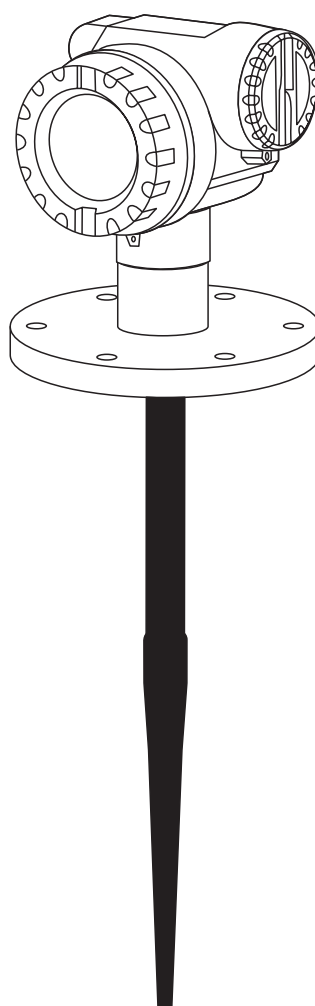
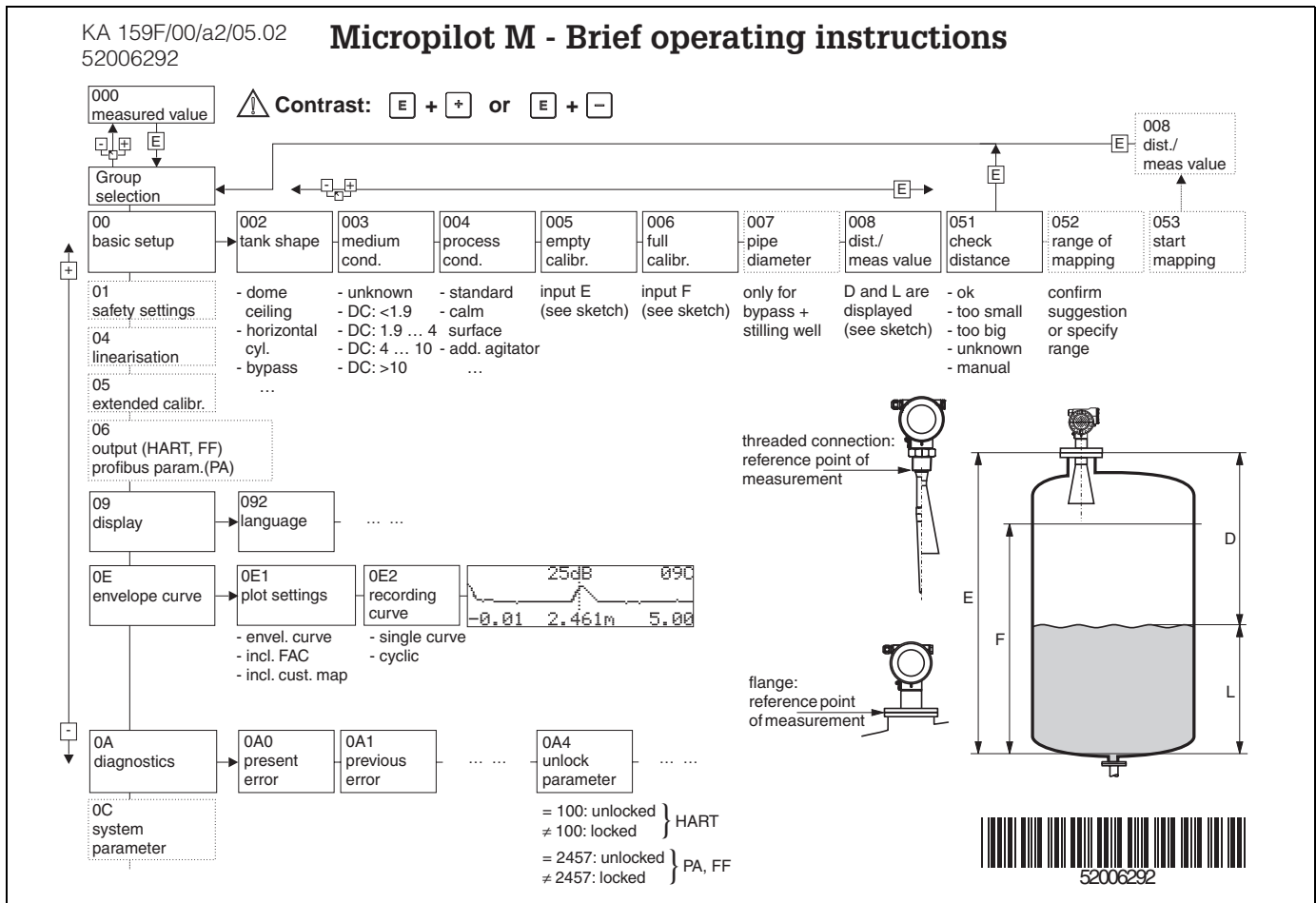


micropilot M **FMR 231** **HART/4...20 mA** **Level-Radar**

Operating Instructions



Brief operating instructions



Note!

This operating manual explains the installation and initial start-up for the level transmitter. All functions that are required for a typical measuring task are taken into account here. In addition, the Micropilot M provides many other functions that are not included in this operating manual, such as optimising the measuring point and converting the measured values.

An **overview of all device functions** can be found on Page 82.

The operating manual BA 221F/00/en "Description of the instrument functions for Micropilot M" provides an **extensive description of all device functions**, which can be found on the enclosed CD-ROM.

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1 Safety instructions

1.1 Designated use

The Micropilot M FMR 231 is a compact radar level transmitter for the continuous, contactless measurement of liquids, pastes and sludge. The device can also be freely mounted outside closed metal vessels because of its operating frequency of about 6 GHz and a maximum radiated pulsed energy of 1mW (average power output 1 µW). Operation is completely harmless to humans and animals.

1.2 Installation, commissioning and operation

The Micropilot M has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect installation or calibration. For this reason, the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual.

1.3 Operational safety

1.3.1 Hazardous areas

Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.

1.3.2 FCC approval

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.









Caution!






Changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

1.4 Notes on safety conventions and symbols

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

Symbol	Meaning
	Warning! A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
	Caution! Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	Note! A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned

	Device certified for use in explosion hazardous area If the device has this symbol embossed on its name plate it can be installed in an explosion hazardous area
	Explosion hazardous area Symbol used in drawings to indicate explosion hazardous areas. – Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection
	Safe area (non-explosion hazardous area) Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. – Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas

	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	Grounded terminal A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	Protective grounding (earth) terminal A terminal which must be connected to earth ground prior to making any other connection to the equipment
	Equipotential connection (earth bonding) A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice

Ordering structure Micropilot M FMR 231 (continued)

20		Type of antenna, O-ring, inactive length				
		Type	Length	Material	O-ring	Nozzle length
	A	Rod antenna	360 mm / 14"	PPS, antistatic	Viton	100 mm / 4"
	B	Stabantenne	510 mm / 20"	PPS, antistatic	Viton	250 mm / 10"
	E	Stabantenne	390 mm / 15"	PTFE, fully insulated		100 mm / 4"
	F	Stabantenne	540 mm / 21"	PTFE, fully insulated		250 mm / 10"
	H	Stabantenne	390 mm / 15"	PPS, antistatic + fully insulated		100 mm / 4"
	J	Stabantenne	540 mm / 21"	PPS, antistatic + fully insulated		250 mm / 10"
	Y	Special version				
30		Process connection, material				
		Threaded connection		Standard	Material	
	GGJ	1½" BSPT (R 1½")		DIN 2999	316L	
	GGS	1½" BSPT (R 1½")		DIN 2999	PVDF	
	GNJ	NPT 1½"			316L	
	GNS	NPT 1½"			PVDF	
		Sanitary coupling		Standard	Material	
	MFJ	DN50 dairy coupling		DIN 11851	316L	
	HFJ	DN50 aseptic		DIN 11864-1 Form A	316L	
		for tubes according to DIN 11850				
	TEJ	2" Tri-clamp		ISO 2852	316L	
	TLJ	3" Tri-clamp		ISO 2852	316L	
		Flange Dia/Pressure		Standard	Material	
	BFJ	DN50 PN16		EN 1092-1, A ¹⁾	316L	
	CFJ	DN50 PN16		EN 1092-1, B1 ¹⁾	316L	
	CFK	DN50 PN16		EN 1092-1 ¹⁾	PTFE >316L	
	BMJ	DN80 PN16		EN 1092-1, A ¹⁾	316L	
	CMJ	DN80 PN16		EN 1092-1, B1 ¹⁾	316L	
	BNJ	DN80 PN40		EN 1092-1, A ¹⁾	316L	
	CNJ	DN80 PN40		EN 1092-1, B1 ¹⁾	316L	
	CMK	DN80 PN16		EN 1092-1 ¹⁾	PTFE >316L	
	BQJ	DN100 PN16		EN 1092-1, A ¹⁾	316L	
	CQJ	DN100 PN16		EN 1092-1, B1 ¹⁾	316L	
	CQK	DN100 PN16		EN 1092-1 ¹⁾	PTFE >316L	
	BWJ	DN150 PN16		EN 1092-1, A ¹⁾	316L	
	CWJ	DN150 PN16		EN 1092-1, B1 ¹⁾	316L	
	CWK	DN150 PN16		EN 1092-1 ¹⁾	PTFE (black) >316L	
		disc made of antistatic PTFE (black)				
	AEJ	2"/150 lbs		ANSI B16.5	316L	
	AEK	2"/150 lbs		ANSI B16.5	PTFE >316L	
	ALJ	3"/150 lbs		ANSI B16.5	316L	
	AMJ	3"/300 lbs		ANSI B16.5	316L	
	ALK	3"/150 lbs		ANSI B16.5	PTFE >316L	
	APJ	4"/150 lbs		ANSI B16.5	316L	
	AQJ	4"/300 lbs		ANSI B16.5	316L	
	APK	4"/150 lbs		ANSI B16.5	PTFE >316L	
	AVJ	6"/150 lbs		ANSI B16.5	316L	
	AVK	6"/150 lbs		ANSI B16.5	PTFE (black) >316L	
		disc made of antistatic PTFE (black)				
	KEJ	10 K 50A		JIS B2210	316L	
	KEK	10 K 50A		JIS B2210	PTFE >316L	
	KLJ	10 K 80A		JIS B2210	316L	
	KLK	10 K 80A		JIS B2210	PTFE >316L	
	KPJ	10 K 100A		JIS B2210	316L	
	KPK	10 K 100A		JIS B2210	PTFE >316L	
	KVJ	10 K 150A		JIS B2210	316L	
	KVK	10 K 150A		JIS B2210	PTFE (black) >316L	
		disc made of antistatic PTFE (black)				
	YY9	Special version				
					1) agreeable to DIN 2527	
FMR 231-					Product designation (part 1)	

Ordering structure Micropilot M FMR 231 (continued)

40							Output and menu based operation
							A 4...20 mA HART with VU 331 (4-line alphanumeric display)
							B 4...20 mA HART
							K 4...20 mA HART, prepared for FHX40, mounting of remote display (accessoty)
							C PROFIBUS PA with VU 331 (4-line alphanumeric display)
							D PROFIBUS PA
							L PROFIBUS PA, prepared for FHX40, mounting of remote display (accessoty)
							E Foundation Fieldbus with VU 331 (4-line alphanumeric display)
							F Foundation Fieldbus
							M Foundation Fieldbus, prepared for FHX40, mounting of remote display (accessoty)
							Y Special version
50							Housing
							A Aluminium F12-housing, coated, IP65
							B 316L F23-housing, IP65/NEMA 4x
							C Aluminium T12-housing with separate connection compartment, coated, IP65
							D Aluminium T12-housing with separate connection compartment, coated, IP65, overvoltage protection
							Y Special version
60							Gland / Entry
							2 M20x1.5 cable gland (for EEx d: cable entry)
							3 G ½ cable entry
							4 ½ NPT cable entry
							5 PROFIBUS PA M12 plug
							6 7/8" FF plug
							9 Special version
70							Gastight feed through
							A without gastight feed through
							C with gastight feed through
80							Additional options
							A Additional options not selected
							B 3.1.B material, wetted parts 316L, Inspection Certificate EN 10204, acc. specification 52005759
							S GL (German Lloyd) marine certificate
							Y Special version
FMR 231-							Complete product designation

2.2 Scope of delivery



Caution!

It is essential to follow the instructions concerning the unpacking, transport and storage of measuring instruments given in the chapter "Incoming acceptance, transport, storage" on Page 11!

The scope of delivery consists of:

- Assembled instrument
- 2 ToF Tool - FieldTool® Package CD-ROMs
 - CD 1: ToF Tool - FieldTool® Program
Program including Device Descriptions (device drivers) and documentation for all Endress+Hauser devices which are operable using ToF Tool
 - CD 2: ToF Tool - FieldTool® Utilities
Utility program (e.g. Adobe Acrobat Reader, MS Internet Explorer)
- Accessories (→ Chap. 8)

Accompanying documentation:

- Short manual (basic setup/troubleshooting): housed in the instrument
- Operating manual (this manual)
- Approval documentation: if this is not included in the operating manual.



Note!

The operating manual "Description of Instrument Functions" you can be found on the enclosed CR-ROM.

2.3 Certificates and approvals

CE mark, declaration of conformity

The instrument is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The instrument complies with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". The instrument described in this manual thus complies with the statutory requirements of the EG directives. Endress+Hauser confirms the successful testing of the instrument by affixing to it the CE mark.

2.4 Registered trademarks

KALREZ®, VITON®, TEFLON®

Registered trademark of the company, E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®

Registered trademark of the company, Ladish & Co., Inc., Kenosha, USA

HART®

Registered trademark of HART Communication Foundation, Austin, USA

ToF®

Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

PulseMaster®

Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

PhaseMaster®

Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

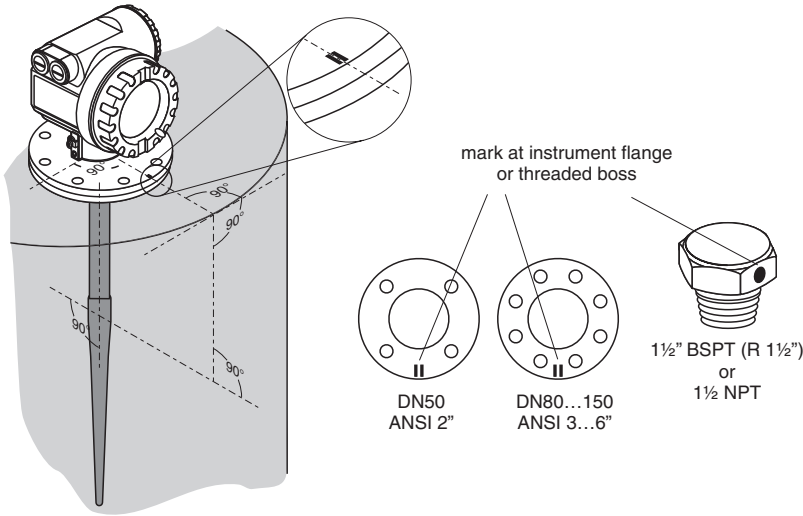
3 Mounting

3.1 Quick installation guide



Observe orientation when installing!

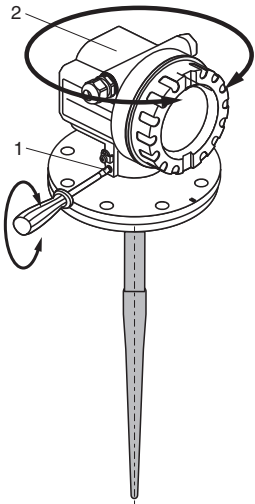
Installation in tank (free space):
Mark on process connector facing the nearest tank wall!



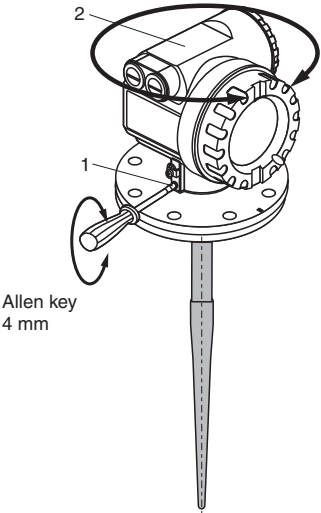
Turn housing

The housing can be turned 350°
in order to simplify access to the
display and the terminal compartment

F12/F23 housing



T12 housing



3.2 Incoming acceptance, transport, storage

3.2.1 Incoming acceptance

Check the packing and contents for any signs of damage.

Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.2.2 Transport



Caution!

Follow the safety instructions and transport conditions for instruments of more than 18 kg.

Do not lift the measuring instrument by its housing in order to transport it.

3.2.3 Storage

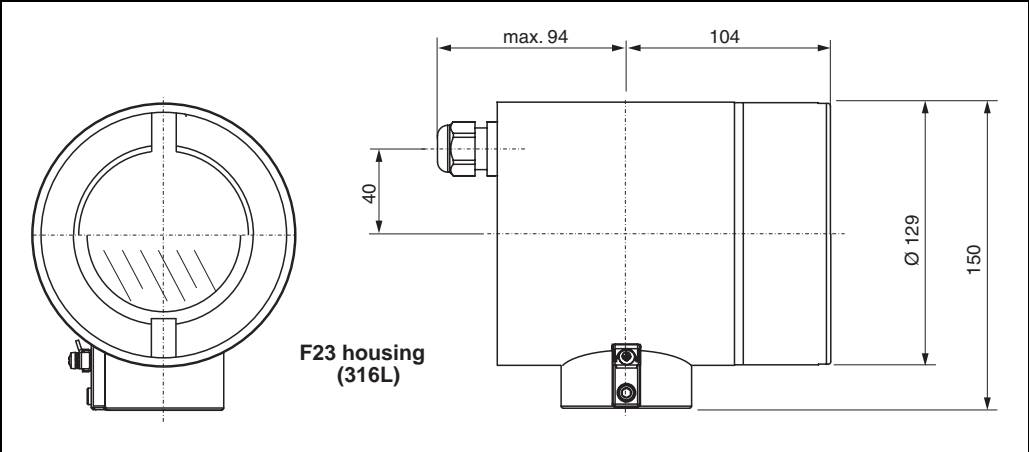
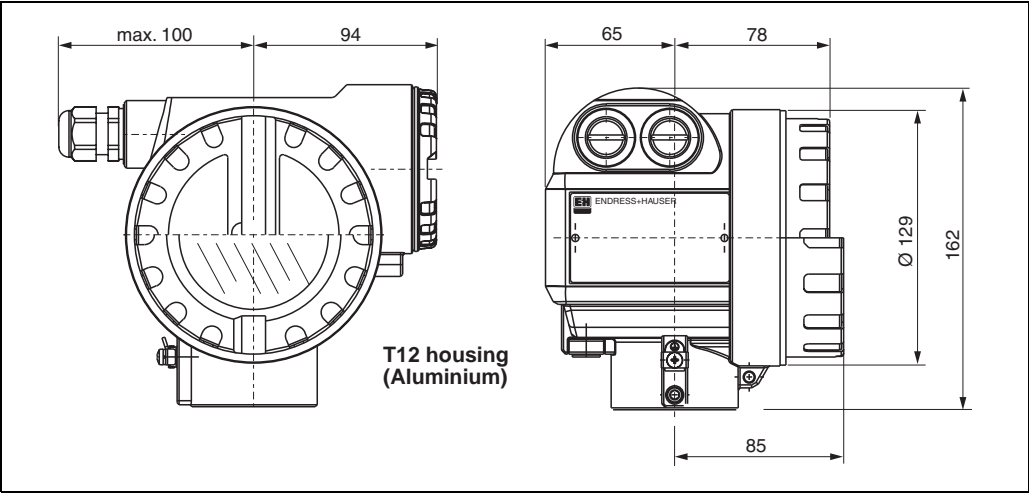
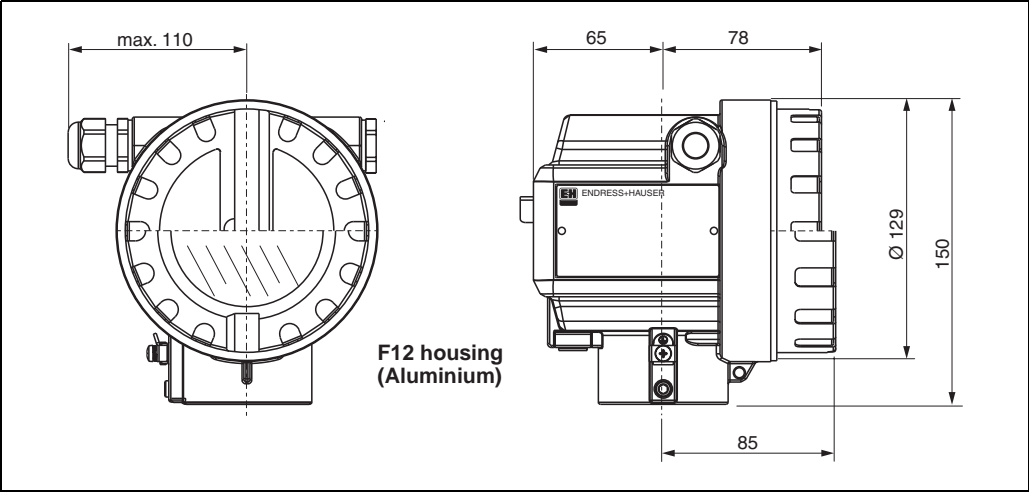
Pack the measuring instrument so that is protected against impacts for storage and transport. The original packing material provides the optimum protection for this.

The permissible storage temperature is -40 °C...+80 °C.

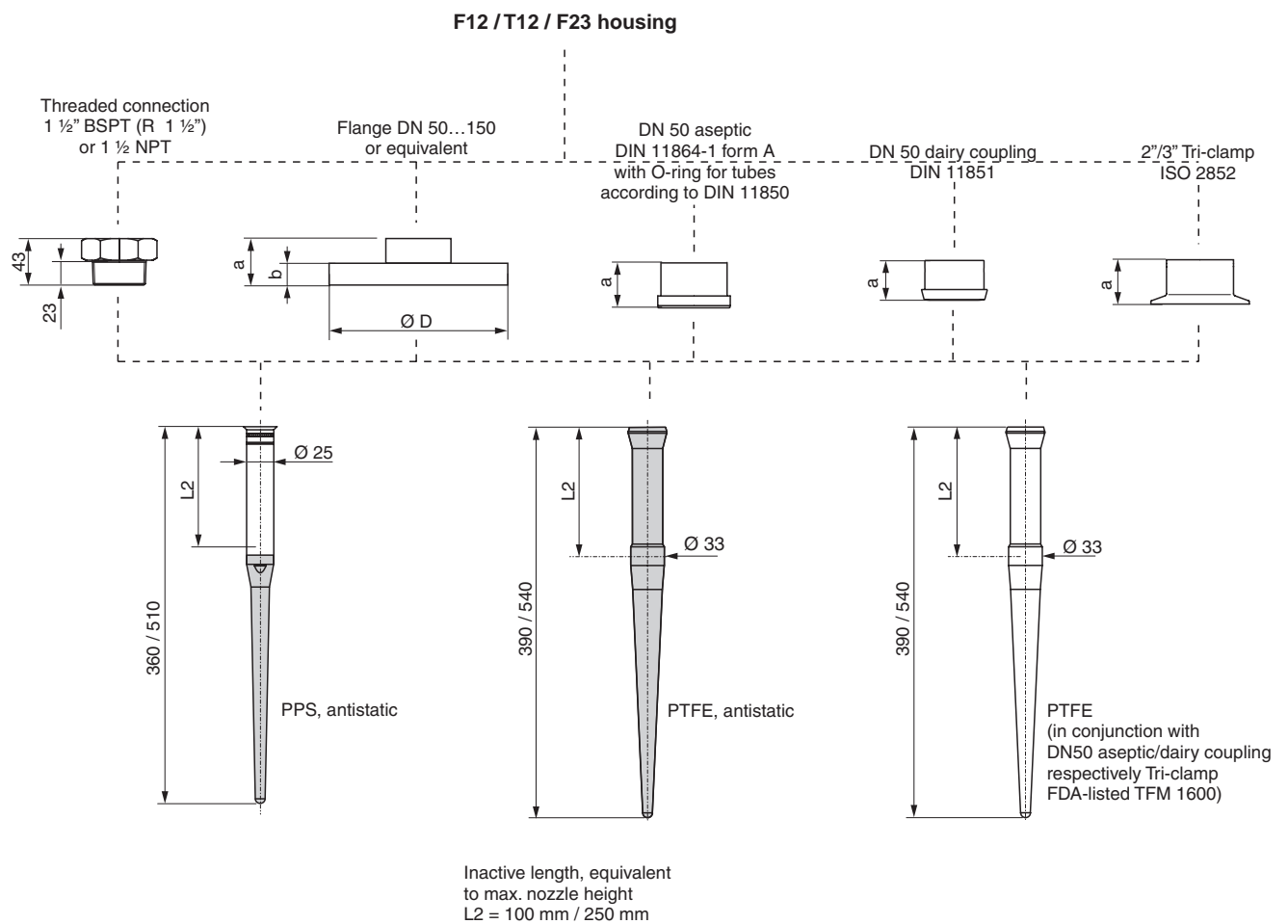
3.3 Installation conditions

3.3.1 Dimensions

Housing dimensions



Micropilot M FMR 231 - process connection, type of antenna

**Flange to EN 1092-1 (agreeable to DIN 2527)**

Flange	DN 50	DN 80	DN 100	DN 150
b [mm]	18	20 (24)	20	22
D [mm]	165	200 (200)	220	285

for PN 16 (for PN 40)

Flange to ANSI B16.5

Flange	2"	3"	4"	6"
b [mm]	19.1	23.9 (28.4)	23.9 (31.8)	25.4
D [mm]	152.4	190.5 (209.5)	228.6 (254)	279.4

for 150 lbs (for 300 lbs)

Flange to JIS B2210

Flange	DN 50	DN 80	DN 100	DN 150
b [mm]	16	18	18	22
D [mm]	155	185	210	280

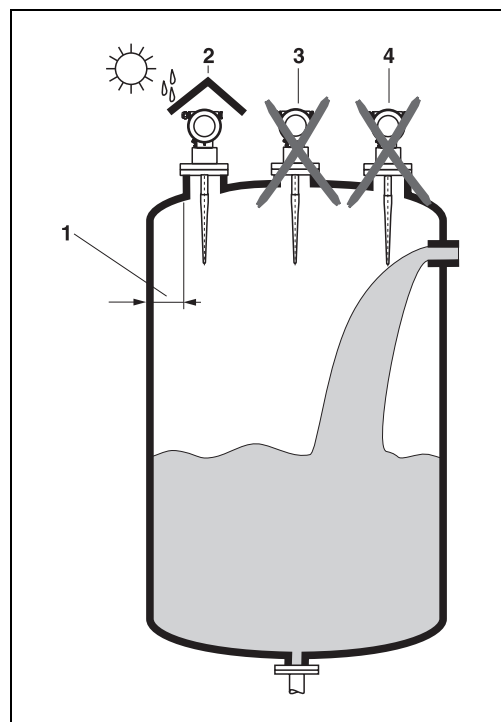
for 10K

Process connection	Flange DN 50...150	DN 50 aseptic coupling	DN 50 dairy coupling	2"/3" Tri-clamp
a [mm] without gastight feedthrough	41	44.5	41	41
a [mm] with gastight feedthrough	77	80.5	77	77

3.3.2 Engineering hints

Orientation

- Recommended distance (1) wall – **outer edge** of nozzle: $\sim 1/6$ of tank diameter. Nevertheless the device should not be installed closer than 30 cm (12") to the tank wall.
- Not in the centre (3), interference can cause signal loss.
- Not above the fill stream (4).
- It is recommended to use a weather protection cover (2) in order to protect the transmitter from direct sun or rain. Assembly and disassembly is simply done by means of a tension clamp (\rightarrow Chap. 8 on Page 59).



