



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

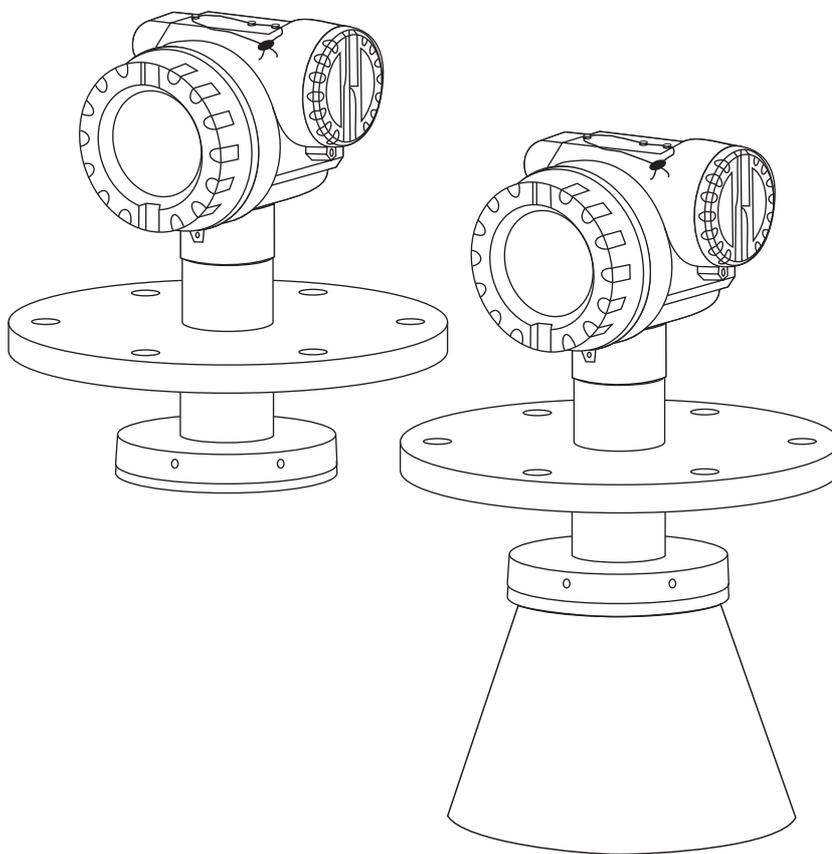


Solutions

Operating Instructions

Micropilot S FMR532

Level-Radar



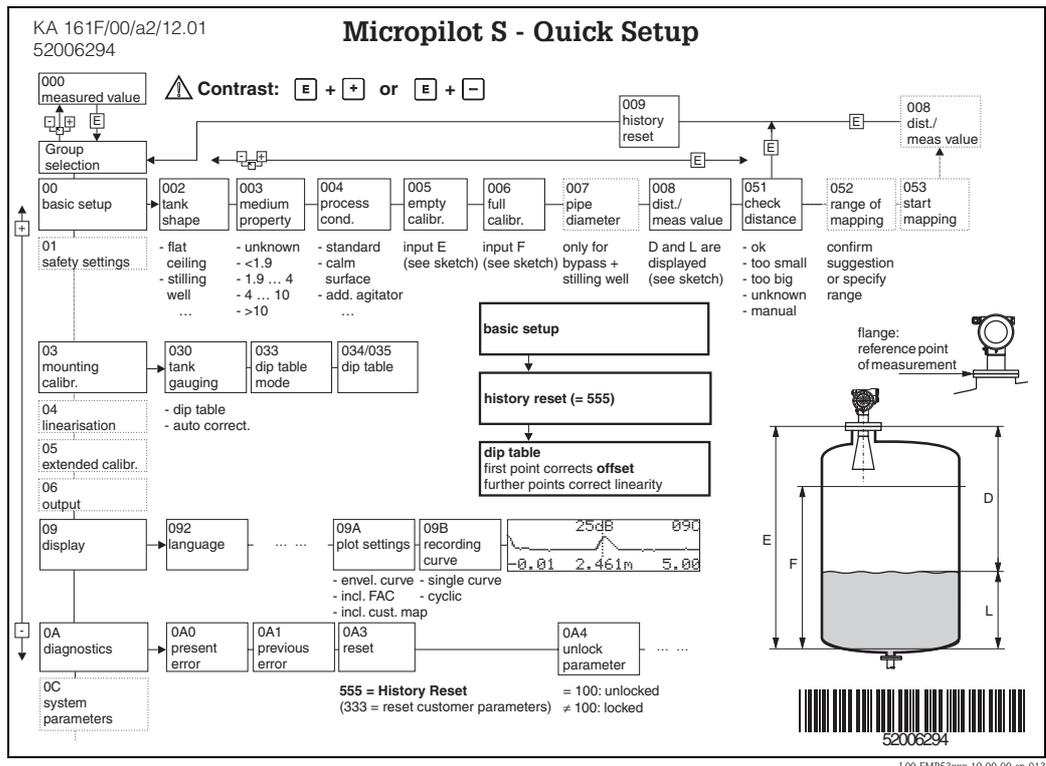
BA00208F/00/EN/13.10
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Valid as of software version
V 01.03.00 (amplifier)
V 01.03.00 (communication)

Endress+Hauser

People for Process Automation

Brief operating instructions



Note!

This operating manual explains the installation and initial start-up for the level transmitter. All functions that are required for a typical measuring task are taken into account here. In addition, the Micropilot 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 → [82](#).

The operating manual BA00217F/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	4	8	Accessories	68
1.1	Designated use	4	8.1	Weather protection cover	68
1.2	Installation, commissioning and operation	4	8.2	Commubox FXA195 HART	68
1.3	Operational safety and process safety	4	8.3	Commubox FXA291	68
1.4	Notes on safety conventions and symbols	5	8.4	ToF Adapter FXA291	68
			8.5	Mounting with Sample hatch on stilling well	69
2	Identification	6	9	Trouble-shooting	70
2.1	Device designation	6	9.1	Trouble-shooting instructions	70
2.2	Scope of delivery	9	9.2	System error messages	71
2.3	Certificates and approvals	9	9.3	Application errors	73
2.4	Registered trademarks	9	9.4	Spare parts	75
			9.5	Return	76
			9.6	Disposal	76
			9.7	Software history	76
			9.8	Contact addresses of Endress+Hauser	76
3	Mounting	10	10	Technical data	77
3.1	Quick installation guide	10	10.1	Additional technical data	77
3.2	Incoming acceptance, transport, storage	10			
3.3	Installation Conditions	11			
3.4	Installation instructions	15			
3.5	Post-installation check	21			
4	Wiring	22	11	Appendix	82
4.1	Quick wiring guide	22	11.1	Operating menu HART (Display modul)	82
4.2	Connecting the measuring unit	24	11.2	Custody transfer mode	84
4.3	Recommended connection	27	11.3	Weight and measure approval, Standards Authorities approval, Compulsory reapproval	84
4.4	Degree of protection	27	11.4	Particularities in "approved" operation	85
4.5	Post-connection check	27	11.5	Definition of terms	85
			11.6	Integrated in tank gauging system	85
			11.7	Patents	86
5	Operation	28			
5.1	Quick operation guide	28			
5.2	Display and operating elements	30			
5.3	Local operation	33			
5.4	Display and acknowledging error messages	36			
5.5	HART communication	37			
6	Commissioning	40	Index	89	
6.1	Function check	40			
6.2	Switching on the measuring device	40			
6.3	Basic Setup	41			
6.4	Basic Setup with the VU331	43			
6.5	Mounting calibration with VU331	51			
6.6	Basic Setup with the Endress+Hauser operating program	61			
6.7	Mounting calibration with Endress+Hauser operating program	65			
7	Maintenance	67			
7.1	Exterior cleaning	67			
7.2	Replacing seals	67			
7.3	Repair	67			
7.4	Repairs to Ex-approved devices	67			
7.5	Replacement	67			

1 Safety instructions

1.1 Designated use

The Micropilot S is a compact radar level transmitter for the continuous, contactless measurement of liquids. The device can also be freely mounted outside closed metal vessels because of its operating frequency of about 6 GHz and a maximum radiated pulsed energy of 1 mW (average power output 1 μ W). 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 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.

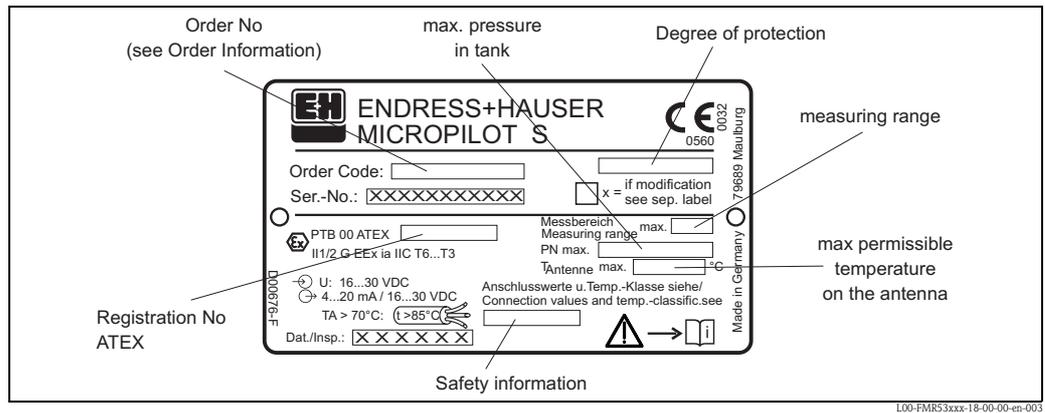
Safety conventions	
	Warning! A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the device.
	Caution! Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or 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	
	Device certified for use in explosion hazardous area If the device has this symbol embossed on its name plate it can be installed in an explosion hazardous area.
	Explosion hazardous area Symbol used in drawings to indicate explosion hazardous areas. Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection.
	Safe area (non-explosion hazardous area) Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas.
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 .
	Temperature resistance of the connection cables States, that the connection cables must be resistant to a temperature of at least 85 °C.

2 Identification

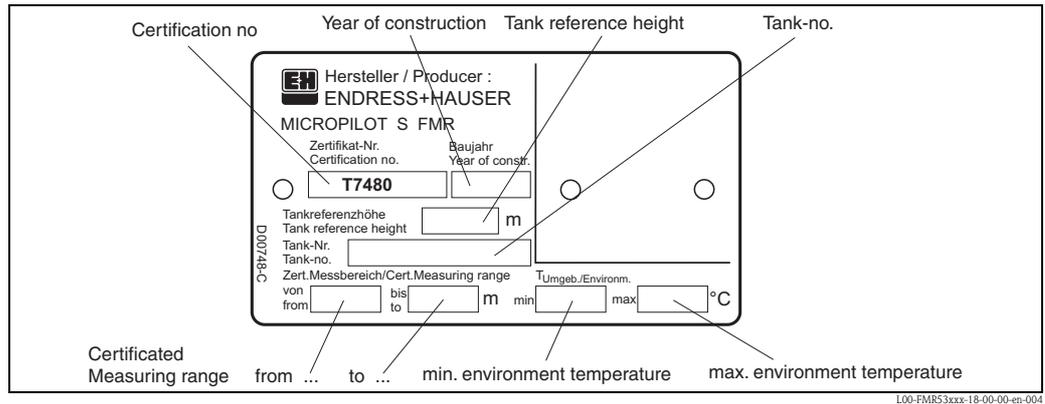
2.1 Device designation

2.1.1 Nameplate

The following technical data are given on the device nameplate:



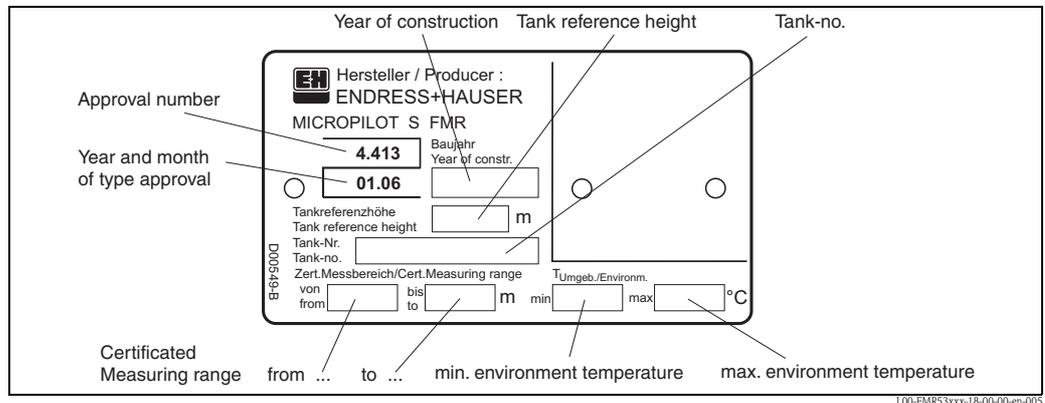
Information on the nameplate of the Micropilot S FMR532



Information on the NMi type plate for custody transfer applications of the Micropilot S FMR532

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 FMR532

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
	1	ATEX II 1/2G EEx ia IIC T6 - XA Note safety instruction (electrostatic charging)!
	6	ATEX II 1/2G EEx ia IIC T6, WHG - XA Note safety instruction (electrostatic charging)!
	D	IEC Ex ia IIC T6 (in preparation)
	G	ATEX II 3G EEx nA II T6
	I	NEPSI Ex ia IIC T6 (in preparation)
	S	FM IS Cl.I Div.1 Gr. A-D, zone 0,1,2
	U	CSA IS Cl.I Div.1 Gr. A-D, zone 0,1,2
	K	TIIS Ex ia IIC T3
	L	TIIS Ex ia IIC T6
	Y	Special version, TSP-No. to be spec.
20	Antenna:	
	1	150mm/6", PTFE surface, FKM, Planar
	2	200mm/8", PTFE surface, FKM, Planar
	3	250mm/10", PTFE surface, FKM, Planar
	4	300mm/12", PTFE surface, FKM, Planar
	Y	Special version, TSP-No. to be spec.
30	Process connection:	
		– EN-Flanges –
	CWJ	DN150 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)
	C1J	DN150 PN25 B1, 316L flange EN1092-1 (DIN2527 C)
	CXJ	DN200 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
	CZJ	DN200 PN25 B1, 316L flange EN1092-1 (DIN2527 C)
	C6J	DN250 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
	C8J	DN300 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
		– ANSI-Flanges –
	AVJ	6" 150lbs RF sch.40, 316/316L flange ANSI B16.5
	AWJ	6" 300lbs RF sch.40, 316/316L flange ANSI B16.5
	A3J	8" 150lbs RF sch.40, 316/316L flange ANSI B16.5
	AXJ	8" 300lbs RF sch.40, 316/316L flange ANSI B16.5
	A5J	10" 150lbs RF sch.40, 316/316L flange ANSI B16.5
	A7J	12" 150lbs RF, 316/316L flange ANSI B16.5
		– JIS-Flanges –
	KVJ	10K 150A RF, 316L flange JIS B2220
	KWJ	20K 150A RF, 316L flange JIS B2220
	KDJ	10K 200A RF, 316L flange JIS B2220
	KXJ	20K 200A RF, 316L flange JIS B2220
	K5J	10K 250A RF, 316L flange JIS B2220
		– JPI-Flanges –
	LJJ	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
	LMJ	300A 150lbs RF, 316/316L flange JPI 7S-15
		– Miscellaneous –
	XXJ	With flange hub, 316L
	XVU	UNI-Flange 6"/DN150/150, 304 max 14.5lbs/PN1/1K, compatible with 6" 150lbs / DN150 PN16 / 10K 150
	X3U	UNI-Flange 8"/DN200/200, 304 max 14.5lbs/PN1/1K, compatible with 8" 150lbs / DN200 PN16 / 10K 200
	X5U	UNI-Flange 10"/DN250/250, 304 max 14.5lbs/PN1/1K, compatible with 10" 150lbs / DN250 PN16 / 10K 250
	X7U	UNI-Flange 12"/DN300/300, 304 max 14.5lbs/PN1/1K, compatible with 12" 150lbs / DN300 PN16 / 10K 300
	YY9	Special version, TSP-No. to be spec.
40	Output; Operation:	
	A	4-20mA HART; 4-line display VU331, envelope curve display on site
	Y	Special version, TSP-No. to be spec.

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 (→ 68)
- 2 seals
- Endress+Hauser operating program on the enclosed CD-ROM
- Brief operating instructions KA01057F/00/EN for quick commissioning
- Brief operating instructions KA00161F/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[®]

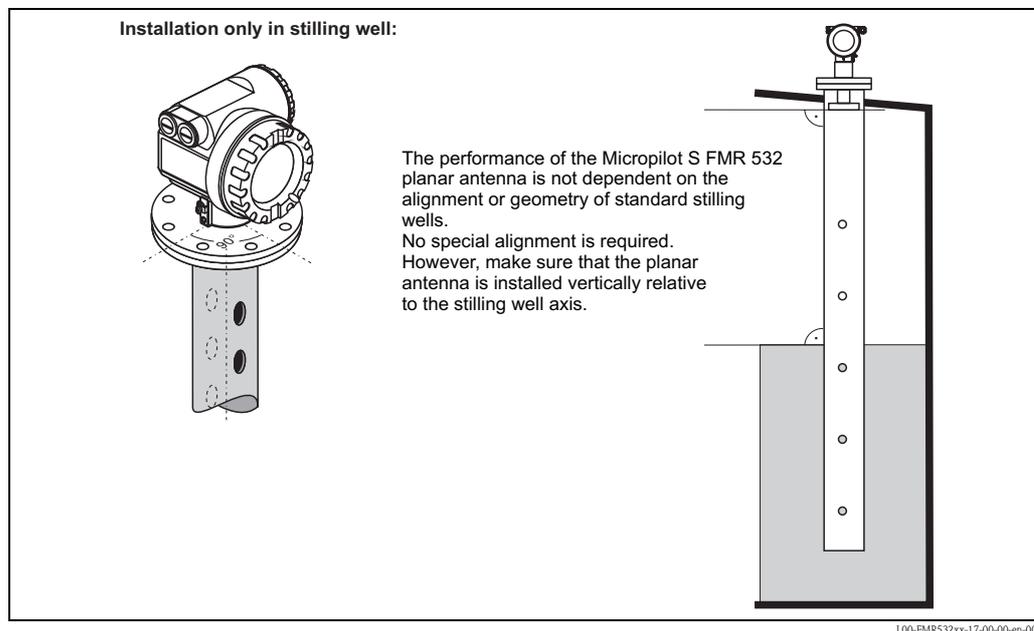
Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

FieldCare[®]

Registered trademark of the Endress+Hauser Process Solutions AG, Reinach, Switzerland

3 Mounting

3.1 Quick installation guide



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!

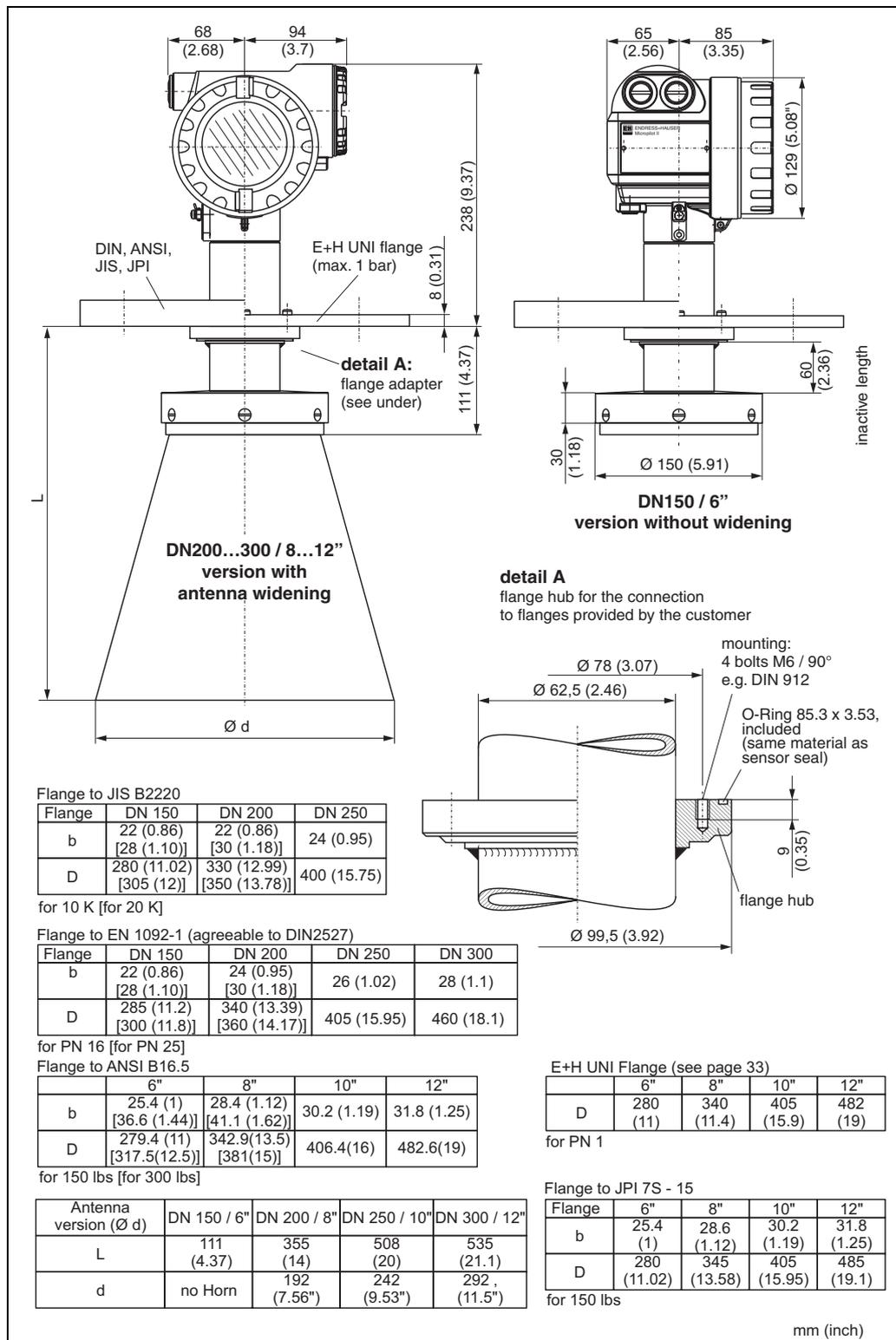
Follow the safety instructions and transport conditions for devices of more than 18 kg.

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 $+80\text{ °C}$.

