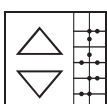
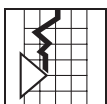
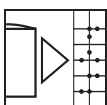


# Radar Level Gauges *micropilot M* **FMR 230/231/240/244/245**

**Smart Transmitter for continuous and non-contact level measurement**  
**Cost-effective 4 to 20 mA 2-wire technology**  
**suitable for hazardous locations**



FMR 230



FMR 231



FMR 240

with horn antenna



with wave guide antenna



FMR 244



FMR 245

- The FMR 240 with the new (1-1/2") horn antenna is ideally suited to small vessels. Furthermore, it is the first choice for storage tanks, stilling wells, and bypass pipes. It's  $\pm 0.12''$  (3 mm) accuracy offers further benefits.
- The FMR 244 combines the advantages of the horn antenna with high chemical resistance.
- The FMR 245 is easy to clean, and resistant to chemicals.

#### Features and benefits

- Low price, 2-wire technology: A real alternative to differential pressure, floats, and displacers. 2-wire technology reduces wiring costs and allows easy implementation into existing systems.
- Non-contact measurement: Measurement is almost independent of product properties.
- Easy on-site operation via menu-driven alphanumeric display.
- Easy commissioning, documentation and maintenance via PC operating software (ToF Tool).
- 2 frequency ranges, 6 GHz (FMR 230/231) and 26 GHz (FMR 240/244/245): No compromises, the right frequency for every application.
- Digital communication via HART®, Profibus-PA, or Foundation Fieldbus protocols.
- High temperatures: Suitable for process temperatures up to 390°F (200°C) and up to 750°F (400°C) with high-temperature antenna.
- Rod antenna is standard with inactive length: Ensures reliable measurement in narrow nozzles, with condensation build-up in the nozzle.

#### Application

The Micropilot M is used for continuous, non-contacting level measurement of liquids, pastes, and slurries. The measurement is unaffected by changing media, temperature, gas blankets, or vapors.

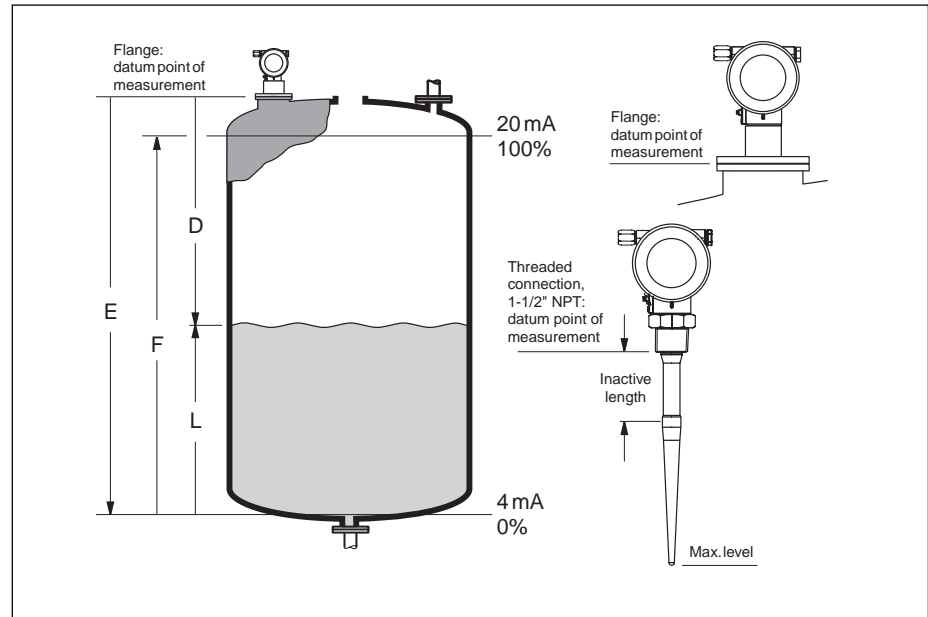
- The FMR 230 is especially suited for measurement in buffer and process tanks.
- The FMR 231 has its strengths wherever high chemical compatibility is required, when measuring aggressive media.



## Function and system design

### Measuring principle

The Micropilot M is a top mounted measuring system, operating on the time-of-flight method. 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 are received by the antenna.



### Input

A microprocessor evaluates the signal and identifies the level echo created by the reflection of the radar impulse at the product surface. The unambiguous signal identification is accomplished by our PulseMaster® software algorithms that are based on many years of experience with time-of-flight technology. The mm accuracy of the Micropilot M could be achieved with the patented algorithms of the PhaseMaster® software.

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

$$D = c \times t/2, \text{ with } c \text{ being the speed of light}$$

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

$$L = E - D$$

Refer to the figure above for the reference point for “ $E$ ”.

The Micropilot M is equipped with functions to suppress interference echoes (tank mapping). The user can activate these functions which ensure that interference echoes (i.e. from edges and weld seams) are not interpreted as level echoes.

### Output

The Micropilot M is commissioned by entering an empty distance  $E$  (= zero), a full distance  $F$  (= span), and an application parameter. The application parameter automatically adapts the instrument to the measuring conditions. The data points “ $E$ ” and “ $F$ ” correspond to 4 mA and 20 mA for instruments with current output. 0% to 100% is shown for digital outputs and the display module.

A linearization with maximum of 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 outlets.

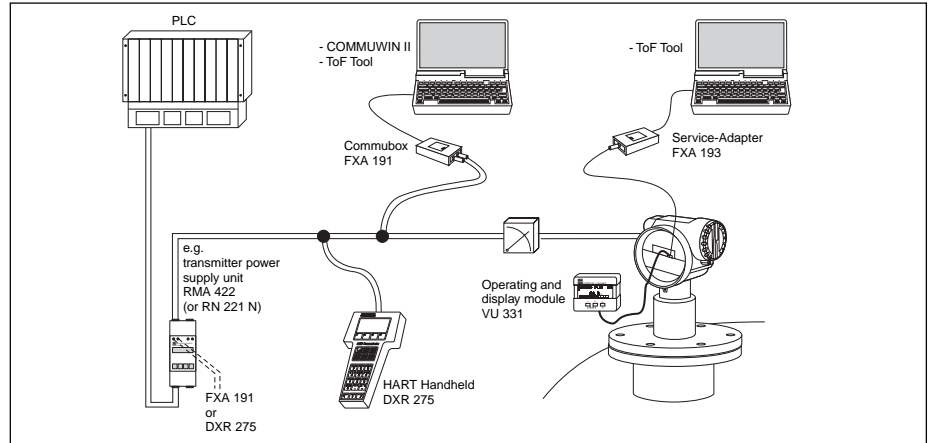
**Measuring system**

**Stand-alone**

The Micropilot M can be used for measurement in a stilling well / bypass pipe as well as in free space. The instrument provides a 4 to 20 mA output with HART® protocol, Profibus-PA or Foundation Fieldbus communication.

**4 to 20 mA output with HART® protocol.**

The complete measuring system consists of:



**On-site operation:**

- with display and operating module VU 331,
- with a Personal Computer, FXA 193 and the operating software ToF Tool. The ToF Tool is a graphical operating software for all instruments from Endress+Hauser that operate based on the time-of-flight principle (radar, ultrasonic, guided micro-impulse). It assists with commissioning, securing data, signal analysis, and creating documentation for the measuring point.

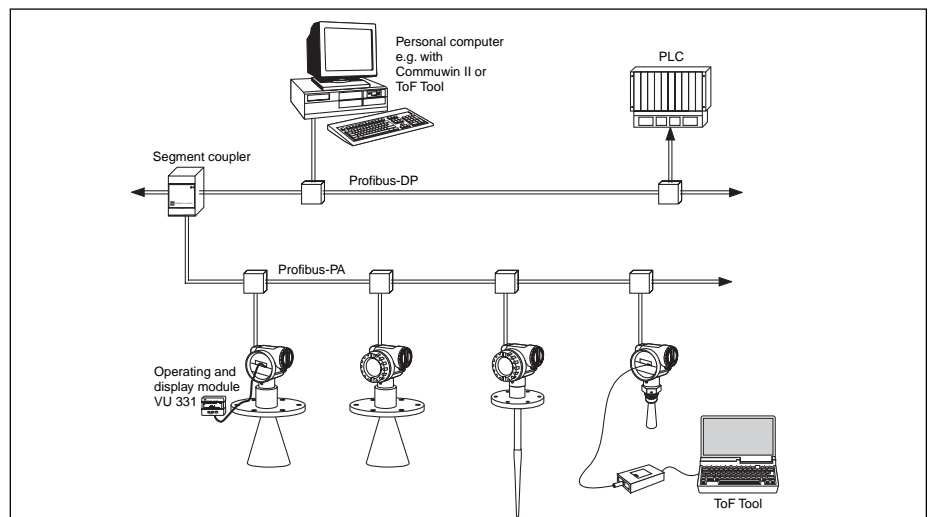
**Remote operation:**

- with HART® handheld DXR 275
- with a PC, Commubox FXA 191 and Commuwin II operating software or the ToF Tool.

**System integration via Profibus-PA**

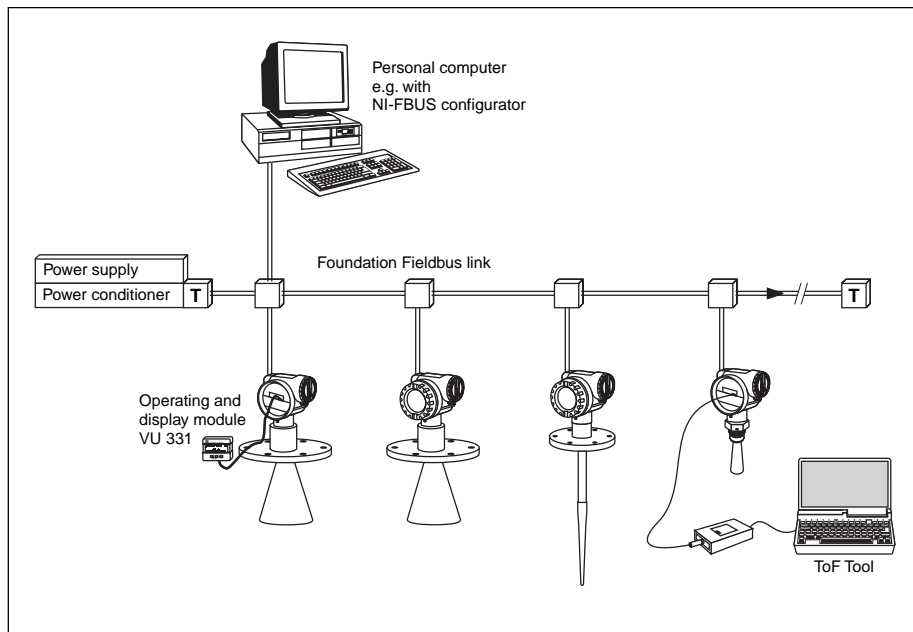
A maximum of 32 instruments (9 if in an explosion hazardous location EEx ia IIC according to FISCO-model) can be connected to the bus. The segment coupler provides the operating voltage to the bus. Both on-site as well as remote operation are possible.

The complete measuring system consists of:



### System integration via Foundation Fieldbus

A maximum of 32 transmitters (non-hazardous, IS or XP) can be connected to the bus. The maximum number of transmitters depends on the established rules and standards for intrinsically safe circuits (EN 60070-14). Both on-site and remote operation are possible. The complete measuring system consists of:



## Input

### Measured variable

The measured variable is the distance between a reference point (refer to the figure on page 2) and a reflective surface (i.e. liquid surface). The level is calculated based on the tank height entered and can be converted into other units (volume, mass) by means of linearization.

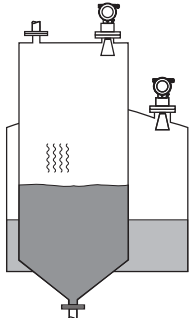
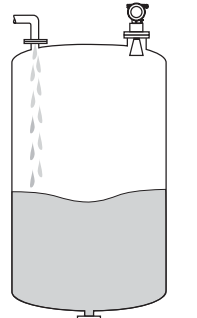
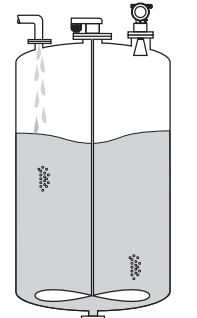
The achievable measuring range depends on the size of the antenna, the reflectivity of the medium, the mounting location, and any interference reflections.

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

Product class	DK ( $\epsilon_r$ )	Examples
A	1.4 to 1.9	Non-conducting liquids, e.g. liquified gas *
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

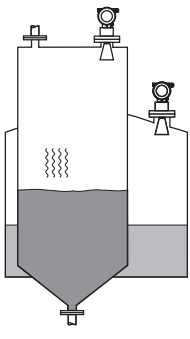
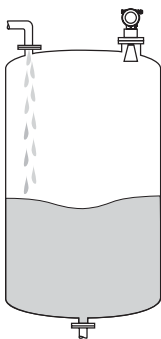
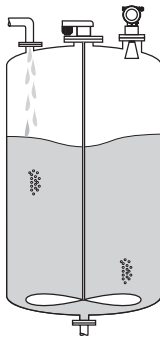
\* Treat Ammonia  $NH_3$  as a medium in group A, i.e. always use a stilling well.

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




Product Class	Storage tank Calm product surface (seldom drained or filled from bottom or immersion tube)		Buffer tank Moving surfaces (continuous filling from above or mixing jets)		Tank with single stage agitator Turbulent surface, single stage agitator < 60 RPM		Stilling well	Bypass pipe	
									
FMR 230: (Horn size)	Measuring range		Measuring range		Measuring range		Measuring range	Measuring range	
	FMR 231:	Rod Antenna	—	Rod Antenna	—	Rod Antenna			—
A DK ( $\epsilon_r$ ) = 1.4 to 1.9	Stilling well recommended							65 ft	*
B DK ( $\epsilon_r$ ) = 1.9 to 4	33 ft	49 ft	16 ft	24 ft	13 ft	20 ft	65 ft	*	
C DK ( $\epsilon_r$ ) = 4 to 10	49 ft	65 ft	24 ft	33 ft	20 ft	27 ft	65 ft	65 ft	
D DK ( $\epsilon_r$ ) = > 10	65 ft	65 ft	33 ft	42 ft	27 ft	33 ft	65 ft	65 ft	

\* Measuring range up to 65 ft. is possible with stilling well or bypass, consult factory for further information.

**Measuring range depending on vessel type, conditions, and product for Micropilot M FMR 240, FMR 244, FMR 245:**

Product Class	Storage tank Calm product surface (seldom drained or filled from bottom or immersion tube)	Buffer tank Moving surfaces (continuous filling from above or mixing jets)	Tank with agitator Turbulent surface, single stage agitator < 60 RPM									
												
	Measuring range											
<b>FMR 240: (antenna nominal size)</b>	1-1/2"   2"   3"   4"	1-1/2"   2"   3"   4"	1-1/2"   2"   3"   4"									
<b>FMR 244: (antenna nominal size)</b>	1-1/2"   –   –   –	1-1/2"   –   –   –	1-1/2"   –   –   –									
<b>FMR 245: (antenna nominal size)</b>	–   2"   3"   –	–   2"   3"   –	–   2"   3"   –									
<b>A</b> DK (εr) = 1.4 to 1.9	Stilling well recommended (65 ft.) or wave guide antenna * (12.5 ft.)											
<b>B</b> DK (εr) = 1.9 to 4	10 ft	16 ft	33 ft	49 ft	7 ft	8 ft	16 ft	25 ft	3 ft	3 ft	7 ft	10 ft
<b>C</b> DK (εr) = 4 to 10	20 ft	33 ft	49 ft	65 ft	10 ft	16 ft	25 ft	33 ft	5 ft	7 ft	10 ft	16 ft
<b>D</b> DK (εr) = > 10	30 ft	49 ft	65 ft	65 ft	16 ft	25 ft	33 ft	42 ft	7 ft	10 ft	16 ft	23 ft

\* In the event of lateral stress, a mechanical support is required for the wave guide antenna or place the wave guide antenna inside a protective pipe.

