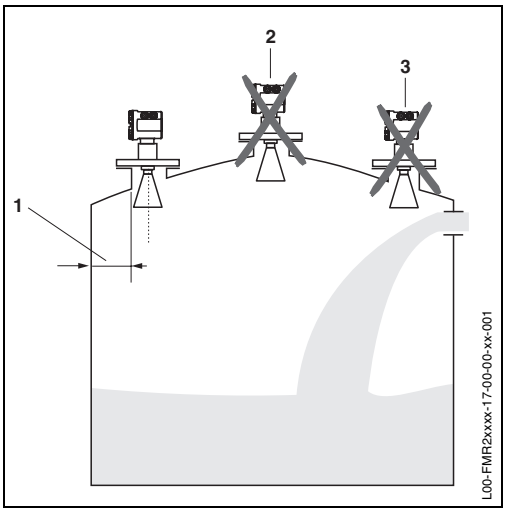
Influence of ambient temperature

0.006% / 10 K referring to maximum measuring range

2) For standalone applications.

Operating conditions / Installation

Installation instructions

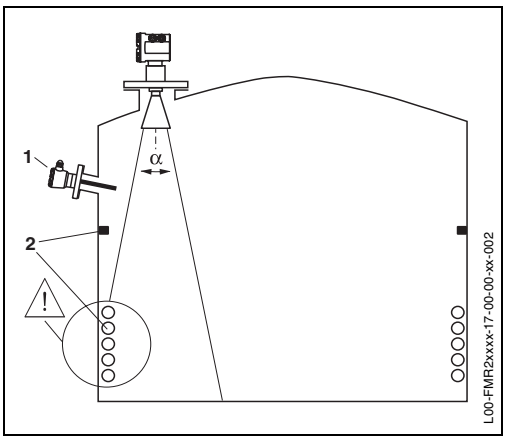


Micropilot orientation on tank

Orientation

1. Recommended distance wall – **outer edge** of nozzle: ~1/6 of tank diameter [FMR 230/ 231: min. 12" (30 cm), FMR 240: min. 6" (15 cm)]
2. Not in the center, radar interference can cause signal loss
3. Not above the fill stream

If required, a protection cover can be provided. Assembly and disassembly is simply done by means of a tension clamp (see »Accessories« on page 34).



Micropilot installation on tank

Tank installations

1. Avoid any installations, such as limit switches, temperature sensors, etc., inside the signal beam (refer to beam angle below).
2. Heating coils, wind rings, welds, etc., can also interfere with the measurement.

Options in order to optimize instrumentation and measurement accuracy

- Antenna size: the bigger the antenna, the smaller the beam angle, the less interference echoes.
- Mapping: the measurement can be optimized by means of electronic suppression of interference echoes.
- Antenna alignment: see "optimum mounting position" on page 13.
- Stilling well: a stilling well wave guide antenna can always be used to avoid interference.

Please contact Endress+Hauser Systems & Gauging for further information or advice.

Beam angle

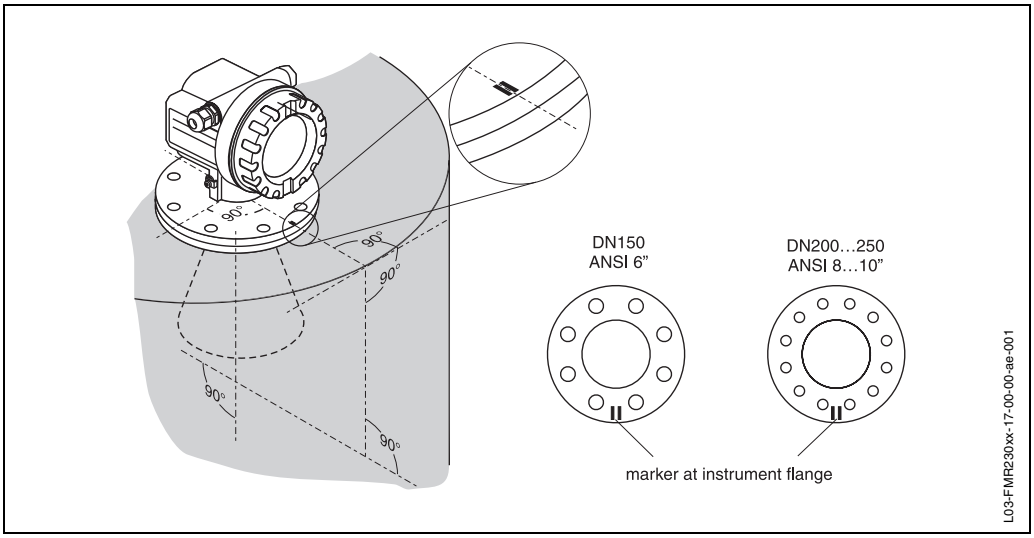
The beam angle is defined as the angle α where the energy density of the radar waves reaches half the value of the maximum energy density (3dB-width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations.

Beam angle in dependence of antenna type (diameter)

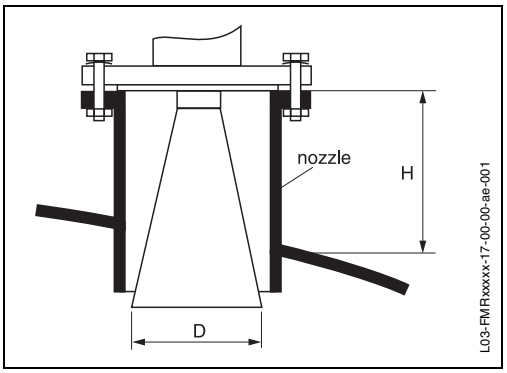
Antenna size	FMR 230			FMR 231	FMR 240			
	DN150 6"	DN200 8"	DN250 10"	Rod	1½" / 40 mm	DN50 2"	DN80 3"	DN100 4"
Beam angle α	23°	19°	15°	30°	23°	18°	10°	8°

Installation in tank (free space) FMR 230

Optimum mounting position



FMR 230 mounted on tank

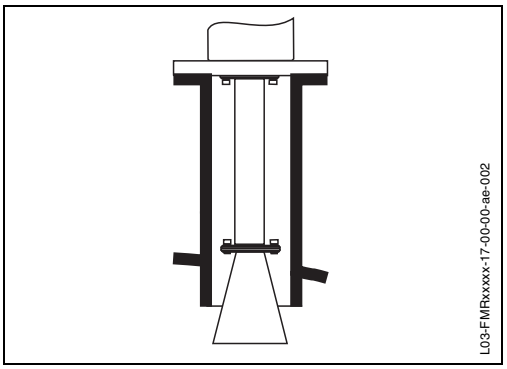


FMR 230 installation on tank

Standard installation

- Observe installation instructions on page 12.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- The horn antenna must extend below the nozzle, otherwise use antenna extension FAR10.
- Align horn antenna vertically.

Antenna size	6" / 150 mm	8" / 200 mm	10" / 250 mm
D [inch / mm]	5.8 / 146	7.5 / 191	9.5 / 241
H [inch / mm]	< 8.1 / < 205	< 11.5 / < 290	<15 / < 380



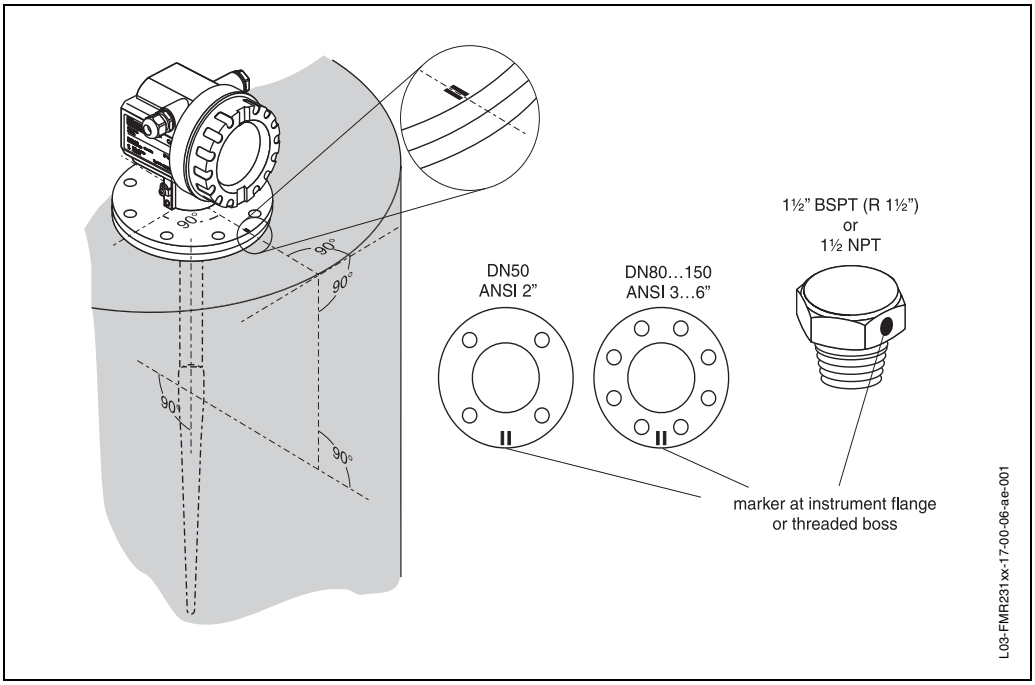
Antenna extension

Antenna extension FAR 10

- The antenna extension has to be selected such that the horn extends below the nozzle.
- If the horn diameter is greater than the nominal width of the nozzle, the antenna, including the extension, is mounted from inside the vessel. The bolts are tightened from outside, with the instrument lifted up. The extension has to be selected such that the instrument can be lifted by at least 4" (100 mm).

