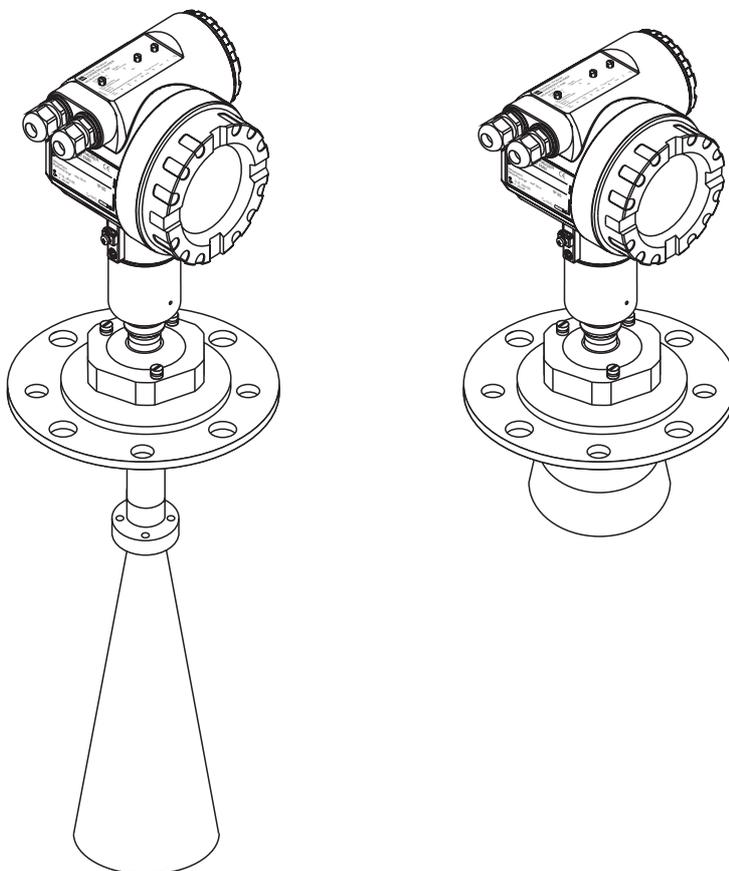|								
Level	Pressure	Flow	Temperature	Liquid Analysis	Registration	Systems Components	Services	Solutions

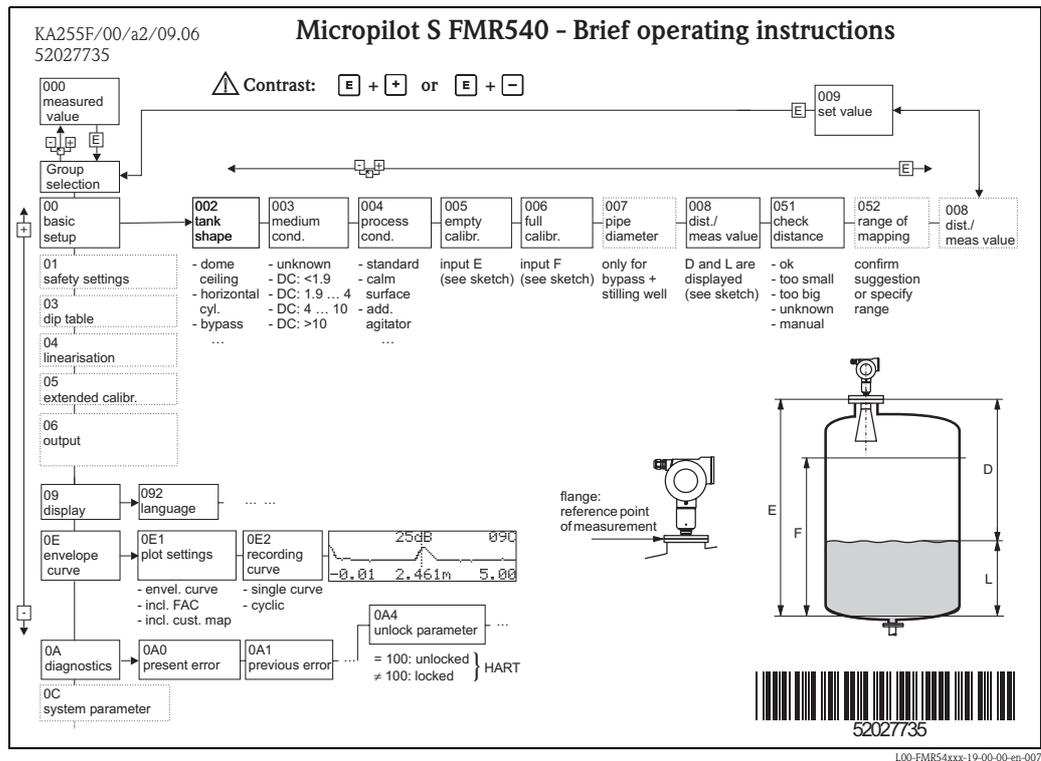Operating Instructions

Micropilot S FMR540

Level-Radar

HART®
COMMUNICATION PROTOCOL

Endress+Hauser

People for Process Automation

Brief operating instructions

KA255F/00/a2/09.06
52027735

Micropilot S FMR540 – Brief operating instructions

⚠ Contrast: [E] + [+] or [E] + [−]

| 000 measured value |
| Group selection |

009 set value

| 00 basic setup | 002 **tank shape** | 003 medium cond. | 004 process cond. | 005 empty calibr. | 006 full calibr. | 007 pipe diameter | 008 dist./ meas value | 051 check distance | 052 range of mapping | 008 dist./ meas value |

01 safety settings

03 dip table

04 linearisation

05 extended calibr.

06 output

- dome ceiling
- horizontal cyl.
- bypass
…

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

- standard
- calm surface
- add. agitator
…

input E (see sketch)

input F (see sketch)

only for bypass + stilling well

D and L are displayed (see sketch)

- ok
- too small
- too big
- unknown
- manual

confirm suggestion or specify range

| 09 display | 092 language |

| 0E envelope curve | 0E1 plot settings | 0E2 recording curve |

25dB   090
−0.01 2.461m 5.00

- envel. curve
- incl. FAC
- incl. cust. map

- single curve
- cyclic

flange: reference point of measurement

| 0A diagnostics | 0A0 present error | 0A1 previous error |

0A4 unlock parameter

= 100: unlocked
≠ 100: locked } HART

0C system parameter

52027735

L00-FMR54xxx-19-00-00-en-007

✎ 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 S 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 → 📄 72.

The operating manual BA00341F/00/EN "Description of Instrument Functions" provides an **extensive description of all device functions**, which can be found on the enclosed CD-ROM.

The Operating Instructions can also be found on our homepage: www.endress.com

Table of contents

1 Safety instructions

1.1 Designated use

The Micropilot S is a compact level radar for the continuous, contactless measurement of predominantly solids. The device can also be freely mounted outside closed metal vessels because of its operating frequency in the K–band and a maximum radiated pulsed energy of 1 mW (average power output 1 µW). Operation is completely harmless to humans and animals.

1.2 Installation, commissioning and operation

The Micropilot S 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 device 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 and process safety

Alternative monitoring measures must be taken to ensure operational safety and process safety during configuration, testing and maintenance work on the device.

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 standards and 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.

Safety conventions	
⚠	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the device.
☞	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the device.
✎	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an device response which is not planned.
Explosion protection	
⟨Ex⟩	**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.
⟨EX⟩	**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.
⟨EX⟩	**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.
Electrical symbols	
⎓	**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.
t >85°C	**Temperature resistance of the connection cables** States, that the connection cables must be resistant to a temperature of at least 85 °C.

2   Identification

2.1   Device designation

2.1.1   Nameplate

The following technical data are given on the device nameplate:
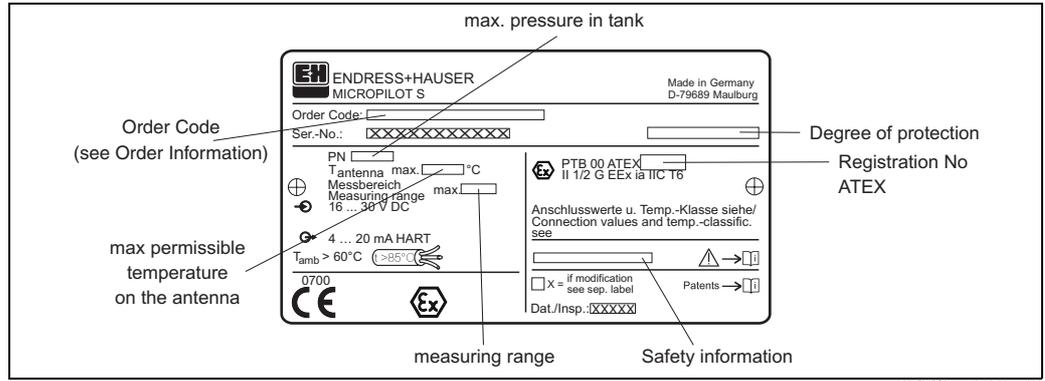
Information on the nameplate of the Micropilot S FMR540
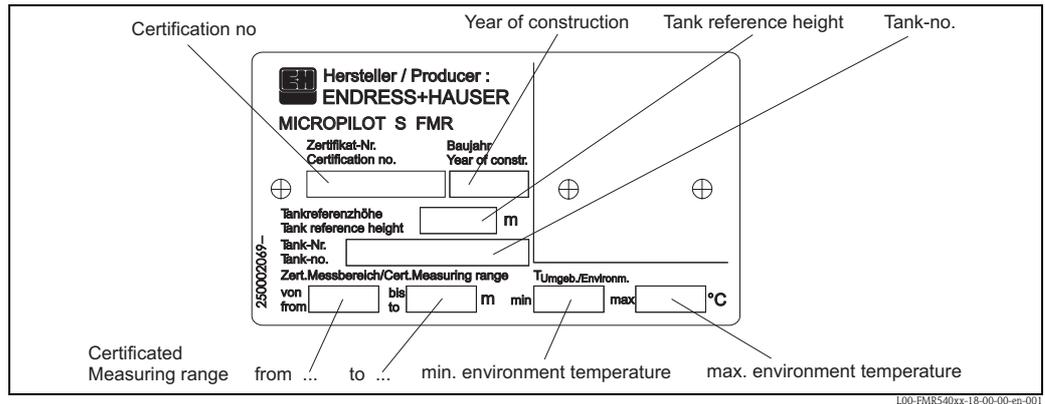
Information on the NMi type plate for custody transfer applications of the Micropilot S FMR540
Note!
The fields are only filled if in feature "70 – Weight + measures approval" the variant "F" is selected.
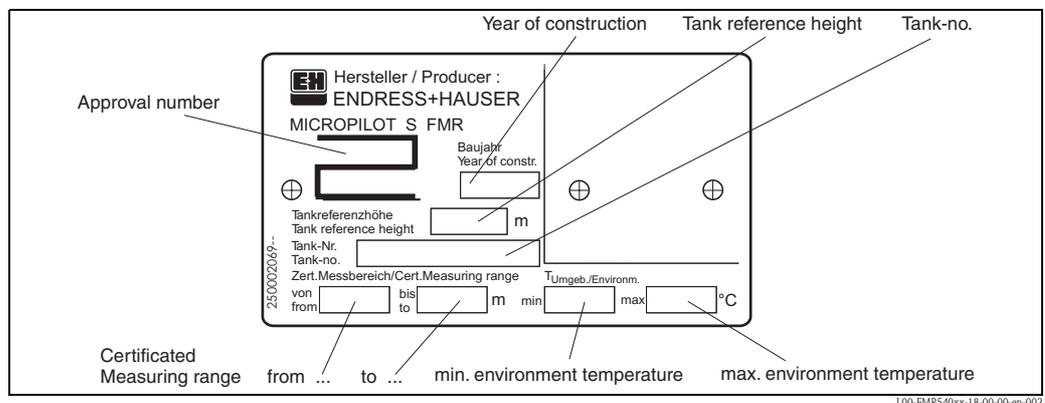
Information on the PTB type plate for custody transfer applications of the Micropilot S FMR540
Note!
The fields are only filled if in feature "70 – Weight + measures approval" the variant "G" is selected.

2.1.2   Ordering structure

This overview does not mark options which are mutually exclusive.

10		Approval:
	A	Non-hazardous area
	D	IEC Ex ia IIC T6 (in preparation)
	G	ATEX II 3G EEx nA II T6 (in preparation)
	I	NEPSI Ex ia IIC T6 (in preparation)
	K	TIIS Ex ia IIC T3 (in preparation)
	L	TIIS Ex ia IIC T6 (in preparation)
	M	TIIS Ex d (ia) T3 (in preparation)
	N	TIIS Ex d (ia) T6 (in preparation)
	S	FM IS Cl.I Div.1 Gr.A-D, zone 0,1,2
	T	FM XP Cl.I Div.1 Gr.A-D, zone 1,2 (in preparation)
	U	CSA IS Cl.I Div.1 Gr.A-D, zone 0,1,2
	V	CSA XP Cl.I Div.1 Gr. A-D, zone 1,2 (in preparation)
	1	ATEX II 1/2G EEx ia IIC T6
	4	ATEX II 1/2G EEx d (ia) IIC T6 (in preparation)
	6	ATEX II 1/2G EEx ia IIC T6, WHG
	Y	Special version, TSP-No. to be spec.

20		Antenna; Seal:
	E	100mm/4" horn, Align. device; FKM Viton GLT
	G	200mm/8" Parabolic, Align. device; FKM Viton GLT
	H	250mm/10" Parabolic, Align. device; FKM Viton GLT
	9	Special version, TSP-No. to be spec.

30		Antenna Extension:
	1	w/o
	2	150mm/6"
	3	250mm/10"
	4	450mm/18"
	9	Special version, TSP-No. to be spec.

40		Process connection:
		– EN-Flanges –
	CQJ	DN100 PN10/16 B1, 316L; flange EN1092-1 (DIN2527 C)
	CWJ	DN150 PN10/16 B1, 316L; flange EN1092-1 (DIN2527 C)
	CKJ	DN200 PN16 B1, 316L; flange EN1092-1 (DIN2527 C)
	C6J	DN250 PN16 B1, 316L; flange EN1092-1 (DIN2527 C)
		– ASME-Flanges –
	APJ	4" 150lbs RF, 316/316L, flange ANSI B16.5
	AVJ	6" 150lbs RF, 316/316L, flange ANSI B16.5
	AKJ	8" 150lbs RF, 316/316L, flange ANSI B16.5
	A5J	10" 150lbs RF, 316/316L flange ANSI B16.5
		– JIS-Flanges –
	KHJ	10K 100A RF, 316L, flange JIS B2220
	KVJ	10K 150A RF, 316L, flange JIS B2220
	KDJ	10K 200A RF, 316L, flange JIS B2220
	K5J	10K 250A RF, 316L, flange JIS B2220
		– JPI-Flanges –
	LHJ	100A 150lbs RF, 316/316L flange JPI 7S-15
	LVJ	150A 150lbs RF, 316/316L flange JPI 7S-15
	LKJ	200A 150lbs RF, 316/316L flange JPI 7S-15
	LLJ	250A 150lbs RF, 316/316L flange JPI 7S-15
		– Miscellaneous –
	XVJ	UNI flange DN150/6"/150, 316L Max PN1/14.5lbs/1K, suitable for DN150 PN10/16, 6" 150lbs, 10K 150
	X3J	UNI flange DN200/8"/200, 316L Max PN1/14.5lbs/1K, suitable for DN200 PN10/16, 8" 150lbs, 10K 200
	X5J	UNI flange DN250/10"/250, 316L Max PN1/14.5lbs/1K, suitable for DN250 PN10/16, 10" 150lbs, 10K 250
	YY9	Special version, TSP-No. to be spec.

50		Output; Operation:
	A	4-20mA HART; 4-line display VU331, envelope curve display on site
	Y	Special version, TSP-No. to be spec.

60								Housing:	
						C		T12 Alu, coated IP68 NEMA6P, separate connection compartment	
						Y		Special version, TSP-No. to be spec.	
70								**Cable entry:**	
						1		Thread M20	
						2		Gland M20	
						3		Thread G1/2	
						4		Thread NPT1/2	
						9		Special version, TSP-No. to be spec.	
80								**Weight + Measure Approval:**	
							A	NMi (<1mm) Type approval	
							F	NMi witnessed initial verificat. (<1mm) Type approval	
							G	PTB witnessed initial verificat. (<1mm) Type approval	
							R	Not selected; Inventory control Version (3 mm)	
							Y	Special version, TSP-No. to be spec.	
90								**Additional Option:**	
							A	Basic version	
							G	GL marine certificate (in preparation)	
							Y	Special version, TSP-No. to be spec.	
995								**Marking:**	
								1	Tagging(TAG), see additional spec.
FMR540–									Complete product designation

2.2   Scope of delivery

Caution!
It is essential to follow the instructions concerning the unpacking, transport and storage of measuring devices given in the chapter "Incoming acceptance, transport, storage", → 🖹 10!

The scope of delivery consists of:
- Assembled device
- Accessories (→ 🖹 60)
- 2 seals
- Endress+Hauser operating program on the enclosed CD-ROM
- Brief operating instructions KA01059F/00/EN for quick commissioning
- Brief operating instructions KA00255F/00/A2 (basic setup/troubleshooting), housed in the device
- Approval documentation: if this is not included in the operating manual
- CD-ROM with further documentation, e.g.
  – Technical Information
  – Operating Instructions
  – Description of Instrument Functions

2.3   Certificates and approvals

CE mark, declaration of conformity
The device 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 device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EG directives. Endress+Hauser confirms the successful testing of the device 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

FieldCare®
Registered trademark of the company Endress+Hauser Process Solutions AG, Rheinach, CH

3 Installation

3.1 Quick installation guide

Marker on
sensor neck
(Example)

Maker on flange
(Example)

