Technical Information
Ti 019G/03/ae

Level-Radar
micropilot S
FMR 530/531/532/533

Radar gauge for continuous and non-contact precision level measurement approved for custody transfer on bulk storage tank applications by NMi and PTB

Applications

The Micropilot S is used for highly accurate level measurement in storage tanks and can be applied in custody transfer applications. It meets the relevant requirements according to OIML R85 and API 3.1B.

- The FMR 530 with horn antenna is suitable for free space applications that disallow the use of a parabolic antenna due to tank/nozzle geometry.
- The FMR 531 with rod antenna is used for highly accurate measurements of very aggressive products and in narrow nozzles.
- The FMR 532 with planar antenna is specifically suited for stilling well applications with ranges up to 124 ft (38 m).
- The FMR 533 with parabolic antenna is excellently suited for free space applications up to 131 ft (40 m).

Features

- 1 mm accuracy
- National approvals (NMi, PTB) for custody transfer
- Applicable as standalone system or tied into tank gauging systems via the Tank Side Monitor NRF 590
- Easy on-site operation via menu-driven alphanumeric display
- Easy commissioning, documentation and maintenance via operating software (ToF tool)
- Application-specific antenna selection
- Cost-effective and simple installation via 4-wire cable with HART and 24 V_{DC} power supply (intrinsically safe) on tank roof
- Gastight process connection (second line of defense) available for any antenna version

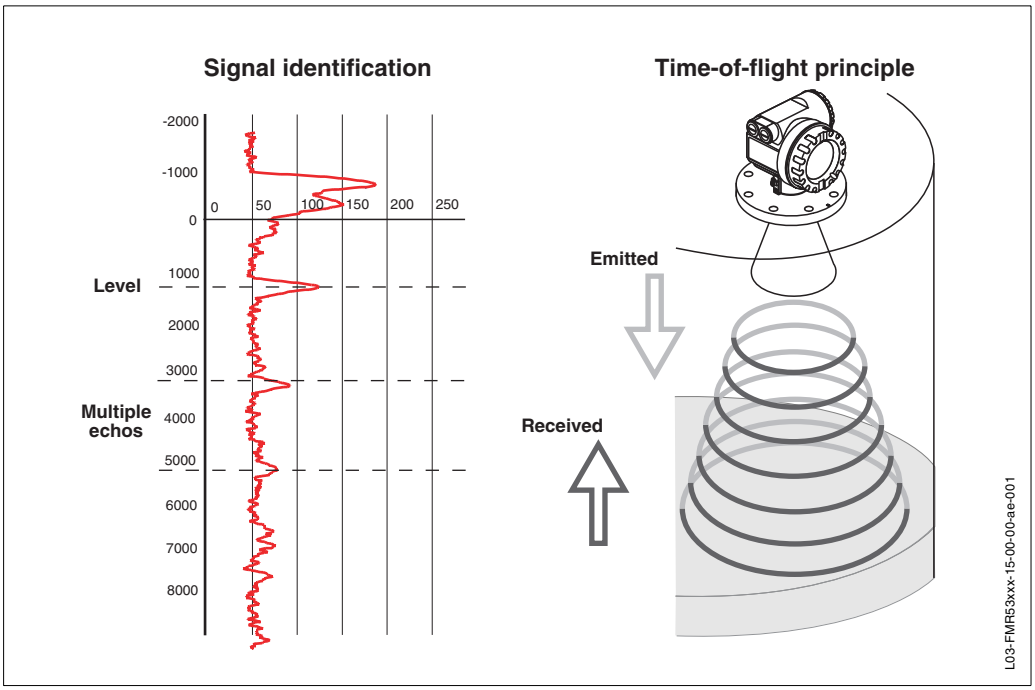
Online
www.systems.endress.com

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

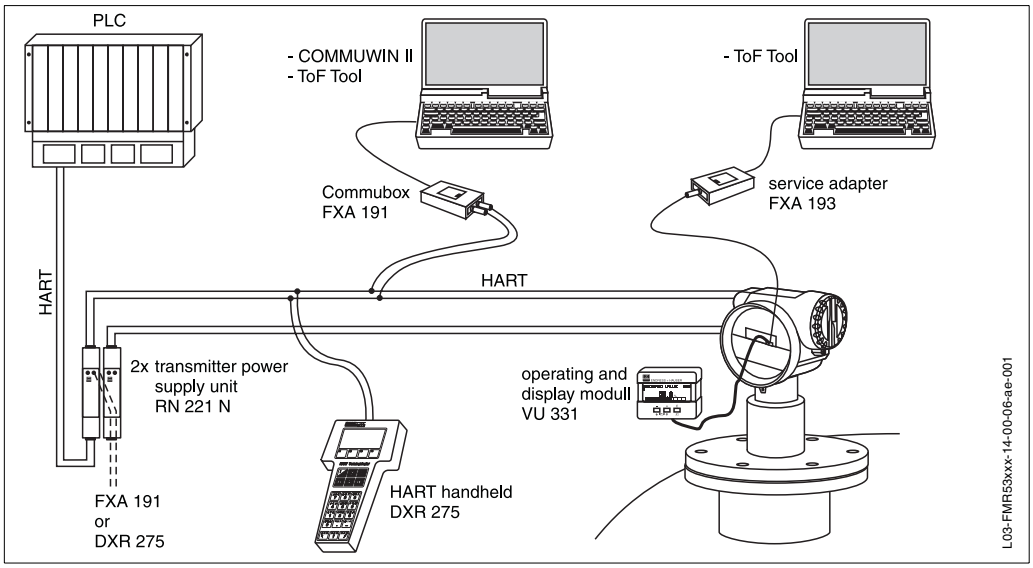
A microprocessor evaluates impulses received and identifies the level echo caused by the reflection of the radar impulse at the product surface. The distance to the product surface is proportional to the time-of-flight of the impulse. The mm-accuracy of the Micropilot S is achieved with the patented algorithms of the PhaseMaster software. 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 needs to be supplied intrinsically safe (i.s.) via a safety barrier. 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.

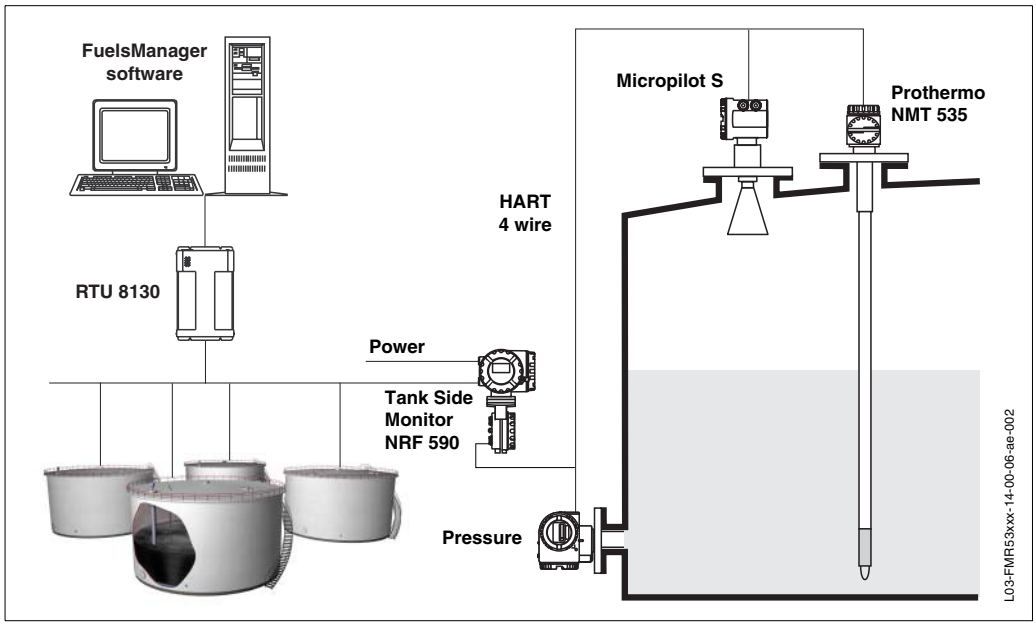


Typical standalone operation

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 (mounting flange) and a reflective surface (i.e. product surface). The measured value and all parameters are displayed using either Imperial units (inch, ft, etc.) or Metrical units. The product level is calculated based on the gauge reference height entered. In order to compensate for non-linear effects, such as movement of the tank roof, an additional correction table (diptable) can be entered. Parameters can be entered on the Tank Side Monitor.

Antenna selection for Micropilot S-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

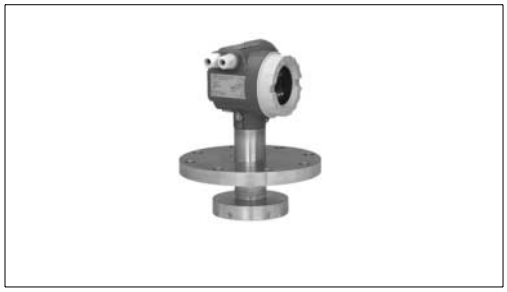
The Micropilot S series radar comes with 4 basic radar antenna forms.

For stilling well applications:
- Planar stilling well antenna (FMR 532)
- Horn antenna [FMR 530 3" (DN80) / 4" (DN100)]

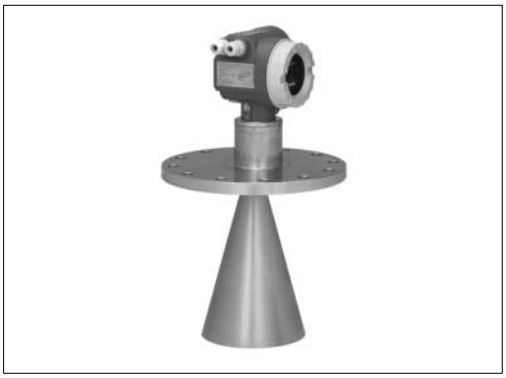
For free space applications:
- Rod antenna (FMR 531)
- Horn antenna [FMR 530 > 4" (DN100)]
- Parabolic antenna (FMR 533)

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.

Planar stilling well antenna



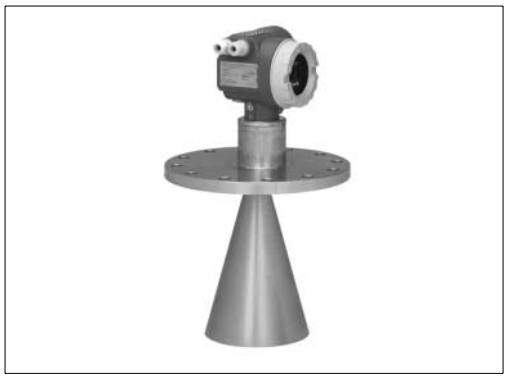
The planar stilling well antenna is specially designed for stilling well applications only. The emitted circular mode radar pattern is a must for high accuracy applications on stilling wells. This special mode allows the software to compensate for variations of the inside diameter of the stilling well and layering of adhering product. The diameter of the antenna itself fits in 6" (DN150) stilling wells directly. Cone adapters allow installation on larger diameter stilling wells. A good match between well and adapter is essential. The Endress+Hauser planar antenna with pulsed radar technology allows direct installation even on tapered stilling wells – a unique feature.



Horn antenna (stilling well)

For cases where the stilling well diameter is smaller than 6" (DN150), it is possible to use a horn antenna on stilling well applications. However, the results will normally not satisfy custody transfer application requirements. For stilling well applications, the diameter of the horn antenna must match the inside diameter of the stilling well as closely as possible. For products with a low radar reflectivity [dielectric constant (εr)<1.9], a stilling well is always required.

Parabolic antenna
The parabolic antenna is the largest free space antenna with the smallest beam angle. It is ideal for applications close to tank walls, where a manway cover is available. The parabolic antenna is also an excellent choice on products with a low reflectivity, such as asphalts and bitumens.



Horn antenna
For free space applications, it is essential that the horn extends below the nozzle (see page 16). 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.

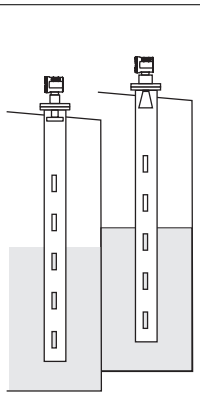
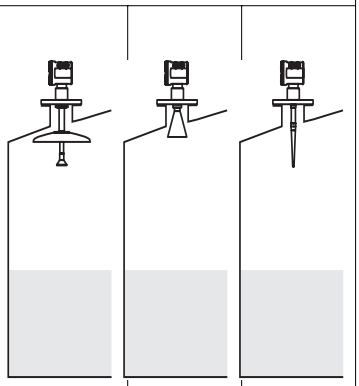
Rod antenna
The rod antenna is ideal for tanks where only small diameter nozzles are available and tanks containing condensing products (or heavy water condensation) or corrosive products, such as sulphur, as the rod is easy to clean and has good "drip-off" properties. The "inactive" length of the antenna should extend below the nozzle (see page 17).

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

Measuring range depending on vessel type, conditions and product for Micropilot S:

Product	Product class		Stilling well/Bypass		Free space (Storage tank)		
							
			Measuring range				
			FMR 532 ≥ 6" (DN150)	FMR 530 3" (DN80) / 4" (100)	FMR 533	FMR 530	FMR 531
LPG	**A**	εr=1.4…1.9	127 ft (38 m)	67 ft (20 m)	–		
White products Black products Crudes Bitumen/Asphalts	**B**	εr=1.9…4			133 ft (40 m)	DN150: 33 ft (10 m) DN200/ 250:67 ft (20 m)	33 ft (10 m)
Chemicals	**C**	εr=4…10					50 ft (15 m)
	D	εr>10					67 ft (20 m)
Max. measuring range with custody transfer approvals			67 ft (20 m)	–	83 ft (25 m)	83 ft (25 m)	33 ft (10 m)

Product considerations for Micropilot S

1) Treat Ammonia NH3 as a product of group A, i.e. always use a stilling well.

Blocking distance

The blocking distance (BD) is the minimum distance from the reference point of the measurement (mounting flange) to the medium surface at maximum level.

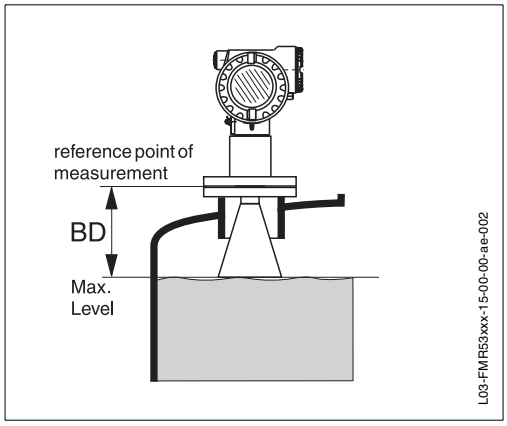


Illustration of blocking distance

Blocking distance (BD)	Free space (Storage tank)			Stilling well / Bypass	
	FMR 533	FMR 530	FMR 531	FMR 532	FMR 530
From flange	1" (40 mm)	Length of horn (see page 24)	15" (390 mm) / 21" (540 mm)	1" (40 mm)	Length of horn (see page 24)

Note!

- If an antenna extension is used, its length has to be added.
- Inside the blocking distance of FMR 532/533, a reliable measurement cannot be guaranteed.

Measuring conditions

- 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 products with a low dielectric constant (groups A and B), the tank bottom can be visible through the product 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 **(A)**.
- The smallest possible measuring range **(B)** depends on the antenna version.
- Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions.
- In applications with planar or parabolic antennas, especially for products with low dielectric constants (see page 6), the end of the measuring range should not be closer than 40" (1 m) to the tip of the antenna.
- Tank diameter and height should be at least dimensioned such that a reflection of the radar signal on both sides of the tank can be ruled out (see »Beam angle« on page 14).
- Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions.