3.3 Installation Conditions

3.3.1 Dimensions



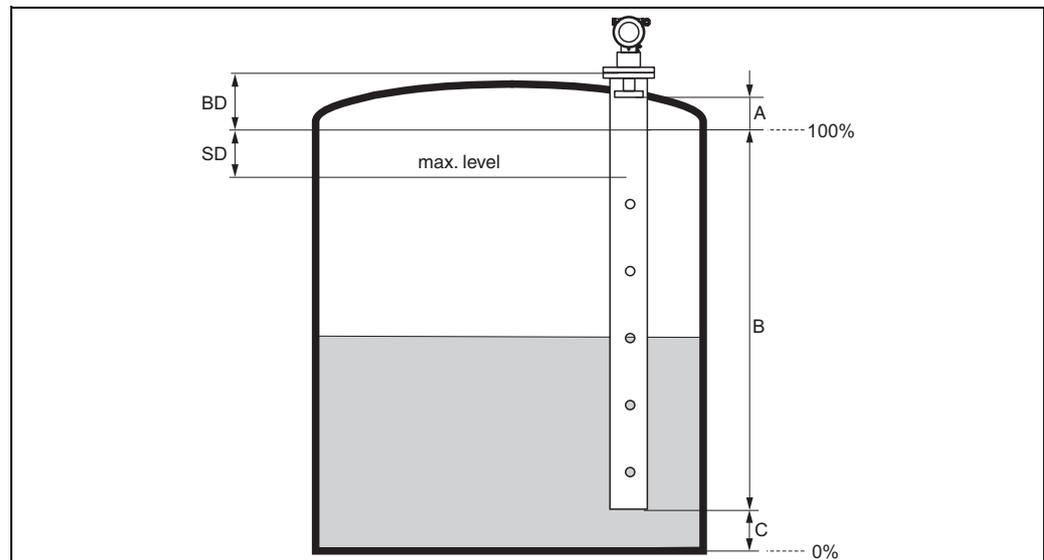
Note!

The inactive length of 60 mm prevents condensation effects to the antenna performance. Special versions with longer construction are available.

3.3.2 Engineering hints

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.
- For **overspill protection**, it is possible to define a safety distance (**SD**) additionally to the blocking distance (**BD**).
- 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.).
- The zero should be positioned at the end of the tube, as the electromagnetic waves do not propagate completely outside the tube. It must be taken into account that the accuracy may be reduced in the area C. In order to guarantee the required accuracy in these cases, it is recommended to position the zero-point at a distance **C** above the tank bottom (see Fig.).
- In applications with **planar** antennas, especially for media with low dielectric constants (media group A and B, → § 13), the end of the measuring range should not be closer than 1 m (40") to the flange (cf. **A** in following figure).
- The safety distance (**SD**) is set to 0.5 m (20") by default, generating an alarm in case the product level rises inside the safety distance.



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	reference: flange / BD (cf. picture)		reference: antenna tip (cf. picture)		
	Blocking distance	Safety distance	recommended additional settings		
	BD [m (ft)]	SD [m (ft)]	A [mm (in)]	B [m (ft)]	C [mm (in)]
FMR532	1 (3.28)	0.5 (1.6)	1000 (40)	0.5 (1.64)	150 to 300 (6 to 12)

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 (E681).

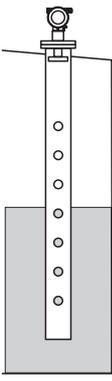
Measuring range

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

The 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.

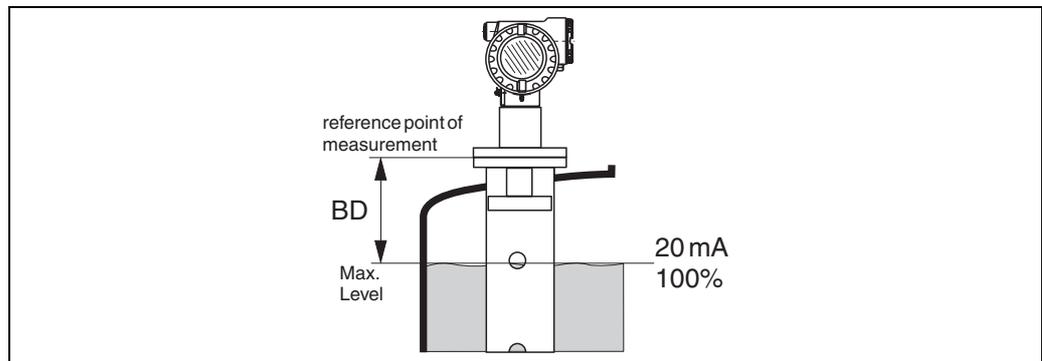
Media group	DC (ϵ_r)	Examples
A	1.4 to 1.9	non-conducting liquids, e.g. liquefied gas (LPG). For more information please contact your Endress+Hauser representative.
B	1.9 to 4	non-conducting liquids, e.g. benzene, oil, toluene, white products, black products, crudes, bitumen/asphalts, ...
C	4 to 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ...
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

Measuring range depending on product class

Media group		Stilling well/ Bypass
		
		Measuring range
		FMR532 ≥ DN150
A	DC (ϵ_r) = 1,4 to 1,9	38 m (124 ft)
B	DC (ϵ_r) = 1,9 to 4	38 m (124 ft)
C	DC (ϵ_r) = 4 to 10	38 m (124 ft)
D	DC (ϵ_r) > 10	38 m (124 ft)
max. measuring range with custody transfer approvals		25 m (82 ft) (NMI) 30 m (98 ft) (PTB)

Blocking distance

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



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Blocking distance (BD) ¹⁾	Free space (Storage tank)
from flange	1 m (40") [→ 11]

1) 1 mm accuracy under reference conditions



Note!
Inside the blocking distance a reliable measurement can not be guaranteed.

3.4 Installation instructions

3.4.1 Mounting kit

For the mounting, you will require the following tool:

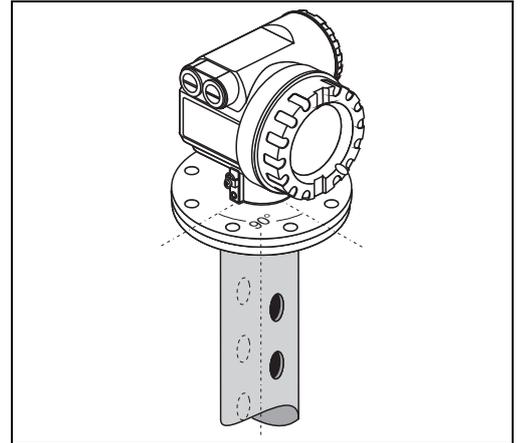
- The tool for flange mounting
- 4 mm (0.1") Allen wrench for turning the housing

3.4.2 Installation in tank (free space)

Optimum mounting position

Standard installation

- Observe installation instructions, → 12.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- Planar axis vertical to flange.
- Measurements can be performed through an open ball valve without any problems.



L00-FMR532xx-17-00-00-xx-008

Recommendations for the stilling well

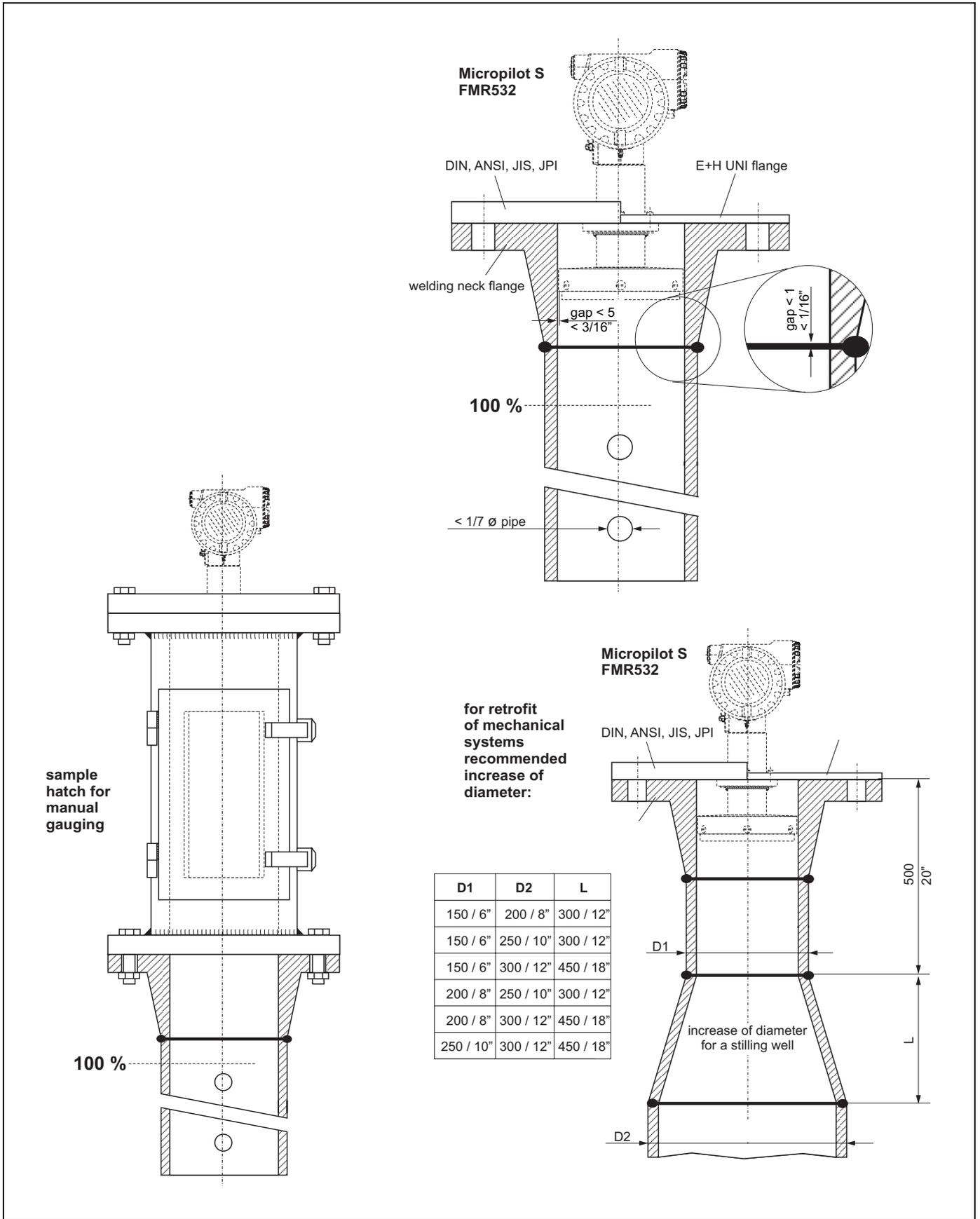
- Metal (no enamel coating, plastic on request).
- Constant diameter.
- When using a FMR532, an increase of the pipe diameter from DN150 to DN200 / DN200 to DN250 / DN250 to DN300 is acceptable. A larger step-width for the increase of the pipe diameter (e.g. DN150 to DN300) is possible if the upper part of the pipe has a suitable length. The length of the stilling well enlargement must be kept. In this case, the upper end of the pipe must have a minimum length of 0.5 m (20") before the diameter increases (refer to table, → 17). If the length is less than "L", please contact Endress+Hauser in order to determine a suitable antenna adapter (separable antenna horn). Ideally, a sample hatch is used.
- Any rectangular increase of the pipe diameter has to be avoided.
- Weld seam as smooth as possible and on the same axis as the slots.
- For best radar propagation behavior holes it is recommended to have holes instead of slots. If slots can not be avoided, they should be as thin and short as possible.
- The diameter of the holes (deburred) can be up to 1/7 of the pipe diameter but should not exceed 30 mm.
- Length and number of the holes do not affect the measurement.
- Maximum gap allowed between the antenna/horn and the inside of the stilling well is 5 mm (3/16").
- At any transition (e.g. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm.
- The stilling well must be smooth on the inside (average roughness $R_z \leq 6.3 \mu\text{m}$). Use extruded or parallel welded stainless steel pipe. An extension of the pipe is possible with welded flanges or pipe sleeves. Flange and pipe have to be properly aligned at the inside.
- Do not weld through the pipe wall. The inside of the stilling well must remain smooth. In case of unintentional welding through the pipe, the weld seam and any unevenness on the inside need to be carefully removed and smoothed. Otherwise, strong interference echoes will be generated and material build-up will be promoted.



Note!

- Select antenna extension as big as possible. For intermediate sizes (e.g. 180 mm) select next larger antenna extension and adapt it mechanically. Maximum gap allowed between the antenna/horn and the inside of the stilling well is 5 mm (3/16").
- The antenna extension of the FMR532 is mounted with defined pressure. It is strongly recommended **not to dismantle this antenna**.
- Dimensions of a nozzle for manual gauging must be adapted to the dimensions of the horn antenna used, compare → 17.

Examples for the construction of stilling wells

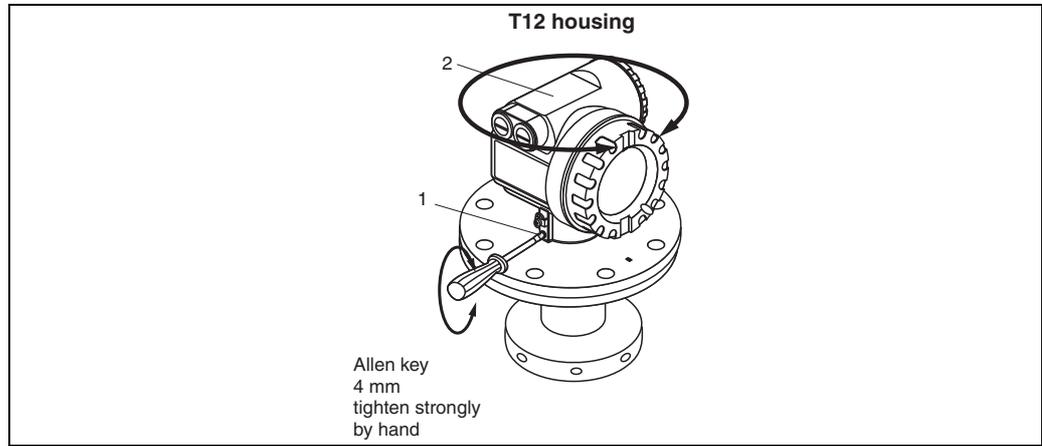


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3.4.3 Turn housing

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

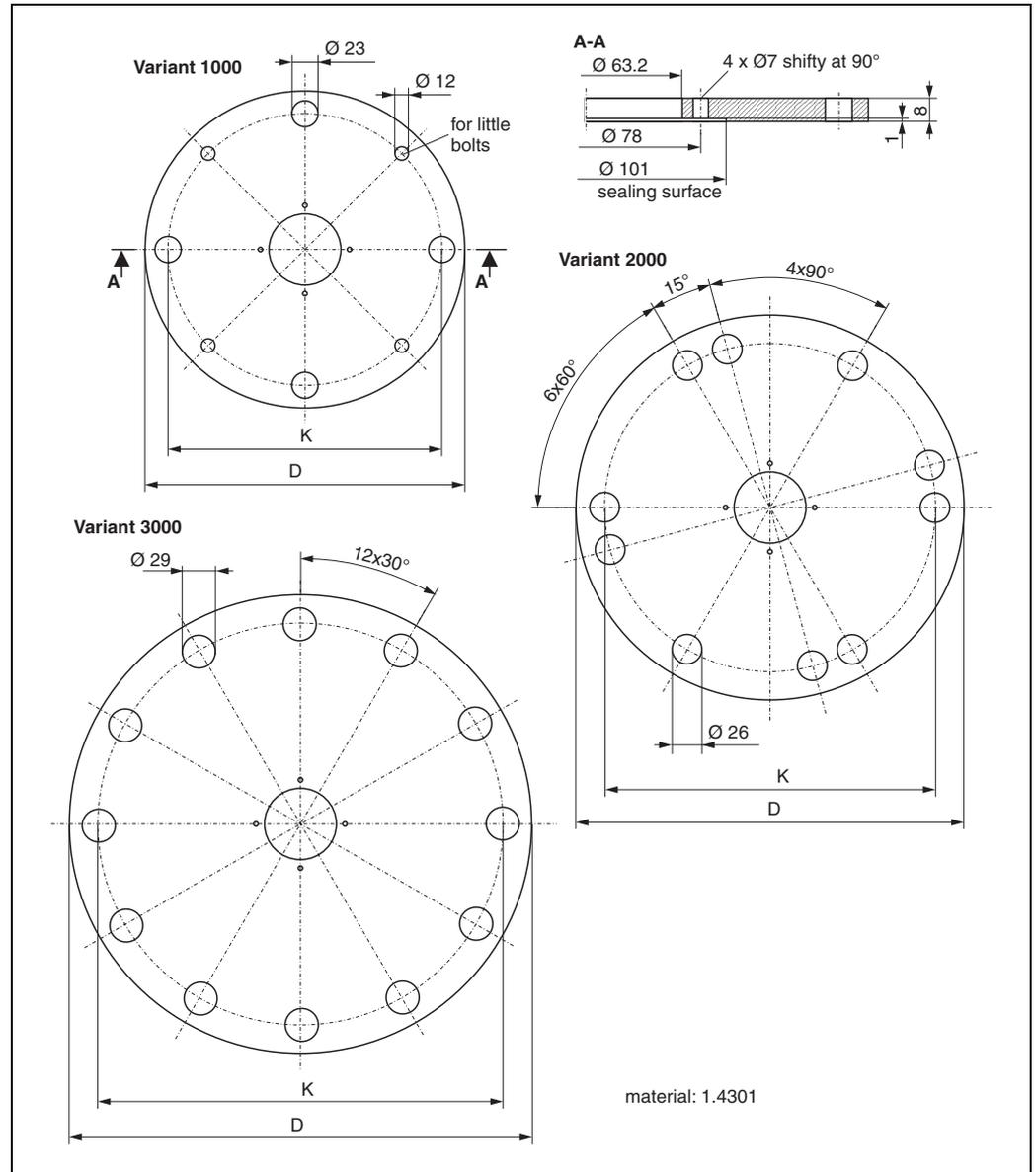
- Undo the fixing screws (1)
- Turn the housing (2) in the required direction
- Tighten up the fixing screws (1)



3.4.4 Installation with Endress+Hauser UNI flange

Installation hints

Endress+Hauser UNI flanges are designed for non-pressurized operation respectively max. 1 bar absolute pressure. 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.



L00-FMR53xxx-06-00-00-en-001

Version	Compatible with	D [mm]	K [mm]	Type plate
1000	DN150 PN16, ANSI 6" 150lbs, JIS 10K 150	280	240	942455-3001
2000	DN200 PN16, ANSI 8" 150lbs, JIS 10K 200	340	294,5	942455-3002
3000	DN250 PN16, ANSI 10" 150lbs, JIS 10K 250	405	358	942455-3003
4000	DN300 PN16, ANSI 12" 150lbs, JIS 10K 300	482	410 (for DIN), 431,8 (for ANSI), 400 (for JIS), 404,5 (for DIN + JIS)	942455-3004

Preparation for the installation of the Endress+Hauser UNi flange

The mounting requires the following tools:

- Philips screw driver size 1
- flat screw driver for M3 / M4
- hexagon key AF 2.5 / AF 4
- unplug tool for antenna plug (order No. 5200 7646)
- eventually a pair of tweezers

Order of exchange:

- Unscrew lid (1) from terminal compartment
- Disconnect cable at terminal module (2)
- Unscrew mounting screws (3) at terminal module and disconnect ground cable
- Pull out terminal module (4). A connection to a cable feed-through is located at the rear side of the module. (the feed-through can be unscrewed, if required)
- Unscrew lid (5) from electronics compartment
- If installed, take display out of holder by pushing the hook (6) upwards
- Break the calibration seal to unplug the sealing pin (16)

 If the calibration seal is broken, the national calibration authority should be informed within 24 hours!

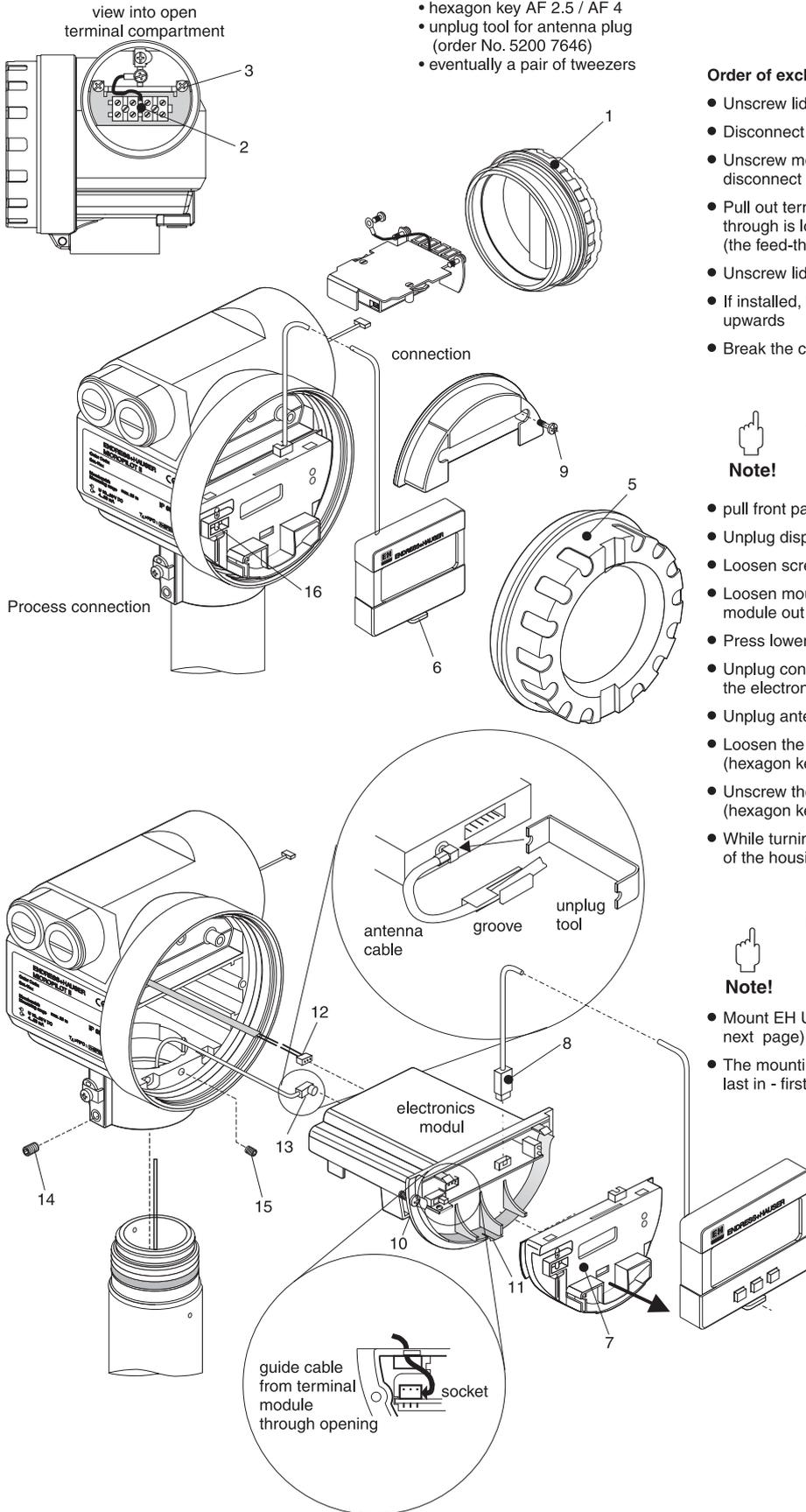
Note!