Product Class	Stilling well	Bypass	Integral wave guide
			
	Measuring range		
<b>FMR 240: (antenna nominal size)</b>	1-1/2" to 4"	2" to 4"	Integral wave guide *
<b>FMR 244: (antenna nominal size)</b>	1-1/2"	–	–
<b>FMR 245: (antenna nominal size)</b>	2" to 3"	2" to 3"	–
<b>A</b> DK (εr) = 1.4 to 1.9	65 ft	Use wave guide	Depending on pipe length, maximum 12.6 ft. (other lengths on request)
<b>B</b> DK (εr) = 1.9 to 4	65 ft	Use wave guide	
<b>C</b> DK (εr) = 4 to 10	65 ft	65 ft	
<b>D</b> DK (εr) = > 10	65 ft	65 ft	

\* In the event of lateral stress, a mechanical support is required for the wave guide antenna or place the wave guide antenna inside a protective pipe.

**Measuring conditions**

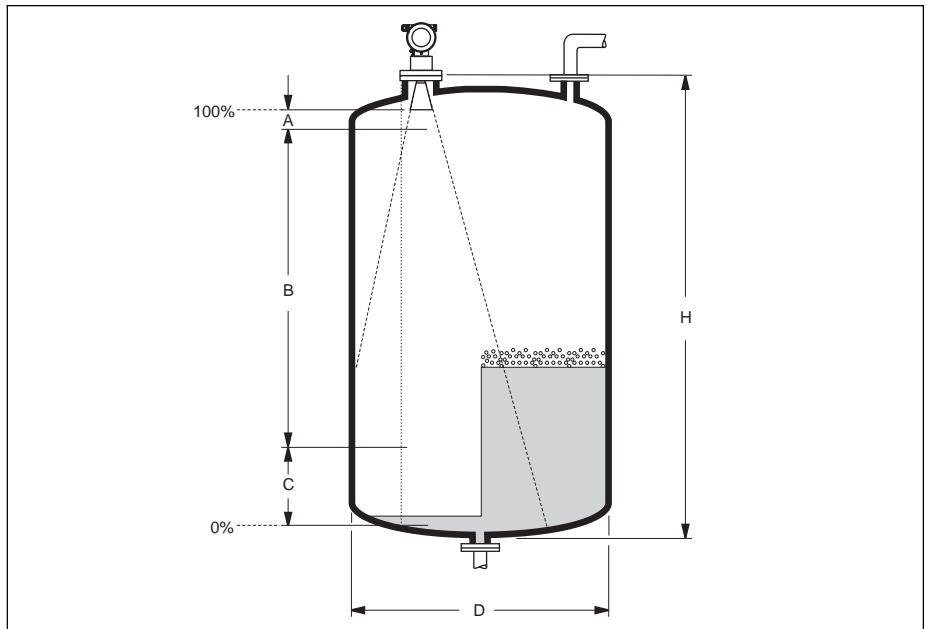
**NOTE!**

Please use FMR 230 or FMR 231 for boiling surfaces or in case of a tendency for foaming.

In case of heavy steam development or condensate, the maximum measuring range of the FMR 240/244/245 may decrease depending on the density, temperature and composition of the steam (-> please use FMR 230 or FMR 231). Please use the FMR 230 in a stilling well for Ammonia NH<sub>3</sub> measurement.

- The measuring range begins where the beam hits the tank bottom. Particularly with dish bottoms or conical outlets. The level cannot be detected below that point.
- For wave guide antennas, the end of the pipe is the beginning of the measuring range.
- In case of media 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 with the FMR 230/231/240. However, due to possible corrosion and build-up, the maximum span should not be any closer than (A) to the tip of the antenna. For FMR 244/245, the end of the measuring range should not be closer than (A) to the tip of the antenna, especially when there is condensate.
- The smallest possible measuring range (B) depends on the antenna version.
- The tank diameter should be greater than (D) listed in the table below, the tank height at least (H).
- Depending on its consistency, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions, consult factory.

	A (in)	B (in)	C (in)	D (in)	H (in)
FMR 230 / 231	2	> 20	6 to 12	> 40	> 60
FMR 240	2	> 8	2 to 6	> 8	> 12
FMR 244	6	> 8	2 to 6	> 8	> 12
FMR 245	8	> 8	2 to 6	> 8	> 12



**Operating frequency**

FMR 230 / 231: Approximately 6 GHz ultra wideband system

FMR 240/244/245: Approximately 26 GHz ultra wideband system

## Output

### Output signal

- 4 to 20 mA with HART® protocol
- Profibus-PA
- Foundation Fieldbus (FF)

### Signal on alarm

- Error information can be accessed via the following interfaces
- Local display (via error symbol (refer to page 23) or plain text display)
  - Current output
  - Digital interface

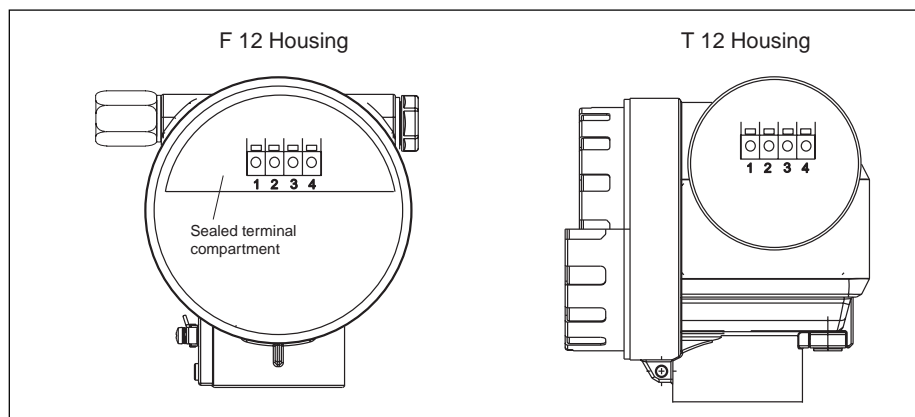
## Power input

### Electrical connection

#### Terminal compartment

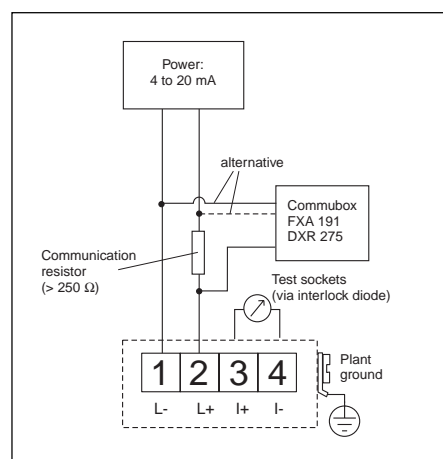
Two housings are available:

- F 12 housing, with additionally sealed terminal compartment for non-hazardous or intrinsically safe applications
- T 12 housing, with separate terminal compartment for non-hazardous, intrinsically safe or explosion proof applications



### Terminal wiring assignment, 4 to 20 mA with HART®

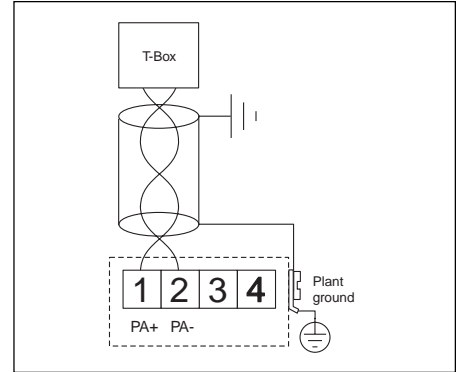
The 2-wire cable is connected to the screw terminals (16 to 18 AWG) in the terminal compartment. Use 2-wire twisted pair with shield for wiring. The circuitry is protected from reverse polarity, RFI and over-voltage.





**Terminal wiring assignment, Profibus-PA**

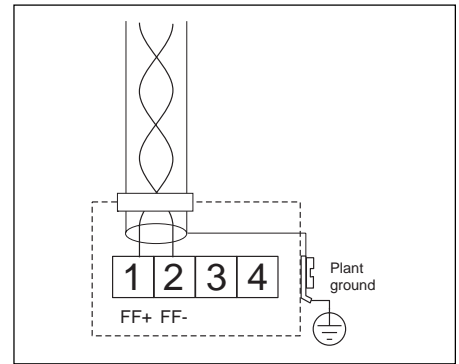
The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the power supply. Use 2-wire twisted pair with shield.



**Terminal wiring assignment, Foundation Fieldbus**

The digital communication signal is transmitted to the bus via 2-wire connection. The bus also provides the power supply. Use 2-wire twisted pair with shield.

Further information can be found in the Foundation Fieldbus specifications or IEC 61158-2



**HART® load** Minimum load for HART® communication, 250 Ω

**Cable entry** 1/2" NPT. Profibus-PA, M12 plug, Foundation Fieldbus, 7/8" plug

**Supply voltage** The following values are the voltages across the terminals on the instrument side.

Communication		Current consumption	Terminal Voltage	
			minimum	maximum
HART	non-hazardous	4 mA	16 V	36 V
		20 mA	7.5 V	36 V
	intrinsically safe	4 mA	16 V	30 V
		20 mA	7.5 V	30 V
	explosion proof	4 mA	16 V	30 V
		20 mA	11 V	30 V
Fixed current *	non-hazardous	11 mA	10 V	36 V
	intrinsically safe	11 mA	10V	30 V

\* measured value transferred at HART®

**Power consumption** Normal operation; minimum 60 mW, maximum 900 mW

Communication	Current consumption
HART®	3.2 to 22 mA
Profibus-PA	approximately 13 mA
Foundation Fieldbus	approximately 15 mA

**Ripple HART®** 47 to 125 Hz: U<sub>pp</sub> = 200 mV (measured at 500Ω)

**Maximum noise HART®** 500 Hz to 10 KHz: U<sub>rms</sub> = 2.2 mV (at 500 Ω)

## 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 area

### Maximum measured error

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

Type of device	to 32 ft	above 32 ft
FMR 230/231	± 0.39 in.	± 0.1% of measuring range
FMR 240/244/245	± 0.12 in.	± 0.03% of measuring range

### Resolution

Digital / analog in % of 4 to 20 mA for FMR 230/231/240/244/245

- 0.04" / 0.03% of measuring range

### Reaction time

The reaction time is a minimum of 1 second and a maximum of approximately 300 seconds. In case of fast level changes, the instrument needs the reaction time to indicate the new value.

### Influence of ambient temperature

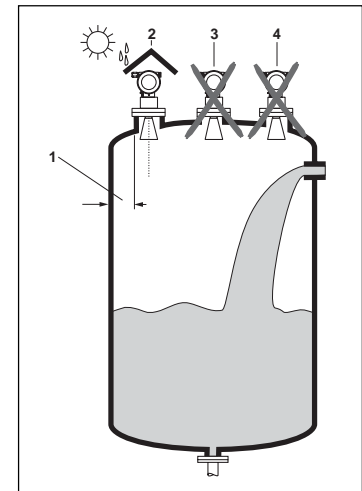
0.006% / 10 K referring to the maximum measuring range

## Operating conditions (installation)

### Installation instructions

#### Location

- Recommended minimum distance (1) from wall to outer edge of nozzle, approximately 1/6 of tank diameter. FMR 230/231; min. 12" (30 cm) FMR 240/244/245; min. 6" (15 cm).
- Do not mount in the center (3), interference echoes can cause signal loss.
- Do not mount the unit above the fill stream.
- It is recommended to use a weather protection cover (2) in order to protect the transmitter in harsh environments (refer to Accessories in the order section).



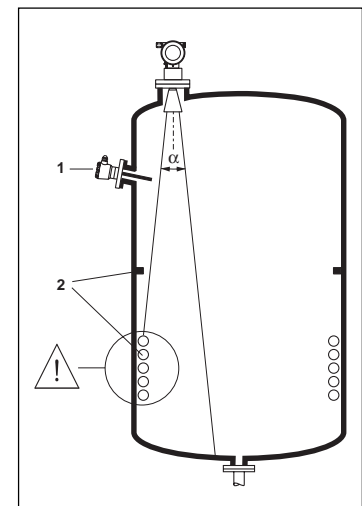
#### Tank installations

- Avoid any installations (1), such as limit switches, temperature sensors, ect., inside the signal beam area.
- Symmetrical installations (2), i.e. vacuum rings, heating coils, baffles, etc., can also interfere with the measurement.

#### Optimization options

- 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: refer to "Recommended mounting position".
- Stilling wells: a stilling well or pipe antenna can always be used to avoid interference.

Please contact Endress+Hauser for further information.



**Beam angle**

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

Beam width diameter “W” is a function of the antenna type (beam angle  $\alpha$ ) and the measuring distance “D”.

		Beam Width Diameter W, ft (m)			
		FMR 230			FMR 231
Antenna size	6"	8"	10"	Rod	
Beam angle $\alpha$	23°	19°	15°	30°	
Measuring distance D, ft (m)					
10 (3)	4.0 (1.2)	3.4 (1.0)	2.6 (0.8)	5.4 (1.6)	
20 (6)	8.1 (2.4)	6.7 (2.0)	5.3 (1.6)	10.7 (3.2)	
30 (9)	12.2 (3.76)	10.9 (3.0)	7.9 (2.4)	16.1 (4.8)	
40 (12)	16.3 (4.9)	13.4 (4.0)	10.5 (3.1)	21.4 (6.4)	
49 (15)	19.9 (6.1)	16.4 (5.0)	12.9 (3.9)	26.3 (8.0)	
65 (20)	26.5 (8.1)	21.8 (6.7)	17.1 (5.3)	34.8 (10.7)	

		Beam Width Diameter W, ft (m)			
Antenna size	FMR 240	1-1/2"	2"	3"	4"
	FMR 244	1-1/2"	-	-	-
	FMR 245	-	2"	3"	-
Beam angle $\alpha$		23°	18°	10°	8°
Measuring distance D, ft (m)					
10 (3)	4.0 (1.2)	3.2 (1.0)	1.8 (0.5)	1.4 (0.4)	
20 (6)	8.1 (2.4)	6.3 (1.9)	3.5 (1.1)	2.8 (0.8)	
30 (9)	12.2 (3.76)	9.5 (2.9)	5.3 (1.6)	4.2 (1.3)	
40 (12)	-	12.7 (3.8)	7.0 (2.1)	5.6 (1.7)	
49 (15)	-	15.5 (4.8)	8.6 (2.6)	6.8 (2.1)	
65 (20)	-	-	11.4 (3.5)	9.1 (2.8)	

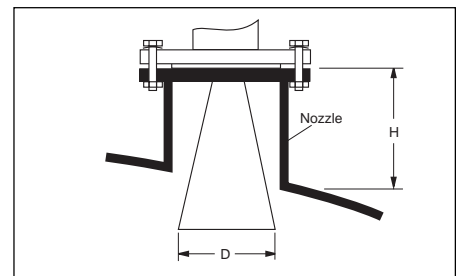
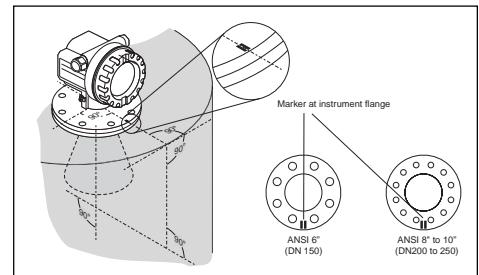
**FMR 230 Installation in tank (free space)**

**Recommended mounting position**

**Standard installation**

- Observe installation instructions on page 10 and above.
- Align flange mark towards tank wall.
- Mark is always between 2 bolt holes on flange.
- The housing can be rotated 350° to simplify access to the display and terminal compartment after mounting.
- The horn antenna must extend below the nozzle, otherwise the FAR 10 antenna extension must be used. (refer to page 12).
- Align horn antenna vertically.