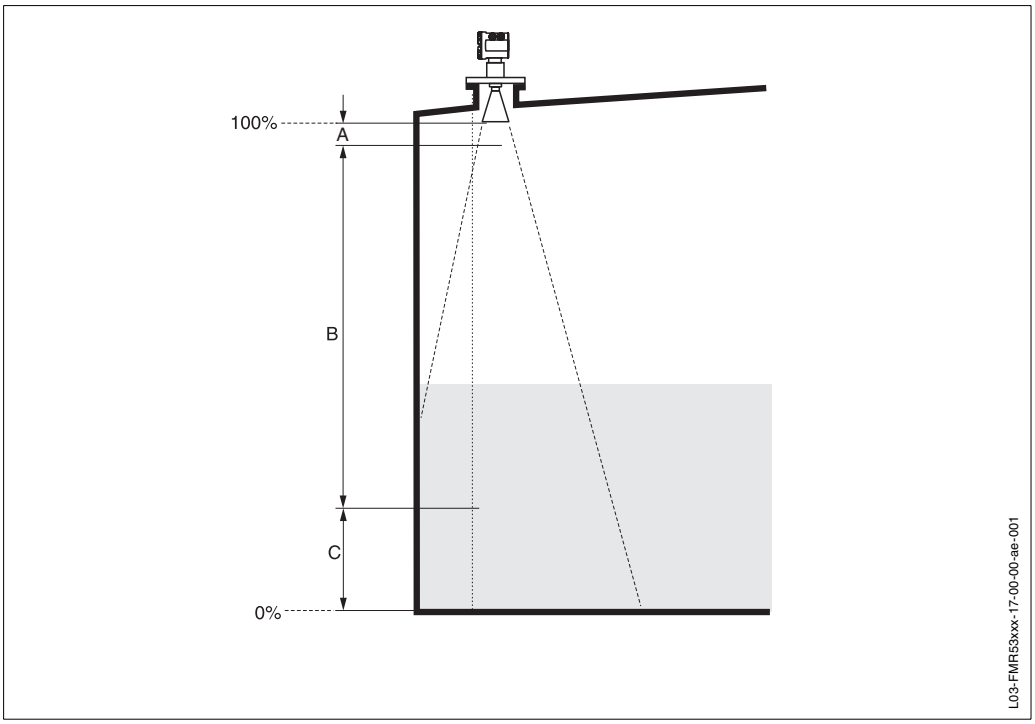


Illustration of measuring conditions

	A [inch / mm]	B [ft / m]	C [inch / mm]
FMR 530	2 / 50	1.64 / 0.5	6"…12" / 150…300
FMR 531	2 / 50	1.64 / 0.5	6"…12" / 150…300
FMR 532	40 / 1000	1.64 / 0.5	6"…12" / 150…300
FMR 533	40 / 1000	1.64 / 0.5	6"…12" / 150…300

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 33)
  - Plain text display
  - LED's: red LED continuously on = alarm, red LED flashes = warning

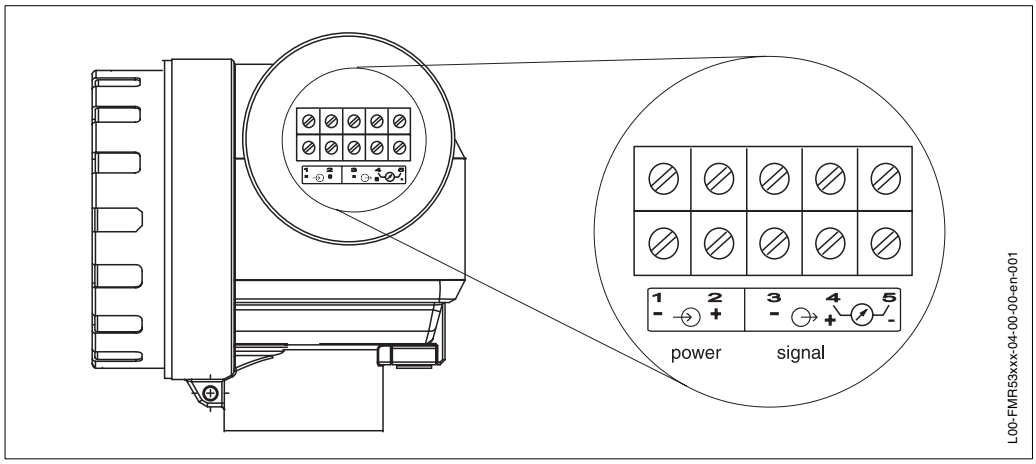
Galvanic isolation

500 V towards ground
500 V between power supply and signal

Auxiliary energy

Electrical connection

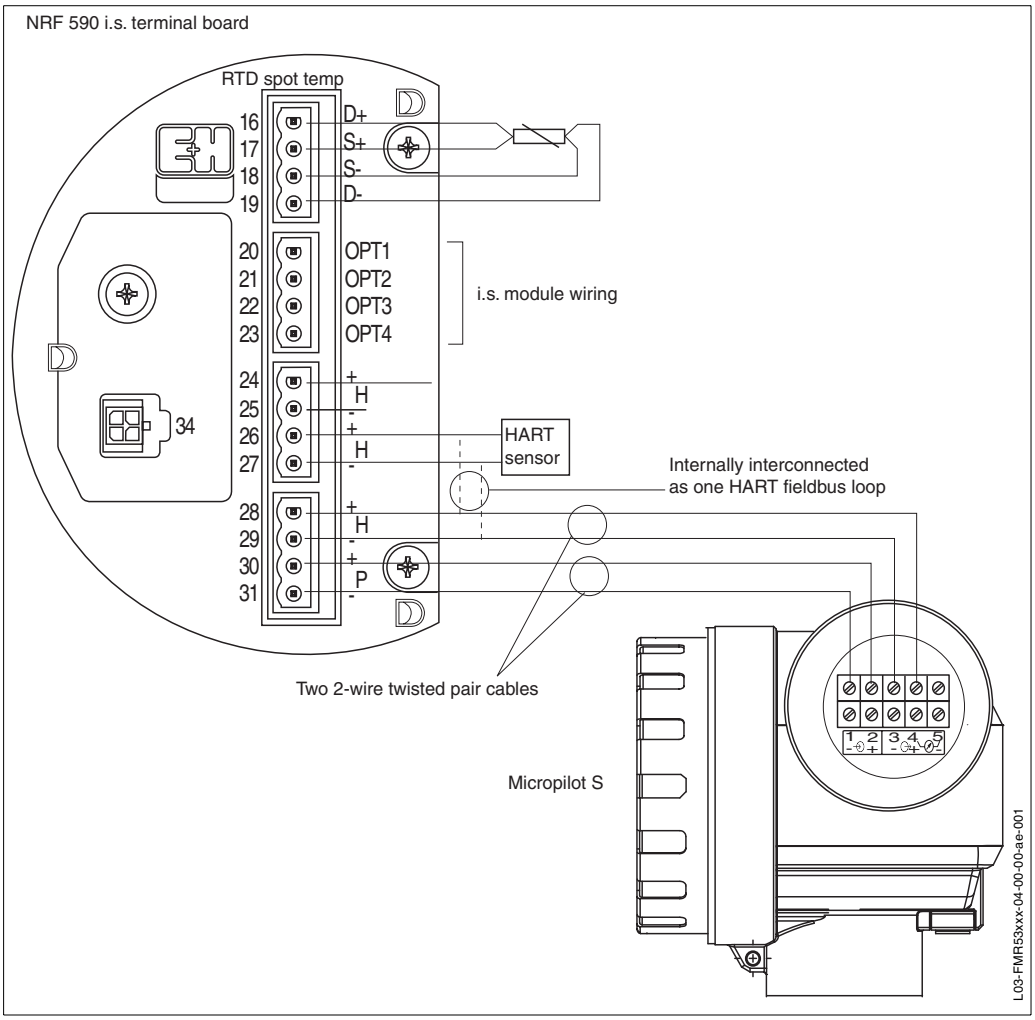
Terminal compartment
The housing features a separate terminal compartment.



Micropilot S terminal housing

Connecting to the Tank Side Monitor NRF 590

The 4-wire cable is connected to the screw terminals [wire diameter 24...10 AWG (0.5…2.5 mm)] in the terminal compartment. Use two 2-wire twisted pair cables with screen for the connection. Protective circuitry against reverse polarity, RFI and over-voltage peaks is built into the device.



Micropilot S 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]

DC voltage: 16…36 V supplied by NRF 590

Communication		Terminal voltage	minimal	maximal
Power supply	Standard	U (@ 20 mA) =	16 V	36 V
	Ex	U (@ 20 mA) =	16 V	30 V
Signal	Ex	U (@ 4 mA) =	11.5 V	30 V
		U (@ 20 mA) =	11.5 V	30 V

Power consumption[2]

Max. 330 mW at 16 V, max. 500 mW at 24 V, max. 600 mW at 30 V

Current consumption[2]

Max. 21 mA (50 mA inrush current)

Power supply

Directly from NRF 590 or for stand alone operation recommended via e.g. E+H RN 221 N.

mm accuracy

For measurements with mm accuracy, the measured variable must be transmitted using HART protocol to ensure the necessary resolution.

Overvoltage protector

- The level transmitter FMR 53x is equipped with an internal overvoltage protector (600 Vrms electrode). Connect the metallic housing of the Micropilot FMR 53x to the tank wall or screen directly with an electrically conductive lead to ensure reliable potential matching.
- Installation with additional overvoltage protector HAW 262 Z (see XA 081F-A "Safety instructions for electrical apparatus certified for use in explosion-hazardous areas").
  – Connect the external overvoltage protector and the Micropilot FMR 53x transmitter to the local potential matching system.
  – Potentials shall be equalized both inside and outside the explosion hazardous area.
  – The cable connecting the overvoltage protector and the Micropilot FMR 53x transmitter shall not exceed 3.3 ft (1 m) in length.
  – The cable shall be protected e.g. routed in an armored hose.

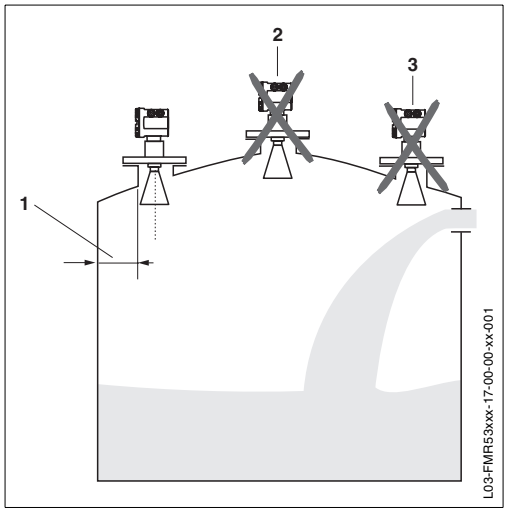
2) For standalone applications (consult factory)

Performance characteristics

Note	Performance characteristics for instruments that can be calibrated for inventory control and custody transfer applications according to regulatory standards in compliance with OIML R85. General operating / environmental conditions (see page 22).
Reference operating conditions	**According to OIML R85:** • Temperature = -13…+131 °F (–25…+55 °C) • Atmospheric pressure • Relative humidity (air) = 65% ±15% • Product properties: e.g. product with good reflectivity and calm surface • Tank diameter: signal beam hits the tank wall only at one side • No major interference reflections inside the signal beam
Maximum measured error	Absolute accuracy: ±1 mm (better than 1/16")
Proof of accuracy	The accuracy of each Micropilot S is established through a calibration certificate that records the absolute and relative error at 10 equidistant points during the final test. A Laser Interferometer (Jenaer Messtechnik ZLM 500) with an absolute accuracy of 0.1 mm is used as a reference. Additional approvals for custody applications are available on demand for all radar instruments.
Non-repeatability	1/64" (0.3 mm)
Hysteresis	0.3 mm
Linearity	Better than 0.02% or ±2 mm
Resolution	• Digital: 0.1 mm • Analog: 0.03% of measuring range
Settling time	Typical 15 sec
Long-term drift	The long-term drift is within the specified accuracy.
Influence of ambient temperature	±1 mm of -13...+131 °F (–25…+55 °C)
Software reliability	The software used in the radar instruments FMR 53x fulfills the requirements of OIML R85. This particularly includes: • Cyclical test of data consistency • Non-volatile memory • Segmented data storage The radar instrument Micropilot S continuously monitors the compliance with accuracy requirements for custody transfer measurements according to OIML R85. If the accuracy cannot be maintained, a specific alarm is generated on the local display and via the digital communication (see page 33).

Operating conditions / Installation

Installation instructions

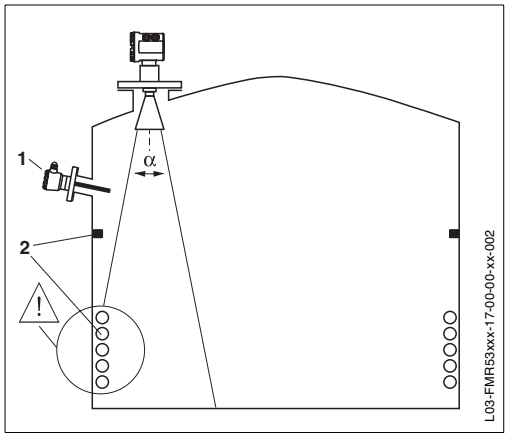


Micropilot orientation on tank

Orientation

1. Recommended distance wall – **outer edge** of nozzle: minimum 12“(30 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 45).



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 16.
- Stilling well: a stilling well can always be used to avoid interference. The FMR 532 with planar antenna is recommended for stilling wells with a diameter 6" (DN150) and larger.

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

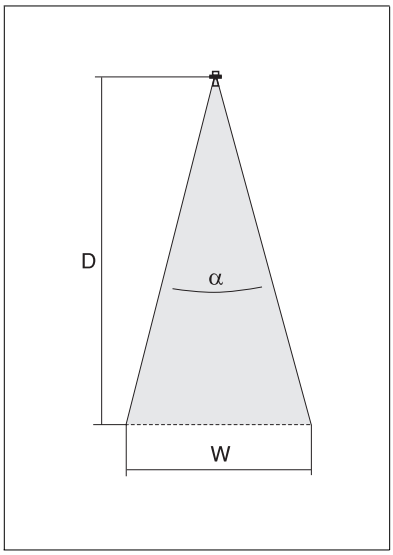
Beam angle

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.