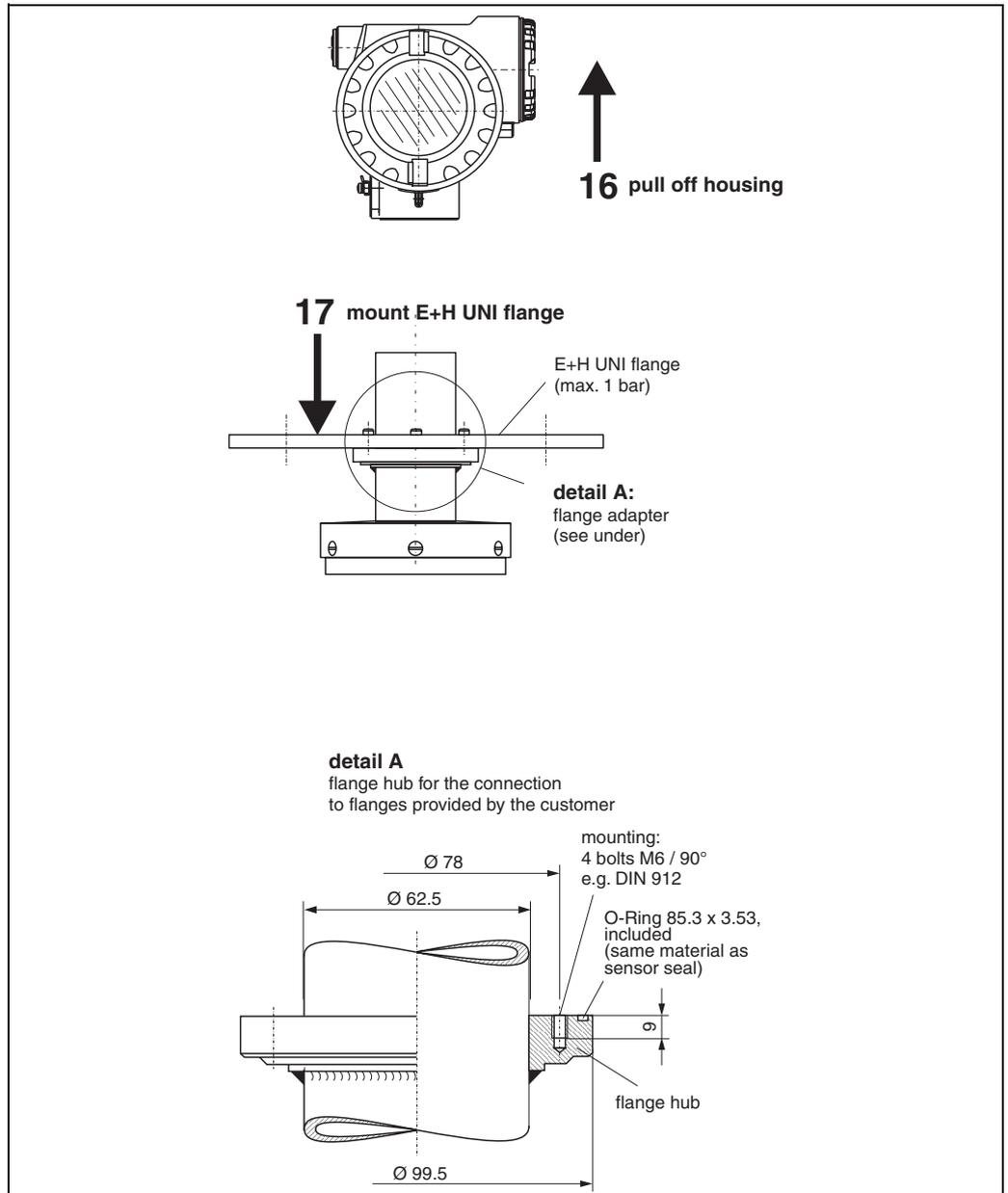
- pull front panel (7) off
- Unplug display cable (8)
- Loosen screw (9) in cover and remove cover
- Loosen mounting screws (10) at electronics module and pull module out of housing
- Press lower hook (11) at module housing slightly inwards
- Unplug connection cable (12) to the terminal module from the electronics
- Unplug antenna cable (13) with unplug tool
- Loosen the set screw (14) in the housing about 1 turn (hexagon key 4 mm)
- Unscrew the stop screw (15) in the housing about 4 - 5 turns (hexagon key 2.5 mm)
- While turning the complete antenna assembly, pull it out of the housing (16) (see next page).

 Don't damage the antenna cable!

Note!

- Mount EH UNi flange (17) on flange-hub with screws (see next page).
- The mounting of housing and electronic raised last in - first out how disassembly.





L00-FMRS32xx-00-00-06-en-003

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 (→ 68)?

4 Wiring

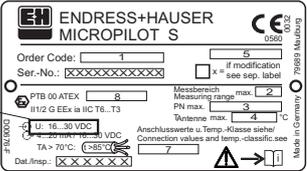
4.1 Quick wiring guide

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!

- 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.



Before connection please note the following:

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.

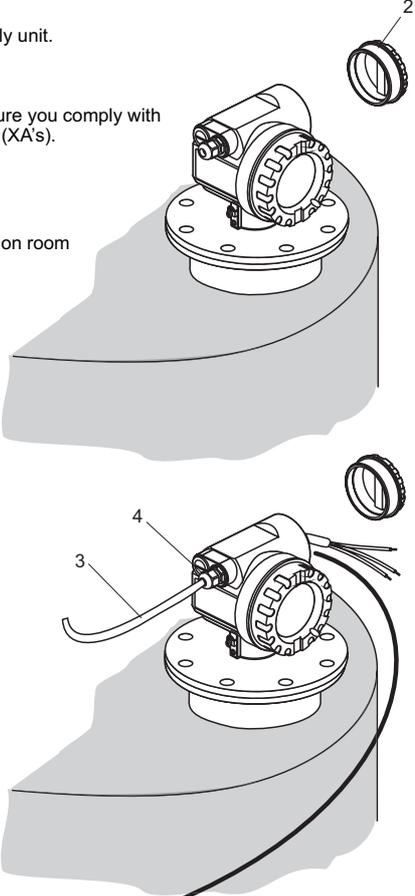
Connect up the Micro pilot S as follows:

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

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

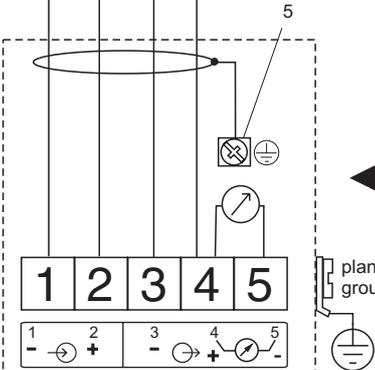
EX Only ground screening of the line (5) on sensor side.

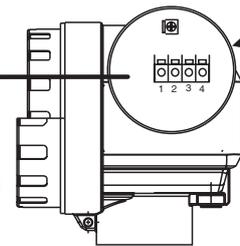
- Make connection (see pin assignment).
- Tighten cable gland (4).
- Screw off housing cover (2).
- Switch on power supply.



power:
24 V DC
(16...30 V);
from a
transmitter
supply unit

signal:
24 V DC
from a
transmitter
supply unit





A Micro pilot 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 Micro pilot at the housing's earth, whereby the Micro pilot S and the power supply unit are connected to the same potential matching line (PML).

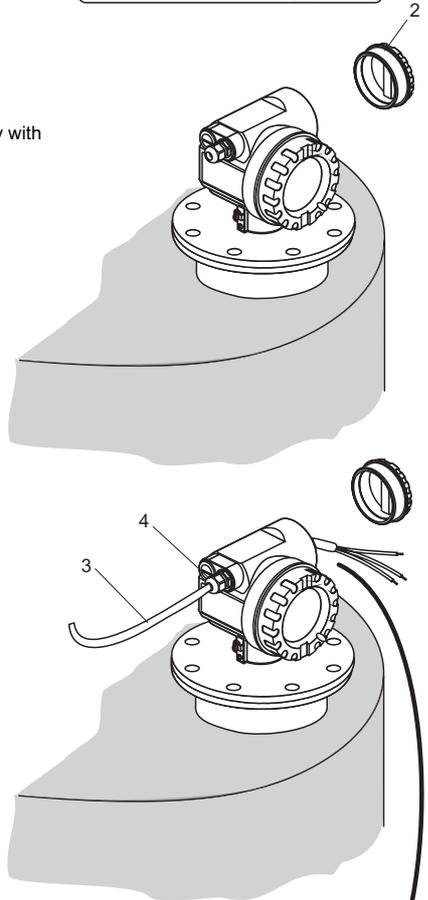
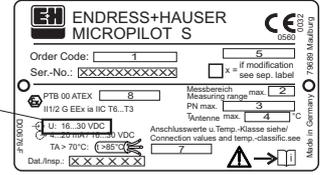
Wiring with Tank Side Monitor NRF590



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.

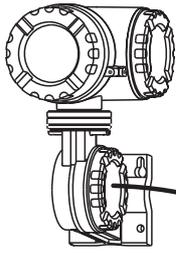


Connect up the Micropilot S as follows:

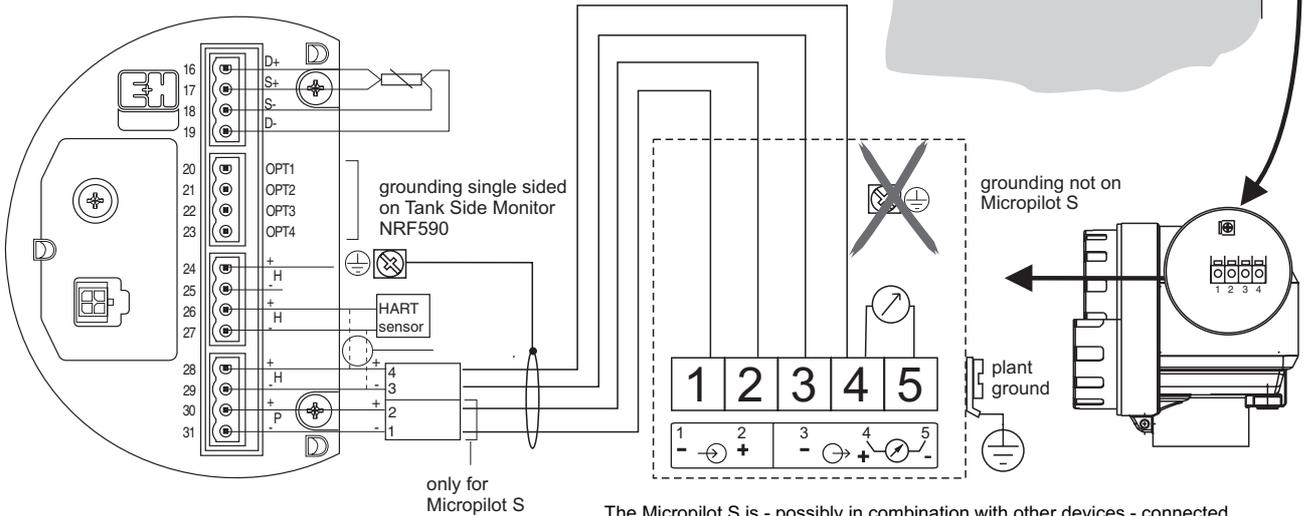
Before unscrew housing cover (2) at separate connection room turn off the power supply!

- 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



intrinsically safe terminal board

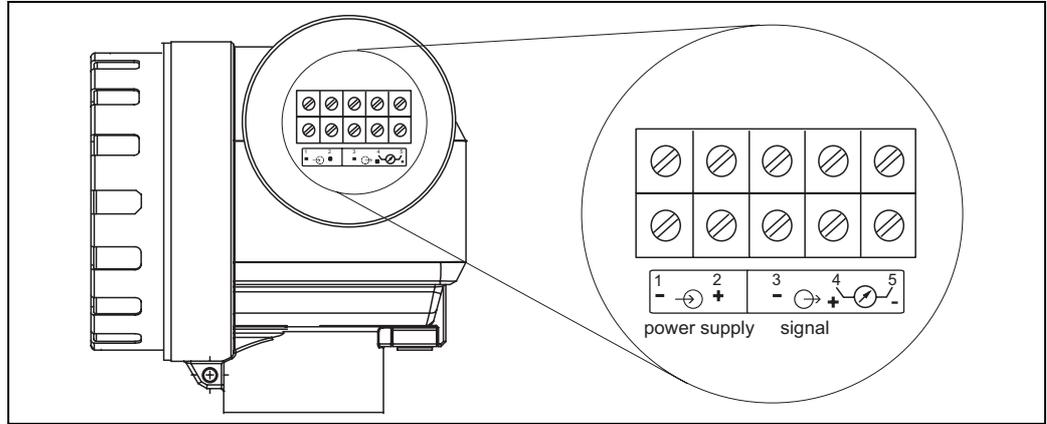


The Micropilot S is - possibly in combination with other devices - connected to a tank side monitor in a hazardous area. In this case, it is recommended that you ground the cable screen centrally at the Tank Side Monitor and connect all devices to the same potential matching line (PML). If, for functional 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.

4.2 Connecting the measuring unit

4.2.1 Terminal compartment

The housing features a separate terminal compartment.



L00-FMR53xxx-04-00-00-en-001

4.2.2 Load HART

Minimum load for HART communication: 250 Ω

4.2.3 Cable entry

- Cable gland: 2 x M20x1.5
- Cable entry: 2 x G $\frac{1}{2}$ or 2 x $\frac{1}{2}$ NPT

4.2.4 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

4.2.5 Power consumption

- Max. 330 mW at 16 V
- Max. 500 mW at 24 V
- Max. 600 mW at 30 V
- Max. 700 mW at 36 V

4.2.6 Current consumption

Max. 21 mA (50 mA inrush current).

4.2.7 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 μ s, $\hat{I} = 10$ kA, 10 pulses). Additionally, the device is protected by a galvanic insulation of 500 Vrms between the power supply and the (HART) current output. 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 XA00081F-B "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.

4.2.8 Power supply

- For stand alone operation via two Endress+Hauser RN221N.
- Integrated in tank gauging system via Endress+Hauser Tank Side Monitor NRF509 (recommended operation mode).

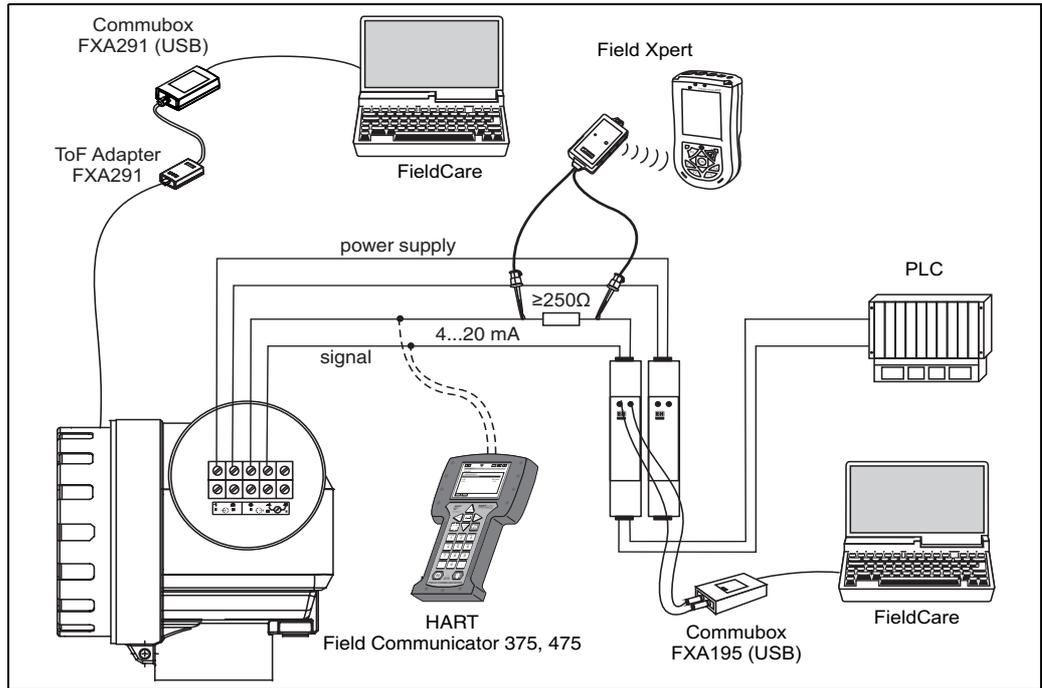
4.2.9 Highly accurate measurement

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

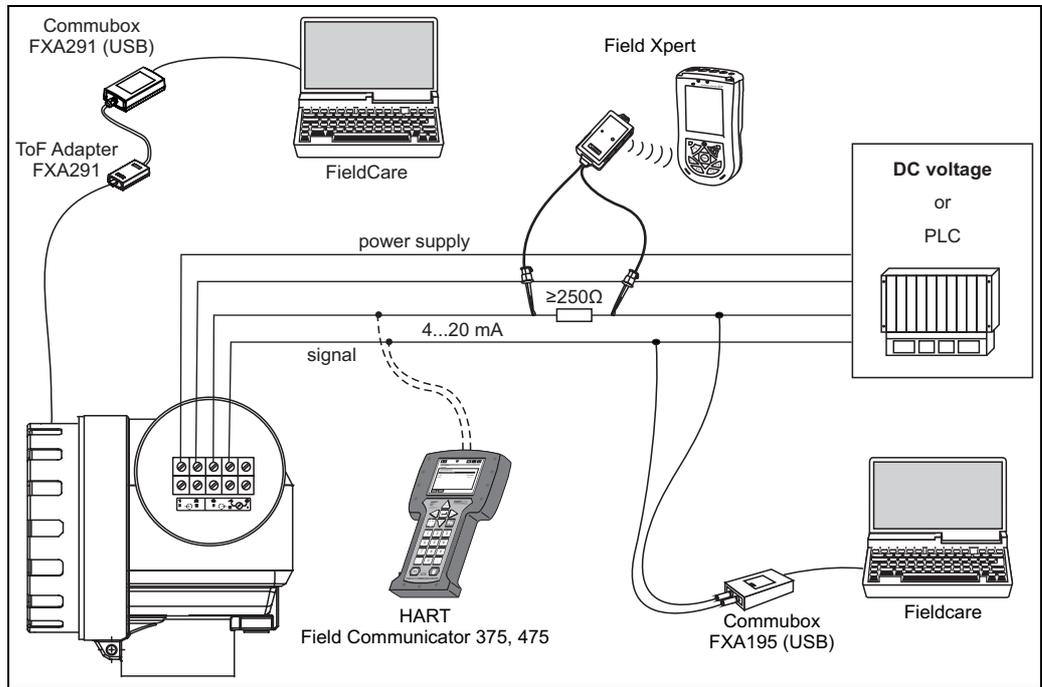
4.2.10 Connection to Tank Side Monitor NRF590

"Wiring with Tank Side Monitor NRF590", →  23.

4.2.11 HART connection with two Endress+Hauser RN221N



4.2.12 HART connection with other supplies



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)

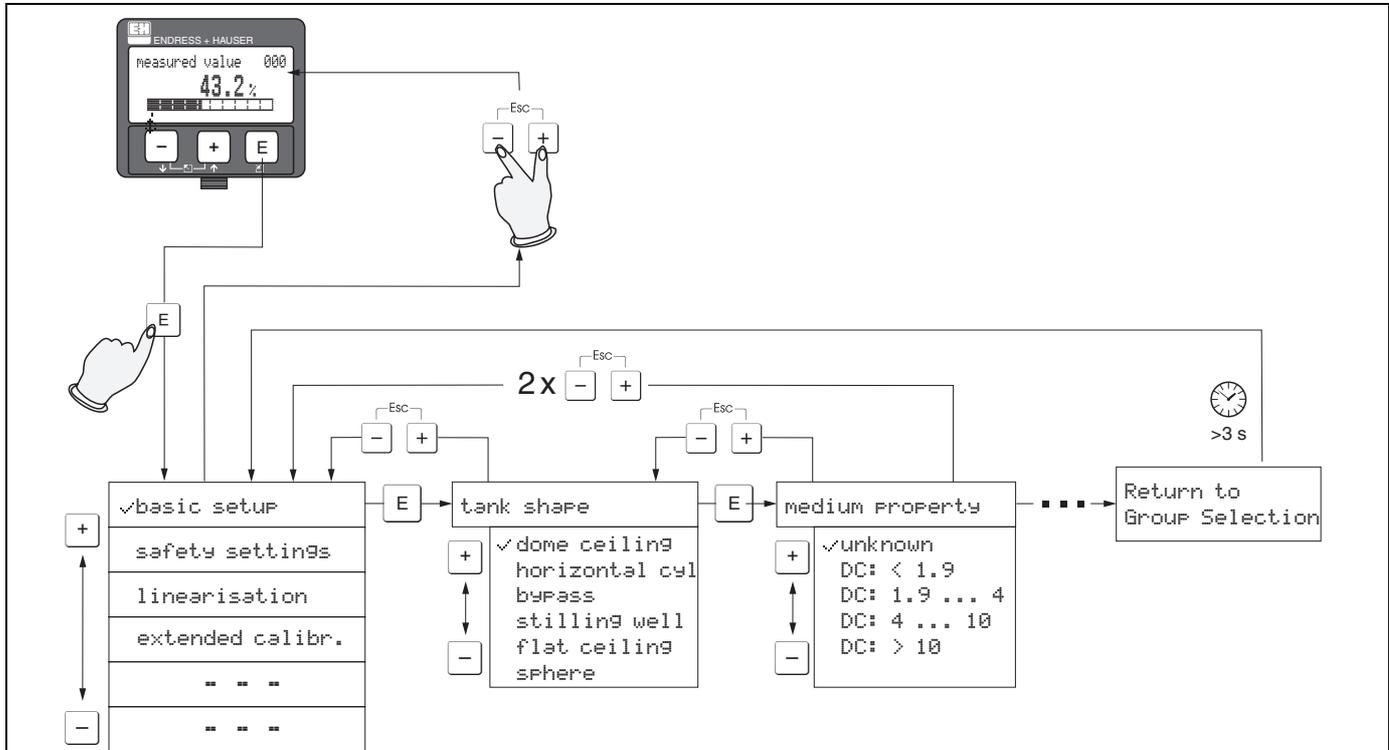
4.5 Post-connection check

After wiring the measuring device, perform the following checks:

- Is the terminal allocation correct (→  22)?
- 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



Selection and configuration in Operation menu:

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

Note!