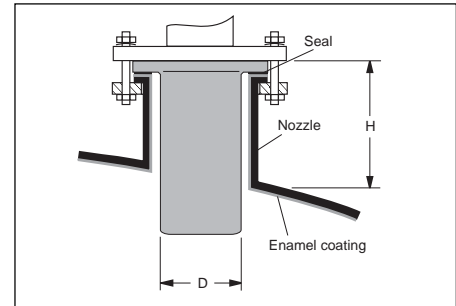
Antenna dim.	6"	8"	10"
D	5.8"	7.5"	9.5"
H	< 8.1"	< 11.5"	< 15"



**Enamelled antenna installation**

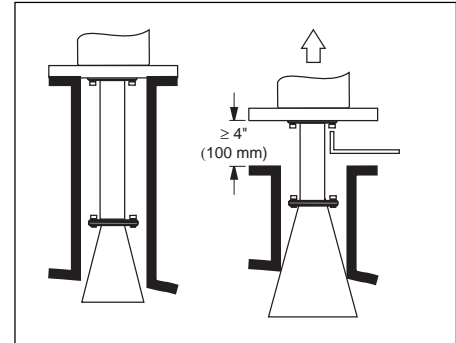
- Refer to standard installation.
- Do not hit or chip the enamelled antenna, the coating can be damaged.

Antenna dim.	6"	8"
D	5.51"	6.22"
H	< 8.62"	< 10.6"



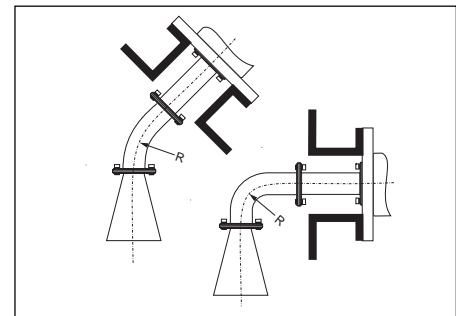
**FAR 10 antenna extension**

- The antenna extension has to be selected so that the horn extends below the nozzle.
- If the horn diameter is greater than the width of the nozzle, the antenna including the extension needs to be 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).



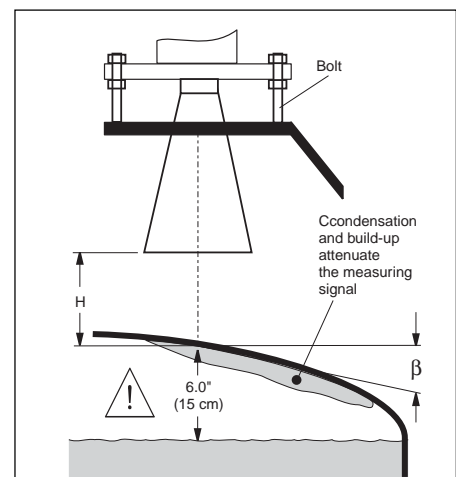
**Special extensions**

- If the antenna has to be mounted on a sloping or vertical vessel wall, an extension with a 45° respectively 90° bend is available.
- The smallest possible radius R for the bend is 12" (300 mm).



**Measurement from the outside through plastic or fiberglass tanks**

- Medium with dielectric constant  $\epsilon_r > 10$ .
- Maximum level must be 6" (15 cm) below tank ceiling.
- Distance H must be greater than 4" (100 mm).
- Preferred mounting is by means of stand-offs for adjustment of the ideal distance H.
- If possible, avoid mounting location where condensation or build-up might occur. In case of outdoor mounting, the space between antenna and tank must be protected from the elements.
- Optimum angle  $\beta$  between 15° and 20°.
- Select vessel construction material with a low dielectric constant and corresponding thickness. Do not use conductive (black) plastics (refer to table).
- If possible, use a 10" diameter horn
- Do not mount any potential reflectors (i.e. pipes) outside the tank within the signal beam angle area.

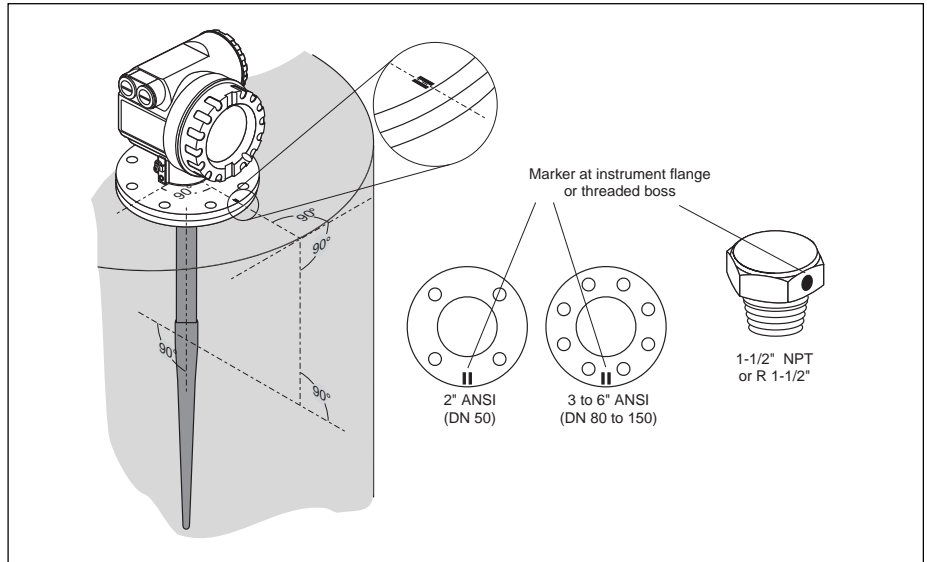


Vessel Material	PE	PTFE	PP	Perspex
DK / $\epsilon_r$	2.3	2.1	2.3	3.1
Optimum thickness	0.62" *	0.65" *	0.62" *	0.53" *

\* Other possible values for the thickness are multiples of the values listed (i.e. PE: 1.24", 1.85", etc.)

**FMR 231 Installation in tank  
(free space)**

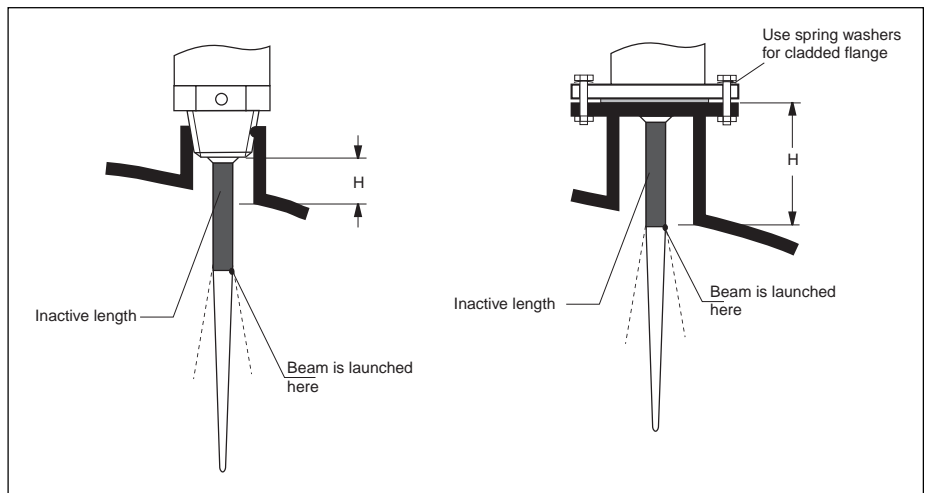
**Recommended mounting position**



**Standard installation**

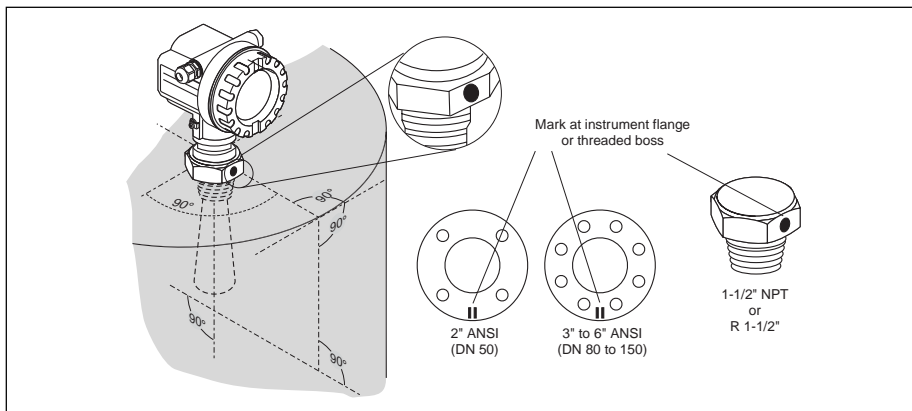
- Observe installation instructions on page 10.
- Align marker towards tank wall.
- The marker is always between two bolt holes on the flange.
- The housing can be rotated 350 ° to simplify access to the display and terminal compartment after mounting.
- The inactive part of the rod antenna must extend below the nozzle.
- The rod antenna must be aligned vertically.

Antenna material	PPS		PTFE	
	Antenna length	14.2"	20.1"	15.4"
H	< 4"	< 10"	< 4"	< 10"



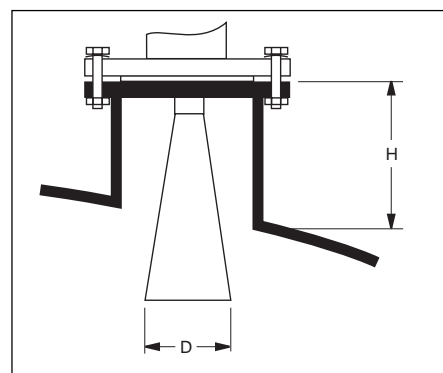
**FMR 240/244/245 Installation in tank (free space)**

**Recommended mounting position**



**Standard installation FMR 240**

- Observe installation instructions on page 10.
  - Align flange mark towards tank wall.
  - Mark is always between 2 bolt holes on flange.
  - The housing can be rotated 350 ° to simplify access to the display and terminal compartment after mounting.
  - The horn antenna must extend below the nozzle. If required, use version with the 4" (100 mm) antenna extension (refer to FMR 240 dimensions page 22).
- NOTE: Please contact Endress+Hauser for applications with higher nozzles.
- Align horn antenna vertically.



Antenna dimensions	1-1/2"	2"	3"	4"
D	1.6"	1.9"	3.0"	3.7"
H	< 3.4"	< 4.5"	< 8.3"	< 11.0"

**External measurement through plastic walls**

- Observe installation instructions on page 10
- If possible, use a 4" antenna horn

Penetrated material	PE	PTFE	PP	Perspex
DK / $\epsilon_r$	2.3	2.1	2.3	3.1
Optimum thickness	0.15"	0.16"	0.15"	0.13"

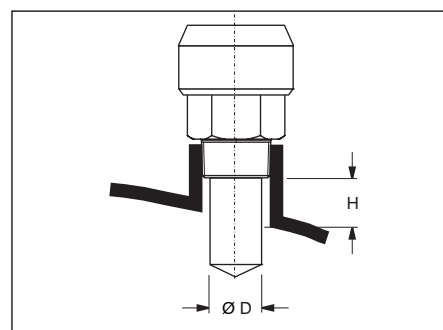
NOTE: Other possible values for the thickness are multiples of the values listed (i.e. 0.30", 0.45", etc.)

**Standard installation FMR 244**

- Observe installation instructions on page 10.
- Marker is aligned towards tank wall.
- After mounting, the housing can be rotated 350° for ease of viewing and wiring.
- For optimum measurement, the antenna should extend below the nozzle. Maximum nozzle height, 19" (500 mm).

NOTE: Please contact Endress+Hauser for applications with higher nozzles.

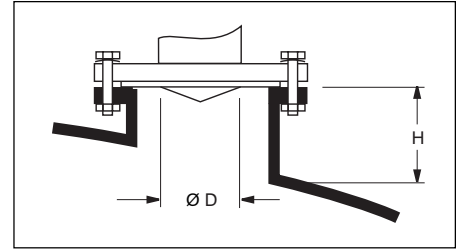
- Align antenna vertically.



Antenna dimensions	1-1/2"
D	1.5"
H	< 3.4"

**Standard installation FMR 245**

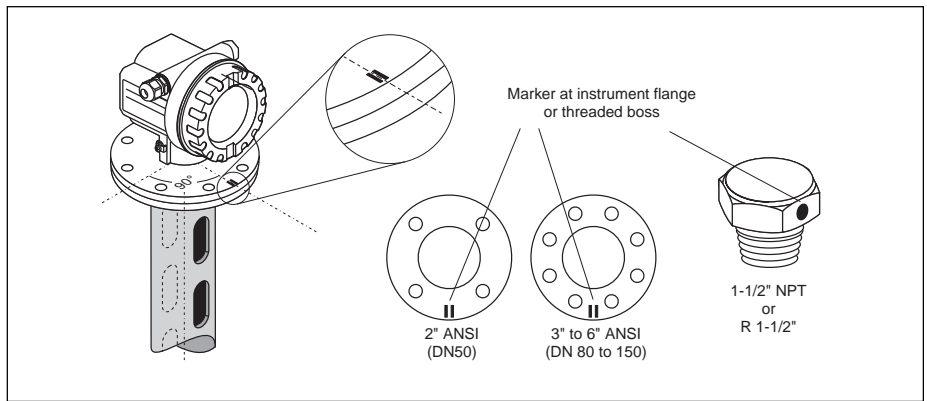
- Observe installation instructions on page 10.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle between two bolt-holes on the flange
- After mounting, the housing can be rotated 350° for ease of viewing and wiring.
- Align horn antenna vertically.



Antenna dimensions	2"	3"
D	1.7"	2.9"
H	< 20"	< 20"

**FMR 230/240/244/245 Installation in stilling well**

**Recommended mounting position**



**Standard installation**

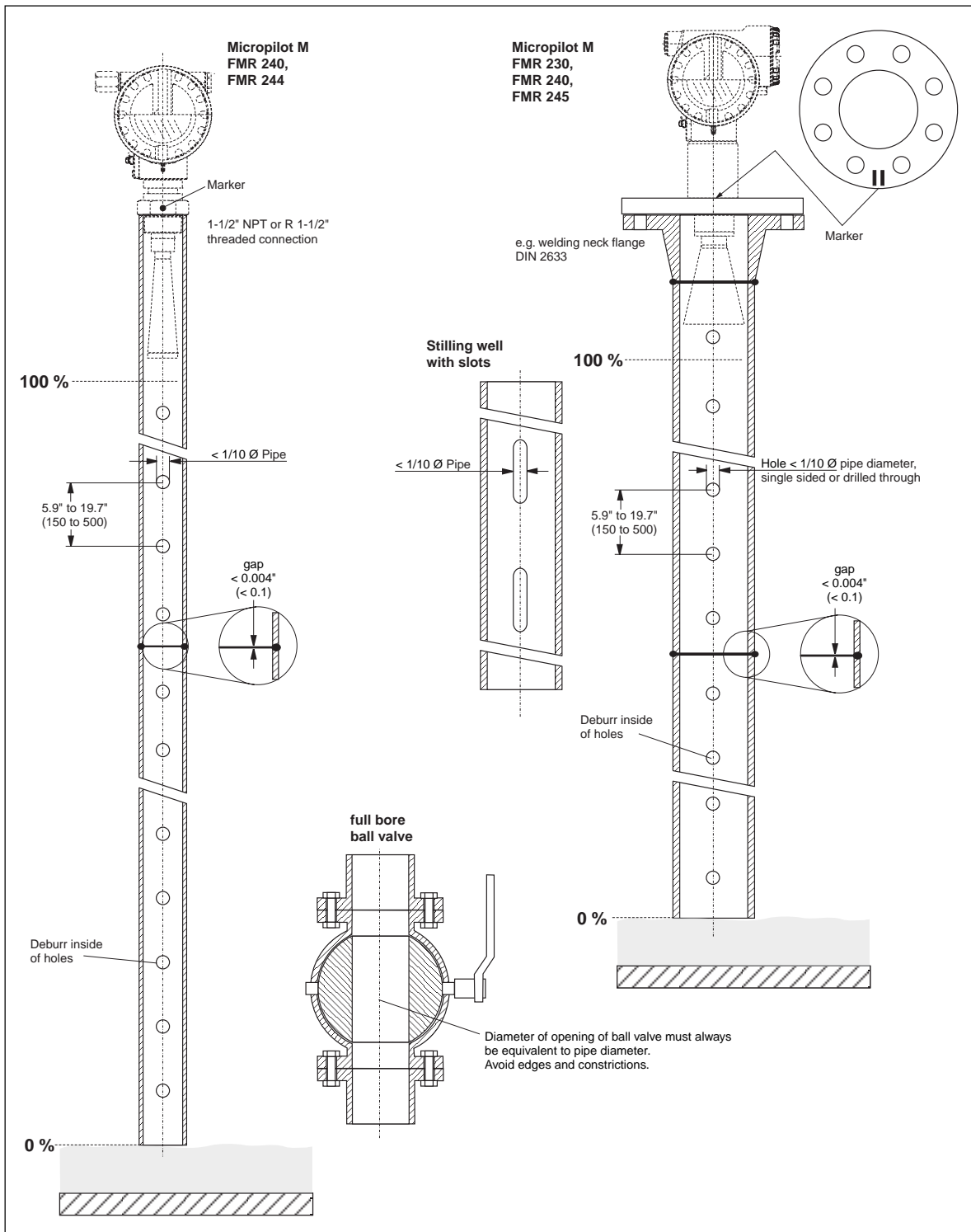
- Observe installation instructions on page 10.
- Align mark toward slots in stilling well.
- Mark is always between 2 bolt holes on flange.
- The housing can be rotated 350° to simplify access to the display and terminal compartment after mounting.
- Measurement can be performed through an open full port ball valve.