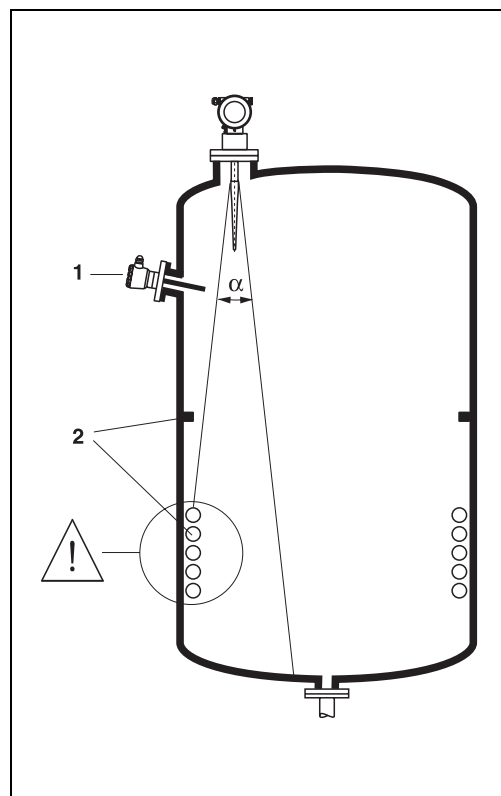
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Tank installations

- Avoid any installations (1), like limit switches, temperature sensors, etc., inside the signal beam (refer to beam angle see "Beam angle" on Page 15).
- 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 "optimum mounting position" (see Page 18).
- Stilling well: a stilling well respectively a Wave Guide antenna can always be used to avoid interference.



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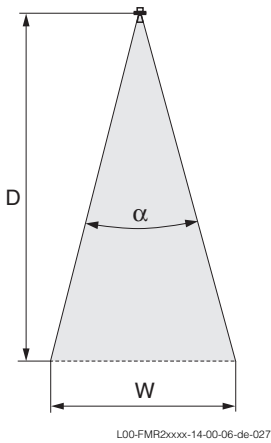
Please contact Endress+Hauser for further information.

Beam angle

The beam angle is defined as the angle α where the energy density of the radar waves reaches half the value of the maximum energy density (3dB-width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations. Beam diameter **W** as function of antenna type (beam angle α) and measuring distance **D**:

Antenna	FMR 231 Rod
Beam angle α	30°

Measuring distance (D)	Beam diameter (W) Rod
3 m / 10 ft	1,61 m / 5.36 ft
6 m / 20 ft	3,22 m / 10.72 ft
9 m / 30 ft	4,83 m / 16.08 ft
12 m / 40 ft	6,43 m / 21.44 ft
15 m / 49 ft	8,04 m / 26.26 ft
20 m / 65 ft	10,72 m / 34.83.ft



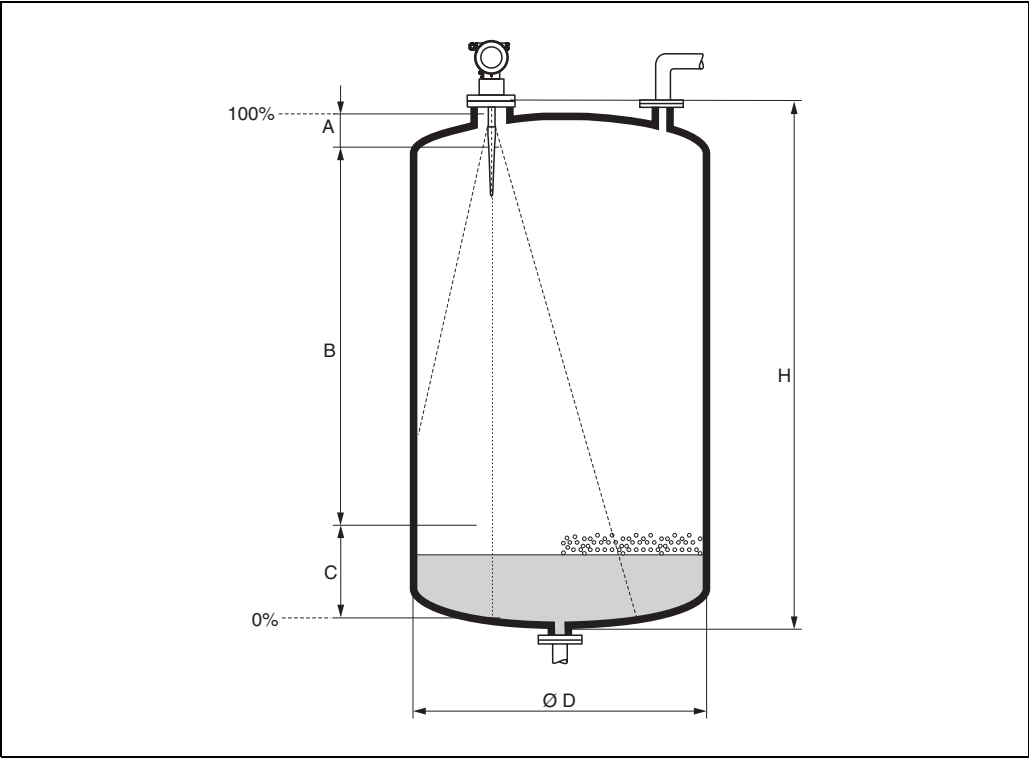
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Measuring conditions



Note!
Please use FMR 230 in stilling well for the measurement of ammonia NH₃.

- The measuring range begins, where the beam hits the tank bottom. Particularly with dish bottoms or conical outlets the level cannot be detected below this point.
- 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 (see Fig.).
- In principle it is possible to measure up to the tip of the antenna with FMR 230/231/240. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than **A** (see Fig.) to the tip of the antenna.
- The smallest possible measuring range **B** depends on the antenna version (see Fig.).
- The tank diameter should be greater than **D** (see Fig.), the tank height at least **H** (see Fig.).
- Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions.



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	A [mm/inch]	B [m/inch]	C [mm/inch]	D [m/inch]	H [m/ft]
FMR 231	50 / 2	> 0.5 / > 20	150...300/6...12	> 1 / > 40	> 1,5 / > 5

Measuring range

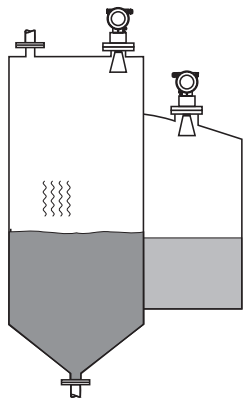
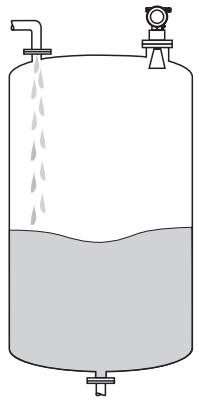
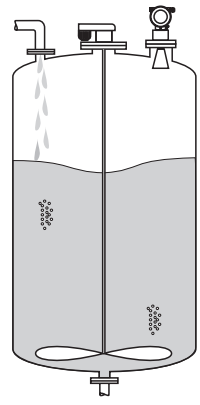
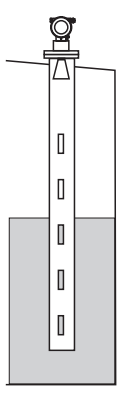

The usable measuring range depends on the size of the antenna, the reflectivity of the medium, the mounting location and eventual interference reflections. The maximum configurable range is 20 m (65 ft) for all Micropilot M (larger ranges up to 35 m (114 ft) on request).

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

Product class	DK (ϵ_r)	Examples
A	1,4...1,9	non-conducting liquids, e.g. liquefied gas ¹⁾
B	1,9...4	non-conducting liquids, e.g. benzene, oil, toluene, ...
C	4...10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ...
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

1) Treat Ammonia NH₃ as a medium of group A, i.e. use FMR 230 in a stilling well.

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

Product class	Storage tank Calm product surface (e.g. intermittent filling, filling from bottom, immersion tubes).	Buffer tank Moving surfaces (e.g. continuous filling, from above, mixing jets).	Process tank with agitator Turbulent surface. Single stage agitator <60 RPM.	Stilling well	Bypass
					
	Measuring range	Measuring range	Measuring range	Measuring range	Measuring range
FMR 231:	Rod antenna	Rod antenna	Rod antenna	Rod antenna	Rod antenna
A DK(ϵ_r)=1,4...1,9	to use a stilling well (20 m / 67 ft) or Wave Guide antenna ¹ (3.8 m / 12.5 ft)			Use FMR 230, FMR 240, FMR 244 resp. FMR 245	Use FMR 230, FMR 240, FMR 244 resp. FMR 245
B DK(ϵ_r)=1,9...4	10 m	5 m	4 m		
C DK(ϵ_r)=4...10	15 m	7,5 m	6 m		
D DK(ϵ_r)>10	20 m	10 m	8 m		

1) In the event of horizontal stress, mechanical support is required or provide the Wave Guide antenna with a protective pipe.

3.4 Installation instructions

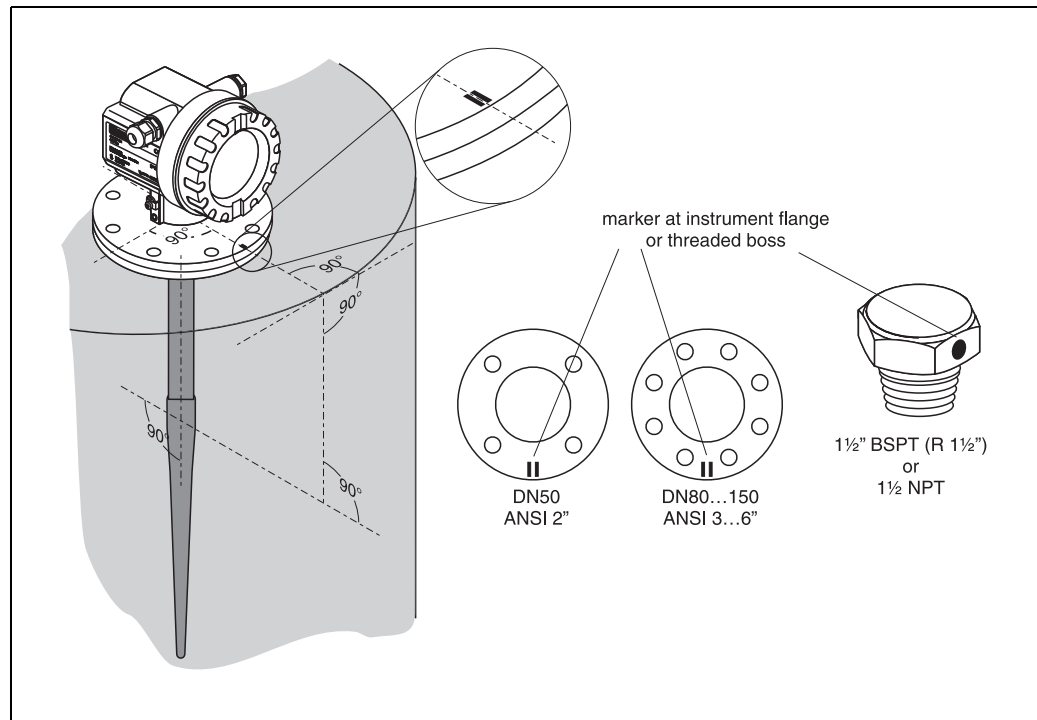
3.4.1 Mounting kit

In addition to the tool needed for flange mounting, you will require the following tool:

- 4 mm/0.1" Allen wrench for turning the housing.

3.4.2 Installation in tank (free space)

Optimum mounting position

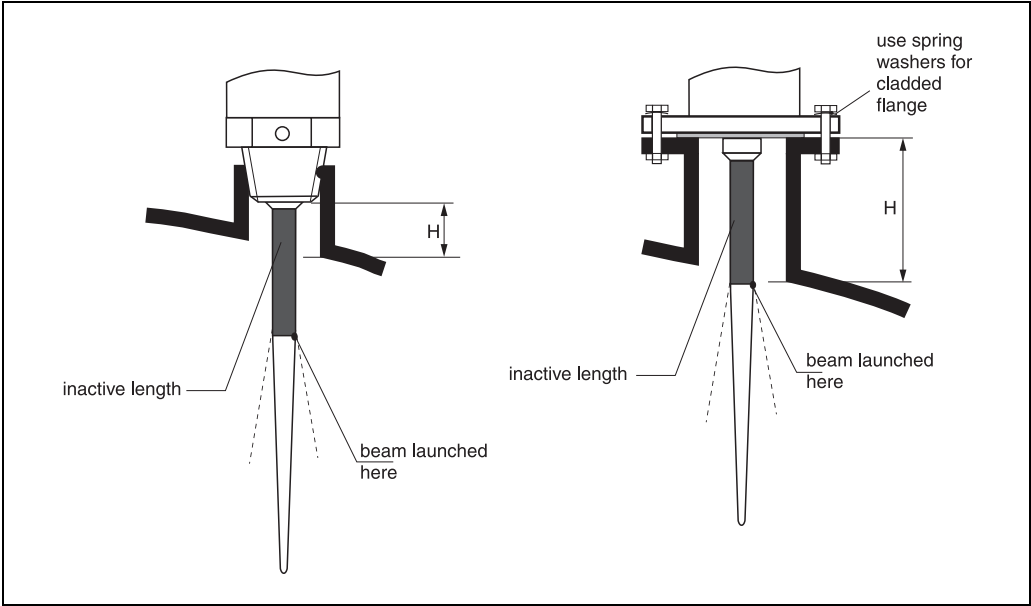


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Standard installation

For installations in a stilling well, follow the engineering hints on Page 14 and note the following points:

- 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 350° in order to simplify access to the display and the terminal compartment.
- The inactive part of the rod antenna must extend below the nozzle.
- The rod antenna must be aligned vertically.



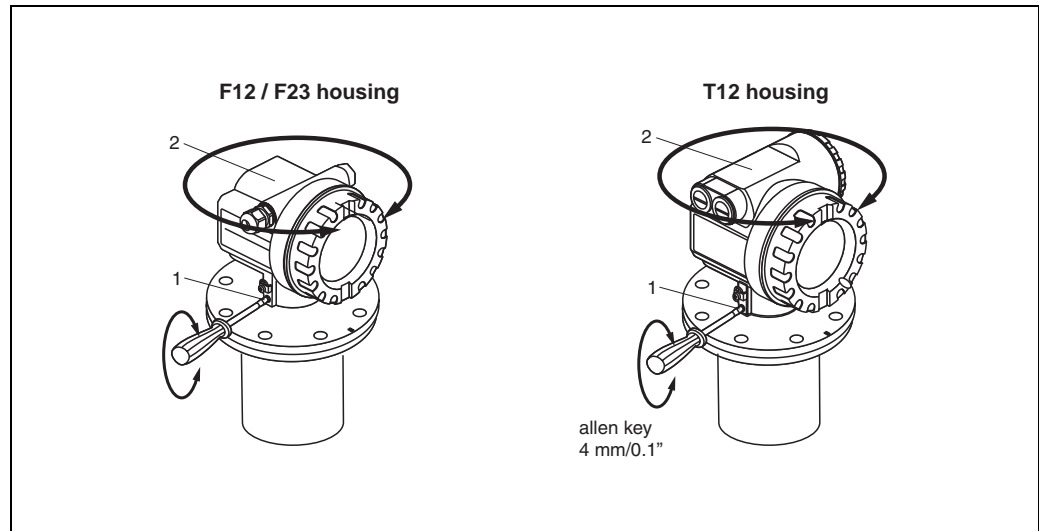
L00-FMR231xx-17-00-00-en-002

Material	PPS		PTFE	
Antenna length [mm / inch]	360 / 14	510 / 20	390 / 15	540 / 21
H [mm/inch]	< 100 / < 4	< 250 / < 10	< 100 / < 4	< 250 / < 10

3.4.3 Turn housing

After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment. Proceed as follows to turn the housing to the required position:

- Undo the fixing screws (1)
- Turn the housing (2) in the required direction
- Tighten up the fixing screws (1)



3.5 Post-installation check

After the measuring instrument has been installed, perform the following checks:

- Is the measuring instrument damaged (visual check)?
- Does the measuring instrument correspond to the measuring point specifications such as process temperature/pressure, ambient temperature, measuring range, etc.?
- Is the flange marking correctly aligned? (→ Page 10)
- Have the flange screws been tightened up with the respective tightening torque?
- Are the measuring point number and labeling correct (visual check)?
- Is the measuring instrument adequately protected against rain and direct sunlight (→ Page 59)?

4 Wiring

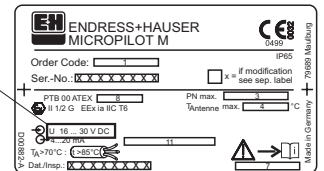
4.1 Quick wiring guide

Wiring in F12/F23 housing



Before connection please note the following:

- The power supply must be identical to the data on the nameplate (1).
- Switch off power supply before connecting up the device.
- Connect Equipotential bonding to transmitter ground terminal before connecting up the device.
- Tighten the locking screw:
It forms the connection between the antenna and the housing ground potential.



When you use the measuring system in hazardous areas, make sure you comply with national standards and the specifications in the safety instructions (XA's). Make sure you use the specific cable gland.

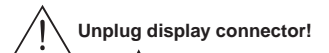
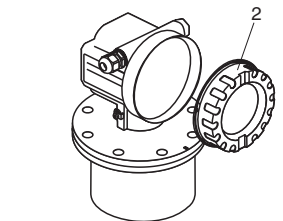


On devices supplied with a certificate, the explosion protection is designed as follows:

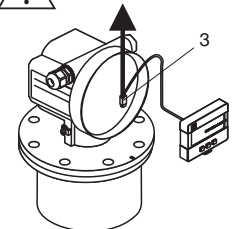
- Housing F12/F23 - EEx ia:
Power supply must be intrinsically safe.
- The electronics and the current output are galvanically separated from the antenna circuit.

Connect up the Micropilot M as follows:

- Unscrew housing cover (2).
- Remove any display (3) if fitted.
- Remove cover plate from terminal compartment (4).
- Pull out terminal module slightly using pulling loop.
- Insert cable (5) through gland (6).
A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).

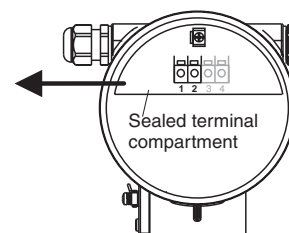
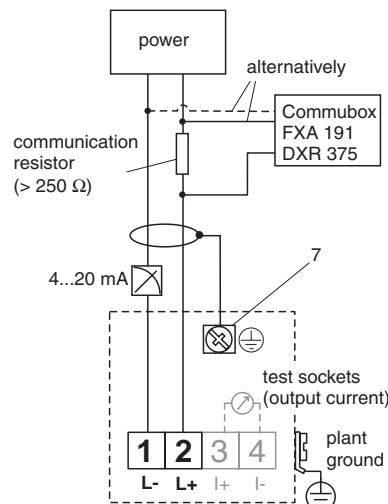
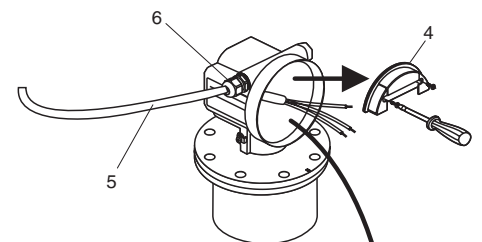


Unplug display connector!



Only ground screening of the line (7) on sensor side.

- Make connection (see pin assignment).
- Re-insert terminal module.
- Tighten cable gland (6).
- Tighten screws on cover plate (4).
- Insert display if fitted.
- Screw on housing cover (2).
- Switch on power supply.

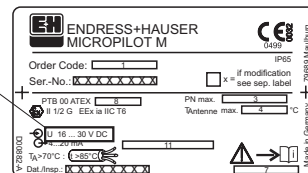


Wiring in T12 housing

**Caution!**

Before connection please note the following:

- The power supply must be identical to the data on the nameplate (1).
- Switch off power supply before connecting up the device.
- Connect Equipotential bonding to transmitter ground terminal before connecting up the device.
- Tighten the locking screw:
It forms the connection between the antenna and the housing ground potential.



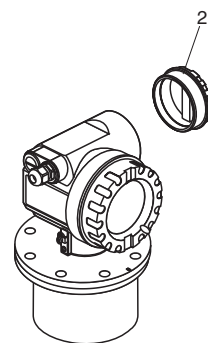
When you use the measuring system in hazardous areas, make sure you comply with national standards and the specifications in the safety instructions (XA's). Make sure you use the specific cable gland.



Connect up the Micropilot M as follows:

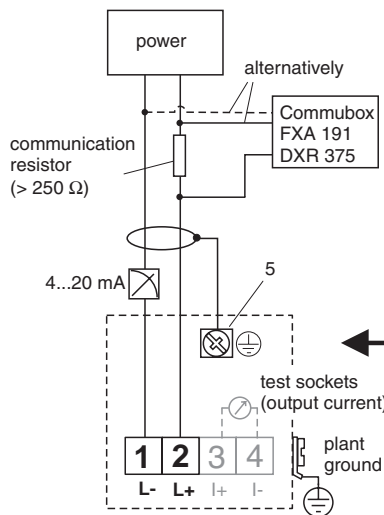
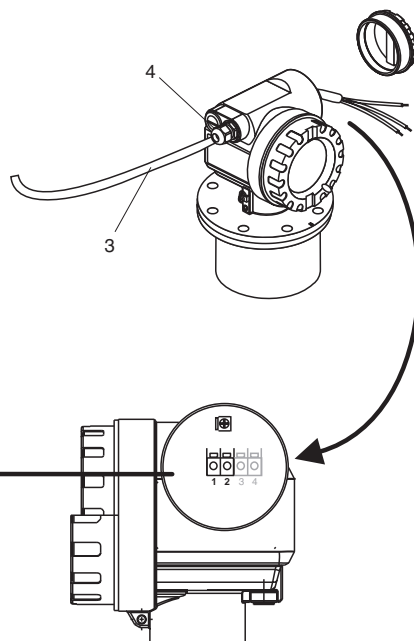
Before unscrew housing cover (2) at separate connection room turn off the power supply!

- Insert cable (3) through gland (4).
- A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).



Only ground screening of the line (5) on sensor side.

- Make connection (see pin assignment).
- Tighten cable gland (4).
- Screw on housing cover (2).
- Switch on power supply.