90°

90°
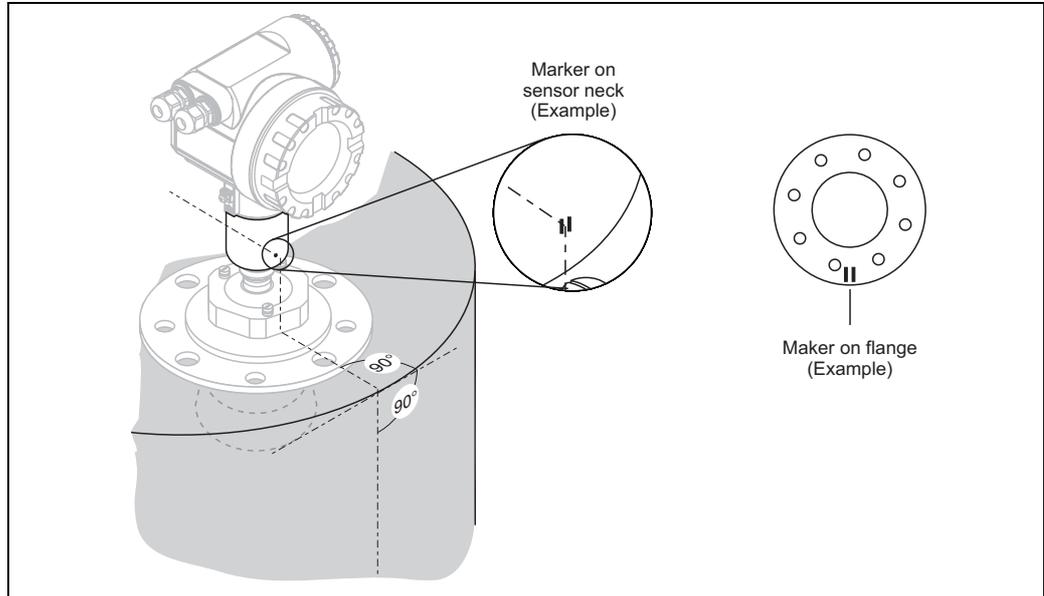
L00-FMR54xxx-17-00-00-en-015

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.
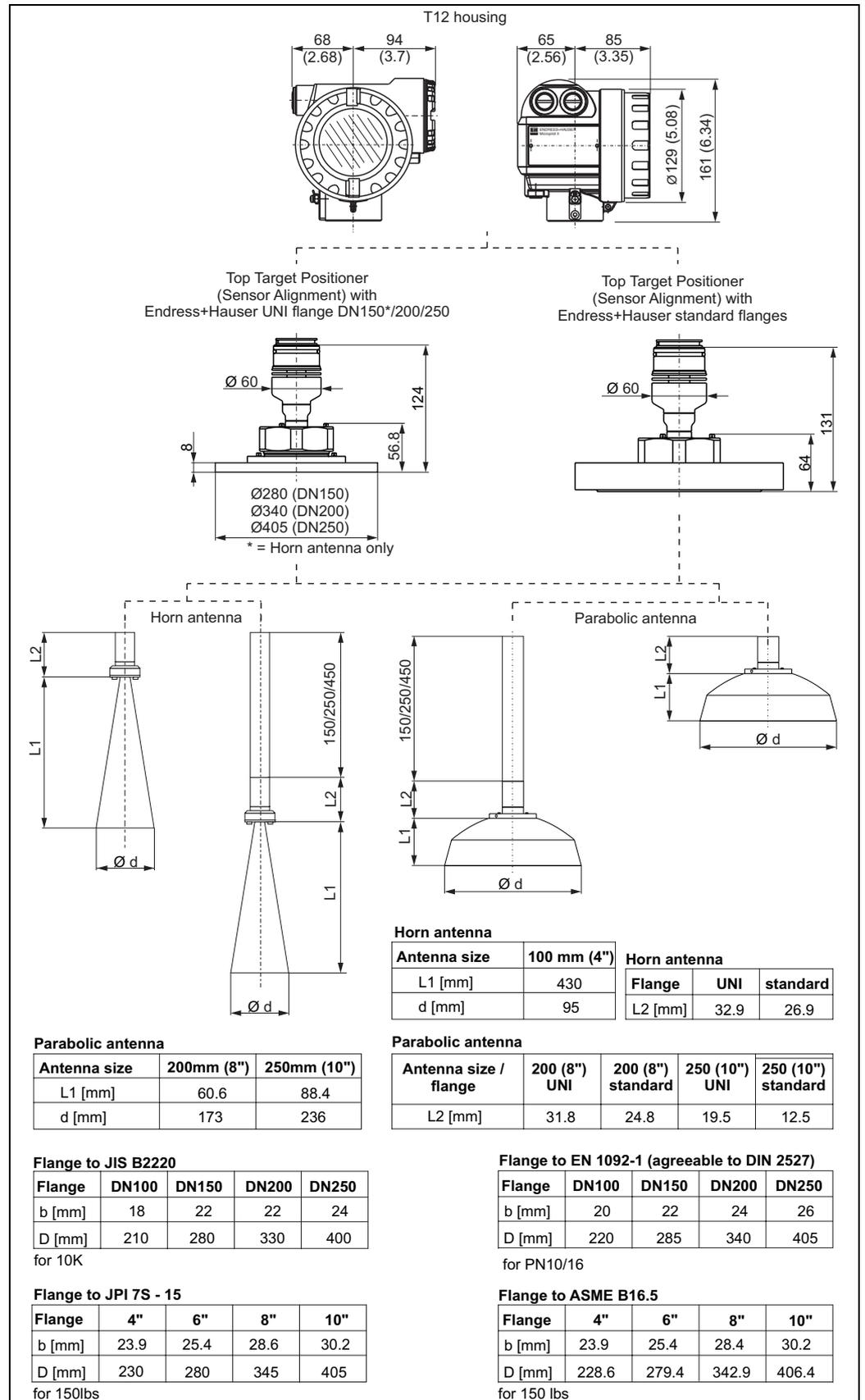
3.2.2 Transport

Caution!
Follow the safety instructions and transport conditions for devices of more than 18 kg.
Do not lift the measuring device by its housing in order to transport it.

3.2.3 Storage

Pack the measuring device 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 to +80 °C or -50 °C to +80 °C.

3.3 Installation conditions

3.3.1 Dimensions

Horn antenna

Antenna size	100 mm (4")
L1 [mm]	430
d [mm]	95

Horn antenna

Flange	UNI	standard
L2 [mm]	32.9	26.9

Parabolic antenna

Antenna size	200mm (8")	250mm (10")
L1 [mm]	60.6	88.4
d [mm]	173	236

Parabolic antenna

Antenna size / flange	200 (8") UNI	200 (8") standard	250 (10") UNI	250 (10") standard
L2 [mm]	31.8	24.8	19.5	12.5

Flange to JIS B2220

Flange	DN100	DN150	DN200	DN250
b [mm]	18	22	22	24
D [mm]	210	280	330	400

for 10K

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

Flange	DN100	DN150	DN200	DN250
b [mm]	20	22	24	26
D [mm]	220	285	340	405

for PN10/16

Flange to JPI 7S - 15

Flange	4"	6"	8"	10"
b [mm]	23.9	25.4	28.6	30.2
D [mm]	230	280	345	405

for 150lbs

Flange to ASME B16.5

Flange	4"	6"	8"	10"
b [mm]	23.9	25.4	28.4	30.2
D [mm]	228.6	279.4	342.9	406.4

for 150 lbs

L00-FMR540xx-06-00-00-en-009

3.3.2 Engineering hints

Orientation

- Recommended distance (1) from tank wall to the center of the nozzle:
  minimum as specified in Table on ("Beam angle", → 🖹 13).
- 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 ("Accessories", → 🖹 60).
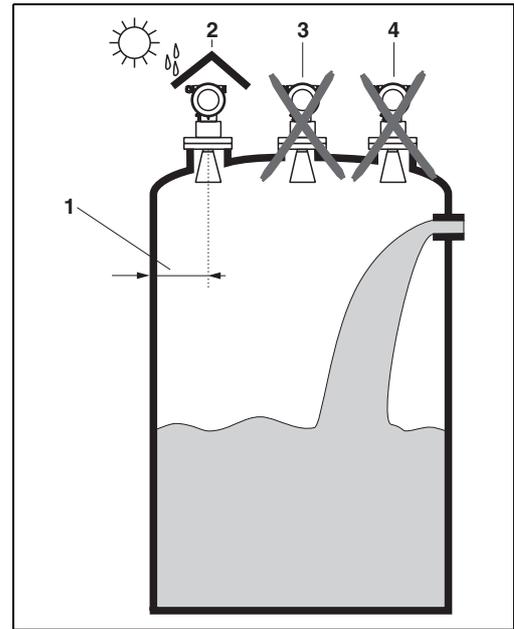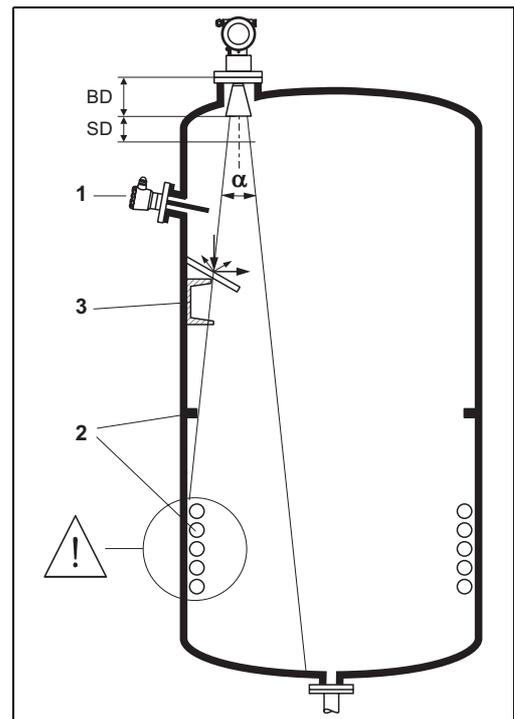
L00-FMR54xxx-17-00-00-yy-012

Tank installations

- Avoid any installations (1), like limit switches, temperature sensors, etc., inside the signal beam ("Beam angle", → 🖹 13).
- It is essential that HiHi alarm is below the blocking distance (BD) and the safety distance (SD).
- Symmetrical installations (2), e.g. 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:
  "Optimum mounting position", → 🖹 16.
- Stilling well: a stilling well can always be used to avoid interference. The FMR532 with planar antenna is recommended for stilling wells with a diameter DN150 (6") and larger.
- Metallic screens (3) mounted at a slope spread the radar signals and can, therefore, reduce interference echoes.

Please contact Endress+Hauser for further information.

L00-FMR54xxx-17-00-00-yy-013

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** ia a function of antenna type (beam angle α) and measuring distance **D.** The recommended distance to the tank wall is indicated in the tables below. It is strongly recommended to avoid any mechanical obstacles within the highlighted area.

	Horn antenna		
Antenna size	100 mm (4")		
Beam angle (α)	8°		

| Measuring distance (D)	Beamwidth diameter (W)	Recommended distance to wall	
		0° tilting	3° tilting
5 m (16 ft)	0.70 m (2.24 ft)	0.89 m (2.92 ft)	0.62 m (2.03 ft)
10 m (32 ft)	1.40 m (4.48 ft)	1.77 m (5.81 ft)	1.23 m (4.04 ft)
15 m (49 ft)	2.10 m (6.85 ft)	2.65 m (8.69 ft)	1.85 m (6.07 ft)
20 m (65 ft)	2.80 m (9.09 ft)	3.53 m (11.58 ft)	2.46 m (8.07 ft)
25 m (82ft)	3.50 m (11.48 ft)	4.41 m (14.47 ft)	3.07 m (10.07 ft)
30 m (98 ft)	4.20 m (13.71 ft)	5.29 m (17.36 ft)	3.69 m (12.11 ft)
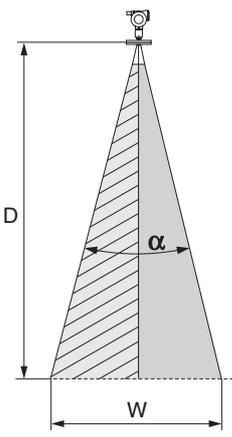
L00-FMR54xxx-14-00-00-xx-003

	Parabolic antenna	
Antenna size	200 mm (8")	250 mm (10")
Beam angle (α)	4.4°	3.3°

Measuring distance (D)	Recommended distance to wall	
5 m (16 ft)	0.35 m (1.15 ft)	0.2 m (0,66 ft)
10 m (32 ft)	0.70 m (2.30 ft)	0.5 m (1.64 ft)
15 m (49 ft)	1.05 m (3.44 ft)	0.75 m (2.46 ft)
20 m (65 ft)	1.40 m (4.59 ft)	1.05 m (3.44 ft)
25 m (82ft)	1.75 m (5.74 ft)	1.3 m (4.27 ft)
30 m (98 ft)	2.10 m (6.89 ft)	1.6 m (5.25 ft)
35 m (115 ft)	2.45 m (8.04 ft)	1.85 m (6.07 ft)
40 m (131 ft)	2.80 m (9.19 ft)	2.1 m (6.89 ft)
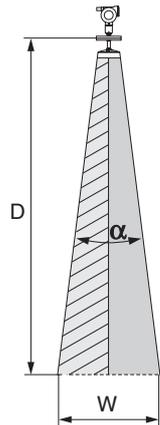
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Measuring conditions

- 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.
- Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions.
- The smallest possible measuring range **B** depends on the antenna version (see fig.).
- Tank diameter and height should be at least dimensioned such that a reflection of the radar signal on both sides of the tank can be avoided.
- In case of media with a low dielectric constant (media groups A and B), the tank bottom can be visible through the medium at low levels (low height **C**). Reduced accuracy has to be expected in this range. If this is not acceptable, we recommend positioning the zero point at a distance **C** (see Fig.) above the tank bottom in these applications.
- In principle it is possible to measure up to the tip of the antenna with FMR540. 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.).

L00-FMR54xxx-17-00-00-yy-009
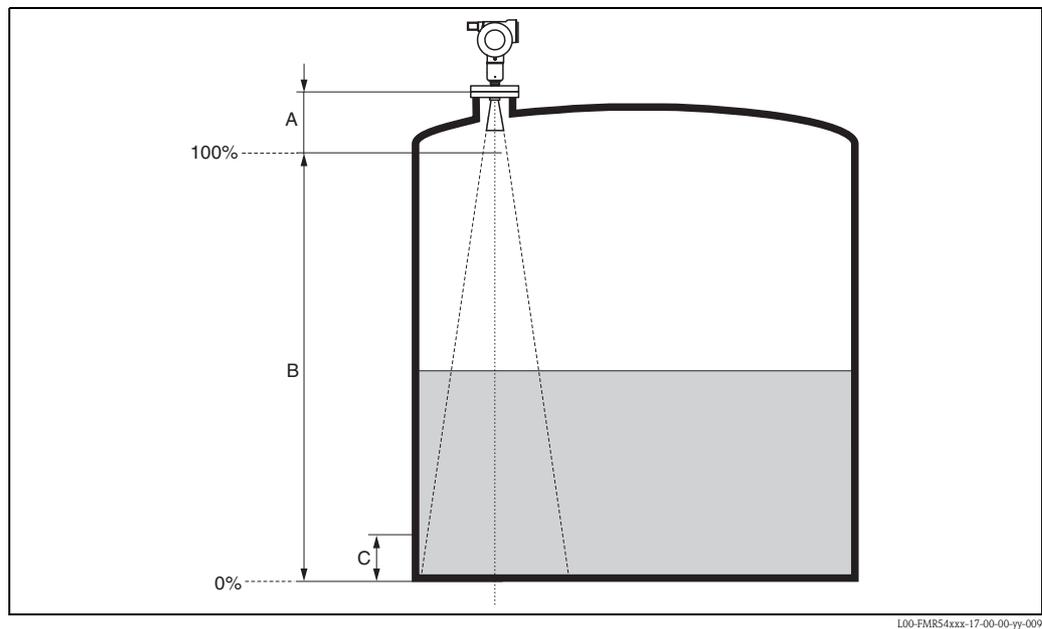
[1)]	A [m (in)]	B [m (in)]	C [mm (in)]
FMR540 (without extension)[2)]	0.6 (23.6)	> 0.5 (> 20)	> 300 (> 12)

1)   All values are based on reference conditions.

2)   The length of a sensor extension shall be added to "A" when selecting the extension option.

Behaviour if measuring range is exceeded

The behaviour in case of the measuring range being exceeded can be freely set:
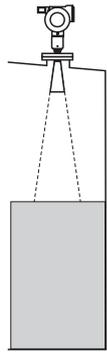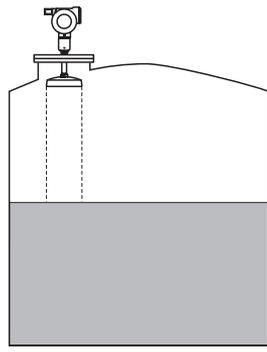The default setting is a current of 22 mA and the generation of a digital warning (E651).

Measuring range

The usable measuring range depends on the size of the antenna, the reflectivity of the medium, the mounting location and possible interference reflections. To achieve an optimised signal strength it is recommended to use an antenna with as large as possible diameter (DN200(8") or DN250 (10") parabolic antenna). 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.

The following table describes the media groups and the dielectric constant εr.

Media group	DC (εr)	Examples
A1	1.4 to 1.6	propane, butane
A2	1.6 to 1.9	non-conducting liquids, kerosene, jet fuels, gasoline, LPG
B	1.9 to 4	non-conducting liquids, e.g. gasline, diesel fuel, heavy oil, motor oil, asphalt, bitumen, BTEX, residual fuel
C	4 to 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, …
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

Measuring range depending on sensor type and media group

Media group		Horn antenna without sensor extension	Parabolic antenna without sensor extension
		Measuring range[1]	Measuring range[1]
A1	DC (εr) = 1.4 to 1.6	Please contact your Endress+Hauser sales organization.	
A2	DC (εr) = 1.6 to 1.9	0.6 to 20 m	0.6 to 40 m
B	DC (εr) = 1.9 to 4	0.6 to 20 m	0.6 to 40 m
C	DC (εr) = 4 to 10	0.6 to 30 m	0.6 to 40 m
D	DC (εr) > 10	0.6 to 30 m	0.6 to 40 m
Max. measuring range with cudstody transfer approval		NMi: 23 m (75 ft) PTB: 23 m (75 ft)	NMi: 26 m (85 ft) PTB: 30 m (98 ft)

1)   All values are based on reference conditions.

✎ Note!
For stilling well applications Micropilot S FMR532 is recommended (see TI00344F/00/EN).
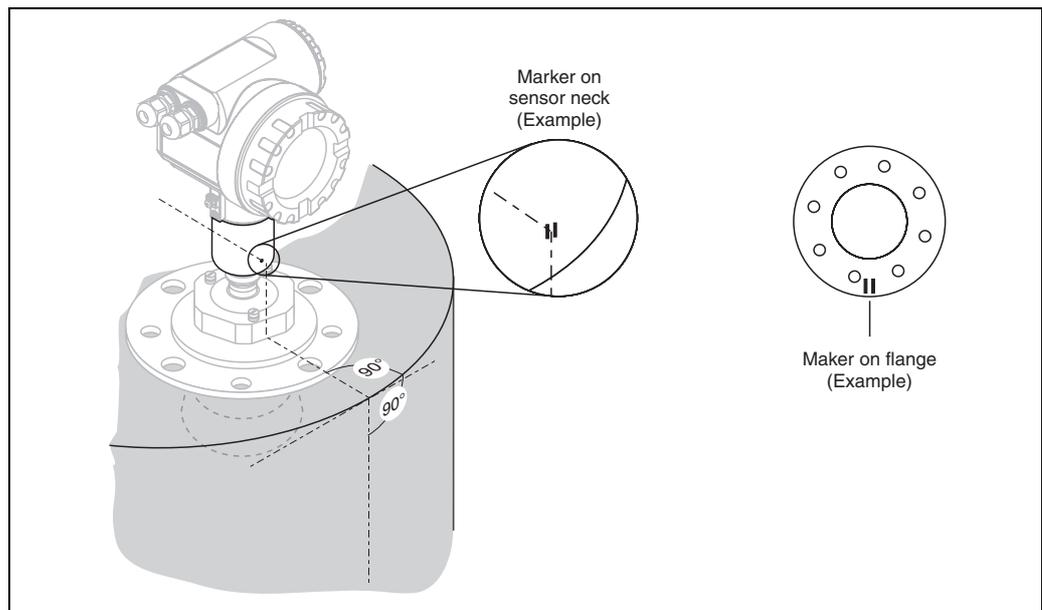
3.4   Installation instructions

3.4.1   Mounting kit

For the mounting , you will require the following tool:
- The tool for flange mounting
- 90 mm wrench for adjustment of the alignment device (only for devices with alignment device)
- 4 mm (0.1") Allen wrench for turning the housing

3.4.2   Installation in vessel

Optimum mounting position

L00-FMR54xxx-17-00-00-en-016

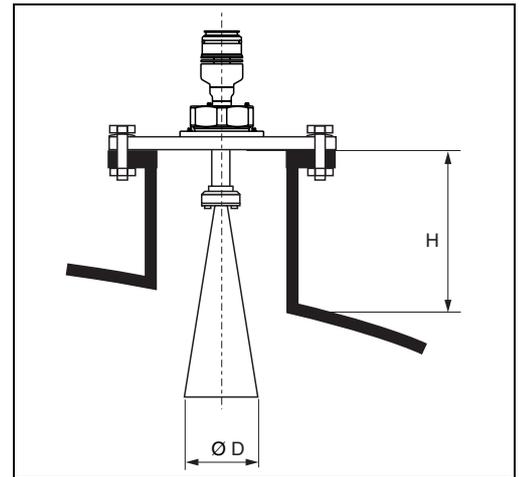**Standard installation FMR540 with horn antenna**
- Observe installation instructions, → 🖹 12.
- Marker must be aligned towards tank wall. The marker is located clearly visible on the sensor neck or the flange.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- Adjust vertical sensor alignment in case the flange is not parallel to the face is medium surface.
- The horn antenna should protrude from the nozzle. If necessary, choose version with antenna extension (→ 🖹 11).
  Note!
  Please contact Endress+Hauser for application with higher nozzle.
- The horn antenna should be installed with 3° inclination towards the tank center.
  To avoid interference reflections or for optimum alignment within the tank, the FMR540 with optional alignment device can be swiveled by 15° in all directions. For more informations please see Operating Instructions KA00274F/00/A2.
  Please contact Endress+Hauser Service Organization for commissioning.

