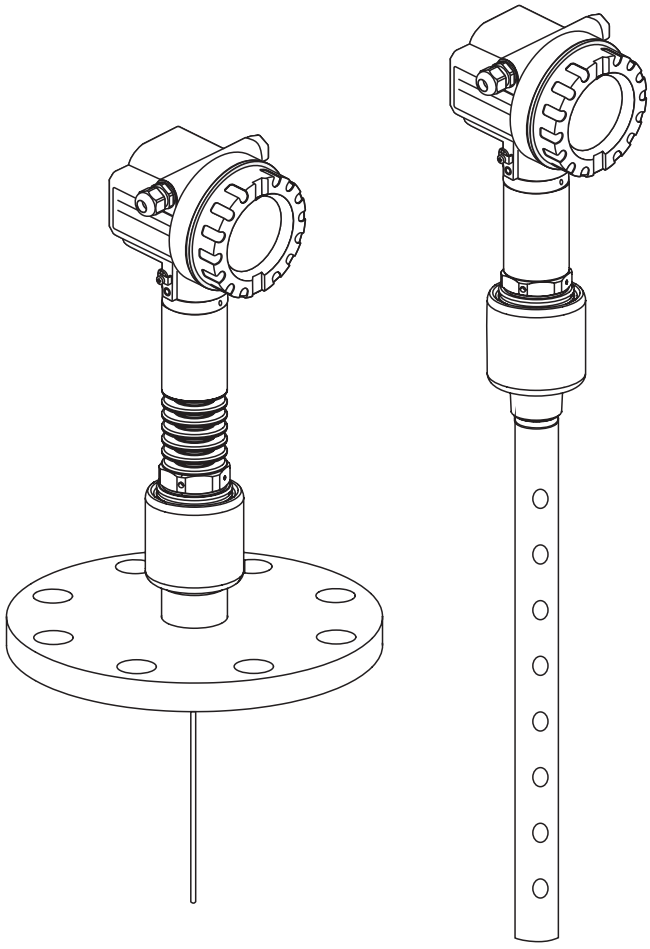
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Levelflex M FMP45
Interface measurement

Guided Level-Radar

HART COMMUNICATION PROTOCOL



BA00365F/00/EN/15.11
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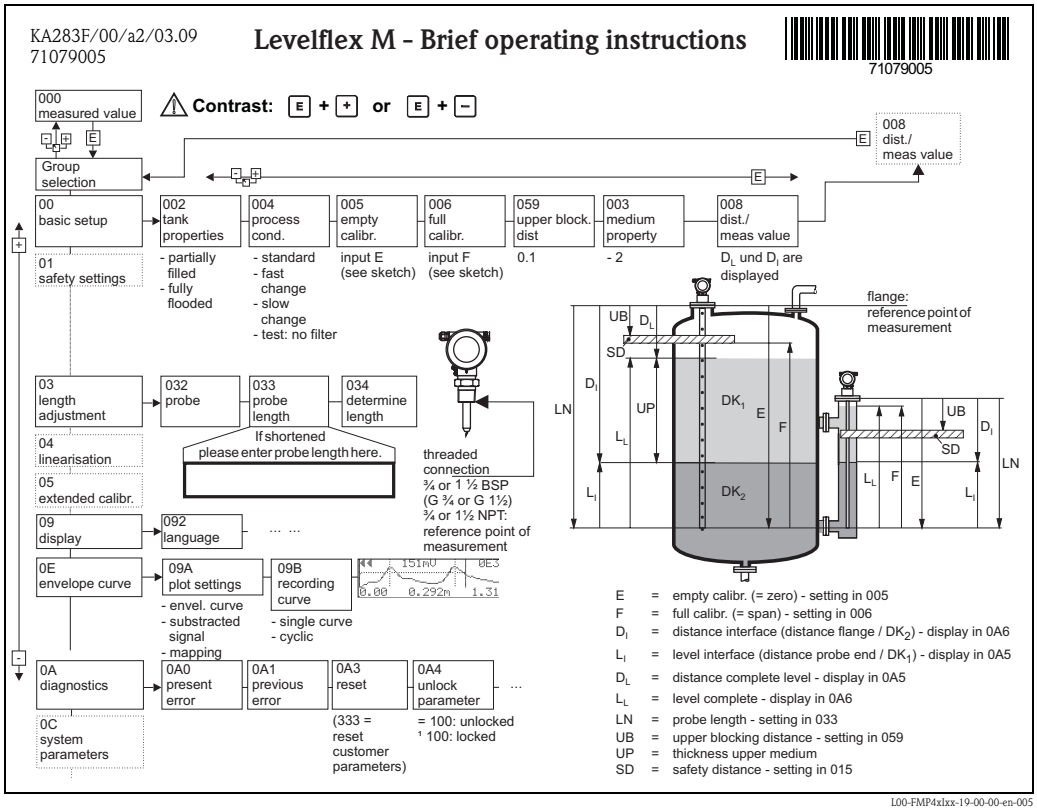
Valid as of software version:
01.08.zz

Endress+Hauser
People for Process Automation

Brief Operating Instructions



Note!
These Operating Instructions explains how to install and commission the level transmitter. All functions that are required for a typical measuring task are taken into account here. In addition, the Levelflex M provides many other functions for optimizing the measuring point and converting measured values. These functions are not included in these Operating Instructions.

An overview of all the device functions can be found on Seite 78.

The operating manual BA00366F/00/EN "Description of Instrument Functions" provides an **extensive description of all the device functions** which can be found on the enclosed CD-ROM.