**Recommendations for the stilling well**

Refer to page 16 for stilling well construction examples.

- Metal stilling well (no enamel coating, plastic on request).
- Stilling well must have a constant diameter.
- Welding seam should be as smooth as possible and on the same axis as the slots.
- Slots must be offset at 180°, not 90°.
- Slot width maximum 1/10 of pipe diameter. The length and number of slots does not effect the measurement.
- Select the horn antenna as large as possible. For intermediate sizes (i.e. 7") select the next larger antenna and adapt it mechanically (FMR 230/240 only).
- At any transition (i.e. when using a ball valve or mending pipe segments) the gap should be < 0.004" (0.1 mm).
- The stilling well must be smooth on the inside (average roughness Rz ≤ 30). 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 aligned on the inside.
- Do not weld through the pipe wall. The inside of the stilling well must remain smooth. In case of unintentional weld through, the weld seam and any unevenness on the inside need to be carefully removed and smoothed; otherwise, strong interference echoes will result and material build-up will occur.
- On small diameter pipes, the flange that is welded to the pipe should have its bolt holes oriented in such a way that the marker on the instrument flange will be aligned towards the stilling well slots or holes.

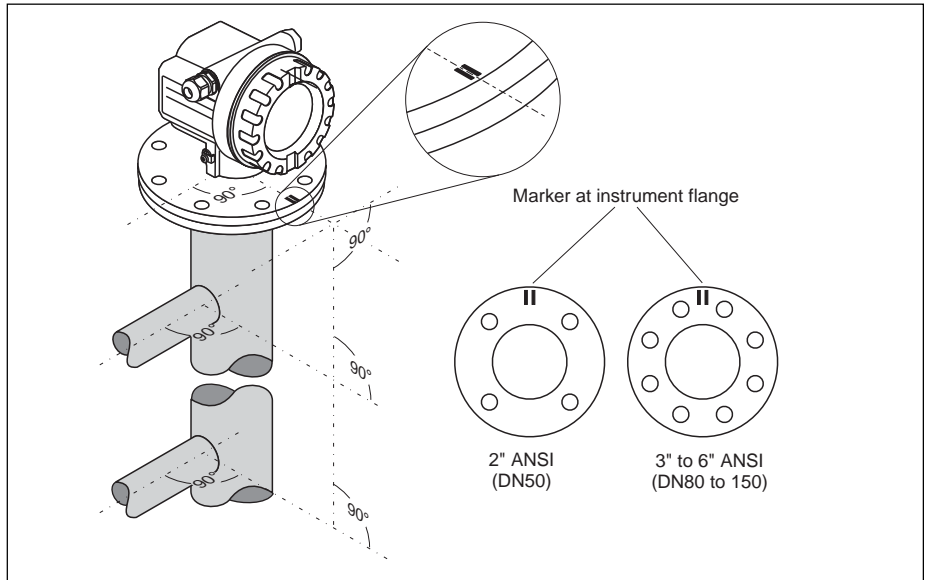
Stilling well construction examples





**FMR 230/240/245 Installation in a bypass**

**Recommended mounting position**

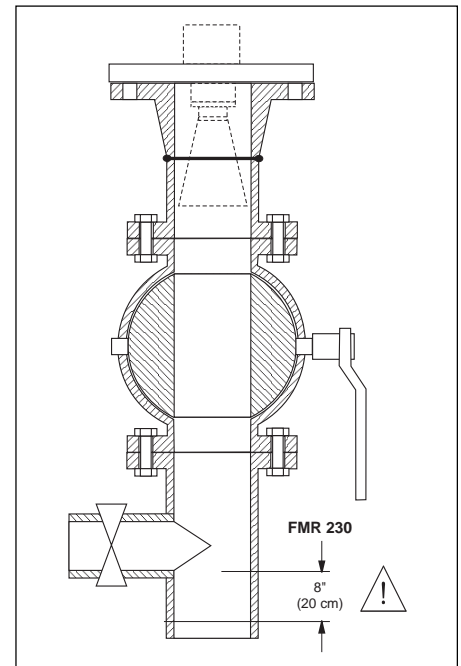


**Standard installation**

- Observe installation instructions on page 10.
- Align mark perpendicular (90°) to tank connector pipes.
- Mark is always between 2 bolt holes on flange.
- The housing can be rotated 350 ° to simplify access to the display and terminal compartment after mounting.
- Align horn antenna vertically.
- Measurements can be performed through an open full port ball valve.

**Recommendations for the bypass pipe**

- Metal bypass pipe (no enamel coating or plastic).
- Bypass pipe must have a constant diameter.
- Select horn antenna as big as possible. For intermediate sizes (i.e. 3.75") select the next larger antenna and adapt it mechanically (FMR 230/240 only).
- At any transition (i.e. when using a ball valve or mending pipe segments) the gap should be < 0.004" (0.1 mm).
- When using a FMR 230, a limited accuracy is to be expected in an area of 8" (20 cm) below the upper connection pipe.

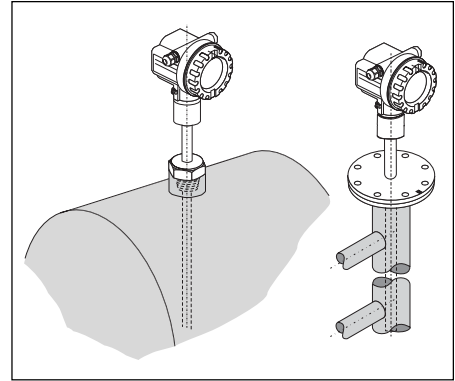


### FMR 240 with pipe antenna installation

#### Recommended mounting position

- Observe installation instructions on page 10.
- FMR 240 can be tank or bypass mounted.
- Alignment is not required
- The housing can be rotated 350 ° to simplify access to the display and terminal compartment after mounting.
- Only suitable for media with low viscosity ( $\leq 500$  cst), without the tendency for build-up in the pipe antenna.
- No minimum distance is required between the wave guide antenna and the tank bottom for measuring related purposes.

NOTE: In the event of lateral forces, mechanical support is required, or install wave guide antenna in a protective pipe.



### Operating conditions (environment)

<b>Ambient temperature range</b>	<p>Transmitter ambient temperature:</p> <ul style="list-style-type: none"> <li>• F 12 housing: -40° to +176°F (-40° to +80°C)</li> <li>• T 12 housing: -40° to +176°F (-40° to +80°C)</li> </ul> <p>A weather protection cover is recommended for outdoor operation if the unit is exposed to direct sunlight.</p>
<b>Storage temperature</b>	-40° to +176°F (-40° to +80°C)
<b>Climate class</b>	DIN EN 60068-2-38 (test Z/AD)
<b>Degree of protection</b>	<ul style="list-style-type: none"> <li>• Housing, NEMA 4x (IP 65); open housing, NEMA 1 (IP 20)</li> <li>• Antenna, NEMA 6P (IP 68)</li> </ul>
<b>Vibration resistance</b>	DIN EN 60068-2-64 / IEC 68-2-64; 20 to 2000 Hz, 5 (m/s <sup>2</sup> )/Hz
<b>Antenna cleaning</b>	<p>The antenna can become contaminated depending on the application. The emission and reception of microwaves can eventually be hindered. The degree of contamination leading to an error depends on the medium and the reflectivity, mainly determined by the dielectric constant <math>\epsilon_r</math>. 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 mechanical or 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.</p>
<b>Electromagnetic compatibility</b>	<ul style="list-style-type: none"> <li>• Emissions according to EN 61326; electrical equipment class B</li> <li>• Interference immunity to EN 61326, Annex A (industrial) and NAMUR recommendations NE 21 (EMC)</li> <li>• A standard installation cable is sufficient if only the analog signal is used. Use a shielded cable when working with a superimposed communications signal (HART®)</li> </ul>

## Operating conditions (process)

### Process temperature range

Process temperature range is dependent on the antenna type, antenna cone, wetted parts, and seal material.

#### *FMR 230*

Standard horn, PTFE cone, wetted parts (PTFE, seal and 316Ti SS), Viton seal:  
-4° to +390°F (-20° to +200°C)

Standard horn, PTFE cone, wetted parts (PTFE, seal and 316Ti SS), EPDM seal:  
-40° to +300°F (-40° to +150°C)

Standard horn, PTFE cone, wetted parts (PTFE, seal and 316Ti SS), Kalrez seal:  
+32° to +390°F (0 to +200°C)

Standard horn, PTFE cone, wetted parts (PTFE and 316Ti SS), PTFE seal  
(non-wetted Viton o-ring):  
-4° to +390°F (-20° to +200°C)

High temperature, Ceramic cone, wetted parts (Ceramic, Graphite and 316Ti SS):  
-76° to +750°F (-60° to +400°C)

Enamel coated, PTFE cone, wetted parts (PTFE and enamel), PTFE seal:  
-40° to +390°F (-40° to +200°C)

#### *FMR 231*

PTFE rod, PVDF threaded connection, wetted parts (PVDF and PTFE):  
-40° to +175°F (-40° to +80°C)

PTFE rod, 316L SS threaded connection, wetted parts (317L SS and PTFE):  
-40° to +300°F (-40° to +150°C)

PTFE rod, 316L SS flange connection, wetted parts (317L SS and PTFE):  
-40° to +300°F (-40° to +150°C)

PTFE rod, 316L SS flange connection, PTFE clad, wetted parts (PTFE):  
-40° to +300°F (-40° to +150°C)

PTFE rod, 316L SS tri-clamp, wetted parts (317L SS and PTFE):  
-40° to +300°F (-40° to +150°C)

PPS rod, antistatic, 316L SS threaded connection or flange, wetted parts  
(317L SS, Viton o-ring, and PPS):  
-4° to +250°F (-20° to +120°C)

PTFE rod, antistatic, 316L SS threaded connection or flange, wetted parts  
(317L SS and PTFE):  
-40° to +300°F (-40° to +150°C)

PTFE rod, antistatic, 316L SS antistatic PTFE clad flange, wetted parts (PTFE):  
-40° to +300°F (-40° to +150°C)

#### *FMR 240*

Standard horn, PTFE antenna cone, 316L SS threaded connection or flange,  
wetted parts (PTFE, Viton seal, and 316L SS):  
-4° to +300°F (-20° to +150°C)

Standard horn, PTFE antenna cone, 316L SS threaded connection or flange,  
wetted parts (PTFE, Viton GLT seal, and 316L SS):  
-40° to +300°F (-40° to +150°C)

Standard horn, PTFE antenna cone, 316L SS threaded connection or flange,  
wetted parts (PTFE, Kalrez seal, and 316L SS):  
+32° to +300°F (0° to +150°C)

#### *FMR 244*

Standard antenna, PTFE encapsulated, PVDF threaded connection,  
wetted parts PTFE (TRM 1600), Viton seal and PVDF:  
-40° to +266°F (-40° to +130°C)

#### *FMR 245*

Standard antenna, PTFE clad, 316L SS flange with PTFE disk,  
wetted parts PTFE (TRM 1600)  
-40° to +302°F (-40° to +150°C)

**Process pressure limits**

**FMR 230**

Standard horn: vacuum to 930 psi (64 bar)  
 High temperature: vacuum to 2320 psi (160 bar)  
 Enamel coated: vacuum to 230 psi (16 bar)

**FMR 231**

PVDF threaded: vacuum to 40 psi (3 bar)  
 316L SS threaded or flange: vacuum to 580 psi (40 bar)  
 PTFE clad flange or tri-clamp: 2", vacuum to 230 psi (16 bar);  
 3", vacuum to 145 psi (10 bar)  
 PPS antistatic 316L SS thread or flange: vacuum to 230 psi (16 bar)  
 PTFE antistatic 316L SS thread or flange: vacuum to 580 psi (40 bar)  
 PTFE antistatic PTFE clad flange: vacuum to 230 psi (16 bar)

**FMR 240**

Standard horn: vacuum to 580 psi (40 bar)  
 Wave guide antenna: vacuum to 580 psi (40 bar)

**FMR 244**

Standard antenna: vacuum to 44 psi (3 bar)

**FMR 245**

Standard antenna: vacuum to 232 psi (16 bar)

The pressure/temperature of the process connections correspond to the relevant blind flange.