L00-FMR540xx-17-00-00-xx-001

Antenna size	100 mm (4")
D [mm (in)]	95 (3.7)
H [mm (in)] (without antenna extension)	< 430 (< 19.2)

Standard installation FMR540 with parabolic antenna

- Observe installation instructions, → 📄 12.
- Marker is aligned towards tank wall.
  The marker is located clearly visible on the sensor neck or the flange.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- Ideally the parabolic antenna should protrude from the nozzle (1). Particularly when using the alignment device, please ensure that the parabolic reflector is protruding from the nozzle/roof so as not to inhibit alignment. Note!
 For application with higher nozzle install parabolic antenna completely in the nozzle (2), including RF–wave guide (3).
- The parabolic antenna should be installed vertically.
  To avoid interference reflections or for optimum alignment within the vessel, the FMR540 with optional alignment device can be swiveled by 15° in all directions.
  For more informations please see Operating Instructiosn KA00274F/00/A2.
 Please, contact Endress+Hauser Service organization for commissioning.
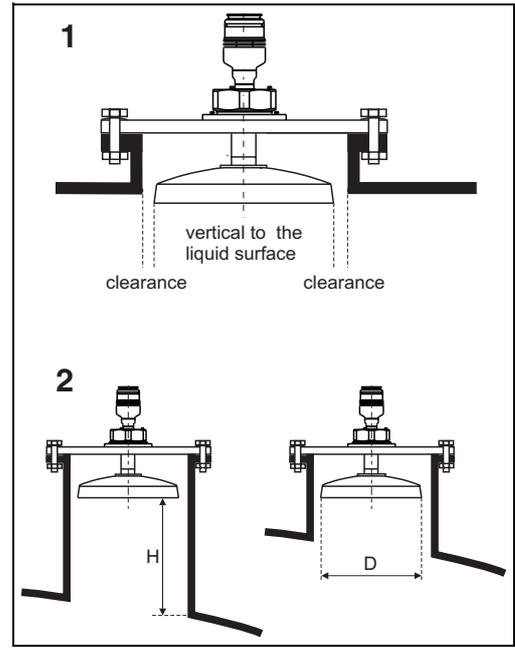
L00-FMR54xxx-17-00-00-en-017

Antenna size	200 mm (8")	250 mm (10")
D [mm (in)]	173 (6.8)	236 (9.4)
H [mm (in)] (without antenna extension)	< 200 (< 7.9)	< 200 (< 7.9)

FMR540 with alignment device

Micropilot S should be installed vertically towards the Liquid surface for best measuring performance of ±1 mm. Using the alignment device it is possible to tilt the antenna axis by up to 15° in all directions. The alignment device is used for the optimum alignment of the radar beam to the liquid surface. The Sensor should be positioned vertical to the liquid surface in inclination of 0° for Parabolic Antenna and up to 3° for Horn Antenna.
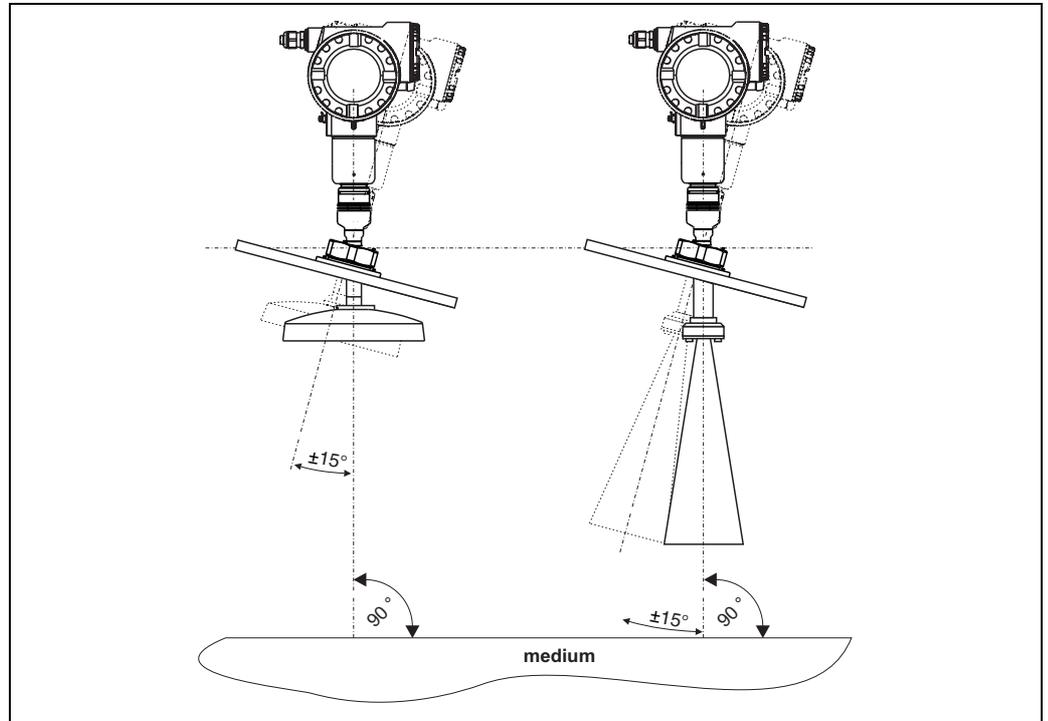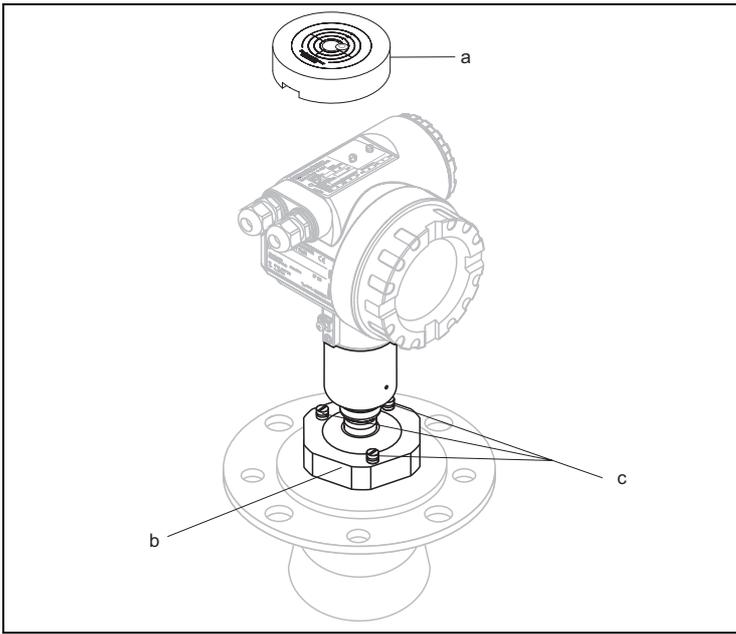

L00-FMR54xxx-17-00-00-en-018

To align the antenna as precisely as possible, it is recommended to use the sensor alignment tool, which is available as an accessory.
For more informations please see instructions in KA00274F/00/A2.
In case of custody Application, the screws must be locked with wires.

Sensor alignment tool for alignment device

L00-FMR540xx-00-00-00-yy-008

A sensor alignment tool (a) is recommended to be used at the time of installation for FMR540 with alignment device.

Alignmen procedure

Note!

This procedure is only applicable to the sensors purchased with talignment device (b). To carry out this procedure requires an accessory from Endress+Hauser, sensor alignment tool (a) for Micropilot S FMR540.

Before starting this procedure, please observe Micropilot S FMR540 has been mounted on the tank in proper position and all flange bolts are tightened.

Tools: 90 mm open wrench

Accessory Package contains:
Sensor alignment tool (part no. 52026756)
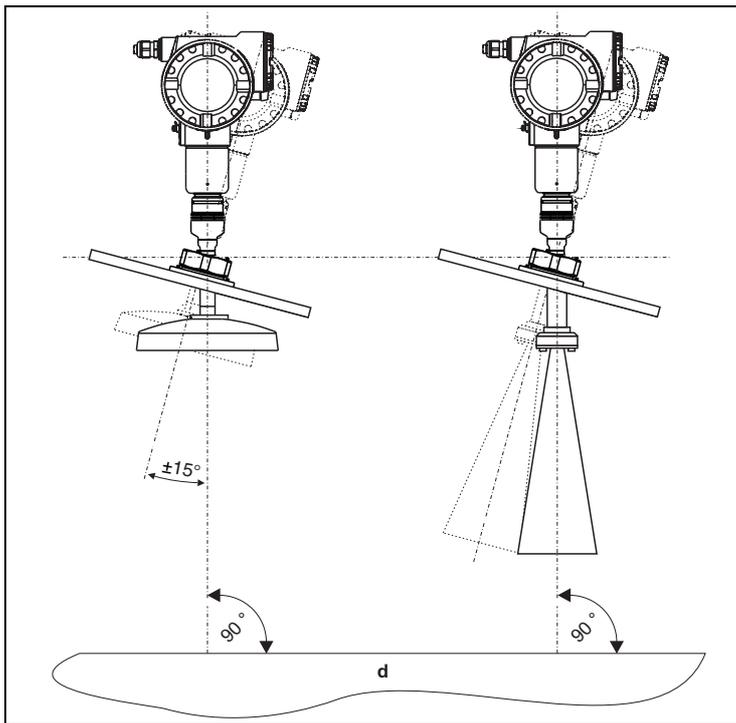Description of procedure "Sensor Alignment using Sensor alignment tool"
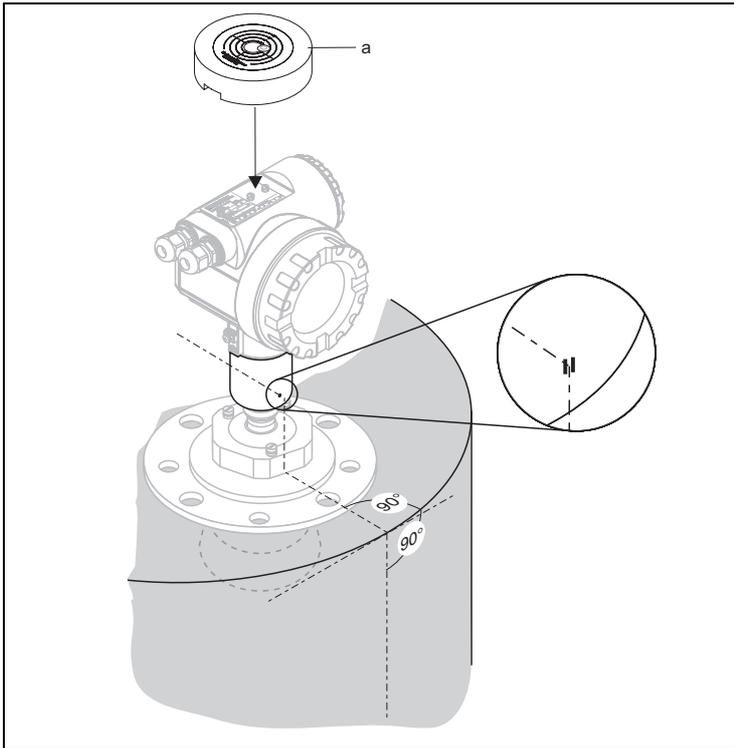(KA00274F/00/A2 part no. 52027425)

1. Loosen the nut (b), so that the FMR540 can tilt smoothly.

2. Observe the sensor can smoothly tilt its position. The nut should not be too loose.

    Tilt the Micropilot S to approximately vertical to the medium surface (d) or horizontal plane.
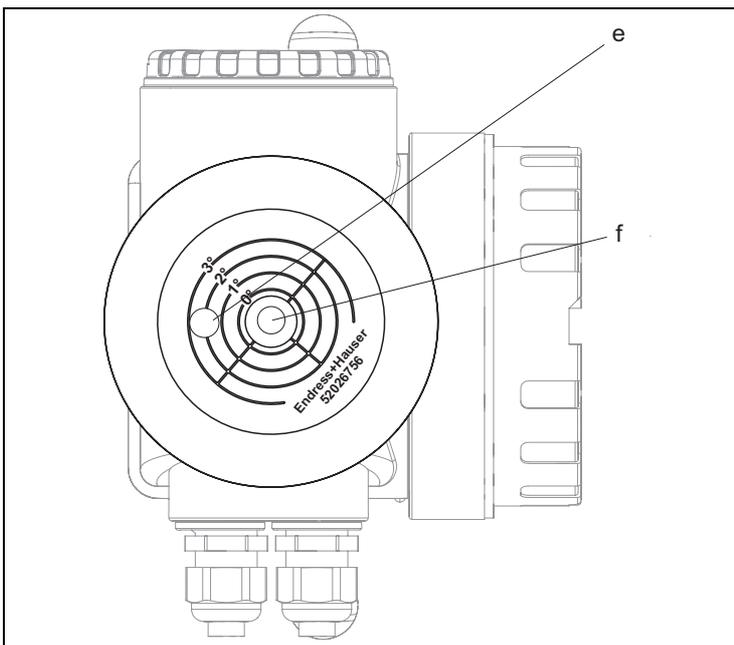

L00-FMR540xx-00-00-00-yy-009

L00-FMR540xx-00-00-00-yy-010

3. Place the Sensor alignment tool (a) for Micropilot S FMR540. Please, note to avoid any obstacles between the backside of the Alignment tool and the nameplate of Micropilot S FMR540.

L00-FMR540xx-00-00-00-yy-007

4. **Micropilot S FMR540 with Horn Antenna:**
    Tilt the FMR540 targeting the direction of tank center up to the position where the angle indicators`s outer circle reaches the circle of 3 deg (e).
    Note!
    Exceeding the 3 degree position may cause a weaker signal (or loss of signal).

    Micropilot S FMR540 with Parabolic Antenna:
    Tilt the FMR540 to the position where the bubble comes into the center (f) of the inclination indicator (0 deg).

    Gradually tighten the nut (b) of the alignment tool and make sure to keep the position of 0 degree/3 degree inclination.

   After tightening the nut, check if the sensor cannot tilt and change its position.
    Torque for the nut: 80 to 85 Nm
    If it is required by the local custody transfer authority, please seal the alignment device at the sealing screws (c) using the provided wires and seal metals.

Sealing for custody transfer applications

The alignment device can be sealed using the provided slotted capstan screws. The seal wires must be installed against the open direction in order to assure that a loosening of the alignment device is not possible.

It is recommended to seal at least two of the three sealing points provided.
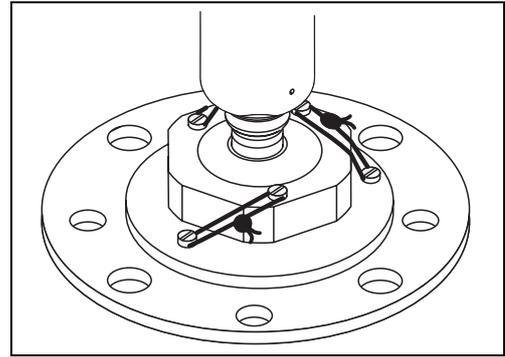
L00-FMR54xxx-17-00-00-yy-020

Integrated air purge connection

In some applications, the integrated air purge connection can prevent clogging of the antenna.

- Permanent operation:
  recommended pressure range of the purge air:
  1.2 to 1.5 bar abs.
- Pulsed operation:
  max. pressure of purge air: 6 bar abs.

Caution!
Make sure to use dry purge air.

air purge connection:
G ¼ (max. torque 3.5 Nm)
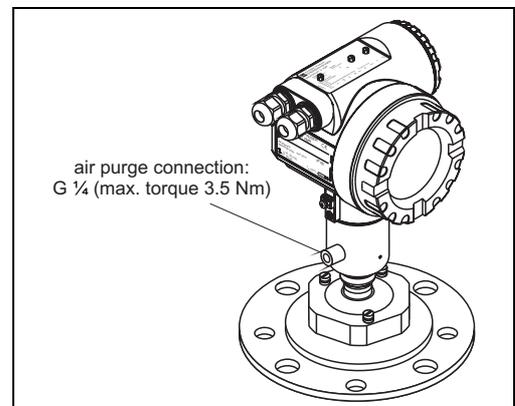
L00-FMR54xxx-17-00-00-en-019

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)

allen key
4 mm (0.16 in)
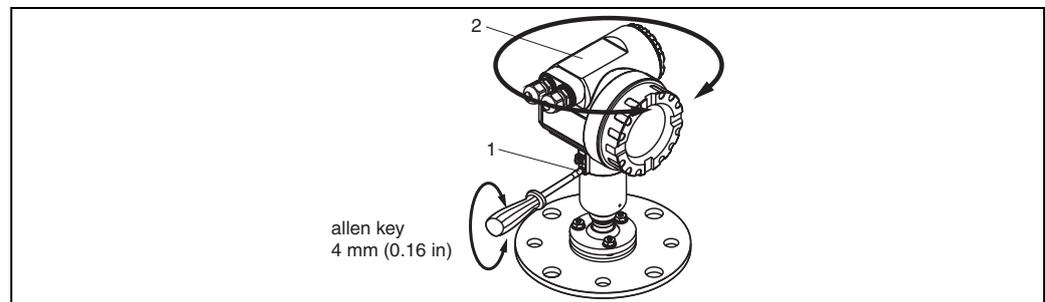
L00-FMR2xxxx-17-00-00-en-010

3.4.4   Endress+Hauser UNI flange

The number of bolts has sometimes been reduced. The bolt-holes have been enlarged for adaption of dimensions, therefore, the flange needs to be properly aligned to the counterflange before the bolts are tightened.