Beamwidth diameter **W** as function of antenna type (beam angle α) and measuring distance **D**

Antenna size	**FMR 530**			**FMR 531**	**FMR 533**
	DN150	DN200	DN250	Stab	parabolic
Beam angle α	23°	19°	15°	30°	7°

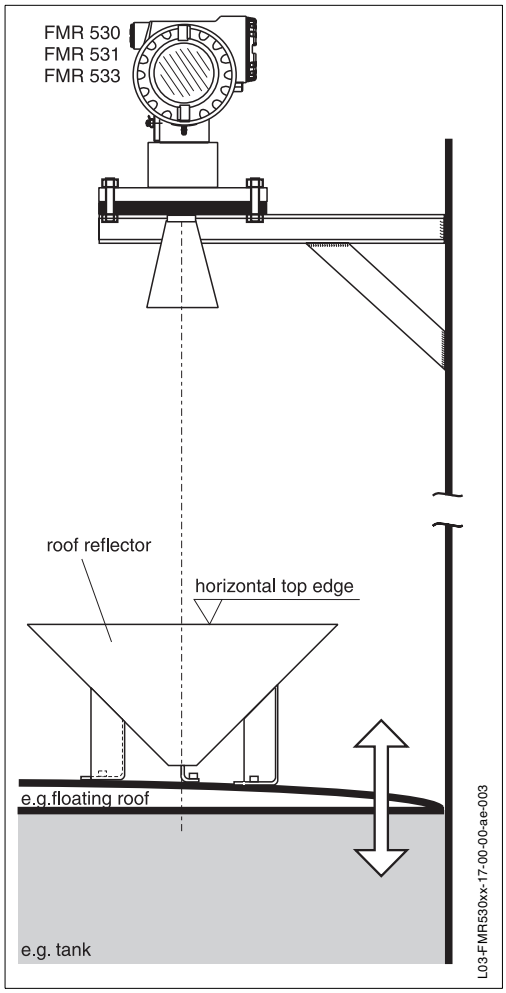
Measuring distance (D)	**Beamwidth diameter (W)**				
	DN150	DN200	DN250	Stab	Parabol
10 ft / 3 m	4.07 ft / 1.22 m	3.35 ft / 1.00 m	2.63 ft / 0.79 m	5.36 ft / 1.61 m	1.22 ft / 0.37 m
20 ft / 6 m	8.14 ft / 2.44 m	6.69 ft / 2.01 m	5.27 ft / 1.58 m	10.72 ft / 3.22 m	2.45 ft / 0.73 m
30 ft / 9 m	12.21 ft / 3.66 m	10.04 ft / 3.01 m	7.90 ft / 2.37 m	16.08 ft / 4.83 m	3.67 ft / 1.10 m
40 ft / 12 m	16.26 ft / 4.88 m	13.39 ft / 4.02 m	10.53 ft / 3.13 m	21.44 ft / 6.43 m	4.89 ft / 1.47 m
50 ft / 15 m	20.35 ft / 6.10 m	16.73 ft / 5.02 m	13.17 ft / 3.95 m	26.79 ft / 8.04 m	6.12 ft / 1.83 m
67 ft / 20 m	27.26 ft / 8.14 m	22.42 ft / 6.69 m	17.64 ft / 5.27 m	35.91 ft / 10.72 m	8.20 ft / 2.45 m
83 ft / 25 m	33.77 ft / 10.17 m	27.78 ft / 8.37 m	21.85 ft / 6.58 m	44.48 ft / 13.40 m	10.15 ft / 3.06 m
127 ft / 38 m	51.68 ft / 15.46 m	42.51 ft / 12.72 m	33.44 ft / 10.01 m	68.06 ft / 20.36 m	15.54 ft / 4.65 m
133 ft / 40 m	54.12 ft / 16.28 m	44.51 ft / 13.39 m	35.02 ft / 10.53 m	71.27 ft / 21.44 m	16.27 ft / 4.89 m



Nozzle for manual gauging See »Construction hints« on page 29.

Roof reflector

Measurements on floating roofs are not recommended for highly accurate measurements due to the unsteady movements of the floating roofs. A special reflector can be used for applications on floating roofs (not for FMR 532 with planar antenna!). See »Construction hints« on page 30.



Installation of roof reflector

Optimum mounting position

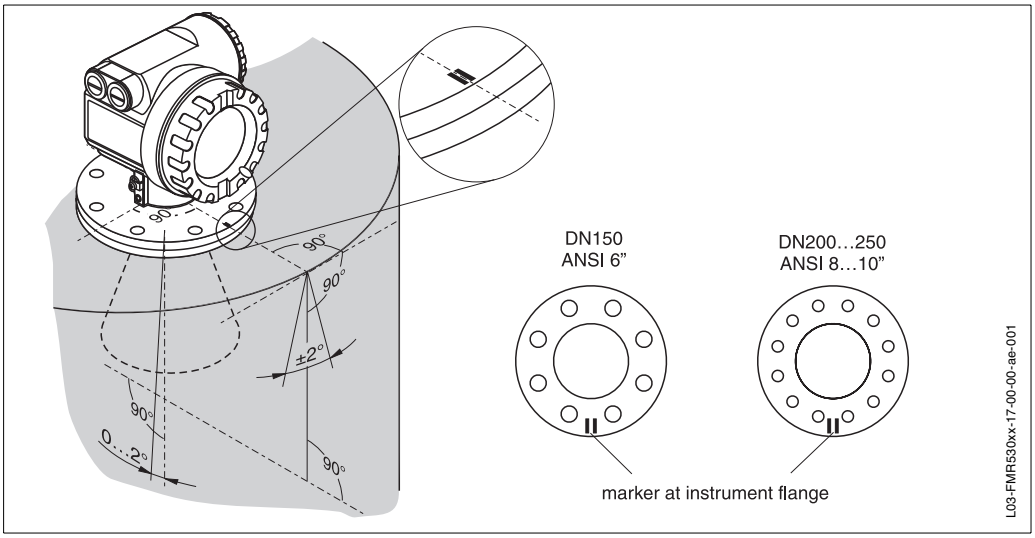
Positioning of the reflector on a floating roof:

- The upper edges of the reflector have to be aligned horizontally.
- For slanted locations (e.g. dome-shaped floating roof), the feet must be extended accordingly.

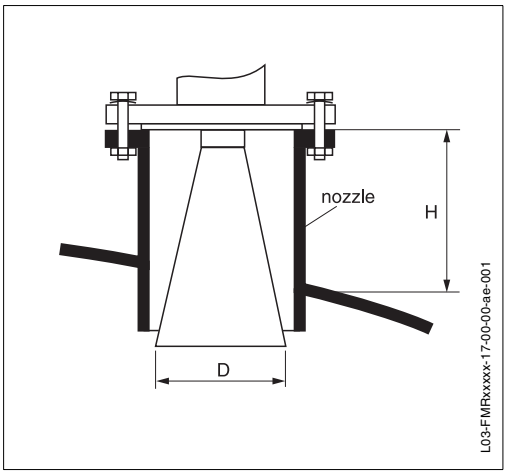
Please contact Endress+Hauser for further information.

Installation in tank (free space) FMR 530

Optimum mounting position



FMR 530 mounted on tank



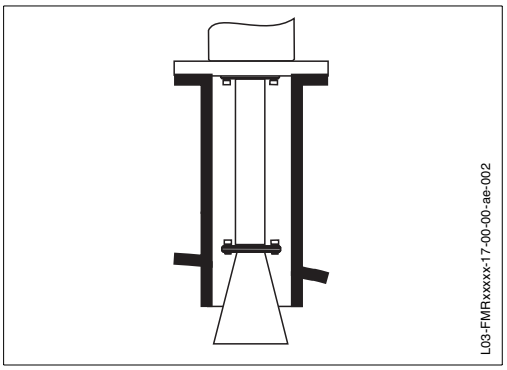
FMR 530 installation on tank

Standard installation

- Observe installation instructions on page 13.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- The device shall not be mounted in a slant towards the tank wall.
- 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.

Attention!
Do not point the radar beam towards tank wall (see figure).

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



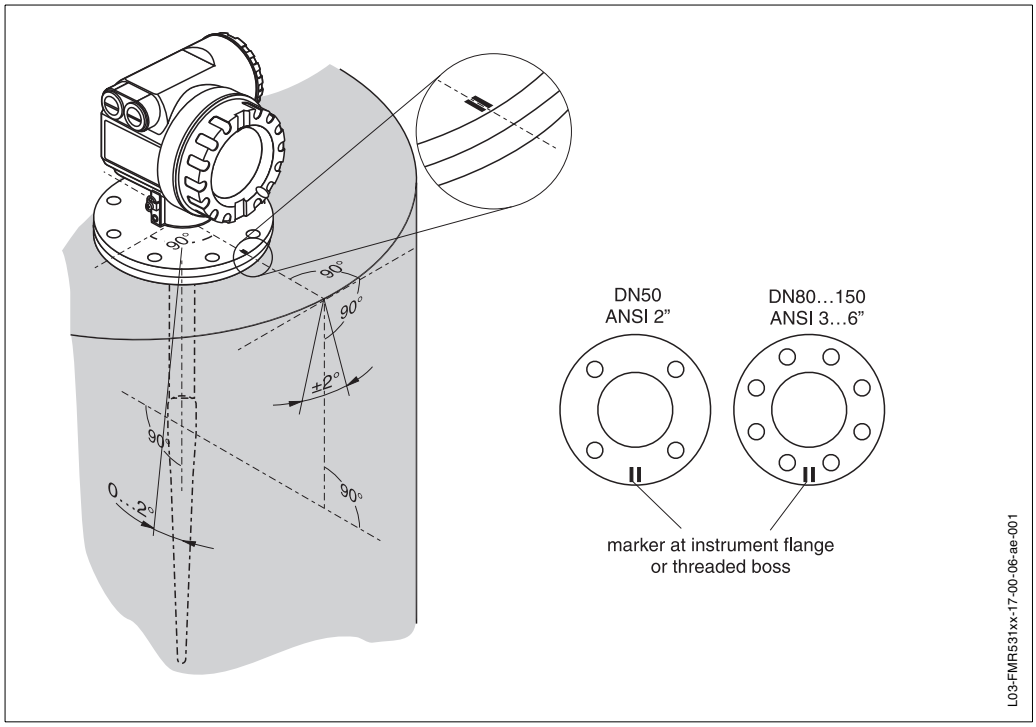
Antenna extension

Antenna extension FAR 10

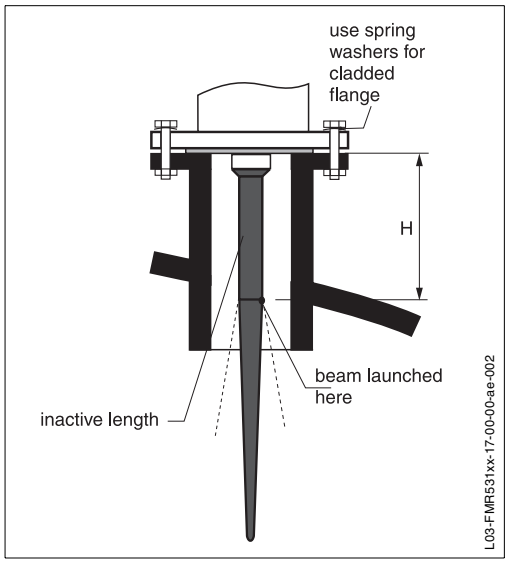
- The antenna extension has to be selected such that the horn extends below the nozzle.
- If the horn diameter is greater than the nominal width of the nozzle, the antenna, including the extension, is mounted from inside the vessel. The bolts are tightened from outside, with the instrument lifted up. 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 531

Optimum mounting position



FMR 531 mounted on tank



FMR 531 installation on tank

Standard installation

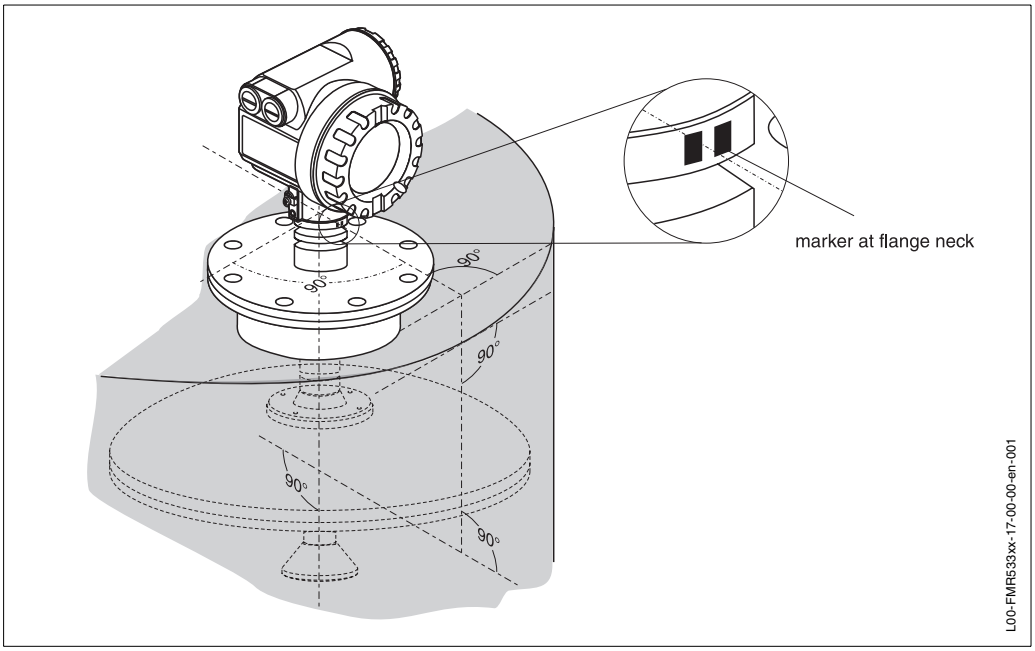
- Observe mounting instructions on page 13.
- Marker is aligned towards tank wall.
- The marker is always exactly in the middle, between two bolt-holes in the flange.
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- In order to minimize temperature influences, spring washers should be used in combination with the plated flange of the FMR 531.
- The rod antenna must extend below the nozzle.
- Align rod antenna vertically.

Attention!
Do not point the radar beam towards the tank wall (refer to figure).

Antenna length [inch / mm]	15 / 390	21 / 540
H [Inch / mm]	< 4 / < 100	< 10 / < 250

Installation in tank (free space) FMR 533

Optimum mounting position



FMR 533 mounted on tank

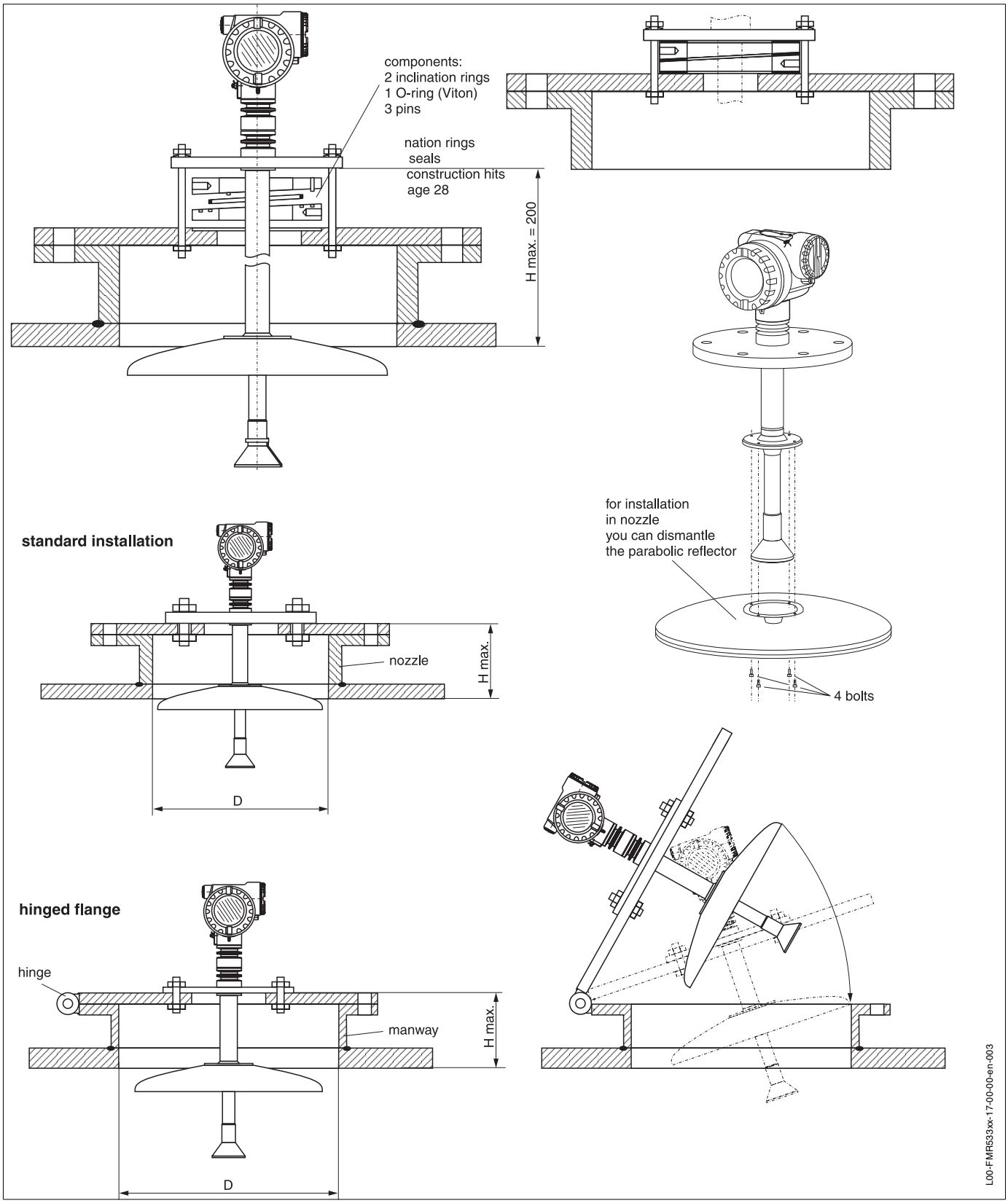
Standard installation

- Observe installation instructions on page 13.
- Marker is aligned towards tank wall.
- The marker is located below the housing at the neck of 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 parabolic mirror must extend below the nozzle.
- Align parabolic antenna vertically.