L00-FMR2xxxx-04-00-00-en-014

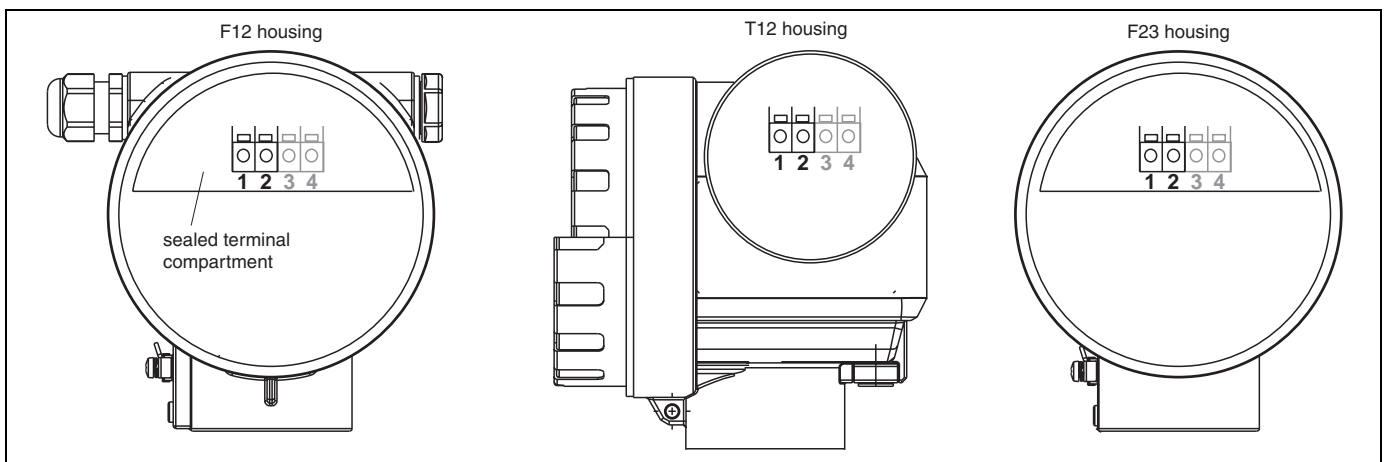
4.2 Connecting the measuring unit

Terminal compartment

Three housings are available:

- Aluminium housing F12 with additionally sealed terminal compartment for:
 - standard,
 - EEx ia.
- Aluminium housing T12 with separate terminal compartment for:
 - standard,
 - EEx e,
 - EEx d,
 - EEx ia (with overvoltage protection).
- 316L housing F23 for:
 - standard,
 - EEx ia.

The electronics and current output are galvanically isolated from the antenna circuit.



L00-FMR2xxxx-04-00-00-en-019

The instrument data are given on the nameplate together with important information regarding the analog output and voltage supply. Housing orientation regarding the wiring, (→ Page 20).

Load HART

Minimum load for Hart communication: 250 Ω

Cable entry

Cable gland: M20x1.5

Cable entry: G ½ or ½ NPT

Supply voltage

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

Communication		Current consumption	Terminal voltage	
			minimal	maximal
HART	standard	4 mA	16 V	36 V
		20 mA	7.5 V	36 V
	EEx ia	4 mA	16 V	30 V
		20 mA	7.5 V	30 V
	EEx em EEx d	4 mA	16 V	30 V
		20 mA	11 V	30 V
Fixed current, adjustable e.g. for solar power operation (measured value transferred at HART)	standard	11 mA	10 V	36 V
	EEx ia	11 mA	10 V	30 V
Fixed current for HART Multidrop mode	standard	4 mA ¹⁾	16 V	36 V
	EEx ia	4 mA ¹⁾	16 V	30 V

1) Start up current 11 mA.

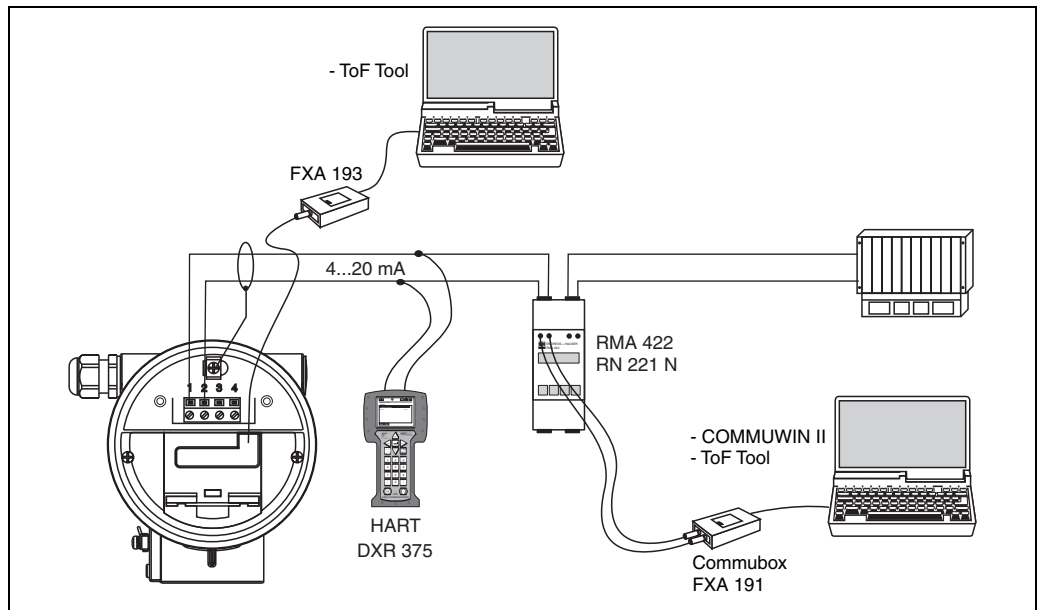
Power consumption

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

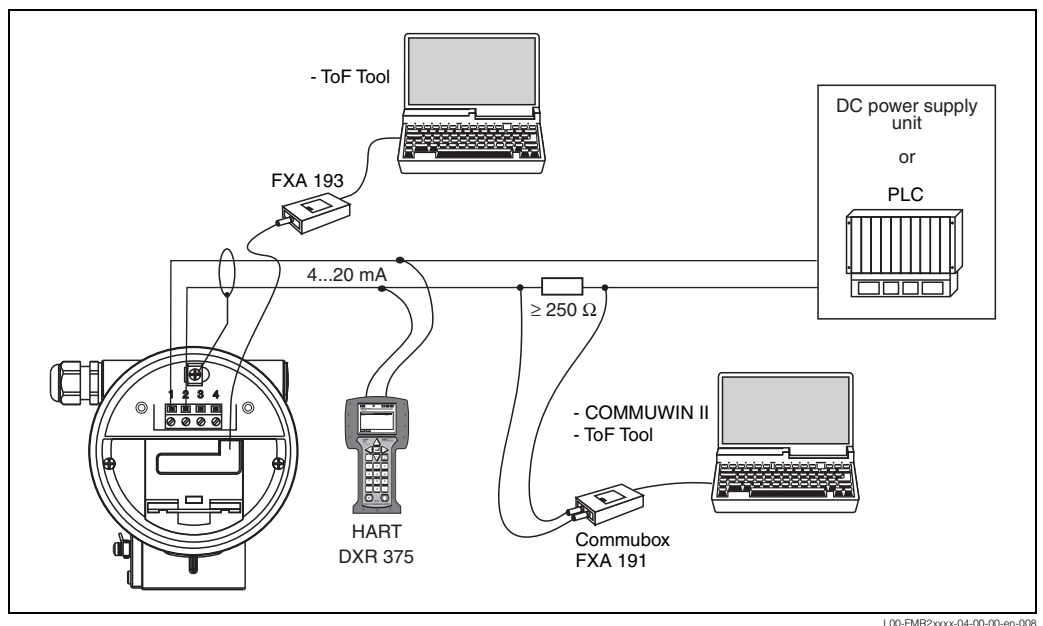
Current consumption

Communication	Current consumption
HART	3.6...22 mA

4.2.1 HART connection with E+H RMA 422 / RN 221 N



4.2.2 HART connection with other supplies



Caution!

If the HART communication resistor is not built into the supply unit, it is necessary to insert a communication resistor of $250\ \Omega$ into the 2-wire line.

4.3 Recommended connection

4.3.1 Equipotential bonding

Connect the equipotential bonding to the external ground terminal of the transmitter.

4.3.2 Wiring screened cable



Caution!

In Ex applications, the screen must only be grounded on the sensor side. Further safety instructions are given in the separate documentation for applications in explosion hazardous areas.

4.4 Degree of protection

- housing: IP 65, NEMA 4X (open housing and pulled out display: IP20, NEMA 1)
- antenna: IP 68 (NEMA 6P)

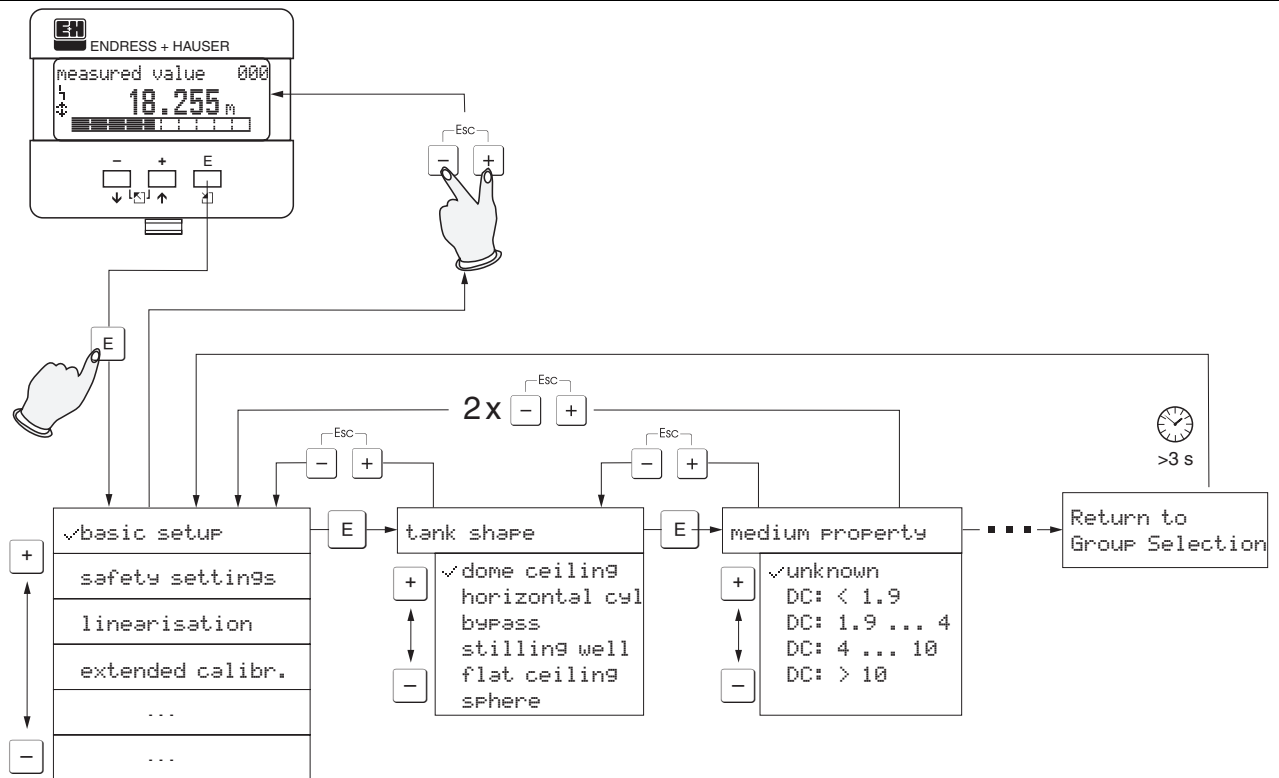
4.5 Post-connection check

After wiring the measuring instrument, perform the following checks:

- Is the terminal allocation correct (→ Page 21 and Page 22)?
- Is the cable gland tight?
- Is the housing cover screwed tight?
- If auxiliary power is available:
Is the instrument ready for operation and does the liquid crystal display show any value?

5 Operation

5.1 Quick operation guide



Selection and configuration in Operation menu:

- 1.) Change from Measured Value Display to **Group Selection** by pressing **E**
- 2.) Press **-** or **+** to select the required **Function Group** (e.g. "basic setup (00)") and confirm by pressing **E** → **First function** (e.g. "tank shape (002)") is selected.

Note!

The active selection is marked by a ✓ in front of the menu text.

- 3.) Activate Edit mode with **+** or **-**.

Selection menus:

- a) Select the required **Parameter** in selected **function** (e.g. "tank shape (002)") with **-** or **+**.
- b) **E** confirms selection → ✓ appears in front of the selected parameter
- c) **E** confirms the edited value → system quits Edit mode
- d) **+** + **-** (= **Esc**) interrupts selection → system quits Edit mode

Typing in numerals and text:

- a) Press **+** or **-** to edit the first character of the **numeral / text** (e.g. "empty calibr. (005)")
- b) **E** positions the cursor at the next character → continue with (a) until you have completed your input
- c) if a **⌫** symbol appears at the cursor, press **E** to accept the value entered → system quits Edit mode
- d) **+** + **-** (= **Esc**) interrupts the input, system quits Edit mode
- 4) Press **E** to select the next **function** (e.g. "medium property (003)")
- 5) Press **+** + **-** (= **Esc**) once → return to previous **function** (e.g. "tank shape (002)")
Press **+** + **-** (= **Esc**) twice → return to **Group selection**
- 6) Press **+** + **-** (= **Esc**) to return to **Measured value display**

5.1.1 General structure of the operating menu

The operating menu is made up of two levels:

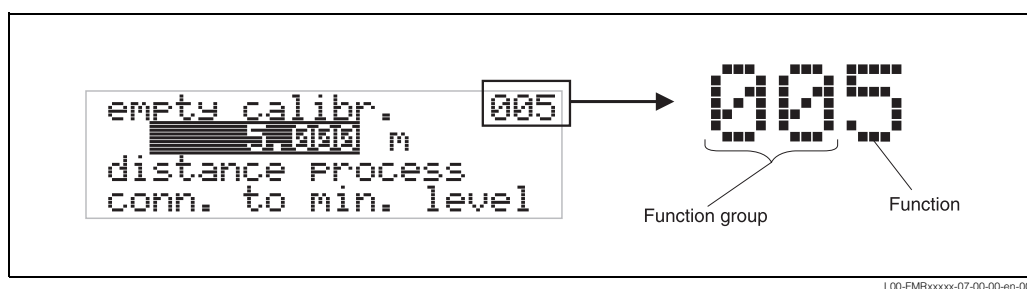
- **Function groups (00, 01, 03, ..., 0C, 0D):** The individual operating options of the instrument are split up roughly into different function groups. The function groups that are available include, e.g.: "**basic setup**", "**safety settings**", "**output**", "**display**", etc.
- **Functions (001, 002, 003, ..., 0D8, 0D9):** Each function group consists of one or more functions. The functions perform the actual operation or parameterisation of the instrument. Numerical values can be entered here and parameters can be selected and saved. The available functions of the "**basic setup**" (00) function group include, e.g.: "**tank shape**" (002), "**medium property**" (003), "**process cond.**" (004), "**empty calibr.**" (005), etc.

If, for example, the application of the instrument is to be changed, carry out the following procedure:

1. Select the "**basic setup**" (00) function group.
2. Select the "**tank shape**" (002) function (where the existing tank shape is selected).

5.1.2 Identifying the functions

For simple orientation within the function menus (see Page 82 ff.), for each function a position is shown on the display.



The first two digits identify the function group:

- **basic setup** 00
- **safety settings** 01
- **linearisation** 04

...

The third digit numbers the individual functions within the function group:

- **basic setup** 00 → • **tank shape** 002
- **medium property** 003
- **process cond.** 004

...

Hereafter the position is always given in brackets (e.g. "**tank shape**" (002)) after the described function.

5.2 Display and operating elements

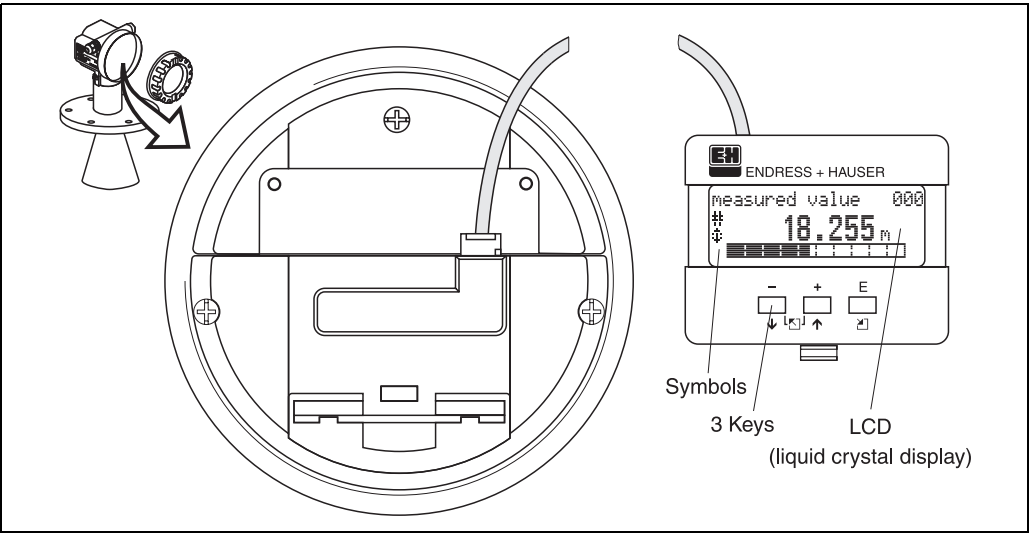


Fig. 2: Layout of the display and operating elements



Note!
To access the display the cover of the electronic compartment may be removed even in hazardous area (IS and XP).

5.2.1 Display

Liquid crystal display (LCD):

Four lines with 20 characters each. Display contrast adjustable through key combination.

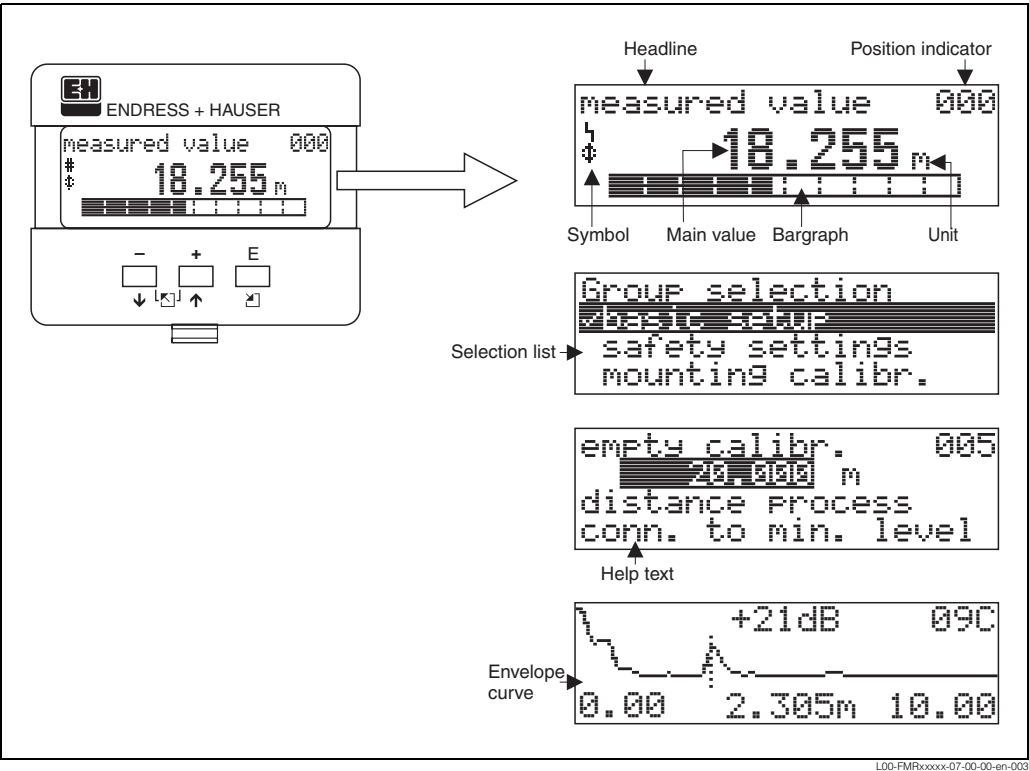





Fig. 3: Display

5.2.2 Display symbols















The following table describes the symbols that appear on the liquid crystal display:

Symbol	Meaning
	ALARM_SYMBOL This alarm symbol appears when the instrument is in an alarm state. If the symbol flashes, this indicates a warning.
	LOCK_SYMBOL This lock symbol appears when the instrument is locked, i.e. if no input is possible.
	COM_SYMBOL This communication symbol appears when a data transmission via e.g. HART, PROFIBUS-PA or Foundation Fieldbus is in progress.

5.2.3 Key assignment

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
 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
 or 	Navigate to the left within a function group
	Navigate to the right within a function group, confirmation.
 and  or  and 	Contrast settings of the LCD
 and  and 	Hardware lock / unlock After a hardware lock, an operation of the instrument via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

5.3 Local operation








5.3.1 Locking of the configuration mode

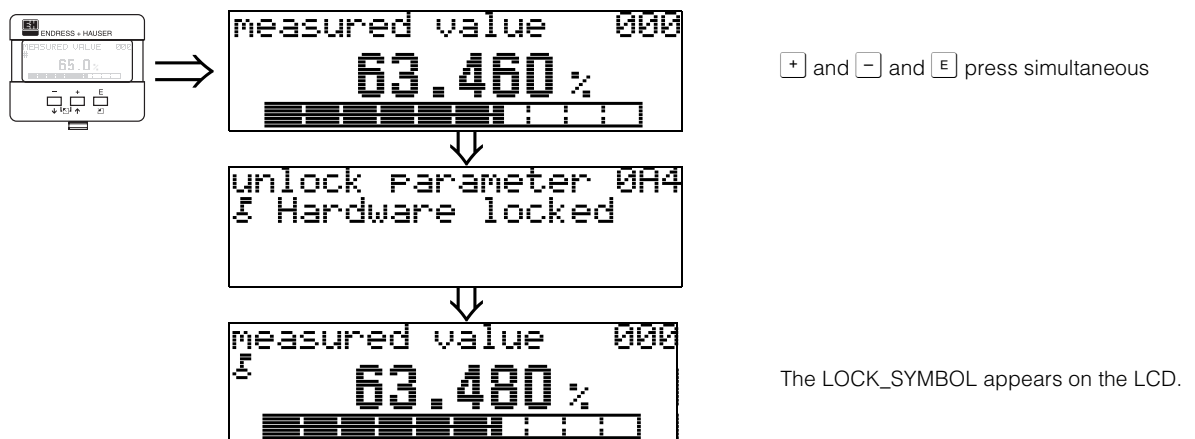
The Micropilot can be protected in two ways against unauthorised changing of instrument data, numerical values or factory settings:

"unlock parameter" (0A4):

A value $\neq 100$ (e.g. 99) must be entered in "unlock parameter" (0A4) in the "diagnostics" (0A) function group. The lock is shown on the display by the  symbol and can be released again either via the display or by communication.

Hardware lock:

The instrument is locked by pressing the  and  and  keys at the same time. The lock is shown on the display by the  symbol and can **only** be unlocked again via the display by pressing the ,  and  keys at the same time again. It is **not** possible to unlock the hardware by communication. All parameters can be displayed even if the instrument is locked.



5.3.2 Unlocking of configuration mode

If an attempt is made to change parameters on display when the instrument is locked, the user is automatically requested to unlock the instrument:

unlock parameter" (0A4):

By entering the unlock parameter (on the display or via communication)

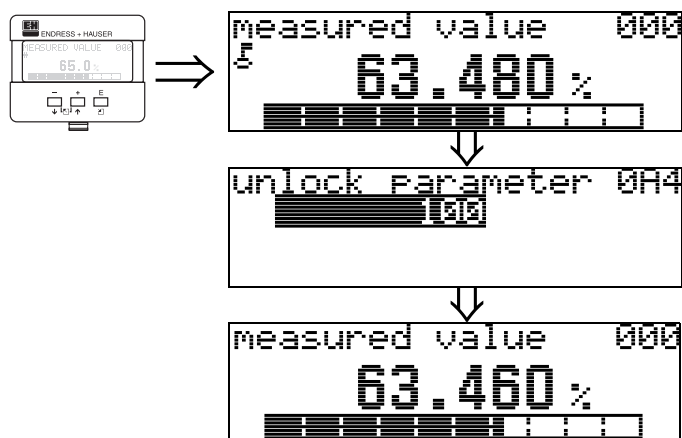
100 = for HART devices

the Micropilot is released for operation.

Hardware unlock:

After pressing the $\boxed{+}$ and $\boxed{-}$ and \boxed{E} keys at the same time, the user is asked to enter the unlock parameter

100 = for HART devices.



$\boxed{+}$ and $\boxed{-}$ and \boxed{E} press simultaneous

Please enter unlock code and confirm with \boxed{E} .



Caution!

Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the E+H service organization. Please contact Endress+Hauser if you have any questions.

5.3.3 Factory settings (Reset)



Caution!

A reset sets the instrument back to the factory settings. This can lead to an impairment of the measurement. Generally, you should perform a basic setup again following a reset.