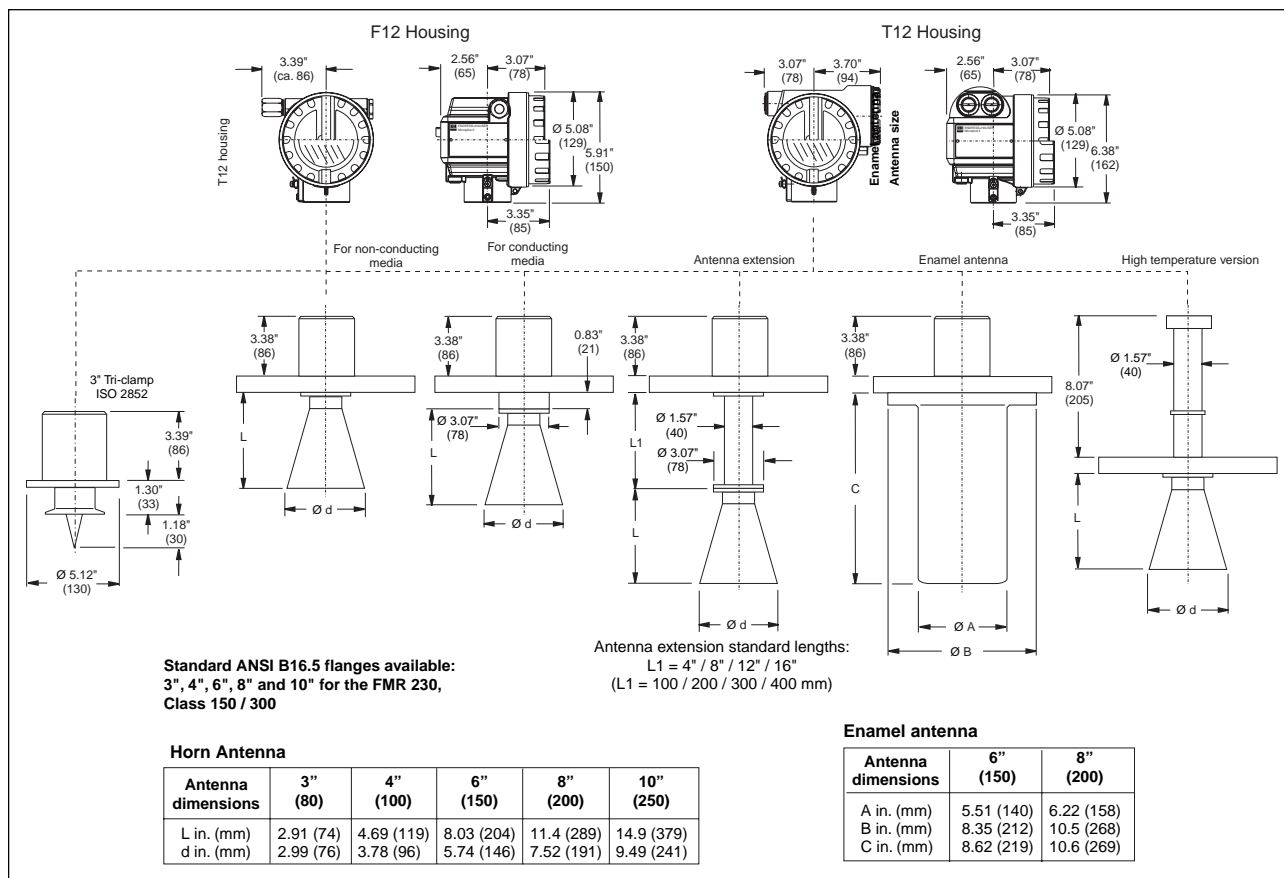
**Dielectric constant**

- Stilling well:  $\epsilon_r \geq 1.4$
- Free space:  $\epsilon_r \geq 1.9$

**Mechanical construction**

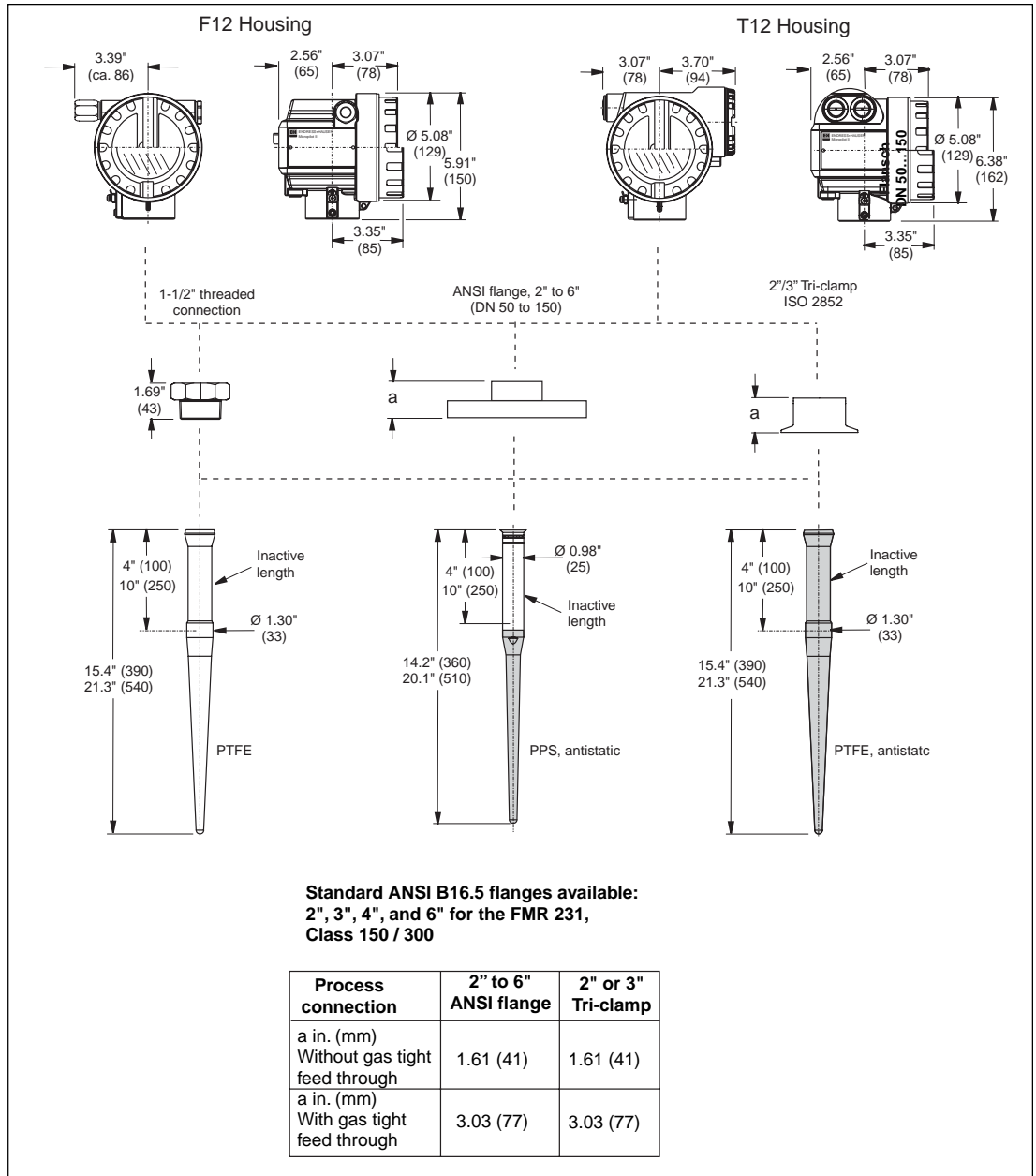
**Dimensions, FMR 230**

Dimensions are in inches (millimeters)



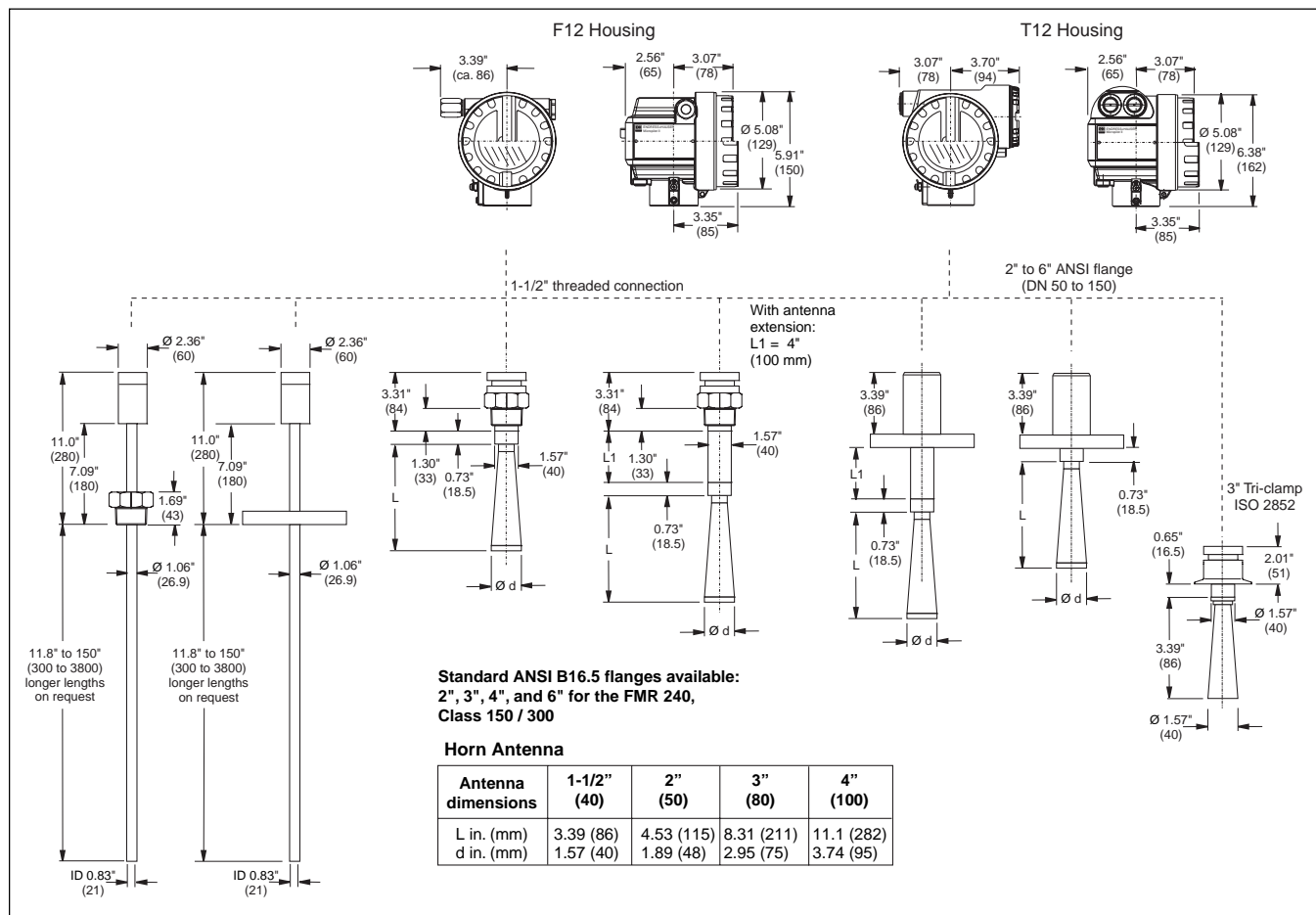
**Dimensions, FMR 231**

Dimensions are in inches (millimeters)



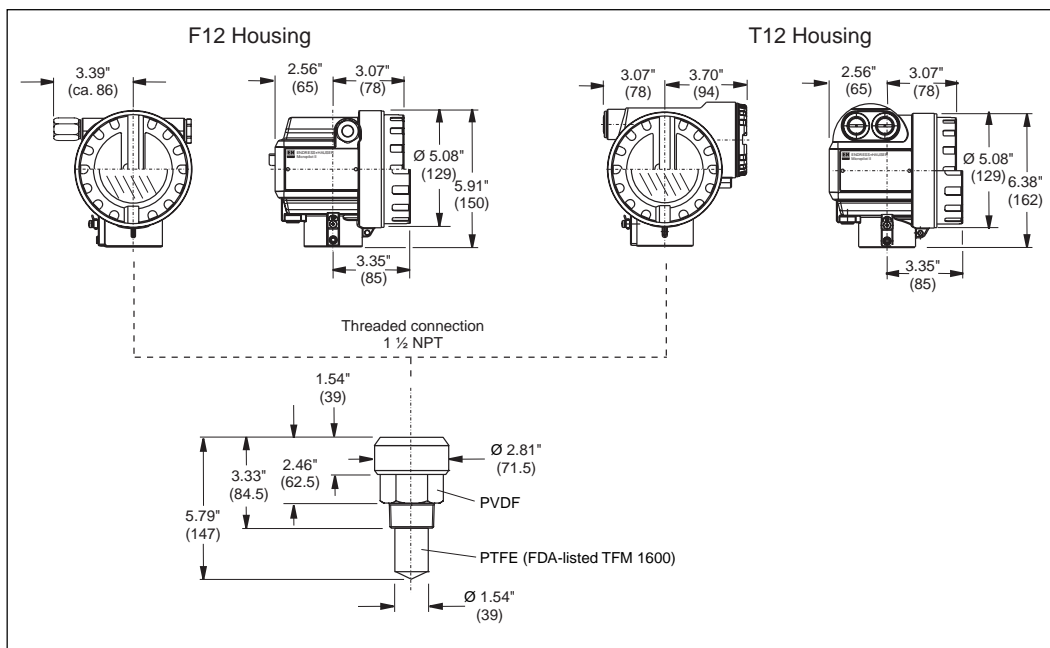
**Dimensions, FMR 240**

Dimensions are in inches (millimeters)



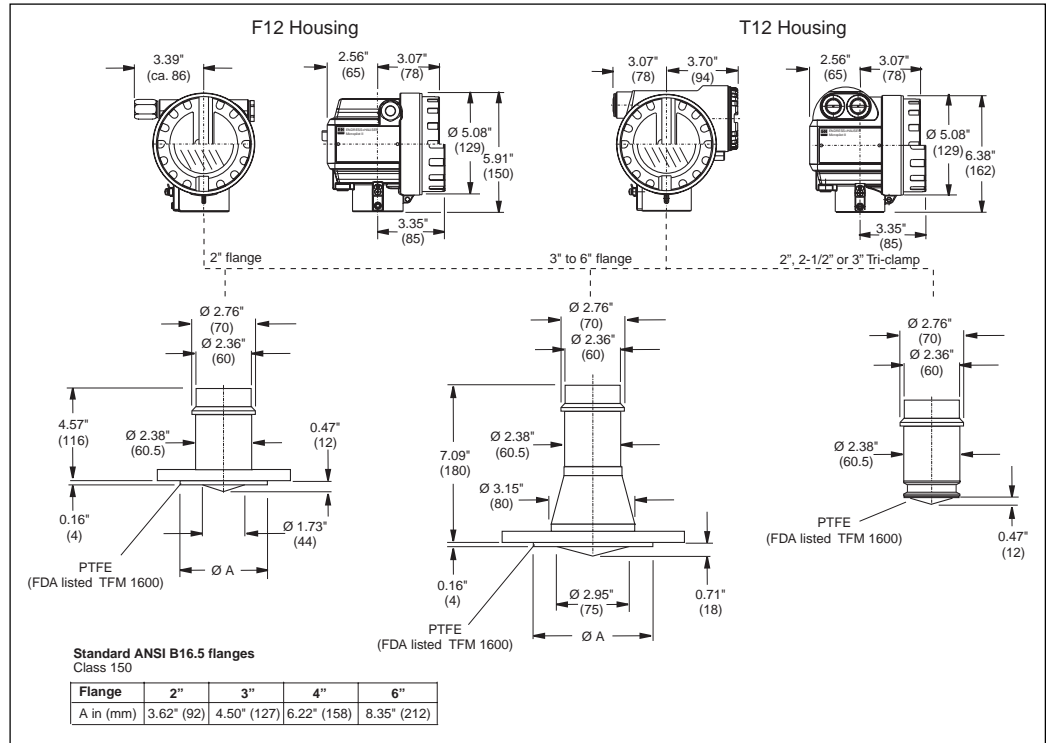
**Dimensions, FMR 244**

Dimensions are in inches (millimeters)



**Dimensions, FMR 245**

Dimensions are in inches (millimeters)



**Weight**

- FMR 230: Approximately 13 lbs. (6 kg) plus weight of flange
- FMR 231 / 240: Approximately 9 lbs. (4 kg) plus weight of flange
- FMR 244: Approximately 5.5 lbs. (2.5 kg)
- FMR 245: Approximately 9 lbs. (4 kg) plus weight of flange

**Housing**

- Housing types:
  - F12 housing with sealed terminal compartment for non-hazardous and IS areas
  - T12 housing with separate terminal compartment for increased safety, XP proof
- Material: aluminum, seawater repellent, chromate, powder coated
- Sight window: glass
- Cable entry: 1/2" NPT; Profibus-PA, M12 plug; Foundation Fieldbus, 7/8" plug

**Process connections**

**FMR 230**

3", 4" Class 150 / Class 300 ANSI B16.5 flanges, 316Ti SS; 6", 8", 10" Class 150 ANSI B16.5 flanges, 316Ti SS; 6", 8" Class 150 ANSI B16.5 flanges, enamelled steel; 6", 8", 10" Class 150 ANSI B16.5 flanges, Hastelloy C4 face

**FMR 231**

1-1/2" NPT, 316L SS; 1-1/2" PVDF; 2", 3", 4", 6" Class 150 ANSI B16.5 flanges, 316L SS; 3", 4" Class 300 ANSI B16.5 flanges, 316L SS; 2", 3", 4", 6" Class 150 ANSI B16.5 flanges, 316L SS, PTFE clad; 2" and 3" ISO 2850 Tri-clamp®, 316L SS

**FMR 240**

1-1/2" NPT, 316L SS; 2", 3", 4" Class 150 / Class 300 ANSI B16.5 flanges, 316L SS; 6" Class 150 ANSI B16.5 flange

**FMR 244**

1-1/2" NPT, PVDF

**FMR 245**

2", 3", 4", 6" 316L SS with PTFE disk, Class 150 ANSI B16.5 flanges  
 2", 2-1/2", 3" 316L SS with PTFE disk, Tri-clamp®

**Seal**

*FMR 230*  
 Standard: Viton, EPDM, Kalrez, PTFE. High temperature: Graphite  
 Enamel: PTFE  
*FMR 231*  
 PPS antistatic: Viton o-ring  
*FMR 240*  
 Standard: Viton, Viton GLT, Kalrez  
*FMR 244*  
 Viton  
*FMR 245*  
 Not required

**Antenna**

*FMR 230*  
 Horn antenna: 3", 4", 6", 8", and 10"  
*FMR 231*  
 Rod antenna, PPS antistatic: 14", 20". Rod antenna, PTFE fully insulated: 15", 21".  
 Rod antenna, PTFE fully insulated, antistatic: 15", 21"  
*FMR 240*  
 Horn antenna: 1-1/2", 2", 3" and 4". Pipe antenna: 12" to 110"  
*FMR 244*  
 PTFE encapsulated  
*FMR 245*  
 PTFE clad

**Display and user interface**

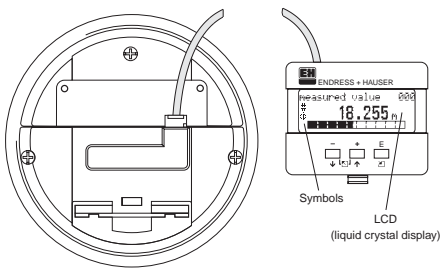
**Operation concept**

The display of the process value and the configuration of the Micropilot M take place locally by means of a large 4-digit alphanumeric display with plain text information. The guided menu system with integrated help text 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.