Installation in tank (free space) FMR 231

Optimum mounting position

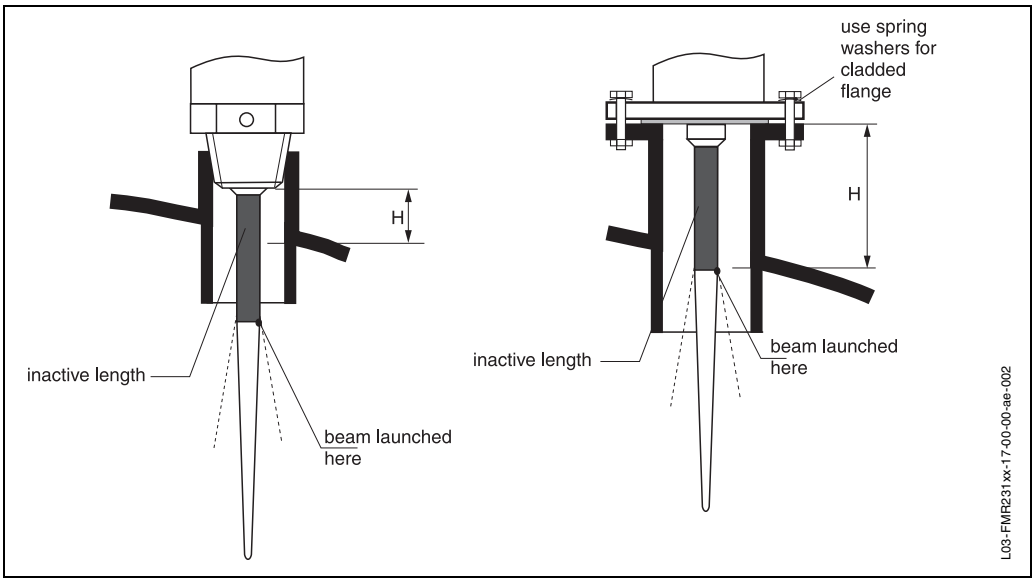


FMR 231 mounted on tank

Standard installation

- Observe installation instructions on page 12.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- The inactive part of the rod antenna must extend below the nozzle.
- The rod antenna must be aligned vertically.

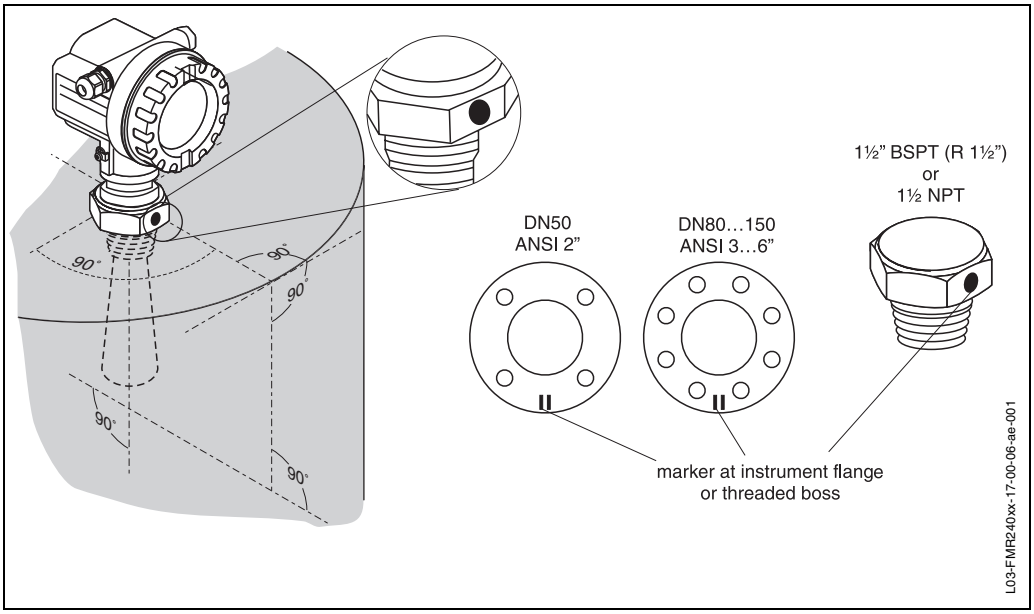
Material	PPS		PTFE	
Antenna length [inch / mm]	14 / 360	20 / 510	14 / 360	20 / 510
H [inch / mm]	< 4 / < 100	< 10 / < 250	< 4 / < 100	< 10 / < 250



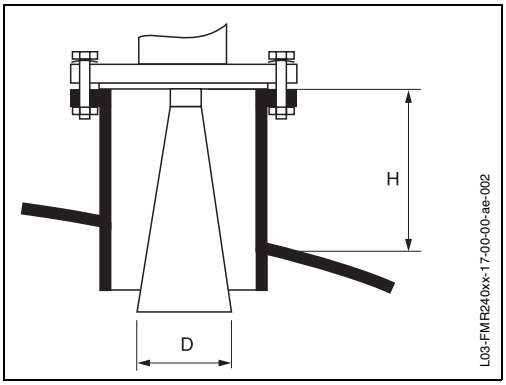
FMR 231 installation on tank

Installation in tank (free space) FMR 240

Optimum mounting position



FMR 240 mounted on tank



FMR 240 installation on tank

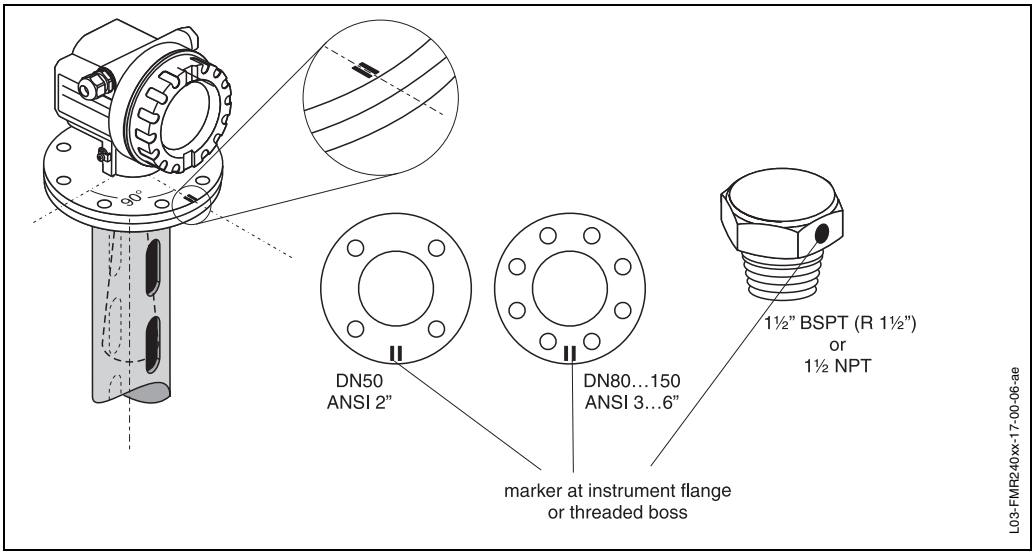
Standard installation

- Observe installation instructions on page 12.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- The horn antenna should extend below the nozzle. If required, use version with 4" (100 mm) antenna extension (see page 22).
- The horn antenna must be aligned vertically.
- The correct horn must be chosen.

Antenna size	1½" / 40 mm	DN50	DN80	DN100
D [inch / mm]	1.5 / 40	1.9 / 48	3 / 75	3.7 / 95
H [inch / mm]	< 3.4 / < 85	< 4.5 / < 115	< 8.3 / < 210	< 11 / < 280

Installation in stilling well FMR 230 / 240

Optimum mounting position



FMR 240 mounted on stilling well

Standard installation

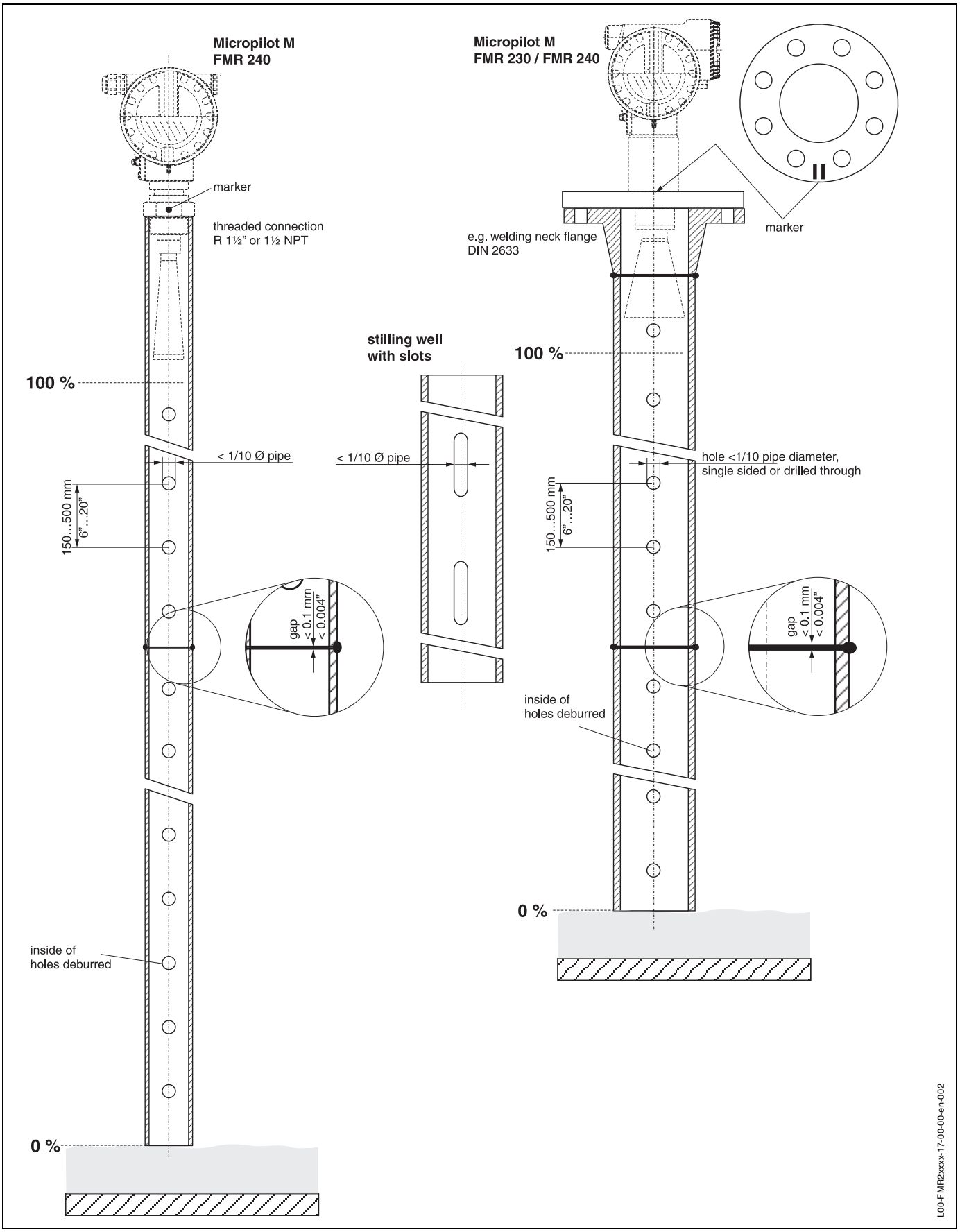
- Observe installation instructions on page 12.
- Marker is aligned toward slots.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- Measurements can be performed through a full bore open ball valve without any problems.