A reset is only necessary:

- if the instrument no longer functions
- if the instrument must be moved from one measuring point to another
- if the instrument is being de-installed /put into storage/installed



User input ("reset" (0A3)):

- 333 = customer parameters

333 = reset customer parameters

This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application:

- The Micropilot is reset to the default values.
- The customer specific tank map is not deleted.
- A linearisation is switched to "**linear**" although the table values are retained. The table can be reactivated in the "**linearisation**" (04) function group.

List of functions that are affected by a reset:

- | | |
|-------------------------|--------------------------|
| • tank shape (002) | • diameter vessel (047) |
| • empty calibr. (005) | • range of mapping (052) |
| • full calibr. (006) | • pres. Map dist (054) |
| • pipe diameter (007) | • offset (057) |
| • output on alarm (010) | • low output limit (062) |
| • output on alarm (011) | • fixed current (063) |
| • outp. echo loss (012) | • fixed cur. value (064) |
| • ramp %span/min (013) | • simulation (065) |
| • delay time (014) | • simulation value (066) |
| • safety distance (015) | • 4mA value (068) |
| • in safety dist. (016) | • 20mA value (069) |
| • level/ullage (040) | • format display (094) |
| • linearisation (041) | • distance unit (0C5) |
| • customer unit (042) | • download mode (0C8) |

The tank map can also be reset in the "**mapping**" (055) function of the "**extended calibr.**" (05) function group.

This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application or if a faulty mapping was started:




- The tank map is deleted. The mapping must be recommenced.

5.4 Display and acknowledging error messages

Type of error

Errors that occur during commissioning or measuring are displayed immediately on the local display. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.



The measuring system distinguishes between two types of error:

- **A (Alarm):**
Instrument goes into a defined state (e.g. MAX 22 mA)
Indicated by a constant  symbol.
(For a description of the codes, see Page 62)
- **W (Warning):**
Instrument continue measuring, error message is displayed.
Indicated by a flashing  symbol.
(For a description of the codes, see Page 62)
- **E (Alarm / Warning):**
Configurable (e.g. loss of echo, level within the safety distance)
Indicated by a constant/flashing  symbol.
(For a description of the codes, see Page 62)



5.4.1 Error messages

Error messages appear as four lines of plain text on the display. In addition, a unique error code is also output. A description of the error codes is given on Page 62.

- The "**diagnostics**" (**0A**) function group can display current errors as well as the last errors that occurred.
- If several current errors occur, use  or  to page through the error messages.
- The last occurring error can be deleted in the "**diagnostics**" (**0A**) function group with the funktion "**clear last error**" (**0A2**).

5.5 HART communication

Apart from local operation, you can also parameterise the measuring instrument and view measured values by means of a HART protocol. There are two options available for operation:

- Operation via the universal handheld operating unit, the HART Communicator DXR 275.
- Operation via the Personal Computer (PC) using the operating program (e.g. ToF Tool or Commwin II) (For connections, see Page 25).



Note!

The Micropilot M can also be operated locally using the keys. If operation is prevented by the keys being locked locally, parameter entry via communication is not possible either.

5.5.1 Handheld unit Field Communicator DXR 375

All device functions can be adjusted via menu operation with the handheld unit DXR 375.

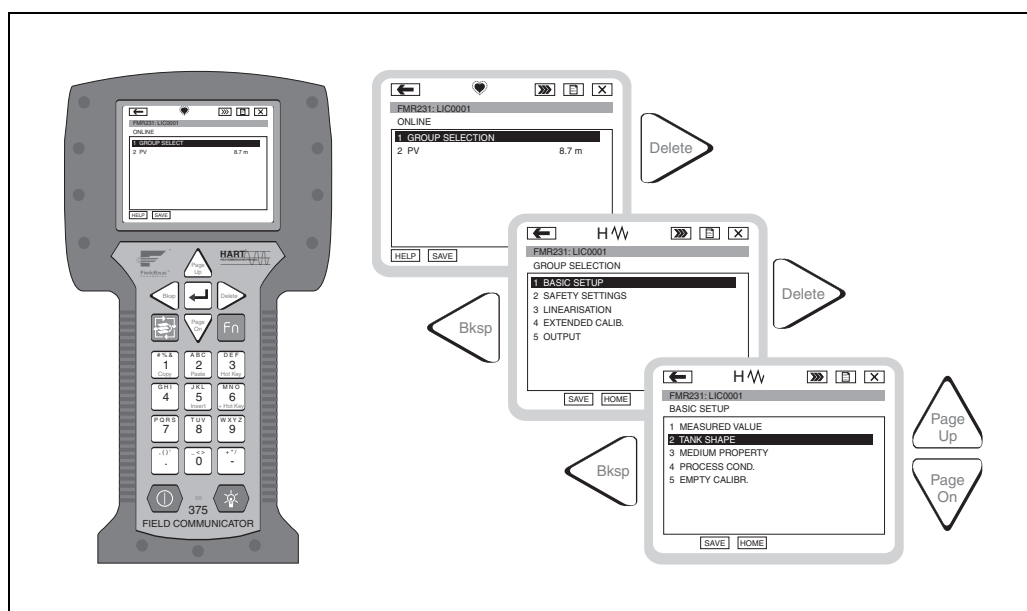


Abb. 4: Menu operation with the DXR 375 handheld instrument



Note!

- Further information on the HART handheld unit is given in the respective operating manual included in the transport bag of the instrument.

5.5.2 ToF Tool operating program

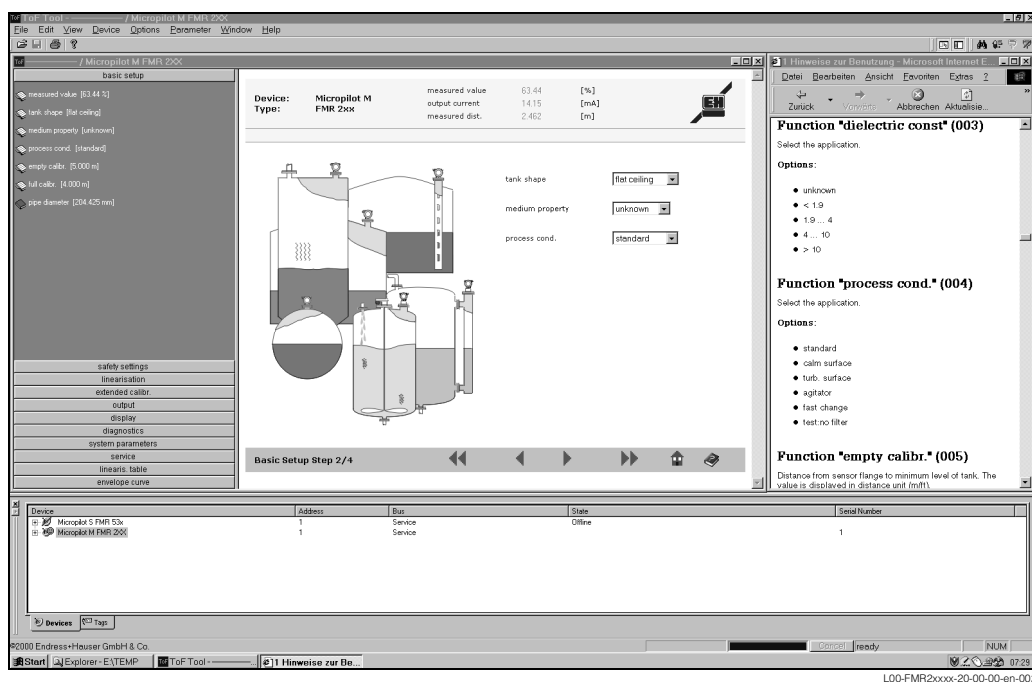
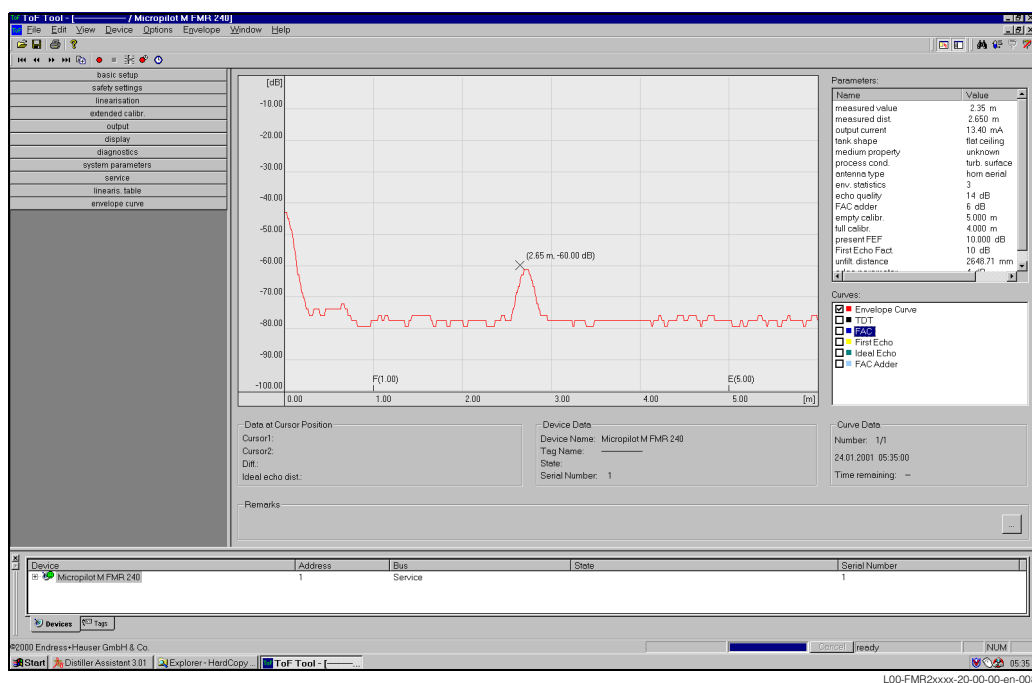
The ToF Tool is a graphical operating software for instruments from Endress+Hauser that operate based on the time-of-flight principle. It is used to support commissioning, securing of data, signal analysis and documentation of the instruments. It is compatible with the following operating systems: Win95,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

The ToF Tool supports the following functions:

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

**Note!**

Further information you may find on the CD-ROM, which is enclosed to the instrument.

Menu-guided commissioning**Signal analysis via envelope curve:****Connection options**

- Service-interface with adapter FXA 193 (see Page 25)
- HART with Commubox FXA 191 (see Page 25)

5.5.3 Commuwin II-Operating Programm

Commuwin II is an operating software with graphical support for intelligent transmitters with the communication protocols Rackbus, Rackbus RS 485, INTENSOR, HART or PROFIBUS-PA. It is compatible with the operating systems Win 3.1/3.11, Win95, Win98 and WinNT4.0. All functions of Commuwin II are supported. The configuration is made via operating matrix or graphic surface. A envelope curve can be displayed in ToF Tool.



Note!

Further information on Commuwin II is given in the following E+H documentation:

- System Information: SI 018F/00/en "Commuwin II"
- Operating Manual: BA 124F/00/en "Commuwin II" operating program

Connection

The table provides an overview of the Commuwin connections.

Interface	Hardware	Server	Device list
HART	Commubox FXA 191 to HART Computer with RS-232C interface	HART	Connected instrument
	Interface FXN 672 Gateway for MODBUS, PROFIBUS, FIP, INTERBUS, etc.	ZA 673 for PROFIBUS	List of all rack bus modules: the required FXN 672 must be selected
	Computer with RS-232C interface or PROFIBUS card	ZA 672 for other	

6 Commissioning

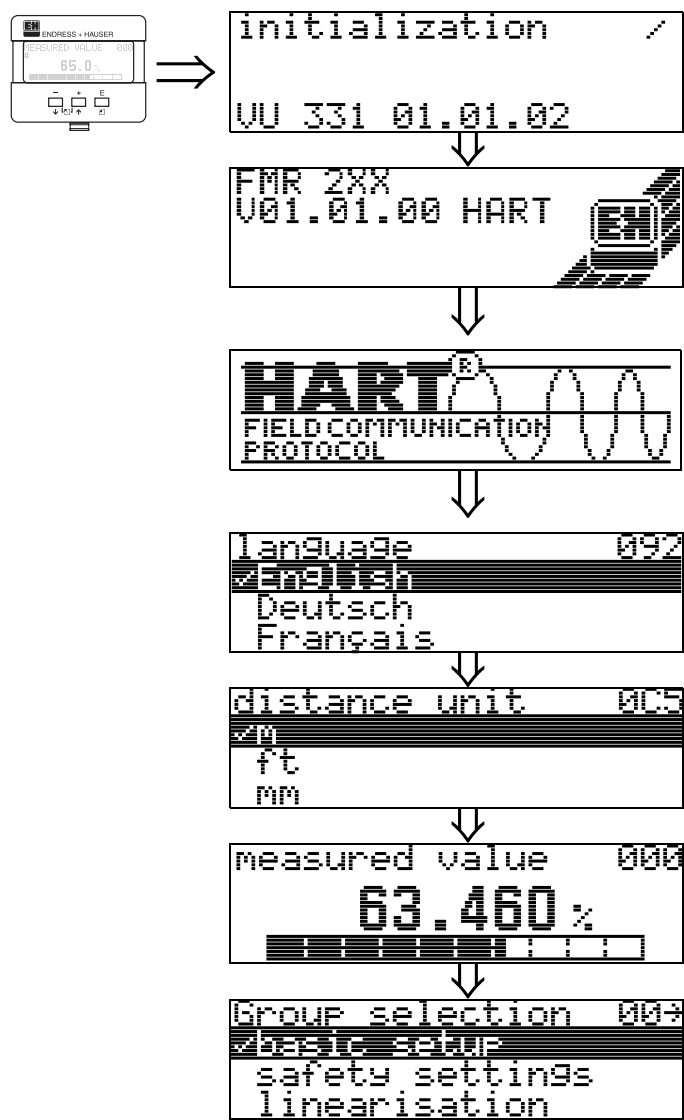
6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:

- Checklist “Post installation check” (see Page 20).
- Checklist “Post connection check” (see Page 26).

6.2 Switching on the measuring device

When the instrument is switched on for the first time, the following messages appear on the display:



After 5 s, the following message appears

After 5 s, the following message appears(e.g. for HART devices)

After 5 s or after you have pressed **E** the following message appears

Select the language (this message appears the first time the instrument is switched on)

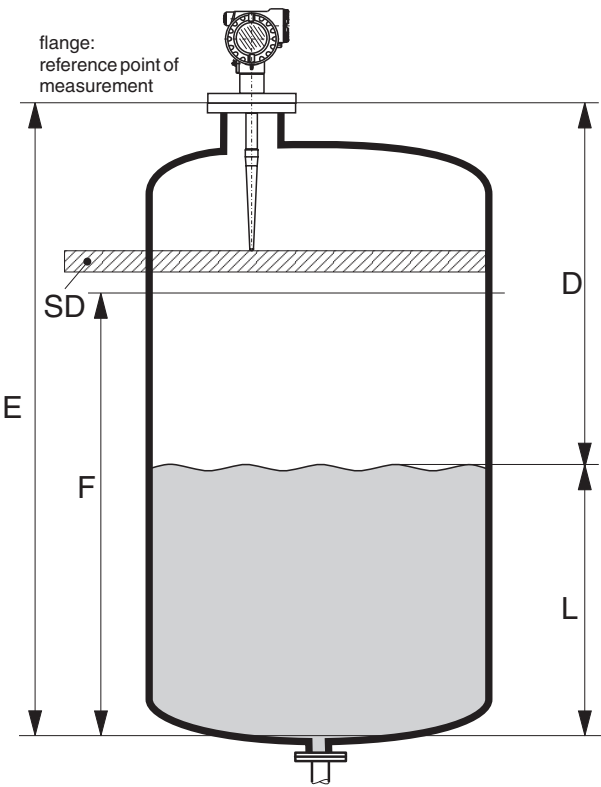
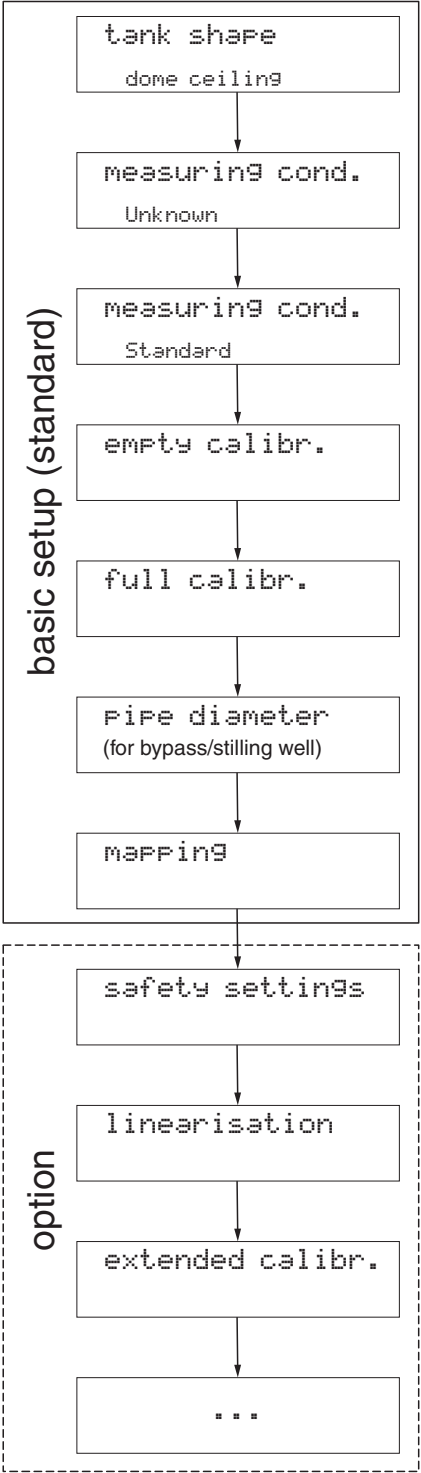
Select the basic unit (this message appears the first time the instrument is switched on)

The current measured value is displayed

After **E** is pressed, you reach the group selection.

This selection enables you to perform the basic setup




6.3 Basic Setup



- E = empty calibr. (= zero point)
setting in 005
- F = full calibr. (= span)
setting in 006
- D = distance (distance flange / product)
display in 0A5
- L = level
display in 0A6
- SD = safety distance
setting in 015

The basic setup is sufficient for successful commissioning in most applications. Complex measuring operations necessitate additional functions that the user can use to customise the Micropilot as necessary to suit his specific requirements. The functions available to do this are described in detail in the BA 221F.

Comply with the following instructions when configuring the functions in the "**basic setup**" (00):

- Select the functions as described on Page 27.
- Some functions can only be used depending on the parameterisation of the instrument. For example, the pipe diameter of a stilling well can only be entered if "**stilling well**" was selected beforehand in the "**tank shape**" (002) function.
- Certain functions (e.g. starting an interference echo mapping (053)) prompt you to confirm your data entries. Press  or  to select "**YES**" and press  to confirm. The function is now started.
- If you do not press a key during a configurable time period (→ function group "**display**" (09)), an automatic return is made to the home position (measured value display).



Note!

- The instrument continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the envelope curve mode is active on the display, the measured values are updated in a slower cycle time. Thus, it is advisable to leave the envelope curve mode after the measuring point has been optimised.
- If the power supply fails, all preset and parameterised values remain safely stored in the EEPROM.



Caution!

All functions are described in detail, as is the overview of the operating menu itself, in the manual "**Description of the instrument functions – BA 221F**", which is found on the enclosed CD-ROM.



Note!

The default values of the parameters are typed in **boldface**.

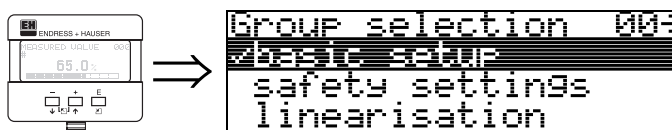
6.4 Basic Setup with the VU 331

Function "measured value" (000)

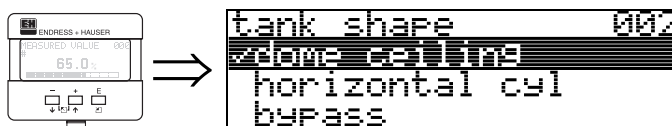


This function displays the current measured value in the selected unit (see "**customer unit**" (042) function). The number of digits after decimal point can be selected in the "**no. of decimals**" (095) function.

6.4.1 Function group "basic setup" (00)



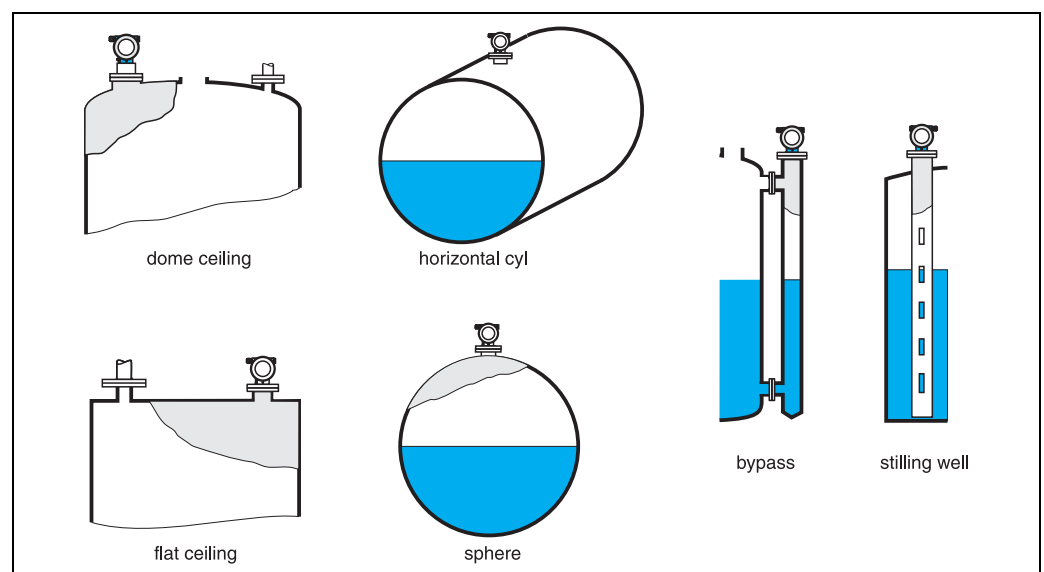
Function "tank shape" (002)



This function is used to select the tank shape.

Selection:

- **dome ceiling**
- horizontal cyl
- bypass
- stilling well, **also for Wave Guide antenna use.**
- flat ceiling
- sphere



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Function "medium property" (003)



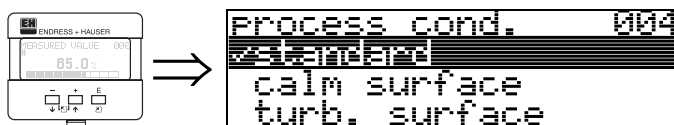
This function is used to select the dielectric constant.

Selection:

- unknown
- DC: < 1.9
- DC: 1.9 ... 4
- DC: 4 ... 10
- DC: > 10

Product class	DC (εr)	Examples
A	1,4...1,9	non-conducting liquids, e.g. liquefied gas ¹
B	1,9...4	non-conducting liquids, e.g. benzene, oil, toluene, ...
C	4...10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ...
D	>10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis


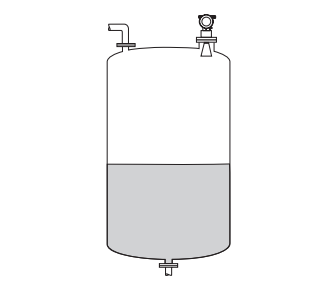
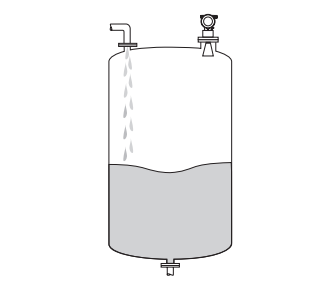
1) Treat Ammonia NH3 as a medium of group A, i.e. use FMR 230 in a stilling well.

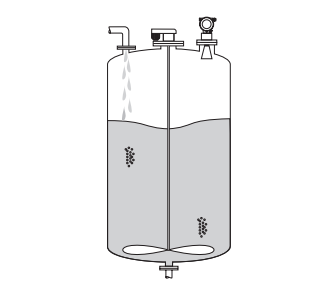
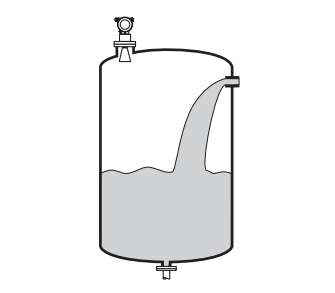

Function "process cond." (004)

This function is used to select the process conditions.