Mounting in manway

The parabolic antenna can be mounted on a manway cover. The manway cover must have an opening with a diameter D1 or D2 for mounting of the antenna (refer to table on page 19). It has to be possible to remove the cover in order to mount the antenna. The instrument can be mounted on the manway cover with a weld-on flange with a neck. Please consider the maximum height of the nozzle [H max. = 8" (200 mm)] for the diameter of the basis.

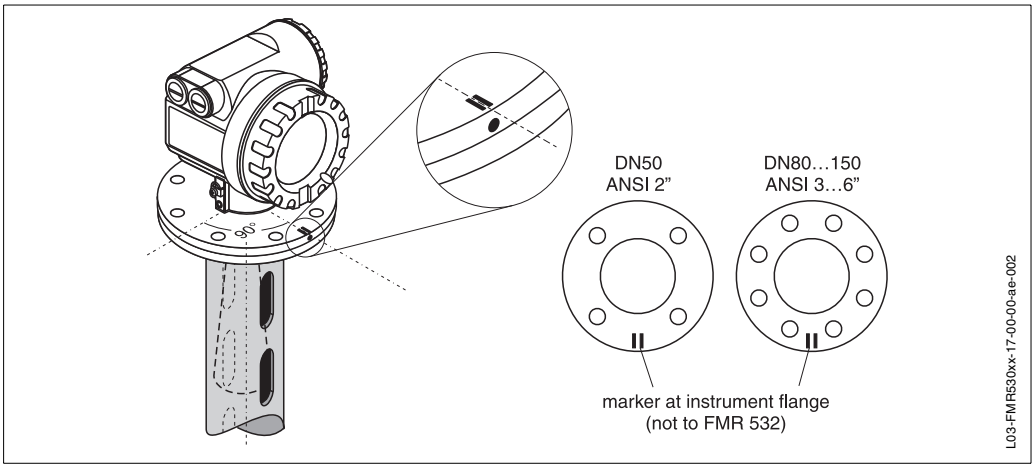
Examples for installation in a manway



	D (inside diameter of manway)	**H max.** (maximum height of nozzle)
Standard installation	≥ 20" / ≥ 500 mm	8" / 200 mm
Hinged flange	≥ 24" / ≥ 600 mm	8" / 200 mm

Installation in stilling well FMR 530 / 532

Optimum mounting position for FMR 530



FMR 530 mounted on stilling well

Standard installation

- For FMR 530 with horn antenna marker is aligned toward slots; no alignment is required for FMR 532 with planar antenna.
- The marker is always exactly in the middle, between two bolt-holes in the flange (not for FMR 532).
- After mounting, the housing can be turned up to 350° in order to simplify access to the display and the terminal compartment.
- Horn- or planar axis vertical to flange, align markers toward slots.
- Measurements can be performed through a full bore open ball valve without any problems.

Recommendations for the stilling well

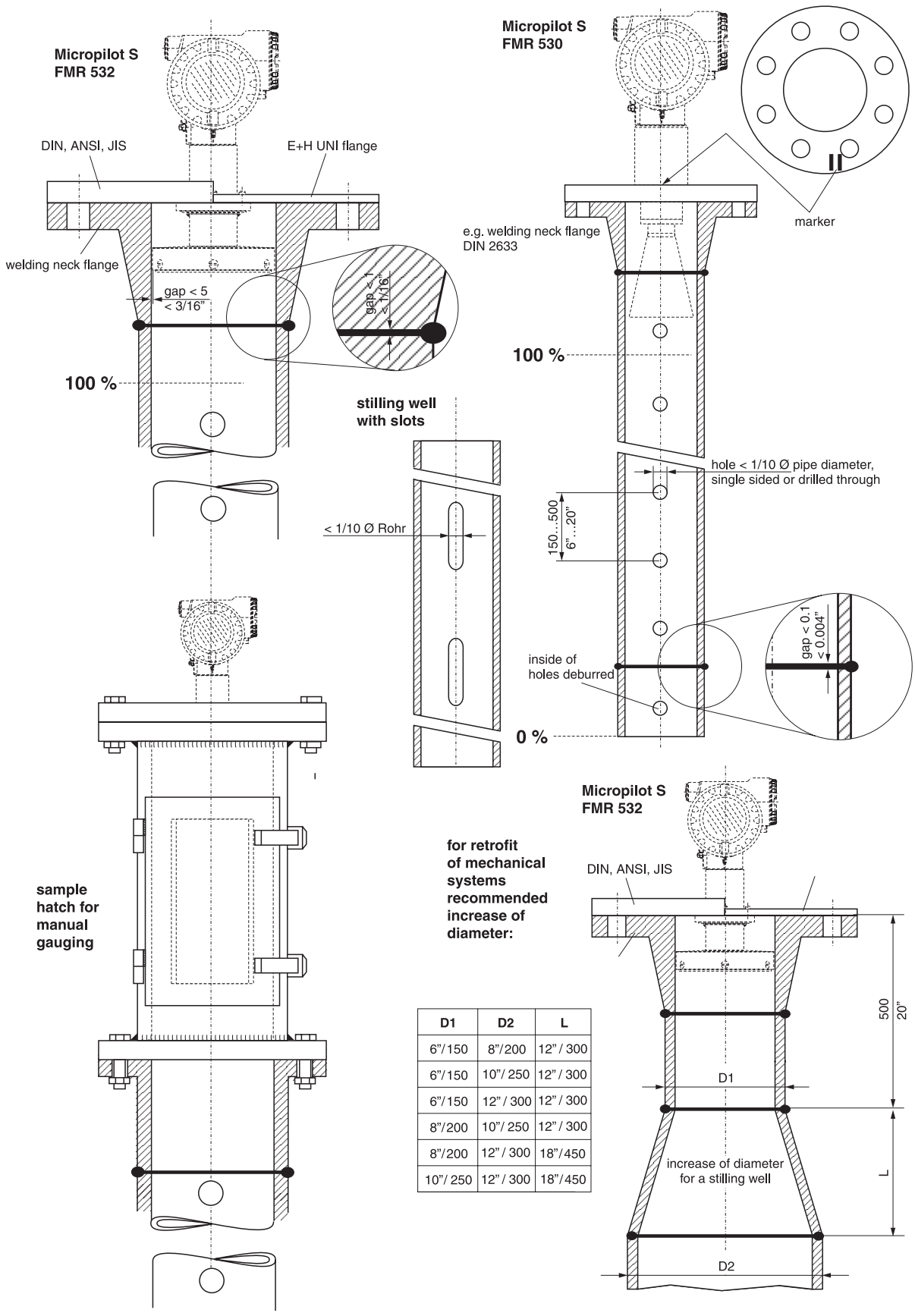
- Metal (no enamel coating, plastic on request)
- Constant diameter
- When using a FMR 532, an increase of the pipe diameter from DN150 to DN200 / DN200 to DN250 / DN250 to DN300 is acceptable. In this case, the upper end of the pipe must have a minimum length of 20" (51 cm) before the diameter increases. Ideally, a sample hatch is used.
- A larger step-width for the increase of the pipe diameter (e.g. DN150 to DN300) is possible if the upper part of the pipe has a suitable length (see table on page 21).
- Any rectangular increase of the pipe diameter has to be avoided.
- Welding seam should be 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.

Additional considerations for horn antenna:

- Select horn antenna as big as possible. For intermediate sizes [e.g. 7" (180 mm)], select next larger antenna and adapt it mechanically. Maximum gap allowed between the antenna of FMR 532 and the inside of the stilling well is 3/16" (5 mm).
- At any transition (e.g. when using a ball valve or mending pipe segments), no gap may be created exceeding 0.1 mm in case of FMR 530 or 1 mm in case of FMR 532.
- The stilling well must be smooth on the inside [average roughness Rz ≤ 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).
- Dimensions of a nozzle for manual gauging must be adapted to the dimensions of the horn antenna used, compare to pages 24 and 31.

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

Examples for the construction of stilling wells



D1	D2	L
6"/150	8"/200	12" / 300
6"/150	10"/ 250	12" / 300
6"/150	12" / 300	12" / 300
8"/200	10"/ 250	12" / 300
8"/200	12" / 300	18"/450
10"/ 250	12" / 300	18"/450

Operating conditions / Environment

Ambient temperature range

Ambient temperature for the transmitter:
- Standard: -40 °F…+176 °F (-40 °C ... +80 °C)
- For calibration to regulatory standards: -30 °F…+140 °F (-25 °C ... +60 °C)

A weather protection cover should be used for outdoor operation if the instrument is exposed to direct sunlight.

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, 5 $(m/s^2)^2$/Hz

Cleaning of the antenna

The antenna can get contaminated, depending on the application. The emission and reception of microwaves can thus eventually be hindered. The degree of contamination leading to an error depends on the 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 has to be taken not to damage the antenna in the process of a 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.

Electromagnetic compatibility

- Interference Emission to EN 61326, Electrical Equipment Class B
- Interference Immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC)
- A standard installation cable is sufficient if only the analog signal is used. Use a screened cable when working with a superimposed communications signal (HART/Intensor).

Approvals for custody transfer applications

All aspects of OIML R85 are fulfilled.

Operating conditions / Process

Process temperature range

Antenna	Horn antenna	Rod antenna	Planar antenna	Parabolic antenna
Temperature range	-40 °F…+ 392 °F (-40 °C…+200 °C)	-40 °F…+ 302 °F (-40 °C…+150 °C)	-40 °F…+302 °F (-40 °C…+150 °C), -4 °F…+302 °F (-20 °C…+150 °C) for FKM-seal	-40 °F…+ 392 °F (-40 °C…+200 °C)

Process pressure limits

- FMR 530: 14.5…580 psi (0…40 bar) / optional 928 psi (64 bar)
- FMR 531: 14.5…580 psi (0…40 bar)
- FMR 532: 14.5…362 psi (0…25 bar)
- FMR 533: 14.5…232 psi (0…16 bar)

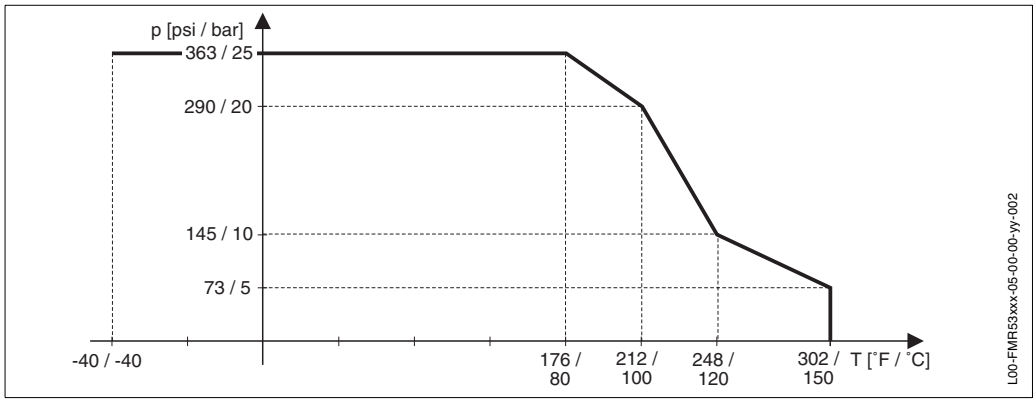


Illustration of temperature and pressure conditions

Dielectric constant

- In a stilling well: $\varepsilon r \geq 1.4$
- In free space: $\varepsilon r \geq 1.9$

Wetted parts

FMR 530

Type of antenna / Seal	Products	Antenna cone	Wetted parts
Standard / Viton -4 °F…+392 °F (-20…+200 °C)	For non-conductive products	PTFE	PTFE and 1.4571
Standard / EPDM -40 °F…+302 °F (-40…+150 °C)			
Standard / Kalrez +32 °F…392 °F (0…+200 °C)			
Standard -4 °F…392 °F (-20…+200 °C) PTFE seal (non wetted Viton O-Ring), gastight	For conductive products	PTFE	PTFE and 1.4571

Note!
The gastight horn version (for conductive products) is resistant to hot vapor.

FMR 531

Type of antenna / Seal	Wetted parts
Rod / gastight; antistatic	1.4435 / SS 316 L / PTFE
Rod / gastight[4]	1.4435 / SS 316 L / PTFE (TFM 1600)

FMR 532

Type of antenna / Seal	Wetted parts
Planar / gastight	1.4435 / HNBR (Hydrated Nitrit Butadien Rubber, resistent to NH_3) or FKM / PTFE glas fibre laminat
Horn adapter for increase of diameter	1.4435

FMR 533

Type of antenna / Seal	Wetted parts
Parabolic / gastight	1.4435 / SS 316 L / PTFE

Note!
The planar antenna is not resistant to hot vapor.