Recommendations for the stilling well

- Metal
- Constant diameter
- Weld seam as smooth as possible and on the same axis as the slots.
- Slots offset 180° (not 90°)
- Slot width (diameter of holes) should be max. 1/10 of pipe diameter, de-burred. Length and number do not have any influence on the measurement [suggested spacing 1 ft (30 cm) and 1" (2.5 cm) diameter. For light products, smaller diameter holes can be considered].
- Select horn antenna as big as possible. For intermediate sizes [i.e. 7" (180 mm)] select next larger antenna and adapt it mechanically.
- At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 0.1 mm.
- The stilling well must be smooth on the inside [average roughness $Rz \leq 30$ µm (0.03 mm)[3]]. 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).

3) Average roughness (Rz) is the arithmetic average of 5 individually measured roughness values.

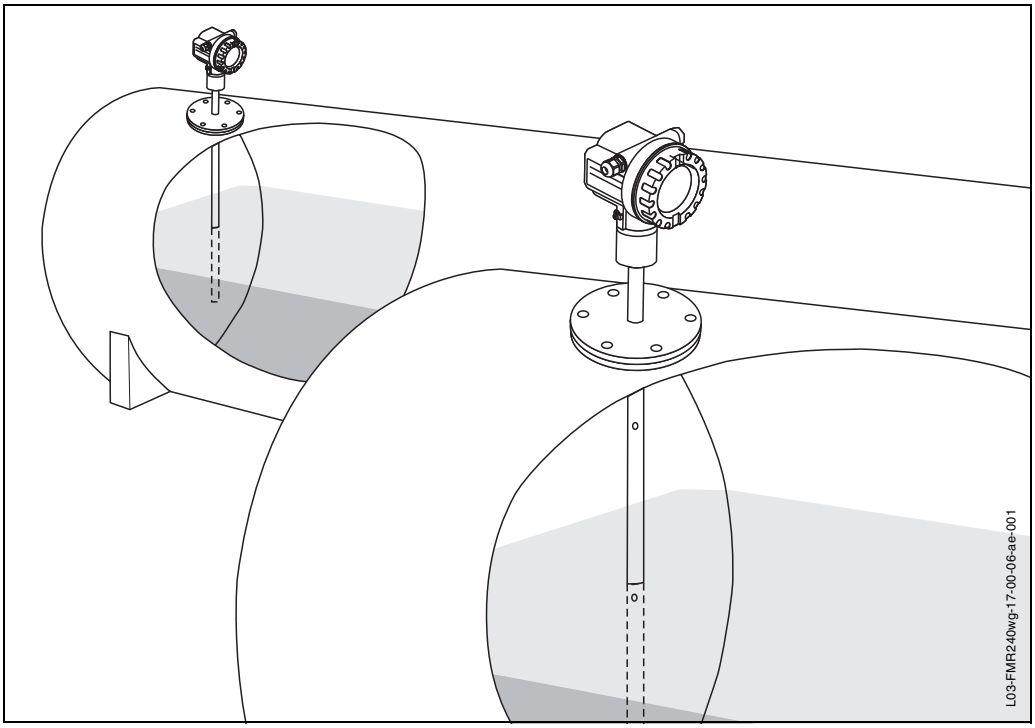
Examples for the construction of stilling wells



Note!
See pages 6 and 7 for minimum 0% and maximum 100% measuring dimensions.

Installation FMR 240 with wave guide antenna

Optimum mounting position



FMR 240 wave guide mounted on bullet tank

Standard installation

- Observe installation instructions on page 12.
- Can be mounted in a tank, bypass or slotted stilling well.
- No alignment is required.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- Only suitable for media with low viscosity, without the tendency for build-up in the wave guide antenna.

Operating conditions / Environment

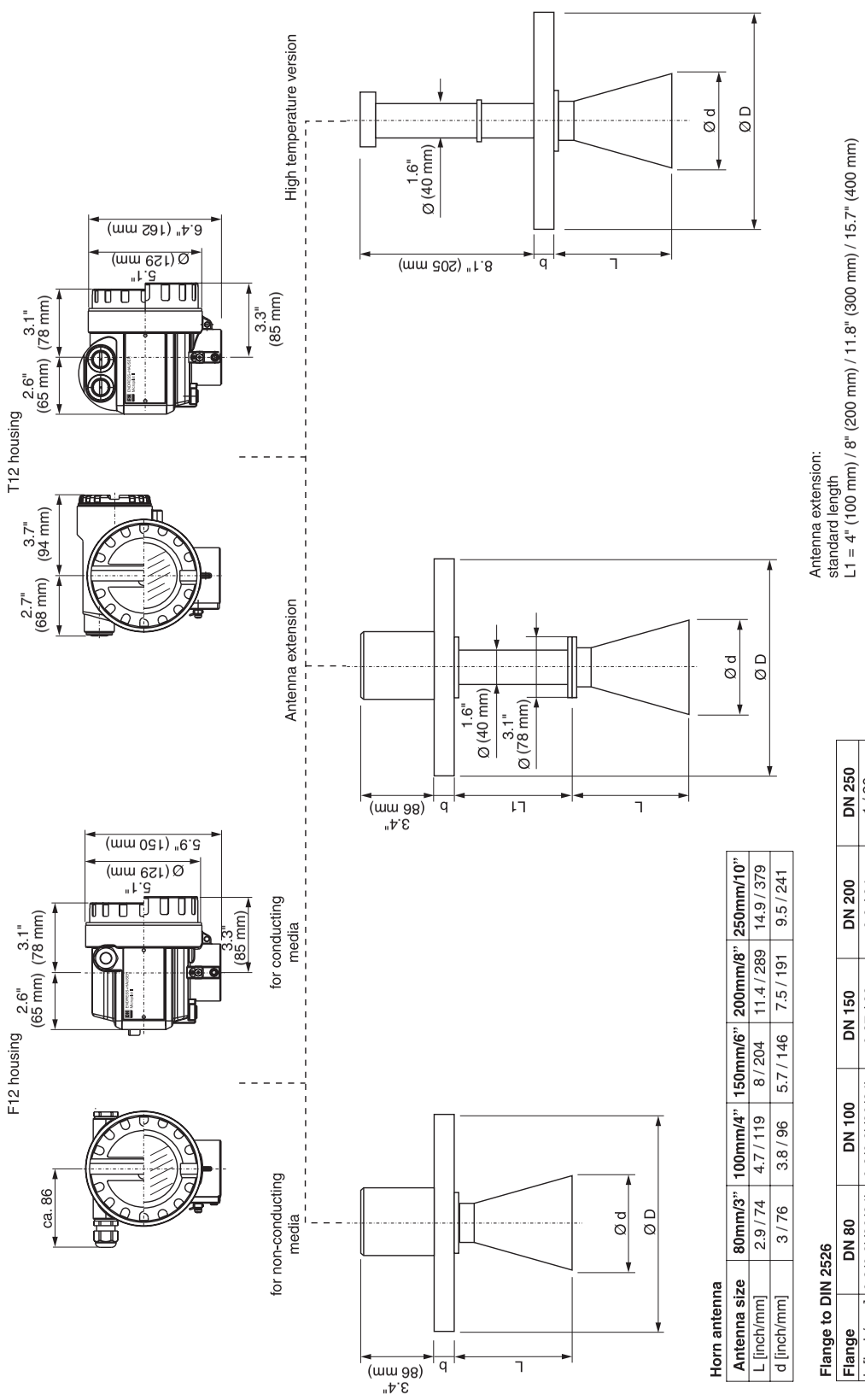
Ambient temperature range	Ambient temperature for the transmitter: • For F12-housing: -40 °F … +176 °F (-40 °C … +80 °C) • For T12-housing: -40 °F … +176 °F (-40 °C … +80 °C)
Storage temperature	-40 °F … +176°F (-40 °C … +80 °C)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Degree of protection	• Housing: IP 65, NEMA 4X (open housing: IP20, NEMA 1) • Antenna: IP 68 (NEMA 6P)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20…2000 Hz, 1 $(m/s^2)^2$/Hz
Cleaning of the antenna	The antenna may become contaminated, depending on the application or product. Thus, the emission and reception of microwaves can eventually degrade over time. The amount of contamination leading to an error depends on the product and the reflectivity, mainly determined by the dielectric constant. If the product tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care should be taken not to damage the antenna during a mechanical or hose-down cleaning. **Note!** **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	• Emissions according to EN 61326; equipment class B • Compatibility according to EN 61326; appendix A (industrial area, 10 V/m) and Namur recommendation EMC (NE 21)

Operating conditions / Process

Process temperature range	See »Ordering information« on page 27 - 33.
Process temperature limits	See »Ordering information« on page 27 - 33.
Process pressure limits	See »Ordering information« on page 27 - 33.
Dielectric constant	• In a stilling well: $\varepsilon r \geq 1.4$ • In free space: $\varepsilon r \geq 1.9$

Mechanical construction

Design, dimensions **Micropilot M FMR 230**



Horn antenna

Antenna size	80mm/3"	100mm/4"	150mm/6"	200mm/8"	250mm/10"
L [inch/mm]	2.9 / 74	4.7 / 119	8 / 204	11.4 / 289	14.9 / 379
d [inch/mm]	3 / 76	3.8 / 96	5.7 / 146	7.5 / 191	9.5 / 241