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

Table of contents

1 Safety instructions

1.1 Designated use

The Levelflex M is a compact level transmitter for the continuous measurement of the total level and the interface level in liquids. Measuring principle: guided level radar/ TDR:
Time **D**omain **R**eflectometry.

1.2 Installation, commissioning and operation

The Levelflex M is designed to meet state-of-the-art safety requirements and conforms to applicable standards and EC regulations. 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 configuration. For this reason, installation, connection to the electricity supply, commissioning, operation and maintenance of the measuring system must only be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain. Modifications and repairs to the device are permissible only when they are expressly approved in the Operating Instructions.

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 word on the device.

The measuring device meets the general safety requirements according to EN 61010-1 and the EMC requirements of IEC/EN 61326 in addition to NAMUR Recommendations NE21 and NE43.

Hazardous areas

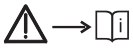
If using the measuring system in hazardous areas, the appropriate national standards must be observed. The device is accompanied by separate Ex documentation, which is an integral part of this documentation. The installation regulations, connection values and safety instructions listed in this document must be observed.

- Ensure that all personnel are suitably qualified.
- Measuring point requirements with regard to measurement and safety must be observed.

1.4 Safety conventions and icons

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 instructions	
	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or the 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, can have an indirect effect on operation or trigger an unexpected response on the part of the device.
Explosion protection	
	**Explosion-protected, type-examined equipment** If the device has this symbol embossed on its nameplate, it can be used in a hazardous area or a non-hazardous area, according to the approval.
	**Hazardous areas** This symbol is used in the drawings of these Operating Instructions to indicate hazardous areas. Devices in hazardous areas, or cables for such devices, must have appropriate explosion protection.
	**Safe area (non-hazardous area)** This symbol is used in the drawings of these Operating Instructions to indicate non-hazardous areas. Devices in the non-hazardous area also have to be certified if connecting cables lead into the hazardous area.
Electrical symbols	
	**Direct voltage** A terminal to which DC voltage is applied or through which direct current flows.
	Alternating voltage A terminal to which alternating voltage (sine-wave) is applied or through which alternating current flows.
	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded by means of a grounding system.
	**Protective ground connection** A terminal which must be connected to ground prior to making any other connection to the equipment.
	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.
	**Temperature resistance of the connection cables** States that the connection cables must be resistant to a temperature of at least 85 °C.

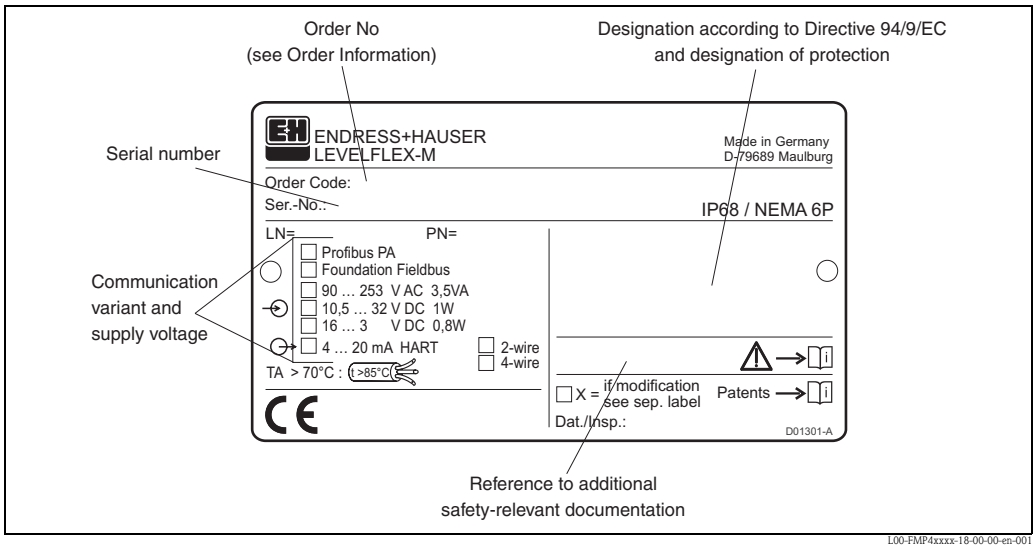
	**Safety instruction** For safety instructions refer to the manual for the appropriate device version.

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 Levelflex M FMP45

2.1.2 Ordering structure

This overview does not mark options which are mutually exclusive.

10	Approval:	
	A	Non-hazardous area
	F	Non-hazardous area, WHG
	1	ATEX II 1/2G EEx ia IIC T6/IECEx Zone 0/1
	2	ATEX II 1/2D / IEC Ex td A20/21, Alu blind cover
	3	ATEX II 1/2G EEx emb (ia) IIC T6/IECEx Zone 0/1
	4	ATEX II 1/3D / IEC Ex td A20/22
	5	ATEX II 1/2G EEx ia IIC T6, ATEX II 1/3D
	6	ATEX II 1/2G EEx ia IIC T6, WHG
	7	ATEX II 1/2G EEx d (ia) IIC T6 / IEC Ex d(ia) IIC T6
	8	ATEX II 1/2G EEx ia IIC T6, ATEX II 1/3D, WHG
	G	ATEX II 3G EEx nA II T6
	C	NEPSI Ex emb (ia) IIC T6
	I	NEPSI Ex ia IIC T6
	J	NEPSI Ex d (ia) IIC T6
	Q	NEPSI DIP (in preparation)
	R	NEPSI Ex nA II T6
	M	FM DIP Cl.II Div.1 Gr. E-G N.I.
	S	FM IS Cl.I,II,III Div.1 Gr. A-G N.I., zone 0, 1, 2
	T	FM XP Cl.I,II,III Div.1 Gr. A-G, zone 1, 2
	N	CSA General Purpose
	P	CSA DIP Cl.II Div.1 Gr. G + coal dust, N.I.
	U	CSA IS Cl.I,II,III Div.1 Gr. A-D,G + coal dust, N.I., zone 0, 1, 2
	V	CSA XP Cl.I,II,III Div.1 Gr. A-D,G + coal dust, N.I., zone 1, 2
	K	TIIS Ex d (ia) IIC T1
	L	TIIS Ex d (ia) IIC T2
	Y	Special version, TSP-No. to be spec.