4) Rod antenna with FDA listed materials, white PTFE (TFM 1600), 3A approved in combination with 2" and 3" Tri-clamp process connection

Mechanical construction

Design, dimensions

Micropilot S FMR 530 with horn antenna

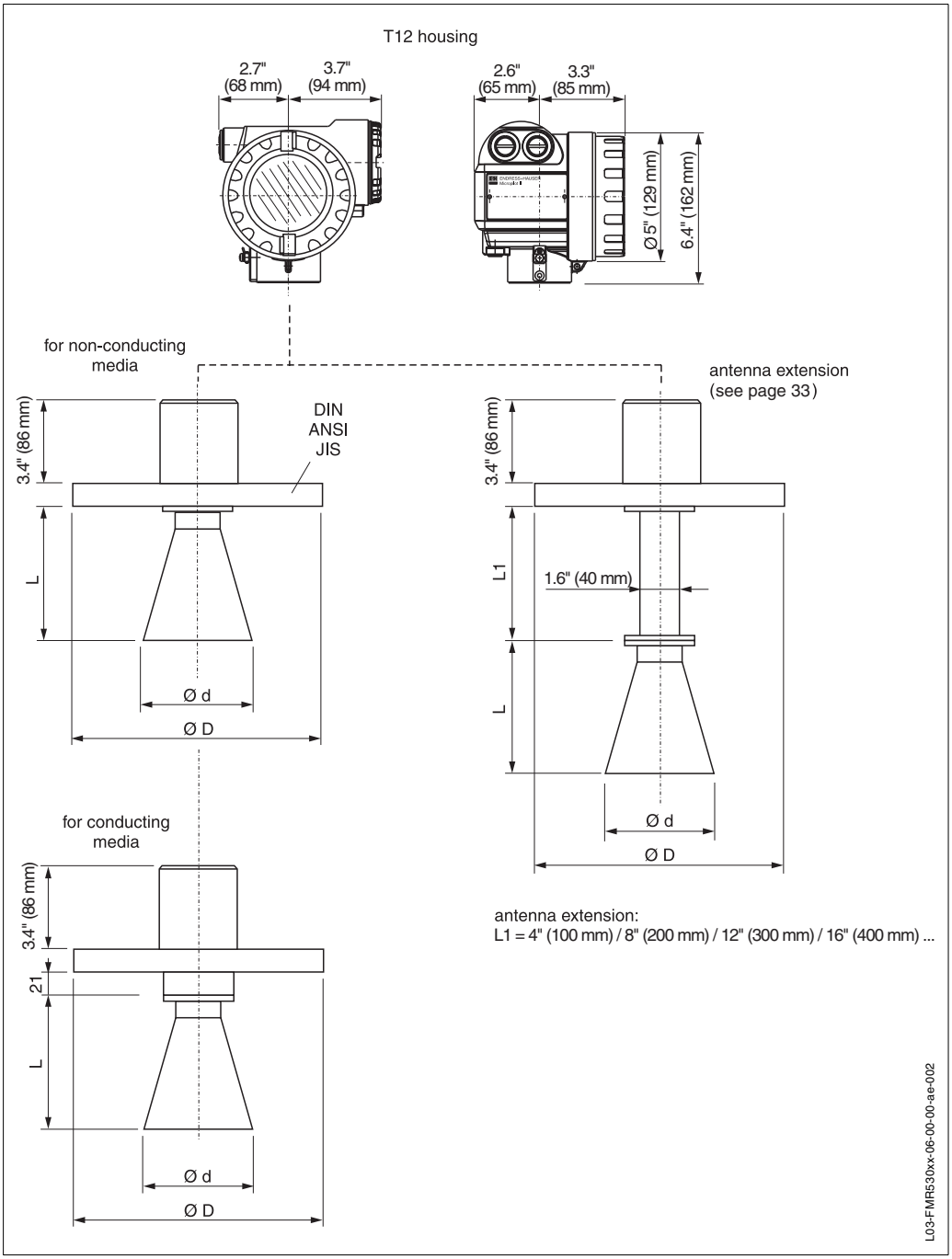


Illustration of FMR 530 with horn antenna

Antenna type (ØD)	3" (DN80)	4" (DN100)	6" (DN150)	8" (DN200)	10" (DN250)
d [inch / mm]	3 / 76	3.8 / 96	5.7 / 146	7.5 / 191	9.5 / 241
L [inch / mm]	2.9 / 74	4.7 / 119	8 / 204	11.4 / 289	14.9 / 379
flange (DIN, ANSI, JIS)	3" (DN80)	4" (DN100)	6" (DN150)	8" (DN200)	10" (DN250)

Micropilot S FMR 531 with rod antenna

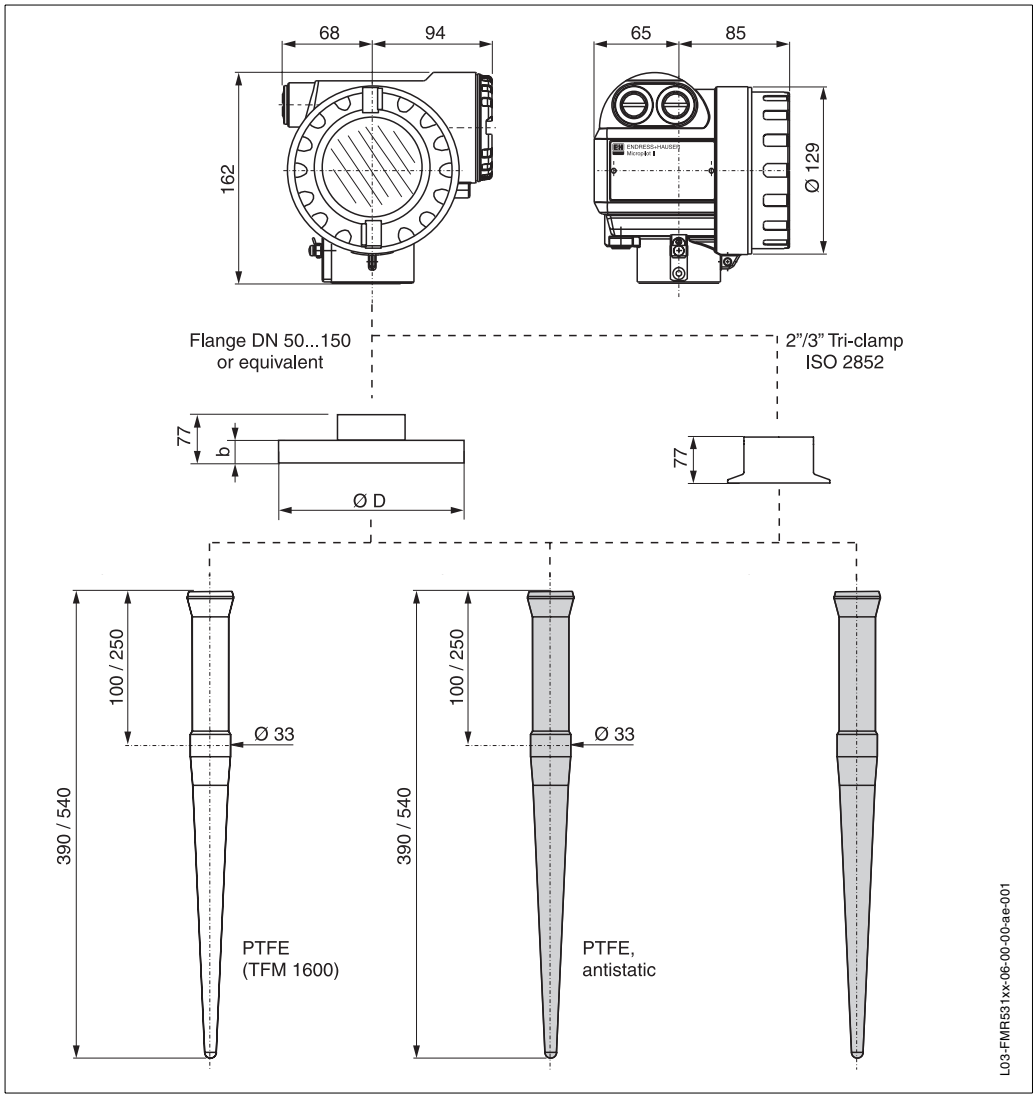


Illustration of FMR 531 with rod antenna

Flange to DIN 2526, for PN 16 (for PN 40)

Flange	DN50	DN80	DN100	DN150
b [mm]	20	20 (24)	20	22
D [mm]	200	200	220	285

Flange to ANSI B16.5, for 150 lbs (for 300 lbs)

Flange	ANSI 2"	ANSI 3"	ANSI 4"	ANSI 6"
b [mm]	19.1	23.9 (28.4)	23.9	25.4
D [mm]	152.4	190.5 (209.5)	228.6	279.4

Flange to JIS B2210, for 10K

Flange	DN50	DN80	DN100	DN150
b [mm]	16	18	18	22
D [mm]	155	185	210	280

Micropilot S FMR 532 with planar antenna

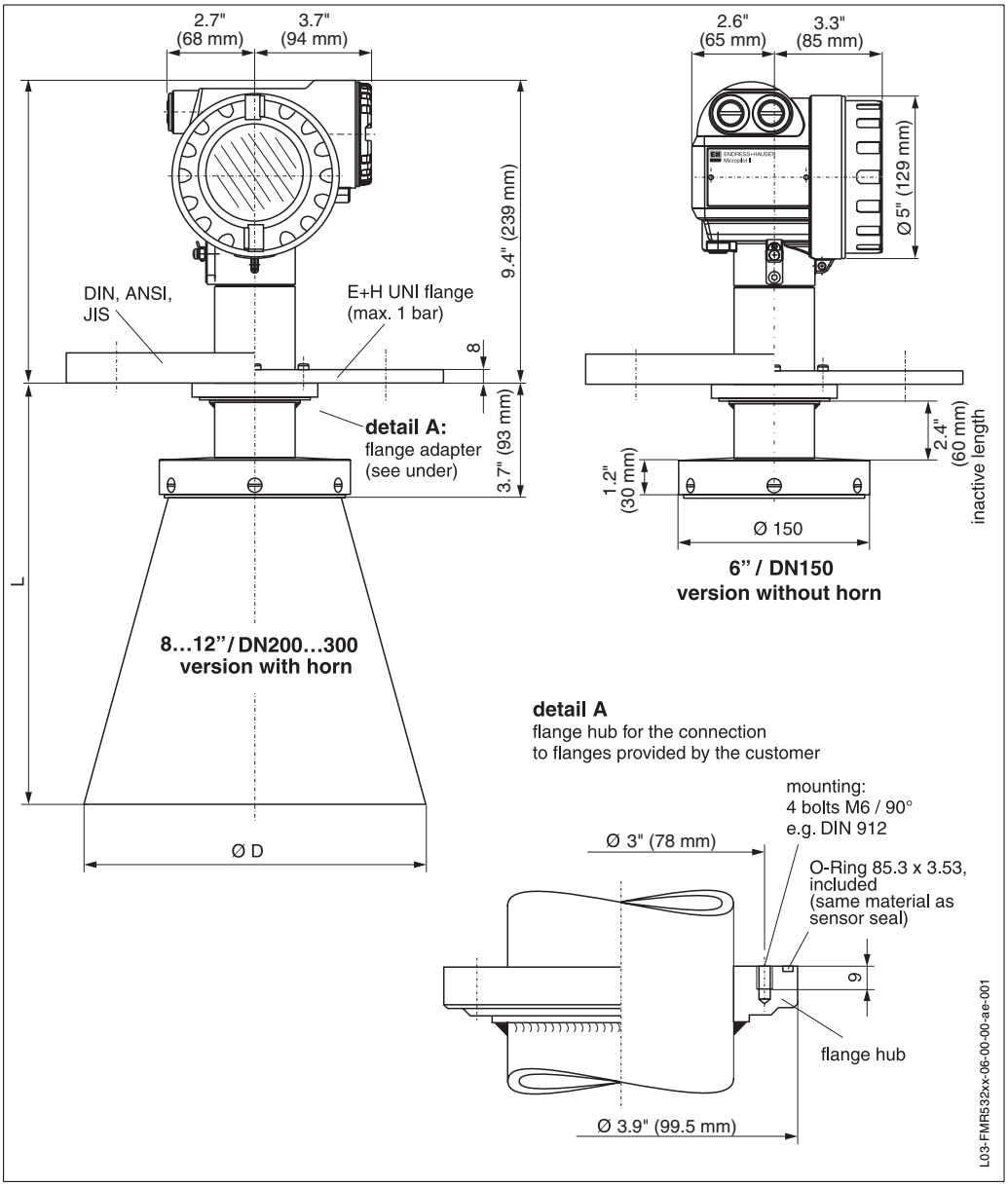


Illustration of FMR 532
with planar antenna

Antenna version	6" / DN150	8" / DN200	10" / DN250	12" / DN300
L [inch / mm]	3.7 / 93	13.3 / 337	19.3 / 490	20.4 / 517
Ø D [inch / mm]	no horn	7.5 / 190	9.4 / 240	11.4 / 290

Note!
The inactive length of 2.4" (60 mm) prevents condensation effects to the antenna performance. Special versions with longer construction are available.

Micropilot S FMR 533 with parabolic antenna

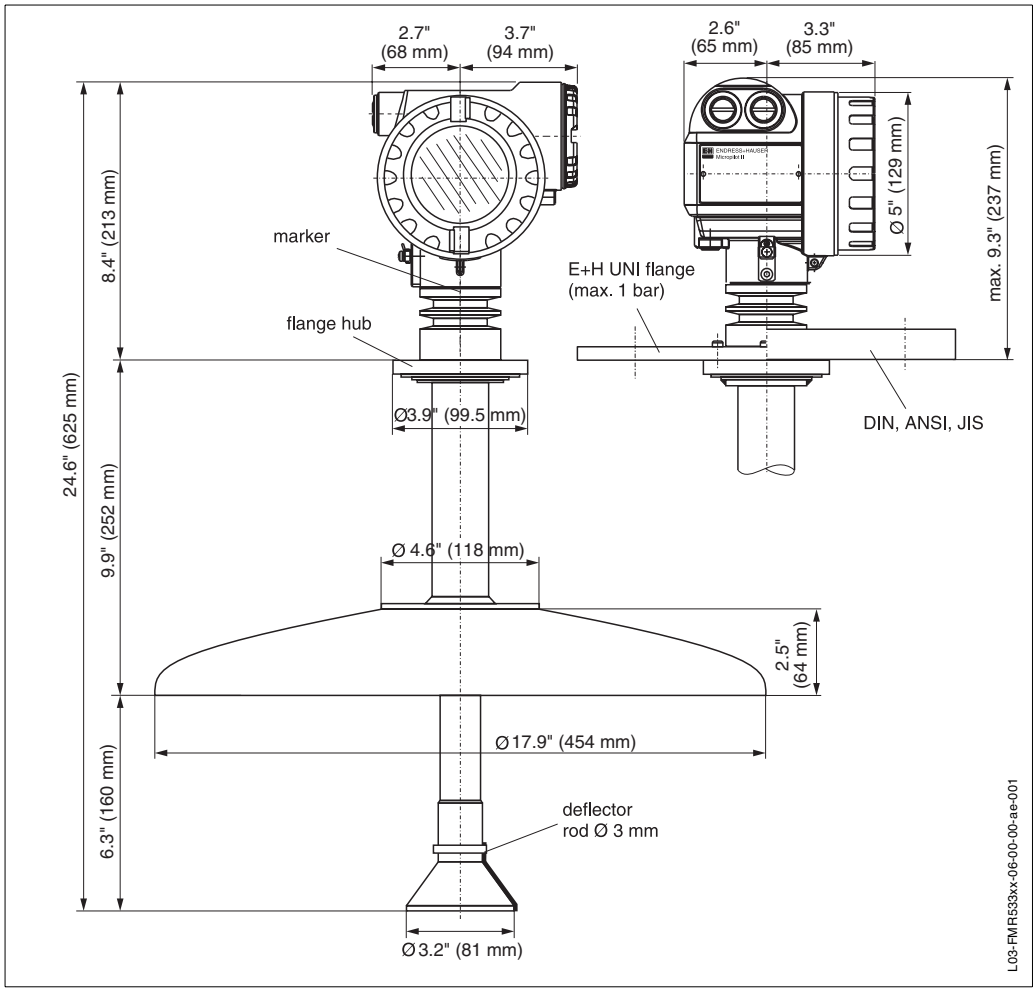


Illustration of FMR 533 with parabolic antenna

Weight

Micropilot S	FMR 530	FMR 531	FMR 532	FMR 533
Weight	13 lb (6 kg) + weight of flange [5]	9 lb (4 kg) + weight of flange [5]	14.3 lb (6.5 kg) + weight of flange [5]	15.9 lb (7.2 kg) + weight of flange [5]

Housing

- Type of housing:
  - 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); ¾ NPT; G ¾ internal thread

Process connection

See »Ordering information« on page 38 - 44. All process connections have a gas-tight glass feed through for the antenna cable to avoid any gas-leakages (second line of defense).