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

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

Selection menus:

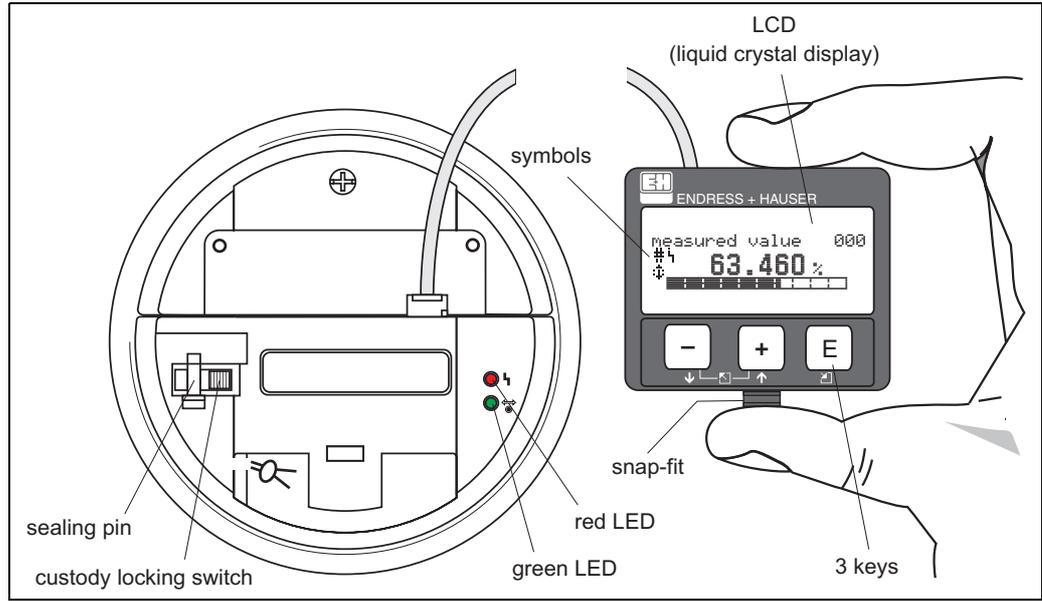
- a) Select the required **Parameter** in selected **function** (e.g. "tank shape (002)") with **-** or **+**.
- b) **E** confirms selection → '✓' appears in front of the selected parameter
- c) **E** confirms the edited value → system quits Edit mode
- d) **+** + **-** (= **Esc**) interrupts selection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

Typing in numerals and text:

- a) Press **+** or **-** to edit the first character of the **numeral / text** (e.g. "empty calibr. (005)")
- b) **E** positions the cursor at the next character → continue with (a) until you have completed your input
- c) if a **⌫** symbol appears at the cursor, press **E** to accept the value entered → system quits Edit mode
- d) **+** + **-** (= **Esc**) interrupts the input, system quits Edit mode

- 4) Press **E** to select the next **function** (e.g. "medium property (003)")
- 5) Press **+** + **-** (= **Esc**) once → return to previous **function** (e.g. "tank shape (002)")
 Press **+** + **-** (= **Esc**) twice → return to **Group selection**
- 6) Press **+** + **-** (= **Esc**) to return to **Measured value display**

5.2 Display and operating elements



L00-FMR53xxx-07-00-00-en-003



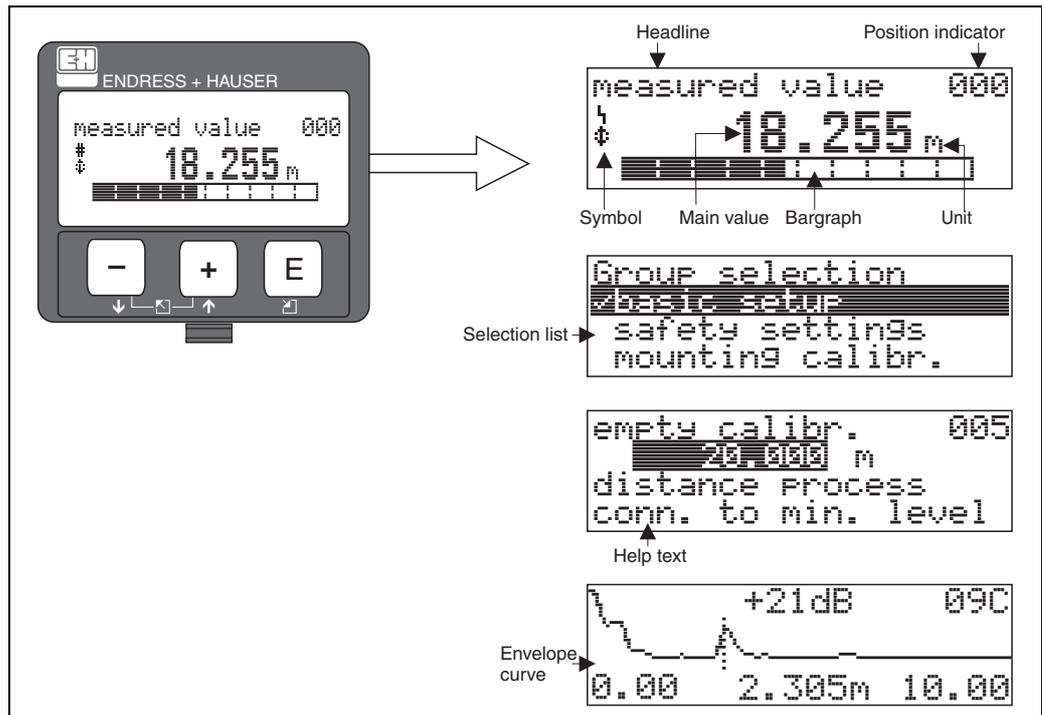
Note!

To access the display the cover of the electronic compartment may be removed even in 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 diodes (LEDs):

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

LED (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.
 or 	Navigate to the right within a function group.
 and  or  and 	Contrast settings of the LCD.
 and  and 	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

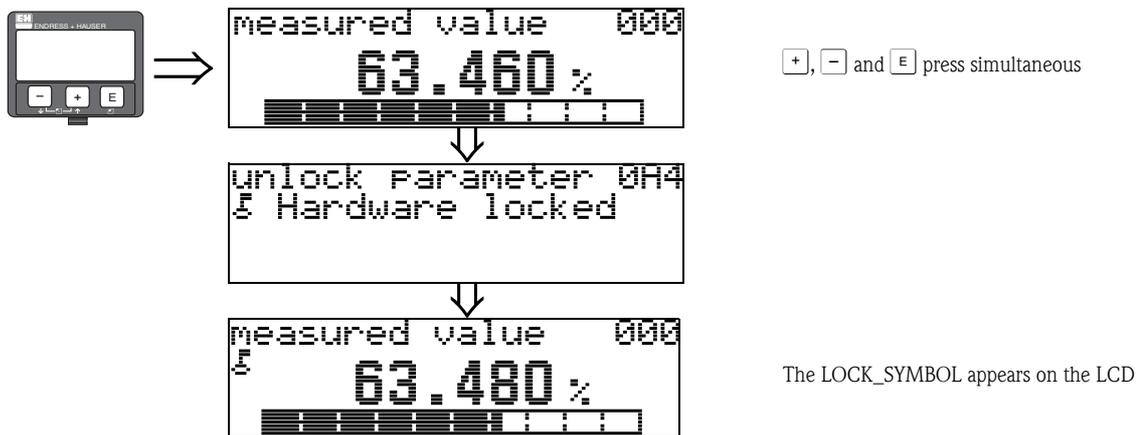
The Micropilot can be protected in two ways against unauthorised changing of device data, numerical values or factory settings:

Function "unlock parameter" (0A4):

A value $\lt \gt 100$ (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 be displayed even if the device is locked.



5.3.2 Unlocking of configuration mode

If an attempt is made to change parameters 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)

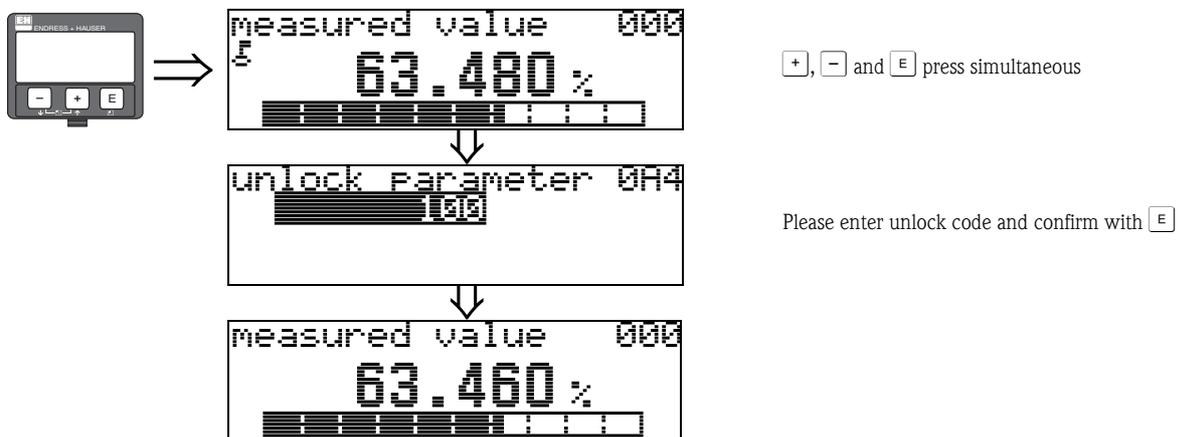
100 = for HART devices

the Micropilot is released for operation.

Hardware unlock:

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

100 = for HART devices.



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



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

- 333 = customer parameters
- 555 = History

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) | ■ linearisation (041) |
| ■ empty calibr. (005) | ■ customer unit (042) |
| ■ full calibr. (006) | ■ diameter vessel (047) |
| ■ pipe diameter (007) | ■ range of mapping (052) |
| ■ output on alarm (010) | ■ pres. Map dist (054) |
| ■ output on alarm (011) | ■ offset (057) |
| ■ outp. echo loss (012) | ■ low output limit (062) |
| ■ ramp %span/min (013) | ■ fixed current (063) |
| ■ delay time (014) | ■ fixed current (064) |
| ■ safety distance (015) | ■ simulation (065) |
| ■ in safety dist. (016) | ■ simulation value (066) |
| ■ Tank Gauging (030) | ■ format display (094) |
| ■ auto correction (031) | ■ distance unit (0C5) |
| ■ level/ullage (040) | ■ download mode (0C8) |

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

555 = History Reset

After mounting and aligning the equipment, carry out a history reset.

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. MIN, MAX, HOLD)
Indicated by a constant  symbol.
(For a description of the codes, →  71)
- **W (Warning):**
Device continue measuring, error message is displayed.
Indicated by a flashing  symbol.
(For a description of the codes, →  71)
- **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, →  71)



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, →  71.

- 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 function "**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, the Field Communicator 375, 475.
- Operation via the Personal Computer (PC) using the operating program (e.g. FieldCare; Connections, →  26).
- Operation via the Tank Side Monitor NRF590.



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	0010 hex
Transmitter specific revision	03 hex
HART specification	5.0
DD-Files	Information and files can be found on: <ul style="list-style-type: none"> ■ www.endress.com ■ www.hartcomm.org
Load HART	Min. 250 Ω
Devices variables	Primary value: level or volume ¹⁾
Features supported	<ul style="list-style-type: none"> ■ 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 a menu operation with the Field Communicator 375, 475.



Note!

Further information on the 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 FieldCare

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

The screenshot shows the FieldCare software interface during the 'Basic Setup Step 1/4'. The left sidebar contains a tree view of configuration options. The main workspace displays a 3D model of a tank with a measuring point. An embedded browser window on the right provides detailed information for two functions:

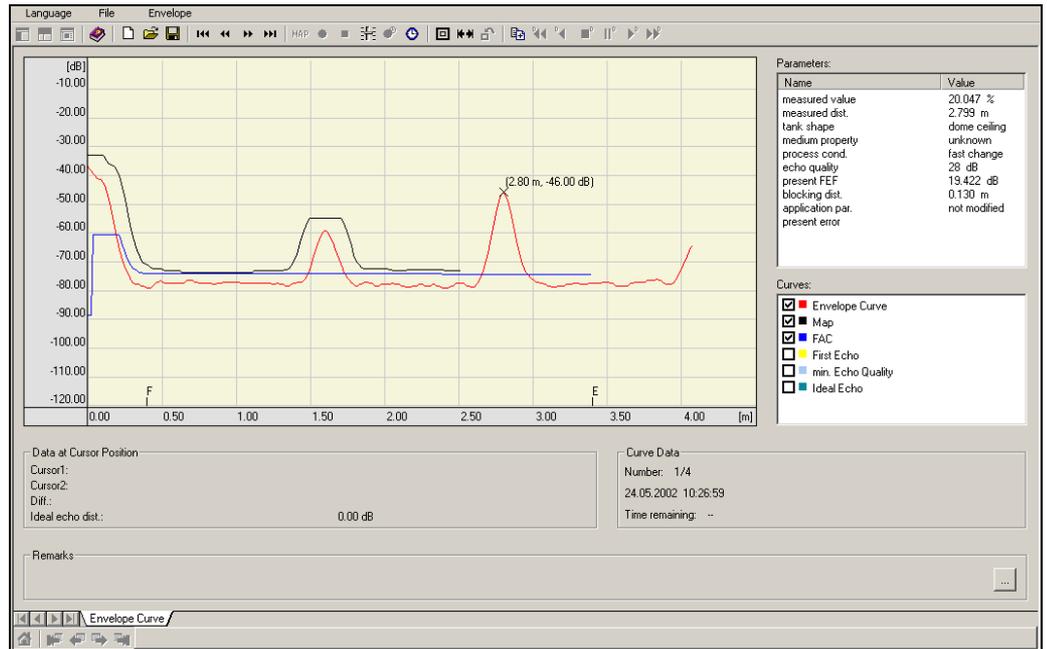
- Function "measured value" (000)**: This function displays the current measured value in the selected unit (see "customer unit" (042) function). The number of digits after decimal point can be selected in the "no.of decimals" (095) function.
- Function "tank shape" (002)**: This function is used to select the tank shape.

Caution! When using an FAR 10 antenna extension, carry out an correction before the basic setup. The length of the FAR 10 is to be entered in the function "antenna extens" (0C9).

The status bar at the bottom indicates 'Basic Setup Step 1/4'.

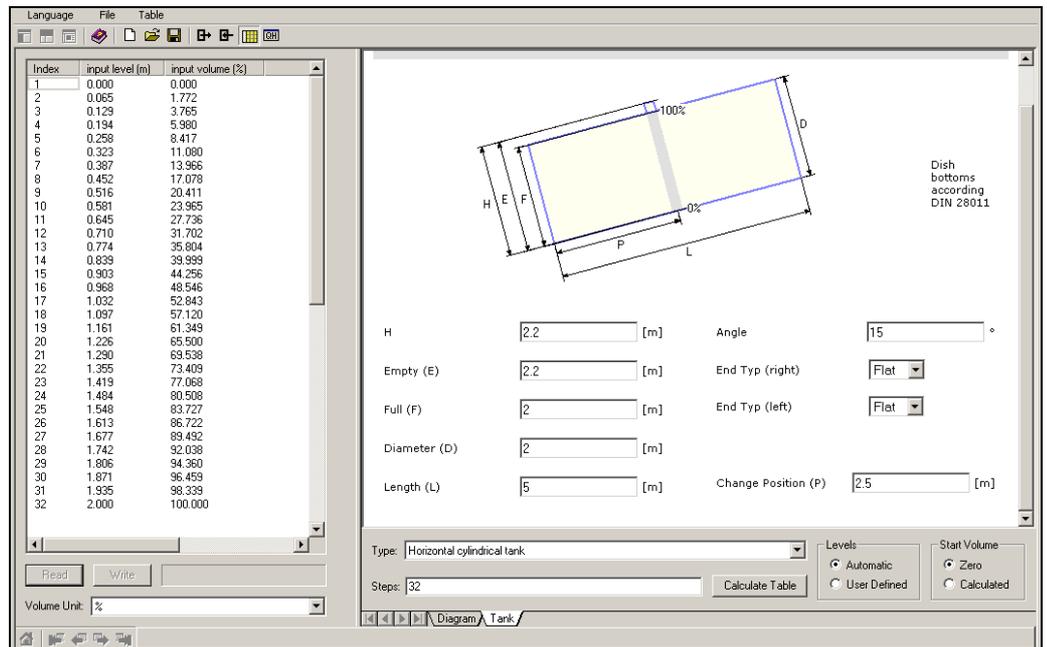
MicropilotM-en-305

Signal analysis via envelope curve



MicroplotM-en-300

Tank linearization



MicroplotM-en-300

6 Commissioning

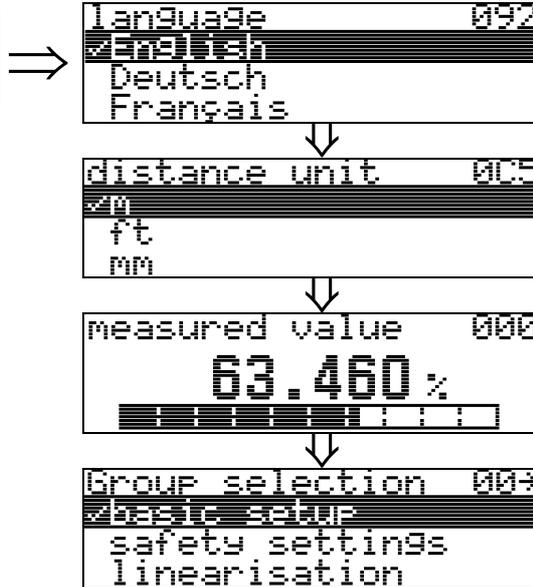
6.1 Function check

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

- Checklist "Post installation check", → [21](#).
- Checklist "Post connection check", → [27](#).

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.



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

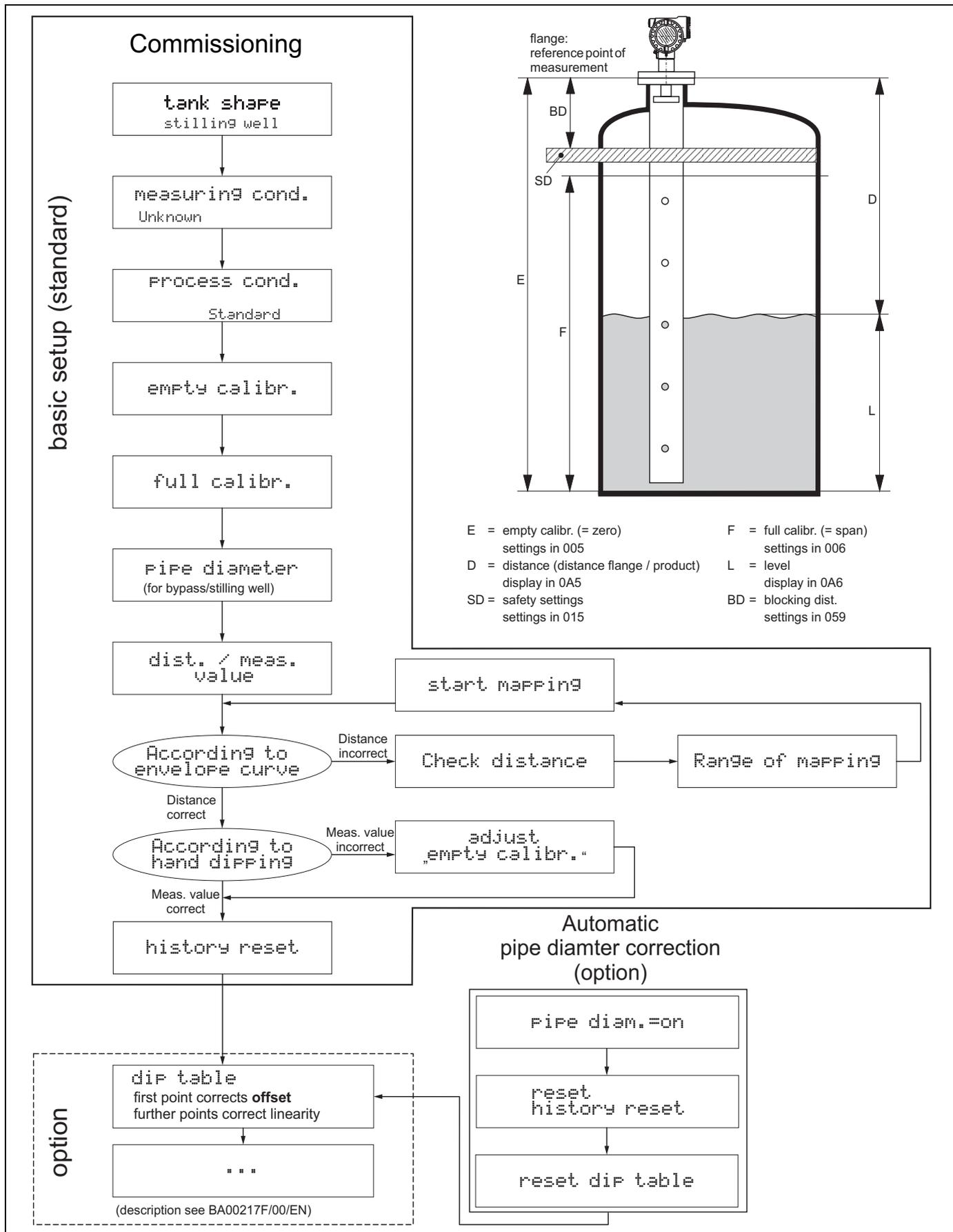
Select the basic unit
(this message appears the first time the device is switched on)

The current measured value is displayed

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

This selection enables you to perform the basic setup

6.3 Basic Setup



**Caution!**

To successfully commission a precise measurement to the nearest mm, it is important you carry out a **history reset** on **first installation** after mechanical installation and **after** the basic setup of the device (→ § 50). Only after a history reset the **mounting calibration** is carried out. Enter the measurement **offset** as the first point in the dip table for the mounting calibration. When a value is dipped at a later date, make a second entry into the dip table, using the semi-automatic mode. This way, you can easily carry out a linear correction of the measurement.

When configuring the function in "**basic setup**" (**00**) please take into account the following notes:

- Select the functions as described, → § 28.
- 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 **⏏** 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 "**BA00217F - Description of Instrument Functions**", which can be found on the enclosed CD-ROM.
- The default values of the parameters are typed in **boldface**.