20	Process temperature:
A	-200...+280 °C / -328...+536 °F (XT); saturated steam max. 200 °C
B	-200...+400 °C / -328...+752 °F (HT)
Y	Special version, TSP-No. to be spec.

30	Probe:
A	..... mm, rope 4mm, 316
C	..... inch, rope 1/6", 316
K	..... mm, rod 16 mm, 316L
L	..... mm, coax, 316L
M	..... inch, rod 16 mm, 316L
N	..... inch, coax, 316L
S	..... mm, rod 16 mm, 316L, 500 mm divisible
T	..... mm, rod 16 mm, 316L, 1000 mm divisible
U	..... inch, rod 16 mm, 316L, 20 in divisible
V	..... inch, rod 16 mm, 316L, 40 in divisible
Y	Special version, TSP-No. to be spec.

40	Process connection:
AFJ	2" 150lbs RF, 316/316L flange ANSI B16.5
AGJ	3" 150lbs RF, 316/316L flange ANSI B16.5
AHJ	4" 150lbs RF, 316/316L flange ANSI B16.5
ARJ	2" 300/600lbs RF, 316/316L flange ANSI B16.5
ASJ	3" 300/600lbs RF, 316/316L flange ANSI B16.5
ATJ	4" 300lbs RF, 316/316L flange ANSI B16.5
A1J	2" 1500lbs RF, 316/316L flange ANSI B16.5
A2J	3" 1500lbs RF, 316/316L flange ANSI B16.5
A3J	4" 600lbs RF, 316/316L flange ANSI B16.5
A4J	4" 900lbs RF, 316/316L flange ANSI B16.5
A5J	4" 1500lbs RF, 316/316L flange ANSI B16.5
CHJ	DN100 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)
CRJ	DN50 PN10-40 B1, 316L flange EN1092-1 (DIN2527 C)
CSJ	DN80 PN10-40 B1, 316L flange EN1092-1 (DIN2527 C)
CTJ	DN100 PN25/40 B1, 316L flange EN1092-1 (DIN2527 C)
C1J	DN50 PN63 B2, 316L flange EN1092-1 (DIN2527 E)
C2J	DN50 PN100 B2, 316L flange EN1092-1 (DIN2527 E)
C3J	DN80 PN63 B2, 316L flange EN1092-1 (DIN2527 E)
C4J	DN80 PN100 B2, 316L flange EN1092-1 (DIN2527 E)
C5J	DN100 PN63 B2, 316L flange EN1092-1 (DIN2527 E)
C6J	DN100 PN100 B2, 316L flange EN1092-1 (DIN2527 E)
KFJ	10K 50A RF, 316L flange JIS B2220
KGJ	10K 80A RF, 316L flange JIS B2220
KHJ	10K 100A RF, 316L flange JIS B2220
K3J	63K 50A RF, 316L flange JIS B2220
K4J	63K 80A RF, 316L flange JIS B2220
K5J	63K 100A RF, 316L flange JIS B2220
GGJ	Thread ISO228 G1-1/2, 200bar, 316L
GJJ	Thread ISO228 G1-1/2, 400bar, 316L
RGJ	Thread ANSI NPT1-1/2, 200bar, 316L
RJJ	Thread ANSI NPT1-1/2, 400bar, 316L
YY9	Special version, TSP-No. to be spec.

50	Power supply; output:
B	2-wire; 4-20mA SIL HART
D	2-wire; PROFIBUS PA
F	2-wire; FOUNDATION Fieldbus
G	4-wire 90-250VAC; 4-20mA SIL HART
H	4-wire 10.5-32VDC; 4-20mA SIL HART
K	2-wire; 4-20mA HART, interface measurement
Y	Special version, TSP-No. to be spec.

60	Operation:
1	W/o display, via communication
2	4-line display VU331, envelope curve display on site
3	Prepared for FHX40, remote display (accessory)
9	Special version, TSP-No. to be spec.

70	**Type of probe:**	
	B	Compact, centering disc d=45 mm, 316L, pipe diameter DN50/2"
	C	Compact, centering disc d=75 mm, 316L, pipe diameter DN80/3" + DN100/4"
	F	Remote, cable 3m, top, center d=45 mm, centering disk d=45 mm, 316L, pipe diameter DN50/2"
	G	Remote, cable 3m, top, center d= 75 mm, centering disk d=75 mm, 316L, pipe diameter DN80/3" + DN100/4"
	H	Remote, cable 3m, side, center d=45 mm, centering disk d=45 mm, 316L, pipe diamter DN50/2"
	I	Remote, cable 3m, side, center d=75 mm, centering disc d=75 mm, 316L, pipe diamter DN80/3" + DN100/4"
	1	Compact, basic version
	3	Remote, cable 3m, top entry
	4	Remote, cable 3m, side entry
	9	Special version, TSP-No. to be spec.