A-A

M80.3

Endress+Hauser UNI flange DN150
compatible with:
- DN150 PN10/16,
- ANSI 6" 150 lbs,
- JIS 10K 150A

4x90°

Ø 23

240

280

material: 316L

Endress+Hauser UNI flange DN200
compatible with:
- DN200 PN10/16,
- ANSI 8" 150 lbs,
- JIS 10K 200A

4x90°

Ø 26

294,5

340

6x90°

Ø 29

Endress+Hauser UNI flange DN250
compatible with:
- DN250 PN10/16,
- ANSI 10" 150 lbs,
- JIS 10K 250A

358

405
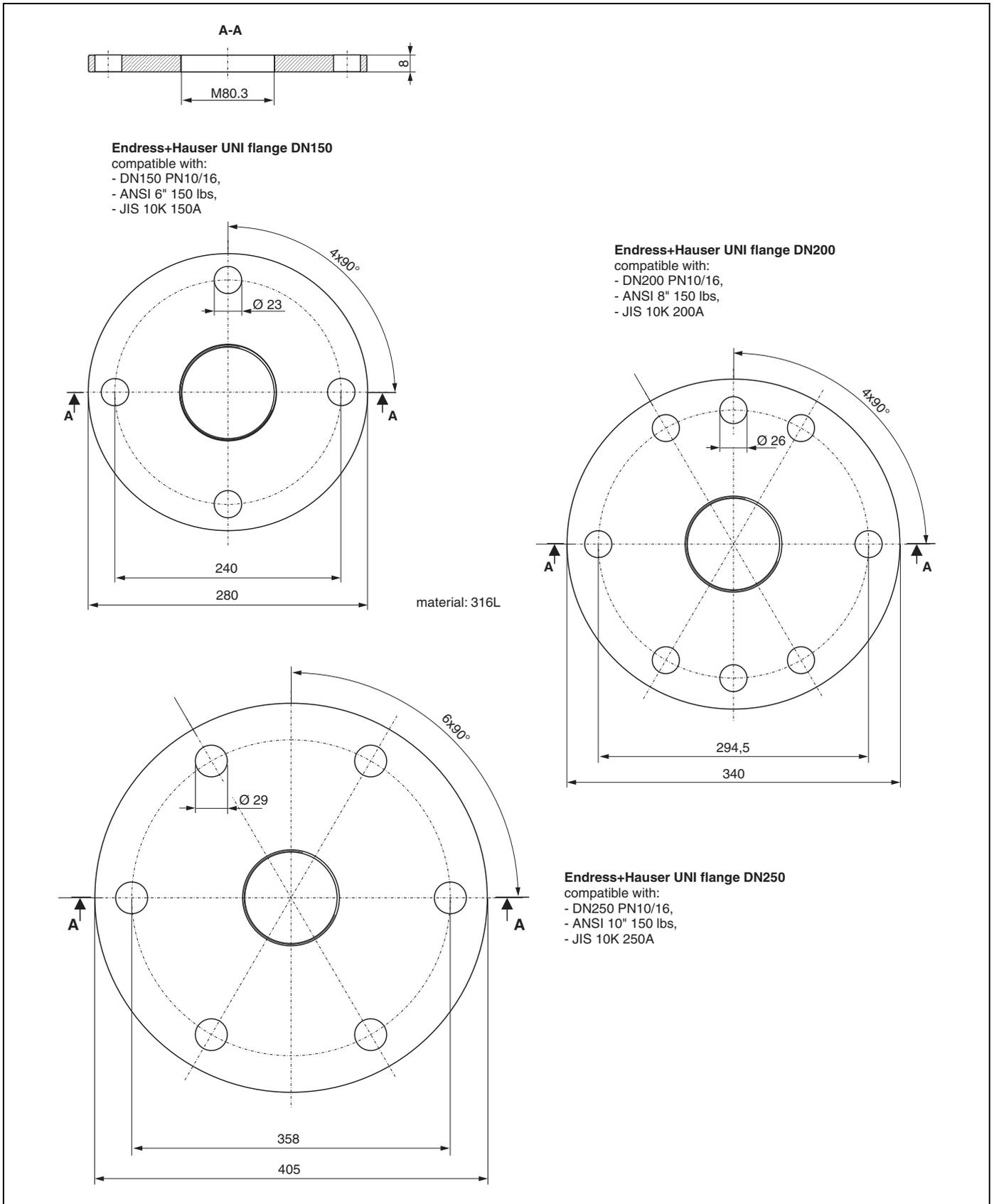
L00-FMR540xx-06-00-00-en-007

3.4.5   Alignment unit with Endress+Hauser UNI flange

L00-FMR540xx-06-00-00-en-008
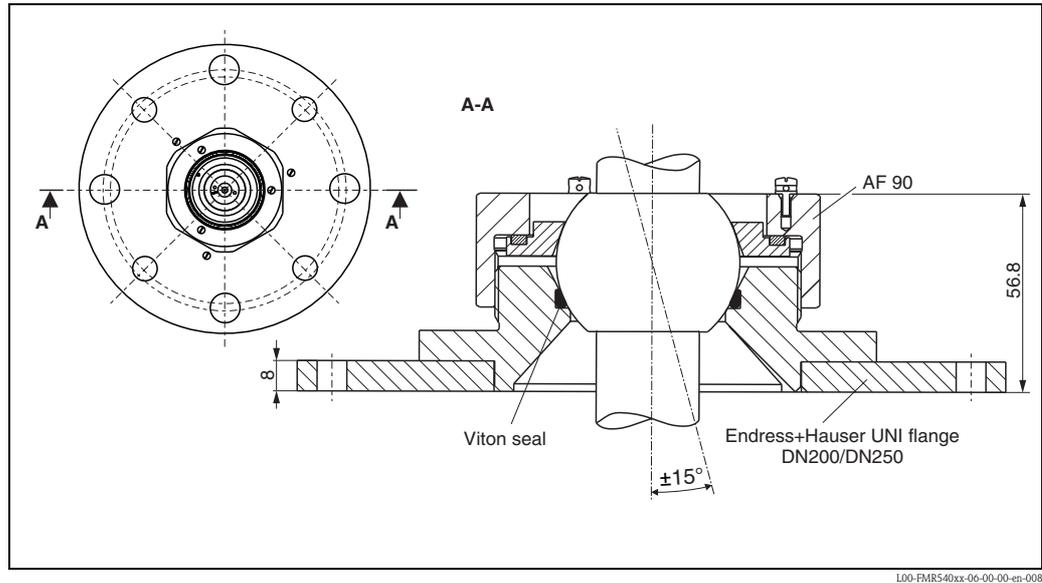
Please, also see sensor alignment tool → 🗎 60.

3.5   Post-installation check

After the measuring device has been installed, perform the following checks:
- Is the measuring device damaged (visual check)?
- Does the measuring device correspond to the measuring point specifications such as process temperature/pressure, ambient temperature, measuring range, etc.?
- Is the flange marking correctly aligned (→ 🗎 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 device adequately protected against rain and direct sunlight (→ 🗎 60)?

4 Wiring

4.1 Quick wiring guide

When grounding conductive screens, the corresponding directives EN 60079-14 and EN 1127-1 must be observed. Recommendation for safe grounding of conductive screens:

Wiring

Caution!

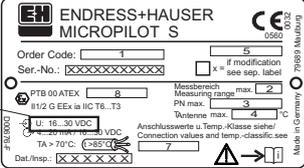Before connection please note the following:

- 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
- The power supply be delivered by a transmitter supply unit.

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 specified cable gland.

Connect up the Micropilot S as follows:

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

- Insert cable (3) through gland (4).
  Use screened, twisted 2-wire or 4-wire cable.

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

- Make connection (see pin assignment).
- Tighten cable gland (4).
- Screw off housing cover (2).
- Switch on power supply.
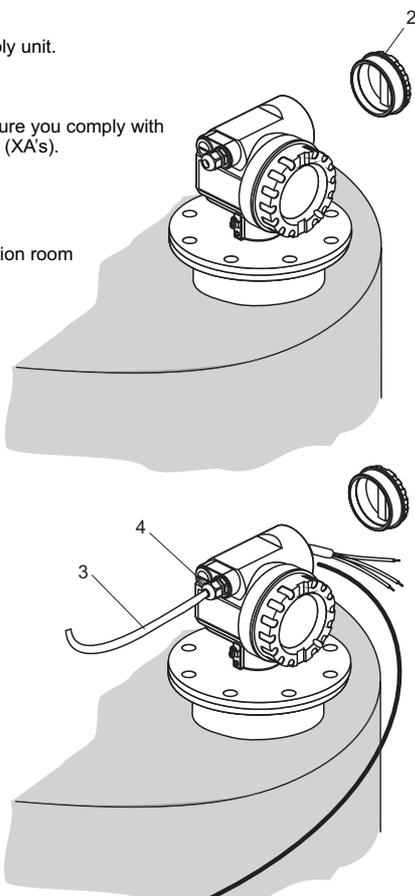
power:
24 V DC
(16…30 V);
from a
transmitter
supply unit

signal:
24 V DC
from a
transmitter
supply unit

plant
ground
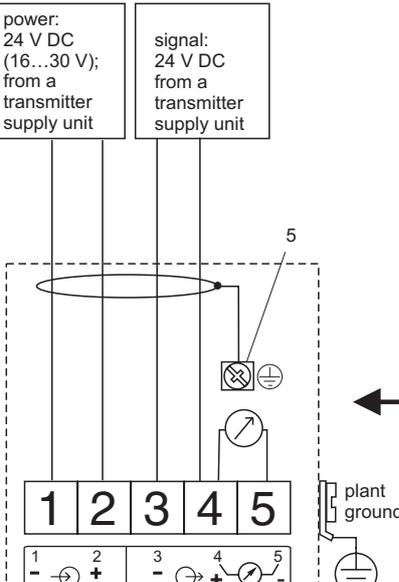
A Micropilot S situated in a hazardous area is connected as a **single device** to a **power supply unit and transmitter** situated outside of the hazardous area. In this case, it is recommended that the screen be connected directly to the Micropilot at the housing's earth, whereby the Micropilot S and the power supply unit are connected to the same potential matching line (PML).

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Wiring with Tank Side Monitor NRF590

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 specified cable gland.

Connect up the Micropilot S as follows:

/EX/

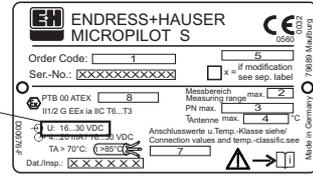Before unscrew housing cover (2) at seperate connection room turn off the power supply!

- Insert cable (3) through gland (4).
  Use screened, twisted 2-wire or 4-wire cable.

- Make connection (see pin assignment).

- Tighten cable gland (4).

- Screw off housing cover (2).

- Switch on power supply.
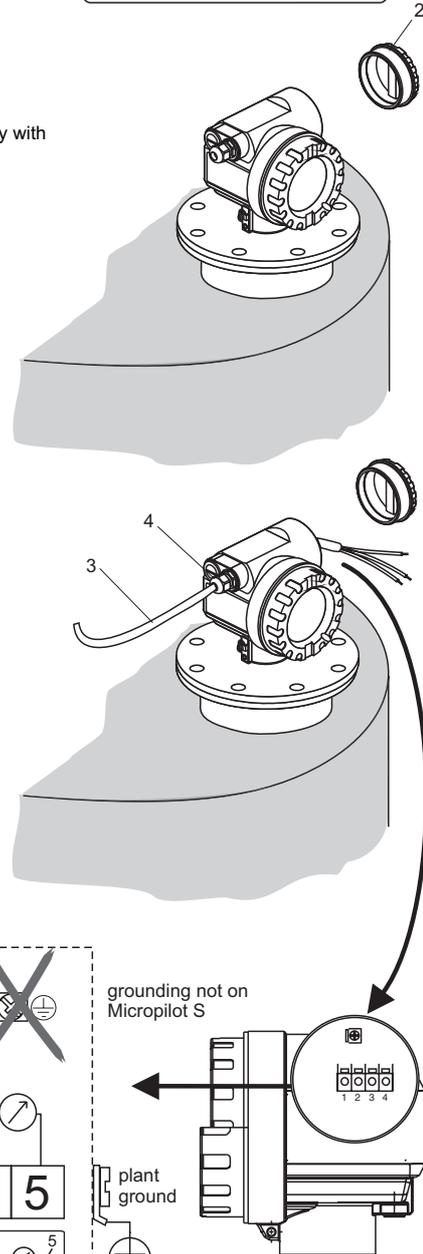
Tank Side Monitor NRF590

intrinsicaly safe terminal board

grounding single sided on Tank Side Monitor NRF590

HART sensor

only for Micropilot S

grounding not on Micropilot S
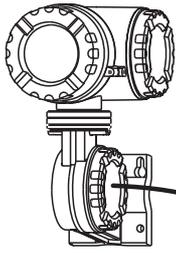
plant ground
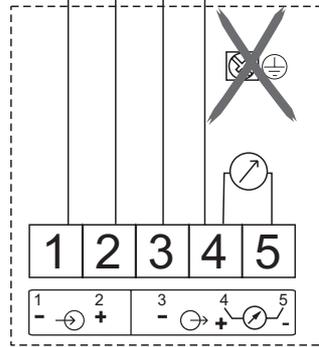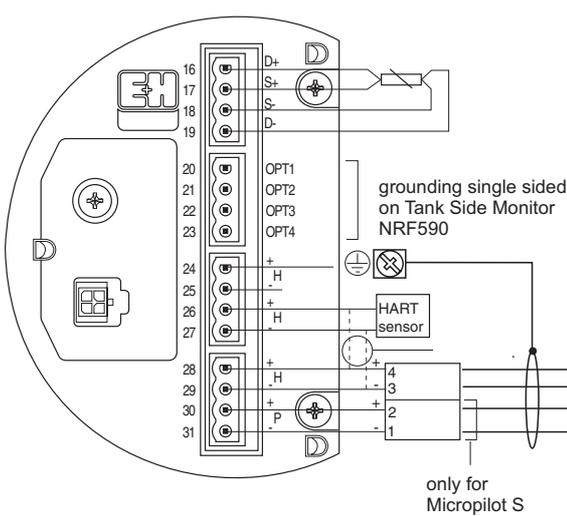
The Micropilot S is - possibly in combination with other devices - connected to a tank side monitor in a hazardous area. In this case, it is recommended that you ground the cable screen centrally at the Tank Side Monitor and connect all devices to the same potential matching line (PML). If, for functional reasons, a capacitive coupling is required between local earth and screen (multiple grounding), ceramic condensers with a dielectric strength of min. 1500 V_{eff} must be used, whereby the total capacitance of 10 nF must not be exceeded. Notes on grounding interconnected intrinsically safe devices are provided by the FISCO model.

L00-FMR53xxx-04-00-00-en-006

4.2 Connecting the measuring unit

Terminal compartment

The housing features a separate terminal compartment.
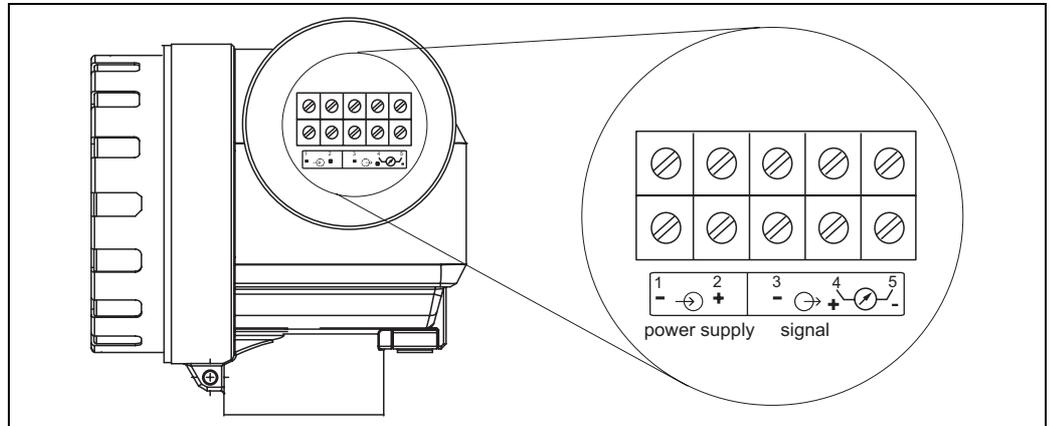
L00-FMR53xxx-04-00-00-en-001

Load HART

Minimum load for HART communication: 250 Ω

Cable entry

- Cable gland: M20x1.5
- Cable entry: G½ or ½NPT, M20 (thread)

Supply voltage

DC voltage: 16 to 36 V DC

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

Power consumption

- max. 400 mW at 16 V
- max. 600 mW at 24 V
- max. 750 mW at 30 V
- Non-Ex: max. 900 mW at 36 V

Current consumption

Max. 25 mA (55 mA inrush current).

Overvoltage protector

- The level transmitter Micropilot S is equipped with an internal overvoltage protector (600 Vrms surge arrester) according to EN/IEC 60079-14 or EN/IEC 60060-1 (impulse current test 8/20 μs, $\hat{I}$ = 10 kA, 10 pulses). Additionally, the device is protected by a galvanic insulation of 500 Vrms between the power supply and the (HART) current ouput. Connect the metallic housing of the Micropilot S to the tank wall or screen directly with an electrically conductive lead to ensure reliable potential matching.
- Installation with additional overvoltage protector HAW560Z/HAW562Z (see XA00338F-C "Safety instructions for electrical apparatus certified for use in explosion-hazardous areas").
  – Connect the external overvoltage protector and the Micropilot S transmitter to the local potential matching system.
    – Potentials shall be equalised both inside and outside the explosion hazardous area.
    – The cable connecting the overvoltage protector and the Micropilot S transmitter shall not exceed 1 m in length.
    – The cable shall be protected e.g. routed in an armoured hose.

Power supply

- For stand alone operation via two Endress+Hauser RN221N.
- Integrated in tank gauging systems via Endress+Hauser Tank Side Monitor NRF590 (recommended operation mode).

Highly accurate measurement

For highly accurate measurements the measured variable must be transmitted using HART protocol to ensure the necessary resolution.

4.2.1   Connection to Tank Side Monitor NRF590

"Wiring with Tank Side Monitor NRF590", → 🖹 26.

4.2.2 HART connection with two Endress+Hauser RN221N
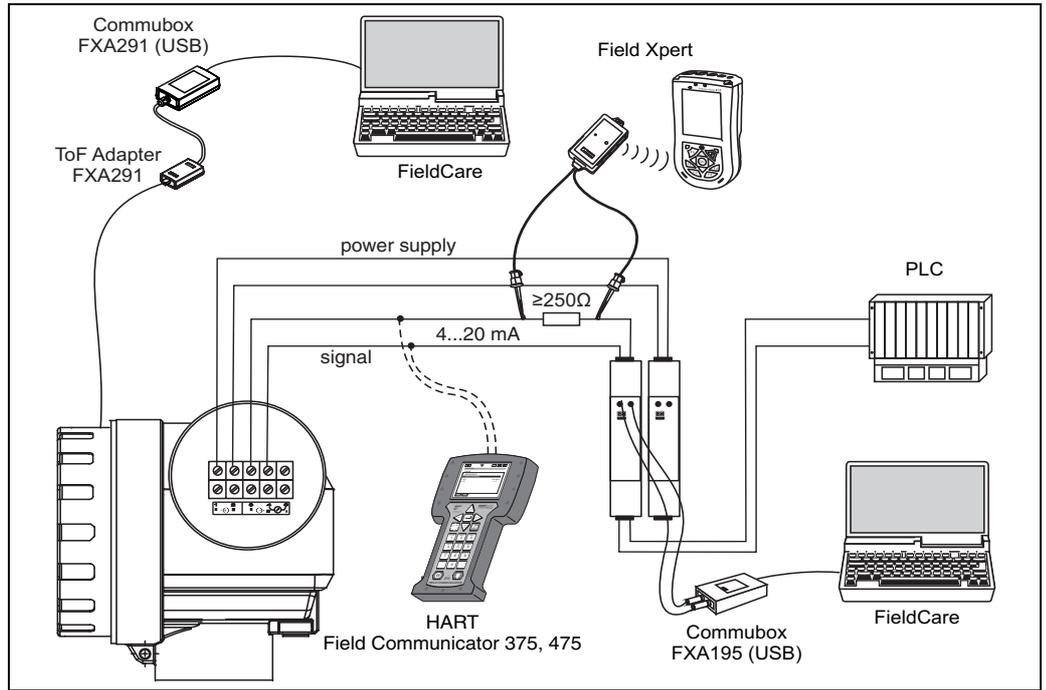
L00-FMR53xxx-04-00-00-en-004

4.2.3 HART connection with other supplies
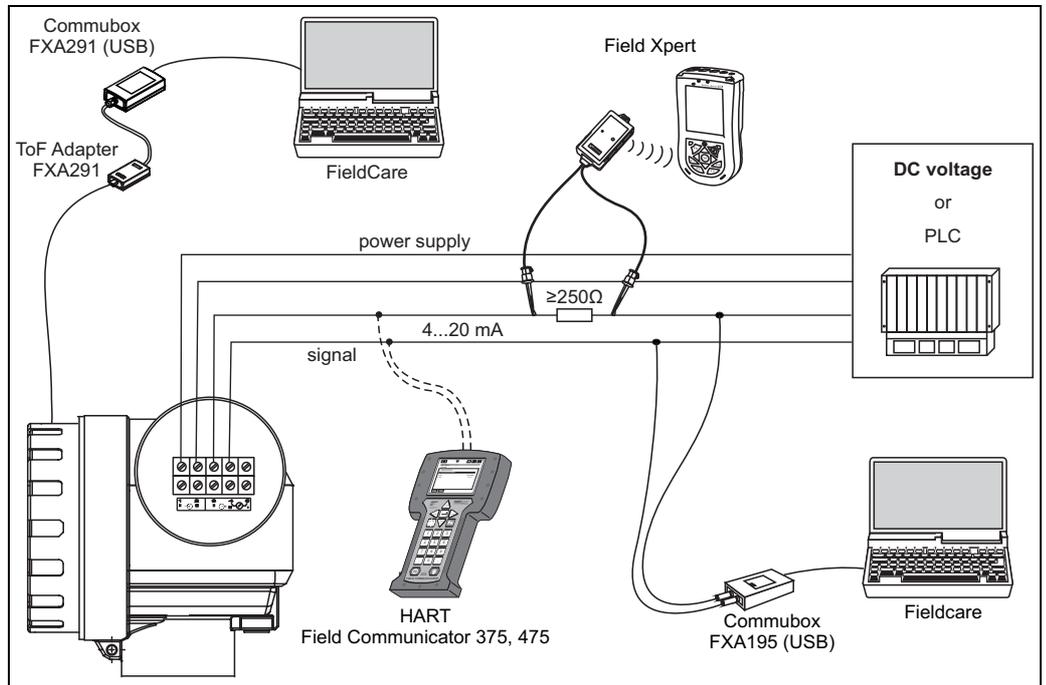
L00-FMR53xxx-04-00-00-en-005

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 device 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: IP68, NEMA 6P (open housing and removed liquid crystal display: IP20, NEMA 1)
- antenna: IP68 (NEMA 6P)

4.5 Post-connection check

After wiring the measuring device, perform the following checks:
- Is the terminal allocation correct (→ 🗎 25)?
- Is the cable gland tight?
- Is the housing cover screwed tight?
- If auxiliary power is available:
  Is the device ready for operation and does the liquid crystal display show any value?
- Is grounding (tank potential) correct?