The diagram shows a cross-section of the instrument with a cable connected to the top. To the right, a close-up of the LCD display is shown. The display shows the text 'ENDRESS + HAUSER' at the top, followed by 'pressure 119.119', '18.255', and '000'. Below the display are several symbols: a lightning bolt, a padlock, a communication symbol, and a star-like symbol. Labels 'Symbols' and 'LCD (liquid crystal display)' point to these elements.

Displayed Symbol	Meaning
	<b>ALARM symbol</b> Symbol appears when the instrument is in an alarm state. Flashing indicates warning, steady ON indicates alarm.
	<b>LOCK symbol</b> The lock symbol appears when the instrument is locked; input is not possible during the locked state
	<b>COMMUNICATION symbol</b> Communication symbol appears when data transmission via HART, PROFIBUS, or Foundation Fieldbus is in progress.
	<b>SIMULATION_SWITCH_ENABLE symbol</b> This communication symbol appears when simulation in Foundation Fieldbus is enabled via the DIP switch.



**Operating elements**

The programming keys are located inside the housing and are accessible by opening the housing lid.

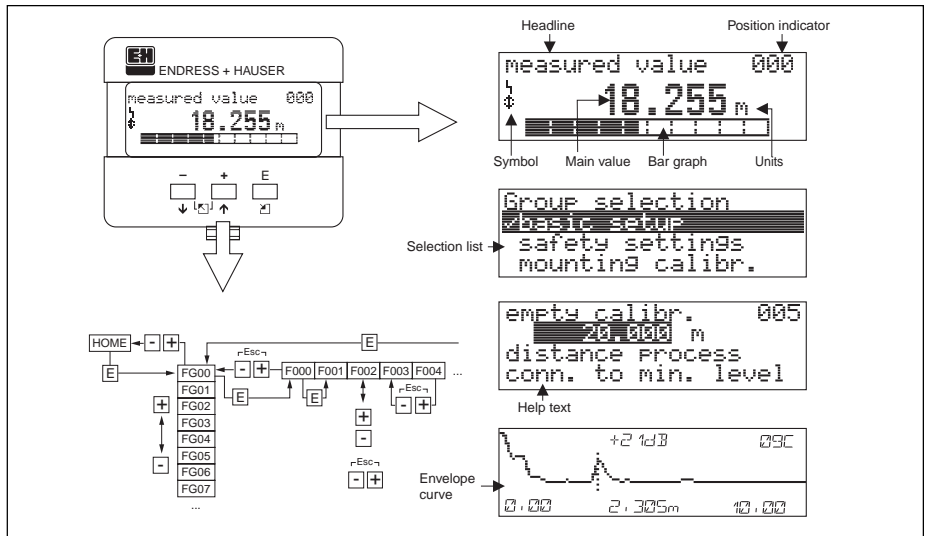
**Key function**

Key (s)	Meaning
[+] Or [↑]	Navigate upwards in the selection list Edit numeric value within a function
[-] Or [↓]	Navigate downwards in the selection list Edit numeric value within a function
[Esc] Or [←]	Navigate to the left within a function group
[E] Or [→]	Navigate to the right within a function group, confirmation
[+] and [E] or [-] and [E]	Contrast settings of the LCD
[+] and [-] and [E]	Hardware lock / unlock After a hardware lock, an operation via the display or communication is not possible. The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

**On-site operation**

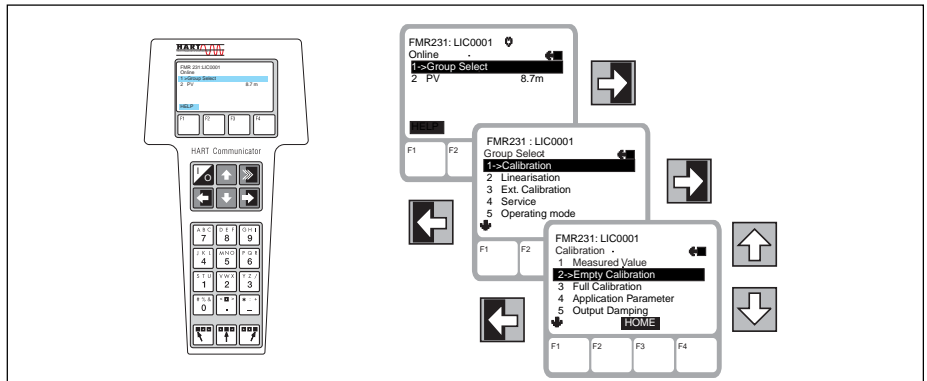
**Operation with VU 331 display**

The LC-Display VU 331 allows configuration via 3 keys. 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.



**Operation with HART® handheld DXR 275**

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



**Remote operation**

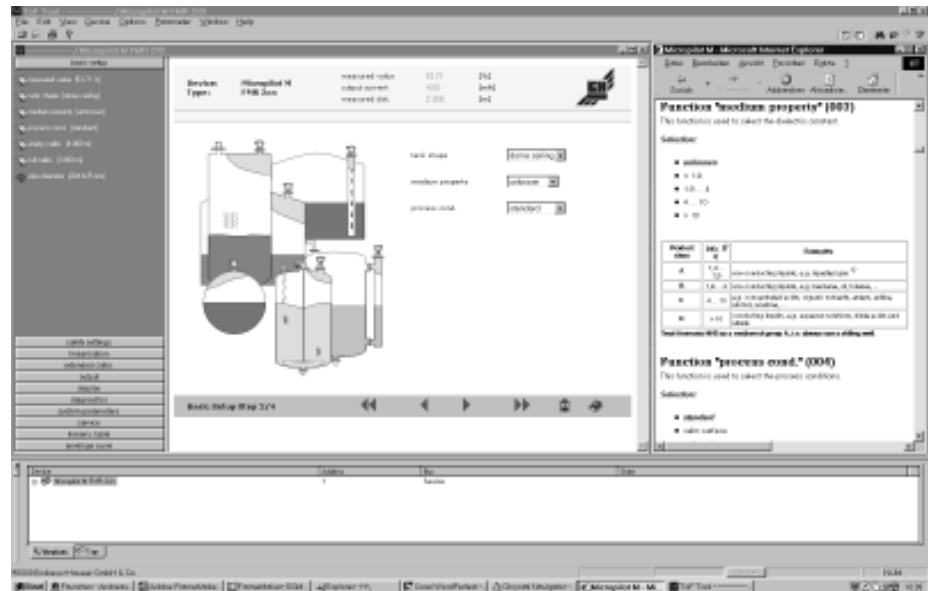
The Micropilot M can be remotely operated via HART®, Profibus-PA and Foundation Fieldbus.

**Operation with ToF Tool**

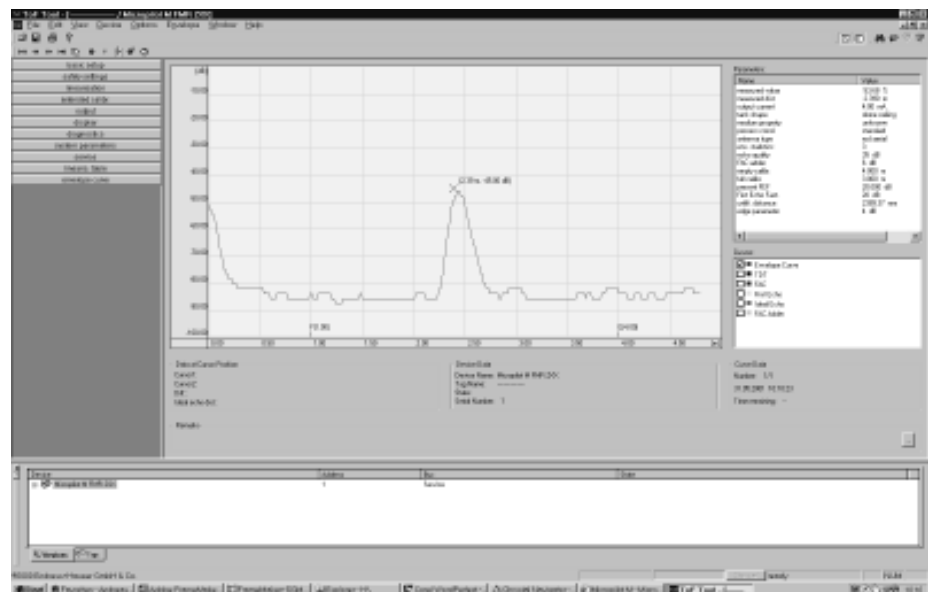
The ToF Tool is a graphical operating software package for instruments from Endress+Hauser that operate based on the time-of-flight principle. It is used to support commissioning, securing of data, signal analysis, and documentation of the instruments. It is compatible with the following operating systems: Win 95, Win 98, WinNT 4.0 and Win 2000. The ToF Tool supports the following functions:

- Online configuration of transmitters
- Signal analysis via envelope curve
- Loading and saving of instrument data (Upload/Download)
- Documentation of measuring point data

Menu-guided commissioning:



Signal analysis via envelope curve:



Connection options:

- HART® with Commubox FXA 191
- Profibus-PA
- Service-interface with FXA 193 adapter

**Operation with Commuwin II**

Commuwin II is an operating software package with graphical support for intelligent transmitters using the following communication protocols: Rackbus, Rackbus RS 485, Intensor, HART®, or Profibus-PA. It is compatible with the operating systems Win 3.1 / 3.11, Win 95, Win 98, and WinNT 4.0. Commuwin II supports the following functions:

- Online configuration of transmitters
- Loading and saving of instrument data (Upload/Download)
- Orderly visualization of measured values and limit values
- Display and recording of measured values with a line recorder
- The envelope curve is displayed via ToF Tool

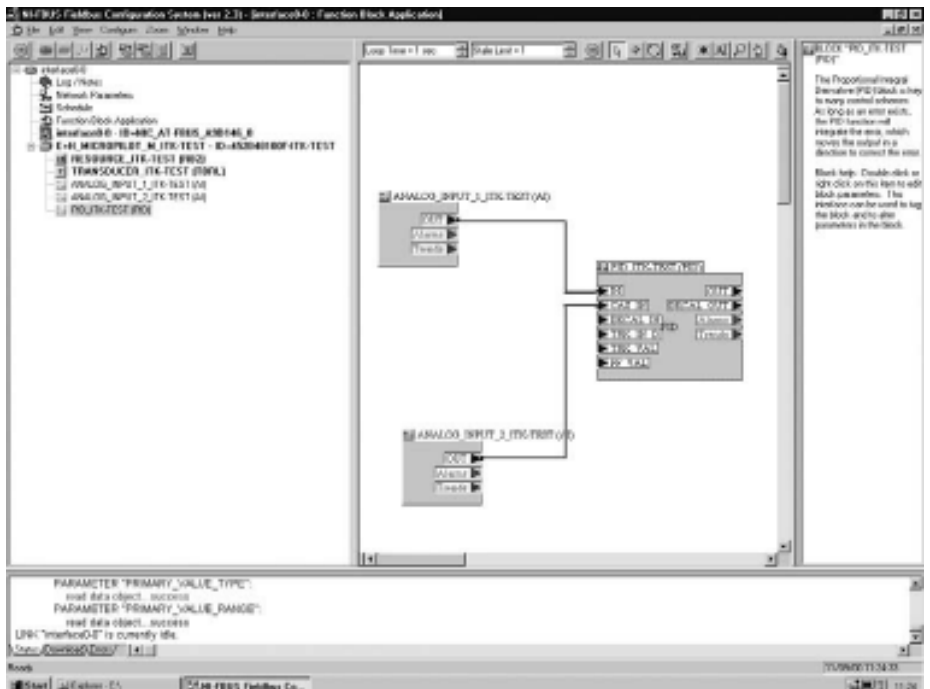
Connections:

- HART® with the FXA 191 Commubox
- Profibus-PA

**Operation with NI-FBUS configurator (Foundation Fieldbus only)**

The NI-FBUS Configurator is an easy to use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts. You can use the NI-BUS Configurator to configure a fieldbus as follows:

- Set block and device tags
- Set device addresses
- Create and edit function block control strategies (function block applications)
- Configure vendor-defined function and transducer blocks
- Create and edit schedules
- Read and write to function block control strategies (function block applications)
- Invoke Device Description (DD) methods
- Display DD menus
- Download a configuration
- Verify a configuration and compare it to a saved configuration
- Monitor a downloaded configuration
- Replace devices
- Log project download changes
- Save and print a configuration



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## Certificates and approvals