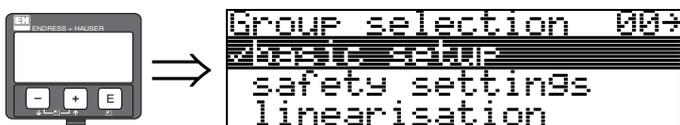
6.4 Basic Setup with the VU331

Function "measured value" (000)

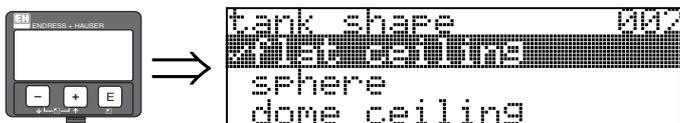


This function displays the current measured value in the selected unit (see "customer unit" (042)) function). The number of digits after decimal point can be selected in the "no. of decimals" (095) function. The length of the bargraph corresponds to the percental value of the present measured value with regard to the span.

6.4.1 Function group "basic setup" (00)



Function "tank shape" (002)



This function is used to select the tank shape.

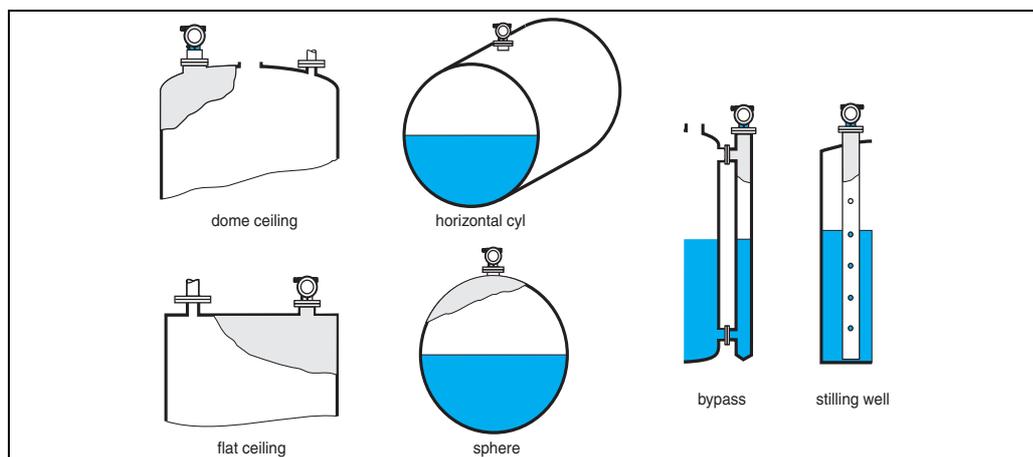


Note!

For the application of the FMR532 the selection "stilling well" has to be chosen in the function "tank shape" (002).

Selection:

- dome ceiling
- horizontal cyl
- bypass
- **stilling well** (factory setting for FMR532)
- flat ceiling (Typical ceiling of storage tanks: a slight slope of only a few degrees can be neglected.)
- sphere



Function "medium property." (003)



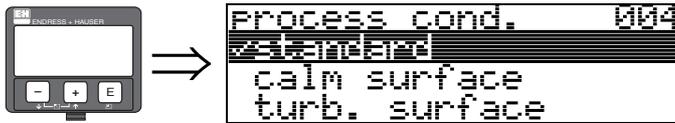
This function is used to select the dielectric constant.

Selection:

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

Media group	DC (ϵ_r)	Examples
A	1.4 to 1.9	non-conducting liquids, e.g. liquefied gas (LPG). For more information please contact your Endress+Hauser representative.
B	1.9 to 4	non-conducting liquids, e.g. benzene, oil, toluene, white products, black products, crudes, bitumen/asphalts, ...
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

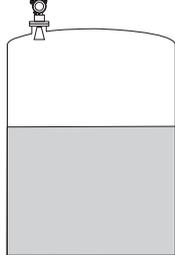
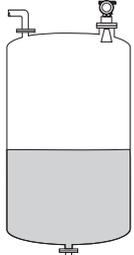
Function "process cond." (004)



This function is used to select the process conditions.

Selection:

- **standard**
- calm surface
- turb. surface
- agitator
- fast change
- heavy conditions
- 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



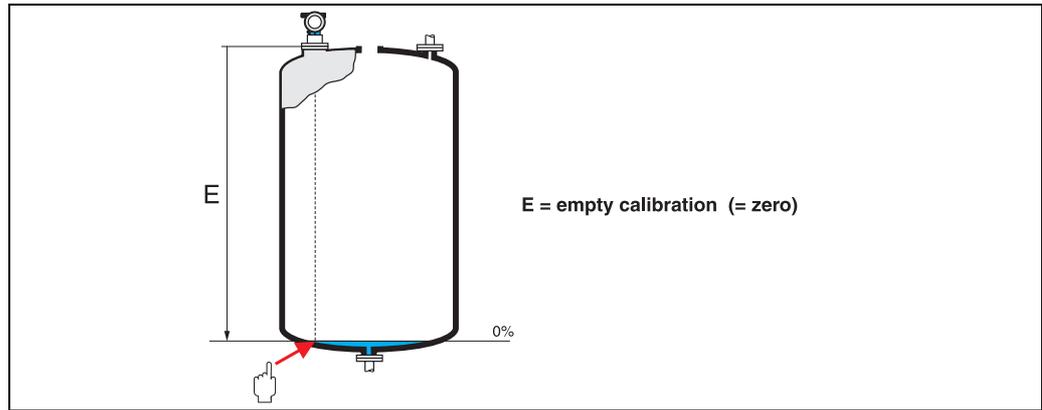
Note!

The phase evaluation of the Micropilot S (→ 51) is only activated if you select the measuring conditions "**standard**", "**calm surface**" or "**heavy conditions**".
 If, however, "**heavy conditions**" is selected, no index values are stored. We strongly recommend that, in the case of rough product surfaces or rapid filling, you activate the appropriate application parameters.

Function "empty calibr." (005)



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



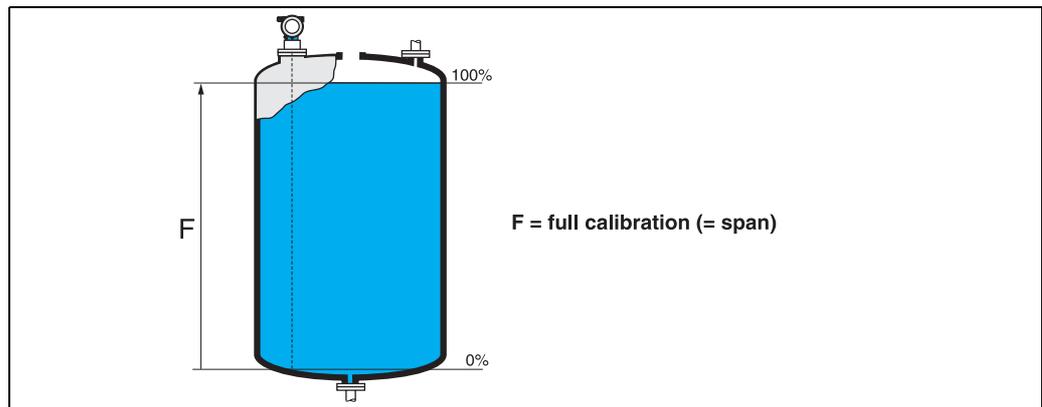
Caution!

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

Function "full calibr." (006)



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



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.



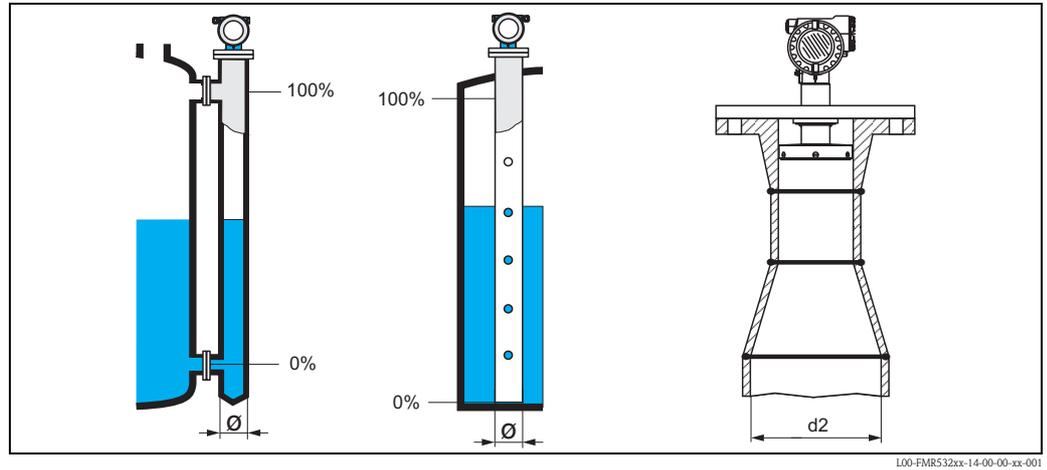
Note!

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)

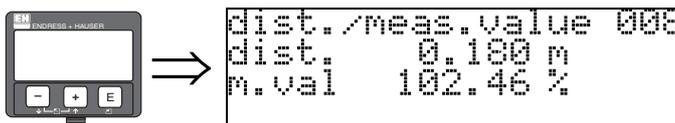


This function is used to enter the pipe diameter of the stilling well or bypass pipe.



Microwaves propagate slower 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. If mounting the FMR532 on stilling wells with a widening of the pipe, the **inner** diameter of the lower part of the pipe (d2 in the Fig.) must be entered. This is the part of the stilling well, where the measurement is actually performed.

Display "dist./ meas. value" (008)



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

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

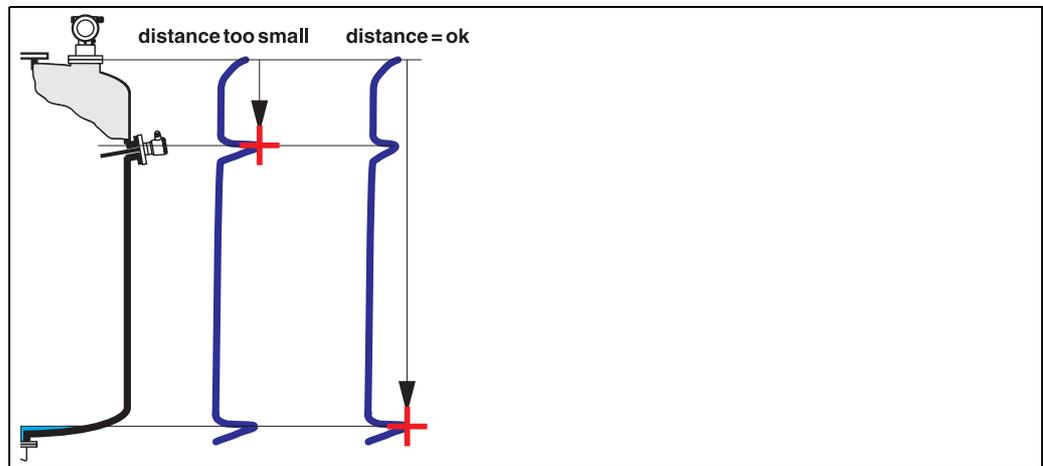
Function "check distance" (051)



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

Selection:

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

**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



Note!

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

dist. too small

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

dist. too big

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

dist. unknown

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

manual

A mapping is also possible by manual entry of the range to be suppressed.

This entry is made in the "**range of mapping.**" (052) function.

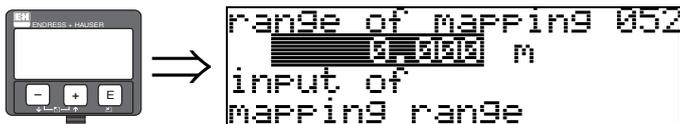


Caution!

The range of mapping must end 0.5 m (20") before the echo of the actual level. For an empty tank, do not enter E, but E – 0.5 m (20"). If a mapping already exists, it is overwritten up to the distance specified in "**range of mapping**" (052).

Beyond this value the existing mapping remains unchanged.

Function "range of mapping" (052)



This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (→ 41). This value can be edited by the operator. For manual mapping, the default value is: 0 m.

Function "start mapping" (053)



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

Selection:

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

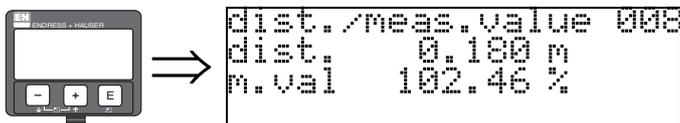
During the mapping process the message "record mapping" is displayed.



Caution!

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

Display "dist./meas.value" (008)



The **distance** measured from the reference point to the product surface and the **level** calculated with the aid of the empty alignment are displayed again. 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 "history reset" (009)



By this function a history reset of the device is performed, i.e. the correspondance table between level an index values is deleted. A new correspondance table will be filled and stored after the history reset, cf. → 51.

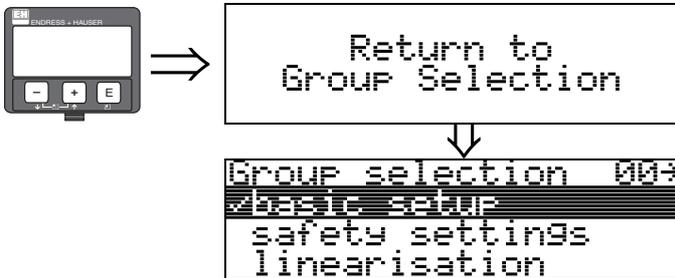


Caution!

A history reset must be performed after:

- first installation or
- change of basic setup or
- change of the installation situation.

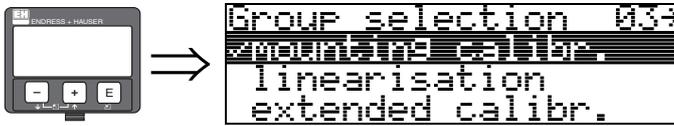
In this case also effect a reset of the dip table in function "**dip table mode**" (033).



After 3 s, the following message appears

6.5 Mounting calibration with VU331

6.5.1 Function group "mounting calibr." (03)



Function "tank gauging" (030)



Using this function, you can either enter a dip table or carry out an auto correction.

Function "auto correction" (031)



When measuring levels with radar systems, so-called "multipath reflections" can affect the level signal giving rise to serious measuring errors. "Multipath reflections" also include radar beams which are received by the radar system, which have not been reflected directly by the medium surface. They may reach the antenna via the basin wall and the medium surface. This phenomenon is particularly noticeable with devices mounted near to walls, as soon as the conical radar beam strikes the basin wall. The Micropilot S can automatically discover and correct measuring errors due to this "multiple path" propagation. This is because it uses two independent sets of information when evaluating reflection signals:

- Firstly, it evaluates the **amplitude** of the reflected energy using the so-called envelope curve system.
- Secondly, it evaluates the **phase** of the reflected energy.

The decisive factor for a constant output signal is to assign the phase values to the associated level values. This assignment is ensured using a correspondence table (index correction table). The Micropilot S learns this for the specific application after installation (learning period). Therefore, after mounting the device, and **after** completing the basic calibration, a **history reset** (must be performed (enter "yes" in the "history reset" (009) function in the "basic setup" (00) function group. Do not switch off the radar system during filling and emptying operations during the teach-in phase. Switching off when there are only negligible level changes produces no error.



Caution!

During the learning period, fast filling/emptying or turbulent surfaces can result in switching off and on the phase evaluation. Subsequently observed measurement errors will disappear as soon as tank levels come back to areas measured by Micropilot S previously with activated phase evaluation. If the observed measurement errors are corrected by dip table entries, the Micropilot S will take care of these corrections and automatically adjust the index correction table. Do **not** correct any settings in the basic calibration or the extended calibration.

**Note!**

Immediately after installation, the Micropilot S measures with the specified mm-accuracy. Until the level range has been completely covered by the medium (setting up the correction table), the maximum permissible filling speed is 100 mm level change / min. After this, the fill speed has no limitation.

Function "pipe diam. corr." (032)

For level measurement in stilling wells, radar systems require highly precise pipe inner diameter data. An mm-exact level measurement cannot be guaranteed for deviations from the actual stilling well inner diameter of more than ± 0.1 mm to the value entered in the function group "**basic setup**" (00). The errors which occur as a result are linear and can be corrected with a dip table containing at least two entries. The Micropilot S also has an automatic pipe inner diameter correction.

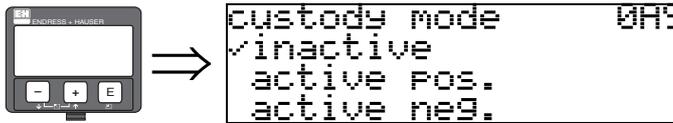
This adjusts the entered stilling well inner diameter (input in the function group "**basic setup**" (00)) to the actual values. However, this presupposes that the value entered in the function group "**basic setup**" (00) matches the actual pipe inner diameter accurately as possible.

The user-defined value entered in the function group "**basic setup**" (00) can be corrected with this value. Then, switch on the "**pipe diam. corr.**" (032) function, after a level change of at least 5 m has occurred since start-up. The pipe diameter, which the device determines automatically, will then be transmitted to the "**pipe diameter**" (007) function.

**Note!**

Only if the "**pipe diameter**" (007) function has changed its value, it is necessary to perform a "**history reset**" (009) and to delete the dip table after activation of the "**pipe diam. corr.**" (032) function. Otherwise the level change of 5 m has not yet been exceeded. The "**pipe diam. corr.**" (032) function must be deactivated again and the procedure should be repeated at a later point of time.

Function "custody mode" (0A9)



This indicates the device calibration mode. The calibration mode (active) can be set using the hardware security lock on the electronics (→ [30](#)).

Selection:

- inactive
- active pos.
- active neg.

active pos.

The custody mode (device is lead-sealed and accurate to the nearest mm) is active and is held.

active neg.

Custody mode (device is lead-sealed and accurate to the nearest mm) is activated and not held, e.g. because the signal-to-noise ratio is less than 5 dB (refer to function "**echo quality**" (056) in the function group "**extended calibr.**" (05)).

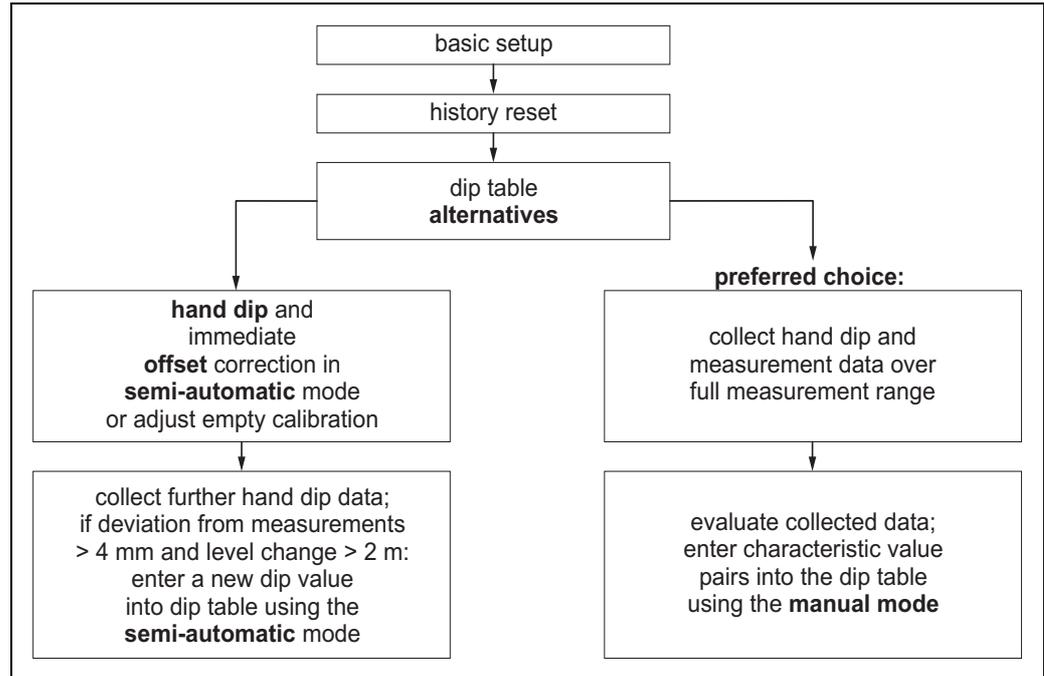


Caution!

After entering all the values and completing mounting and aligning work, enter the Reset Code "555" in the function "**reset**" (0A3) to reset the device history for auto-correction or set history reset to "yes" in order to reset the device history for the auto-correction.

Dip table

The dip table is used to correct the level readings of the Micropilot S using independently taken hand dips. The dip table is used in particular to adapt the level gauge to the specific application conditions as mechanical offset and tank/stilling well design. Depending on national regulations, national inspectors will dip the tank at one to three levels during a calibration run and check the level readings. Only one value pair must be entered into the dip table to correct the measurement **offset**. If a second value pair is entered into the dip table, the Micropilot S accepts the corrected measured values identically for both value pairs. All other measured values are determined by linear extrapolation. If you enter more than two value pairs, the system carries out a linear interpolation between adjacent value pairs. Outside these value pairs, extrapolation is also linear.



L00-FMR53xxx-19-00-00-en-014

To collect and enter data into the dip table, two alternative procedures may be carried out. In order not to mix up measurement values corrected by the offset or linearisation of the dip table with uncorrected measurement values, it is recommended to use the "semi-automatic" mode of the dip table to enter new data pairs. In this case, the first dip value should be entered immediately after the basic calibration. Further linearization points should be entered only after a level change of at least 2 m (cf. upper figure, preferred choice) and a deviation between the "uncorrected measurement value" and the hand dip value of at least > 4 mm. If this procedure can not be followed, then **no** value pair should be entered into the dip table after basic calibration. Measurement data and hand dip values should be collected over the full measurement range and be evaluated with regard to a good linear fit. Only then characteristic value pairs should be entered into the dip table using the "manual mode" (cf. upper figure, right side). If further linearisation is needed, further hand dip values should be entered **using only the "semi-automatic mode"**.



Note!

- The offset should **not** be determined and entered within the close range of the antenna (conf. definition of the safety distance) or immediately in the range of the tank bottom, because within these ranges interferences of the radar signal may occur.
- The dip table can be printed out using FieldCare. Before doing this, FieldCare must be reconnected to the device in order to update the values within FieldCare.
- Make your inputs into the dip table in semi-automatic mode. We advise you to leave "**auto correction**" (031) activated ("on") while you enter your inputs.



Caution!

After entering one or more points into the dip table, make sure that the dip table is activated and left in the "**table on**" dip table mode.

Function "dip table state" (037)



```
dip table state 037
✓table off
table on
```

This function displays the dip table status.