Seal

See »Ordering information« on page 38 - 44

Antenna

See »Ordering information« on page 38 - 44

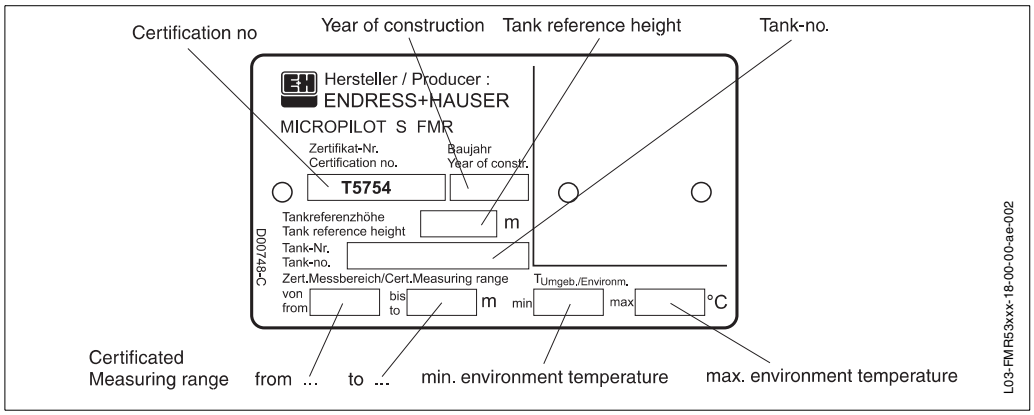
5) Flange weights according to form sheet

Type plate / type plate for calibration to regulatory standards

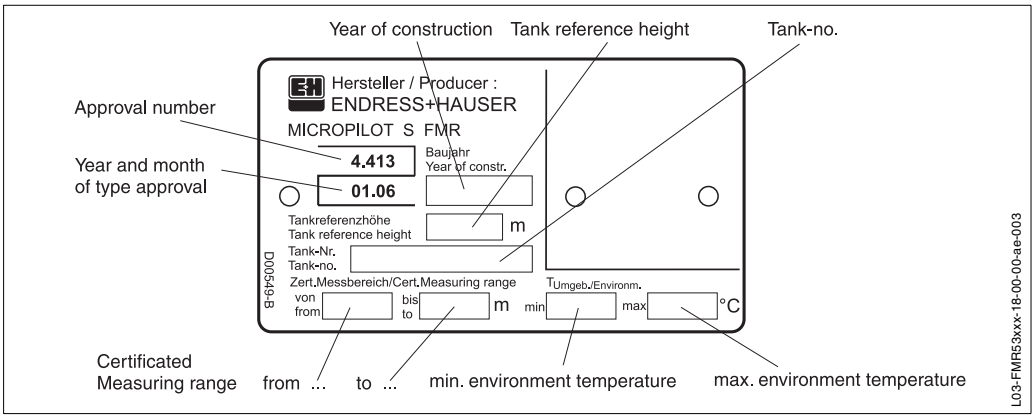
In addition to the standard type plate, the instrument features a type plate for custody transfer applications with the following statements:
- Manufacturer
- Instrument type
- Label for custody transfer approval
  PTB:"Z" with approval number and issuing agency, the 4-digit approval number is shown in the upper part of the "Z", the lower part shows year and month of type approval.
  NMi: field for 5-digit approval number
- Year of manufacturing
- Space for imprinted tank identification number
- Statement of measuring range suitable for custody transfer approval including unit
- Statement of ambient temperature range suitable for calibration to regulatory standards

The following statements are also required for calibration to regulatory standards. They are listed on the standard type plate and are not repeated here:
- Date of manufacturing
- Tester

The type plate for calibration to regulatory standards can be sealed. It is mounted with screws, therefore also available as a spare part. The "stamping" of the electronic compartment is achieved with the write protection switch (compare page 29) and does not require any additional stamping location. NMi and PTB type plate for custody transfer approval refer to illustration:



NMi type plate for custody transfer approval



PTB type plate for custody transfer approval

E+H UNI flange

Construction hints

E+H UNI flanges are designed for non-pressurized operation [max. 14.5 psi (1 bar) absolute pressure]. The number of bolts can sometimes be reduced. The bolt-holes have been enlarged for adaption of dimensions, therefore, the flange needs to be properly aligned to the counterflange before the bolts are tightened.

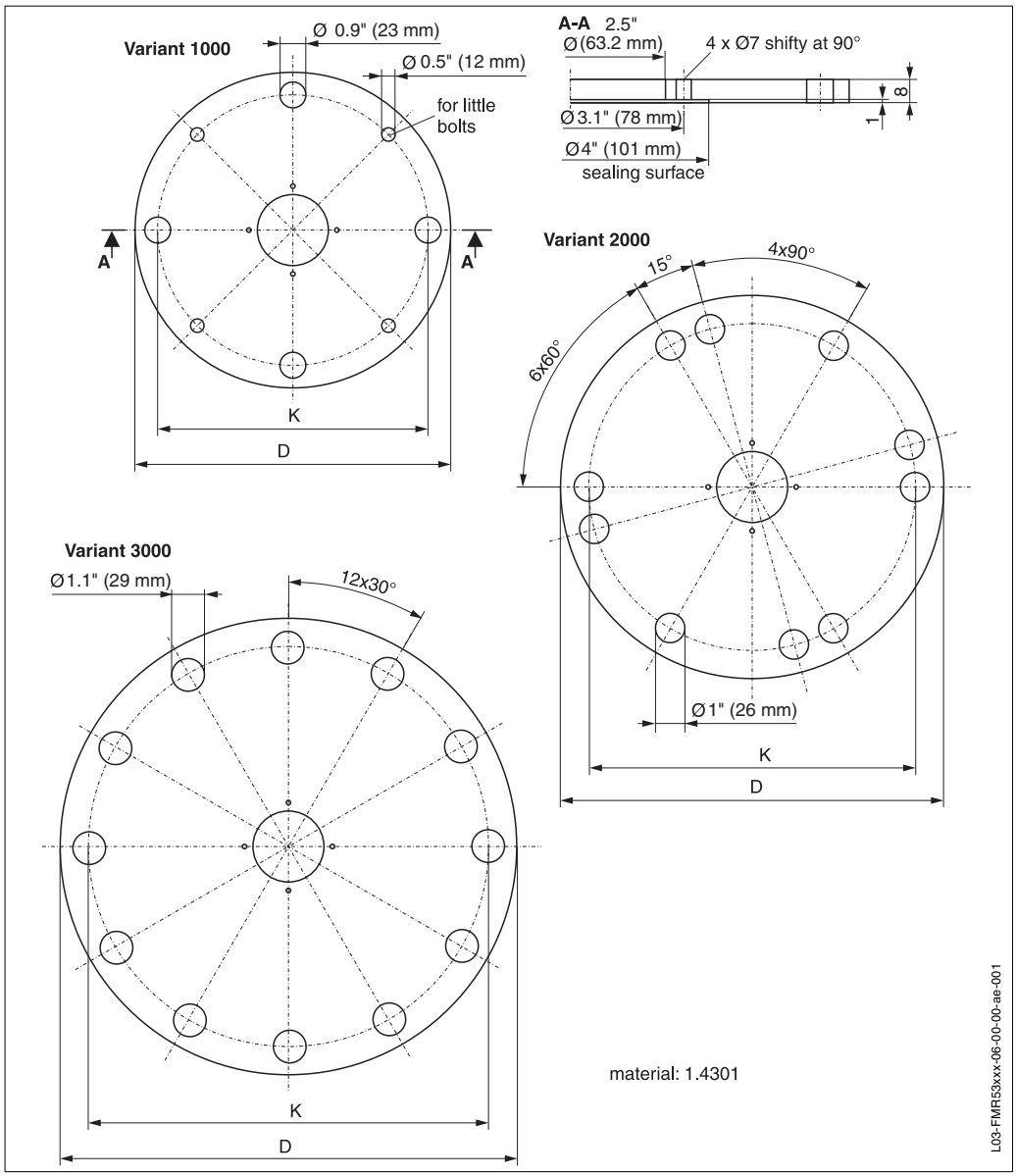


Illustration of E+H UNI flanges

Version	Compatible with	D[inch / mm]	K[inch / mm]	Type plate no.
1000	DN150 PN16, ANSI 6" 150lbs JIS 10K 150	11 / 280	9.4 / 240	942455-3001
2000	DN200 PN16, ANSI 8" 150lbs JIS 10K 200	13.4 / 340	11.6 / 295	942455-3002
3000	DN250 PN16, ANSI 10" 150lbs JIS 10K 250	16 / 405	14 / 358	942455-3003
4000	DN300 PN16, ANSI 12" 150lbs JIS 10K 300	19 / 482	410 (for DIN) 431,8 (for ANSI) 400 (for JIS) 404,5 (for DIN + JIS)	

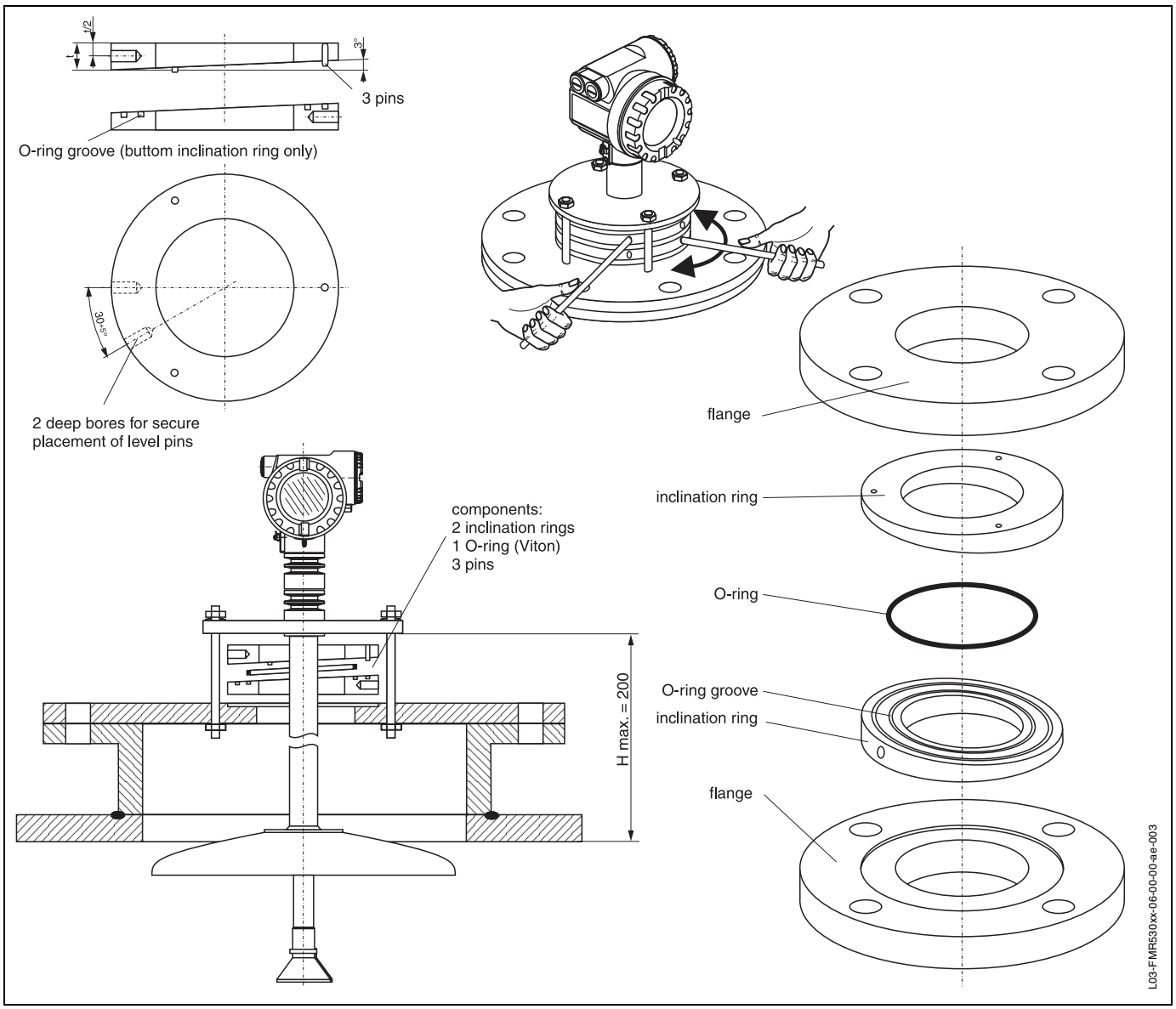
Inclination device

Construction hints

The inclination can be adjusted up to 6° by means of an inclination device. The purpose is to align the antenna axis such that the radar beam does not touch the tank wall.

Note!

The inclination device is not part of the standard offering from Endress+Hauser.



Installation of inclination device

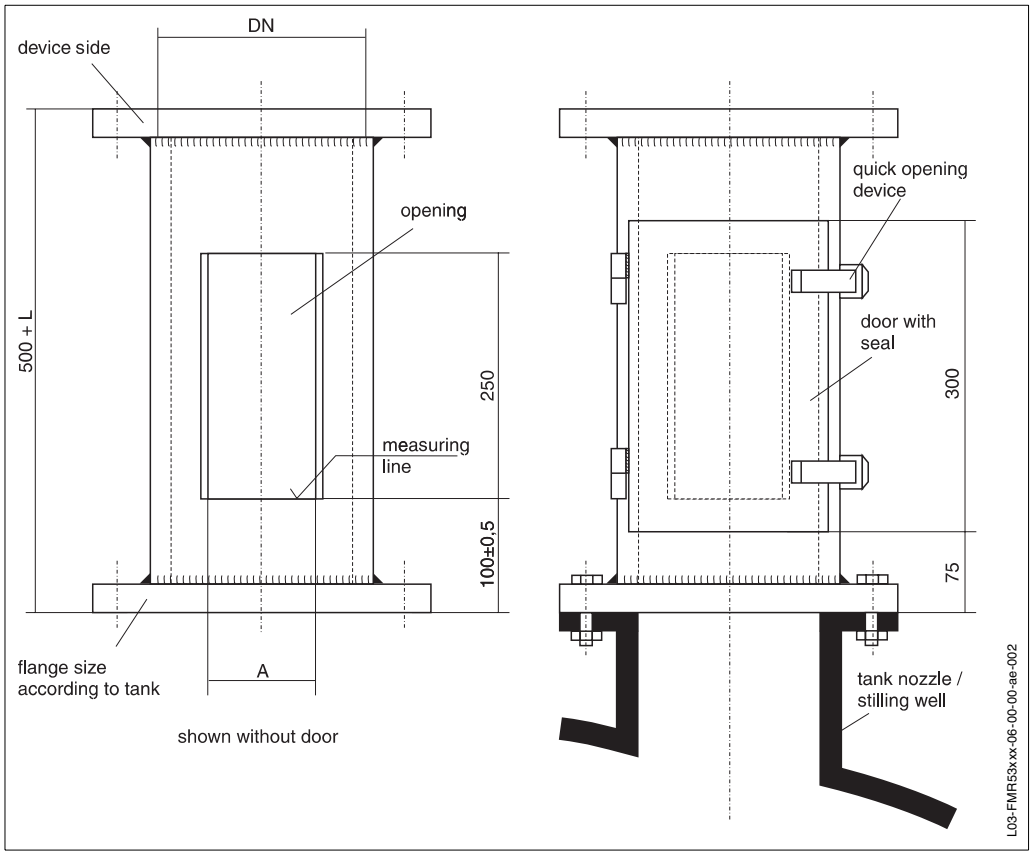
Sample hatch for Micropilot S FMR 530/532

Construction hints

For control and cleaning purposes, as well as for hand dipping (tape), a sample hatch gauging is recommended. The sensor head can be easily checked in the area of the opening. Manual gauging with gauge rod or tape is possible without removal of the transmitter. The lower edge of the opening is the reference for the gauging. The construction is only suitable for non-pressurized operation.

Note!

The nozzle for manual gauging is not part of the standard offering from Endress+Hauser.