5 Operation

5.1 Quick operation guide
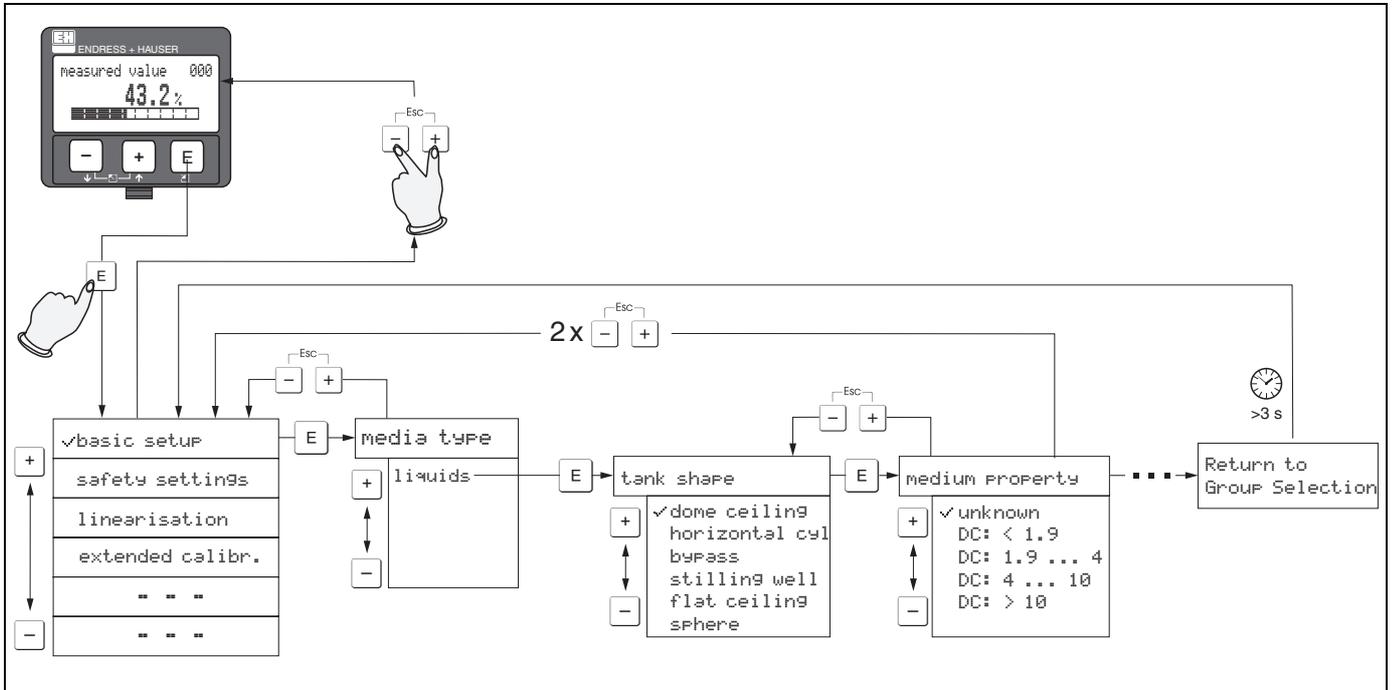
Example - Selection and configuration in Operation menu:

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 f**unction** (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) [+] + [−] (= ⊟⊞) 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) [+] + [−] (= ⊟⊞) interrupts the input, system quits Edit mode

4) Press [E] to select the next **function** (e.g. "medium property (003)")

5) Press [+] + [−] (= ⊟⊞) once ➔ return to previous **function** (e.g. "tank shape (002)")

Press [+] + [−] (= ⊟⊞) twice ➔ return to **Group selection**

6) Press [+] + [−] (= ⊟⊞) to return to **Measured value display**

L00-FMR54xxx-19-00-00-en-008

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 device 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 device. 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 device 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 ($\rightarrow$ 📄 72), for each function a position is shown on the display.

L00-FMRxxxxx-07-00-00-en-005

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

Four lines with 20 characters each. Display contrast adjustable through key combination.
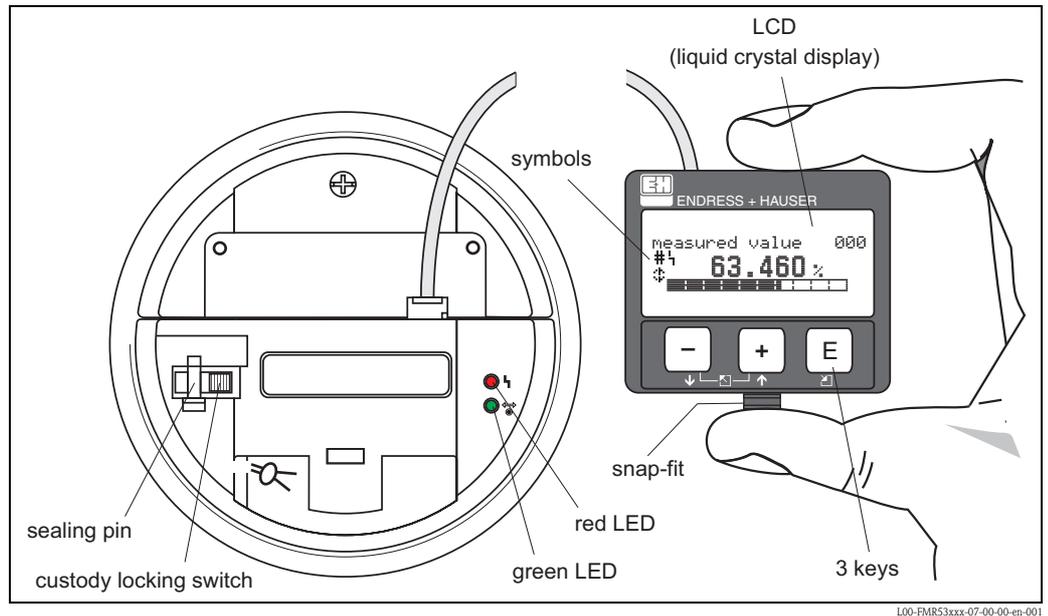
L00-FMR53xxx-07-00-00-en-001

✏ Note!
To access the display, it is possible to open the cover of the electronics compartment even in an explosion hazardous area. The LCD display can be removed to ease operation by simply pressing the snap–fit (see graphic above). It is connected to the device by means of a 500 mm cable.

5.2.1 Display

Liquid crystal display (LCD):

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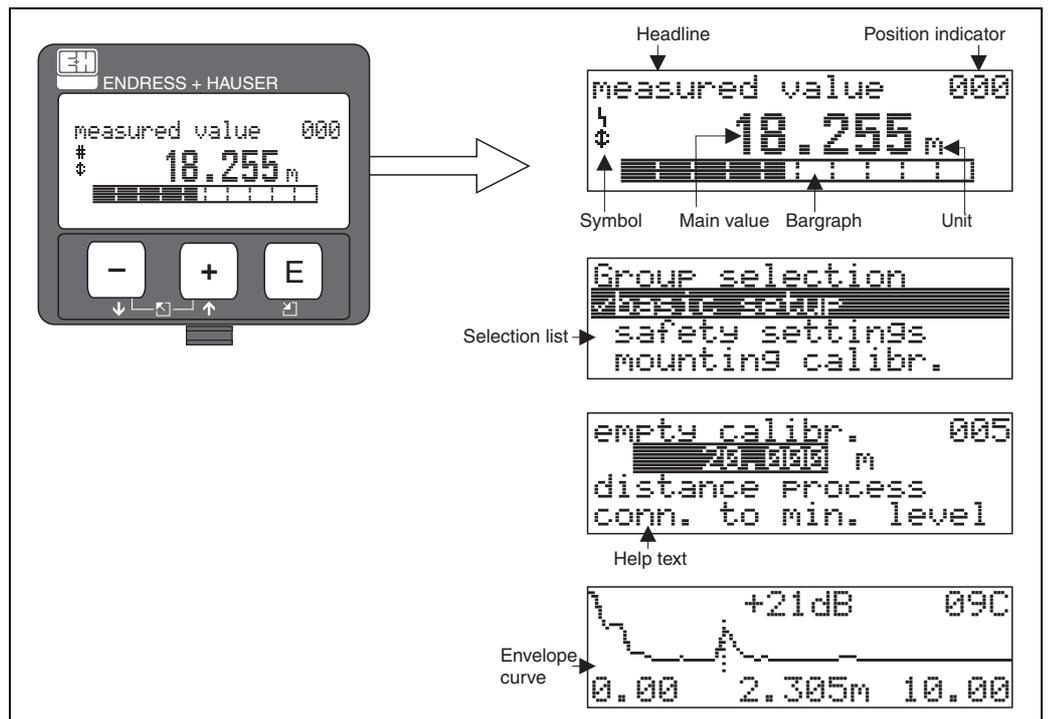

L00-FMRxxxxx-07-00-00-en-003

5.2.2   Display symbols

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

Symbols	Meaning
	ALARM_SYMBOL This alarm symbol appears when the device is in an alarm state. If the symbol flashes, this indicates a warning.
	LOCK_SYMBOL This lock symbol appears when the device is locked, i.e. if no input is possible.
	COM_SYMBOL This communication symbol appears when a data transmission via e.g. HART is in progress.
	Calibration to regulatory standards disturbed If the device is not locked or it cannot guarantee the calibration to regulatory standards, the situation will be indicated on the display via the symbol.

Light emitting diods (LEDs):

There is a green and a red LED besides the liquid crystal display.

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

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.
E or E↲	Navigate to the right within a function group.
⊞ and E or ⊟ and E	Contrast settings of the LCD.
⊞ and ⊟ and E	Hardware lock / unlock. After a hardware lock, an operation of the device 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.

Custody locking switch

Access to the electronics can be prevented by means of a custody locking switch that locks the device settings. The custody locking switch can be sealed for custody transfer applications.

Software reliability

The software used in the radar device Micropilot S fulfills the requirements of OIML R85. This particularly includes:
- cyclical test of data consistency
- non-volatile memory
- segmented data storage

The radar device Micropilot S continuously monitor the compliance with accuracy requirements for custody transfer measurements according to OIML R85. If the accuracy cannot be maintained, a specific alarm is generated on the local display and via the digital communication.

5.3   Local operation

5.3.1   Locking of the configuration mode

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

Function "unlock parameter" (0A4):

A value **<> 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 device is locked by pressing the ⊞, ⊟ 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 de displayed even if the device is locked.

⊞, ⊟ and ⒠ press simultaneous

The LOCK_SYMBOL appears on the LCD
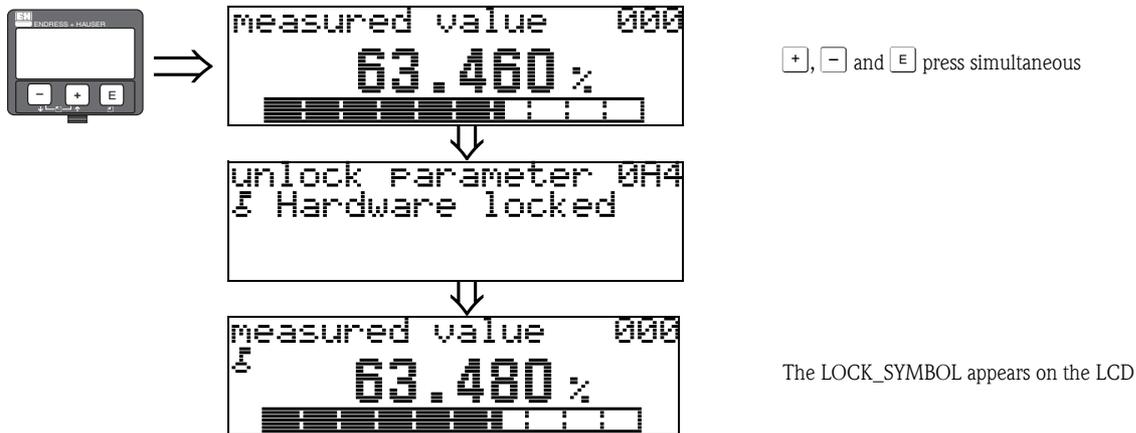
5.3.2 Unlocking of configuration mode

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

Function "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 ⊞, ⊟ and E keys at the same time, the user is asked to enter the unlock parameter

100 = for HART devices.

⊞, ⊟ and E press simultaneous

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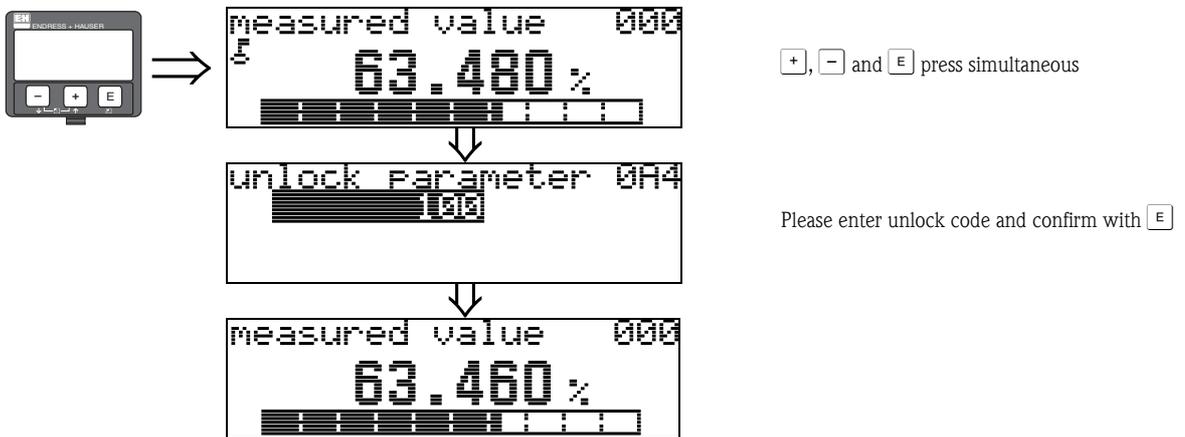
☝ Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special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

5.3.3   Factory settings (Reset)

Caution!
A reset sets the device 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 device...
- ... no longer functions
- ... must be moved from one measuring point to another
- ... is being de-installed /put into storage/installed

```
reset                    0A3
████████████████0
for reset code
see manual
```

User input ("reset" (0A3)):
- 333 = customer parameters

333 = reset customer parameters
This reset is recommended whenever an device 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) – liquids only	▪ diameter vessel (047)
▪ vessel / silo (00A) – solids only	▪ range of mapping (052)
▪ empty calibr. (005)	▪ pres. Map dist (054)
▪ full calibr. (006)	▪ offset (057)
▪ pipe diameter (007) – liquids only	▪ low output limit (062)
▪ output on alarm (010)	▪ curr. output mode (063)
▪ output on alarm (011)	▪ fixed cur. value (064)
▪ outp. echo loss (012)	▪ simulation (065)
▪ ramp %span/min (013)	▪ simulation value (066)
▪ delay time (014)	▪ 4mA value (068)
▪ safety distance (015)	▪ 20mA value (069)
▪ in safety dist. (016)	▪ format display (094)
▪ dip table (030)	▪ distance unit (0C5)
▪ level/ullage (040)	▪ download mode (0C8)
▪ linearisation (041)	
▪ customer unit (042)	

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 device 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 the following types of error:
- **A (Alarm):**
  Device goes into a defined state (e.g. MAX 22 mA)
  Indicated by a constant ⌐ symbol.
  (For a description of the codes, → 🗎 63)
- **W (Warning):**
  Device continue measuring, error message is displayed.
  Indicated by a flashing ⌐ symbol.
  (For a description of the codes, → 🗎 63)
- **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, → 🗎 63)


```
present error      0A0
linearisation ch1
not complete,
not usable         A671
```
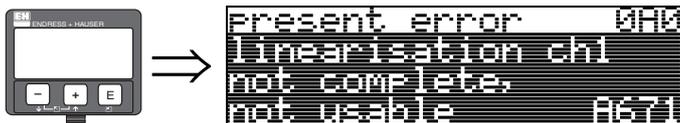
5.4.1   Error messages

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 → 🗎 63.
- 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 device and view measured values by means of a HART protocol. There are two options available for operation:

- Operation via the universal handheld operating unit, Field Communicator 375, 475.
- Operation via the Personal Computer (PC) using the operating program
  (e.g. FieldCare; Connections, → 🖹 56).

✎ Note!
The Micropilot S 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 Protocol specific data

Manufacturer-ID	000011 hex
Device Type Code	001F hex
Transmitter specific revision	01 hex
HART specification	5.0
DD–Files	Information and files can be found on: ■ www.endress.com ■ www.hartcomm.org
Load HART	Min. 250 Ω
Device variables	Primary value: level or volume[1]
Features supported	■ Burst mode ■ Additional Transmitter Status

1)   according to configuration

5.5.2 Operation with Field Communicator 375, 475

All device functions can be adjusted via menu operation with the Field Communicator 375, 475.

✎ Note!
Further information on the HART handheld unit is given in the respective operating manual included in the transport bag of the Field Communicator 375, 475.

5.5.3 Operation with Endress+Hauser operating program

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements you can find on the internet: www.endress.com → select your country → Search: FieldCare → FieldCare → Technical Data.