80	**Housing:**	
	A	F12 Alu, coated IP68 NEMA6P
	B	F23 316L IP68 NEMA6P
	C	T12 Alu, coated IP68 NEMA6P, separate conn. compartment
	D	T12 Alu, coated IP68 NEMA6P + OVP[1], separate conn. compartment
	Y	Special version, TSP-No. to be spec.

90	**Cable Entry:**	
	2	Gland M20 (EEx d > thread M20)
	3	Thread G1/2
	4	Thread NPT1/2
	5	Plug M12
	6	Plug 7/8"
	9	Special version, TSP-No. to be spec.

100	**Additional options:**	
	A	Basic version
	B	EN10204-3.1 material, wetted parts, (316L wetted parts for rod/coax) inspection certificate
	C	EN10204-3.1 material, wetted parts, (316L pressurized for rope version) inspection certificate
	D	Steam boiler app.+EN10204-3.1 material, Steam boiler approval EN12952-11/12953-9, EN10204-3.1 material, wetted parts (316L wetted parts for rod/coax) inspection certificate
	H	5-point linearity protocol, see additional spec.
	J	5-point, 3.1, NACE, 5-point linearity protocol, see additional spec., EN10204-3.1 material, NACE MR0175 (316L wetted parts) inspection certificate
	N	EN10204-3.1 material, NACE MR0175, (316L wetted parts) inspection certificate
	U	Steam boiler app. 300 mm / 11" gas phase, Steam boiler approval EN12952-11/12953-9, Gas phase comp. 300 mm / 11" reference rod, EN10204-3.1 material, NACE MR0175 (316L wetted parts) inspection certificate
	V	Steam boiler app. 550 mm / 21" gas phase, Steam boiler approval EN12952-11/12953-9, Gas phase comp. 550 mm / 21" reference rod, EN10204-3.1 material, NACE MR0175 (316L wetted parts) inspection certificate
	Y	Special version, TSP-No. to be spec.

995	**Marking:**	
	1	Tagging (TAG), see additional spec.
	2	Bus address, see additional spec.

FMP45-	Complete product designation

[1] OVP = overvoltage protection

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", Seite 10!

The scope of delivery consists of:
- Assembled device
- Accessories (→ 56)
- Endress+Hauser operating program on the enclosed CD-ROM
- Brief operating instructions KA00283F/00/A2 (basic setup/troubleshooting), housed in the device
- Brief operating instructions KA01052F/00/EN for quick commissioning
- 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 EC 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 E.I. Du Pont de Nemours & Co., Wilmington, USA

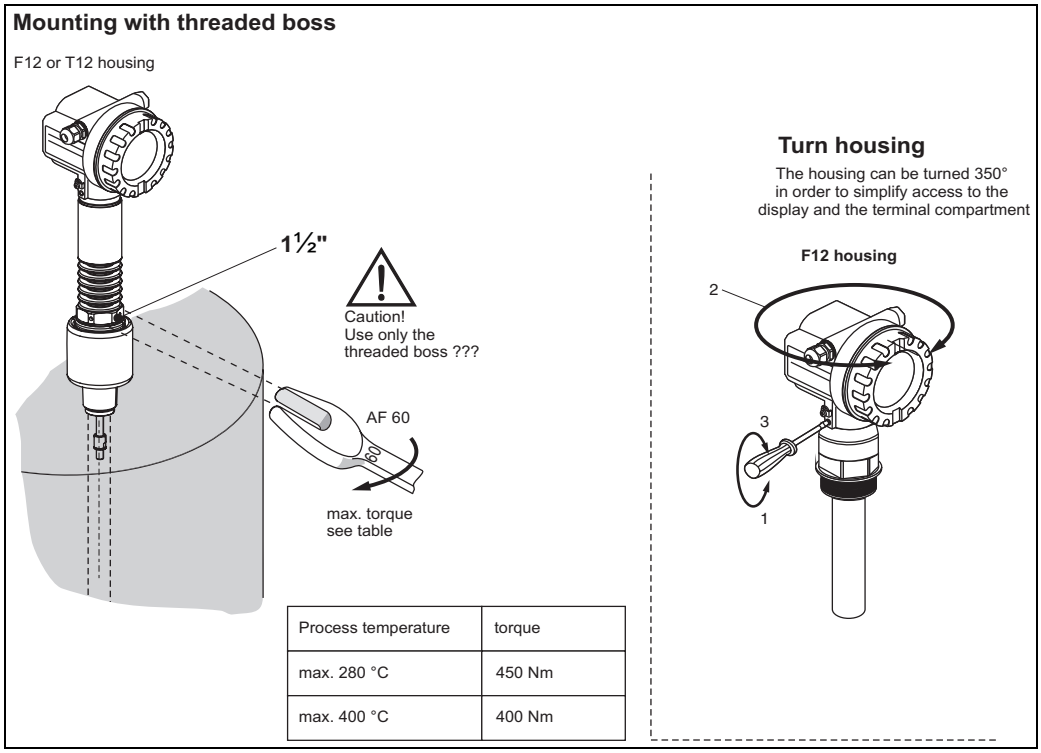
TRI-CLAMP®
Registered trademark of Ladish & Co., Inc., Kenosha, USA

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

PulseMaster®
Registered trademark of Endress+Hauser GmbH+Co. KG, Maulburg, Germany