Installation of sample hatch

Flange	DN150	DN200	DN250/300
PN [bar] [6]	16	16	16
A [inch / mm]	4.3 / 110	5.5 / 140	6.7 / 170
L [inch / mm}	—	11.8 / 300	17.7 / 450

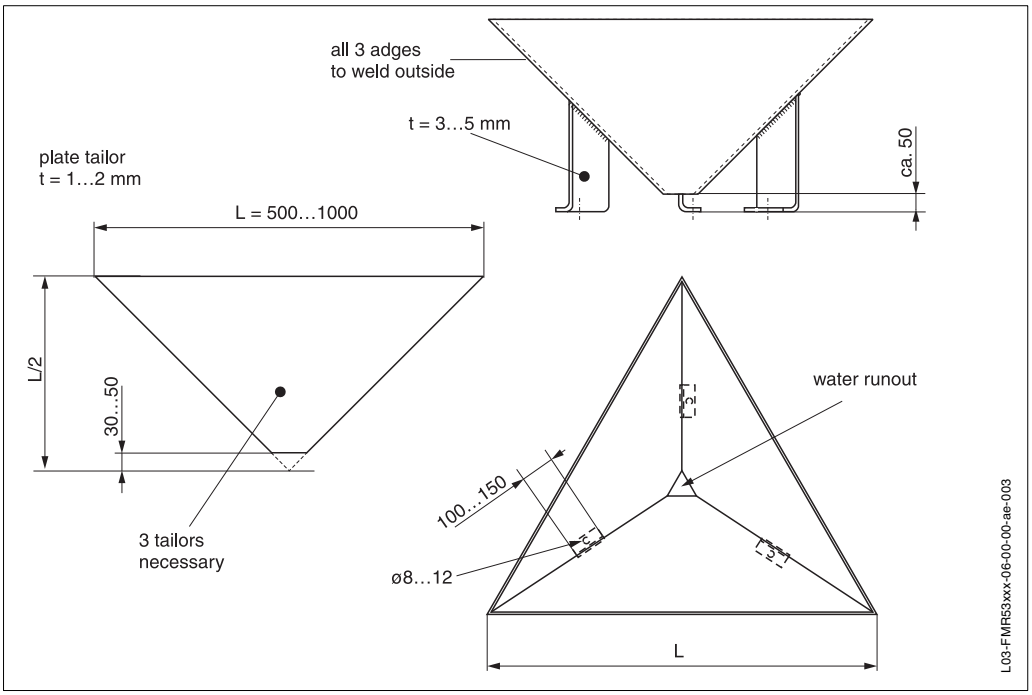
Flange	ANSI 6"	ANSI 8"	ANSI 10"
PN [lbs] [6]	150	150	150
A [inch / mm]	4.3 / 110	5.5 / 140	6.7 / 170
L [inch / mm]	—	11.8 / 300	17.7 / 450

6) Only dimensions adapted to standard. Designed for non-pressurized operation only, therefore thickness of flange can be reduced (e.g. 8 mm).

Roof reflector

Installation hints

Note!
The roof reflector is not part of the standard offering from Endress+Hauser.



Roof reflector

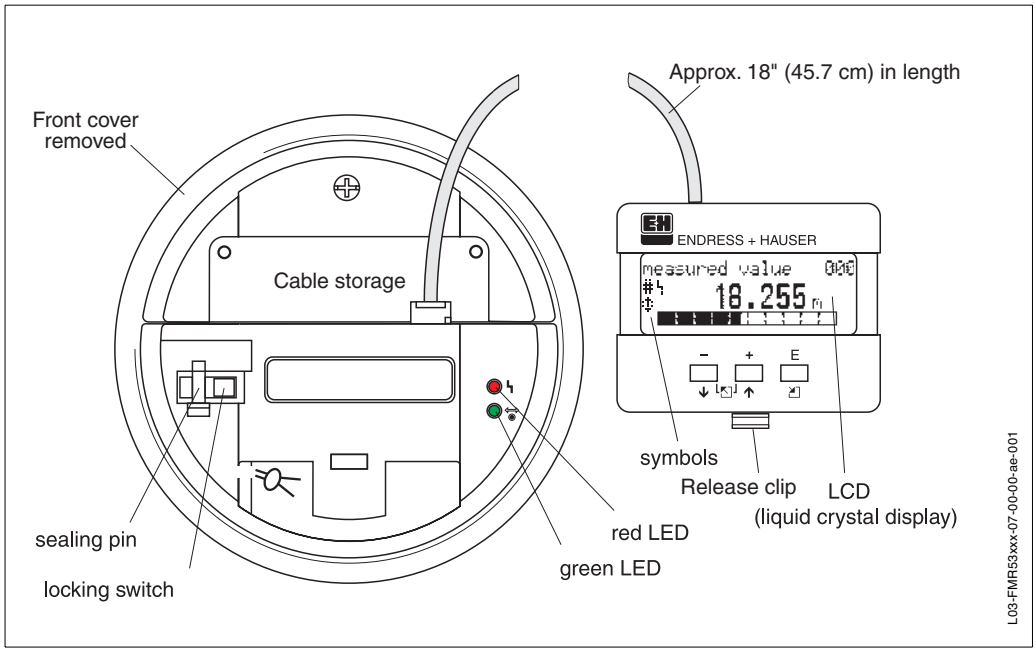
Human interface

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. Display and operation can occur in one out of 6 languages (English, German, French, Italian, Dutch and Spanish). During the first start-up, the instrument explicitly asks for the desired unit / language. Remote commissioning, including documentation of the measuring point and in-depth analysis functions, is supported via the ToF Tool, the graphical operating software for E+H time-of-flight systems. Access to the electronics can be prevented by means of a locking switch that locks the device settings. The locking switch can be sealed for custody transfer applications.

Display elements

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



Micropilot S display

Symbol on the display	continuously on	flashes			
Meaning	alarm	warning	remote communication	locked	calibration to regulatory standards disturbed

If the instrument is not locked or it cannot guarantee the calibration to regulatory standards, the situation will be indicated on the display via the symbol “calibration to regulatory standards disturbed” (#).

Light emitting diodes (LEDs):
There is a green and a red LED beside the liquid crystal display.

LED	Meaning
Red LED continuously on	Alarm
Red LED flashes	Warning
Red LED off	No alarm
Green LED continuously on	Operation
Green LED flashes	Communication with external device

Operating elements

The operating elements are located inside the housing and are accessible for operation by opening the lid of the housing.

Function of the keys

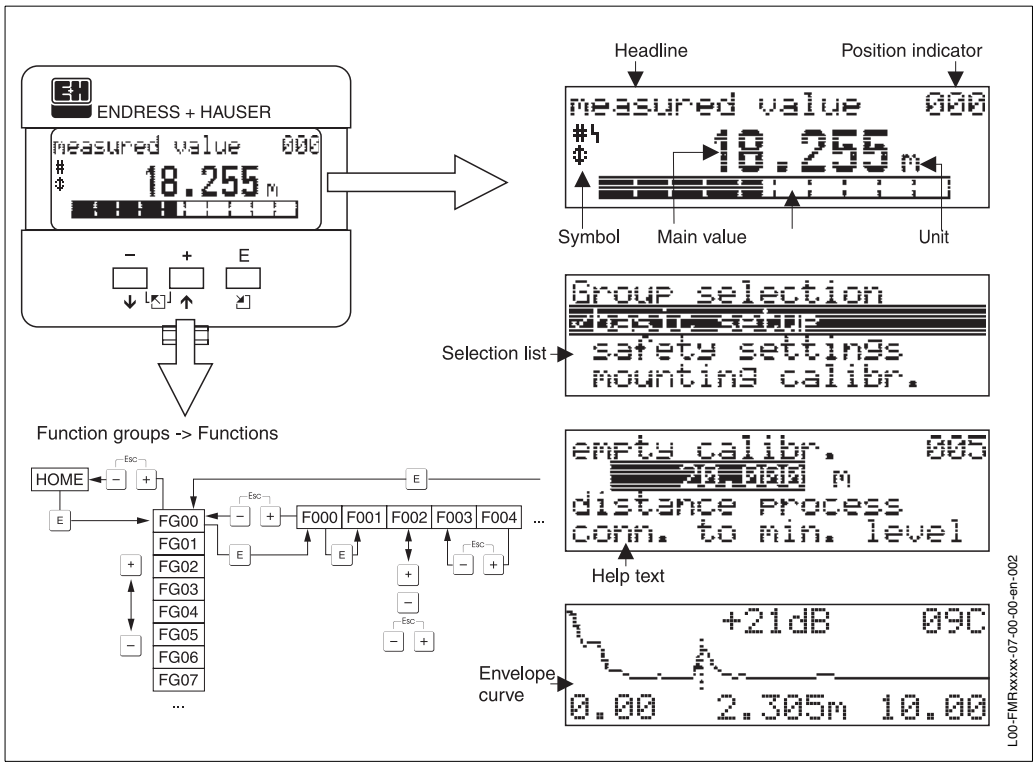
.

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

On-site operation

Operation with VU 331

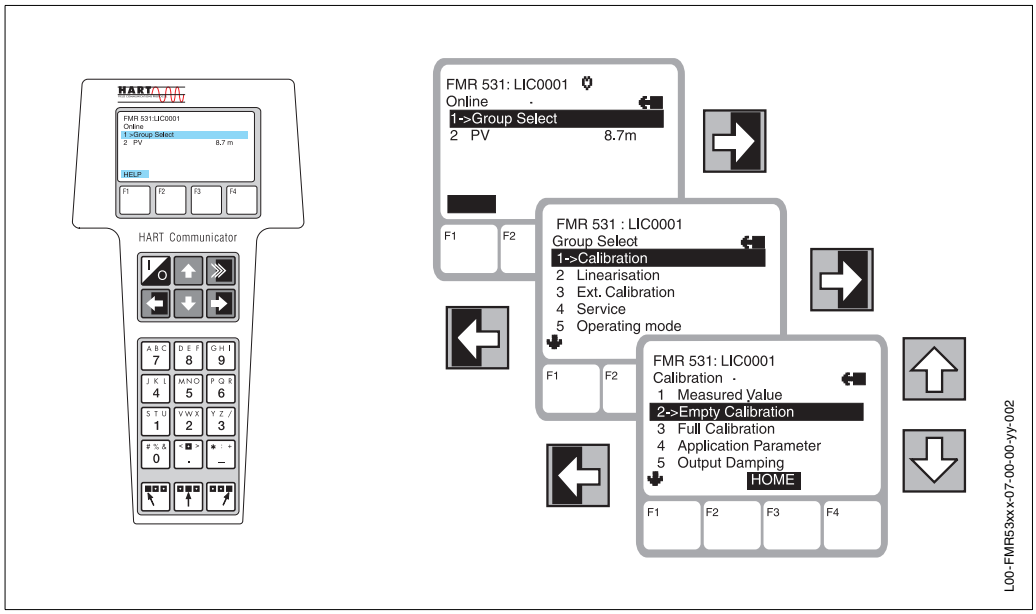
The LC-Display VU 331 allows configuration via 3 keys directly at the instrument. All device functions can be set through a menu system. The menu consists of function groups and functions. Within a function, application parameters can be read or adjusted. The user is guided through a complete configuration 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

Remote operation

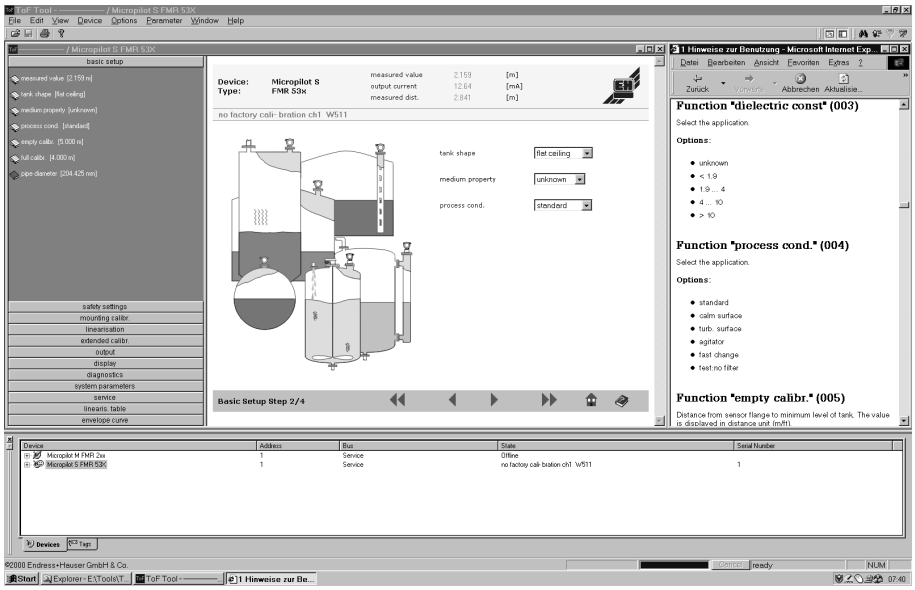
The Micropilot S can be remotely operated via HART. On-site adjustments are also possible.

Operation with ToF Tool

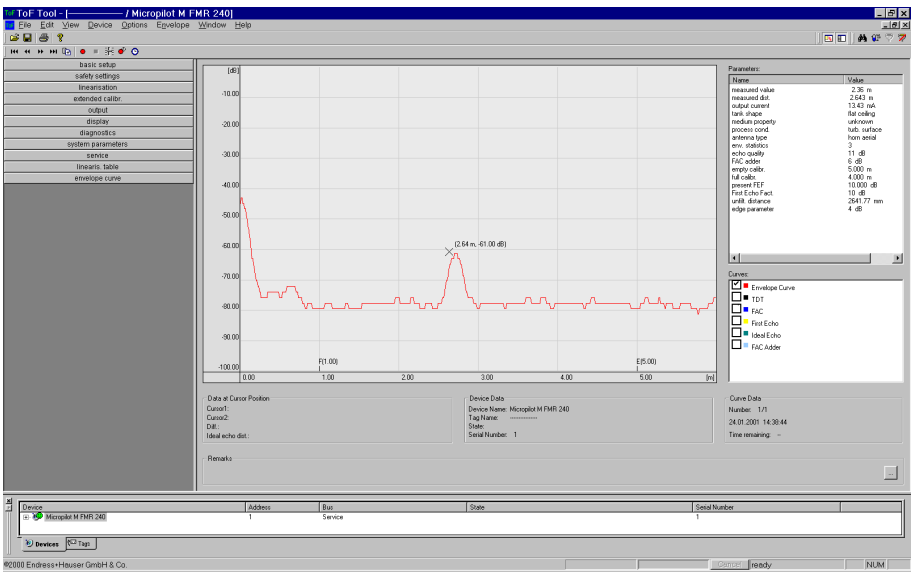
The ToF Tool is a graphical operation software for instruments from Endress+Hauser that operate based on the time-of-flight principle. It is used to support commissioning, securing of data, signal analysis and documentation of the instruments. It is compatible with the following operating systems: Win95, Win98, WinNT4.0 and Win2000.
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

Menu-guided commissioning:



Signal analysis via envelope curve:



Connection options:

- HART with Commubox FXA 191
- Service-interface with adapter FXA 193

Certificates and approvals

CE approval	The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.
RF approvals	R&TTE 1999/5/EG, FCC CRF 47, part 15
Ex approval	See »Ordering information« on page 38 - 44
Type approvals for custody transfer approvals	PTB / NMi
External standards and guidelines	The conception and development for Micropilot S have followed the 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 **API (American Petroleum Institute)** Particularly "Manual of Petroleum Measurement Standards" **OIML R85 (Organisation Internationale de Métrologie Légale)**

Ordering information

Micropilot S FMR 530

10 Certificates

A	For non-hazardous areas	
K	TIIS	Ex ia IIC T3
L	TIIS	Ex ia IIC T6
S	FM	IS - Class I, Division 1, Group A-D
U	CSA	IS - Class I, Division 1, Group A-D
1	ATEX II 1/2 G	EEx ia IIC T6
6	ATEX II 1/2 G	EEx ia IIC T6 + WHG
Y	Special version	