FieldCare supports the following functions:
- Configuration of transmitter in online operation
- Signal analysis via envelope curve
- Tank linearization
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB port on a computer
- Commubox FXA291 with ToF Adapter FXA291 (USB) via service interface

Menu-guided commissioning
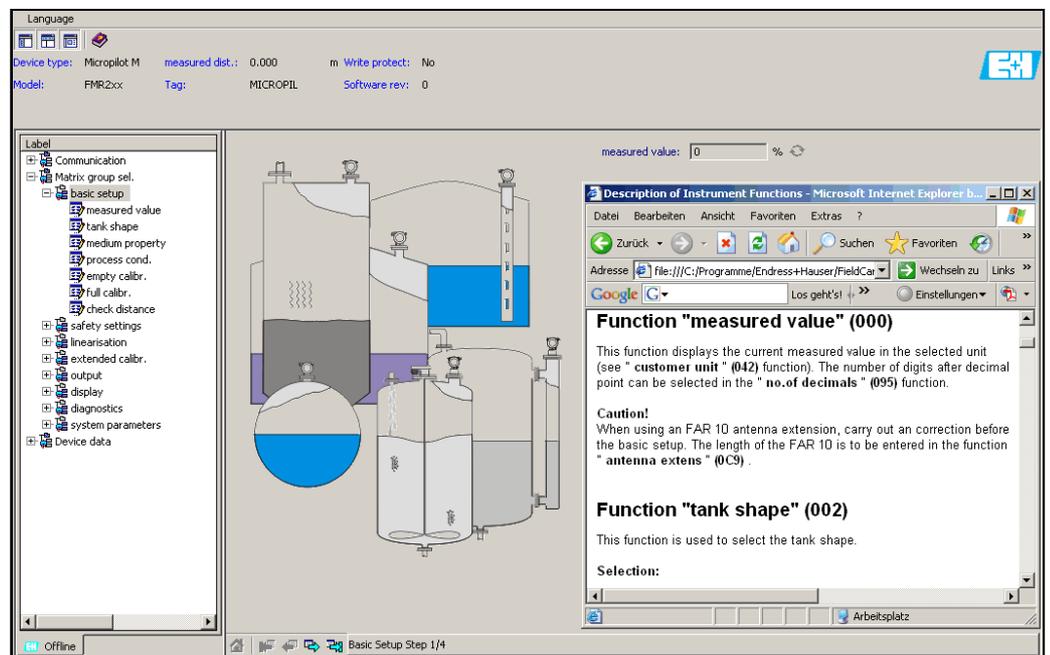
MicropilotM-en-305

Signal analysis via envelope curve
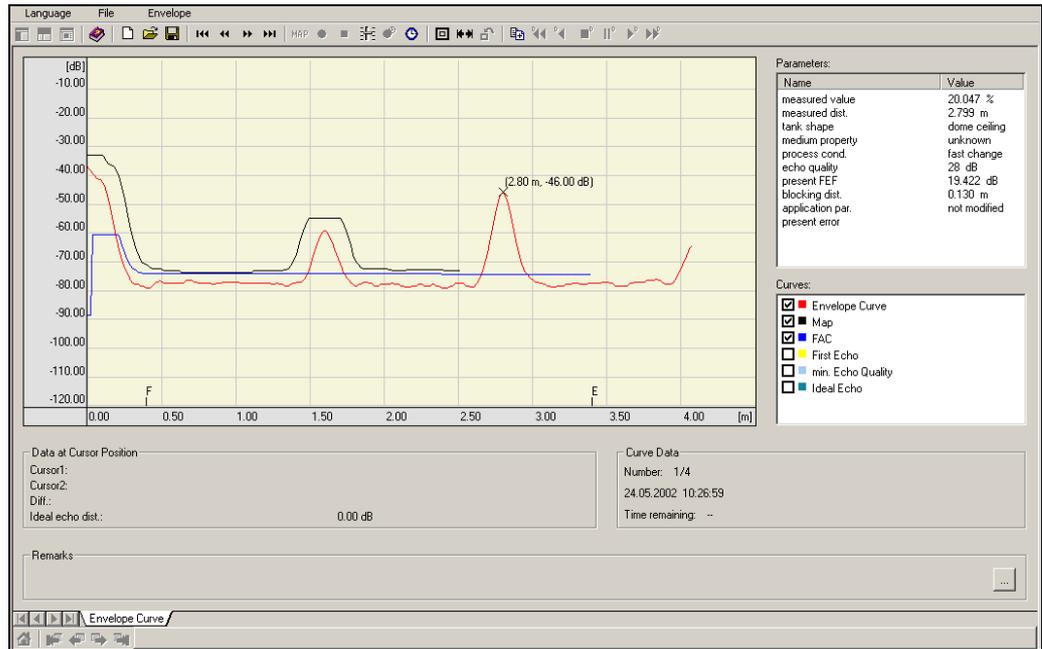
MicropilotM-en-306

Tank linearization

MicropilotM-en-307

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", → 🖹 24.
- Checklist "Post connection check", → 🖹 30.

6.2 Switching on the measuring device

When the device is switched on for the first time, the following messages appear in a sequence of 5 s on the display: software version, communication protocol and language selection.

language   092
✓**English**
  Deutsch
  Français
	Select the language
	(this message appears the first time the device is switched on)

distance unit   0C5
✓**m**
  ft
  mm
	Select the basic unit
	(this message appears the first time the device is switched on)

measured value 000 **63.460 %**	The current measured value is displayed After ⒠ is pressed, you reach the group selection

Group selection   00→
✓**basic setup**
  safety settings
  linearisation
	This selection enables you to perform the basic setup

6.3 Basic Setup

Commissioning

basic setup (standard)

tank shape
flat ceiling

measuring cond.
Unknown

process cond.
Standard

empty calibr.

full calibr.

pipe diameter
(for bypass/stilling well)

dist. / meas. value

According to envelope curve

Distance incorrect → **Check distance** → **Range of mapping**

start mapping

Distance correct

According to hand dipping

Meas. value incorrect → **set value**

Meas. value correct

option

dip table
first point corrects **offset**
further points correct linearity

...

(description see BA00341F/00/EN)

flange: reference point of measurement

BD
SD
D
E
F
L

E = empty calibr. (= zero), 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
BD = blocking distance, setting in

L00-FMR540xx-19-00-00-en-001

Caution!

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 BA00341F/00/EN.

Comply with the following instructions when configuring the functions in the "**basic setup**" **(00)**:
- Select the functions as described, → 🖹 31.
- Some functions can only be used depending on the parameterisation of the device. 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 E 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 device 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.
- All functions are described in detail, as is the overview of the operating menu itself, in the manual "**BA00341F – Description of Instrument Functions**", which is found on the enclosed CD-ROM.
- The default values of the parameters are typed in **boldface**.

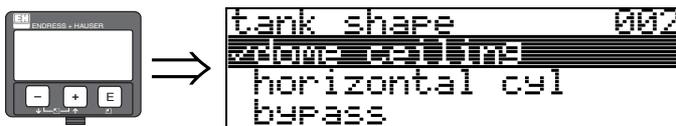## 6.4   Basic Setup with the VU331

Function "measured value" (000)

```
measured value    000
   63.460 %
▮▮▮▮▮▮▮▮▮▯▯▯▯
```

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)

```
Group selection   00→
▓basic setup
 safety settings
 linearisation
```

Function "tank shape" (002), liquids only

```
tank shape        002
▓dome ceiling
 horizontal cyl
 bypass
```

This function is used to select the tank shape.

Selection:
- **dome ceiling**
- horizontal cyl
- bypass
- stilling well
- flat ceiling
- sphere

dome ceiling   horizontal cyl

flat ceiling   sphere
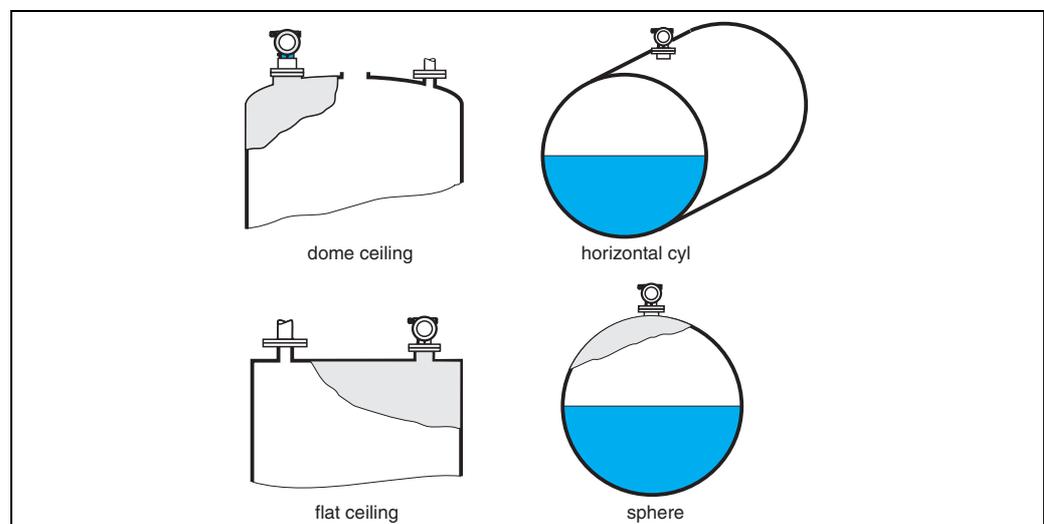
L00-FMR2xxxx-14-00-06-en-007

Function "medium property" (003), liquids only

```
medium property   003
≠unknown
  DC: < 1.9
  DC: 1.9 ... 4
```

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 to 1.9	non-conducting liquids, e.g. liquefied gas
B	1.9 to 4	non-conducting liquids, e.g. benzene, oil, toluene, …
C	4 to 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, …
D	>10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

Function "process cond." (004) , liquids only

```
process cond.    004
≠standard
  calm surface
  turb. surface
```
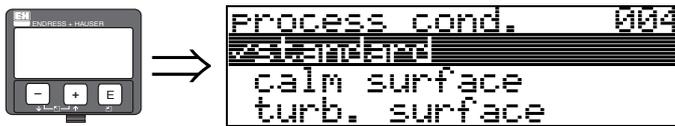
This function is used to select the process conditions.

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

standard	calm surface
For all applications that do not fit into any of the following groups.	Storage tanks with immersion tube or bottom filling
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
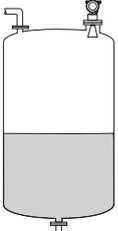
Function "empty calibr." (005)

```
empty calibr.      005
████ 5.000  m
distance process
conn. to min. level
```

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

E = empty calibration (= zero)

0%

L00-FMR2xxxx-14-00-06-en-008
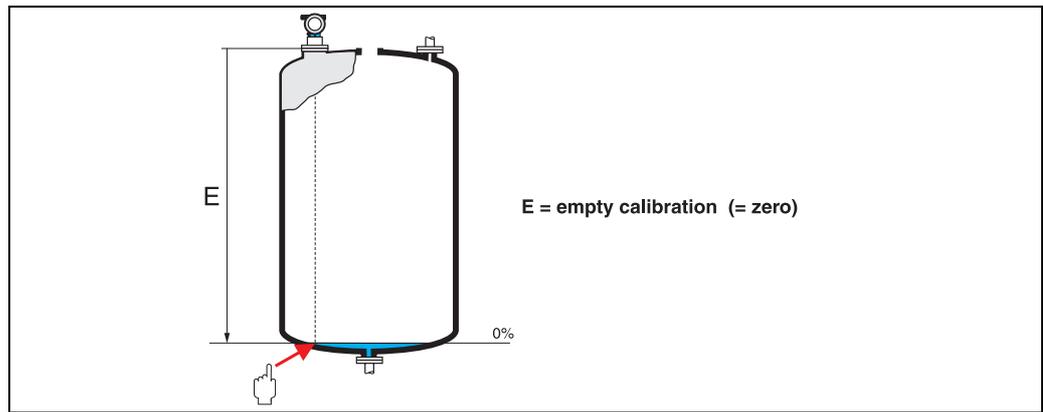
Caution!
For dish bottoms or conical outlets, the zero point should be no lower than the point at which the radar beam hits the bottom of the vessel.

Function "full calibr." (006)

```
full calibr.       006
████ 4.000  m
span
```

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

100%

F = full calibration (= span)

0%

L00-FMR2xxxx-14-00-06-en-009
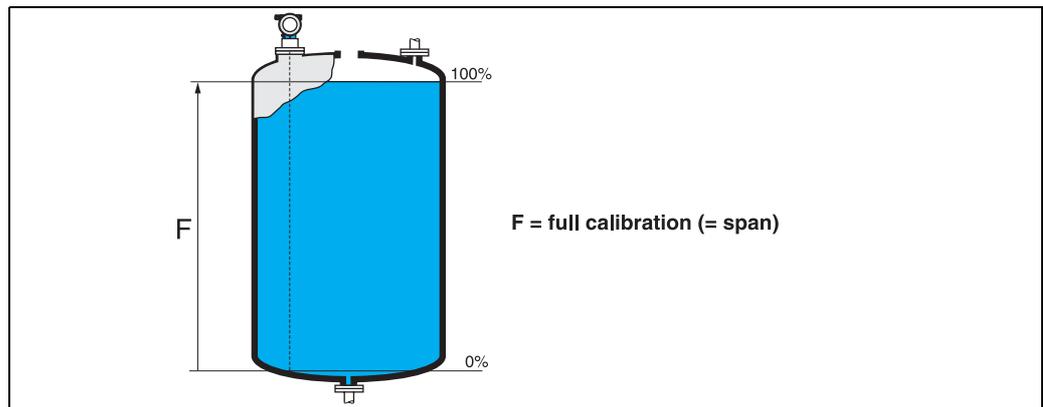
In principle, it is possible to measure up to the tip of the antenna. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than 50 mm (2") to the tip of the antenna.

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

Function "pipe diameter" (007)

```
Pipe diameter    007
    204.425 mm
inner diameter of
bypass/stilling well
```

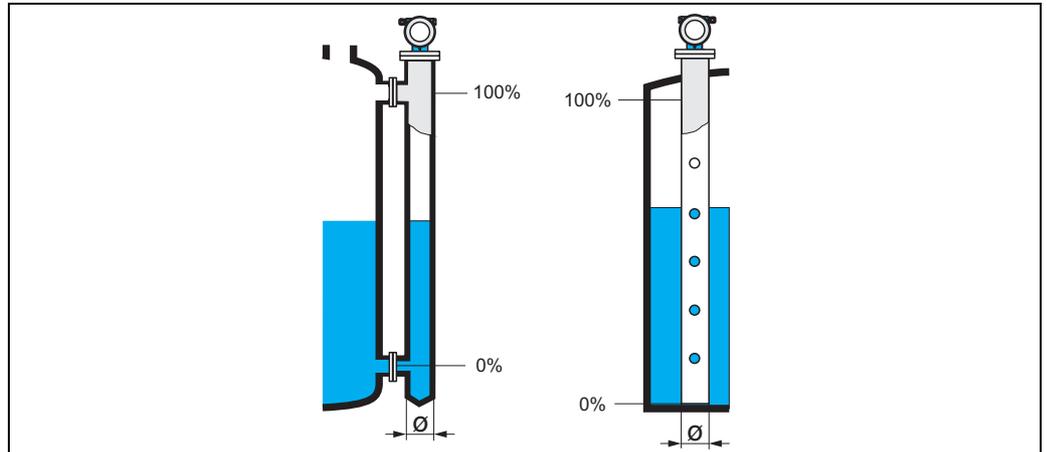This function is used to enter the pipe diameter of the stilling well or bypass pipe.

L00-FMR532xx-14-00-00-xx-002

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)
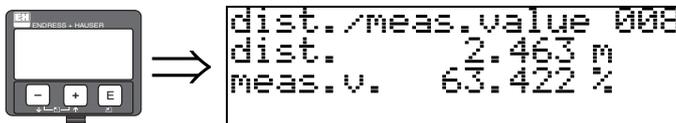
```
dist./meas.value 008
dist.       2.463 m
meas.v.    63.422 %
```

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)

```
check distance    051
dist. unknown
 manual
 distance = ok
```
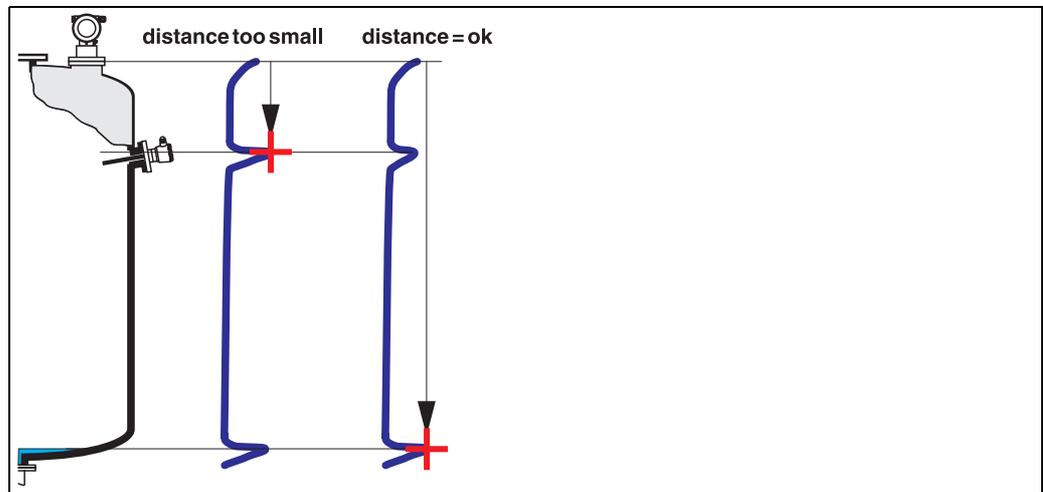
This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

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

L00_FMR2xxxxx-14-00-06-en-010

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 vessel, 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)

```
range of mapping 052
      0.000  m
input of
mapping range
```
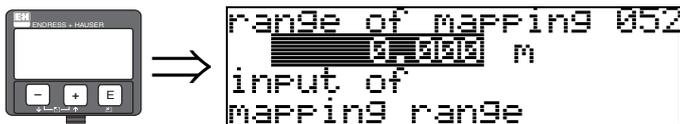
This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (→ 🗎 44). This value can be edited by the operator.
For manual mapping, the default value is 0 m.

Function "start mapping" (053)

```
start mapping    053
✓off
 on
```

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)
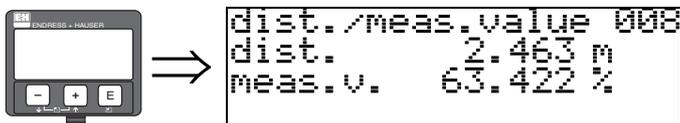
```
dist./meas.value 008
dist.      2.463 m
meas.v.   63.422 %
```

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 "set value" (009)

```
set value              009
        5.000  m
for empty correction
```
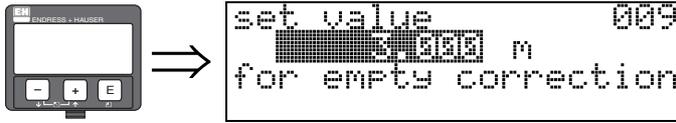
This function enables the user to offset the difference between the reference level and the measured level (or between ullage value and measured distance). To make an offset effective, input the reference level measured by the dip measurement by using key buttons. The software offsets the dist./meas value with the difference between reference level and measured value.

Level (Reference) is the value to be input in "**set value**" **(009)** Function.

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```
        Return to
     Group Selection
```

After 3 s, the following message appears

```
Group selection    00→
✓basic setup
 safety settings
 linearisation
```
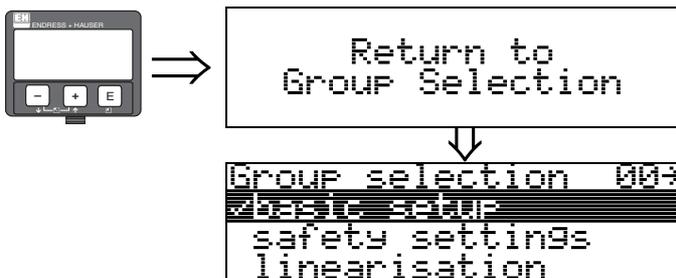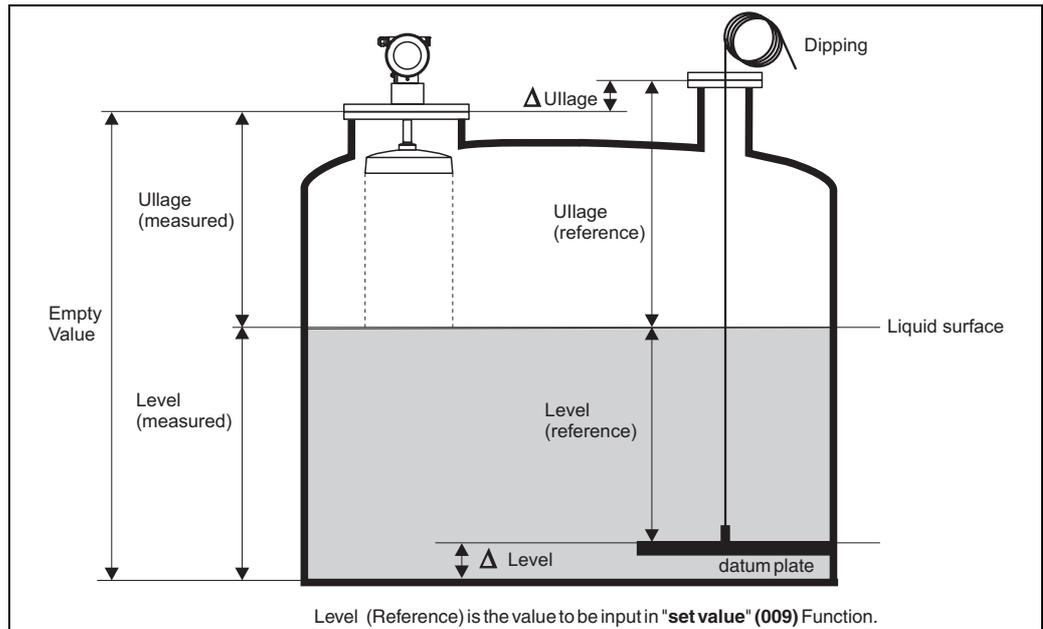
✎ Note!
After the basic setup, an evaluation of the measurement with the aid of the envelope curve (function group **"Envelope curve" (0E)**) is recommended.

6.4.2 Envelope curve with VU331

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

Function "plot settings" (0E1)


```
plot settings     0E1
envelope curve
 env.curve+FAC
 env.curve+cust.map
```

Select which information will be displayed in the LCD:
- **envelope curve**
- env.curve+FAC (on FAC see BA00341F/00/EN)
- 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.