Selection:

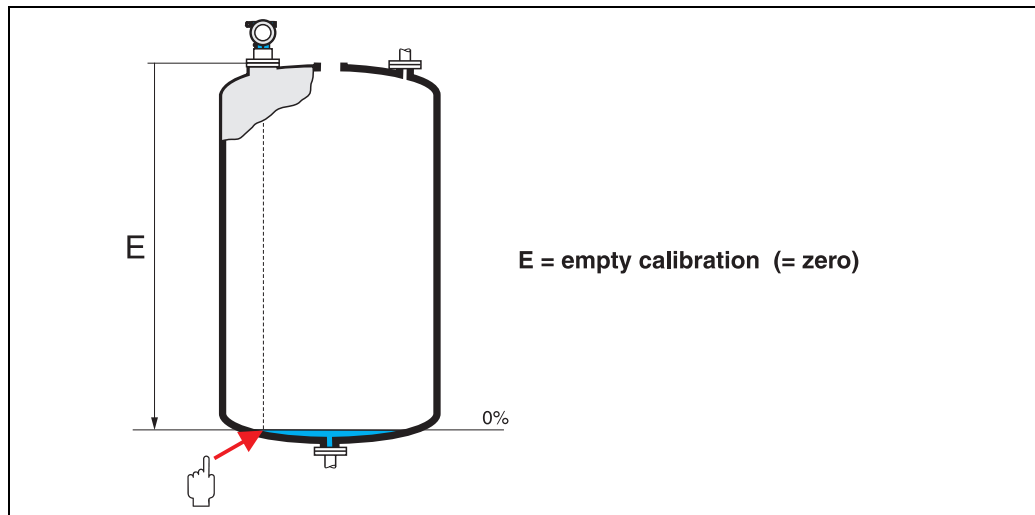
- **standard**
- calm surface
- turb. surface
- agitator
- fast change
- test:no filter

standard	calm surface	turb. surface
For all applications that do not fit into any of the following groups.	Storage tanks with immersion tube or bottom filling	Storage / buffer tanks with rough surface due to free filling or mixer nozzles
		
The filter and output damping are set to average values.	The averaging filters and output damping are set to high values. → steady meas. value → precise measurement → slower reaction time	Special filters to smooth the input signals are emphasised. → smoothed meas. value → medium fast reaction time

agitator	fast change	test:no filter
Agitated surfaces (with possible vortex) due to agitators	Rapid change of level, particularly in small tanks	All filters can be switched off for service / diagnostic purposes.
		
Special filters to smooth the input signals are set to high values. → smoothed meas. value → medium fast reaction time → minimization of effects by agitator blades	The averaging filters are set to low values. The output damping is set to 0. → rapid reaction time → possibly unsteady meas. value	All filters off.

Function "empty calibr." (005)

This function is used to enter the distance from the flange (reference point of the measurement) to the minimum level (=zero).



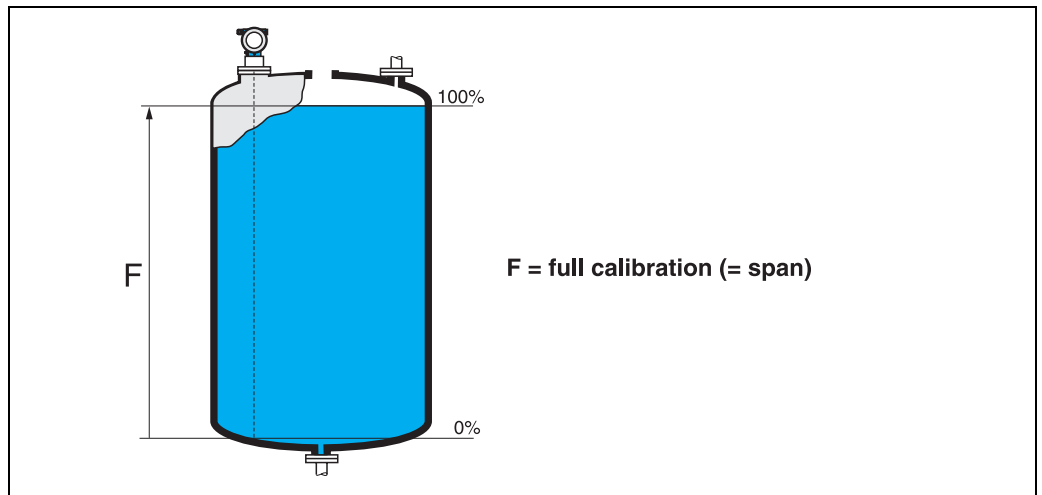
L00-FMR2xxxx-14-00-06-en-008

**Caution!**

For dish bottoms or conical outlets, the zero point should be no lower than the point at which the radar beam hits the bottom of the tank.

Function "full calibr." (006)

This function is used to enter the distance from the minimum level to the maximum level (=span).



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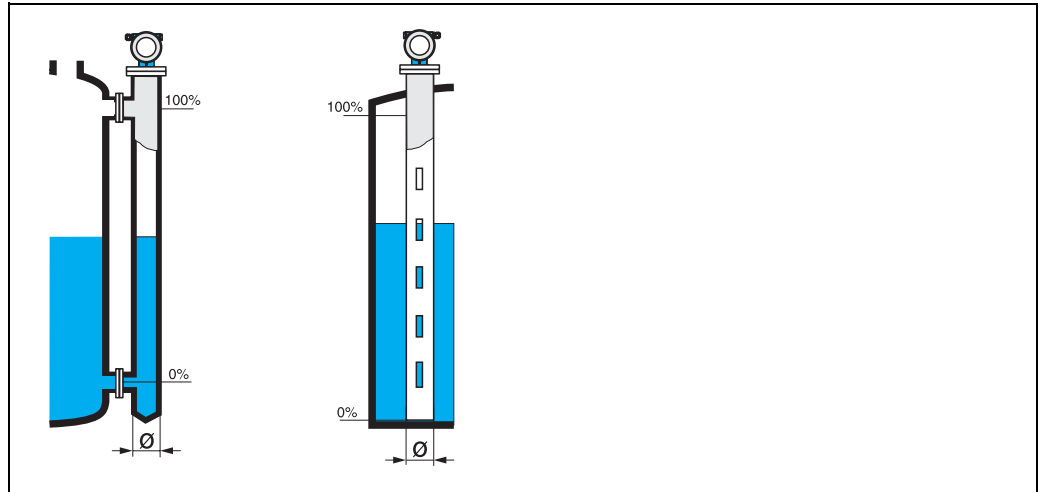
**Note!**

If **bypass** or **stilling well** was selected in the "**tank shape**" (002) function, the pipe diameter is requested in the following step.

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 50 mm (2") to the tip of the antenna.

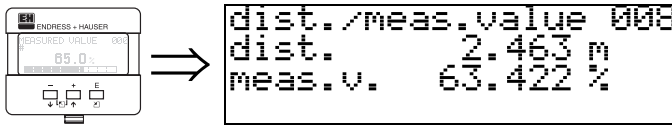
Function "pipe diameter" (007)

This function is used to enter the pipe diameter of the stilling well or bypass pipe.



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Microwaves propagate more slowly in pipes than in free space. This effect depends on the inside diameter of the pipe and is automatically taken into account by the Micropilot. It is only necessary to enter the pipe diameter for applications in a bypass or stilling well.

display (008)

The **distance** measured from the reference point to the product surface and the **level** calculated with the aid of the empty adjustment are displayed. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

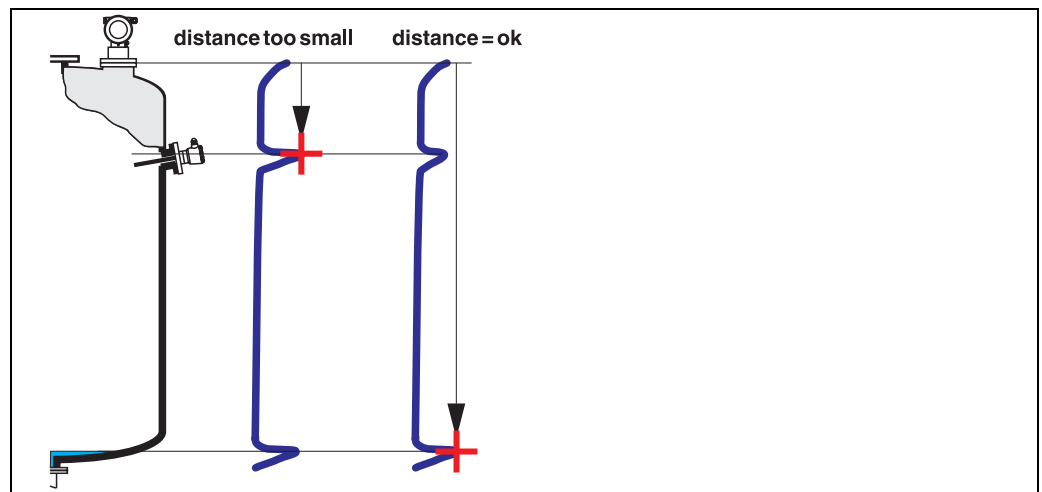
- Distance correct – level correct → continue with the next function, "**check distance**" (051)
- Distance correct – level incorrect → Check "**empty calibr.**" (005)
- Distance incorrect – level incorrect → continue with the next function, "**check distance**" (051)

Function "check distance" (051)

This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

Selection:

- distance = ok
- dist. too small
- dist. too big
- **dist. unknown**
- manual



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distance = ok

- mapping is carried out up to the currently measured echo
- The range to be suppressed is suggested in the "**range of mapping**" (052) function

Anyway, it is wise to carry out a mapping even in this case.

dist. too small

- At the moment, an interference is being evaluated
- Therefore, a mapping is carried out including the presently measured echoes
- The range to be suppressed is suggested in the **"range of mapping" (052)** function

dist. too big

- This error cannot be remedied by interference echo mapping
- Check the application parameters **(002)**, **(003)**, **(004)** and **"empty calibr." (005)**

dist. unknown

If the actual distance is not known, no mapping can be carried out.

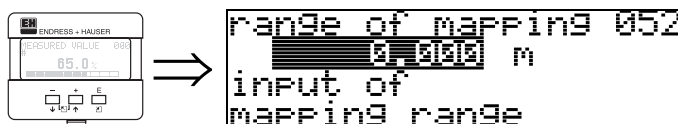
manual

A mapping is also possible by manual entry of the range to be suppressed. This entry is made in the **"range of mapping" (052)** function.

**Caution!**

The range of mapping must end 0.5 m (20") before the echo of the actual level. For an empty tank, do not enter E, but E – 0.5 m (20").

If a mapping already exists, it is overwritten up to the distance specified in **"range of mapping" (052)**. Beyond this value the existing mapping remains unchanged.

Function "range of mapping" (052)

This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (QUERVERWEIS). This value can be edited by the operator.

For manual mapping, the default value is 0 m.

Function "start mapping" (053)

This function is used to start the interference echo mapping up to the distance given in **"range of mapping" (052)**.

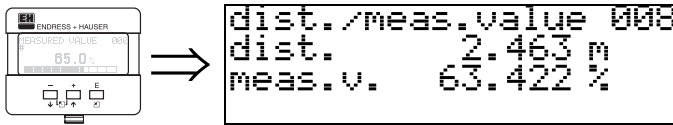
Selection:

- off → no mapping is carried out
- on → mapping is started

During the mapping process the message **"record mapping"** is displayed.

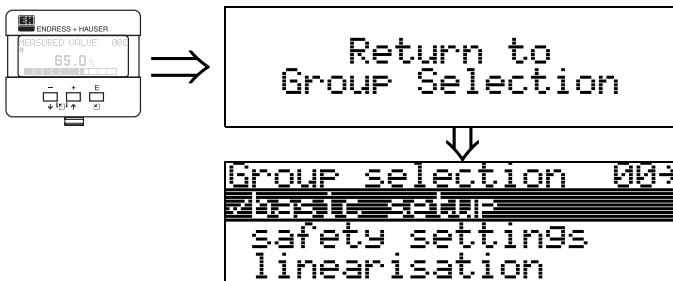
**Caution!**

A mapping will be recorded only, if the device is not in alarm-state.

display (008)

The **distance** measured from the reference point to the product surface and the **level** calculated with the aid of the empty adjustment are displayed. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

- Distance correct – level correct → continue with the next function, "**check distance**" (051)
- Distance correct – level incorrect → Check "**empty calibr.**" (005)
- Distance incorrect – level incorrect → continue with the next function, "**check distance**" (051)

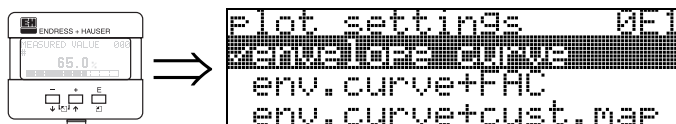


After 3 s, the following message appears

6.4.2 Envelope curve with VU 331

After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("**envelope curve**" (0E) function group) is recommended.

Function "plot settings" (0E1)



Select which information will be displayed in the LCD:

- **envelope curve**
- env.curve+FAC (on FAC see BA 221F)
- env.curve+cust.map (i.e. customer tank map is also displayed)

Function "recording curve" (0E2)

This function defines whether the envelope curve is read as a

- **single curve**
- or
- cyclic.



Note!

If the cyclical envelope curve is active in the display, the measured value is refreshed in a slower cycle time. It is therefore recommended to exit the envelope curve display after optimising the measuring point.

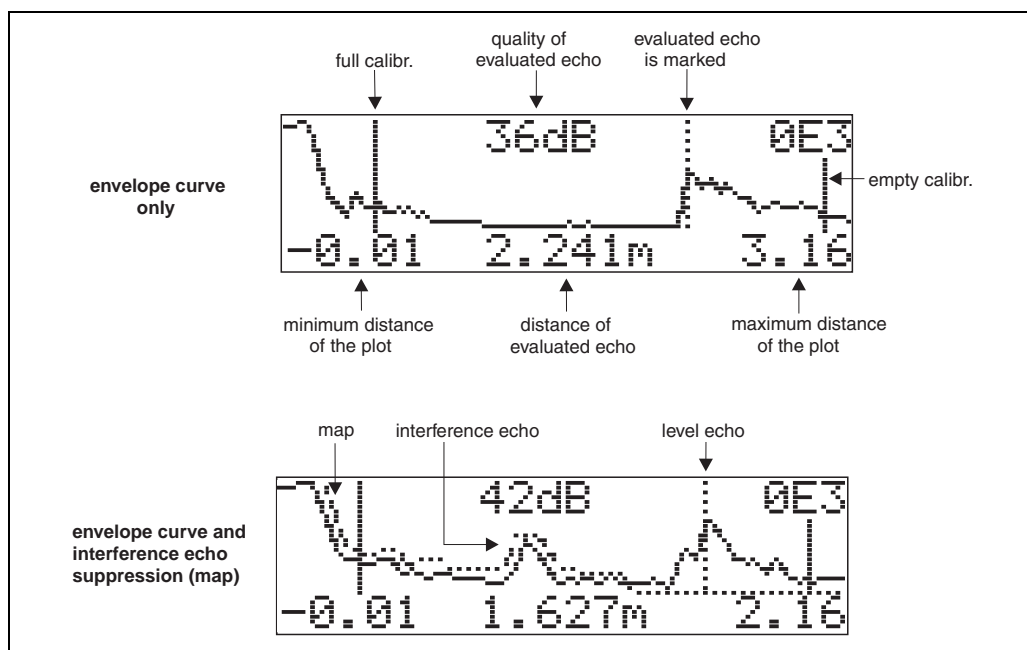


Note!

An **orientation** of the Micropilot can help to optimise measurement in applications with very weak level echos or strong interference echos by increasing the useful echo/ reducing the interference echo (see "Orientation of the Micropilot" on Page 66). When using the Wave Guide antenna **no** orientation is required!

Function "envelope curve display" (0E3)

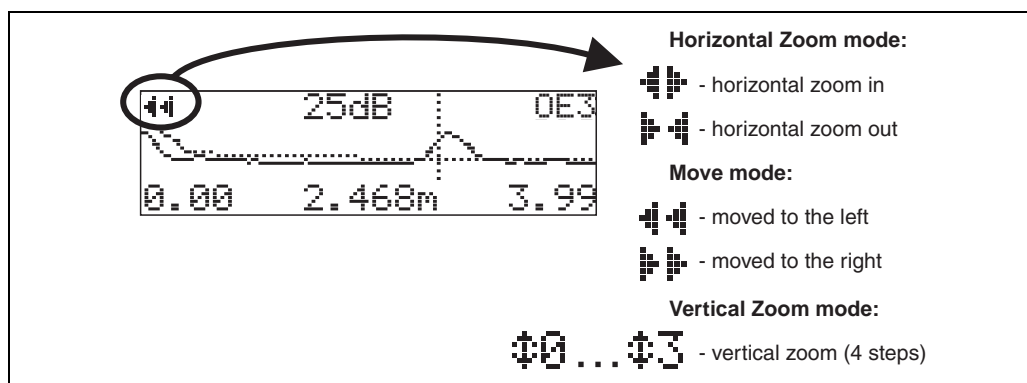
The envelope curve is displayed in this function. You can use it to obtain the following information:



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Navigating in the envelope curve display

Using navigation, the envelope curve can be scaled horizontally and vertically and shifted to the left or the right. The active navigation mode is indicated by a symbol in the top left hand corner of the display.

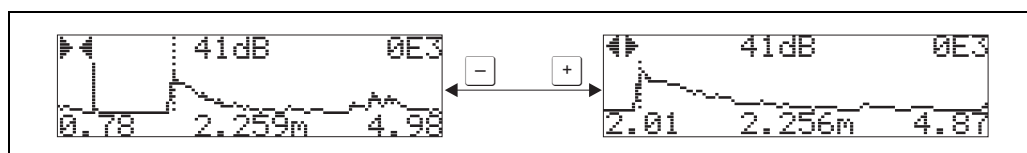


L00-FMxxxxxx-07-00-00-en-004

Horizontal Zoom mode

Firstly, go into the envelope curve display. Then press $\boxed{+}$ or $\boxed{-}$ to switch to the envelope curve navigation. You are then in Horizontal Zoom mode. Either $\boxed{\leftarrow \rightarrow}$ or $\boxed{\rightarrow \leftarrow}$ is displayed.

- $\boxed{+}$ increases the horizontal scale.
- $\boxed{-}$ reduces the horizontal scale.

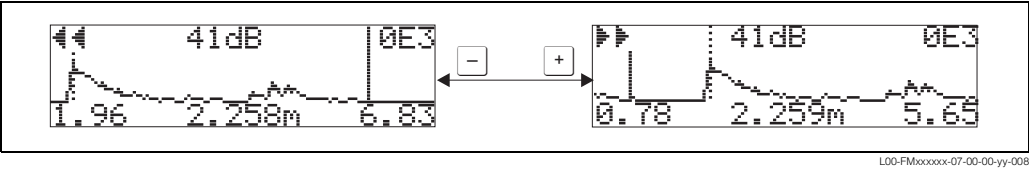


L00-FMxxxxxx-07-00-00-yy-007

Move mode

Then press **[E]** to switch to Move mode. Either **↔** or **↔** is displayed.

- **+** shifts the curve to the right.
- **-** shifts the curve to the left.

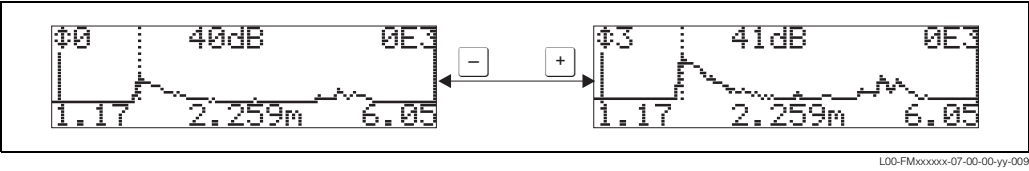


Vertical Zoom mode

Press **[E]** once more to switch to Vertical Zoom mode. **01** is displayed. You now have the following options.

- **+** increases the vertical scale.
- **-** reduces the vertical scale.

The display icon shows the current zoom factor (**00** to **03**).



Exiting the navigation

- Press **[E]** again to run through the different modes of the envelope curve navigation.
- Press **+** and **-** to exit the navigation. The set increases and shifts are retained. Only when you reactivate the **"recording curve" (0E2)** function does the Micropilot use the standard display again.



After 3 s, the following message appears

6.5 Basic Setup with the ToF Tool

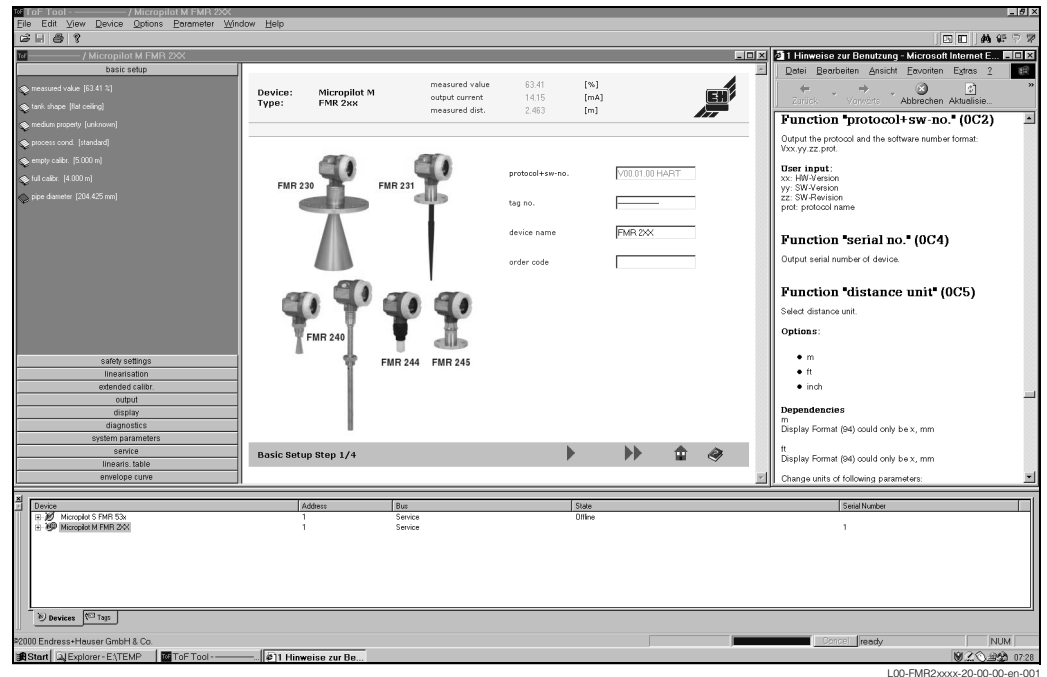
To carry out the basic setup with the ToF Tool operating program, proceed as follows:

- Start the ToF Tool operating program and establish a connection
- Select the **"basic setup"** function group in the navigation bar

The following display appears on the screen:

Basic Setup step 1/4:

- Status image
- Enter the measuring point description (TAG number).

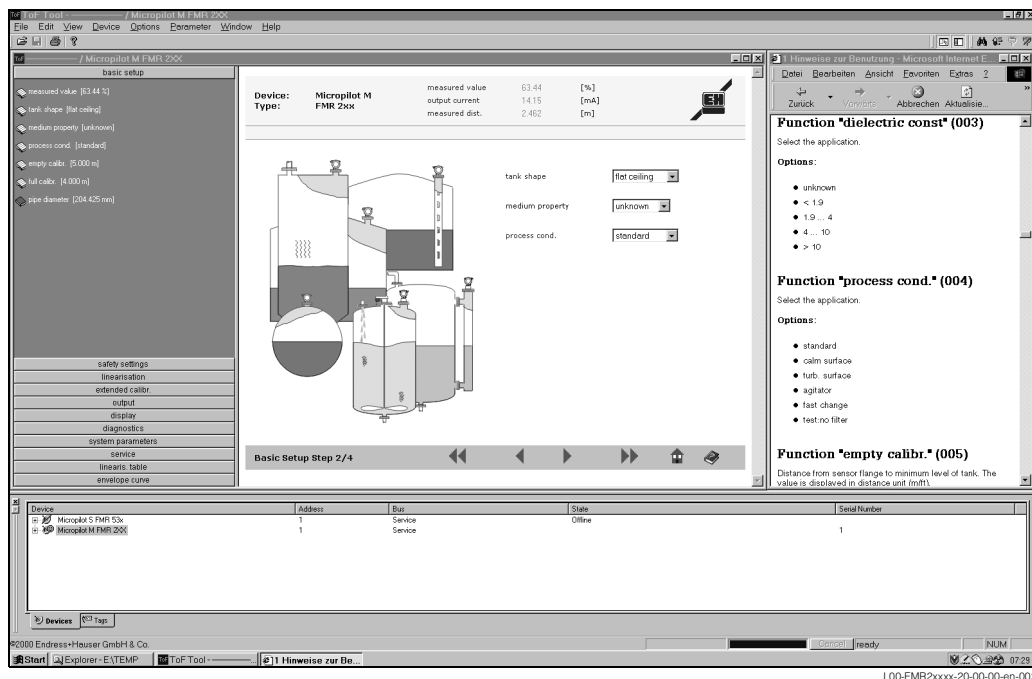


Note!