Flange to DIN 2526

Flange	DN 80	DN 100	DN 150	DN 200	DN 250
b [inch/mm]	0.8(0.9)/20(24)	0.8(0.9)/20(24)	0.87 / 22	0.9 / 24	1 / 26
D [inch/mm]	7.9 / 200	8.7(9.3)/220(235)	11.2 / 285	13.4 / 340	15.9 / 405

for PN 16 (for PN 40)

Flange to ANSI B16.5

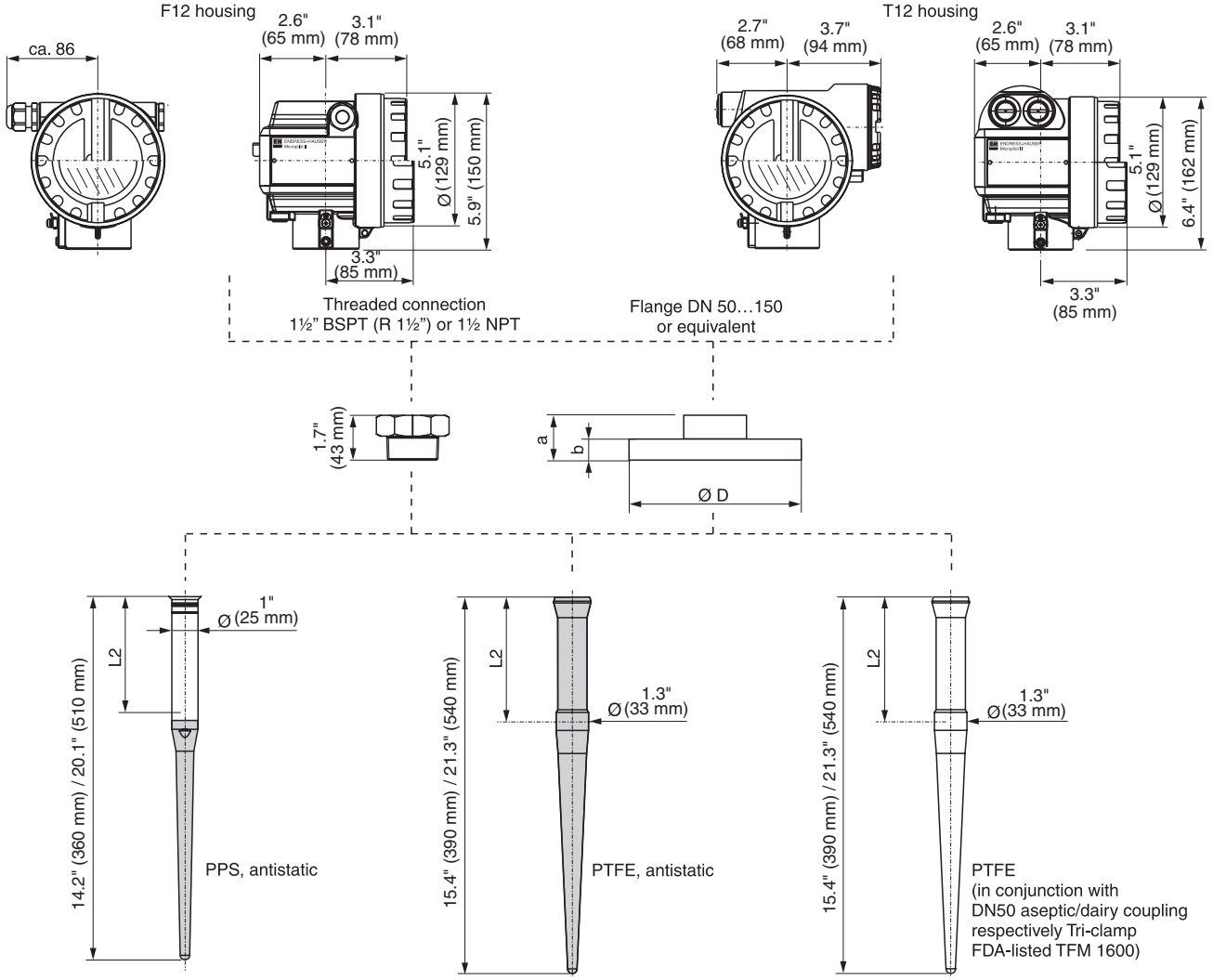
Flange	3"	4"	6"	8"	10"
b [inch/mm]	1.1(1.1)/28.9(28.4)	0.9(1.3)/23.9(31.8)	1 / 25.4	1.1 / 28.4	1.2 / 30.2
D [inch/mm]	7.5(8.2)/190.5(209.5)	9(10)/228.6(254)	11 / 279.4	13.5 / 342.9	16 / 406.4

for 150 lbs (for 300 lbs)

Flange to JIS B2210

Flange	DN 80	DN 100	DN 150	DN 200	DN 250
b [inch/mm]	0.7 / 18	0.7 / 18	0.87 / 22	0.87 / 22	0.9 / 24
D [inch/mm]	7.3 / 185	8.3 / 210	11 / 280	13 / 330	15.7 / 400

for 10K



Flange to DIN 2526

Flange	DN 50	DN 80	DN 100	DN 150
b [inch/mm]	0.8 / 20	0.8(0.9)/20(24)	0.8(0.9)/20(24)	0.87 / 22
D [inch/mm]	7.9 / 200	7.9 / 200	8.7(9.3)/220(235)	11.2 / 285

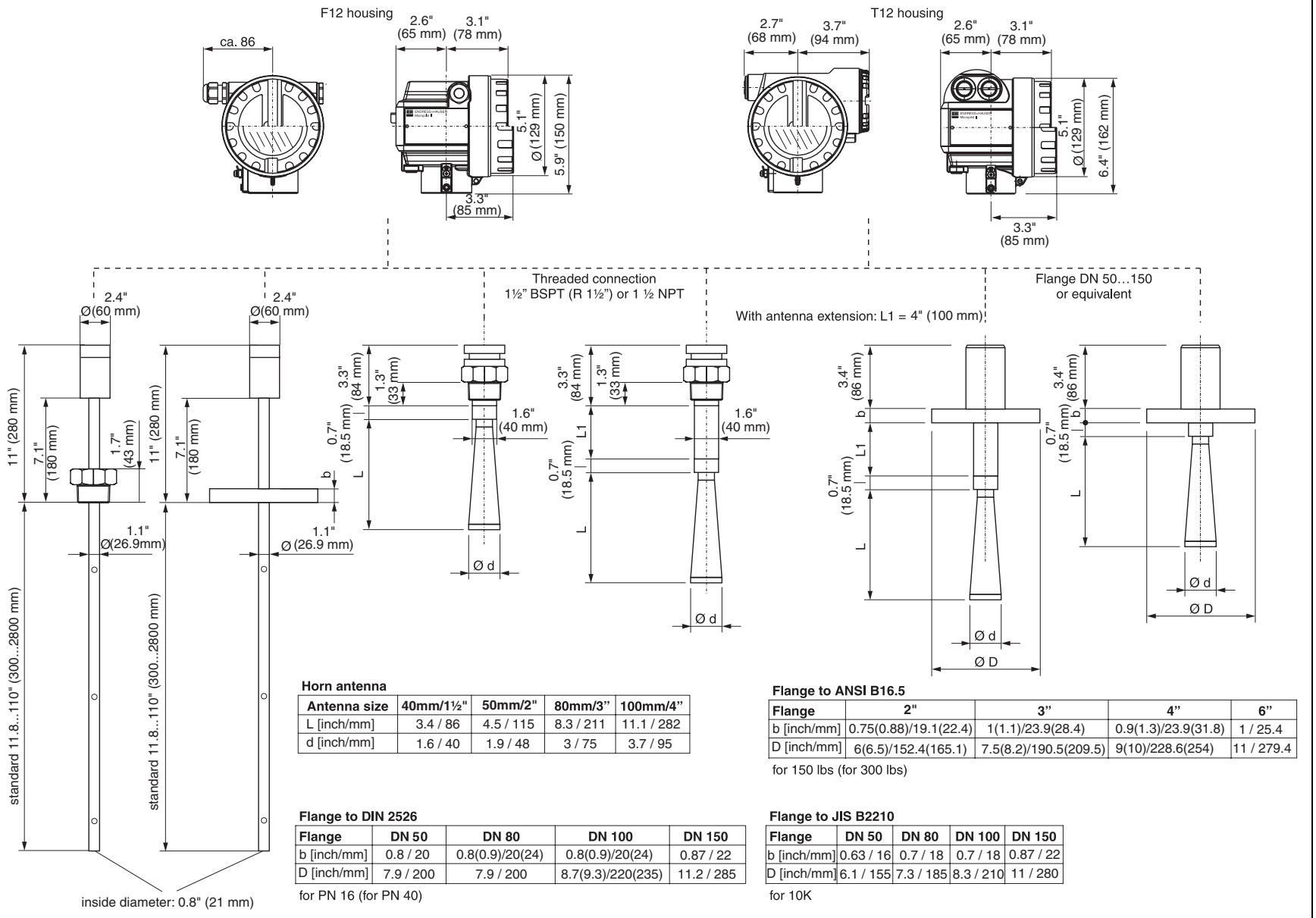
for PN 16 (for PN 40)

Flange to ANSI B16.5 and JIS B2210 see FMR 240

Inactive length, equivalent to max. nozzle height
L2 = 4" (100 mm) / 9.8" (250 mm)

Process connection	Flange DN 50…150	DN 50 aseptic coupling	DN 50 diary coupling	2"/3" Tri-clamp
a [inch/mm] without gastight feedthrough	1.6 / 41	1.8 / 44.5	1.6 / 41	1.6 / 41
a [inch/mm] with gastight feedthrough	3 / 77	3.2 / 80.5	3 / 77	3 / 77

L03-FMR231xx-06-00-00-ae-001



Horn antenna

Antenna size	40mm/1½"	50mm/2"	80mm/3"	100mm/4"
L [inch/mm]	3.4 / 86	4.5 / 115	8.3 / 211	11.1 / 282
d [inch/mm]	1.6 / 40	1.9 / 48	3 / 75	3.7 / 95

Flange to ANSI B16.5

Flange	2"	3"	4"	6"
b [inch/mm]	0.75(0.88)/19.1(22.4)	1(1.1)/23.9(28.4)	0.9(1.3)/23.9(31.8)	1 / 25.4
D [inch/mm]	6(6.5)/152.4(165.1)	7.5(8.2)/190.5(209.5)	9(10)/228.6(254)	11 / 279.4

for 150 lbs (for 300 lbs)

Flange to DIN 2526

Flange	DN 50	DN 80	DN 100	DN 150
b [inch/mm]	0.8 / 20	0.8(0.9)/20(24)	0.8(0.9)/20(24)	0.87 / 22
D [inch/mm]	7.9 / 200	7.9 / 200	8.7(9.3)/220(235)	11.2 / 285

for PN 16 (for PN 40)

Flange to JIS B2210

Flange	DN 50	DN 80	DN 100	DN 150
b [inch/mm]	0.63 / 16	0.7 / 18	0.7 / 18	0.87 / 22
D [inch/mm]	6.1 / 155	7.3 / 185	8.3 / 210	11 / 280

for 10K

L03-FMR240xx-06-00-00-ae-001

Weight

Micropilot M	FMR 230	FMR 231	FMR 240
Weight	Approx. 13 lb (6 kg) + weight of flange	Approx. 9 lb (4 kg) + weight of flange	Approx. 9 lb (4 kg) + weight of flange

Housing

- Types of housings:
  - housing F12: with additionally sealed terminal compartment for standard or EEx ia
  - housing T12: separate terminal compartment for increased safety respectively explosion proof
- Material: aluminum, seawater repellent, chromate, powder coated
- Sight window: glass

Cable entry

M20x1.5; Pg 13.5 (gland included); ½ NPT; G ½ internal thread

Process connection

See »Ordering information« on page 27 - 33.