3 Installation

3.1 Quick installation guide



3.2 Incoming acceptance, transport, storage

3.2.1 Incoming acceptance

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

3.2.2 Transport

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

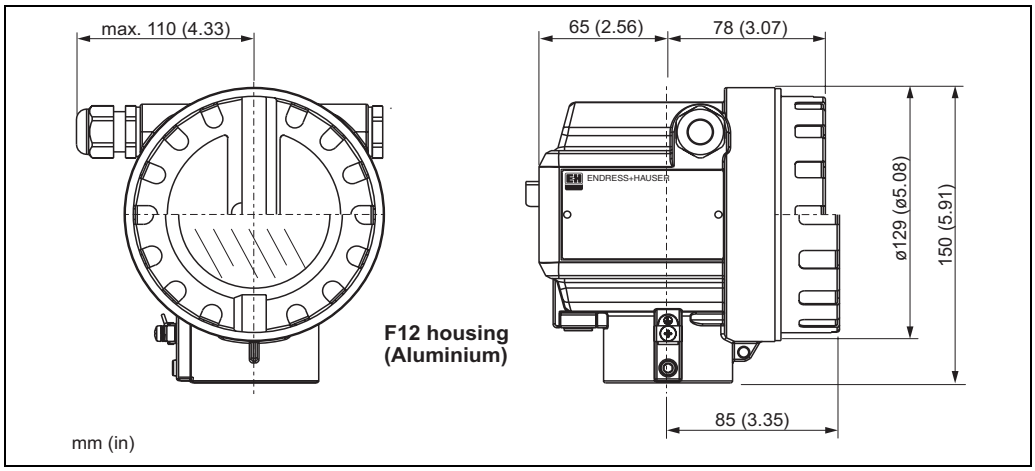
3.2.3 Storage

Pack the device so that is protected against impacts for storage and transport. The original packing material provides the optimum protection for this.
The permissible storage temperature is -40 °C to +80 °C.

3.3 Installation conditions

3.3.1 Dimensions

Housing dimensions



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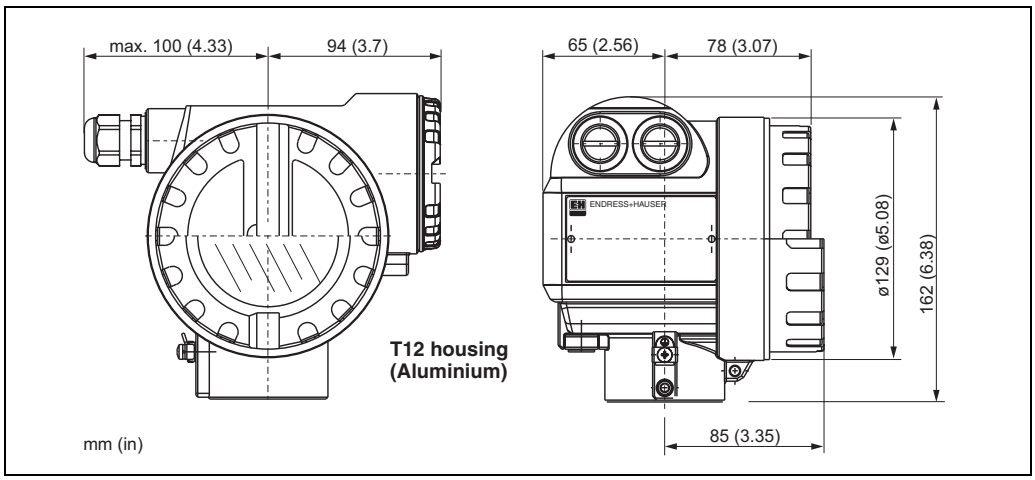

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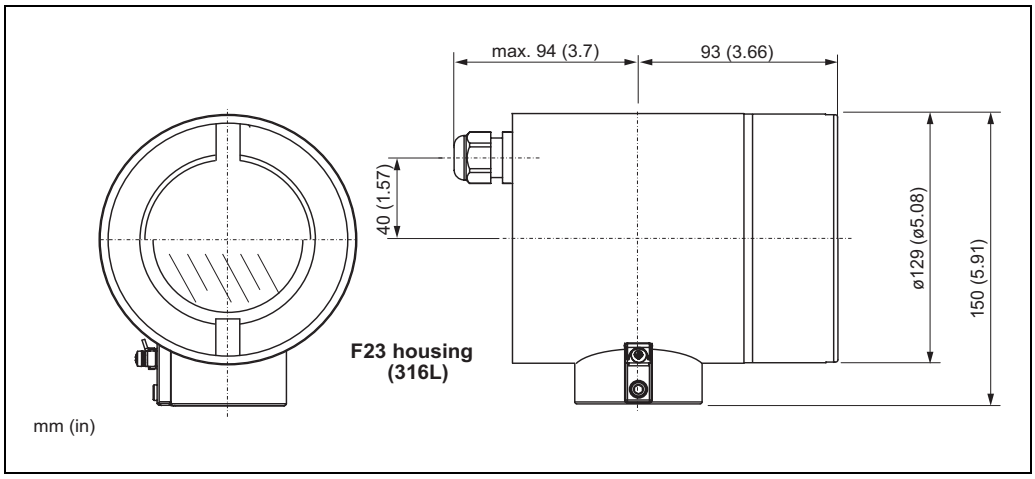