```
recording curve   0E2
single curve
 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.

Function "envelope curve display" (0E3)

The envelope curve is displayed in this function. You can use it to obtain the following information:
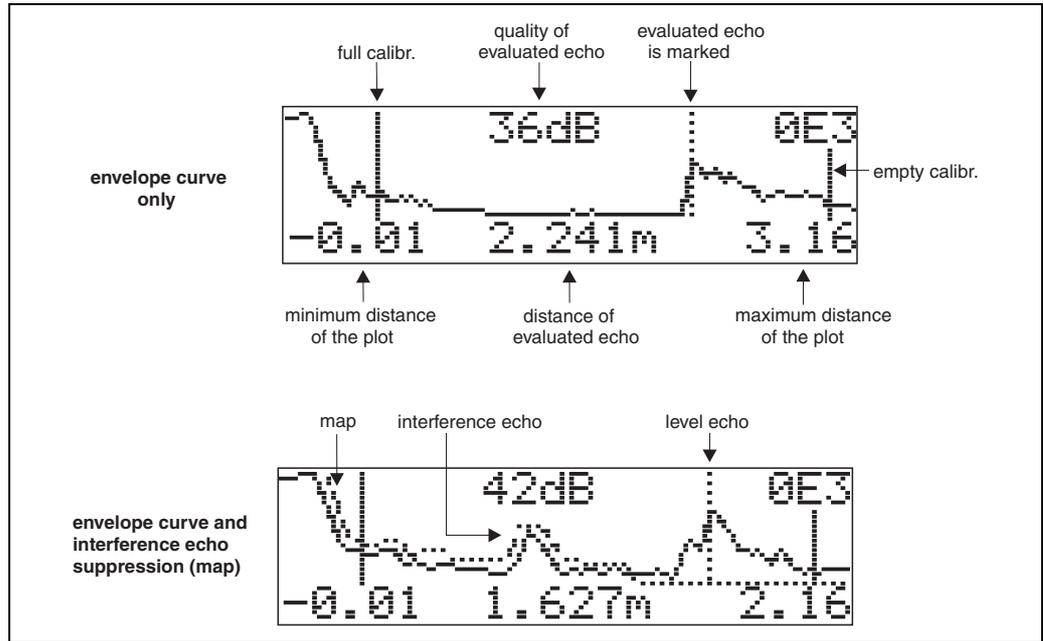
L00-FMU4xxxxx-07-00-00-en-003

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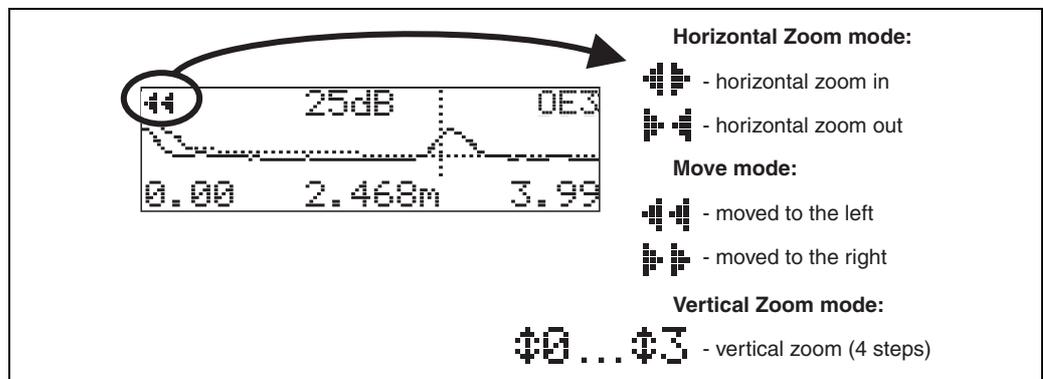
L00-FMxxxxxx-07-00-00-en-004

Horizontal Zoom mode

Firstly, go into the envelope curve display. Then press ⊕ or ⊖ to switch to the envelope curve navigation. You are then in Horizontal Zoom mode. Either ▪◆▪ or ▶◀ is displayed.
- ⊕ increases the horizontal scale.
- ⊖ reduces the horizontal scale.
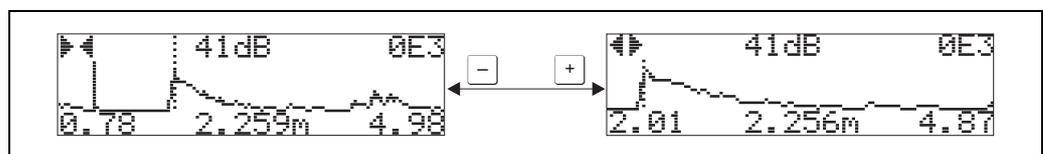
L00-FMxxxxxx-07-00-00-yy-007

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.

| ◀◀ 41dB 0E3 | | ▶▶ 41dB 0E3 |
| 1.96 2.258m 6.83 | ← − + → | 0.78 2.259m 5.65 |
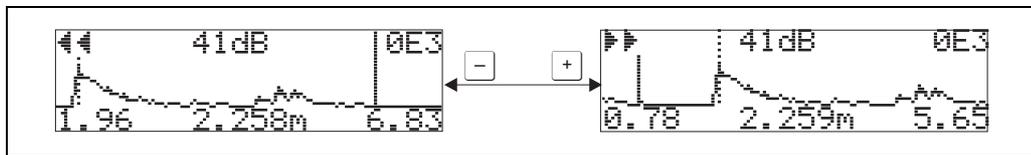
L00-FMxxxxxx-07-00-00-yy-008

Vertical Zoom mode

Press E once more to switch to Vertical Zoom mode. ↕1 is displayed. You now have the following options.
- + increases the vertical scale.
- − reduces the vertical scale.

The display icon shows the current zoom factor (↕0 to ↕3).

| ↕0 40dB 0E3 | | ↕3 41dB 0E3 |
| 1.17 2.259m 6.05 | ← − + → | 1.17 2.259m 6.05 |
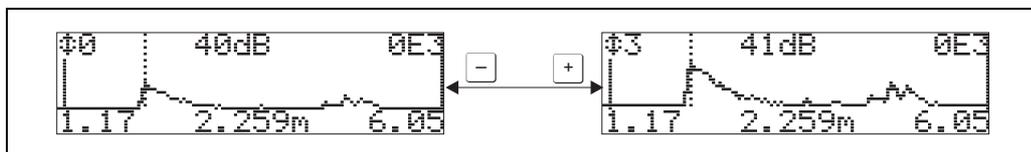
L00-FMxxxxxx-07-00-00-yy-009

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.

```
            Return to
         Group Selection
```

After 3 s, the following message appears

```
Group selection   0E
envelope curve
 display
 diagnostics
```

6.5   Basic Setup with the Endress+Hauser operating program

To carry out the basic setup with the operating program, proceed as follows:
■ Start the operating program and establish a connection
■ Select the "**basic setup**" function group in the navigation window

The following display appears on the screen:

Basic Setup step 1/4:

■ Status image
■ Enter the measuring point description (TAG number).
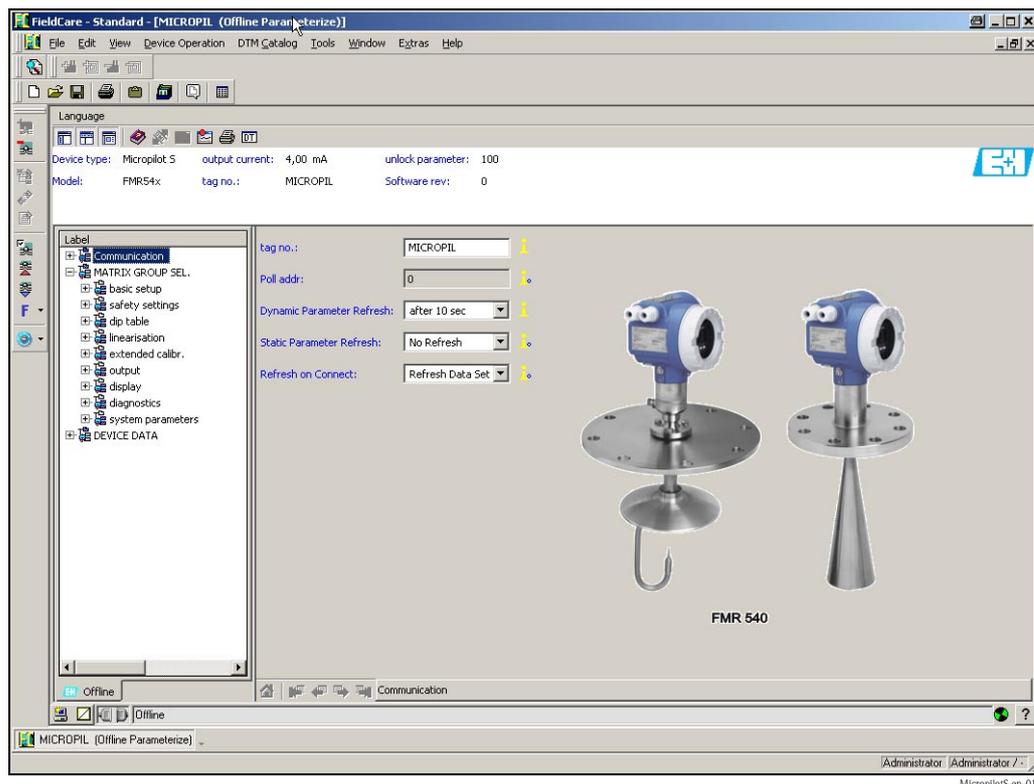
MicropilotS-en-011

■ The "**Next**" button moves you to the next screen display.

✎   Note!
Each parameter that is changed must be confirmed with the **return** key!

Basic Setup step 2/4:

- Enter the application parameters:
  – Tank shape
  – Medium property
  – Process cond.
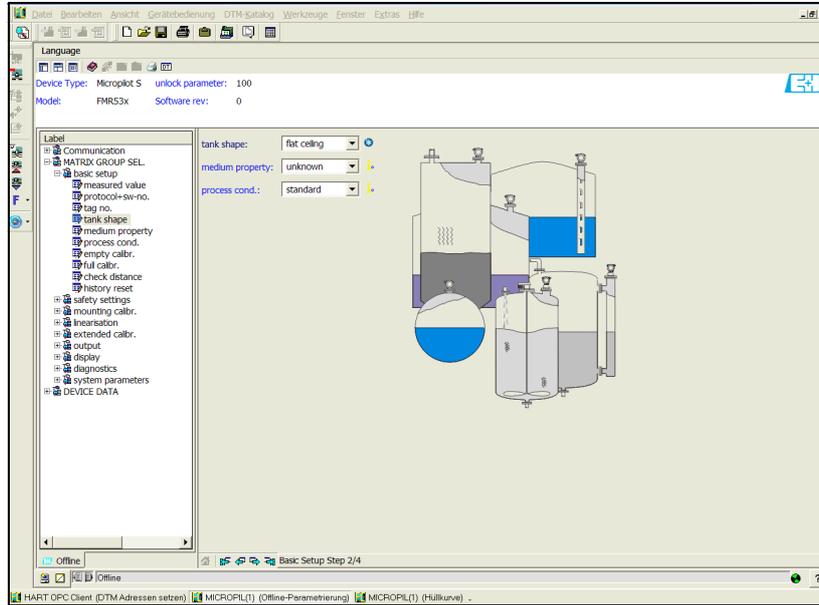
MicropilotS-en-002

Basic Setup step 3/4:

Enter the following parameters according to the tank:
- Empty calibr.
- Full calibr.
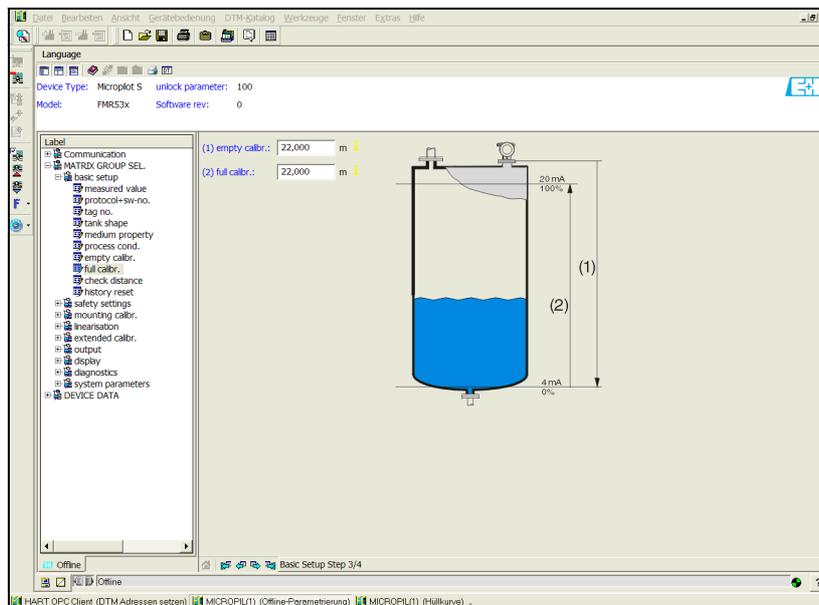
MicropilotS-en-006

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, → 🗎 49
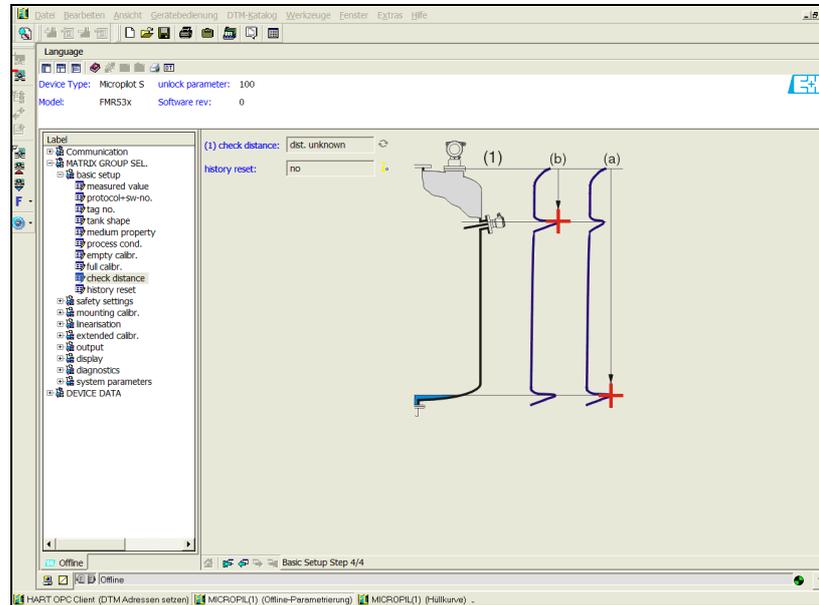
MicropilotS-en-007

6.5.1   Signal analysis via envelope curve

After the basic setup, an evaluation of the measurement using the envelope curve is recommended.
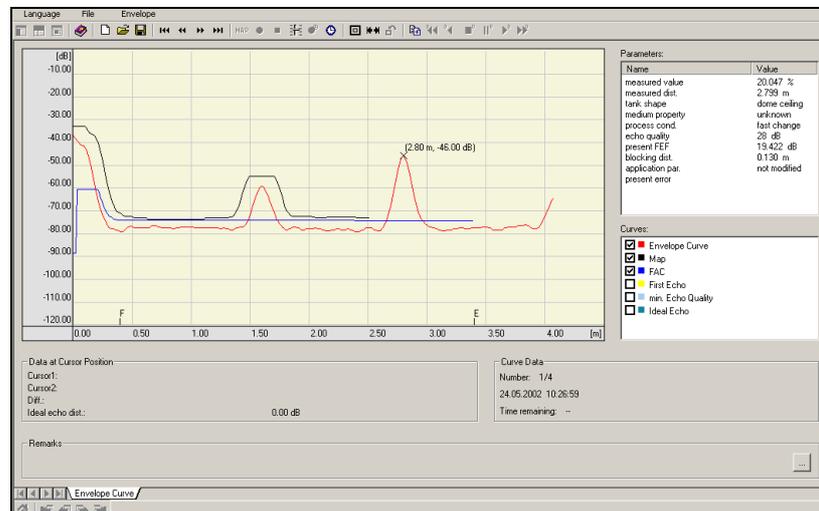
MicropilotM-en-306

6.5.2   User-specific applications (operation)

For details of setting the parameters of user-specific applications, see separate documentation BA00341F/00/EN "Description of Instrument Functions" on the enclosed CD-ROM.

7   Maintenance

The Micropilot S measuring device 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", → 📄 67). 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 the 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 our 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 device again via the communication interface. Prerequisite to this is that the data were uploaded to the PC beforehand using FieldCare.
Measurement can continue without having to carry out a new setup.

With a complete download of parametrization,
- you may have to activate linearisation (see BA00341F/00/EN 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 S.

8.1 Weather protection cover

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

L00-FMR2xxxx-00-00-06-en-001
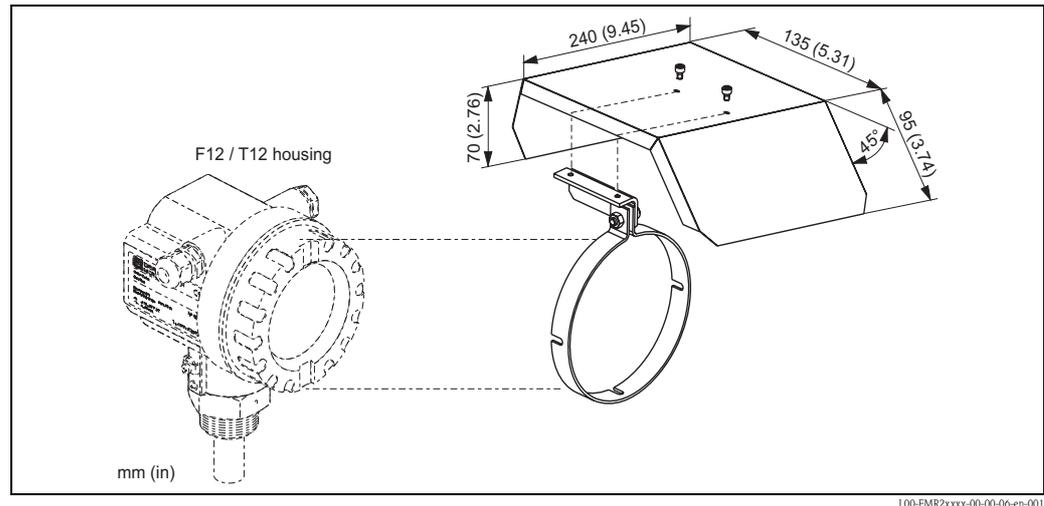
8.2 Sensor alignment tool for alignment device

A sensor alignment tool (a) is recommended to be used at the time of installation for FMR540 with alignment device.
Order code: 52026756

L00-FMR540xx-00-00-00-yy-008
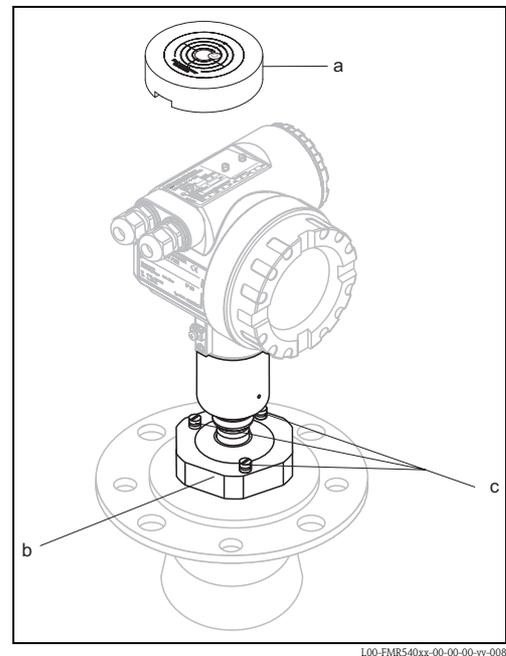
a: Alignment tool
b: Alignment device

8.3   Commubox FXA195 HART

For intrinsically safe communication with FieldCare via the USB interface.
For details refer to TI00404F/00/EN.