Seal

See »Ordering information« on page 27 - 33.

Antenna

See »Ordering information« on page 27 - 33.

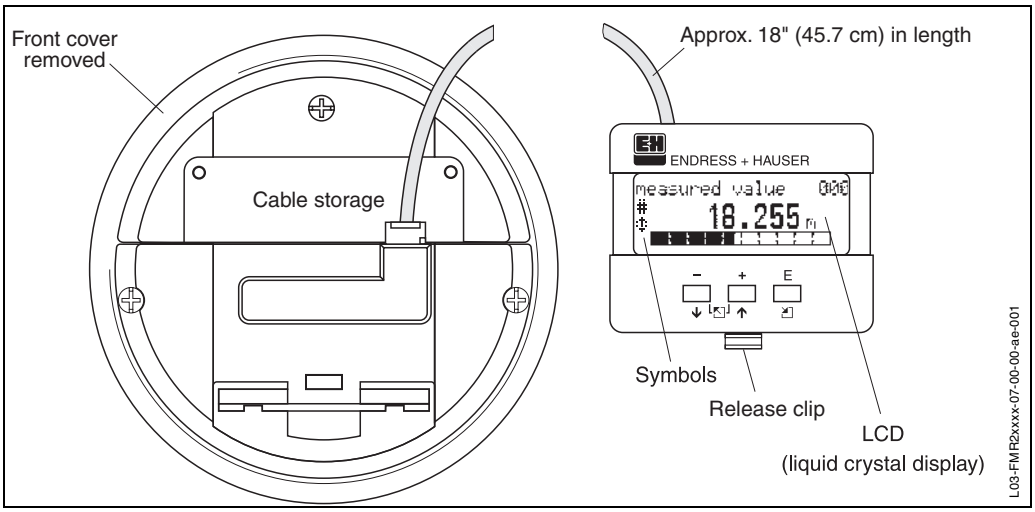
Human interface

Operation concept

The display of the process value and the configuration of the Micropilot occur locally by means of a large 4-line alphanumeric display with plain text information. The guided menu system with integrated help texts ensures a quick and safe commissioning. Remote commissioning, including documentation of the measuring point and in-depth analysis functions, is supported via the ToF Tool, the graphical operating software for Endress+Hauser time-of-flight systems.

Display elements

Liquid crystal display (LCD):
Four lines with 20 characters each. Display contrast is adjustable through key combination.



Micropilot M display

Symbol on the display	continuously on	flashes on/off		
Meaning	alarm	warning	remote communication	locked

Operating elements

The operating elements are located inside the housing and are accessible for operation by removing the front cover of the housing.

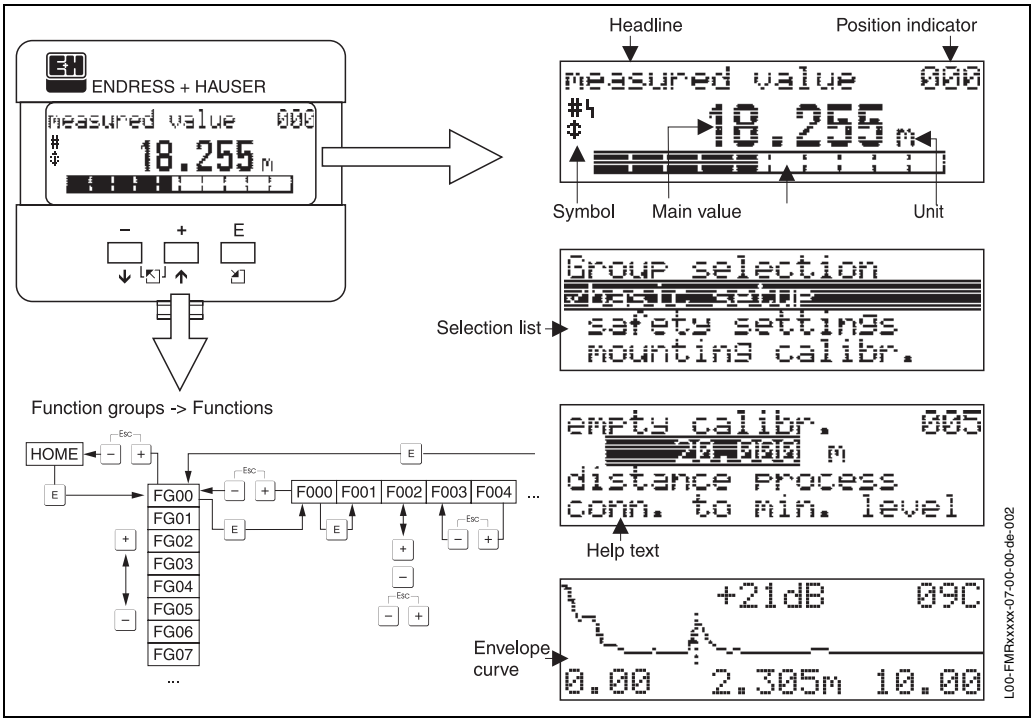
On-site operation

Operation with VU 331
The LC-Display VU 331 allows configuration via 3 keys directly at the instrument.

Function of the keys

Key(s)	Meaning
+	Navigate upwards in the selection list Edit numeric value within a function
−	Navigate downwards in the selection list Edit numeric value within a function
Esc − +	Navigate to the left within a function group
E	Navigate to the right within a function group
+ and E or − and E	Contrast settings of the LCD
+ and − and E	Hardware lock/unlock

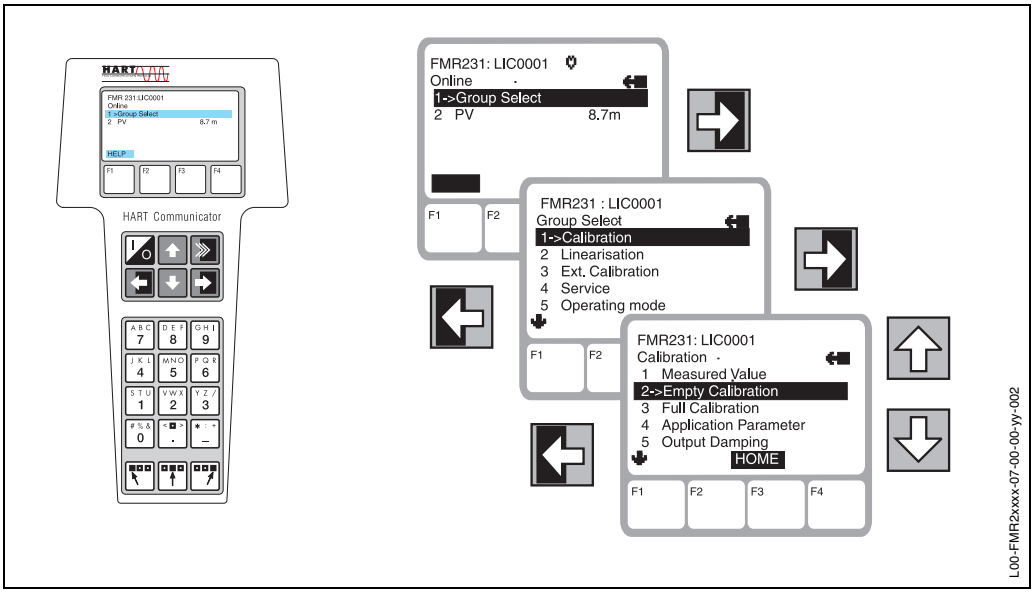
All device functions can be set through a menu system. The menu consists of function groups and functions. Within a function, application parameters can be read or adjusted. The user is guided through a complete configuration procedure.



VU 331 LC-Display operation

Operation with handheld unit DXR 275

All device functions can be adjusted via a menu operation with the handheld unit DXR 275.