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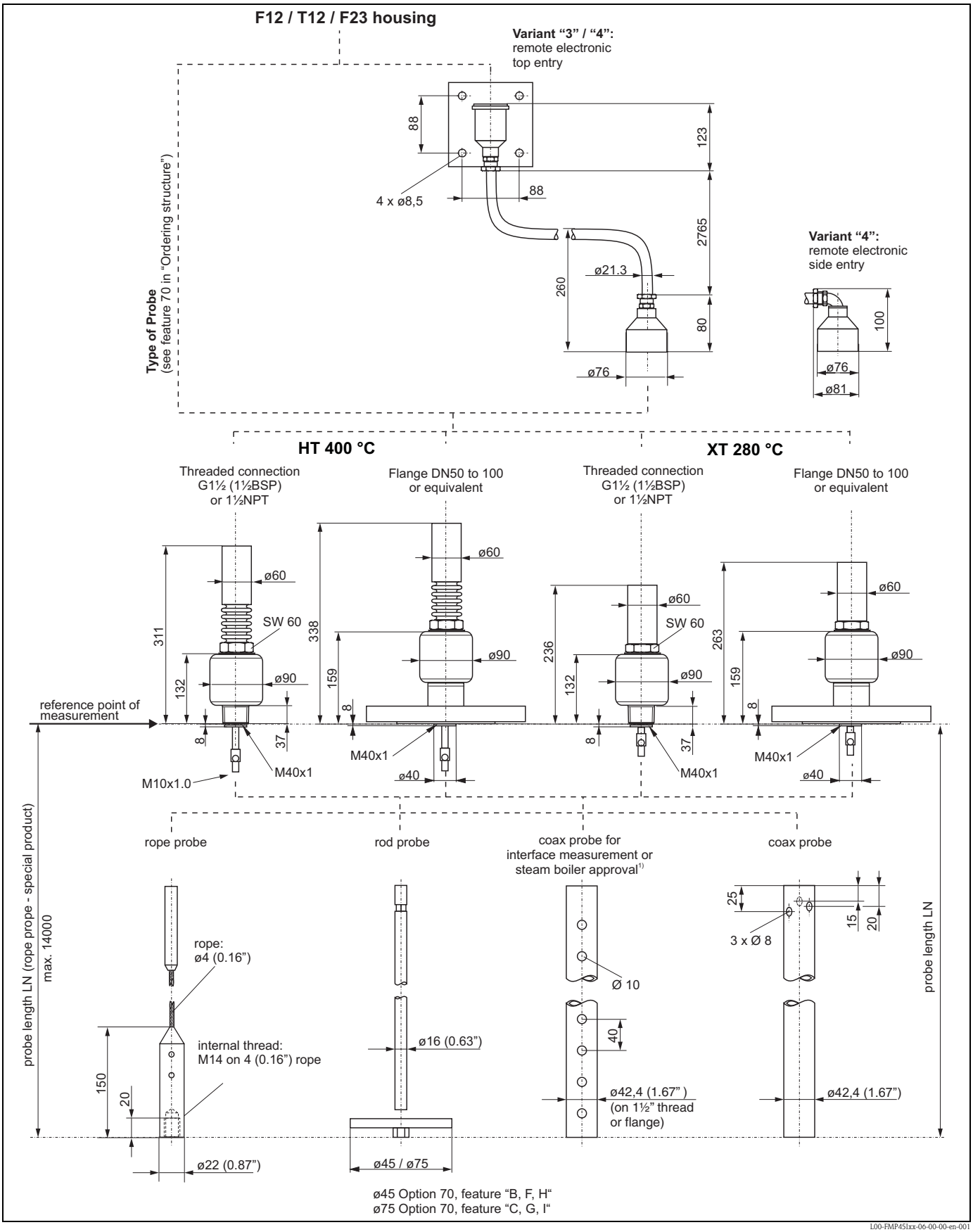
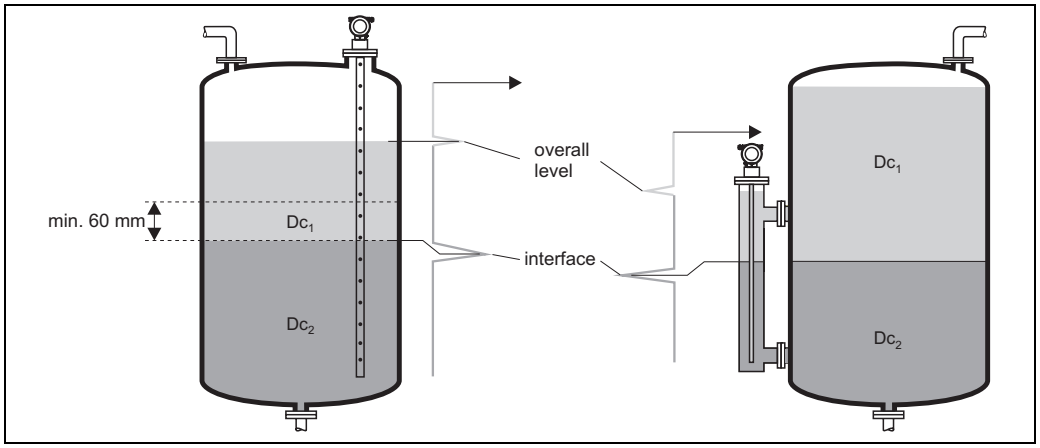
Process connection, type of probe



1) See SD00288F/00/EN "Steam boiler approval".

3.4 General information on interface measurement

The Levelflex M with the "interface" electronics version is the ideal solution for measuring interfaces. The device measures variable interfaces and variable total levels simultaneously.