- Each parameter that is changed must be confirmed with the **RETURN** key!
- The **"Next"** button moves you to the next screen display:

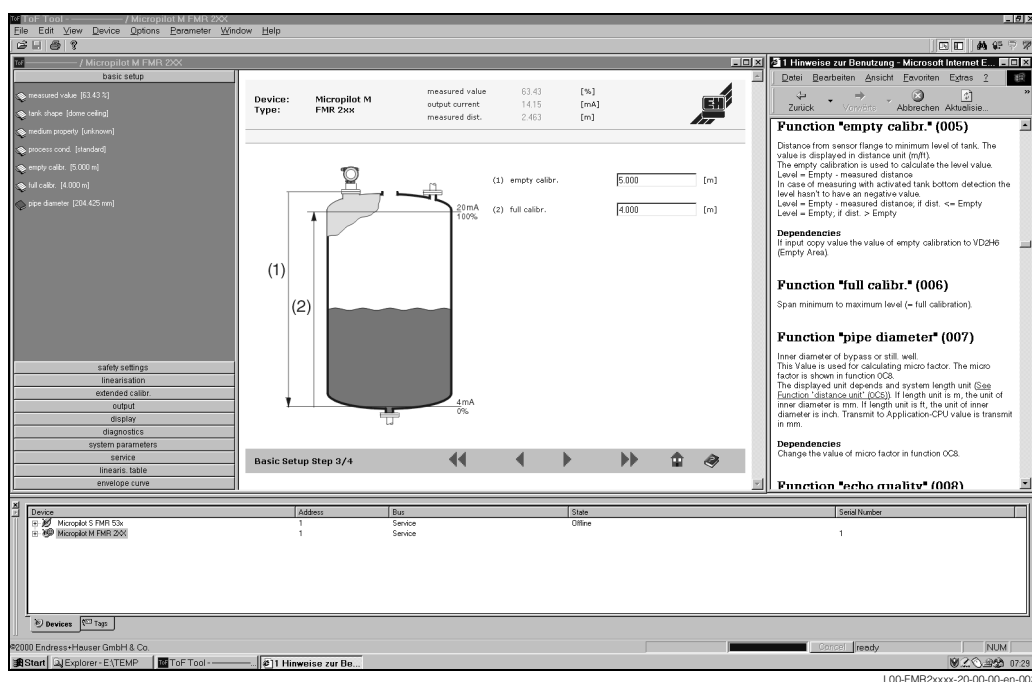
Basic Setup step 2/4:

- Enter the application parameters:
 - tank shape (for a description, see Page 41)
 - medium property (for a description, see Page 42)
 - process cond. (for a description, see Page 43)

**Basic Setup step 3/4:**

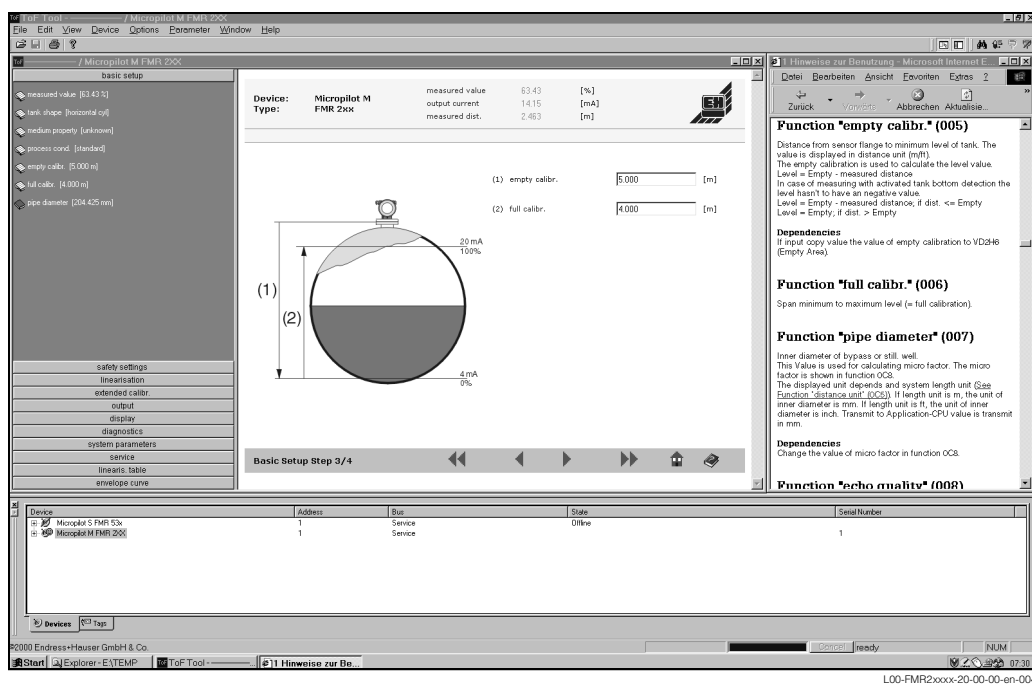
If "**dome ceiling**" is selected in the "**tank shape**" function, the following display appears on the screen:

- empty calibr. (for a description, see Page 44)
- full calibr. (for a description, see Page 45)



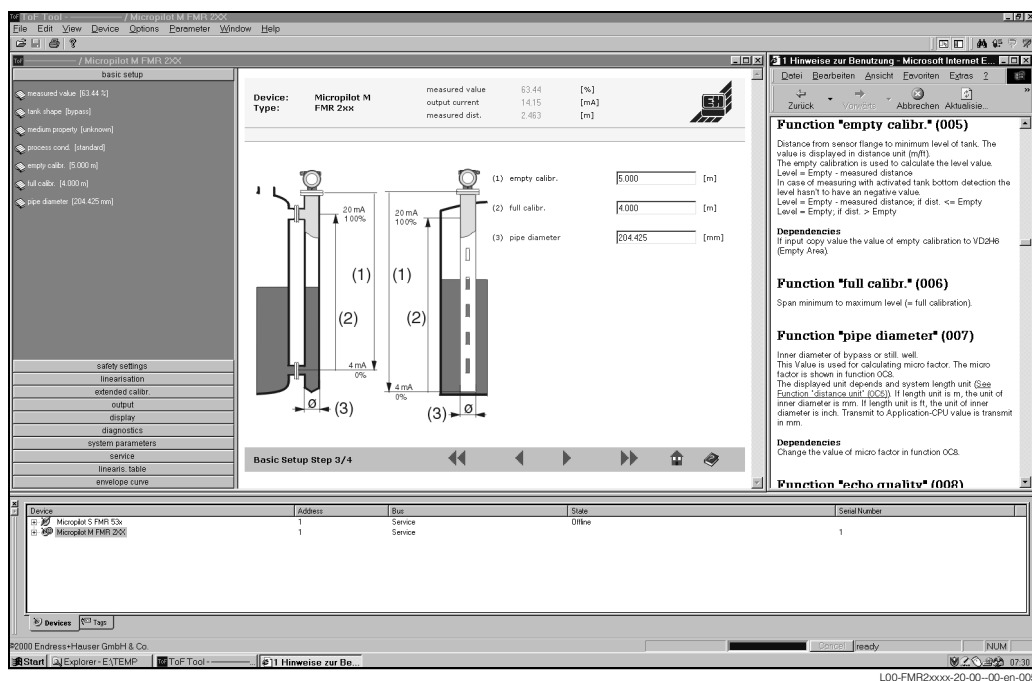
If **"horizontal cyl"** or **"sphere"** is selected in the **"tank shape"** function, the following display appears on the screen:

- empty calibr. (for a description, see Page 44)
- full calibr. (for a description, see Page 45)



If **"stilling well"** or **"bypass"** is selected in the **"tank shape"** function, the following display appears on the screen:

- empty calibr. (for a description, see Page 44)
- full calibr. (for a description, see Page 45)
- diameter of bypass / stilling well (for a description, see Page 46)

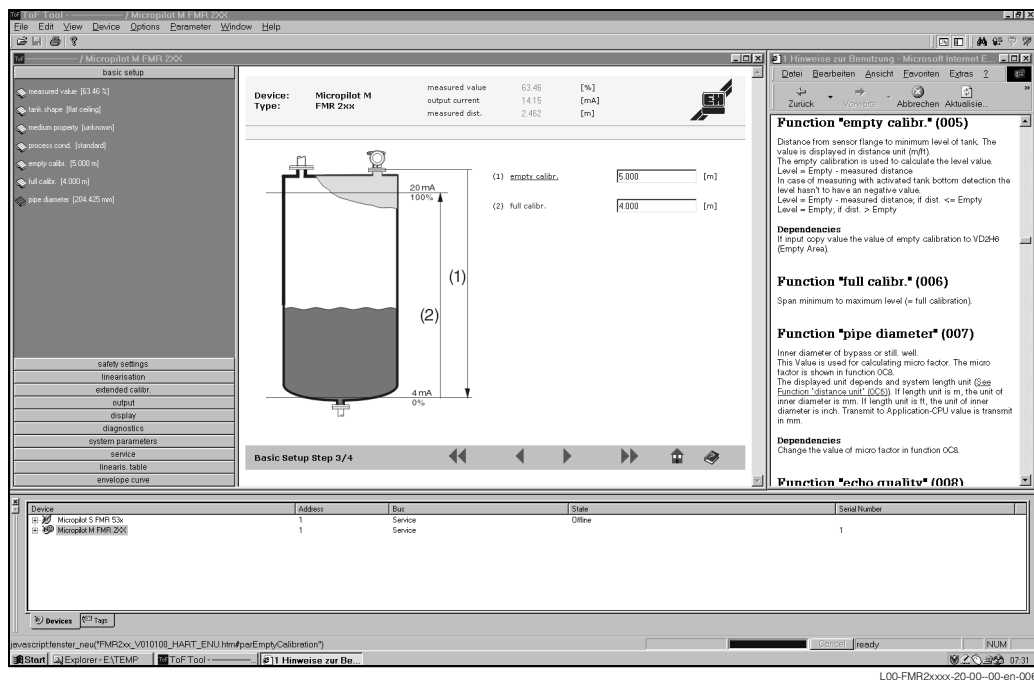


Note!

You can also specify the pipe diameter in this display.

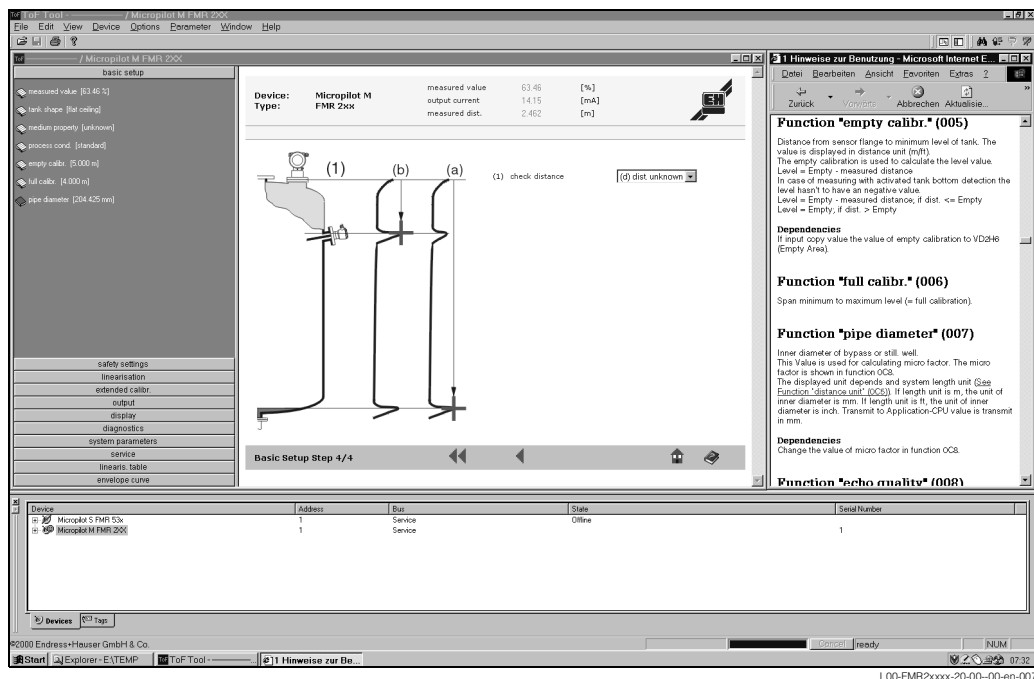
If **"flat ceiling"** is selected in the **"tank shape"** function, the following display appears on the screen:

- empty calibr. (for a description, see Page 44)
- full calibr. (for a description, see Page 45)



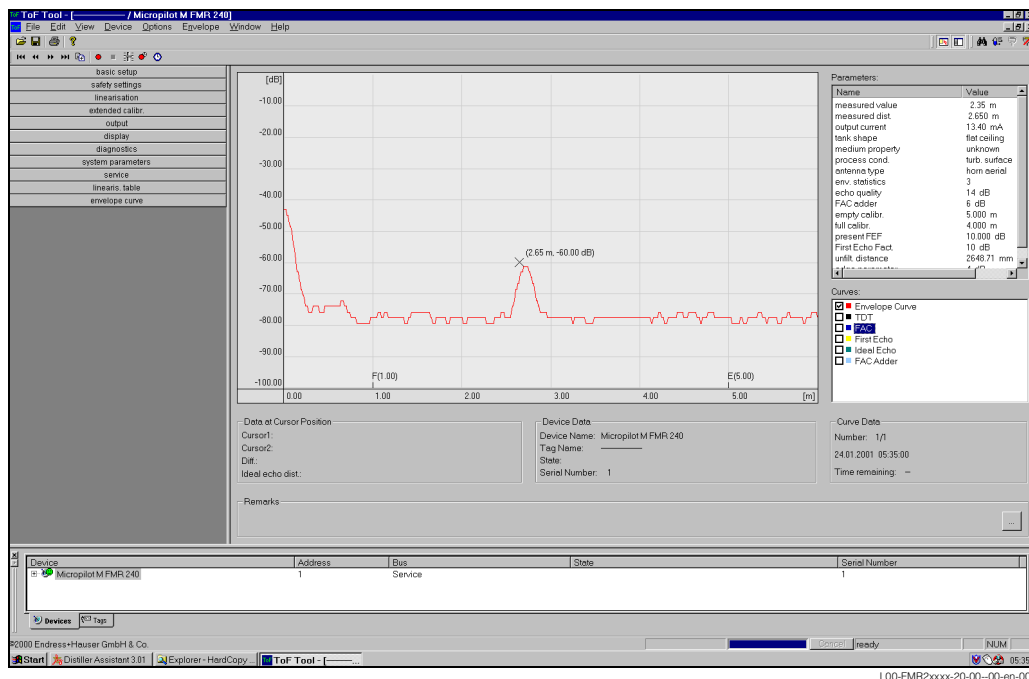
Basic Setup step 4/4:

- This step starts the tank mapping
- The measured distance and the current measured value are always displayed in the header
- A description is given on Page 47



6.5.1 Envelope curve with the ToF Tool

After the basic setup, an evaluation of the measurement using the envelope curve is recommended.



Note!

If the level of echo is very weak or there is a heavy interference echo, an orientation of the Micropilot can help optimise the measurement (increase of the useful echo/reduction of the interference echo) (see "Orientation of the Micropilot" on Page 66). When using the Wave Guide antenna **no** orientation is required!

6.5.2 User-specific applications (operation)

For details of setting the parameters of user-specific applications, see separate documentation BA 221F/00/en "Description of the instrument functions for Micropilot M" on the enclosed CD-ROM.

7 Maintenance

The Micropilot M measuring instrument requires no special maintenance.

Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

Replacing seals

The process seals of the sensors must be replaced periodically, particularly if molded seals (aseptic construction) are used. The period between changes depends on the frequency of cleaning cycles and on the temperature of the measured substance and the cleaning temperature.

Repairs

The Endress+Hauser repair concept assumes that the measuring devices have a modular design and that customers are able to undertake repairs themselves. Spare parts are contained in suitable kits. They contain the related replacement instructions. All the spare parts kits which you can order from Endress+Hauser for repairs to the Micropilot M are listed with their order numbers on [page 10](#) and [page 11](#). Please contact Endress+Hauser Service for further information on service and spare parts.

Repairs to Ex-approved devices

When carrying out repairs to Ex-approved devices, please note the following:

- Repairs to Ex-approved devices may only be carried out by trained personnel or by Endress+Hauser Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Endress+Hauser.
- When ordering a spare part, please note the device designation on the nameplate. Only replace parts with identical parts.
- Carry out repairs according to the instructions. On completion of repairs, carry out the specified routine test on the device.
- Only Endress+Hauser Service may convert a certified device into a different certified variant.
- Document all repair work and conversions.

Replacement

After a complete Micropilot or electronic module has been replaced, the parameters can be downloaded into the instrument again via the communication interface. Prerequisite to this is that the data were uploaded to the PC beforehand using the ToF Tool / Commuwin II.

Measurement can continue without having to carry out a new setup.

- You may have to activate linearisation (see BA 221F on the enclosed CD-ROM)
- You may need to record the tank map again (see Basic Setup)

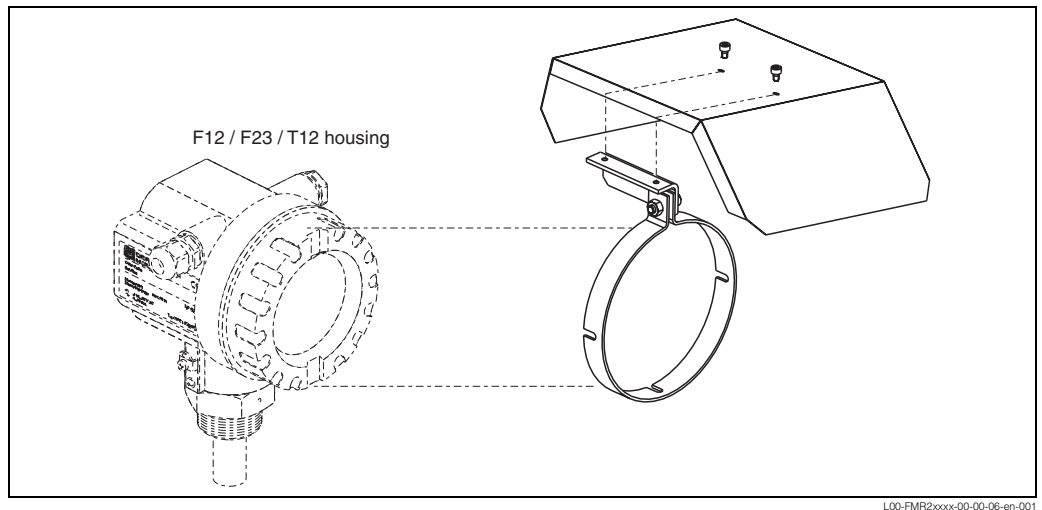
After an antenna component or electronic has been replaced, a new calibration must be carried out. This is described in the repair instructions.

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the Micropilot M.

Weather protection cover

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



Commubox FXA 191 HART

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

Service Interface FXA 193

For communication with ToF Tool via the display connector.

Ordering structure:

- FXA 193-A: for use in non-hazardous area
- FXA 193-B: for use in hazardous area (ATEX, CSA, FM)

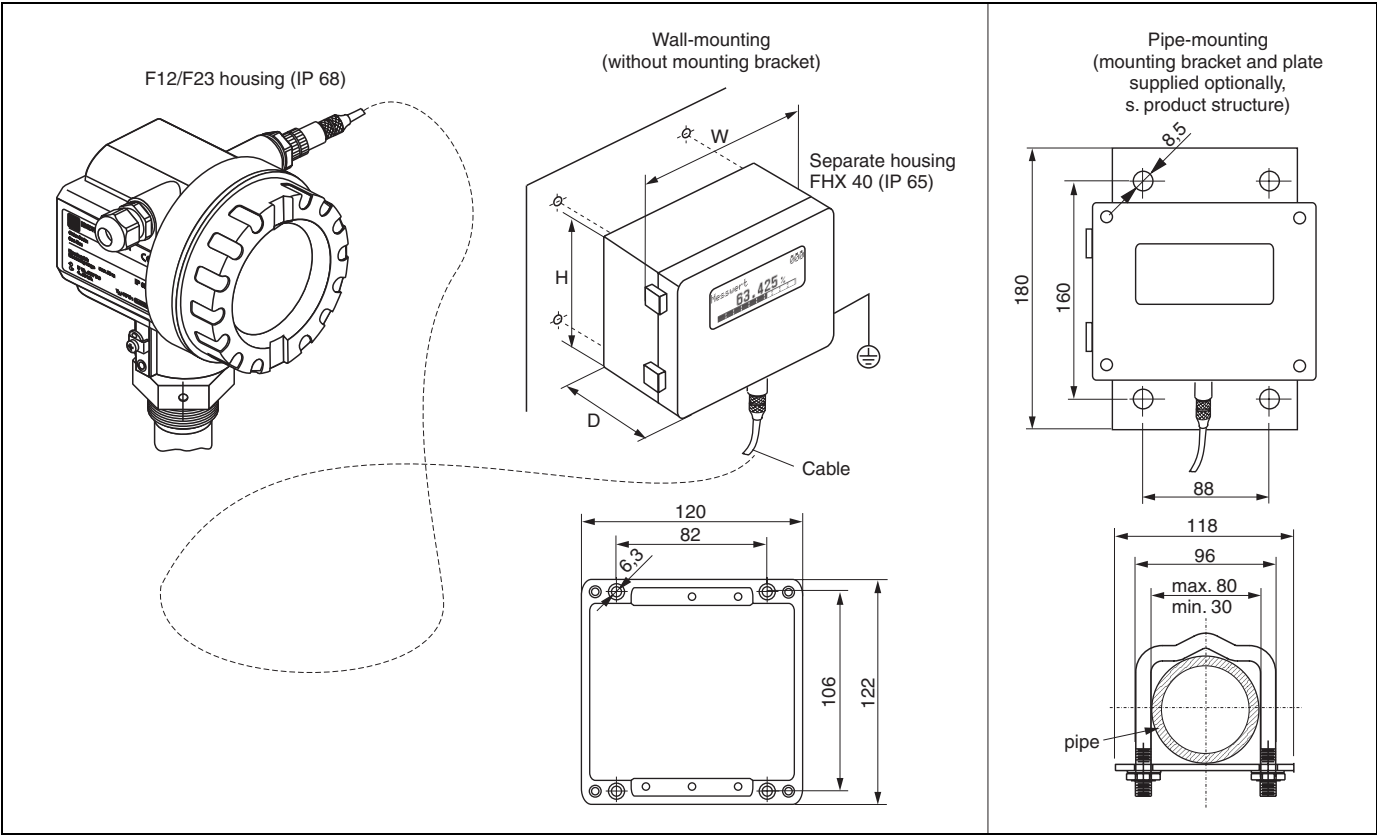
The connection to a ToF device needs an additional FXA connection cable (order code.: 50101787).

Commuwin II

Operating software for intelligent instruments.