DXR 275 Handheld unit operation

Connection options:

- HART with Commubox FXA 191
- Service-interface with adapter FXA 193
- Via Tank Side Monitor NRF 590

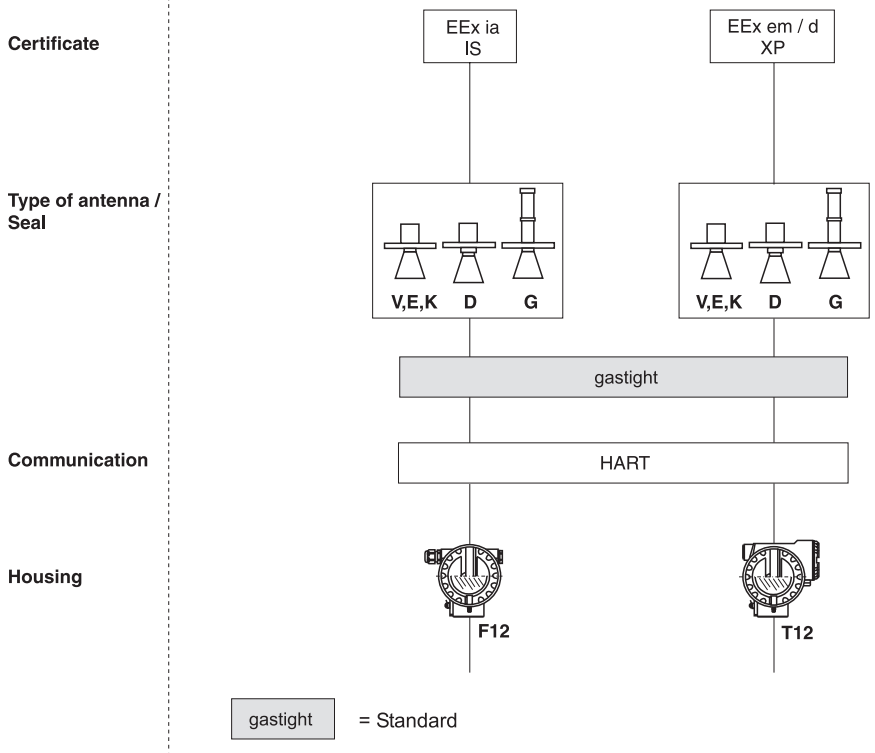
Certificates and approvals

CE approval	The measuring system meets the legal requirements of the CE-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.
RF approvals	R&TTE, FCC
Ex approval	See »Ordering information« on page 27 - 33.
Overspill protection	WHG (in preparation). See »Ordering information« on page 27 - 33.
External standards and guidelines	**EN 60529** Protection class of housing (IP-code) **EN 61010** Safety regulations for electrical devices for measurement, control, regulation and laboratory use **EN 61326** Emissions (equipment class B), compatibility (appendix A – industrial area) **NAMUR** Standards committee for measurement and control in the chemical industry

Ordering information

Micropilot M FMR 230

Instrument selection



Type of antenna / Seal / Temperature	**V** Standard, Viton 4 °F…+392 °F (-20 °C…+200 °C) **E** Standard, EPDM -40 °F…+302 °F (-40 °C…+150 °C) **K** Standard, Kalrez 32 °F…+392 °F (0 °C…+200 °C)	**D** Standard, PTFE seal (non-wetted Viton O-Ring) -4 °F…+392 °F (-20 °C…+200 °C)	**G** High temperature, Graphit -76 °F…+752 °F (-60 °C…+400 °C)
Pressure	…928 psi (…64 bar)	…928 psi (…64 bar)	…1450 psi (…100 bar)
Media	for non-conductive media	for conductive media	
Antenna cone	PTFE	PTFE	Ceramic
Wetted parts	PTFE, seal and SS316Ti	PTFE and SS316Ti	Ceramic, Graphit and SS316Ti

L03-FMR230xx-16-00-00-ae-001

10	Certificates		
	A	For non-hazardous areas	
	1	ATEX II 1/2 G	EEx ia IIC T6
	2	ATEX II 1/2 G	EEx ia IIC T6, note safety instruction (XA) for electrostatic charging!
	3	ATEX II 1/2 G	EEx em [ia] IIC T6
	4	ATEX II 1/2 G	EEx d [ia] IIC T6
	F	For non-hazardous areas + WHG	
	6	ATEX II 1/2 G	EEx ia IIC T6 + WHG
	7	ATEX II 1/2 G	EEx ia IIC T6 + WHG, note safety instruction (XA) for electrostatic charging!
	8	ATEX II 1/2 G	EEx em [ia] IIC T6 + WHG
	S	FM	IS - Class I, Division 1, Group A-D
	T	FM	XP - Class I, Division 1, Group A-D
	U	CSA	IS - Class I, Division 1, Group A-D
	V	CSA	XP - Class I, Division 1, Group A-D
	K	TIIS	EEx ia IIC T4
	Y	Special version	

FMR 230-									Product designation (part 1)

20 Antenna size

2	3" / 80 mm
3	4" / 100 mm
4	6" / 150 mm
5	8" / 200 mm
6	10" / 250 mm

30 Type of antenna, sealing, temperature

	Type	*Sealing*	*Temperature range*
V	Standard	Viton/FKM	-4 °F…+392 °F / -20 °C…200 °C
E	Standard	EPDM	-40 °F…+302 °F / -40 °C…150 °C
K	Standard	Kalrez	32 °F…+392 °F / 0 °C…200 °C
D	Standard	PTFE	-4 °F…+392 °F / -20 °C…200 °C
G	High temperature	Graphit	-76 °F…+752 °F / -60 °C…400 °C
Y	Special version		

40 Process connection, material

	Flange Dia/Pressure	*Standard*	*Material*
CM2	DN80 PN16	DIN 2526 Form C	SS316Ti
CN2	DN80 PN40	DIN 2526 Form C	SS316Ti
CQ2	DN100 PN16	DIN 2526 Form C	SS316Ti
CR2	DN100 PN40	DIN 2526 Form C	SS316Ti
CW2	DN150 PN16	DIN 2526 Form C	SS316Ti
CX2	DN200 PN16	DIN 2526 Form C	SS316Ti
C62	DN250 PN16	DIN 2526 Form C	SS316Ti
EWT	DN150 PN16	DIN 2526 Form E	enamelled steel
EXT	DN200 PN16	DIN 2526 Form E	enamelled steel
CQ5	DN100 PN16	DIN 2526 Form C	Hastelloy C4 face
CW5	DN150 PN16	DIN 2526 Form C	Hastelloy C4 face
C65	DN250 PN16	DIN 2526 Form C	Hastelloy C4 face
AL2	3"/150 lbs	ANSI B16.5	SS316Ti
AM2	3"/300 lbs	ANSI B16.5	SS316Ti
AP2	4"/150 lbs	ANSI B16.5	SS316Ti
AQ2	4"/300 lbs	ANSI B16.5	SS316Ti
AV2	6"/150 lbs	ANSI B16.5	SS316Ti
A32	8"/150 lbs	ANSI B16.5	SS316Ti
A52	10"/150 lbs	ANSI B16.5	SS316Ti
AVT	6"/150 lbs	ANSI B16.5	enamelled steel
A3T	8"/150 lbs	ANSI B16.5	enamelled steel
AV5	6"/150 lbs	ANSI B16.5	Hastelloy C4 face
A35	8"/150 lbs	ANSI B16.5	Hastelloy C4 face
A55	10"/150 lbs	ANSI B16.5	Hastelloy C4 face
KA2	10 K 80	JIS B2210	SS316Ti
KH2	10 K 100	JIS B2210	SS316Ti
KV2	10 K 150	JIS B2210	SS316Ti
KD2	10 K 200	JIS B2210	SS316Ti
K52	10 K 250	JIS B2210	SS316Ti
YY9	Special version		

50 Output and menu based operation

A	4…20 mA HART with VU 331 (4-line alphanumeric display)
B	4…20 mA HART
Y	Special version

60 Housing

A	Aluminum F12-housing, coated, IP65
C	Aluminum T12-housing with separate connection compartment, coated, IP65
Y	Special version

70 Gland / Entry

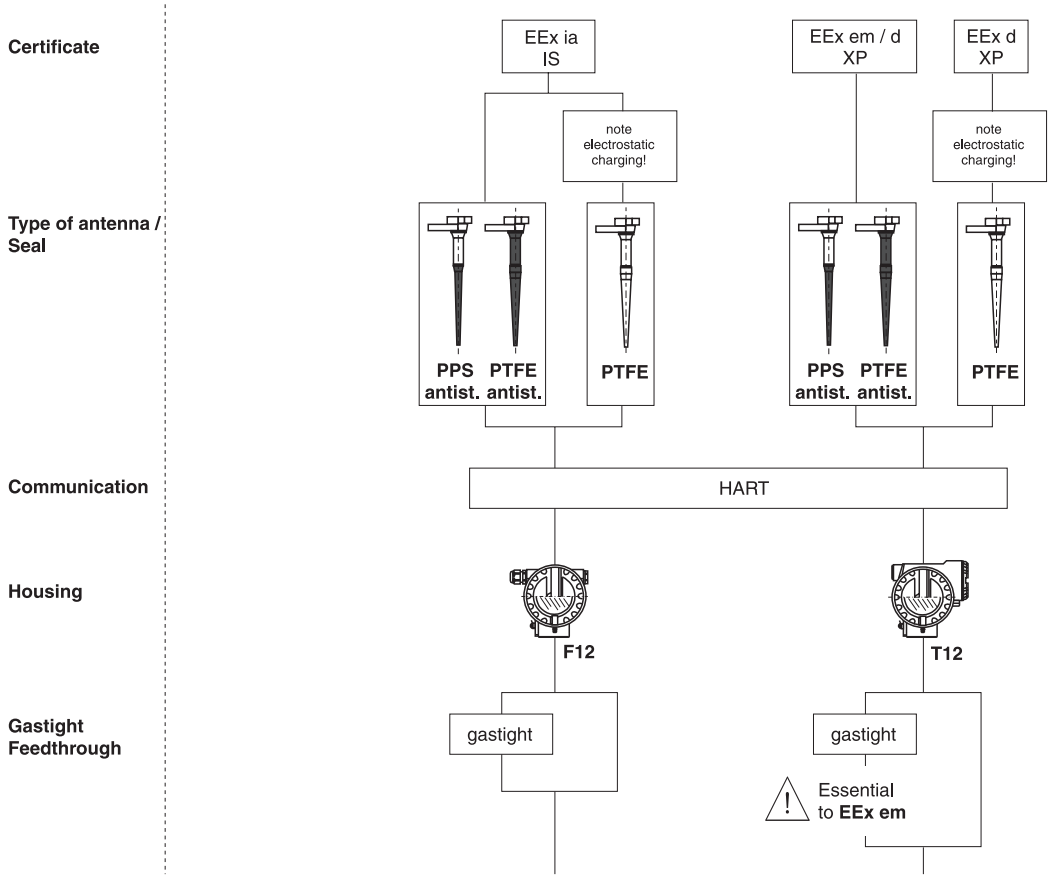
1	Pg13.5 cable gland
2	M20x1.5 cable gland
3	G ½ cable entry
4	½ NPT cable entry
9	Special version