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In addition, the following general conditions must be observed for interface measurement:
- The DC of the upper medium must be known and constant. The DC can be determined with the aid of the "DC manual" CP00019F/00/EN. In addition, it is also possible to calculate the DC automatically in FieldCare if the interface thickness is available and known.
- The DC of the upper medium may not be greater than 10.
- The DC difference between the upper medium and lower medium must be >10.
- The interface must have a minimum thickness of 60 mm.
- Emulsion layers in the vicinity of the interface can severely dampen the signal. However, emulsion layers up to 50 mm are permitted.
- The measuring range for interface measurement is limited to 10 m. Larger measuring range available on request.

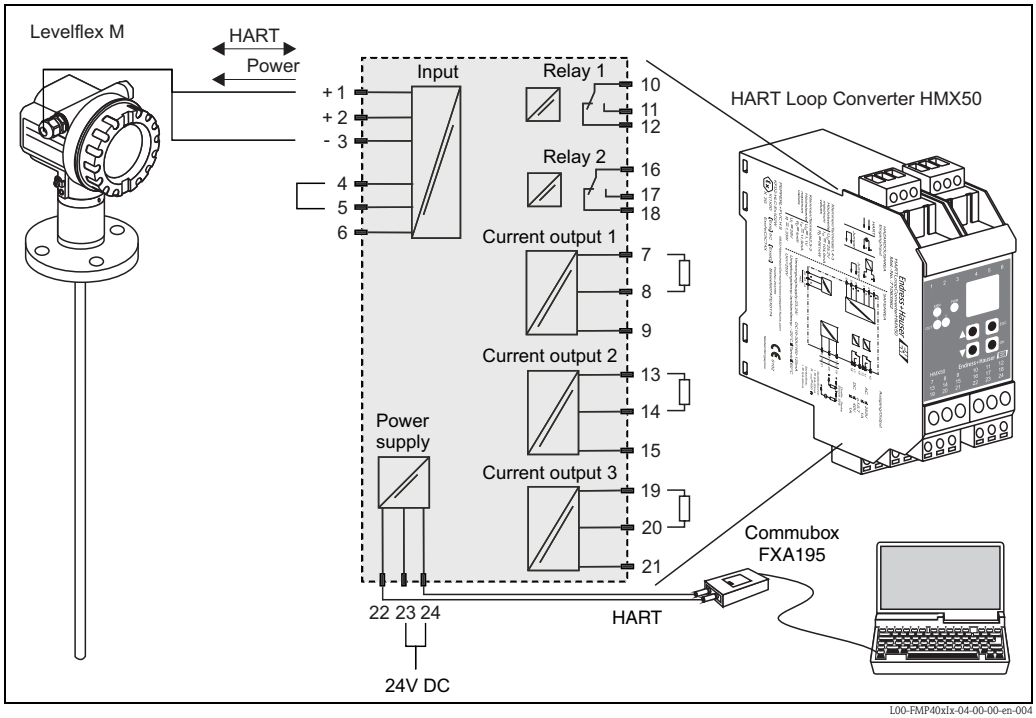
3.4.1 Electronics

The process variables are output using the dynamic variables of the HART protocol. The process variables can be flexibly assigned to the dynamic variables (primary, secondary, tertiary, quaternary value).

Dynamic variables of the HART protocol	Possible process variable assignment	Comment
Primary value (PV)	■ **Interface** (default) ■ Total level ■ Thickness of the upper medium (upper phase)	The "primary value" is permanently assigned to the 4 to 20 mA current output
Secondary value (SV)	■ **Total level** (default) ■ Interface ■ Thickness of the upper medium (upper phase)	—
Tertiary value (TV)	■ **Thickness of the upper medium (upper phase)** (default) ■ Interface ■ Total level ■ Amplitude of the total level signal	—
Quaternary (4th) value (QV)	Amplitude of the interface level signal	No variable assignment

3.4.2 Using the HART loop converter HMX50

The dynamic variables of the HART protocol can be converted into individual 4 to 20 mA sections using the HART loop converter HMX50. The variables are assigned to the current output and the measuring ranges to the individual parameters in the HMX50.



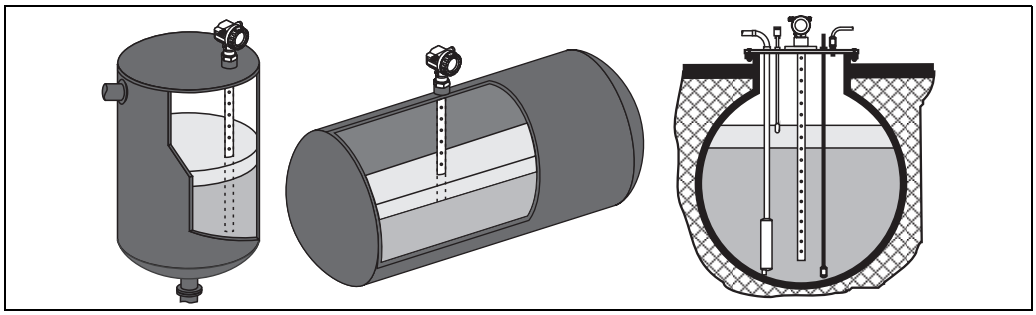
Connection diagram for HART loop converter HMX50
(example: passive 2-wire device and current outputs connected as power source)

The HART loop converter HMX50 can be acquired using the order number 71063562.
Additional documentation: TI00429F/00/EN and BA00371F/00/EN.

3.5 Special information on interface measurement

Installation in horizontal cylindrical, upright and underground tanks

- Use coax probes or rod probes in the bypass/stilling well. A segmented probe is available as a special version for longer measuring ranges.
- Any distance from the wall is possible for coax probes or rod probes in the stilling well. In the case of rod probes, it must be ensured that the probe does not come into contact with the wall.