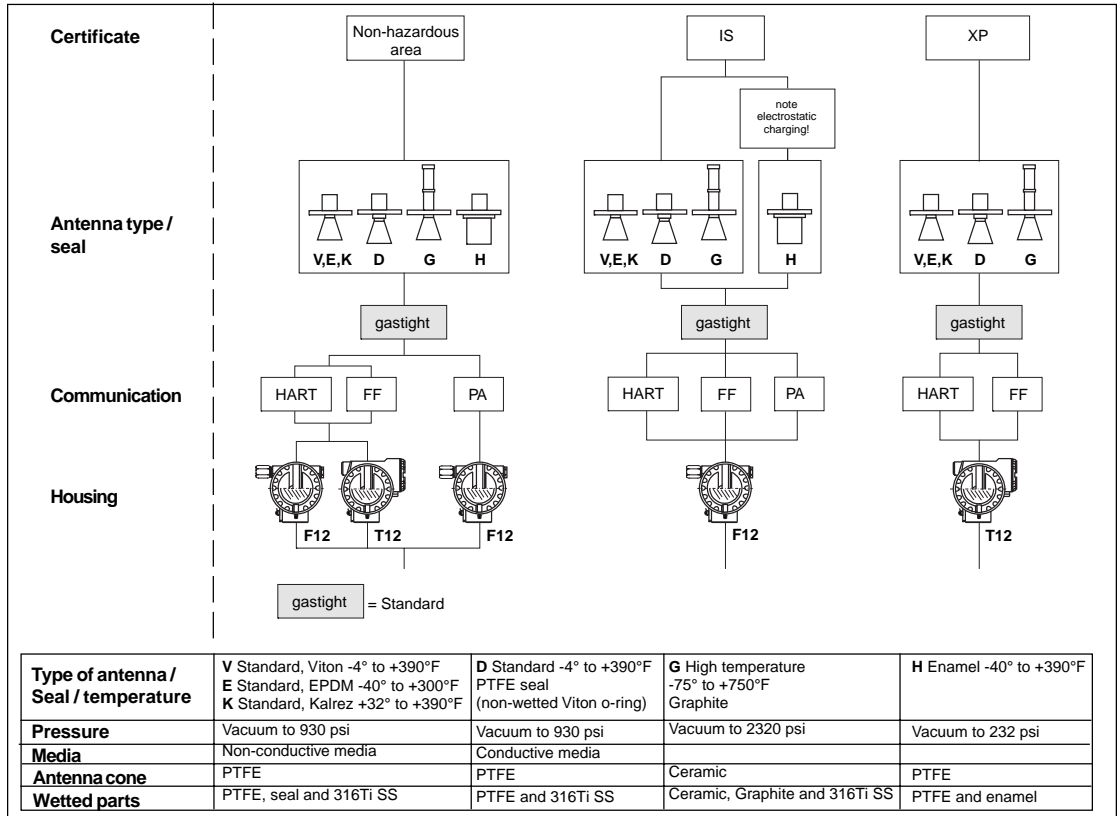
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<b>CE approval</b>	By attaching the CE mark, Endress+Hauser confirms that the instrument fulfills all the requirements of the relevant EC directives.
<b>RF approvals</b>	R&TTE, FCC
<b>Hazardous area approvals</b>	FM approved intrinsically safe Class I, Division 1, Groups A-D FM approved explosion proof Class I, Division 1, Groups A-D CSA approved intrinsically safe Class I, Division 1, Groups A-D CSA approved explosion proof Class I, Division 1, Groups A-D
<b>Overspill protection</b>	WHG
<b>Sanitary compatibility</b>	FMR 231 with PTFE antenna made of 3A / FDA listed TFM 1600. Only in combination with food-grade process connection, Tri-clamp®. FMR 245 with flange cladding made of FDA-listed TFM 1600
<b>Other standards and guidelines</b>	Protection class of housing, IP-code, EN 60529 Safety regulations for electrical devices for measurement, control, regulation, and laboratory use, EN 61010 Emissions (equipment class B), compatibility (appendix A - industrial area) EN 61326 Standards committee for measurement and control in the chemical industry, NAMUR

## Ordering information

**FMR 230**

Instrument selection



FMR 230 -  1  2  3  4  5  6  7  8

- |   |  |
|---|--|
| <p><b>1 Certificates</b></p> <ul style="list-style-type: none"> <li>A Non-hazardous areas</li> <li>F Non-hazardous areas, WHG overspill protection</li> <li>S FM approved IS, Class I, Div. 1, Grps. A-D</li> <li>T FM approved XP, Class I, Div. 1, Grps. A-D</li> <li>N CSA general purpose</li> <li>U CSA approved IS, Class I, Div. 1, Grps. A-D</li> <li>V CSA approved XP, Class I, Div. 1, Grps. A-D</li> </ul> <p><b>2 Antenna size</b></p> <ul style="list-style-type: none"> <li>1 Without horn, for pipe installation</li> <li>2 3" / 80 mm</li> <li>3 4" / 100 mm</li> <li>4 6" / 150 mm</li> <li>5 8" / 200 mm</li> <li>6 10" / 250 mm</li> </ul> <p><b>3 Type of antenna / sealing / temperature range</b></p> <ul style="list-style-type: none"> <li>V Standard / Viton / -4° to +390°F (-20° to +200°C)</li> <li>E Standard / EPDM / -40° to +300°F (-40° to +150°C)</li> <li>K Standard / Kalrez / +32° to +390°F (0° to +200°C)</li> <li>D Standard / PTFE / -4° to +390°F (-20° to +200°C)</li> <li>G High temperature / Graphite / -75° to +750°F (-60° to +400°C)</li> <li>H Enamel antenna / PTFE / -40° to +390°F (-40° to +200°C)</li> </ul> <p><b>4 Process connection / material</b></p> <ul style="list-style-type: none"> <li>AL2 3" Class 150 ANSI B16.5 / 316Ti SS</li> <li>AM2 3" Class 300 ANSI B16.5 / 316Ti SS</li> <li>AP2 4" Class 150 ANSI B16.5 / 316Ti SS</li> <li>AQ2 4" Class 300 ANSI B16.5 / 316Ti SS</li> <li>AV2 6" Class 150 ANSI B16.5 / 316Ti SS</li> <li>A32 8" Class 150 ANSI B16.5 / 316Ti SS</li> <li>A52 10" Class 150 ANSI B16.5 / 316Ti SS</li> <li>AVT 6" Class 150 ANSI B16.5 / enamelled steel</li> <li>A3T 8" Class 150 ANSI B16.5 / enamelled steel</li> <li>AV5 6" Class 150 ANSI B16.5 / Alloy C4 face</li> <li>A35 8" Class 150 ANSI B16.5 / Alloy C4 face</li> <li>A55 10" Class 150 ANSI B16.5 / Alloy C4 face</li> <li>TL2 3" Tri-clamp®, 316Ti SS, ISO 2852</li> </ul> | <p><b>5 Output / display</b></p> <ul style="list-style-type: none"> <li>A 4 to 20 mA HART / VU 331 4-line display</li> <li>B 4 to 20 mA HART</li> <li>K 4 to 20 mA HART, prepared for FHX 40, mounting of remote display (accessory)</li> <li>C Profibus-PA / VU 331 4-line display</li> <li>D Profibus-PA</li> <li>L Profibus-PA, prepared for FHX 40, mounting of remote display (accessory)</li> <li>E Foundation Fieldbus / VU 331 4-line display</li> <li>F Foundation Fieldbus</li> <li>M Foundation Fieldbus, prepared for FHX 40, mounting of remote display</li> </ul> <p><b>6 Housing</b></p> <ul style="list-style-type: none"> <li>A F12 housing, aluminum, coated, NEMA 4X (IP 65)</li> <li>C T12 housing, aluminum, coated, NEMA 4X (IP 65)</li> </ul> <p><b>7 Cable entry</b></p> <ul style="list-style-type: none"> <li>4 1/2" NPT</li> <li>5 M12 plug, Profibus-PA</li> <li>6 7/8" plug, Foundation Fieldbus</li> </ul> <p><b>8 Additional options</b></p> <ul style="list-style-type: none"> <li>A Additional options not selected</li> <li>B 3.1.B material, wetted parts 316Ti SS, Inspection Certificate EN 10204, according to specification 52005759</li> </ul> |
|---|--|

FMR 231

Instrument selection

Antenna	PTFE					PPS antistatic			PTFE antistatic		
	Threaded connection		Flange		Sanitary coupling *	Threaded connection	Flange	Threaded connection	Flange		
Process connection	PVDF (not gastight)	Metal	Unclad	Clad	Tri-clamp Dairy aseptic	Metal	Unclad	Metal	Unclad	Clad antistatic	
Temperature	-40° to +175°F		-40° to +300°F			-4° to +250°F		-40° to +300°F			
Pressure **	44 psi	580 psi	230 psi (2") 145 psi (3")	360 psi	317LSS + PTFE (TFM 1600)	230 psi	580 psi	230 psi			
Wetted parts	PVDF + PTFE	317LSS + PTFE	PTFE	317LSS + PTFE (TFM 1600)	317LSS + Viton + PPS	317LSS + PTFE	PTFE				

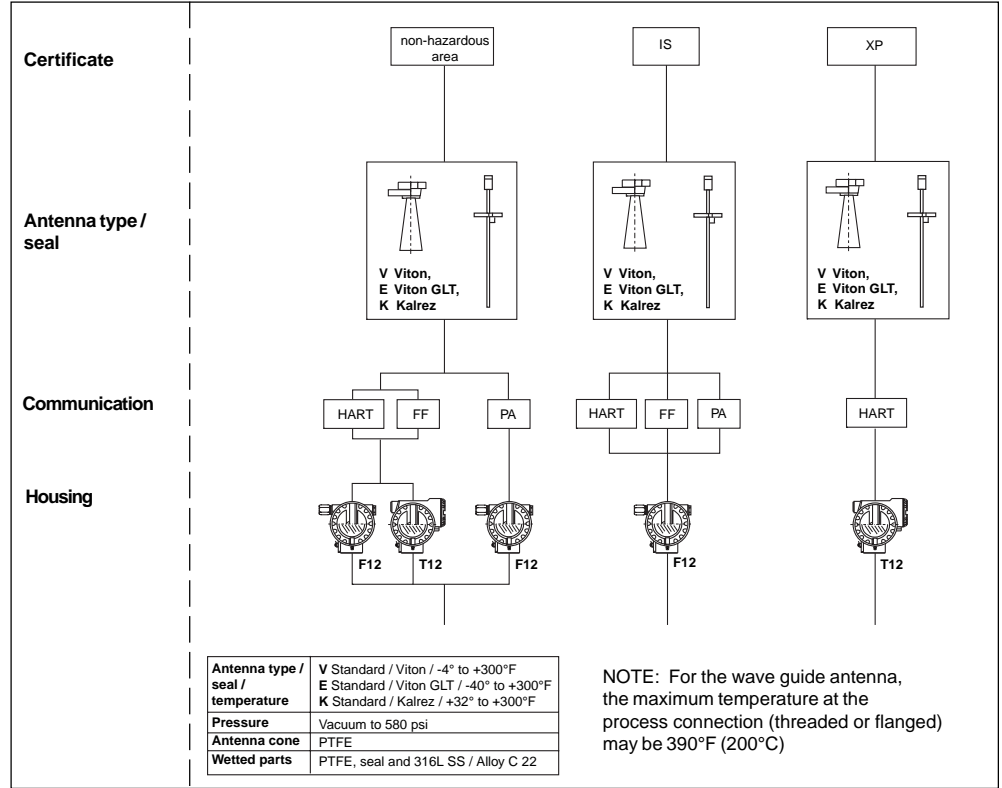
\* Sanitary couplings are 3-A approved, FDA listed material  
 \*\* All pressure ratings are from vacuum to value listed

FMR 231 -  1  2  3  4  5  6  7  8

- 1 Certificates
  - A Non-hazardous areas
  - F Non-hazardous areas, WHG overspill protection
  - S FM approved IS, Class I, Div. 1, Grps. A-D
  - T FM approved XP, Class I, Div. 1, Grps. A-D
  - N CSA general purpose
  - U CSA approved IS, Class I, Div. 1, Grps. A-D
  - V CSA approved XP, Class I, Div. 1, Grps. A-D
- 2 Antenna type / length / nozzle length
  - A Rod antenna, PPS antistatic with Viton o-ring / 14" / 4" nozzle
  - B Rod antenna, PPS antistatic with Viton o-ring / 20" / 10" nozzle
  - E Rod antenna, PTFE, fully insulated / 15" / 4" nozzle
  - F Rod antenna, PTFE, fully insulated / 21" / 10" nozzle
  - H Rod antenna, PTFE, fully insulated, antistatic / 15" / 4" nozzle
  - J Rod antenna, PTFE, fully insulated, antistatic / 21" / 10" nozzle
- 3 Process connection / material
  - GNJ 1-1/2" NPT / 316L SS
  - GNS 1-1/2" NPT / PVDF
  - AEJ 2" Class 150 ANSI B16.5 / 316L SS
  - ALJ 3" Class 150 ANSI B16.5 / 316L SS
  - AMJ 3" Class 300 ANSI B16.5 / 316L SS
  - APJ 4" Class 150 ANSI B16.5 / 316L SS
  - AQJ 4" Class 300 ANSI B16.5 / 316L SS
  - AVJ 6" Class 150 ANSI B16.5 / 316L SS
  - AEK 2" Class 150 ANSI B16.5 / 316L SS, PTFE clad
  - ALK 3" Class 150 ANSI B16.5 / 316L SS, PTFE clad
  - APK 4" Class 150 ANSI B16.5 / 316L SS, PTFE clad
  - AVK 6" Class 150 ANSI B16.5 / 316L SS, PTFE clad
  - TEJ 2" Tri-clamp ISO 2852 / 316L SS
  - TLJ 3" Tri-clamp ISO 2852 / 316L SS
- 4 Output / display
  - A 4 to 20 mA HART / VU 331 4-line display
  - B 4 to 20 mA HART
  - K 4 to 20 mA HART, prepared for FHX 40, mounting of remote display (accessory)
  - C Profibus-PA / VU 331 4-line display
  - D Profibus-PA
  - L Profibus-PA, prepared for FHX 40, mounting of remote display (accessory)
  - E Foundation Fieldbus / VU 331 4-line display
  - F Foundation Fieldbus
  - M Foundation Fieldbus, prepared for FHX 40, mounting of remote display (accessory)
- 5 Housing
  - A F12 housing, aluminum, coated, NEMA 4X (IP 65)
  - C T12 housing, aluminum, coated, NEMA 4X (IP 65)
- 6 Cable entry
  - 4 1/2" NPT
  - 5 M12 plug, Profibus-PA
  - 6 7/8" plug, Foundation Fieldbus
- 7 Gastight feed through
  - A Without gastight feed through
  - C With gastight feed through
- 8 Additional options
  - A Additional options not selected
  - B 3.1.B material, wetted parts 316Ti SS, Inspection Certificate EN 10204, according to specification 52005759