80 Additional options

A	Additional options not selected
B	3.1.B material, wetted parts SS316Ti, Inspection Certificate EN 10204, acc. specification 52005759

FMR 230- Complete product designation

Micropilot M FMR 231 Instrument selection



Antenna	PTFE				PPS antistatic		PTFE antistatic		
Process-connection	Threaded connection		Flange		Threaded connection	Flange	Threaded connection	Flange	
	PVDF (not gastight)	metal	unclad	clad	metal	unclad	metal	unclad	clad antistatic
Temperature	-40 °F…+176 °F (-40 °C…+80 °C)	-40 °F…+302 °F (-40 °C…+150 °C)			-4 °F…+248 °F (-20 °C…+120 °C)		-40 °F…+302 °F (-40 °C…+150 °C)		
Pressure	…43.5 psi …3 bar	…580 psi …40 bar		…232 psi (2")/…16 bar …145 psi (3")/…10 bar	…232 psi …16 bar		…580 psi …40 bar		…232 psi …16 bar
Wetted parts	PVDF + PTFE	1.4435 + PTFE		PTFE	1.4435 +Viton + PPS		1.4435 + PTFE		PTFE

L03-FMR231xx-16-00-00-ae-001

10	Certificates	
	A	For non-hazardous areas
	1	ATEX II 1/2 G EEx ia IIC T6
	2	ATEX II 1/2 G EEx ia IIC T6, note safety instruction (XA) for electrostatic charging!
	3	ATEX II 1/2 G EEx em [ia] IIC T6
	4	ATEX II 1/2 G EEx d [ia] IIC T6
	5	ATEX II 1/2 G EEx d [ia] IIC T6, note safety instruction (XA) for electrostatic charging!
	F	For non-hazardous areas + WHG
	6	ATEX II 1/2 G EEx ia IIC T6 + WHG
	7	ATEX II 1/2 G EEx ia IIC T6 + WHG, note safety instruction (XA) for electrostatic charging!

FMR 231-									Product designation (part 1)

10 Certificates

8	ATEX II 1/2 G	EEx em [ia] IIC T6 + WHG
S	FM	IS - Class I, Division 1, Group A-D
T	FM	XP - Class I, Division 1, Group A-D
U	CSA	IS - Class I, Division 1, Group A-D
V	CSA	XP - Class I, Division 1, Group A-D
K	TIIS	EEx ia IIC T4
Y	Special version	

20 Type of antenna, O-ring, inactive length

	Type	*Length*	*Material*	*O-ring*	*Nozzle length*
A	Rod antenna	14" / 360 mm	PPS, antistatic	Viton	4" / 100 mm
B	Rod antenna	20" / 510 mm	PPS, antistatic	Viton	10" / 250 mm
E	Rod antenna	14" / 360 mm	PTFE, fully insulated		4" / 100 mm
F	Rod antenna	20" / 510 mm	PTFE, fully insulated		10" / 250 mm
H	Rod antenna	14" / 360 mm	PTFE, antistatic + fully insulated		4" / 100 mm
J	Rod antenna	20" / 510 mm	PTFE, antistatic + fully insulated		10" / 250 mm
Y	Special version				

30 Process connection, material

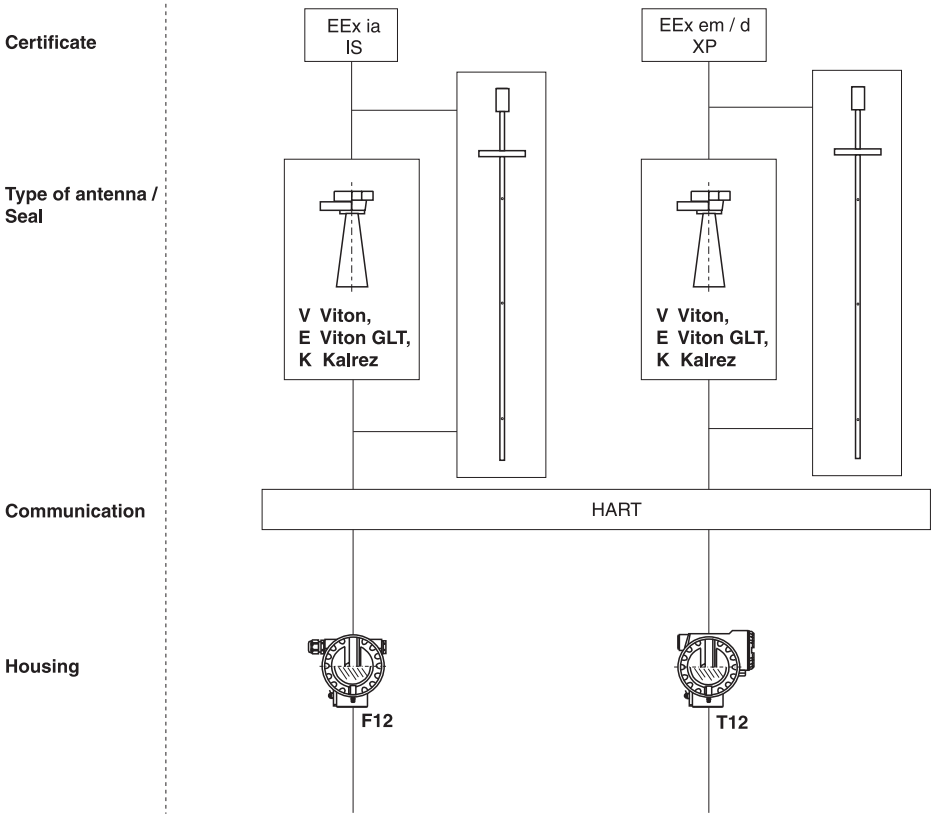
	Threaded connection	*Material*	
GGJ	1½" BSPT (R 1½", DIN 2999)	SS316L	
GGS	1½" BSPT (R 1½", DIN 2999)	PVDF	
GNJ	NPT 1½"	SS316L	
GNS	NPT 1½"	PVDF	
	Flange Dia/Pressure	*Standard*	*Material*
BFJ	DN50 PN16	DIN 2526 Form B	SS316L
BMJ	DN80 PN16	DIN 2526 Form B	SS316L
BNJ	DN80 PN40	DIN 2526 Form B	SS316L
BQJ	DN100 PN16	DIN 2526 Form B	SS316L
BWJ	DN150 PN16	DIN 2526 Form B	SS316L
CFJ	DN50 PN16	DIN 2526 Form C	SS316L
CMJ	DN80 PN16	DIN 2526 Form C	SS316L
CNJ	DN80 PN40	DIN 2526 Form C	SS316L
CQJ	DN100 PN16	DIN 2526 Form C	SS316L
CWJ	DN150 PN16	DIN 2526 Form C	SS316L
CFK	DN50 PN16	DIN 2526 Form C	SS316L, PTFE-clad
CMK	DN80 PN16	DIN 2526 Form C	SS316L, PTFE-clad
CQK	DN100 PN16	DIN 2526 Form C	SS316L, PTFE-clad
CWK	DN150 PN16	DIN 2526 Form C	SS316L, PTFE-clad
AEJ	2"/150 lbs	ANSI B16.5	SS316L
ALJ	3"/150 lbs	ANSI B16.5	SS316L
AMJ	3"/300 lbs	ANSI B16.5	SS316L
APJ	4"/150 lbs	ANSI B16.5	SS316L
AQJ	4"/300 lbs	ANSI B16.5	SS316L
AVJ	6"/150 lbs	ANSI B16.5	SS316L
AEK	2"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
ALK	3"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
APK	4"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
AVK	6"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
KEJ	10 K 50A	JIS B2210	SS316L
KLJ	10 K 80A	JIS B2210	SS316L
KPJ	10 K 100A	JIS B2210	SS316L
KVJ	10 K 150A	JIS B2210	SS316L
KEK	10 K 50A	JIS B2210	SS316L, PTFE-clad
KLK	10 K 80A	JIS B2210	SS316L, PTFE-clad
KPK	10 K 100A	JIS B2210	SS316L, PTFE-clad
KVK	10 K 150A	JIS B2210	SS316L, PTFE-clad
	Sanitary coupling	*Standard*	*Material*
MFJ	DN50 dairy coupling	DIN 11851	SS316L
HFJ	DN50 aseptic	DIN 11864-1	SS316L
TEJ	2" Tri-clamp	ISO 2852	SS316L
TLJ	3" Tri-clamp	ISO 2852	SS316L
YY9	Special version		

FMR 231- Product designation (part 2)

40									**Output and menu based operation**	
								A	4…20 mA HART with VU 331 (4-line alphanumeric display)	
								B	4…20 mA HART	
								Y	Special version	
50							**Housing**			
							A	Aluminum F12-housing, coated, IP65		
							C	Aluminum T12-housing with separate connection compartment, coated, IP65		
							Y	Special version		
60						**Gland / Entry**				
						1	Pg13.5 cable gland			
						2	M20x1.5 cable gland			
						3	G ½ cable entry			
						4	½ NPT cable entry			
						9	Special version			
70							**Gastight feed through**			
						A	without gastight feed through			
						C	with gastight feed through			
80								**Additional options**		
							A	Additional options not selected		
							B	3.1.B material, wetted parts SS316Ti, Inspection Certificate EN 10204, acc. specification 52005759		
FMR 231-									Complete product designation	

Micropilot M FMR 240

Instrument selection



Type of antenna / Seal / Temperature	V Standard, Viton -4 °F…+302 °F (-20 °C…+150 °C) E Standard, Viton GLT -40 °F…+302 °F (-40 °C…+150 °C) K Standard, Kalrez -32 °F…+302°F (0 °C…+150 °C)
Pressure	…580 psi /…40 bar
Antenna cone	PTFE
Wetted parts	PTFE, seal and SS316L

L03-FMR240xx-16-00-00-ae-001

10		Certificates	
	A	For non-hazardous areas	
	1	ATEX II 1/2 G	EEx ia IIC T6
	3	ATEX II 1/2 G	EEx em [ia] IIC T6
	4	ATEX II 1/2 G	EEx d [ia] IIC T6
	F	For non-hazardous areas + WHG	
	6	ATEX II 1/2 G	EEx ia IIC T6 + WHG
	8	ATEX II 1/2 G	EEx em [ia] IIC T6 + WHG
	S	FM	IS - Class I, Division 1, Group A-D
	T	FM	XP - Class I, Division 1, Group A-D
	U	CSA	IS - Class I, Division 1, Group A-D
	V	CSA	XP - Class I, Division 1, Group A-D
	K	TIIS	EEx ia IIC T4
	Y	Special version	