Remote display FHX 40

Dimensions



Technical data:

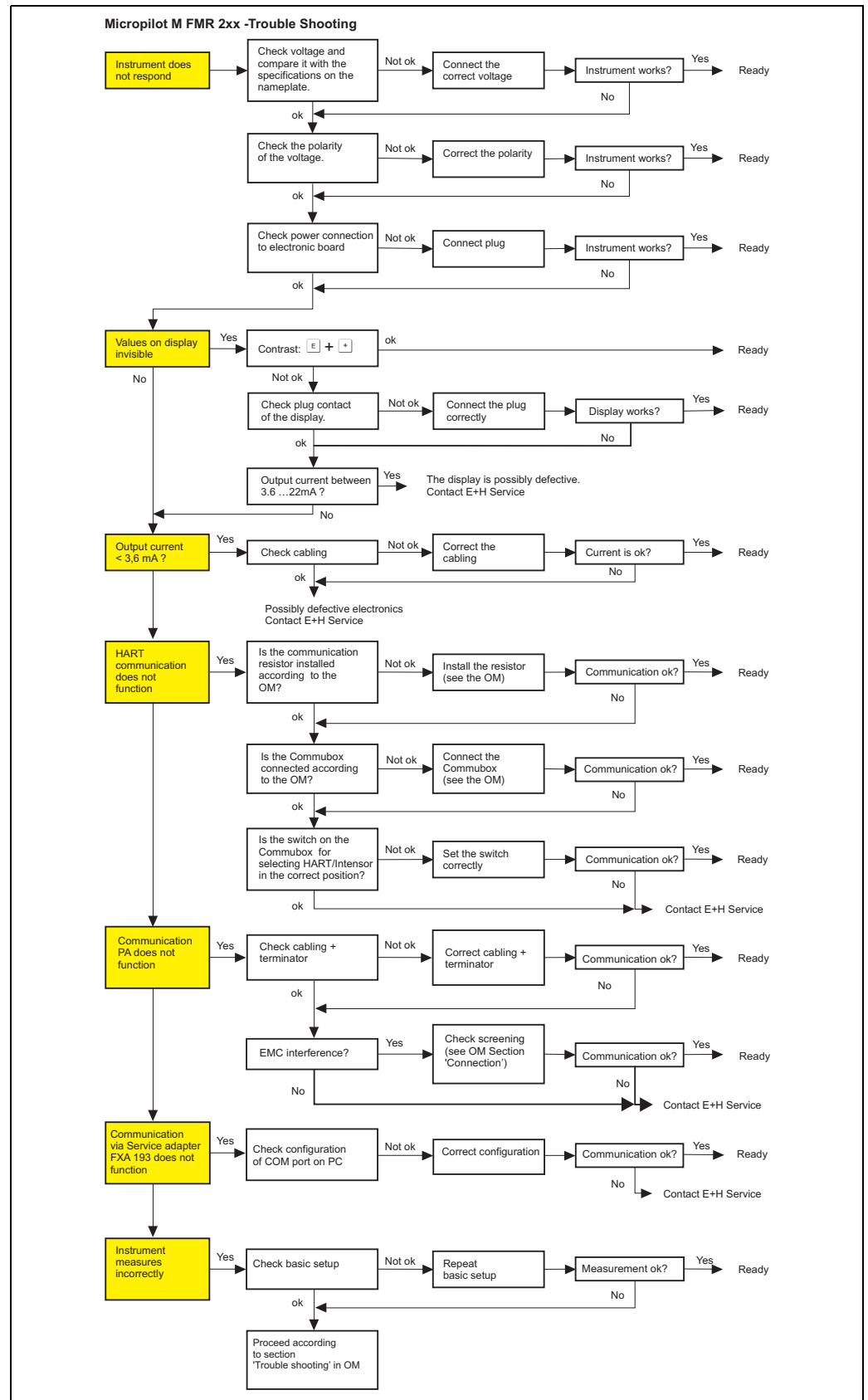
Max. cable length	20 m (65 ft)
Temperature range	-30 °C...+70 °C (-22 °F...158 °F)
Degree of protection	IP65 acc. to EN 60529 (NEMA 4)
Material for housing	Alloy of Aluminium AL Si 12
Dimensions [mm] / [inch]	122x150x80 (HxBxT) / 4.8x5.9x3.2

Ordering structure

Certificates		
A	For non-hazardous area	
1	ATEX II 2 G EEx ia IIC T6, ATEX II 3D	
S	FM IS Class I Div. 1, Groups A,B,C,D (in preparation)	
U	CSA IS Class I, Div. 1, Groups A,B,C,D (in preparation)	
N	CSA General Purpose (in preparation)	
Cable length		
1	20 m cable	
Additional option		
A	Additional option not selected	
B	Mounting bracket 1" or 2" pipe	
FHX 40 -		Complete product designation

9 Trouble-shooting

9.1 Trouble-shooting instructions



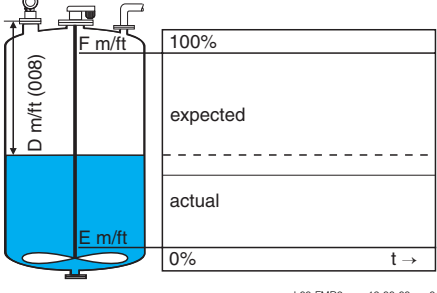
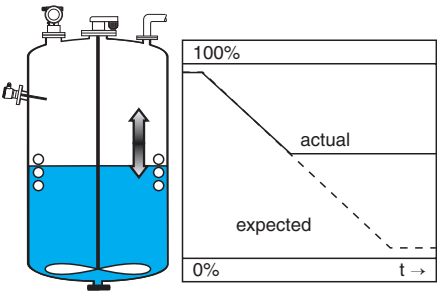
L00-FMR2xxxx-19-00-00-en-010

9.2 System error messages

Code	Description	Possible cause	Remedy
A102	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E ² PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
W103	initialising - please wait	E ² PROM storage not yet finished	wait some seconds; if warning prevails, exchange electronics
A106	downloading please wait	processing data download	wait until warning disappears
A110	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E ² PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
A111	electronics defect	RAM defective	reset; if alarm prevails after reset, exchange electronics
A113	electronics defect	RAM defective	reset; if alarm prevails after reset, exchange electronics
A114	electronics defect	E ² PROM defect	reset; if alarm prevails after reset, exchange electronics
A115	electronics defect	general hardware problem	reset; if alarm prevails after reset, exchange electronics
A116	download error repeat download	checksum of stored data not correct	restart download of data
A121	electronics defect	no factory calibration existant; EPROM defective	contact service
W153	initialising - please wait	initialisation of electronics	wait some seconds; if warning prevails, power off device and power on again
A155	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A160	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E ² PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
A164	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A171	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A231	sensor 1 defect check connection	HF module or electronics defective	exchange HF module or electronics
W511	no factory calibration ch1	factory calibration has been deleted	record new factory calibration
A512	recording of mapping please wait	mapping active	wait some seconds until alarm disappears
A601	linearisation ch1 curve not monotone	linearisation not monotonously increasing	correct linearisation table
W611	less than 2 linearisation points for channel 1	number of entered linearisation points < 2	correct linearisation table

Code	Description	Possible cause	Remedy
W621	simulation ch. 1 on	simulation mode is active	switch off simulation mode
E641	no usable echo channel 1 check calibr.	echo lost due to application conditions or built up on antenna	check installation; optimize orientation of antenna; clean antenna (cf. OM)
E651	level in safety distance - risk of overspill	level in safety distance	alarm will disappear as soon as level leaves safety distance;
E671	linearisation ch1 not complete, not usable	linearisation table is in edit mode	activate linearisation table
W681	current ch1 out of range	current out of range (3.8 mA...21.5 mA)	check calibration and linearisation

9.3 Application errors

Error	Output	Possible cause	Remedy
A warning or alarm has occurred.	Depending on the configuration	See table of error messages (see Page 62)	1. See table of error messages (see Page 62)
Measured value (00) is incorrect	<div></div>	<div>Measured distance (008) OK? yes →</div> <div>no ↓</div> <div>Measurement in bypass or stilling well? yes →</div> <div>no ↓</div> <div>Is an offset (057) active? yes →</div> <div>no ↓</div> <div>An interference echo may have been evaluated. yes →</div>	<div>1. Check empty calibr. (005) and full calibr. (006). 2. Check linearisation: → level/ullage (040) → max. scale (046) → diameter vessel (047) → Check table</div> <div>1. Is bypass or stilling well selected in tank shape (002)? 2. Is the pipe diameter (007) correct?</div> <div>1. offset (057) correctly set?</div> <div>1. Carry out tank mapping → basic setup</div>
No change off measured value on filling/emptying	<div></div>	Interference echo from installations, nozzle or extension on the antenna	1. Carry out tank mapping → basic setup 2. If necessary, clean antenna 3. If necessary, select better mounting position (see Page 14)

Error	Output	Possible cause	Remedy
If the surface is not calm (e.g. filling, emptying, agitator running), the measured value jumps sporadically to a higher level	<p>L00-FMR2xxxx-19-00-00-en-015</p> <p>L00-FMR2xxxx-19-00-00-en-016</p>	Signal is weakened by the rough surface – the interference echoes are sometimes stronger	<ol style="list-style-type: none"> 1. Carry out tank mapping → basic setup 2. Set the process cond. (004) to "turb. surface" or "agitator" 3. Increase the output damping (058) 4. Optimise the orientation (see Page 66) 5. If necessary, select a better mounting position and/or larger antenna (see Page 14)
During filling/emptying the measured value jumps ownwards	<p>L00-FMR2xxxx-19-00-00-en-017</p>	Multiple echoes	yes → <ol style="list-style-type: none"> 1. Check the tank shape (002), e.g. "dome ceiling" or "horizontal cyl" 2. In the range of the blocking dist. (059) there is no echo evaluation → Adapt the value 3. If possible, do not select central installation position (see Page 14) 4. Perhaps use a stilling well ()
E 641 (loss of echo)	<p>L00-FMR2xxxx-19-00-00-en-018</p>	Level echo is too weak. Possible causes: <ul style="list-style-type: none"> • Rough surface due to filling/ emptying • Agitator running • Foam 	yes → <ol style="list-style-type: none"> 1. Check application parameters (002), (003) and (004) 2. Optimise alignment (see Page 66) 3. If necessary, select a better installation position and/or larger antenna (see Page 14)
E 641 (loss of echo) after turn on the power supply	If the instrument is configured to Hold by loss of echo the output is set to any value/ current.	noise level during the initialisation phase to high.	Repeat once more empty calibr. (005). Caution! Before conformation change with or to the edit mode.

9.4 Orientation of the Micropilot

For orientation a marker is found on the flange or threaded boss of the Micropilot. During installation this must be oriented as follows (see Page 10):

- In tanks: to the vessel wall
- In stilling wells: to the slots
- In bypass pipes: vertical to the tank connectors
- When using the Wave Guide antenna **no** orientation is required!

After commissioning the Micropilot, the echo quality indicates whether a sufficiently large measuring signal is obtained. If necessary, the quality can be optimised later. Vice versa, the presence of an interference echo can be used to minimise this by optimum orientation. The advantage of this is that the subsequent tank mapping uses a somewhat lower level that causes an increase in the strength of the measuring signal. Proceed as follows:



Warning!

Subsequent alignment can lead to personal injury. Before you unscrew or loosen the process connection, make sure that the vessel is not under pressure and does not contain any injurious substances.

1. It is best to empty the container so that the bottom is just covered. However, alignment can be carried out even if the vessel is empty.
2. Optimisation is best carried out with the aid of the envelope graph in the display or the ToF Tool.
3. Unscrew the flange or loosen the threaded boss by a half a turn.
4. Turn the flange by one hole or screw the threaded boss by one eighth of a turn. Note the echo quality.
5. Continue to turn until 360° is reached.
6. Optimum alignment:

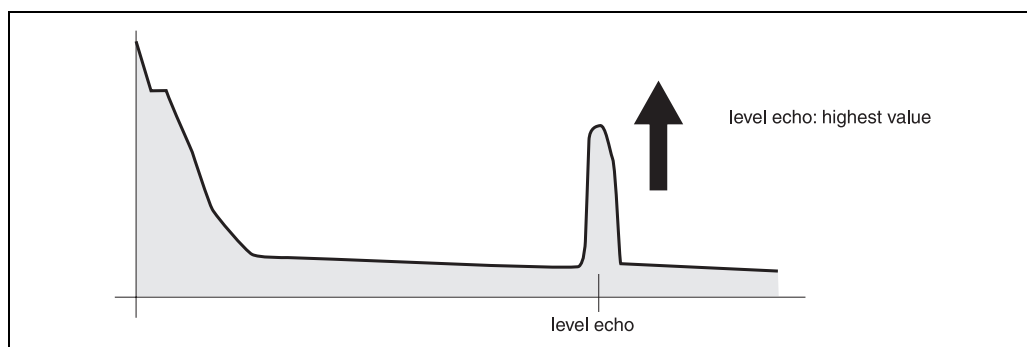


Fig. 5: Vessel partly full, no interference echo obtained

L00-FMRxxxx-19-00-00-en-002

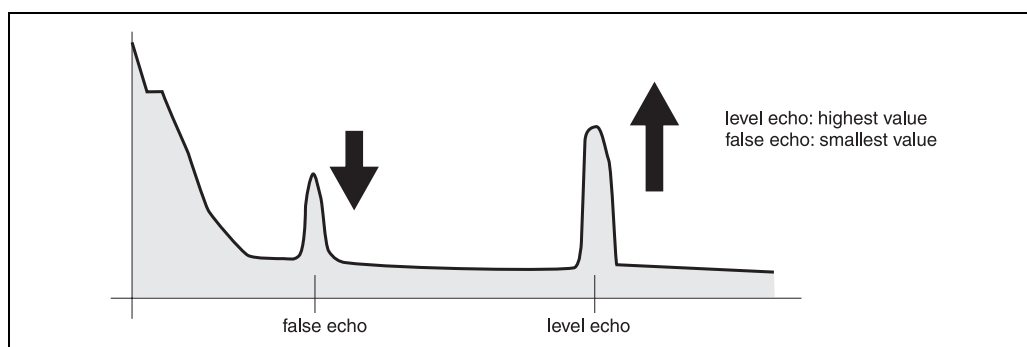


Fig. 6: Vessel partly full, interference echo obtained:

L00-FMRxxxx-19-00-00-en-003

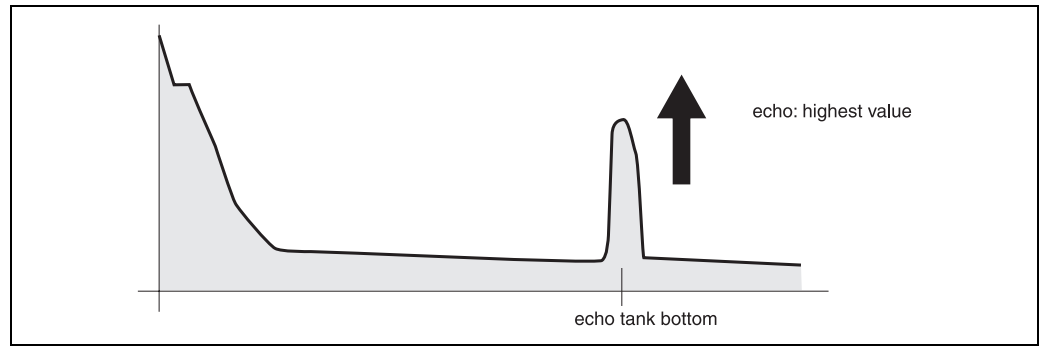


Fig. 7: Vessel empty, no interference echo

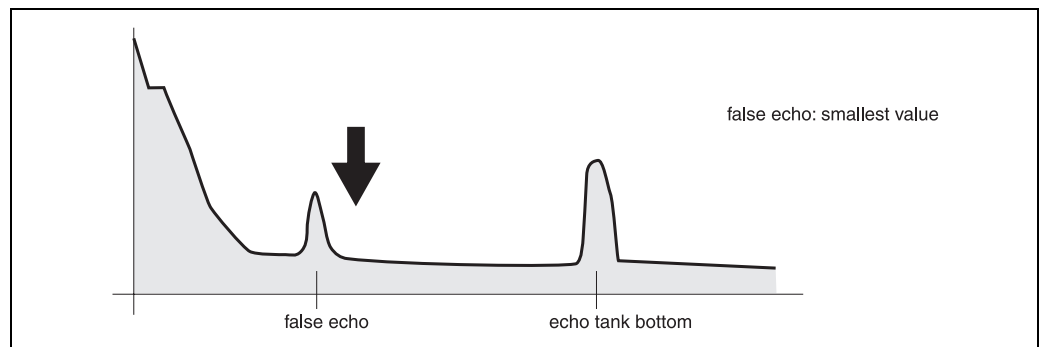


Fig. 8: Vessel empty, interference echo obtained

7. Fix the flange or threaded boss in this position.
If necessary, replace the seal.
8. Carry out tank mapping, see Page 47.

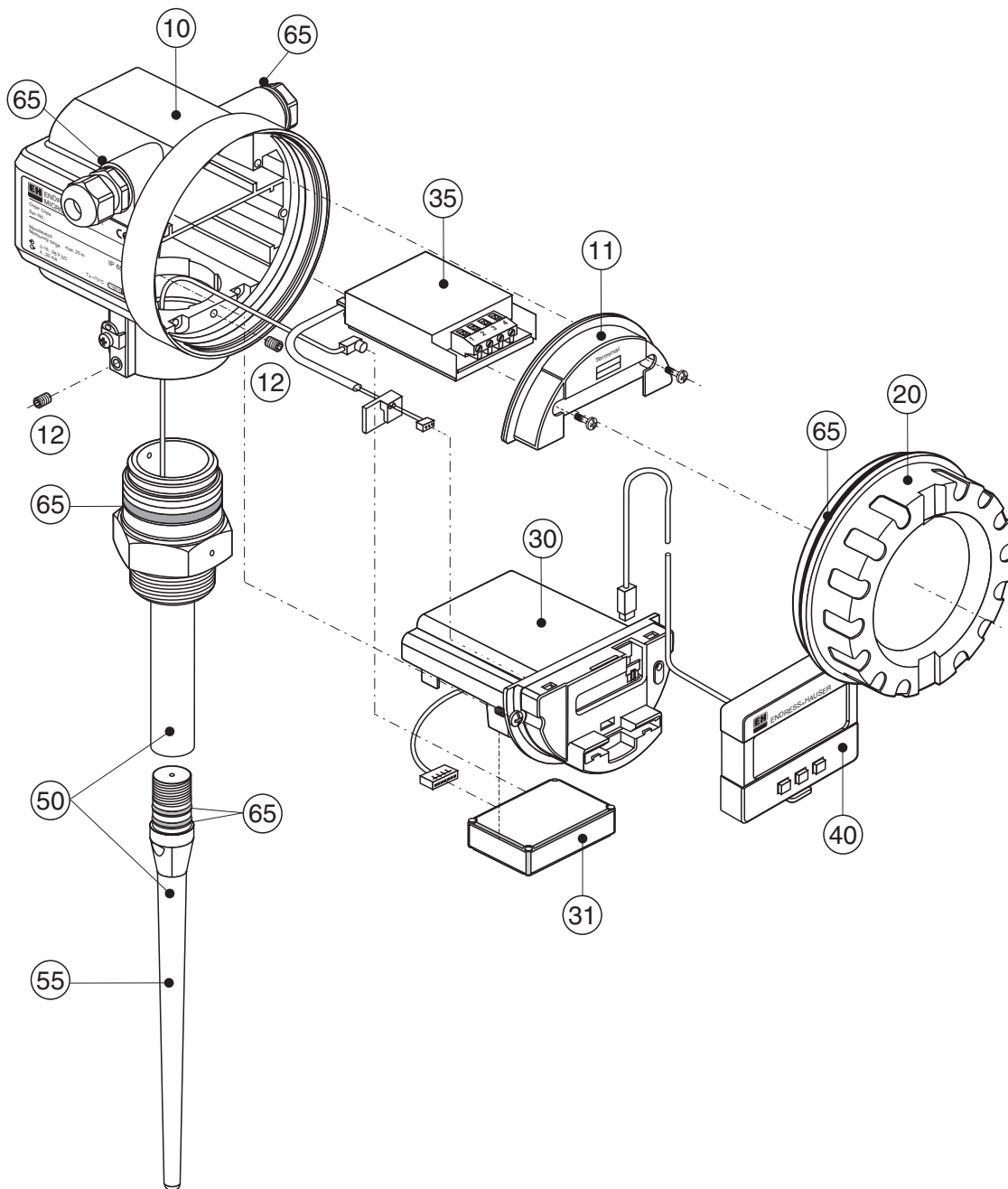
9.5 Spare parts



Note!

You can order spare parts directly from your E+H service organization by giving the serial number which is printed on the measuring transducer nameplate (see Page 6s. Seite 6 ff.). The corresponding spare part number also appears on each spare part. Installation instructions are given on the instruction card that is also delivered.

Spare parts Micropilot M FMR 231, F12 housing with combined wiring and electronics compartment



L00-FMR231xx-00-00-06-xx-001

10 Housing

543120-0022	Housing F12, Aluminium, G1/2
543120-0023	Housing F12, Aluminium, NPT1/2
543120-0024	Housing F12, Aluminium, M20
52001992	Housing F12, Aluminium, M20, PA-plug
52008556	Housing F12, Aluminium, M20, FF-plug

11 Hood for terminal compartment

52006026	Cover terminal compartment F12
52019062	Hood terminal compartment F12, FHX40

12 Screw set

535720-9020	Set of screws housing F12/T12
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20 Cover

52005936	Cover F12/T12 Aluminium, window, gasket
517391-0011	Cover F12/T12 Aluminium, coated, gasket

30 Electronics

52014976	Electronics MICROPILOT-M, Ex, 2Dr, HART, 2.0
52014975	Electronics MICROPILOT-M, Ex, PROFIBUS PA, 2.0
52014979	Electronics MICROPILOT-M, Ex, Foundation Fieldbus, 2.0

31 HF module

517260-0063	HF module MICROPILOT-M, 6,3 GHz
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35 Terminal module / power supply board

52006197	Terminal module 4pole, HART, 2-wire with cable connection
52012156	Terminal module 4pole, PROFIBUS PA, Foundation Fieldbus
52014817	Terminal module 4pole, HART, ferrit (F12), GL marine certificate
52014818	Terminal module 4pole, PROFIBUS PA, Foundation Fieldbus ferrit (F12), GL marine certificate

40 Display

52005585	Display VU331
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50 Antenna assembly with process connection on request!

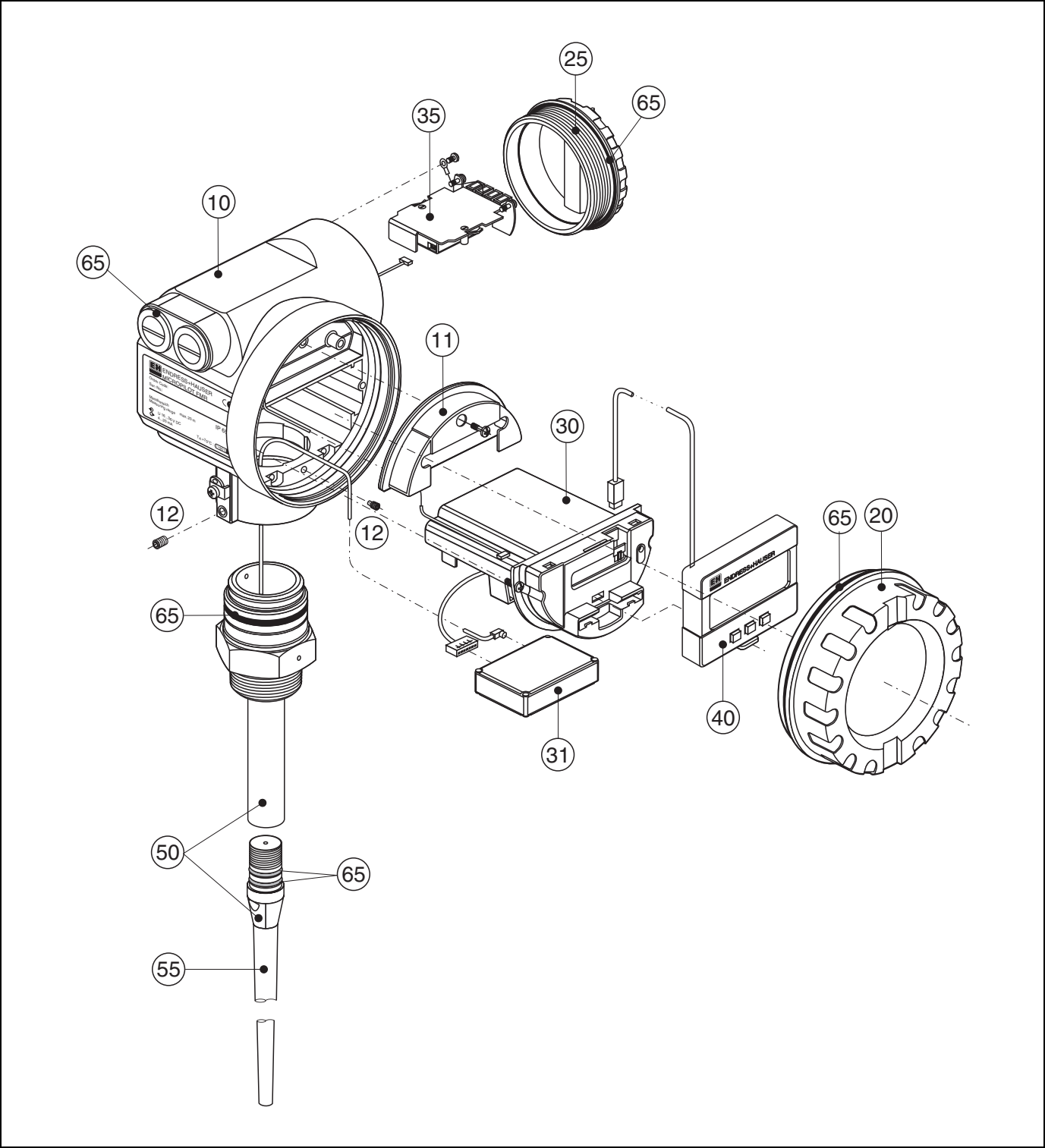
55 Rod antenna

543109-0000 Rod antenna, PPS, + Viton O-ring

65 Sealing kit

535720-9010 consists of:
2 x gasket Pg13.5 FA
2 x O-ring 17.0x2.0 EPDM
1 x O-ring 49.21x3.53 EPDM
2 x O-ring 17.12x2.62 FKM
1 x O-ring 113.9x3.63 EPDM
1 x O-ring 72.0x3.0 EPDM

Spare parts Micropilot M FMR 231, T12 housing with separate wiring and electronics compartment



L00-FMR231xx-00-00-06-xx-002

10 Housing

543180-0022	Housing T12, Aluminium, coated, G1/2, PAL
543180-0023	Housing T12, Aluminium, coated, NPT1/2, PAL
543180-0024	Housing T12, Aluminium, coated, M20, PAL
543180-1023	Housing T12, Aluminium, NPT1/2, PAL, cover, EEx d
52006204	Housing T12, Aluminium, G1/2, PAL, cover, EEx d
52006205	Housing T12, Aluminium, M20, PAL, cover, EEx d

11 Hood for terminal compartment

52005643	Hood T12
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12 Screw set

535720-9020	Set of screws housing F12/T12
-------------	-------------------------------

20 Cover

52005936	Cover F12/T12 Aluminium, window, gasket
517391-0011	Cover F12/T12 Aluminium, coated, gasket

25 Cover for terminal compartment

518710-0020	Cover T3/T12, Aluminium, coated, gasket
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30 Electronics

52014976	Electronics MICROPILOT-M, Ex, HART, 2.0
52014975	Electronics MICROPILOT-M, Ex, PROFIBUS PA, 2.0
52014979	Electronics MICROPILOT-M, Ex, Foundation Fieldbus, 2.0

31 HF module

517260-0063	HF module MICROPILOT-M, 6,3 GHz
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35 Terminal module / power supply board

52013302	Terminal module 4pole, 2-wire, HART, EEx d
52013303	Terminal module 2pole, 2-wire, PROFIBUS PA / Foundation Fieldbus, EEx d
52018949	Terminal module 4pole, 2-wire, HART, EEx ia, overvoltage protection
52018950	Terminal module 4pole, 2-wire, PROFIBUS PA / Foundation Fieldbus, EEx ia, overvoltage protection

40 Display

52005585	Display VU331
----------	---------------

50 Antenna assembly with process connection on request!

55 Rod antenna

543109-0000 Rod antenna, PPS, + Viton O-ring

65 Sealing kit

535720-9010 consists of:
2 x gasket Pg13.5 FA
2 x O-ring 17.0x2.0 EPDM
1 x O-ring 49.21x3.53 EPDM
2 x O-ring 17.12x2.62 FKM
1 x O-ring 113.9x3.63 EPDM
1 x O-ring 72.0x3.0 EPDM

Spare parts Micropilot M FMR 231, F23 housing with combined wiring and electronics compartment**Stainless steel housing on request!****20 Cover**

52018670	Cover F23, 316L, sight glass, gasket
52018671	DeCoverckel F23, 316L, gasket

9.6 Return

The following procedures must be carried out before a transmitter is sent to Endress+Hauser e.g. for repair or calibration:

- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- Always enclose a duly completed "Declaration of contamination" form (a copy of the "Declaration of contamination" is included at the end of this operating manual). Only then can Endress +Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.