**FMR 240**

Instrument selection

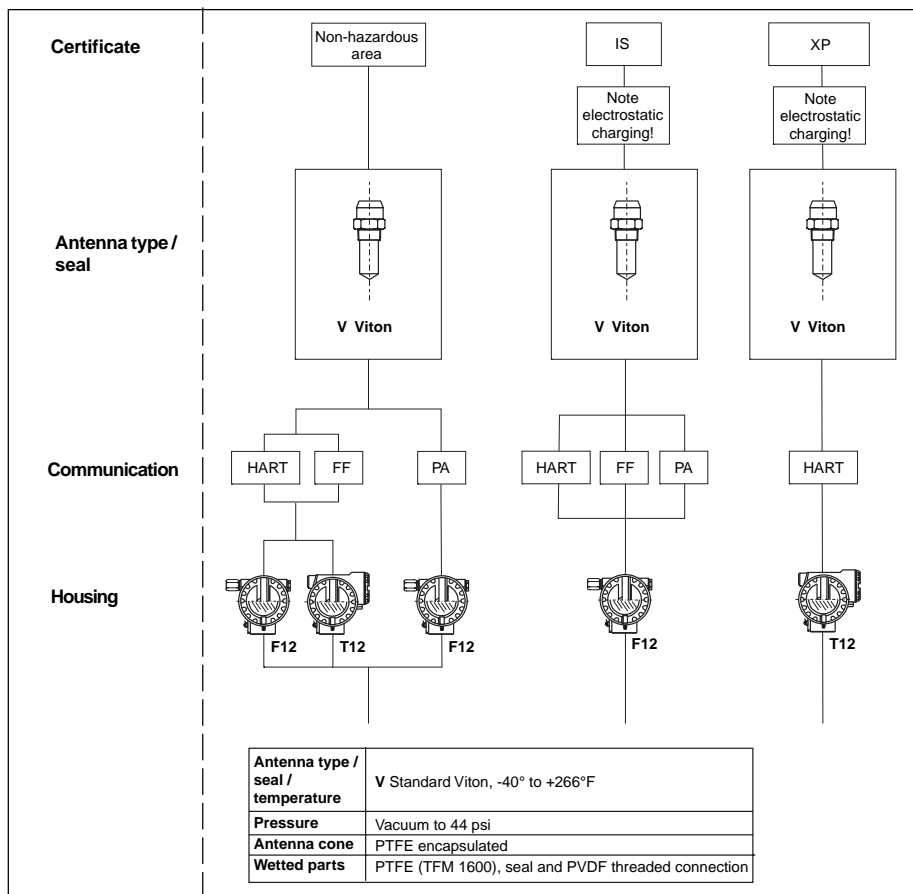


FMR 240 -

- 1 Certificates
  - A Non-hazardous areas
  - F Non-hazardous areas, WHG overspill protection
  - S FM approved IS, Class I, Div. 1, Grps. A-D
  - T FM approved XP, Class I, Div. 1, Grps. A-D
  - N CSA general purpose
  - U CSA approved IS, Class I, Div. 1, Grps. A-D
  - V CSA approved XP, Class I, Div. 1, Grps. A-D
- 2 Antenna size
  - 1 Pipe antenna, 0.8" (21 mm) inside diameter, 12" to 110"
  - 2 1-1/2" / 40 mm
  - 3 2" / 50 mm
  - 4 3" / 80 mm
  - 5 4" / 100 mm
  - 8 Wave guide antenna, 3/4" ID, priced per inch (12" to 150")
- 3 Type of antenna / sealing / temperature range
  - V Standard / Viton / -4° to +390°F (-20° to +200°C)
  - E Standard / Viton GLT / -40° to +300°F (-40° to +150°C)
  - K Standard / Kalrez / +32° to +300°F (0° to +150°C)
- 4 Antenna extension
  - 1 Without antenna extension
  - 2 4" (100 mm) extension
- 5 Process connection / material
  - GNJ 1-1/2" NPT / 316L SS
  - AEJ 2" Class 150 ANSI B16.5 / 316L SS
  - AFJ 2" Class 300 ANSI B16.5 / 316L SS
  - ALJ 3" Class 150 ANSI B16.5 / 316L SS
  - AMJ 3" Class 300 ANSI B16.5 / 316L SS
  - APJ 4" Class 150 ANSI B16.5 / 316L SS
  - AQJ 4" Class 300 ANSI B16.5 / 316L SS
  - AWJ 6" Class 150 ANSI B16.5 / 316L SS
  - AEM 2" Class 150 ANSI B16.5 / Alloy C22 face
  - AFM 2" Class 300 ANSI B16.5 / Alloy C22 face
  - ALM 3" Class 150 ANSI B16.5 / Alloy C22 face
  - AMM 3" Class 300 ANSI B16.5 / Alloy C22 face
  - APM 4" Class 150 ANSI B16.5 / Alloy C22 face
  - AQM 4" Class 300 ANSI B16.5 / Alloy C22 face
  - AWM 6" Class 150 ANSI B16.5 / Alloy C22 face
  - TLJ 3" Tri-clamp®, ISO 2852, 316L SS
- 6 Output / display
  - A 4 to 20 mA HART / VU 331 4-line display
  - B 4 to 20 mA HART
  - K 4 to 20 mA HART, prepared for FHX 40, mounting of remote display (accessory)
  - C Profibus-PA / VU 331 4-line display
  - D Profibus-PA
  - L Profibus-PA, prepared for FHX 40, mounting of remote display (accessory)
  - E Foundation Fieldbus / VU 331 4-line display
  - F Foundation Fieldbus
  - M Foundation Fieldbus, prepared for FHX 40, mounting of remote display (accessory)
- 7 Housing
  - A F12 housing, aluminum, coated, NEMA 4X (IP 65)
  - C T12 housing, aluminum, coated, NEMA 4X (IP 65)
- 8 Cable entry
  - 4 1/2" NPT
  - 5 M12 plug, Profibus-PA
  - 6 7/8" plug, Foundation Fieldbus
- 9 Additional options
  - A Additional options not selected
  - B 3.1.B material, wetted parts 316Ti SS, Inspection Certificate EN 10204, according to specification 52005759

FMR 244

Instrument selection



FMR 244-

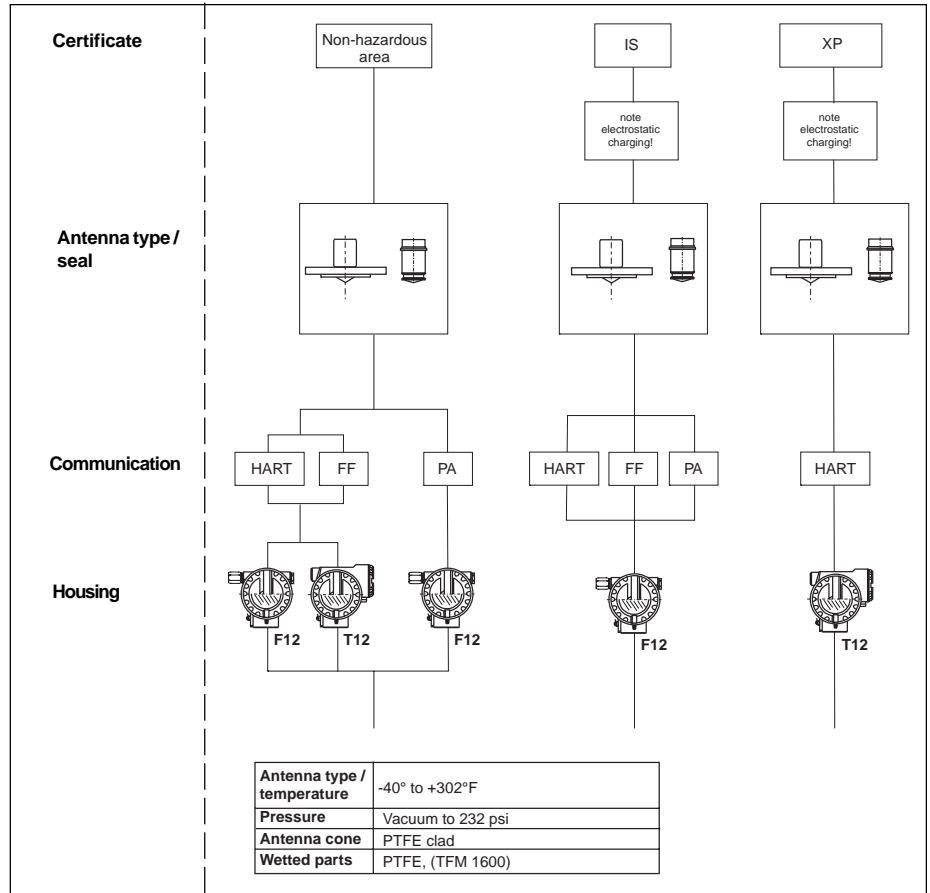
- 1 Certificates
  - A Non-hazardous areas
  - S FM approved IS, Class I, Div. 1, Grps. A-D
  - T FM approved XP, Class I, Div. 1, Grps. A-D
  - N CSA general purpose
  - U CSA approved IS, Class I, Div. 1, Grps. A-D
  - V CSA approved XP, Class I, Div. 1, Grps. A-D
- 2 Antenna size
  - 2 1-1/2"
- 3 Type of antenna / sealing / temperature range
  - V Standard / Viton / -40° to +266°F (-40° to +130°C)
- 4 Process connection / material
  - GNS 1-1/2" NPT / PVDF
  - GGG G 1-1/2" / PVDF
- 5 Output / display
  - A 4 to 20 mA HART / VU 331 4-line display
  - B 4 to 20 mA HART
  - K 4 to 20 mA HART, prepared for FHX 40, mounting of remote display (accessory)
  - C Profibus-PA / VU 331 4-line display
  - D Profibus-PA
  - L Profibus-PA, prepared for FHX 40, mounting of remote display (accessory)
  - E Foundation Fieldbus / VU 331 4-line display
  - F Foundation Fieldbus
  - M Foundation Fieldbus, prepared for FHX 40, mounting of remote display (accessory)

- 6 Housing
  - A F12 housing, aluminum, coated, NEMA 4X (IP 65)
  - C T12 housing, aluminum, coated, NEMA 4X (IP 65)
- 7 Cable entry
  - 4 1/2" NPT
  - 5 M12 plug, Profibus-PA
  - 6 7/8" plug, Foundation Fieldbus
- 8 Additional options
  - A Additional options not selected



FMR 245

Instrument selection



FMR 245 -

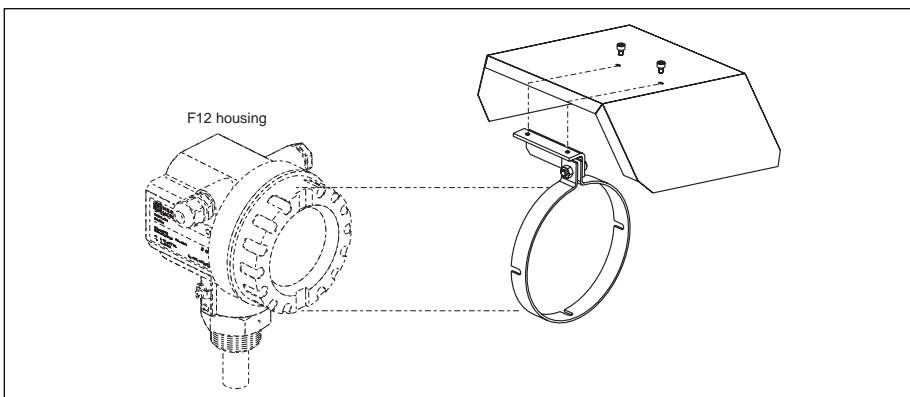
- 1 Certificates
  - A Non-hazardous areas
  - S FM approved IS, Class I, Div. 1, Grps. A-D
  - T FM approved XP, Class I, II, III; Div. 1, Grps. A-G
  - N CSA general purpose
  - U CSA approved IS, Class I, Div. 1, Grps. A-D
  - V CSA approved XP, Class I, Div. 1, Grps. A-D
- 2 Antenna size
  - 3 2"
  - 4 3"
- 3 Process connection / material
  - AEK 2" Class 150 ANSI B16.5 / 316L SS with PTFE disk
  - ALK 3" Class 150 ANSI B16.5 / 316L SS with PTFE disk
  - APK 4" Class 150 ANSI B16.5 / 316L SS with PTFE disk
  - AWK 6" Class 150 ANSI B16.5 / 316L SS with PTFE disk
  - TDK 2" Tri-clamp ISO 2862 / 316L SS with PTFE disk
  - TEK 2-1/2" Tri-clamp ISO 2852 / 316L SS with PTFE disk
  - TFK 3" Tri-clamp ISO 2852 / 316L SS with PTFE disk
- 4 Output / display
  - A 4 to 20 mA HART / VU 331 4-line display
  - B 4 to 20 mA HART
  - K 4 to 20 mA HART, prepared for FHX 40, mounting of remote display (accessory)
  - C Profibus-PA / VU 331 4-line display
  - D Profibus-PA
  - L Profibus-PA, prepared for FHX 40, mounting of remote display (accessory)
  - E Foundation Fieldbus / VU 331 4-line display
  - F Foundation Fieldbus
  - M Foundation Fieldbus, prepared for FHX 40, mounting of remote display (accessory)

- 5 Housing
  - A F12 housing, aluminum, coated, NEMA 4X (IP 65)
  - C T12 housing, aluminum, coated, NEMA 4X (IP 65)
- 6 Cable entry
  - 4 1/2" NPT
  - 5 M12 plug, Profibus-PA
  - 6 7/8" plug, Foundation Fieldbus
- 7 Additional options
  - A Additional options not selected

## Accessories

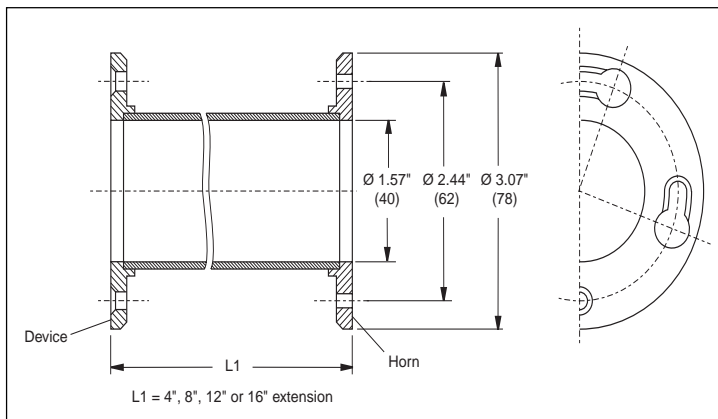
### Protective cover

A protective cover made of stainless steel is available for outdoor mounting. Shipment includes cover and tension clamp.  
Part Number: 543199-0001



### FAR 10 Antenna extension (FMR 230)

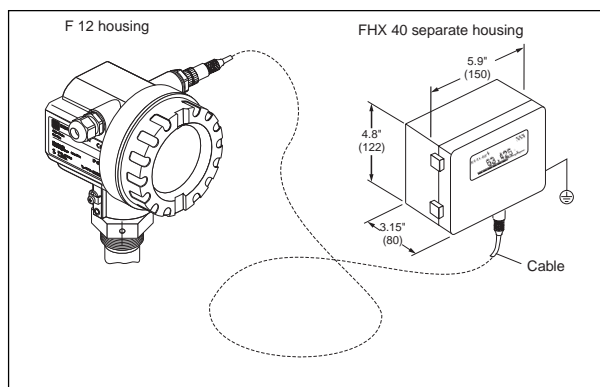
- FAR 10 -  1  2
- 1 Material
    - 2 316Ti SS
    - 4 Alloy B3
    - 5 Alloy C4
    - 9 Special material
  - 2 Overall length (L1)
    - A 4" (100 mm)
    - B 8" (200 mm)
    - C 12" (300 mm)
    - D 16" (400 mm)



### FHX 40 remote display and operating unit

- FHX 40 -  1  2  3
- 1 Certificates
    - A For non-hazardous areas
    - S FM IS Class I, Div. 1, Grps. A-D
    - U CSA IS Class I, Div. 1, Grps. A-D
    - N CSA general purpose
  - 2 Cable length
    - 1 65 ft (20 m)
  - 3 Additional option
    - A Option not selected
    - B Mounting bracket, 1" or 2" pipe

**NOTE:** The FMR series remote housing is not FM/CSA approved as of this printing. Please consult factory for information.



The FHX 40 provides remote display and operation for the FMR 230, 231, 240, 244, and 245 units. The display unit must be specified when ordering the Micropilot M sensors, it cannot be retrofitted due to the preinstallation of the plug connectors. Maximum cable length is 65 feet (20 m).

- Temperature range: -22° to +158°F (-30° to +70°C)
  - Protection: NEMA 4 (IP 65)
  - Material: Aluminium alloy AL Si 12
  - Maximum cable length: 65 ft. (20 m)
- Consult factory for ordering information.

**FXA 191 Commubox**

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

**FXA 193 Service adapter**

For communication with ToF Tool via the display connector.

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**Supplemental documentation**

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- FMR 230 Micropilot M operating instructions BA 218F/00/en
  - PROFIBUS-PA, BA 225F/00/en
  - Foundation Fieldbus, BA 228F/00/en
- FMR 231 Micropilot M operating instructions BA 219F/00/en
  - PROFIBUS-PA, BA 226F/00/en
  - Foundation Fieldbus, BA 229F/00/en
- FMR 240 Micropilot M operating instructions BA 220F/00/en
  - PROFIBUS-PA, BA 227F/00/en
  - Foundation Fieldbus, BA 230F/00/en
- FMR 244 Micropilot M operating instructions BA 248F/00/en
  - PROFIBUS-PA, BA 249F/00/en
  - Foundation Fieldbus, BA 250F/00/en
- FMR 245 Micropilot M operating instructions BA251F/00/en
  - PROFIBUS-PA, BA 252F/00/en
  - Foundation Fieldbus, BA 253F/00/en
- Micropilot M instrument functions description BA 221F/00/en (for all units)
- ToF Tool operation BA 224F/00/en  
(includes CD-ROM with on-line help and PDF-file)

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

- US 5,387,919  $\cong$  EP 0 535 196
- US 5,689,265  $\cong$  EP 0 626 063
- US 5,659,321
- US 5,614,911  $\cong$  EP 0 670 048
- US 5,594,449  $\cong$  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

For application and selection assistance,  
call 888-ENDRESS

For total support of your installed base,  
24 hours a day, call 800-642-8737

Visit us on our web site, [www.us.endress.com](http://www.us.endress.com)

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