20		Antenna size
	2	1 ½" / 40 mm
	3	2" / 50 mm
	4	3" / 80 mm
	5	4" / 100 mm
	7	mm Wave Guide antenna, inside diameter: 21 mm
	8	inch Wave Guide antenna, inside diameter: 21 mm

FMR 240-										Product designation (part 1)

30 Type of antenna, sealing, temperature

	Type	*Sealing*	*Temperature range*
V	Standard	Viton/FKM	-4 °F…+302 °F / -20° C…150° C
E	Standard	Viton GLT	-40 °F…+302 °F / -40° C…150° C
K	Standard	Kalrez	32 °F…+302 °F / 0° C…150° C

40 Antenna extension

1	without antenna extension
2	4" / 100 mm antenna extension
9	Special length

50 Process connection, material

	Threaded connection	*Material*	
GNJ	NPT 1½"	SS316L	
GGJ	1½" BSPT (R 1½", DIN 2999)	SS316L	
	Flange Dia/Pressure	*Standard*	*Material*
CFJ	DN50 PN16	DIN 2526 Form C	SS316L
CGJ	DN50 PN40	DIN 2526 Form C	SS316L
CMJ	DN80 PN16	DIN 2526 Form C	SS316L
CNJ	DN80 PN40	DIN 2526 Form C	SS316L
CQJ	DN100 PN16	DIN 2526 Form C	SS316L
CRJ	DN100 PN40	DIN 2526 Form C	SS316L
CWJ	DN150 PN16	DIN 2526 Form C	SS316L
AEJ	2"/150 lbs	ANSI B16.5	SS316L
AFJ	2"/300 lbs	ANSI B16.5	SS316L
ALJ	3"/150 lbs	ANSI B16.5	SS316L
AMJ	3"/300 lbs	ANSI B16.5	SS316L
APJ	4"/150 lbs	ANSI B16.5	SS316L
AQJ	4"/300 lbs	ANSI B16.5	SS316L
AWJ	6"/150 lbs	ANSI B16.5	SS316L
KEJ	10 K 50A	JIS B2210	SS316L
KLJ	10 K 80A	JIS B2210	SS316L
KPJ	10 K 100A	JIS B2210	SS316L
KWJ	10 K 150A	JIS B2210	SS316L
YY9	Special version		

60 Output and menu based operation

A	4…20 mA HART with VU 331 (4-line alphanumeric display)
B	4…20 mA HART
Y	Special version

70 Housing

A	Aluminium F12-housing, coated, IP65
C	Aluminium T12-housing with separate connection compartment, coated, IP65
Y	Special version

80 Gland / Entry

1	Pg13.5 cable gland
2	M20x1.5 cable gland
3	G ½ cable entry
4	½ NPT cable entry
9	Special version

90 Additional options

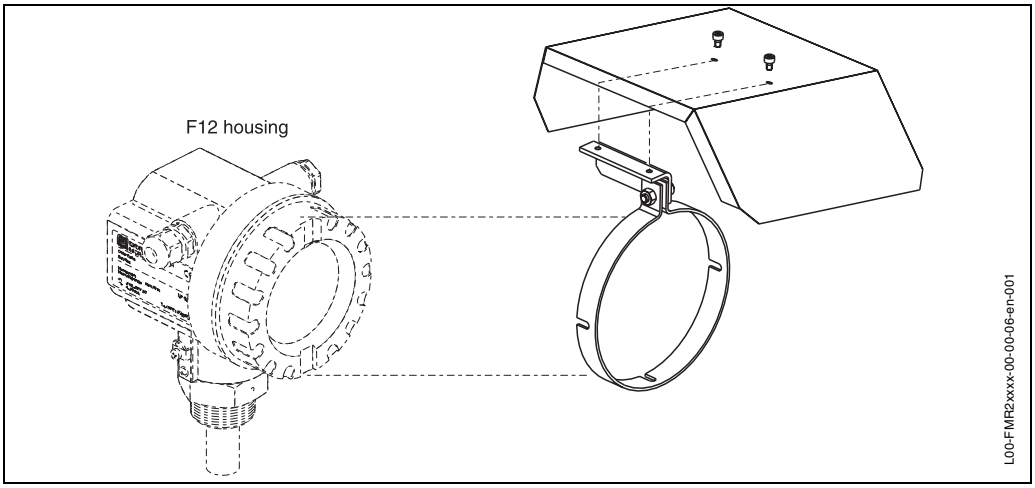
A	Additional options not selected
B	3.1.B material, wetted parts SS316L, Inspection Certificate EN 10204, acc. specification 52005759

FMR 240- Complete product designation

Accessories

Protective cover

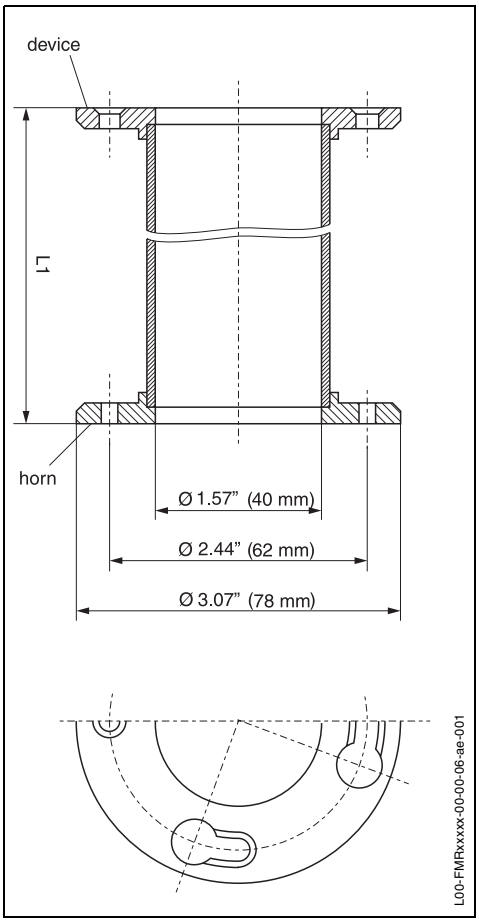
A protective cover made of stainless steel is available for additional protection (order code: 543199-0001). The shipment includes the protective cover and tension clamp.



Protective cover placement on Micropilot M

Antenna extension FAR 10 (for FMR 230)

Dimensions



FMR 230 antenna extension

Ordering information

10			**Material**
		2	1.4571
		4	2.4600/Hastelloy B3
		5	2.4610/Hastelloy C4
		9	Special material
80			**Overall length L1**
		A	4" / 100 mm
		B	8" / 200 mm
		C	12" / 300 mm
		D	16" / 400 mm
		Y	Special length
FAR 10-			Complete product designation

Commubox FXA 191

For intrinsically safe communication with ToF Tool or Commuwin II via the RS 232C-interface

Service adapter FXA 193

For communication with ToF Tool via the display connector

Documentation

System information	**SI 039G/03/ae** System information for Tank Side Monitor NRF 590
Technical Information	**TI 039G/03/ae** Technical information for Tank Side Monitor NRF 590
Operating instructions	**BA 218F/00/en** Operating instructions for Micropilot M FMR 230 (HART) **BA 219F/00/en** Operating instructions for Micropilot M FMR 231 (HART) **BA 220F/00/en** Operating instructions for Micropilot M FMR 240 (HART) **KA 159F/00/a2** Short manual (quick reference) in housing (HART)
Certificates	**XA 099F-A** Installation Micropilot M FMR 2xx (F12 / EEx ia IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G) **XA 100F-A** Installation Micropilot M FMR 2xx (T12 / EEx em [ia] IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G) **XA 101F-A** Installation Micropilot M FMR 2xx (T12 / EEx d [ia] IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G) **XA 103F-A** Installation Micropilot M FMR 2xx (F12 / EEx ia IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G) **XA 104F-A** Installation Micropilot M FMR 2xx (T12 / EEx em [ia] IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G) **XA 105F-A** Installation Micropilot M FMR 2xx (T12 / EEx d [ia] IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G) **ZD 055F/00** Control drawing Micropilot M FMR 2xx HART FM, IS (F12 / Ex ia IIC) **ZD 058F/00** Control drawing Micropilot M FMR 2xx HART FM, XP-IS (T12 / Ex d [ia] IIC) **ZD 059F/00** Control drawing Micropilot M FMR 2xx HART CSA, IS (F12 / Ex ia IIC)

ZD 062F/00
Control drawing Micropilot M FMR 2xx HART
CSA, XP-IS (T12 / Ex d [ia] IIC)

This product may be protected by at least one of the following listed patents. Further patents are pending.

- US 5,387,918 ≙ EP 0 535 196
- US 5,689,265 ≙ EP 0 626 063
- US 5,659,321
- US 5,614,911 ≙ EP 0 670 048
- US 5,594,449 ≙ EP 0 676 037
- US 6,047,598
- US 5,880,698
- US 5,926,152
- US 5,969,666
- US 5,948,979
- US 6,054,946
- US 6,087,978
- US 6,014,100

Locations

Endress+Hauser
Systems & Gauging,Inc.
2901 W. Sam Houston Pkwy. N.
Houston, TX 77043
USA
Tel: +1 (832) 590-6200
Fax: +1 (832) 590-6201

Endress+Hauser
Systems & Gauging, Inc.
1800 Diagonal Road
Suite 300
Alexandria, VA 22314
USA
Tel: +1 (703) 837-9202
Fax: +1 (703) 837-9209

Endress+Hauser
Systems & Gauging, Inc.
500 West Central Avenue
Suite A
Brea, CA 92821
Tel: +1 (714) 529-1925
Fax: +1 (714) 529-2949

Systems & Gauging Headquarters

Endress+Hauser
Systems & Gauging, Inc.
5834 Peachtree Corners East
Norcross (Atlanta), GA 30092
USA
Tel: +1 (770) 447-9202
Fax: +1 (770) 662-8939
http://www.systems.endress.com

Endress+Hauser
Systems & Gauging

Technical Information
Ti 018G/03/ae/07.01
Printed in USA