Additionally specify:

- An exact description of the application.
- The chemical and physical characteristics of the product.
- A short description of the error that occurred (specify error code if possible)
- If necessary, give the error code.

9.7 Disposal

In case of disposal please separate the different components according to their material consistence.

9.8 Software history

Software version / Date	Software changes	Documentation changes
V 01.01.00 / 12.2000	Original software. Operated via: <ul style="list-style-type: none"> – ToF Tool from version 1.5 – Commuwin II (from version 2.07-3) – HART communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1. 	
V 01.02.00 / 05.2002 V 01.02.02 / 03.2003	<ul style="list-style-type: none"> • Function group: envelope curve display • Katakana (japanese) • current turn down (HART only) • the customer tank map can be edited • length of antenna extension FAR 10 can be entered directly Operated via: <ul style="list-style-type: none"> – ToF Tool from version 3.1 – Commuwin II (from version 2.08-1) – HART communicator DXR 375 with Rev. 1, DD 1. 	Description of new functions.

9.9 Contact addresses of Endress+Hauser

The addresses of Endress+Hauser are given on the back cover of this operating manual. If you have any questions, please do not hesitate to contact your E+H representative.

10 Technical data

10.1 Additional technical data

10.1.1 Input

Measured variable	<p>The measured variable is the distance between a reference point and a reflective surface (i.e. medium surface).</p> <p>The level is calculated based on the tank height entered.</p> <p>The level can be converted into other units (volume, mass) by means of a linearization.</p>
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10.1.2 Output

Output signal	4...20 mA with HART protocol
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Signal on alarm	<p>Error information can be accessed via the following interfaces:</p> <ul style="list-style-type: none"> • Local display: <ul style="list-style-type: none"> – Error symbol (see Page 30) – Plain text display • Current output • Digital interface
-----------------	--

Linearization	<p>The linearization function of the Micropilot M allows the conversion of the measured value into any unit of length or volume. Linearization tables for calculating the volume in cylindrical tanks are pre-programmed. Other tables of up to 32 value pairs can be entered manually or semi-automatically.</p>
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10.1.3 Auxiliary energy

Ripple HART	47...125 Hz: $U_{ss} = 200 \text{ mV}$ (at 500Ω)
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Max. noise HART	500 Hz...10 kHz: $U_{eff} = 2.2 \text{ mV}$ (at 500Ω)
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10.1.4 Performance characteristics

Reference operating conditions	<ul style="list-style-type: none"> • temperature = $+20 \text{ °C}$ (68 °F) $\pm 5 \text{ °C}$ (9 °F) • pressure = 1013 mbar abs. (14.7 psia) $\pm 20 \text{ mbar}$ (0.3 psi) • relative humidity (air) = 65 \% $\pm 20 \text{ \%}$ • ideal reflector • no major interference reflections inside the signal beam
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Maximum measured error	<p>Typical statements for reference conditions, include linearity, repeatability, and hysteresis:</p> <ul style="list-style-type: none"> • FMR 231: up to $10 \text{ m} \pm 10 \text{ mm}$, off $10 \text{ m} \pm 0.1 \text{ \%}$ of measuring range
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Resolution	Digital / analog in % 4...20 mA • FMR 231: 1mm / 0.03 % of measuring range
Reaction time	The reaction time depends on the parameter settings (min. 1 s). In case of fast level changes, the instrument needs the reaction time to indicate the new value.
Influence of ambiente temperature	The measurements are carried out in accordance with EN 61298-3: • digital output (HART, PROFIBUS PA, Foundation Fieldbus): – FMR 231 average T_K : 5 mm/10 K, max. 15 mm over the entire temperature range -40 °C...+80 °C • Current output (additional error, in reference to the span of 16 mA): – Zero point (4 mA) average T_K : 0,03 %/10 K, max. 0,45 % over the entire temperature range -40 °C...+80 °C – Span (20 mA) average T_K : 0,09 %/10 K, max. 0,95 % over the entire temperature range -40 °C...+80 °C

10.1.5 Operating conditions: Environment

Ambient temperature range	Ambient temperature for the transmitter: -40 °C ... +80 °C (-40 °F ... +176 °F), -50 °C (-58 °F) on request. The functionality of the LCD display may be limited for temperatures $T_a < -20$ °C and $T_a > +60$ °C. A weather protection cover should be used for outdoor operation if the instrument is exposed to direct sunlight.
Storage temperature	-40 °C ... +80 °C (-40 °F ... +176°F), -50 °C (-58 °F) on request.
Climate class	DIN EN 60068-2-38 (test Z/AD)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20...2000 Hz, 1 (m/s ²) ² /Hz This value can be reduced for Wave Guide antennas, depending on the length. In the event of horizontal stress, mechanical support is required or provide the Wave Guide antenna with a protective pipe.
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 medium and the reflectivity, mainly determined by the dielectric constant ϵ_r . If the medium tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care has to be taken not to damage the antenna in the process of a mechanical or hose-down cleaning (eventually connection for cleaning liquid). 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 analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).

10.1.6 Operating conditions: Process

Antenna	PPS antistatic		PTFE antistatic		
Process connection	Threaded connection	Flange	Threaded connection	Flange	
	metal	unclad	metal	unclad	clad antistatic
Temperature	-20 °C...+120 °C (-4 °F...+248 °F)		-40 °C...+150 °C (-40 °F...+302 °F)		
Pressure	vacuum...16 bar (...232 psi)		vacuum...40 bar (...580 psi)		vacuum...16 bar (...232 psi)
Wetted parts	316 L / 1.4435 + Viton + PPS		316 L / 1.4435 + PTFE (TFM 4220, 2% conductive additives)		PTFE (TFM 4220, 2% conductive additives)

Antenna	PTFE					
Process connection	Threaded connection		Flange		Sanitary coupling ¹⁾	
	PVDF (not gastight)	metal	unclad	clad	Triclamp	Milchrohr Aseptisch
Temperature	-40 °C...+80 °C (-40 °F...+176 °F)		-40 °C...+150 °C (-40 °F...+302 °F)			
Pressure	vacuum...3 bar (...43.5 psi)	vacuum...40 bar (...580 psi)		vacuum...16 bar (...232 psi)	vacuum...16 bar (2") (...232 psi) vacuum...10 bar (3") (...145 psi)	vacuum...25 bar (...362 psi)
Wetted parts	PVDF + PTFE	316 L / 1.4435 + PTFE		PTFE ²⁾	316 L / 1.4435 + PTFE (TFM 1600)	

1) 3A approval, FDA-listed material

2) on DN150, 6" ANSI, JIS 150A the disc is made of antistatic PTFE (= black)

Dielectric constant

- in a stilling well/Wave Guide antenna: $\epsilon_r \geq 1,4$
- in free space: $\epsilon_r \geq 1,9$

10.1.7 Mechanical construction

Weight

- F12/T12 housing: approx 4 kg + weight of flange
- F23 housing: approx 7.4 kg + weight of flange

10.1.8 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, FCC

Overspill protection	german WHG, see ZE 244F/00/de. SIL 2, see SD 150F/00/en "Functional Safety Manula".
External standards and guidelines	<p>EN 60529 Protection class of housing (IP-code)</p> <p>EN 61010 Safety regulations for electrical devices for measurement, control, regulation and laboratory use.</p> <p>EN 61326 Emissions (equipment class B), compatibility (appendix A - industrial area)</p> <p>NAMUR Standards committee for measurement and control in the chemical industry</p>
Ex approval	<p>XA 099F-C Installation Micropilot M FMR 2xx (F12 / EEx ia IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G)</p> <p>XA 100F-C Installation Micropilot M FMR 2xx (T12 / EEx em [ia] IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G)</p> <p>XA 101F-C Installation Micropilot M FMR 2xx (T12 / EEx d [ia] IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G)</p> <p>XA 103F-D Installation Micropilot M FMR 2xx (F12 / PTFE antenna, non-conductive / EEx ia IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G)</p> <p>XA 105F-D Installation Micropilot M FMR 2xx (T12 / PTFE antenna, non-conductive / EExd [ia] IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G)</p> <p>XA 203F-B Installation Micropilot M FMR 2xx (F23 / EEx ia IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G)</p> <p>XA 205F-B Installation Micropilot M FMR 2xx (F23 / PTFE antenna, non-conductive / EEx ia IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G)</p> <p>XA 207F-B Installation Micropilot M FMR 2xx (T12 with overvoltage protection / EEx ia IIC T6) PTB 00 ATEX 2118, Equipment marking: (II 1/2 G)</p> <p>XA 209F-B Installation Micropilot M FMR 2xx (T12 with overvoltage protection / PTFE antenna, non-conductive / EEx ia IIC T6) PTB 00 ATEX 2117 X, Equipment marking: (II 1/2 G)</p> <p>XA 233F-A Installation Micropilot M FMR 2xx (ATEX II 3 G EEx nA IIC T6, in preparation)</p>

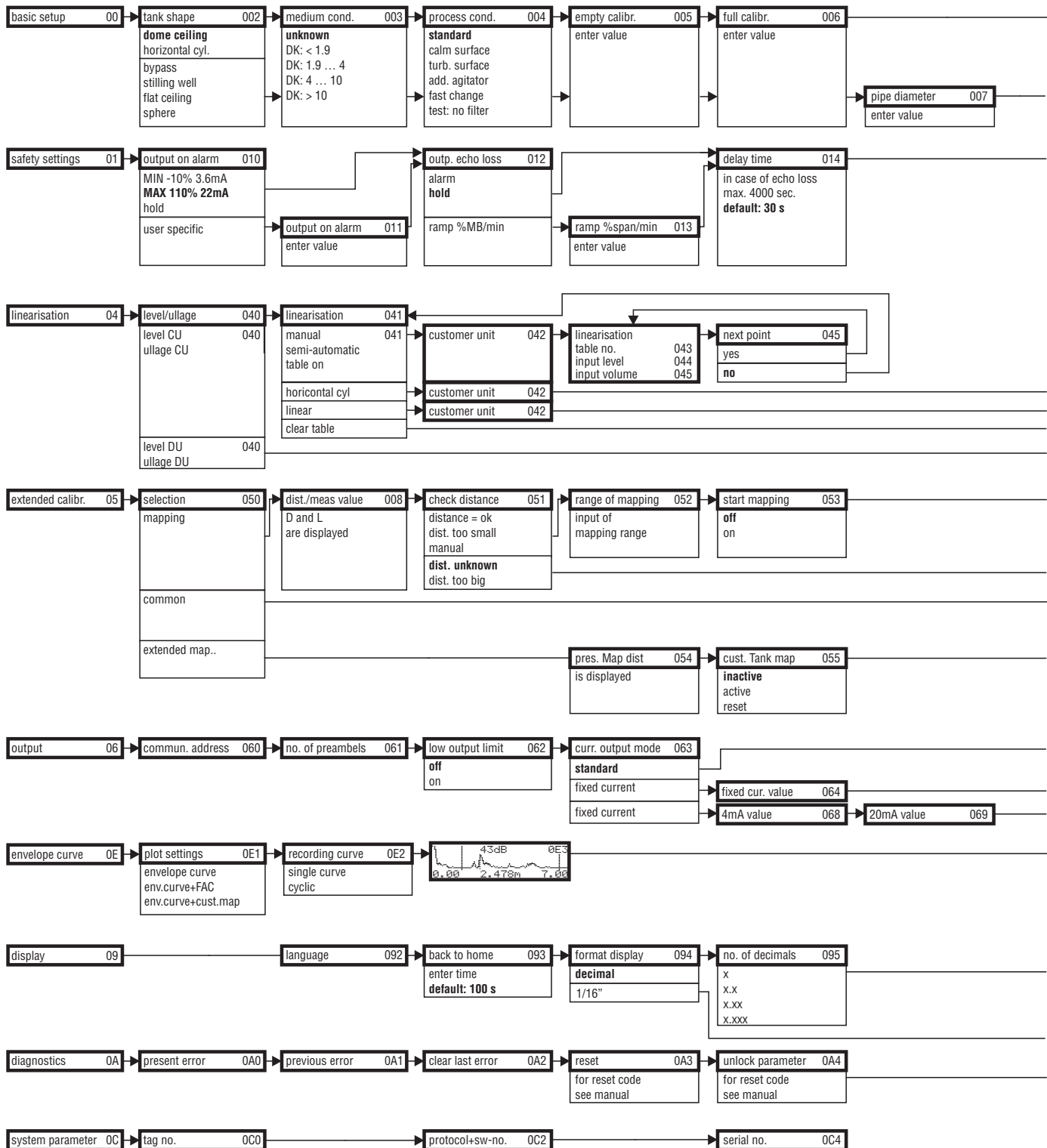
Marine certificate	GL (German Lloyd) – HART, PROFIBUS PA – not Wave Guided antenna, not HT antenna
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10.1.9 Supplementary Documentation

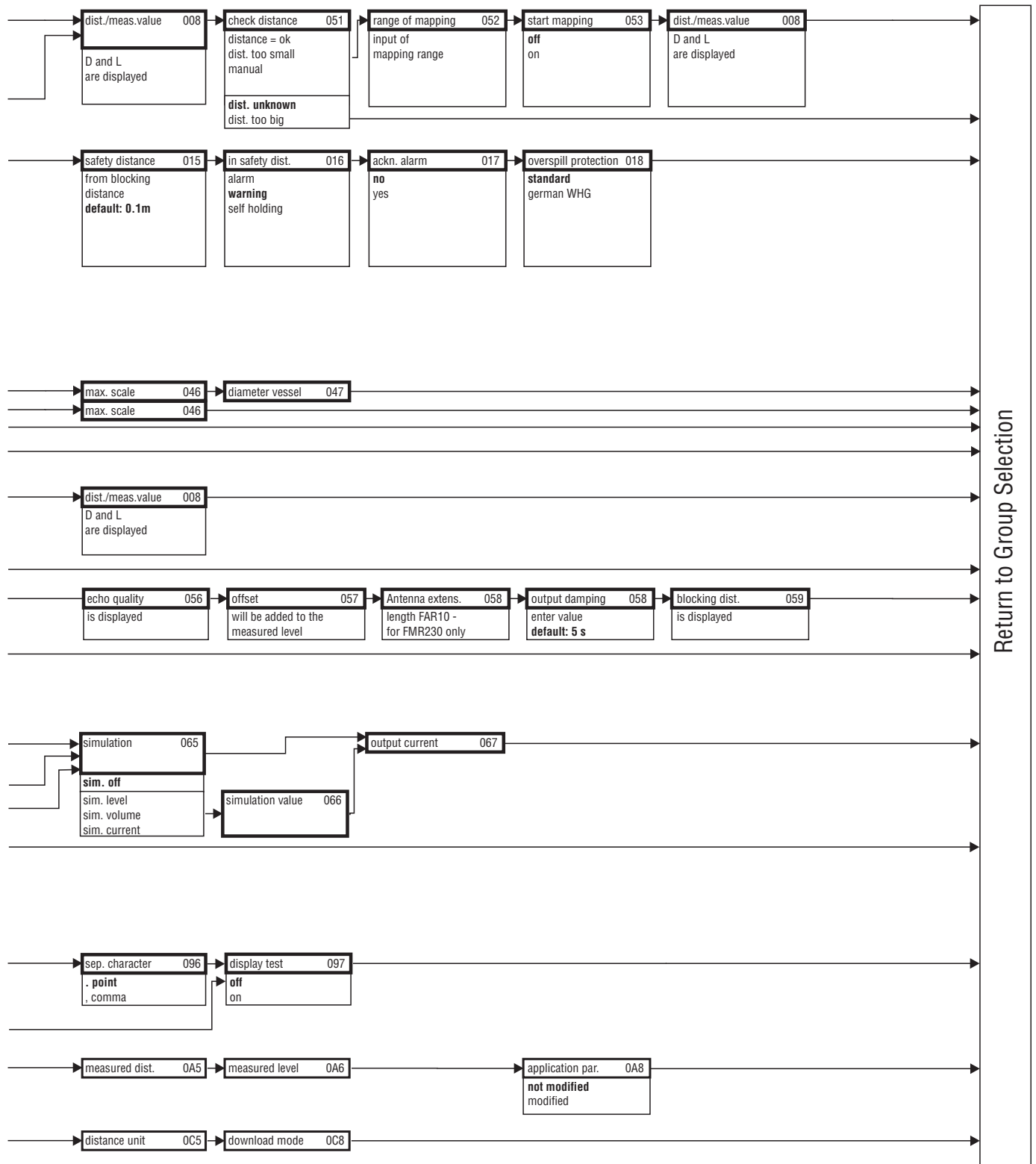
Supplementary Documentation	<ul style="list-style-type: none">• System Information Micropilot (SI 019F/00/en)• Technical Information (TI 345F/00/en)• Operating Instructions "Description of instrument functions" (BA 221F/00/en)• Safety Manual "Functional Safety Manual" (SD 150F/00/en).
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11 Appendix

11.1 Operating menu HART (display modul), ToF Tool



Note! The default values of the parameters are typed in boldface.



11.2 Operating matrix HART / Commuwin II

Operating Matrix HART / COMMUWIN II

Function group	V-CWII	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
00 basic setup	V0	measured value		tank shape	medium property	process cond.	empty calibr.	full calibr.	pipe diameter		
01 safety settings	V1	output on alarm	output on alarm	outp. echo loss	ramp %span/min	delay time	safety distance	in safety dist.	ackn. alarm	overspill protection	
04 linearisation	V3	level/ullage	linearisation	customer unit	table no.	input level	input volume	max. scale	diameter vessel		
05 extended calibr.	V4		check distance	range of mapping	start mapping	pres. Map dist	cust. Tank map	echo quality	offset	output damping	blocking dist.
06 output	V5	commun. address	no. of preambels	low output limit	curr.output mode	fixed cur. value	simulation	simulation value	output current	4mA value	20mA value
09 display	V6			language	back to home	format display	no.of decimals	sep. character			
0D service	V7										
0A diagnostics	V9	present error	previous error	clear last error	reset	unlock parameter	measured dist.	measured level		application par.	
0C system parameter	VA	tag no.		protocol-hsw-no.		serial no.	distance unit			download mode	antenna ext.

L00-FMR2xxxx-19-00-00-de-000

11.3 Description of functions



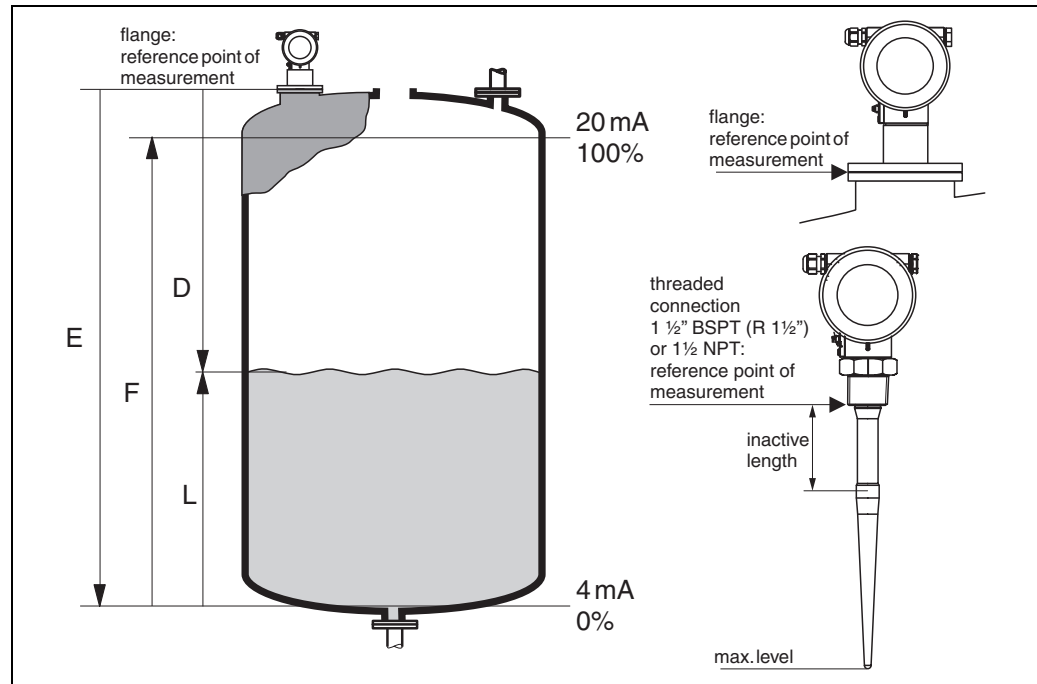
Note!

A detailed description of the function groups, functions and parameters is given in the documentation BA 221F/00/en - a description of the instrument functions of the Micropilot M.

11.4 Function and system design

11.4.1 Function (Measuring principle)

The Micropilot is a "downward-looking" measuring system, operating based 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 received again by the radar system.



L00-FMR2xxxx-15-00-00-en-001

Input

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

The mm-accuracy of the Micropilot S could be achieved with the patented algorithms of the PhaseMaster® software.

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

$$D = c \cdot t/2,$$

with c being the speed of light.

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

$$L = E - D$$

Refer to the above figure for the reference point for "E".

The Micropilot is 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.

Output

The Micropilot 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 process cond.. The data points "E" and "F" correspond with 4mA and 20mA for instruments with current output. They correspond with 0 % and 100 % for digital outputs and the display module.

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

11.4.2 Equipment architecture

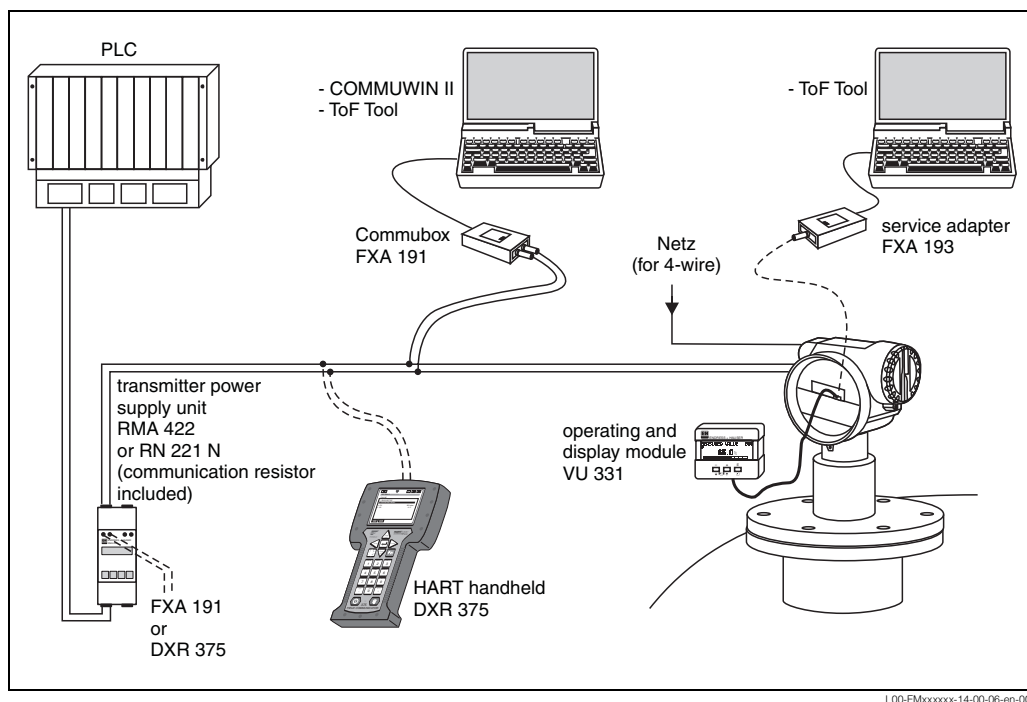
Stand-alone

The Micropilot M can be used for measurement in a stilling well / bypass as well as in free space.

The instrument provides a 4...20 mA output with HART protocol, or PROFIBUS PA respectively Foundation Fieldbus communication.

4...20 mA output with HART protocol

The complete measuring system consists of:



If the HART communication resistor is not built into the supply unit, it is necessary to insert a communication resistor of 250 Ω into the 2-wire line.

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 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 documentation of the measuring point.

Remote operation

- with HART handheld DXR 375,
- with a Personal Computer, Commubox FXA 191 and the operating software COMMUWIN II respectively ToF Tool.

11.4.3 Patents

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

- US 5,387,918 \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

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