8.4   Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field devices with CDI interface
(= Endress+Hauser Common Data Interface) to the USB interface of a personal computer or a
notebook. For details refer to TI00405C/07/EN.

✎ Note!
For the device you need the "ToF Adapter FXA291" as an additional accessory.

8.5   ToF Adapter FXA291

The ToF Adapter FXA291 connects the Commubox FXA291 via the USB interface of a personal
computer or a notebook to the device. For details refer to KA00271F/00/A2.

9 Trouble-shooting

9.1 Trouble-shooting instructions

Micropilot S FMR540 -Trouble Shooting

| Instrument does not respond → Check voltage and compare it with the specifications on the nameplate. | Not ok → Connect the correct voltage → Instrument works? | Yes → Ready |
| No → ok |
| Check the polarity of the voltage. | Not ok → Correct the polarity → Instrument works? | Yes → Ready | No |
| Check power connection to electronic board | Not ok → Connect plug → Instrument works? | Yes → Ready | No |

Values on display invisible — Yes → Contrast: [E] + [+] — ok → Ready
No — Not ok

Check plug contact of the display. — Not ok → Connect the plug correctly → Display works? — Yes → Ready — No

Output current between 3.6 …22mA ? — Yes → The display is possibly defective. Contact Endress+Hauser Service — No

Output current < 3,6 mA ? — Yes → Check cabling — Not ok → Correct the cabling → Current is ok? — Yes → Ready — No — ok
Possibly defective electronics Contact E+H Service

HART communication does not function — Yes → Is the communication resistor installed according to the OM? — Not ok → Install the resistor (see the OM) → Communication ok? — Yes → Ready — No — ok

Is the Commubox connected according to the OM? — Not ok → Connect the Commubox (see the OM) → Communication ok? — Yes → Ready — No — ok

Is the switch on the Commubox for selecting HART/Intensor in the correct position? — Not ok → Set the switch correctly → Communication ok? — Yes → Ready — No — ok → Contact Endress+Hauser Service

Communication via Service adapter does not function — Yes → Check configuration of COM port on PC — Not ok → Correct configuration → Communication ok? — Yes → Ready — No → Contact Endress+Hauser Service

Instrument measures incorrectly — Yes → Check basic setup — Not ok → Repeat basic setup → Measurement ok? — Yes → Ready — No — ok

Proceed according to section 'Trouble shooting' in OM

L00-FMR540xx-19-00-00-en-005

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; EEPROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
W103	initialising – please wait	EEPROM 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; EEPROM 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	EEPROM 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; EEPROM 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; EEPROM 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 and electronics
A270	Custody switch out of check position	Switch for custody transfer may be defective	check position of custody switch; exchange electronics
W511	no factory calibration ch1	factory calibration has been deleted	record new factory calibration
W512	recording of mapping please wait	mapping active	wait some seconds until alarm disappears

Code	Description	Possible cause	Remedy
W601	linearisation ch1 curve not monotone	linearization not monotonously increasing	correct linearisation table
W611	less than 2 linearisation points for channel 1	number of entered linearization points < 2	correct linearisation table
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. Operating Instrcutions)
E651	level in safety distance - risk of overspill	level in safety distance	alarm will disappear as soon as level leaves safety distance;
A671	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 to 20.5 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 (→ 🗎 63)		1. See table of error messages (→ 🗎 63)
Measured value (00) is incorrect	L00-FMR540xx-19-00-00-en-006	Measured distance (008) OK?	yes →	1. Check empty calibr. (005) and full calibr. (006). 2. Check linearisation: → level/ullage (040) → max. scale (046) → diameter vessel (047) → Check table 3. Check dip table
		no ↓		
		An interference echo may have been evaluated.	yes →	1. Carry out tank mapping → basic setup 2. Is the pipe diameter (007) correct?
		no ↓		
		Customise the measurement with help of dip table		
No change off measured value on filling/emptying	L00-FMR54xxx-19-00-00-en-002	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
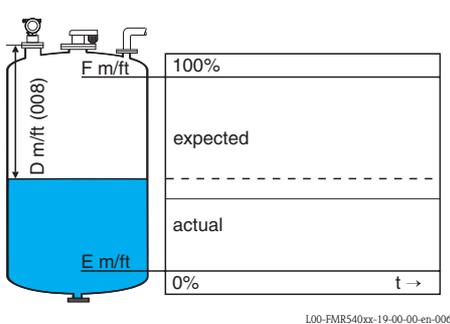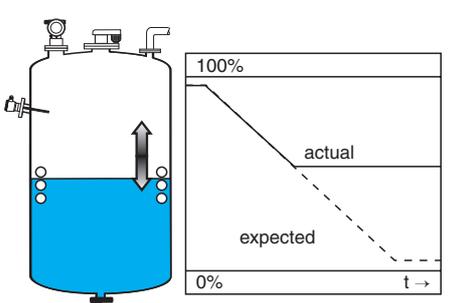
Error	Output	Possible cause		Remedy
If the surface is not calm (e.g. filling, emptying, agitator running), the measured value jumps sporadically to a higher level	L00-FMR54xxx-19-00-00-en-003 L00-FMR54xxx-19-00-00-en-004	Signal is weakened by the rough surface – the interference echoes are sometimes stronger		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. If necessary, select a better mounting position and/or larger antenna
During filling/ emptying the measured value jumps ownwards	L00-FMR54xxx-19-00-00-en-005	Multiple echoes	yes →	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
E641 (lost of echo)	L00-FMR54xxx-19-00-00-en-006	Level echo is too weak. Possible causes: ■ Rough surface due to filling/ emptying ■ Agitator running ■ Foam	yes →	1. Check application parameters (002), (003) and (004) 2. If necessary, select a better installation position and/or larger antenna

9.4   Spare parts

An overview of the spare parts for your device is available in the internet at www.endress.com. To obtain information on the spare parts, proceed as follows:

1.   Go to "www.endress.com" and select your country.

2.   Click "Instruments".

3.   Enter the product name into the "product name" field.

4.   Select the device.

5.   Click the "Accessories/Spare parts" tab.

6.   Select the required spare parts (You may also use the overview drawing on the right side of the screen.)

When ordering spare parts, always quote the serial number indicated on the nameplate. As far as necessary, the spare parts also include replacement instructions.

9.5   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)
- Operating time of the device.

9.6   Disposal

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

9.7   Software history

Date	Software version	Software changes	Documentation changes
10.2006	V 01.01.00	Original software. Operated via: – ToF Tool from version 4.6 – HART communicator DXR375 with Rev. 1, DD 1.	
07.2009	V 01.01.02	Adaptation parabolic antenna	

9.8   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 Endress+Hauser representative.

10 Technical data

10.1 Additional technical data

10.1.1 Application

The Micropilot S is used for highly accurate level measurement in storage tanks and can be applied in custody transfer applications. It meets the relevant requirements according to OIML R85 and API 3.1B. The FMR540 with
- parabolic antenna is excellently suited for free space applications up to 40 m (131 ft).
- horn antenna is suitable for free space applications that disallow the use of a parabolic antenna due to tank/nozzle geometry.

10.1.2 Input

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

10.1.3 Output

Output signal	4 to 20 mA (invertible) with HART protocol

Signal on alarm	Error information can be accessed via the following interfaces:
	- Local display:
	  – Error symbol ($\rightarrow$ 📄 34)
	  – Plain text display
	- Current output
	- Digital interface

Linearization	The linearization function of the Micropilot S 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.

10.1.4 Auxiliary energy

Residual ripple HART	47 to 125 Hz: $U_{pp} = 200$ mV

Max. noise HART	500 Hz to 10 kHz: Ueff = 19 mV (at 500 Ω)

10.1.5   Performance characteristics

Reference operating conditions	**According to OIML R85:** ■ Temperature = –25 °C to +55 °C (–13 °F to +131 °F) ■ Atmospheric pressure ■ Relative humidity (air) = 60 % ±15 % ■ Medium properties: e.g. medium with good reflectivity and calm surface ■ Tank diameter: signal beam hits the tank wall only at one side ■ No major interference reflections inside the signal beam
Maximum measured error	Absolute accuracy: better than ±1 mm (better than 1/16")
Resolution	Digital 0.1 mm/analogue: 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 device needs the reaction time to indicate the new value.
Influence of ambiente temperature	■ **Zero point (4 mA)** average T_K: 0,025 %/10 K, max. 0,291 % over the entire temperature range –40 °C to +80 °C ■ **Span (20 mA)** average T_K: 0,07 %/10 K, max. 0,824 % over the entire temperature range –40 °C to +80 °C

10.1.6   Operating conditions: Environment

Ambient temperature range	Ambient temperature for the transmitter: –40 °C to +80 °C (–40 °F to +176 °F) or –50 °C to +80 °C (–58 °F to +176 °F). The functionality of the LCD display may be limited for temperatures Ta < –20 °C and Ta > +60 °C. A weather protection cover should be used for outdoor operation if the device is exposed to direct sunlight.
Storage temperature	–40 °C to +80 °C (–40 °F to +176°F) or –50 °C to +80 °C (–58 °F to +176 °F)
Climate class	DIN EN 60068–2–38 (test Z/AD)
Vibration resistance	DIN EN 60068–2–64 / IEC 68–2–64: 20 to 2000 Hz, 1 $(m/s^2)^2$/Hz
Cleaning of the antenna	The antenna can get contaminated, depending on the application. The emission and reception of microwaves can thus eventually be hindered. The degree of contamination leading to an error depends on the medium and the reflectivity, mainly determined by the dielectric constant εr. 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 air purge connection). 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	■ Electromagnetic compatibility in accordance with all relevant requirements of the EN 61326 series and NAMUR recommendation EMC (NE21). For details refer to the Declaration of Conformity. Maximum deviation <0.5 % of the span. ■ 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).

10.1.7 Operating conditions: Process

Process temperature range	FKM Viton GLT, –40 °C to +200 °C (–40 °F to +392 °F)

Dielectric constant	In free space: $\varepsilon r \geq 1.8$

10.1.8 Mechanical construction

Weight	Approx 6 kg + weight of flange

Material	Refer to TI00412F/00/EN, chapter "Material (not in contact with process)" and "Material (in contact with process).

10.1.9 Certificates and approvals

CE approval	The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the device passing the required tests by attaching the CE-mark.

RF approvals	R&TTE, FCC

External standards and guidelines	**EN 60529** Protection class of housing (IP-code). **EN 61010** Safety regulations for electrical devices for measurement, control, regulation and laboratory use. **EN 61326** Emissions (equipment class B), compatibility (appendix A – industrial area). **NAMUR** Standards committee for measurement and control in the chemical industry.

Ex approval   Correlation of safety instructions (XA) and certificates (ZE) to the device:

Device	Certificate	Explosion protection	Output	Communication	PTB 00 ATEX	XA	WHG
FMR540	1	ATEX II 1/2 G EEx ia IIC T6	A	HART	2067X	XA00338F/00/A3	ZE00243F/00/DE
	6	ATEX II 1/2 G EEx ia, WHG					

Control Drawings   Correlation of Control Drawings to the device:

Device	Certificate	Explosion protection	Output	Communication	Documentation
FMR540	S	FM IS	A	HART	XA00554F/00/EN
	U	CSA IS			ZD00196F/00/EN

10.1.10 Supplementary Documentation

Supplementary Documentation	■ Technical Information (TI00412F/00/EN) ■ Operating Instructions "Description of Instrument functions" (BA00341F/00/EN) ■ Brief Operating Instructions (KA01059F/00/EN)

11   Appendix

11.1   Operating menu HART (display modul)

basic setup	00	→	tank shape	002	→	medium cond.	003	→	process cond.	004	→	empty calibr.	005	→	full calibr.	006	→

dome ceiling
horizontal cyl.

bypass
stilling well
flat ceiling
sphere

unknown
DK: < 1.9
DK: 1.9 … 4
DK: 4 … 10
DK: > 10

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

enter value

enter value

pipe dia...
enter val...

safety settings	01	→	output on alarm	010					outp. echo loss	012				delay time	014	

MIN -10% 3.6mA
MAX 110% 22mA
hold

user specific

output on alarm   011
enter value

alarm
hold

ramp %MB/min

ramp %span/min   013
enter value

in case of echo loss
max. 4000 sec.
default: 30 s

dip table	03	→	dip table state	030	→	dip table mode	031

table off
table on

view points

add manually

add semi-autom

delete point

del all points

dip table   034
m. val   034
dip val   035
TabNo   032

view handling   036
next point
previous point
return

dip table   034
m. val   034
dip val   035
remain   033

store point   037
no
yes

add next
yes
no

dip table   034
m. val   034
dip val   035
remain   033

store point   037
no
yes

dip table   034
m. val   034
dip val   035
TabNo   032

delete handling   039
next point
previous point
delete
return

delete po...
no
yes

del all po...
no
yes

linearisation	04	→	level/ullage	040	→	linearisation	041

level CU   040
ullage CU

level DU   040
ullage DU

manual   041
semi-automatic
table on

horicontal cyl
linear
clear table

customer unit   042

customer unit   042
customer unit   042

linearisation
table no.   043
input level   044
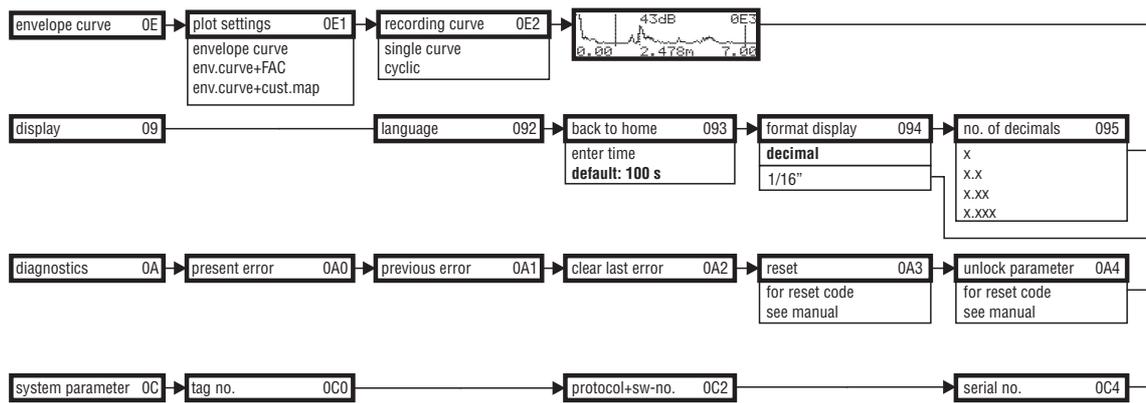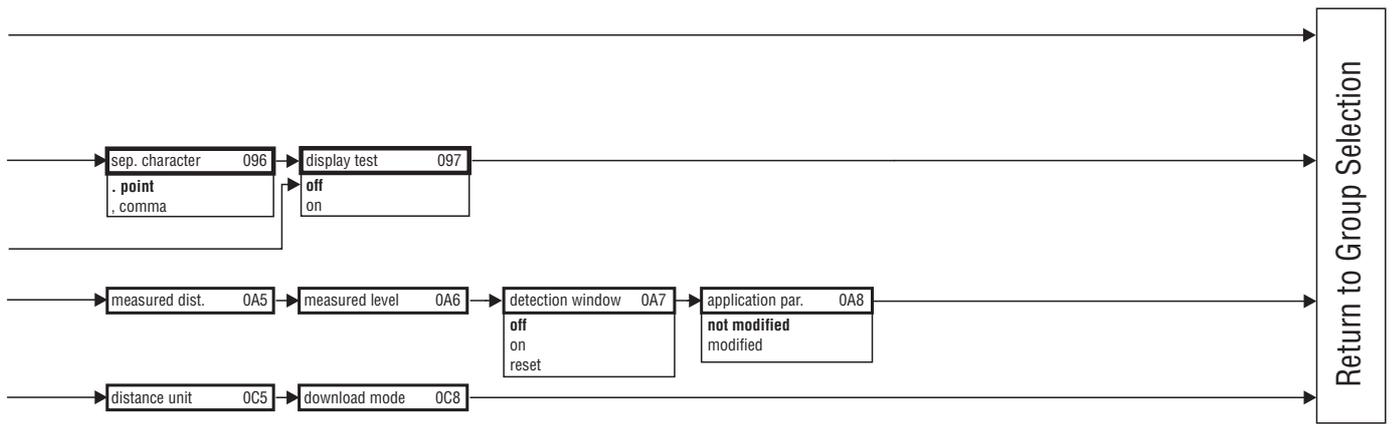input volume   045

next point   045
yes
no

extended calibr.	05	→	selection	050	→	dist./meas value	008	→	check distance	051	→	range of mapping	052	→	start mapping	053

mapping

common

extended map..

D and L
are displayed

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

input of
mapping range

off
on

pres. Map dist   054
is displayed

cust. Tank map   055
inactive
active
reset

output	06	→	commun. address	060	→	no. of preambels	061	→	low output limit	062	→	curr. output mode	063

off
on

standard

fixed current

fixed current

fixed cur. value   064

4mA value   068

20mA val...

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

L00-FMR54xxx-19-00-01-en-009

dist./meas.value 008	check distance 051	range of mapping 052	start mapping 053	dist./meas.value 008	set value 009
D and L are displayed	distance = ok dist. too small manual **dist. unknown** dist. too big	input of mapping range	**off** on	D and L are displayed	

safety distance 015	in safety dist. 016	ackn. alarm 017	overspill protection 018
from blocking distance **default: 0.1m**	alarm **warning** self holding	**no** yes	**standard** german WHG

dip table state 030
table off table on

Return to Group Selection

max. scale 046	diameter vessel 047
max. scale 046	

dist./meas.value 008
D and L are displayed

echo quality 056	offset 057	Antenna extens. 058	output damping 058	blocking dist. 059
is displayed	will be added to the measured level	length FAR10 - for FMR230 only	enter value **default: 5 s**	is displayed

simulation 065	output current 067
sim. off sim. level sim. volume sim. current	

simulation value 066

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envelope curve 0E	plot settings 0E1	recording curve 0E2	43dB 0E3
	envelope curve env.curve+FAC env.curve+cust.map	single curve cyclic	0.00 2.478m 7.00

display 09		language 092	back to home 093	format display 094	no. of decimals 095
			enter time **default: 100 s**	**decimal** 1/16"	x x.x x.xx x.xxx

diagnostics 0A	present error 0A0	previous error 0A1	clear last error 0A2	reset 0A3	unlock parameter 0A4
				for reset code see manual	for reset code see manual

system parameter 0C	tag no. 0C0		protocol+sw-no. 0C2		serial no. 0C4

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

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sep. character	096
. point	
, comma	

display test	097
off	
on	

measured dist.	0A5

measured level	0A6

detection window	0A7
off	
on	
reset	

application par.	0A8
not modified	
modified	

distance unit	0C5

download mode	0C8

Return to Group Selection

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11.2   Patents

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

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

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Declaration of Hazardous Material and De-Contamination
Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.
Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°F] _____ [°C]   Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [μS/cm]   Viscosity / *Viskosität* _____ [cp] _____ [mm²/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits- schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium *Medium im Prozess*								
Medium for process cleaning *Medium zur Prozessreinigung*								
Returned part cleaned with *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____
_____
_____

Company data / *Angaben zum Absender*

Company / *Firma* _____
_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*
_____

Address / *Adresse*
_____
_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge. We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

_____
(place, date / *Ort, Datum*)

_____
Name, dept./ *Abt.* (please print / *bitte Druckschrift*)

_____
Signature / *Unterschrift*

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