Display:

- table on
- **table off**

table on

Indicates whether the dip table is active.

table off

Indicates whether the dip table is not active.

Function "dip table mode" (033)



The dip table can be switched on or off using this function.

Selection:

- manual
- semi-automatic
- table on
- **table off**
- clear table
- view

Manual

The "manual mode" of the dip table can be used to enter collected data after a series of data pairs taken at different tank levels. The parameter "manual" in the "**dip table**" (033) function can be used to enter data pairs, which have been recorded at different levels, into the dip table. The measured value and the dip value can be entered.

- uncorrected measured value:

This is the measured value supplied by the device, **not** corrected by the dip table.

The choice of measured value, level or remaining fill height is dependent on the device setting.

- Dip value:

This is the level or distance to flange respectively, given by the hand dip. This value should be used to correct the measured value.



Note!

The bigger the distance between the different levels while taking hand dips, the more accurate the linearisation of the dip table will be.

Semi-automatic

The value pairs in the dip table can be read. You can enter the dip value only. When there are new value pairs, the current uncorrected level or distance is accepted as the measured value.

Table on

The dip table is switched on.

Table off

The dip table is switched off.

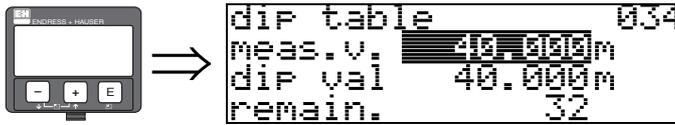
Clear table

The complete dip table is deleted. The table is switched off. The number of free table entries is set to the maximum value (= **32**).

View

The value pairs in the dip table can **only** be read. You can still select this menu option, even if there is no dip table available. In this case, the number of free table entries is at maximum value (= **32**).

Function "dip table" (034)



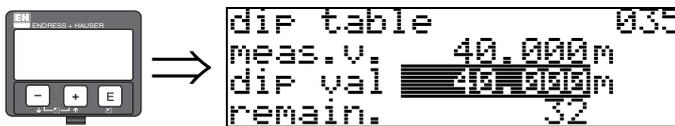
This function edits measured variable. The number behind the entry "**remain**" indicates the current number of remaining free value pairs. The maximum number of value pairs is 32; after each entry, the remaining number is decremented.



Note!

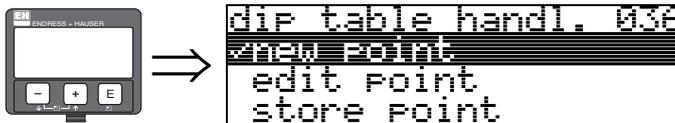
The **uncorrected** measured value is displayed in the "**dip table**" (034) function. This may differ considerably from the measured values when a dip table is activated.

Function "dip table" (035)



This function edits the dip value.

Function "dip table handl." (036)



Use this function to enter the dip value (level or distance) which will correct the measurement values.

Selection:

- new point
- edit point
- store point
- delete point
- return
- next point
- previous point

General procedure:

To enter a new point into the dip table, use

- "**new point**" to enter the value (pairs),
- "**store point**" to sort the new value (pairs),
- "**return**" to go to the dip table mode and
- "**table on**" to activate the dip table.

New point

You can enter a new point. Suggested values displayed for the measured value and dip value are the current uncorrected level or remaining fill height. The new value pair can be altered without selecting the "**edit point**" parameter. If the table is full, you can still select this parameter. In this case, the number of free table entries stands at minimum value (= 0).

Edit point

The displayed value pair can be changed.

Only the dip value can be changed with semi-automatic input mode.



Caution!

To accept the value pair in the table, confirm it with "**store point**".

Store point

The displayed value pair is sorted in the table.



Note!

For sorting, the following criteria must be met:

- Measured variables may not be equal but have different dip values.
- A measured variable available in the table is recognised as equal when it is closer than 1 mm to the sorting value.
- After successful sorting, the setting remains at "**edit point**" and the number of free table entries is decremented.



Caution!

If the value cannot be sorted, the setting remains at the previous menu option.

No warning or error message is generated. However, the number of remaining table entries is not decremented.

Delete point

The currently displayed point is deleted from the table. After deletion, the previous point is displayed. If the table only consisted of one point before deletion, then the current measured variable is displayed as a value pair.

Return

By selecting this point, you return to the function "**dip table mode**" (033).

Next point

This scrolls down in the table. If the table is empty, you can still select this option. However, the displayed value does not change.

Previous point

This scrolls up in the table. If the table is empty, you can still select this option. However, the displayed value does not change.



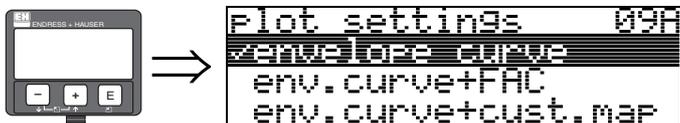
Caution!

After entering one or more points into the dip table, make sure that the dip table is activated in the "**table on**" dip table mode.

6.5.2 Envelope curve with VU331

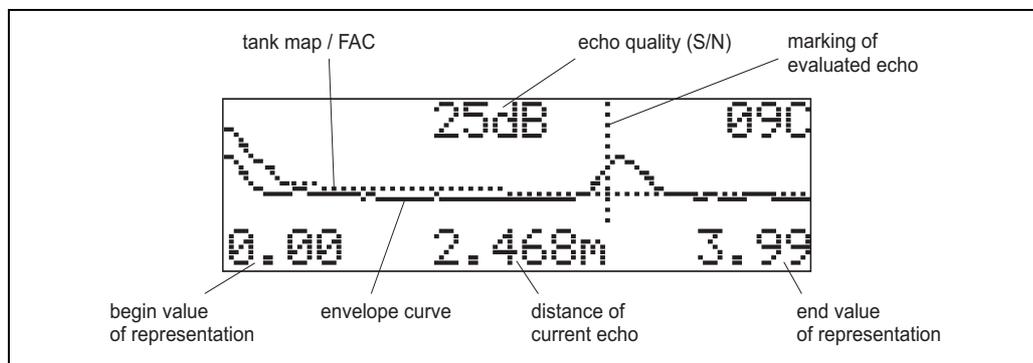
After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("display" (09) function group) is recommended.

Function "plot settings" (09A)



Here you can select which information is shown on the display:

- **envelope curve**
- env. curve+FAC (for FAC see BA00217F/00/EN)
- env. curve+cust.map (i.e. the tank map is also displayed)



L00-FMRxxxxx-07-00-00-en-004

Function "recording curve" (09B)

This function determines whether the envelope curve is read as:

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

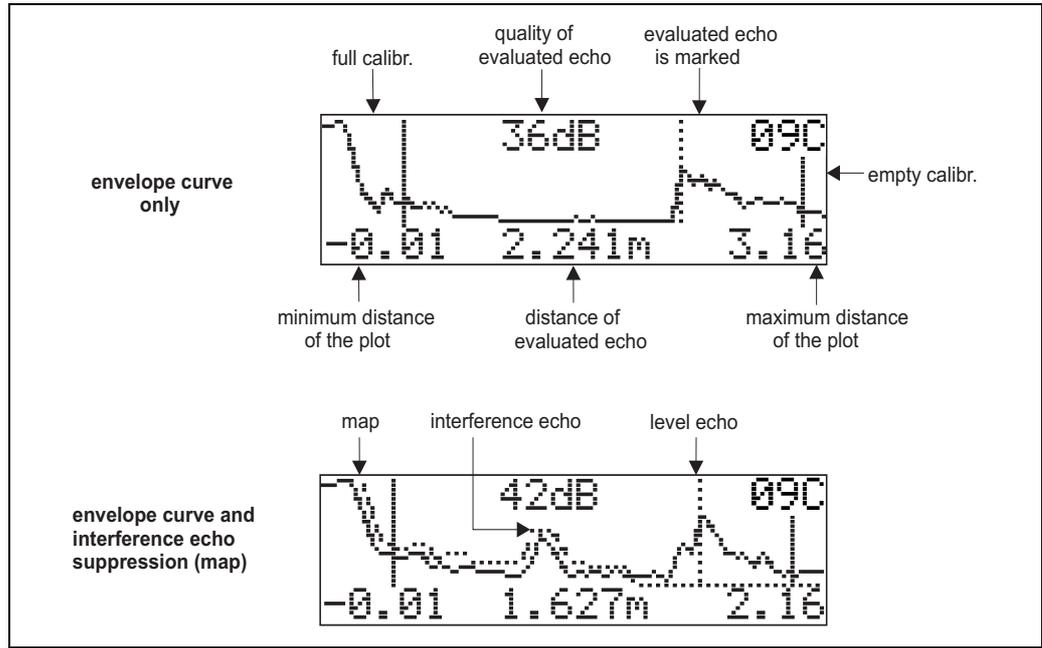


Note!

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.

Function "envelope curve display" (09C)

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



L00-FMR53xxxx-07-00-00-en-003

6.6 Basic Setup with the Endress+Hauser operating program

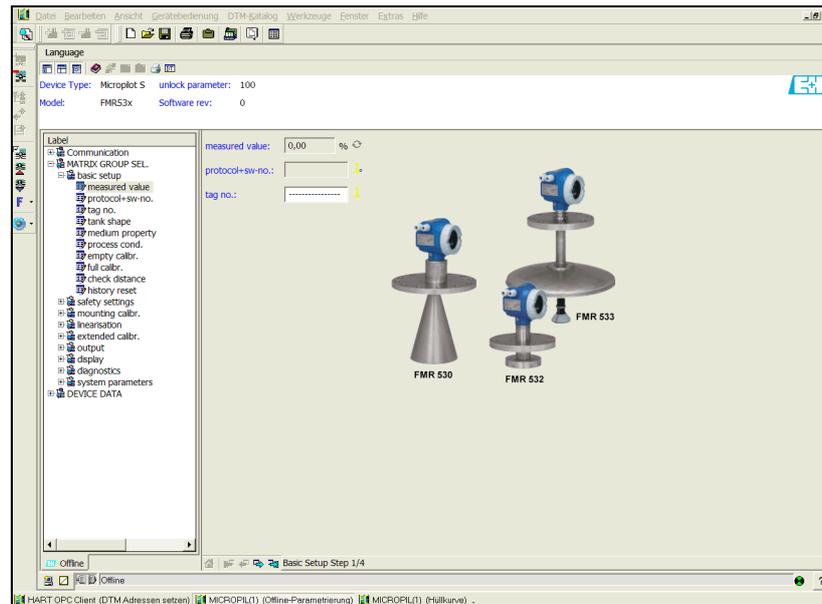
To carry out the basic setup with operating program, proceed as follows:

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

The following display appears on the screen:

Basic Setup step 1/5:

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



MicroplotS-en-001

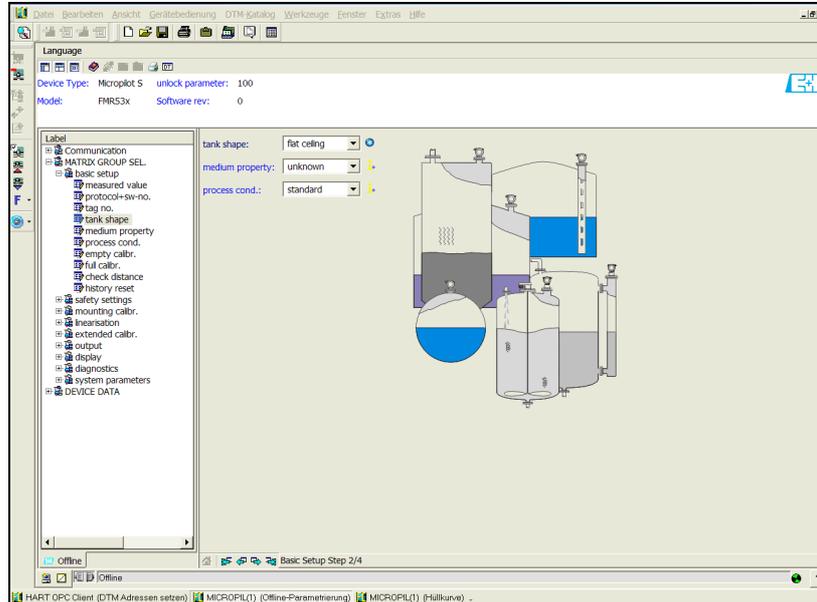


Note!

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

Basic Setup step 2/5:

- Enter the application parameters:
 - Tank shape
 - Medium property
 - Process cond.

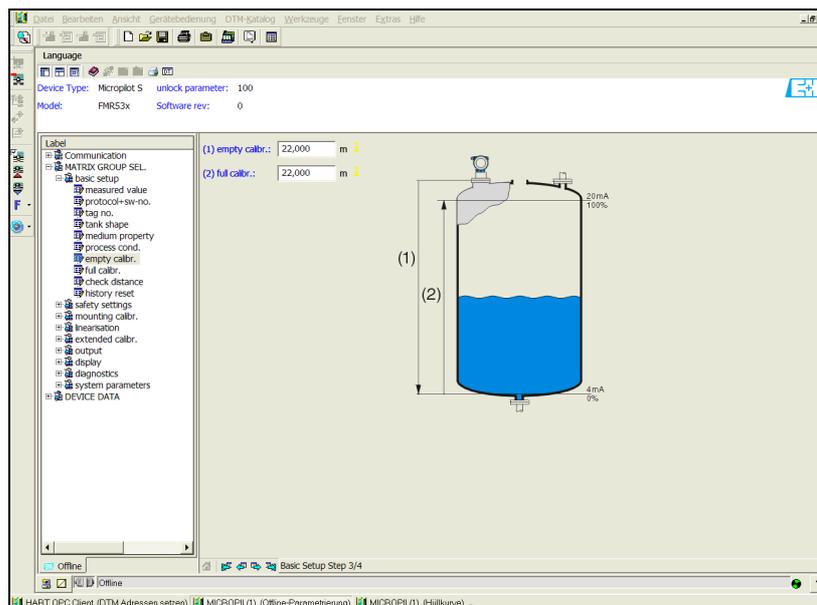


MicroplotS-en-002

Basic Setup step 3/5:

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

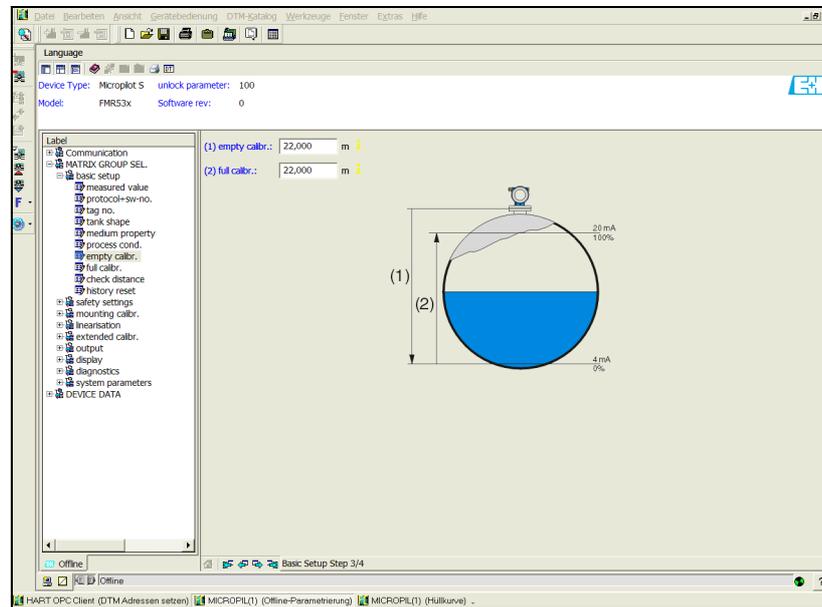
- Empty calibr.
- Full calibr.



MicroplotS-en-003

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

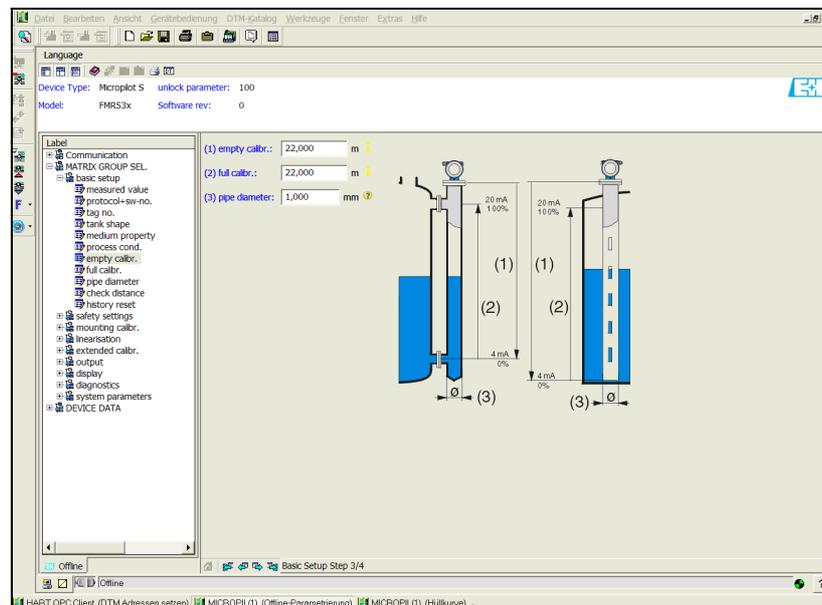
- Empty calibr.
- Full calibr.



MicroplotS-en-004

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

- Empty calibr.
- Full calibr.
- Diameter of bypass / stilling well



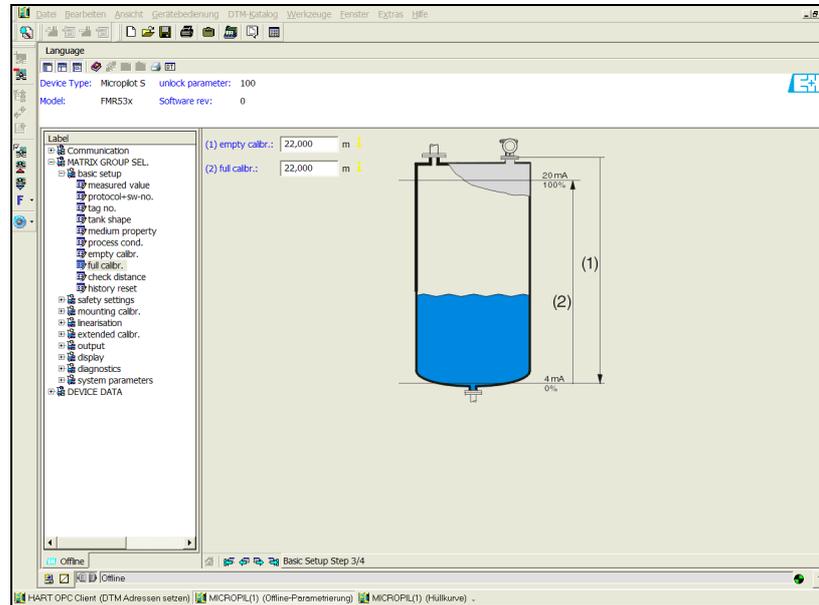
MicroplotS-en-005



Note!
You must also specify the pipe diameter in this display.

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

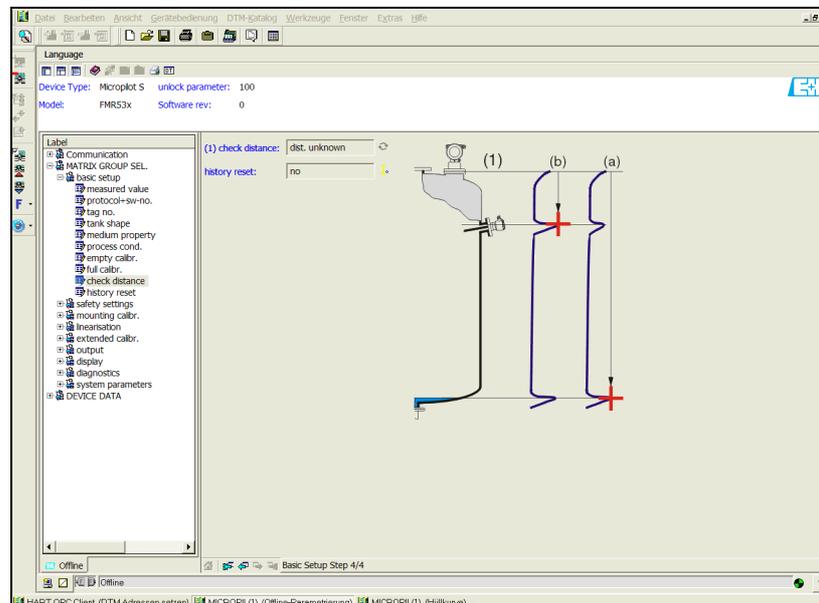
- Empty calibr.
- Full calibr.



MicropilotS-en-006

Basic Setup step 4/5:

- This step starts the tank mapping.
- The measured distance and the current measured value are always displayed in the header.
- A description is given, → 48.



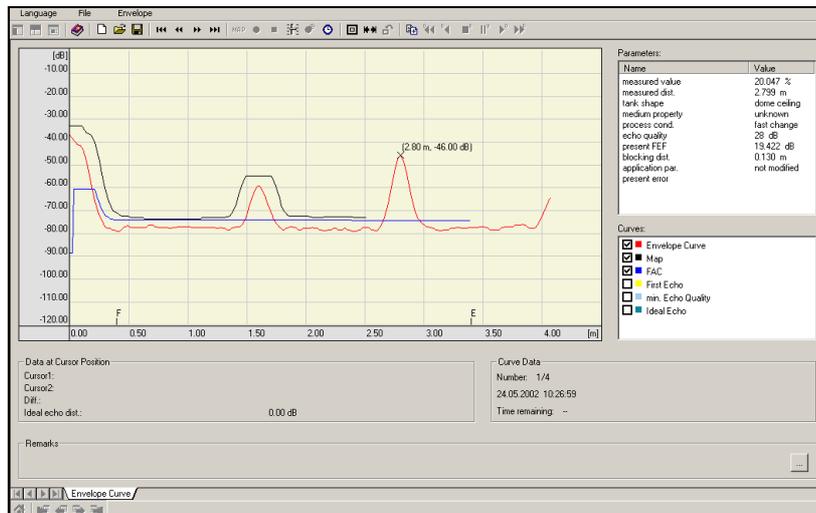
MicropilotS-en-007

Basic Setup step 5/5:

After the first installation of the device, initialise the index correction table. To do so set the history reset to "yes".

6.6.1 Signal analysis via envelope curve

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



MicroplotM-en-306

6.6.2 User-specific applications (operation)

For details of setting the parameters of user-specific applications, see separate documentation BA00217F/00/EN "Description of Instrument Functions" on the enclosed CD-ROM.