20 Antenna type

	Type	*Size*		*Sealing*
A	Horn antenna	6" / 150 mm	for non-conductive media, gastight	Viton
C	Horn antenna	6" / 150 mm	for non-conductive media, gastight	Kalrez
D	Horn antenna	6" / 150 mm	for conductive media, gastight	PTFE
E	Horn antenna	10 " / 250 mm	for non-conductive media, gastight	Viton
G	Horn antenna	10 " / 250 mm	for non-conductive media, gastight	Kalrez
H	Horn antenna	10 " / 250 mm	for conductive media, gastight	PTFE
I	Horn antenna	4" / 100 mm	for non-conductive media, gastight	Vitron
K	Horn antenna	4" / 100 mm	for non-conductive media, gastight	Kalrez
L	Horn antenna	4" / 100 mm	for conductive media, gastight	PTFE
M	Horn antenna	3" / 80 mm	for non-conductive media, gastight	Vitron
P	Horn antenna	3" / 80 mm	for non-conductive media, gastight	Kalrez
R	Horn antenna	3" / 80 mm	for conductive media, gastight	PTFE
U	Horn antenna	8" / 200 mm	for non-conductive media, gastight	Vitron
W	Horn antenna	8" / 200 mm	for non-conductive media, gastight	Kalrez
X	Horn antenna	8" / 200 mm	for conductive media, gastight	PTFE
Y	Special version			

30 Process connection

	Flange Dia/Pressure	*Norm*	*Material*
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
CQ2	DN100 PN16	DIN 2526 Form C	SS316Ti
CM2	DN80 PN16	DIN 2526 Form C	SS316Ti
CN2	DN80 PN40	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
KA2	10 K 80	JIS B2210	SS316Ti
KD2	10 K 200	JIS B2210	SS316Ti
KH2	10 K 100	JIS B2210	SS316Ti
KV2	10 K 150	JIS B2210	SS316Ti
K52	10 K 250	JIS B2210	SS316Ti
YY9	Special version		

40 Output and operation

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

50 Housing

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

FMR 530- Product designation (Part 1)

70		**Custody transfer approvals**
	A	NMi, PTB type and test rig approval
	F	NMi initial verification, type and test rig approval
	G	PTB initial verification, type and test rig approval
	Y	Special approval for custody transfer

80		**Additional options**
	A	Without additional options
	Y	Special version
FMR 530-		Complete product designation

Micropilot S FMR 531

10 Certificates

A	For non-hazardous areas	
K	TIIS	Ex ia IIC T3
L	TIIS	Ex ia IIC T6
S	FM	IS - Class I, Division 1, Group A-D
U	CSA	IS - Class I, Division 1, Group A-D
1	ATEX II 1/2 G	EEx ia IIC T6
6	ATEX II 1/2 G	EEx ia IIC T6 + WHG
Y	Special version	

20 Antenna type

	Type	*Size*	*Material*	*Nozzle length*
H	Rod antenna	15" / 390 mm	PTFE, antistatic + fully insulated	4" / 100 mm
J	Rod antenna	21" / 540 mm	PTFE, antistatic + fully insulated	10" / 250 mm
E	Rod antenna	15" / 390 mm	PTFE, fully insulated	4" / 100 mm
F	Rod antenna	21" / 540 mm	PTFE, fully insulated	10" / 250 mm
Y	Special version			

30 Process connection

	Threaded connection	*Standard*	*Material*
TEJ	2" Tri-clamp	ISO 2852	SS316L
TLJ	3" Tri-clamp	ISO 2852	SS316L
	Flange Dia/Pressure	*Standard*	*Material*
AEJ	2"/150 lbs	ANSI B16.5	SS316L
AEK	2"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
ALJ	3"/150 lbs	ANSI B16.5	SS316L
ALK	3"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
AMJ	3"/300 lbs	ANSI B16.5	SS316L
APJ	4"/150 lbs	ANSI B16.5	SS316L
APK	4"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
AQJ	4"/300 lbs	ANSI B16.5	SS316L
AVJ	6"/150 lbs	ANSI B16.5	SS316L
AVK	6"/150 lbs	ANSI B16.5	SS316L, PTFE-clad
CFJ	DN50 PN16	DIN 2526 Form C	SS316L
CFK	DN50 PN16	DIN 2526 Form C	SS316L, PTFE-clad
CMJ	DN80 PN16	DIN 2526 Form C	SS316L
CMK	DN80 PN16	DIN 2526 Form C	SS316L, PTFE-clad
CNJ	DN80 PN40	DIN 2526 Form C	SS316L
CQJ	DN100 PN16	DIN 2526 Form C	SS316L
CQK	DN100 PN16	DIN 2526 Form C	SS316L, PTFE-clad
CWJ	DN150 PN16	DIN 2526 Form C	SS316L
CWK	DN150 PN16	DIN 2526 Form C	SS316L, PTFE-clad
KEJ	10 K 50A	JIS B2210	SS316L
KEK	10 K 50A	JIS B2210	SS316L, PTFE-clad
KLJ	10 K 80A	JIS B2210	SS316L
KLK	10 K 80A	JIS B2210	SS316L, PTFE-clad
KPJ	10 K 100A	JIS B2210	SS316L
KPK	10 K 100A	JIS B2210	SS316L, PTFE-clad
KVJ	10 K 150A	JIS B2210	SS316L
KVK	10 K 150A	JIS B2210	SS316L, PTFE-clad
YY9	Special version		

40 Output and operation

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

50 Housing

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

FMR 531- Product designation (Part 1)

70								**Custody transfer approvals**	
								A	NMi, PTB type and test rig approval
								F	NMi initial verification, type and test rig approval
								G	PTB initial verification, type and test rig approval
								Y	Special approval for custody transfer
80								**Additional options**	
								A	Without additional options
								Y	Special version
FMR 531-									Complete product designation

Micropilot S FMR 532

10 Certificates

A	For non-hazardous areas	
K	TIIS	Ex ia IIC T3
L	TIIS	Ex ia IIC T6
S	FM	IS - Class I, Division 1, Group A-D
U	CSA	IS - Class I, Division 1, Group A-D
1	ATEX II 1/2 G	EEx ia IIC T6, note safety instruction (XA) for electrostatic charging!
6	ATEX II 1/2 G	EEx ia IIC T6 + WHG, note safety instruction (XA) for electrostatic charging!
Y	Special version	

20 Antenna type

	Type	*Size*	*Material*	*Sealing*
A	Planar antenna	DN150 / 6"	SS316L	FKM inside
B	Planar antenna	DN150 / 6"	SS316L	HNBR inside
E	Planar antenna	DN250 / 10"	SS316L	FKM inside
F	Planar antenna	DN250 / 10"	SS316L	HNBR inside
U	Planar antenna	DN200 / 8"	SS316L	FKM inside
V	Planar antenna	DN200 / 8"	SS316L	HNBR inside
W	Planar antenna	DN300/12"	SS316L	HNBR inside
X	Planar antenna	DN300/12"	SS316L	FKM inside
Y	Special version			

30 Process connection

	Flange Dia/Pressure	*Standard*	*Material*
AVJ	6"/150 lbs	ANSI B16.5	SS316L
A3J	8"/150 lbs	ANSI B16.5	SS316L
A5J	10"/150 lbs	ANSI B16.5	SS316L
AWJ	6"/300 lbs	ANSI B16.5	SS316L
AXJ	8"/300 lbs	ANSI B16.5	SS316L
A7J	12"/150 lbs	ANSI B16.5	SS316L
CWJ	DN150 PN16	DIN 2526 Form C	SS316L
CXJ	DN200 PN16	DIN 2526 Form C	SS316L
CZJ	DN200 PN25	DIN 2526 Form C	SS316L
C1J	DN150 PN25	DIN 2526 Form C	SS316L
C6J	DN250 PN16	DIN 2526 Form C	SS316L
C8J	DN300 PN16	DIN 2526 Form C	SS316L
KDJ	10 K 200	JIS B2210	SS316L
KV2	10 K 150	JIS B2210	SS316L
K5J	10 K 250	JIS B2210	SS316L
KWJ	20 K 150	JIS B2210	SS316L
KXJ	20 K 200	JIS B2210	SS316L
XXJ	with flange hub		1.4404 / 1.4435 / SS316L
XVU	E+H UNI Flange: 6"/14.5 lbs meets also: DN150 PN1 1 K 150	ANSI B16.5 DIN 2526 Form C JIS B2210	SS304
X3U	E+H UNI Flange: 8"/14.5 lbs meets also: DN200 PN1 1 K 200	ANSI B16.5 DIN 2526 Form C JIS B2210	SS304
X5U	E+H UNI Flange: 10"/14.5 lbs meets also: DN250 PN1 1 K 250	ANSI B16.5 DIN 2526 Form C JIS B2210	SS304
X7U	E+H UNI Flange: 12"/14.5 lbs meets also: DN300 PN1 1 K 300	ANSI B16.5 DIN 2526 Form C JIS B2210	SS304
YY9	Special version		

40 Output and operation

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

50 Housing

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

FMR 532- Product designation (Part 1)

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							**Custody transfer approvals**		
							A	NMi, PTB type and test rig approval	
							F	NMi initial verification, type and test rig approval	
							G	PTB initial verification, type and test rig approval	
							Y	Special approval for custody transfer	
80								**Additional options**	
								A	Without additional options
								Y	Special version
FMR 532-									Complete product designation

Micropilot S FMR 533

10 Certificates

A	For non-hazardous areas	
K	TIIS	Ex ia IIC T3
L	TIIS	Ex ia IIC T6
S	FM	IS - Class I, Division 1, Group A-D
U	CSA	IS - Class I, Division 1, Group A-D
1	ATEX II 1/2 G	EEx ia IIC T6, note safety instruction (XA) for electrostatic charging!
6	ATEX II 1/2 G	EEx ia IIC T6 + WHG, note safety instruction (XA) for electrostatic charging!
Y	Special version	

20 Antenna

	Type	*Size*	*Material*	*sealing*
A	Parabolic antenna	DN450 / 20"	1.4435 / PTFE	not wetted o-ring
Y	Special version			

30 Process connection

	Flange Dia/Pressure	*Standard*	*Material*
AVJ	6"/150 lbs	ANSI B16.5	SS316L
A3J	8"/150 lbs	ANSI B16.5	SS316L
A5J	10"/150 lbs	ANSI B16.5	SS316L
CWJ	DN150 PN16	DIN 2526 Form C	1.4404 / 1.4435
CXJ	DN200 PN16	DIN 2526 Form C	1.4435
C6J	DN250 PN16	DIN 2526 Form C	1.4435
KDJ	10 K 200	JIS B2210	SS316L
KV2	10 K 150	JIS B2210	SS316L
K5J	10 K 250	JIS B2210	SS316L
XXJ	with flange hub		1.4404 / 1.4435 / SS316L
XVU	E+H UNI Flange: 6"/14,5 lbs meets also: DN150 PN1 1 K 150	ANSI B16.5 DIN 2526 Form C JIS B2210	1.4301
YY9	Special version		

40 Output and operation

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

50 Housing

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 Custody transfer approvals

A	NMi, PTB type and test rig approval
F	NMi initial verification, type and test rig approval
G	PTB initial verification, type and test rig approval
Y	Special approval for custody transfer

80 Additional options

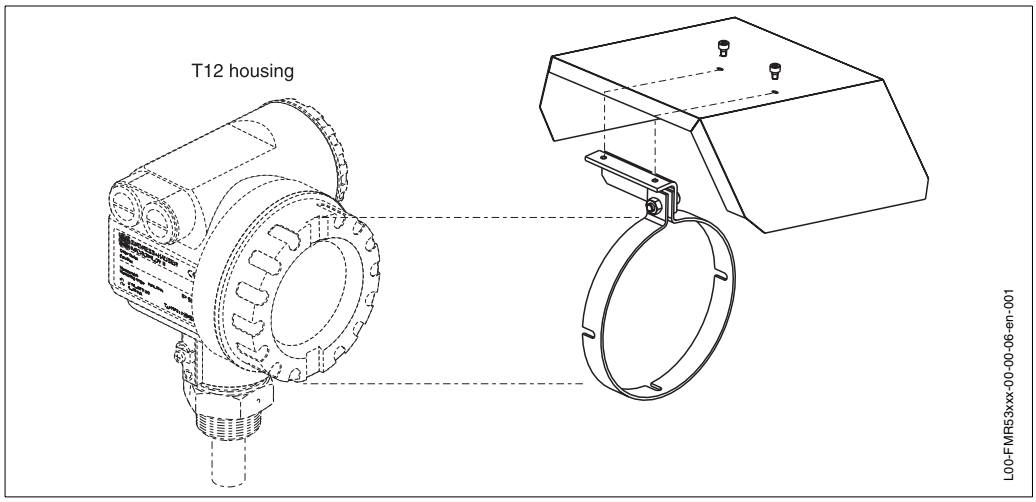
A	Without additional options
Y	Special version

FMR 533- Complete product designation

Accessories

Protective cover

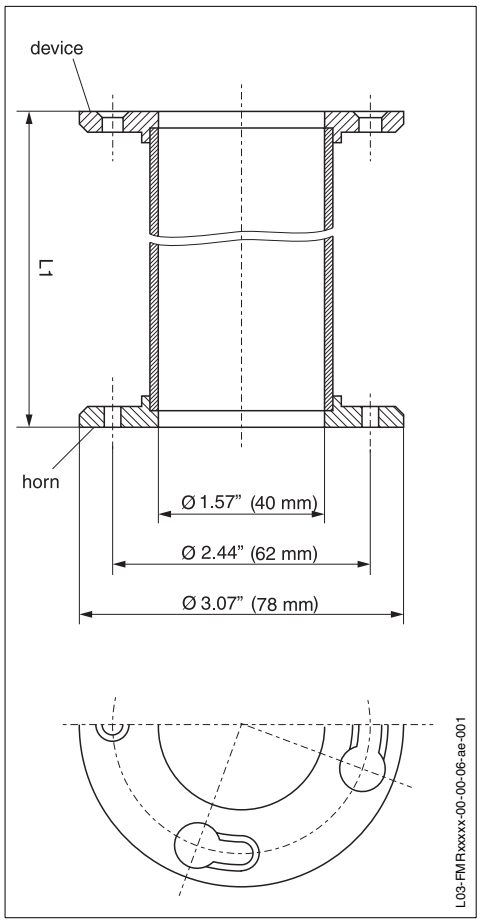
A protective cover made of stainless steel is available for outdoor mounting (order code: 543199-0001). The shipment includes the protective cover and tension clamp.



Protective cover placement on Micropilot S

Antenna extension FAR 10 (for FMR 530)

Dimensions



FMR 530 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

Correlation of operating instructions to the instrument:

Instrument	Output	Communication	Operating Instructions	Description of Instrument Functions	Brief Operating Instructions (in the instrument)
FMR 530	A	HART	BA 206F/00/en	BA 217F/00/en	KA 161F/00/a2
FMR 531	A	HART	BA 207F/00/en	BA 217F/00/en	KA 161F/00/a2
FMR 532	A	HART	BA 208F/00/en	BA 217F/00/en	KA 161F/00/a2
FMR 533	A	HART	BA 209F/00/en	BA 217F/00/en	KA 161F/00/a2

Certificates

Correlation of safety instructions (XA) and certificates (ZE) to the instrument:

Instrument	Certificate	Explosion protection	Output	Communication	PTB 00 ATEX	XA	WHG
FMR 530, FMR 531, FMR 532, FMR 533	1	ATEX II 1/2 G EEx ia IIC T6	A	HART	2067 X	XA 081 F-A	–
	6	ATEX II 1/2 G EEx ia IIC T6 + WHG	A	HART	2067 X	XA 081 F-A	ZE 243F/00/en

Correlation of Control Drawings (ZD) to the instrument:

Instrument	Certificate	Explosion protection	Output	Communication	ZD
FMR 530, FMR 531, FMR 532, FMR 533	S	FM IS	A	HART	ZD 065F/00
FMR 530, FMR 531, FMR 532, FMR 533	U	CSA IS	A	HART	ZD 073F/00

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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

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