6.7 Mounting calibration with Endress+Hauser operating program

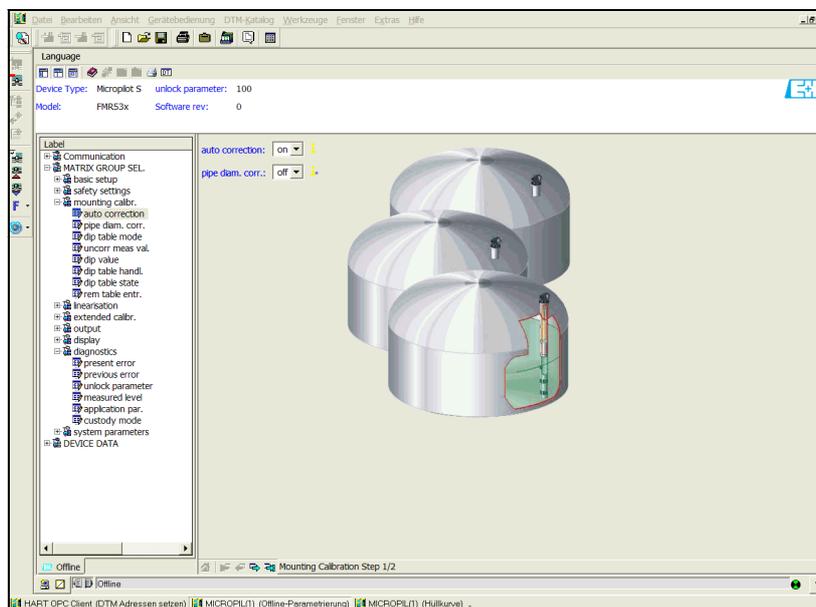
To carry out the mounting calibration with operating program, proceed as follows:

- Start the operating program and establish a connection.
- Select the "**mounting calibr.**" function group in the navigation bar.

The following display appears on the screen:

Mounting calibration step 1/2:

- auto correction
- pipe diam. corr.



MicroplotS-en-009

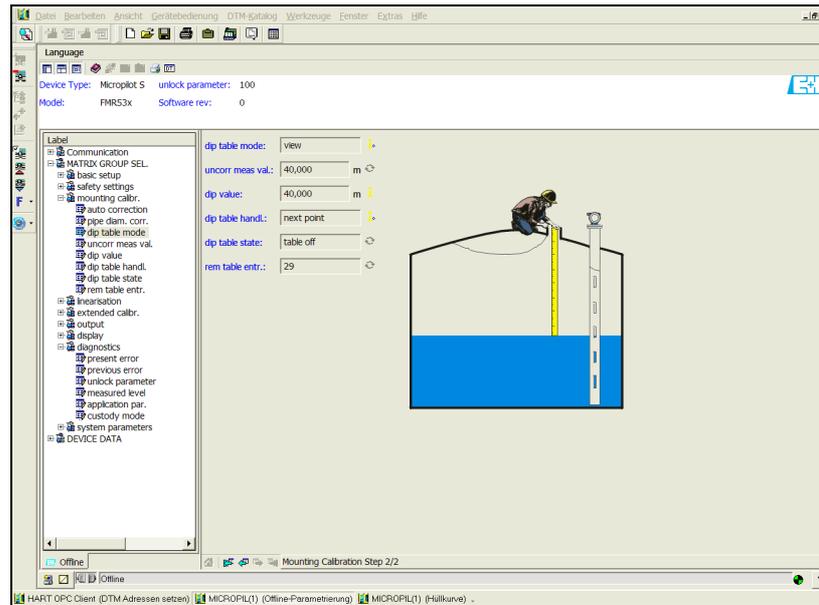


Note!

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

Mounting calibration step 2/2:

- dip table mode
- meas. v.
- dip value
- dip table handl.
- dip table state
- left dip t.entr.



MicropilotS-en-010

7 Maintenance

The Micropilot S measuring device requires no special maintenance.

7.1 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.

7.2 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 product and the cleaning temperature.

7.3 Repair

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", →  75). Please contact Endress+Hauser Service for further information on service and spare parts.

7.4 Repairs to Ex-approved devices

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

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

7.5 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 the FieldCare.

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

- You may have to activate linearisation (see BA00217F/00/EN on the enclosed CD-ROM.)
- You may need to record the tank map again (see Basic Setup)

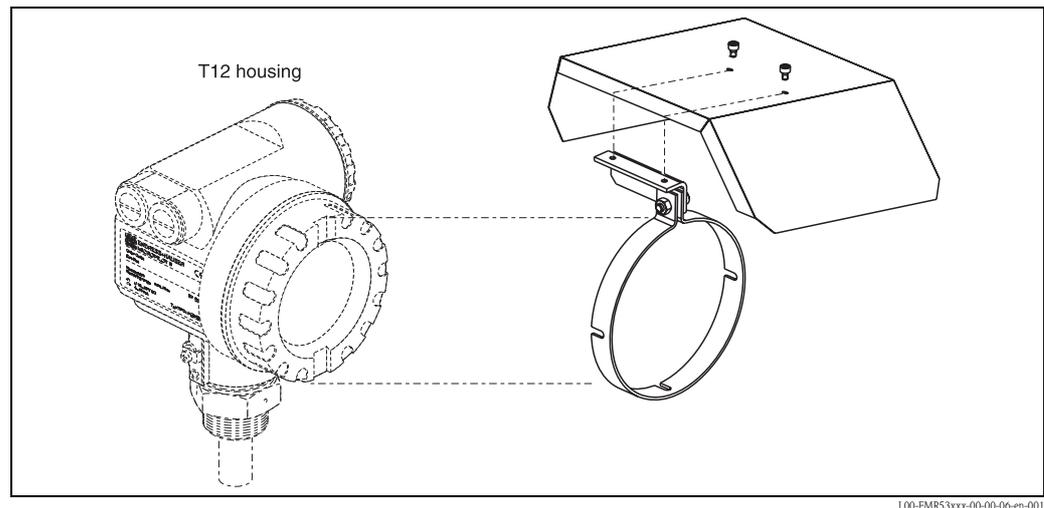
After an antenna component or electronic has been replaced, a new calibration must be carried out. This is described in the repair instructions.

8 Accessories

A variety of accessories is available for the Micropilot S. They can be ordered separately from Endress+Hauser.

8.1 Weather protection cover

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



8.2 Commubox FXA195 HART

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

8.3 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.

8.4 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.

8.5 Mounting with Sample hatch on stilling well

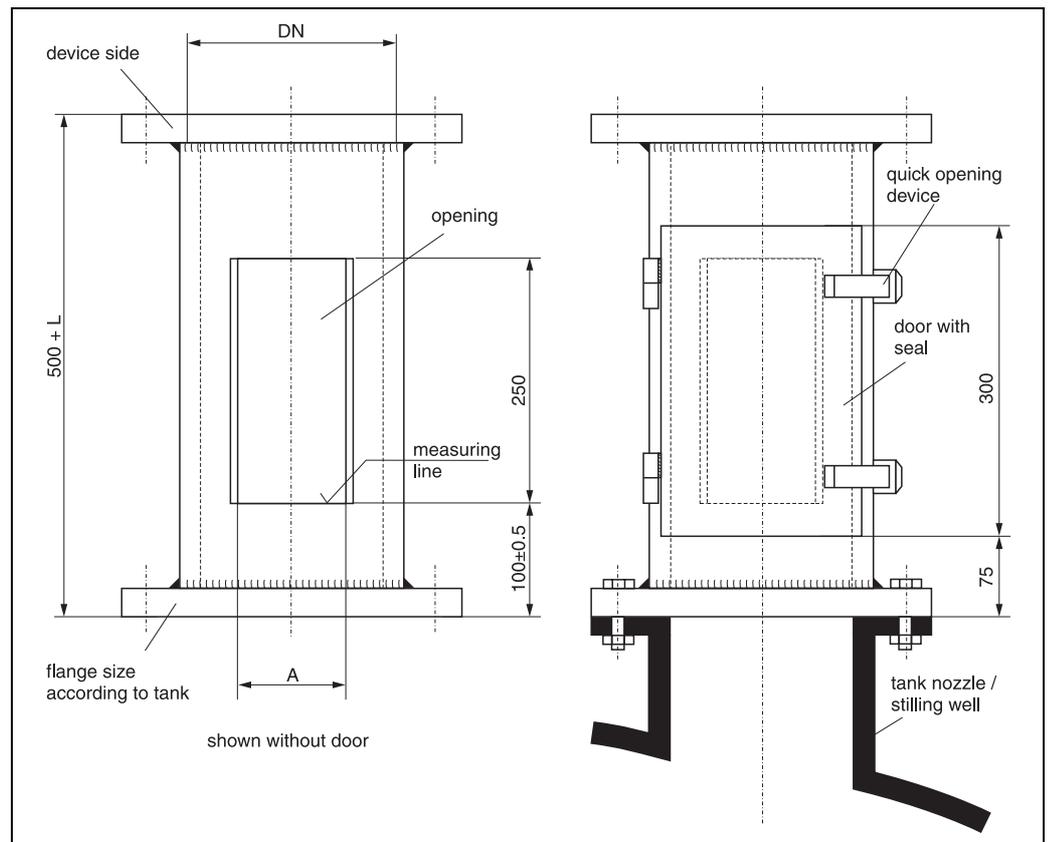
8.5.1 Installation hints

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



Note!

The sample hatch is not part of the standard offering from Endress+Hauser. Please contact Endress+Hauser for further information.



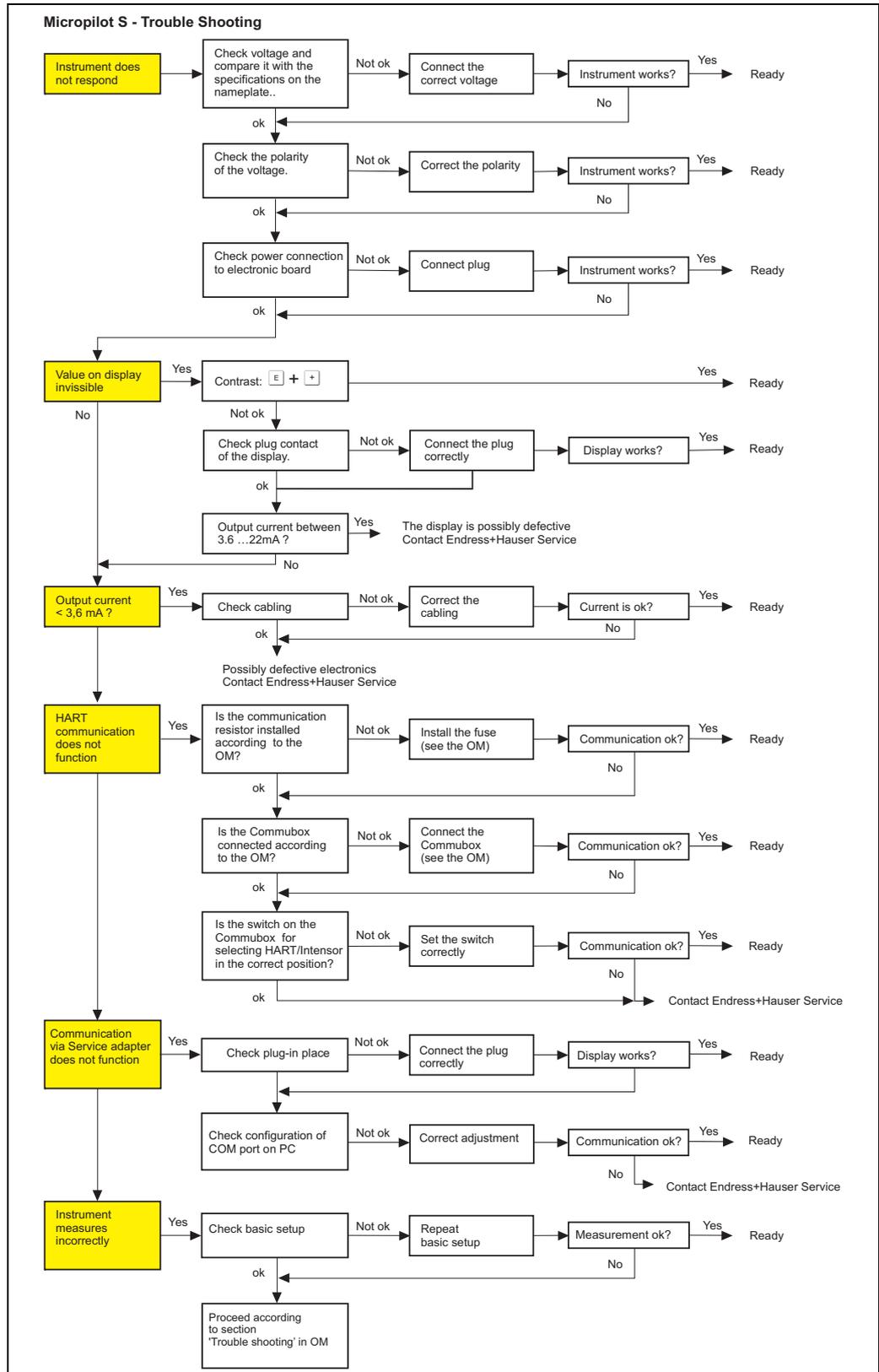
L00-FMR53xxx-06-00-00-en-004

Flange	DN150	DN200	DN250/300	Flange	ANSI 6"	ANSI 8"	ANSI 10"
PN [bar] ¹⁾	16	16	16	PN [lbs] ¹⁾	150	150	150
A [mm]	110	140	170	A [mm]	110	140	170
L [mm]	—	300	450	L [mm]	—	300	450

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

9 Trouble-shooting

9.1 Trouble-shooting instructions



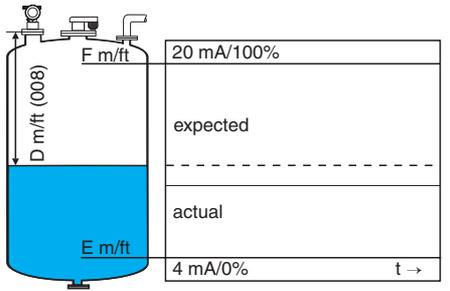
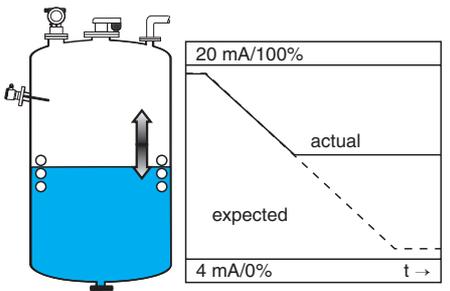
L00-FMR53xxx-19-00-00-en-010

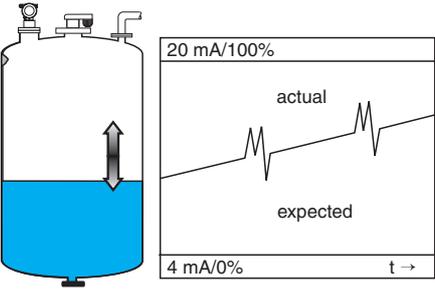
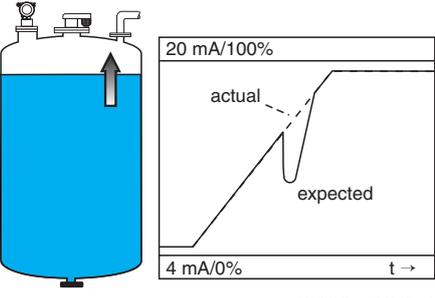
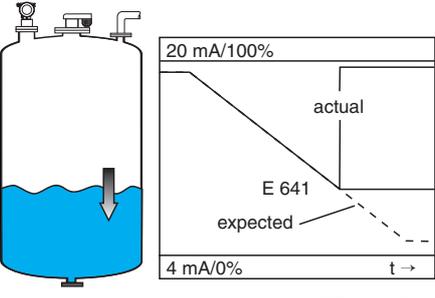
9.2 System error messages

Code	Description	Possible cause	Remedy
A102	checksum error general reset & new calibr.required.	device has been powered off before data could be stored; emc problem 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 defect	Reset if alarm prevails after reset, exchange electronics
A113	electronics defect	RAM defect	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 electronics
A270	custody switch undefcheck position	switch for custody transfer may be defective	check position of custody switchexchange electronics
#	mm - accuracy not ensured	inconsistency between phase and amplitude evaluation inconsistent microfactor inconsistent index mapping	check basic calibrationcheck mounting calibrationcheck echo quality > 10 dB history reset

Code	Description	Possible cause	Remedy
A272	electronics defect amplifier	inconsistency in amplification	exchange electronics
W275	electronics defect factory setting	offset drift of A/D commuter	exchange electronics
W511	no factory calibration ch1	factory calibration has been deleted	record new factory calibration
A512	recording of mapping please wait	mapping active	wait some seconds until alarm disappears
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	check calibr	echo lost due to application conditions of built up on antenna Antenna defect	check installation optimize orientation of antenna clean antenna (cf. OM)
E651	- 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
<p>A warning or alarm has occurred</p>	<p>Depending on the configuration</p>	<p>See table of error messages (→ 71)</p>	<p>1. See table of error messages (→ 71)</p>
<p>Measured value (00) is incorrect</p>		<p>Measured distance (008) OK?</p> <p>yes →</p> <p>no ↓</p> <p>Measurement in bypass or stilling well?</p> <p>yes →</p> <p>no ↓</p> <p>Is "offset" (057) active?</p> <p>yes →</p> <p>no ↓</p> <p>An interference echo may have been evaluated.</p> <p>yes →</p>	<p>1. Check empty calibr. (005) and full calibr (006).</p> <p>2. Check linearisation: → level/ullage (040) → max. scale (046) → diameter vessel (047) → Check table</p> <p>3. Check dip table</p> <p>1. Is bypass or stilling well selected in tank shape?</p> <p>2. Is the pipe diameter (007) correct?</p> <p>3. Pipe diameter correction (032) activated?</p> <p>1. offset (057) correctly set?</p> <p>1. Carry out tank mapping → basic setup</p> <p>2. Activate auto correction (031)</p>
<p>No change off measured value on filling/emptying</p>		<p>Interference echo from installations, nozzle or extension on the antenna</p>	<p>1. Carry out tank mapping → basic setup</p> <p>2. If necessary, clean antenna</p> <p>3. If necessary, select better mounting position (→ 12)</p>

Error	Output	Possible cause	Remedy
<p>During filling/emptying the measured value jumps sporadically to a higher/lower level</p>	 <p style="text-align: right; font-size: small;">L00-FMR53xxx-19-00-00-en-009</p>	<p>During definition of the auto correction table the device has been switched off and the level has changed.</p>	<ol style="list-style-type: none"> 1. Reset "555" 2. If possible, do not switch off the device before the complete measuring range has been passed through.
<p>During filling/emptying the measured value jumps downwards</p>	 <p style="text-align: right; font-size: small;">L00-FMR53xxx-19-00-00-en-004</p>	<p>Multiple echoes</p>	<p>yes →</p> <ol style="list-style-type: none"> 1. Check the tank shape (002), e.g. "dome ceiling" or "horizontal cyl" 2. In the range of the blocking dist. (059) there is no echo evaluation → Adapt the value 3. If possible, do not select central installation position (→ 12) 4. Activate auto correktion (031)
<p>E641 ((loss ofecho)</p>	 <p style="text-align: right; font-size: small;">L00-FMR53xxx-19-00-00-en-005</p>	<p>Level echo is too weak.</p> <p>Possible causes:</p> <ul style="list-style-type: none"> ■ Rough surface dueto filling/emptying ■ Agitator running ■ Foam 	<p>yes →</p> <ol style="list-style-type: none"> 1. Check application parameters (002), (003) and (004) 2. If necessary, select a better installation position and/or larger antenna (→ 12)
<p>E641 (loss ofecho) after turn onthe power supply</p>	<p>If the device is configured to Hold by loss of echo the output is set to anyvalue/current.</p>	<p>noise level during theinitialisation phase tohigh.</p>	<p>Repeat once more empty calibr. (005).</p> <p>Caution! Before conformation change with <input type="checkbox"/> or <input type="checkbox"/> to the edit mode.</p>

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.

Endress+Hauser product search

Via product name

Enter the product name

4. Select the device.
5. Click the "Accessories/Spare parts" tab.

General information	Technical information	Documents/ Software	Service	Accessories/ Spare parts
---------------------	-----------------------	---------------------	---------	--------------------------

- ▶ Accessories
- ▼ All Spare parts
 - ▶ Housing/housing accessories
 - ▶ Sealing
 - ▶ Cover
 - ▶ Terminal module
 - ▶ HF module
 - ▶ Electronic
 - ▶ Power supply
 - ▶ Antenna module



Advice

Here you'll find a list of all available accessories and spare parts. To only view accessories and spare parts specific to your product(s), please contact us and ask about our Life Cycle Management Service.

◀ | 1 / 2 | ▶ | 🔍

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:

- The chemical and physical characteristics of the product
- An exact description of the application
- 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 separate the different components according to their material consistence.

9.7 Software history

Date	Software-version	Software changes	Documentation changes
12.2000	V 01.00.00	Original software. Operated via: – ToF Tool from version 1.5 – Commuwin II (from version 2.05.03) – HART-Communicator DXR375 with Rev. 1, DD 1.	
03.2002	V 01.02.00	simplified commissioning history reset in basic calibration ■ Function group: envelope curve display ■ Katakana (japanese) Operated via: – ToF Tool (V 3.0) – Commuwin II (from version 2.05.03) – HART-Communicator DXR375 with Rev. 1, DD 1.	Description of Instrument Functions
06.2005	V 01.02.02	Function "echo lost" improved Operated via: – Fieldcare – ToF Tool (from V 3.0) – HART-Communicator DXR375 with Rev. 1, DD 1.	
04.2009	V 01.03.00	■ Adaption of planar antenna ■ Enhanced phase evaluation	

9.8 Contact addresses of Endress+Hauser

Contact addresses can be found on our homepage: www.endress.com/worldwide.
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 FMR532 with planar antenna is specifically suited for stilling well applications with ranges up to 38 m (124 ft).

10.1.2 Input

Measured variable	The measured variable is the distance between a reference point GRH (mounting flange) and a reflective surface (e.g. product surface). The measured value and all parameters are displayed using either metrical SI-units or US/UK-units (inch, ft, ...). The level is calculated based on the tank height entered. In order to compensate for non-linear effects like movement of the tank roof, an additional correction table (diptable) can be entered.
Measuring range	"Measuring range", →  13.

10.1.3 Output

Output signal	4 to 20 mA (invertible) with HART protocol (e.g. for multidrop connection to the Tank Side Monitor NRF 590): This version can be operated via the PC operating software FieldCare. The device supports both point-to-point and multidrop operation. For measurements with mm accuracy, the measured value must be transmitted via the HART protocol in order to ensure the required accuracy.
Signal on alarm	Error information can be accessed via the following interfaces:: <ul style="list-style-type: none"> ■ Local display: <ul style="list-style-type: none"> – Error symbol (→  31) – Plain text display – LED's: red LED continuously on = alarm, red LED flashes = warning ■ Current output ■ Digital interface
Galvanic isolation	500 V between <ul style="list-style-type: none"> ■ power supply and ground ■ power supply and signal

10.1.4 Auxiliary energy

Ripple HART	47 to 125 Hz: $U_{ss} = 200 \text{ mV}$ (at 500Ω)
Max. noise HART	500 Hz to 10 kHz: $U_{eff} = 2.2 \text{ mV}$ (at 500Ω)
Electrical connection	T12 housing with separate terminal compartment
Load HART	Minimum load for HART communication: 250Ω
Cable entry	<ul style="list-style-type: none"> ■ Cable gland: 2 x M20x1.5 ■ Cable entry: 2 x G½ or 2 x ½NPT
Supply voltage	"Supply voltage", →  24
Power consumption	<ul style="list-style-type: none"> ■ Max. 330 mW at 16 V ■ Max. 500 mW at 24 V ■ Max. 600 mW at 30 V ■ Max. 700 mW at 36 V
Current consumption	Max. 21 mA (50 mA inrush current)
Power supply	Integrated in Tank Gauging system via Endress+Hauser Tank Side Monitor NRF590 (recommended operation mode).

10.1.5 Performance characteristics

Note!	Performance characteristics for devices that can be calibrated in compliance with OIML R85.
Reference operating conditions	<p>According to OIML R85:</p> <ul style="list-style-type: none"> ■ Temperature = -25 °C to $+55 \text{ °C}$ (-13 °F to $+131 \text{ °F}$) ■ Atmospheric pressure ■ Relative humidity (air) = $65 \% \pm 15 \%$ ■ 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	<p>Absolute accuracy: better than $\pm 1 \text{ mm}$</p> <p> Note! Free space Micropilot S radar gauges typically provide accuracy of $\pm 0.5 \text{ mm}$ (2 sigma value). Depending on the respective national gauging regulations, the admissible errors after installation of the device on the tank are $\pm 4 \text{ mm}$ (OIML, API)....</p>
Non-repeatability	0.3 mm (1/64")
Hysteresis	0.3 mm (1/64")
Long-term drift	The long-term drift is within the specified accuracy

Influence of ambiente temperature	Within the specified accuracy according to OIML R85
Proof of accuracy of custody transfer versions	<p>The accuracy of each Micropilot S is established through a calibration certificate that records the absolute and relative error at 10 equidistant points during the final test. A Laser Interferometer (Jenaer Messtechnik ZLM 500) with an absolute accuracy of 0.1 mm is used as a reference for the free space measurements with FMR530/533.</p> <p>For stilling well measurements with FMR532, a NMI / PTB calibrated tape with an absolute accuracy of 0.25 mm is used. Each Micropilot S is delivered with the PTB and NMI type approval. Additional initial factory verifications for custody applications are available on demand for radar device Micropilot S.</p>
Maximum fill speed	By the first pass trough of measuring range: 100 mm/min., thereafter unlimited
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.
Resolution	<ul style="list-style-type: none"> ■ digital: 0.1 mm ■ analog: 0.03 % of measuring range
Settling time	Typical 15 sec.
Software reliability	<p>The software used in the radar device Micropilot S fulfills the requirements of OIML R85. This particularly includes:</p> <ul style="list-style-type: none"> ■ cyclical test of data consistency ■ non-volatile memory ■ segmented data storage <p>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.</p>
Inventory control versions	All device types can be delivered as "Inventory Conctrol Versions" with a reduced accuracy of ± 3 mm (under reference conditions). To these versions, the calibration certificate or custody transfer type approval is not attached. The "Inventory Control Versions" can be selected by choosing the option "R" in feature "70 - Custody transfer approvals", →  7.

10.1.6 Operating conditions: Environment

Ambient temperature range	<p>Ambient temperature for the transmitter:</p> <ul style="list-style-type: none"> ■ Standard: -40 °C to +80 °C (-40 °F to +176 °F) ■ For calibration to regulatory standards: -25 °C to +55 °C (-30 °F to +140 °F) <p>With $T_u < -20$ °C and $T_u > +60$ °C the operability of the LC-display is reduced. A weather protection cover should be used for outdoor operation if the device is exposed to direct sunlight.</p>
Storage temperature	-40 °C to +80 °C (-40 °F to +176 °F)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Degree of protection	<ul style="list-style-type: none"> ■ Housing: IP68, NEMA 6P (open housing and removed liquid crystal display: IP20, NEMA 1) ■ Antenna: IP68 (NEMA 6P)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20 to 2000 Hz, 1 (m/s ²)/Hz
Cleaning of the antenna	<p>The antenna can get contaminated, depending on the application. The emission and reception of microwaves can thus eventually be hindered. The degree of contamination leading to an error depends on the medium and the reflectivity, mainly determined by the dielectric constant ϵ_r. If the medium tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care has to be taken not to damage the antenna in the process of a mechanical or hose-down cleaning. The material compatibility has to be considered if cleaning agents are used! The maximum permitted temperature at the flange should not be exceeded</p>
Electromagnetic compatibility (EMC)	<ul style="list-style-type: none"> ■ Electromagnetic compatibility in accordance with all the 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	-40 °C to +200 °C
Process pressure limits	0 to 40 bar (Option 64 bar)
Dielectric constant	<ul style="list-style-type: none"> ■ In a stilling well: $\epsilon_r \geq 1.4$ ■ In free space: $\epsilon_r \geq 1.9$

10.1.8 Mechanical construction

Weight	Approx 6 kg + weight of flange
Material	Refer to TI00344F/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 1999/5/EG, FCC CRF 47, part 15
Custody type approval	All aspects of OIML R85 are fulfilled
Overspill protection	WHG, see ZE00243F/00/DE.
External standards and guidelines	To conception and development for Micropilot S have been followed the external standards and guidelines: EN 60529 Protection class of housing (IP-code) EN 61010 Safety regulations for electrical devices for measurement, control, regulation, and laboratory use. EN 61326 Emissions (equipment class B), compatibility (appendix A – industrial area) NAMUR Standards committee for measurement and control in the chemical industry API (American Petroleum Institute) Particularly "Manual of Petroleum Measurement Standards". OIML R85 (Organisation Internationale de Métrologie Légale)

Ex approval	XA00081F-B Safety Instructions for Micropilot S FMR530, FMR532, FMR533 (T12 / EEx ia IIC T6...T1) PTB 00 ATEX 2067 X, Equipment marking: (II 1/2 G)
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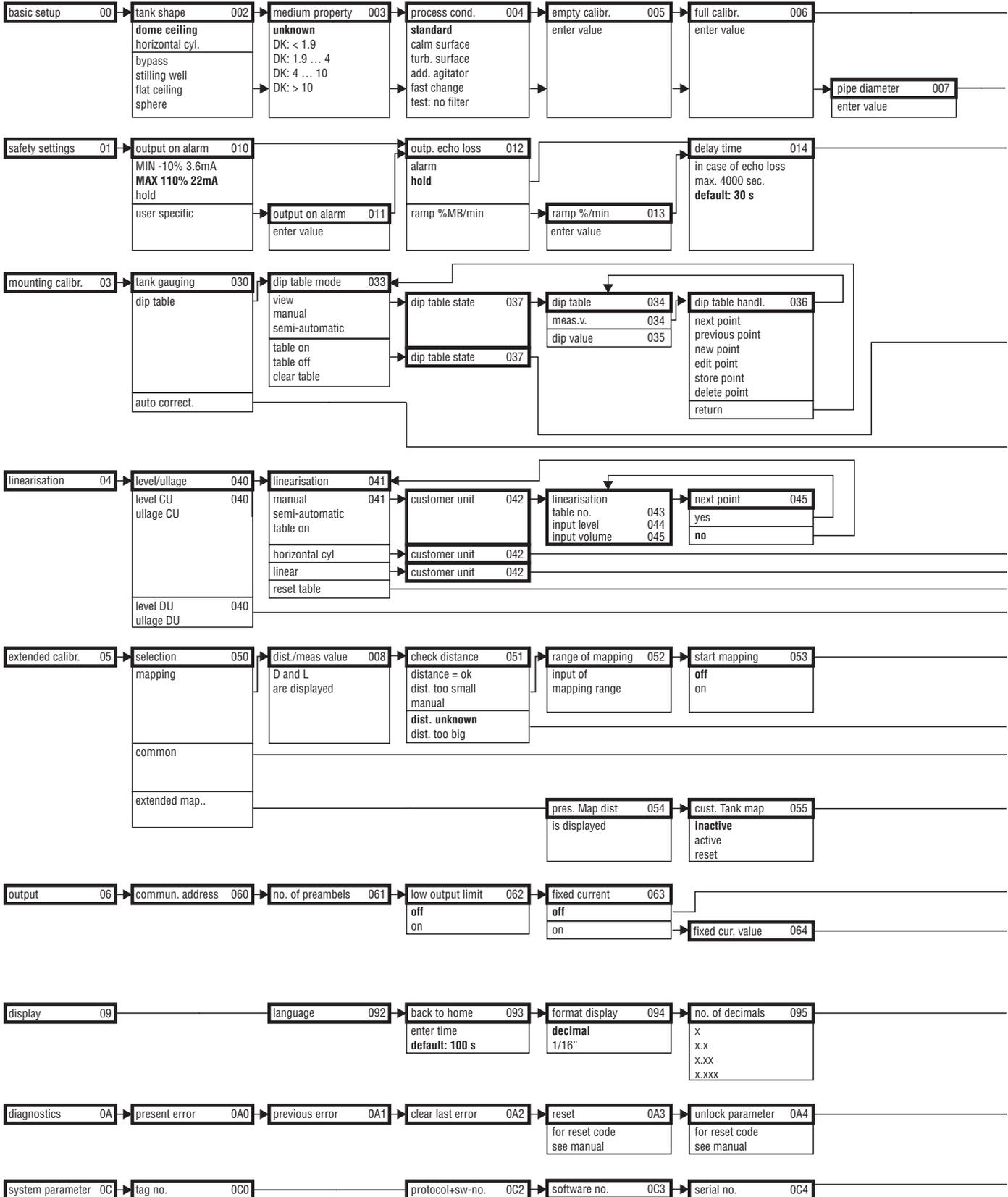
Marine certificate	GL (Germanischer Lloyd)
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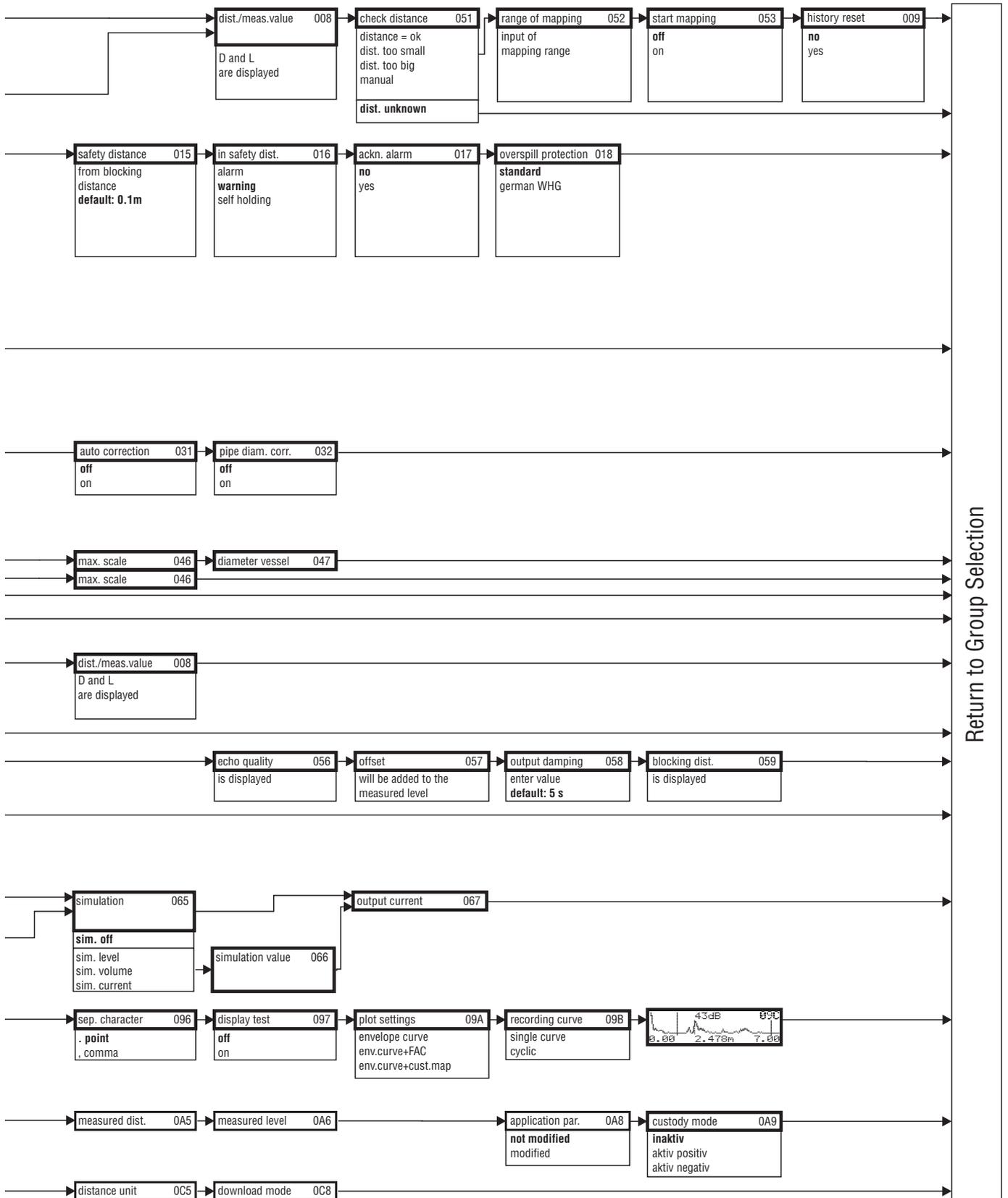
10.1.10 Supplementary Documentation

Supplementary Documentation	<ul style="list-style-type: none"> ■ System Information Micropilot (SI00019F/00/EN) ■ Technical Information (TI00344F/00/EN) ■ Operating Instructions "Description of Instrument functions" (BA00217F/00/EN) ■ Certificate "German WHG" (ZE00243F/00/DE)
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11 Appendix

11.1 Operating menu HART (Display modul)





11.2 Custody transfer mode

Micropilot S is a weight and measure approved level transmitter. Either the innage or the ullage can be selected as the custody transfer variable. The selected variable is the basis for the subsequent calculation of the current amount of product in a tank, along with other measured variables such as (average) temperature and pressure.

This opens up numerous application options in custody transfer:

- Quantity calculation of mineral oils
- Quantity calculation of alcohols

11.3 Weight and measure approval, Standards Authorities approval, Compulsory reapproval

The type approvals for custody transfer issued by the PTB and NMI, a copy of which is enclosed with every device, prove the fundamental suitability of the various types for custody transfer.

In addition to this, the accuracy of every single device is documented using a calibration certificate, which is issued in the factory after the device has been tested on a reference test rig.

On request, a separate Initial verification of the devices can be carried out with a National Standards Authorities inspector present, who issues a preliminary test certificate for every device. In the initial verification, the device is tested to ensure that it complies with the limit of error in legal metrology, which lies at ± 2 mm for radar measuring devices in Germany.

Essentially, this proves that the devices are weight and measure approved. The devices must not, however, be used in custody transfer mode straight away.

The measuring device is not approved until after the approval after installation by the Standards Authorities. For this, the device's level measurement is compared with the tank gauging by a National Standards Authorities inspector using manual dips (also "Initial verification"). As a rule, a quiescent tank gauging is dipped by hand three times in a row and then compared with the value displayed by the level radar. Depending on national regulations, the transfer error limit, calculated as the arithmetic mean of the absolute deviations of all three measurements, must not exceed double the limit of error in legal metrology (compare, for example, the German "Eichordnung" or the American "API 3.1B", in which the necessary procedures are also defined).

Depending on national regulations, this test is repeated with various tank gaugings. Using linearisation tables to compensate any non-linearities that occur in measurement is permitted. For this, the Micropilot S level radar offers a special dip table, compare → Chap. 6.5. After the measurement has been approved by an inspector, he seals the level radar at the stamp position and thereby also secures the programming status of the device.

Those operating an approved level transmitter are obligated to obtain reapproval in accordance with the applicable national regulations from the Standards Authorities.

11.4 Particularities in "approved" operation

The Micropilot S level radar is set to custody transfer mode after commissioning using a custody locking switch (→ 30). The position of the custody locking switch is secured and sealed using the sealing pin. During custody transfer measurement, all custody transfer-relevant functions for operation are automatically locked, so that the device software can not be used, either via local operation or via digital communication settings. This locked status is displayed by the key symbol (). Micropilot S radar devices continuously monitor the compliance with accuracy requirements for custody transfer measurements according to OIML R85. If, for example, the accuracy cannot be maintained due to quick surface movements, this is reported via a separate alarm in the local display (displays "#"- symbols) and via digital communication.

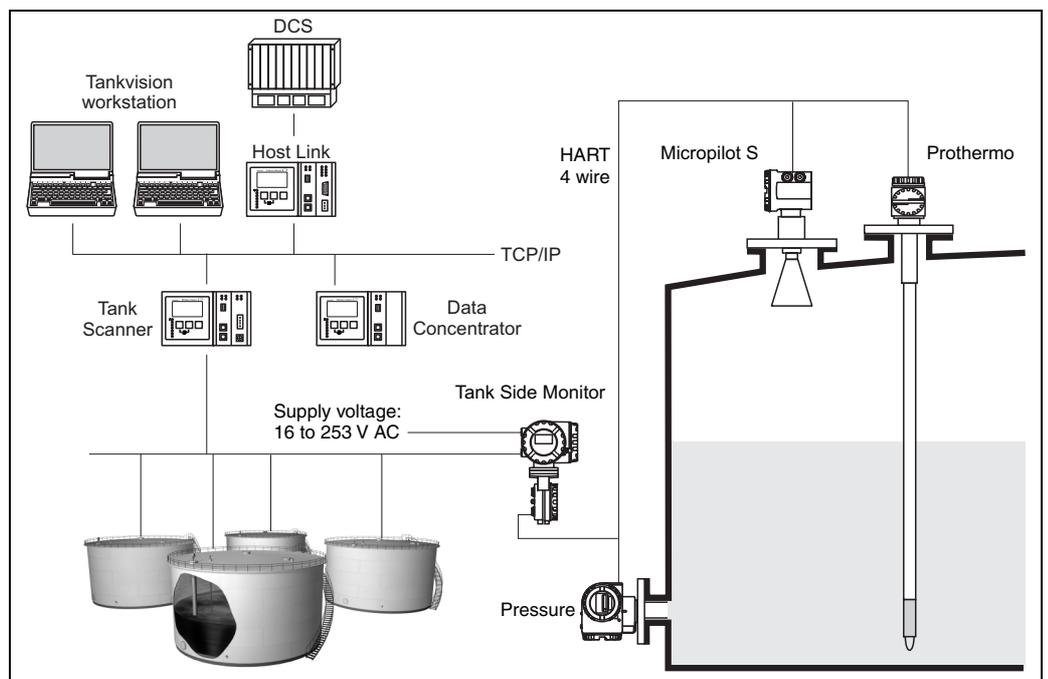
11.5 Definition of terms

For definitions and procedures please refer to the following documents:

- Manual of Petroleum Measurement Standards, Chapter 3 - Tank Gauging, Section 1.B - Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging, American Petroleum Institute, second edition, 2001
- OIML R 85, Organisation Internationale de Métrologie Légale, International Recommendation R 85, edition 1998 (E).

11.6 Integrated in tank gauging system

The Endress+Hauser Tank Side Monitor NRF590 provides integrated communications for sites with multiple tanks, each with one or more sensors on the tank, such as radar, spot or average temperature, capacitive probe for water detection and/or pressure sensors. Multiple protocols out of the Tank Side Monitor guarantee connectivity to nearly any of the existing industry standard tank gauging protocols. Optional connectivity of analog 4...20 mA sensors, digital I/O and analog output simplify full tank sensor integration. Use of the proven concept of the intrinsically safe HART bus (HART multidrop) for all on-tank sensors yields extremely low wiring costs, while at the same time providing maximum safety, reliability and data availability.



L00-FMR53xxx-14-00-06-en-006

11.7 Patents

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

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

Index

A

Accessories 68
 Alarm 31, 36
 Application errors 73

B

Basic setup 41, 43, 61
 Bypass 47

C

Cable entry 24
 CE mark 9
 Commissioning 40
 Commubox 26, 68
 Connection 26
 Current consumption 24
 Custody locking switch 32

D

Declaration of conformity 9
 Declaration of contamination 76
 Degree of protection 27
 Designated use 4
 Dielectric constant 44
 Dimensions 11
 Dip table 54
 Display 30
 Disposal 76
 Distance 41, 47

E

Empty calibration 41, 46
 Engineering hints 12
 Envelope curve 59, 65
 Equipotential bonding 27
 Error messages 36
 Ex approval 81
 Exterior cleaning 67

F

Field Communicator 375, 475 26
 FieldCare 61, 65
 Full calibration 41, 46
 Function groups 29
 Functions 29

G

Green LED 31

H

Hardware lock 33
 Hardware unlock 34
 HART 26, 37

I

Installation in tank (free space) 15
 Interference echo suppression 49, 64

Interference echoes 48

K

Key assignment 32

L

Level 41

M

Maintenance 67
 Mapping 48–49
 Measuring conditions 12
 Media group 13
 Medium properties 44
 Mounting 10

N

Nameplate 6

O

Operating menu 28
 Operating menus 29
 Operation 28, 33
 Operational safety and process safety 4
 Ordering structure 7

P

Performance characteristics 78
 Pipe diameter 47
 Power consumption 24
 Process conditions 45, 62

R

Red LED 31
 Repair 67
 Repairs to Ex- approved devices 67
 Replacement 67
 Reset 35
 Return 76
 Rf approval 81
 RN221N 26

S

Safety conventions and symbols 5
 Safety distance 41
 Service Interface FXA291 68
 Software history 76
 Supply voltage 24
 System error messages 71

T

T12 housing 23
 Tag 62
 Tank shape 43
 Technical data 77
 Trouble-shooting 70
 Trouble-shooting instructions 70

Turn housing. 10, 18

U

Unlock parameter 33–34

V

VU331 43, 59

W

Warning 36

Weather protection cover 68

Wiring. 22

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

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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 Schutzzeineinrichtungen

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

* 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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