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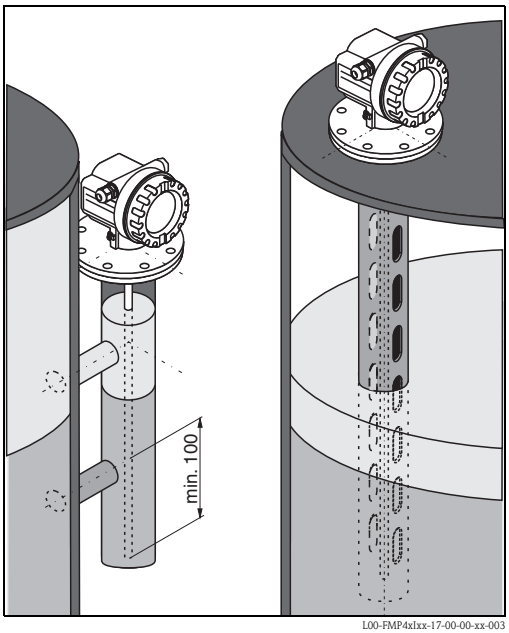
Installation in stilling well or bypass

- A rod probe can be used for pipe diameters bigger than 40 mm.
- Rod probe installation can take place up to a diameter size of 100 mm. In the event of larger diameters, a coax probe is recommended.
- Welded joints that protrude up to approx. 5 mm inwards do not affect the measurement.
- The pipe may not exhibit any steps in diameter.
- If a rod probe is used, the probe length must be 100 mm longer than the lower disposal.
- In the case of rod probes, it must be ensured that the probe does not come into contact with the wall. If necessary, use a centering disk at the end of the probe.



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Note!
A plastic centering disk has to be used for interface measurement (→ 📄 58, "Centering disks").

Note!
Rope and rod probes can only be freely installed in the tank under certain circumstances – please contact your Endress+Hauser office.

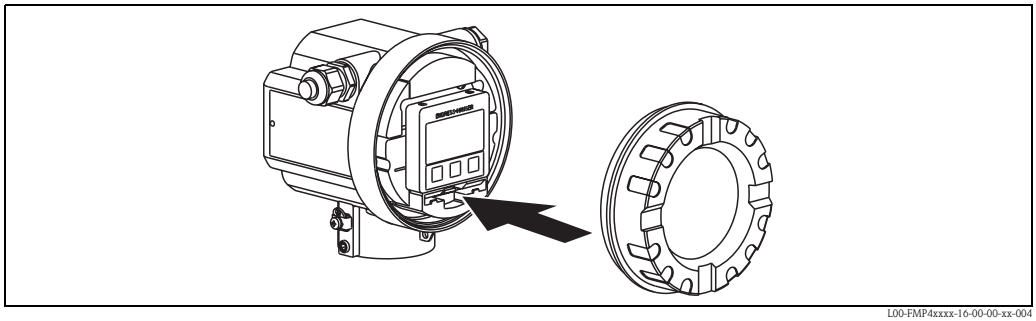
3.6 Installation instructions

3.6.1 Mounting kit

In addition to the tool needed for flange mounting, you will require the following tool:
- For mounting adapters: 60 mm open-end spanner for 1½".
- A 4 mm Allen key for turning the housing.

3.6.2 Shortening probes

Note!
When shortening the probe: Enter the new length of probe into the Quick Setup which can be found in the electronics housing under the display module.



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Rod probes

It is necessary to shorten a rod probe if the distance to the tank floor or outlet cone is less than 50 mm. The rods of a rod probe are shortened by sawing or separating at the bottom end.

Coax probes

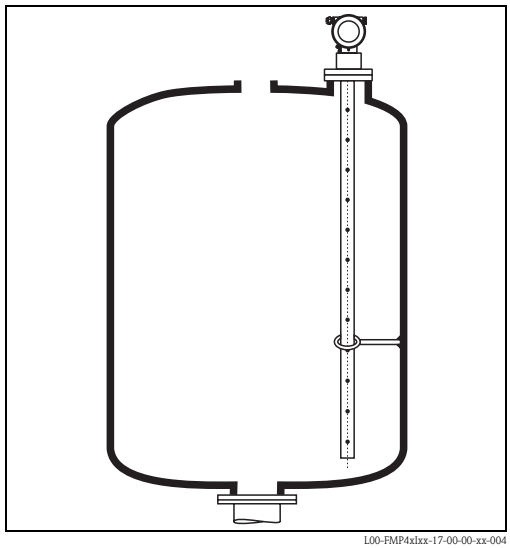
It is necessary to shorten a coax probe if the distance to the tank floor or outlet cone is less than 10 mm. Coax probes can be shortened a maximum of 80 mm from the end. They have centering units inside which fix the rod centrally in the pipe. The centerings are held on the rod by flanges. Shortening is possible up to approx. 10 mm below the centering.

Note!
Seal for devices with G1½" adapter
Sealing form at the FMP45 corresponds the DIN 3852 Part1, screwed end form A. The screwed end has an overall length of 45 mm. In addition, suitable sealing ring as per DIN 7603 with dimensions 48x55 mm. Please use a sealing ring according to this standard in the form A, C or D and of a material that is resistant to the application.

3.6.3 Supporting probes against warping

For GL/ABS approval:
A support is required for probe lengths ≥ 3 m, (see drawing).

Coax probes



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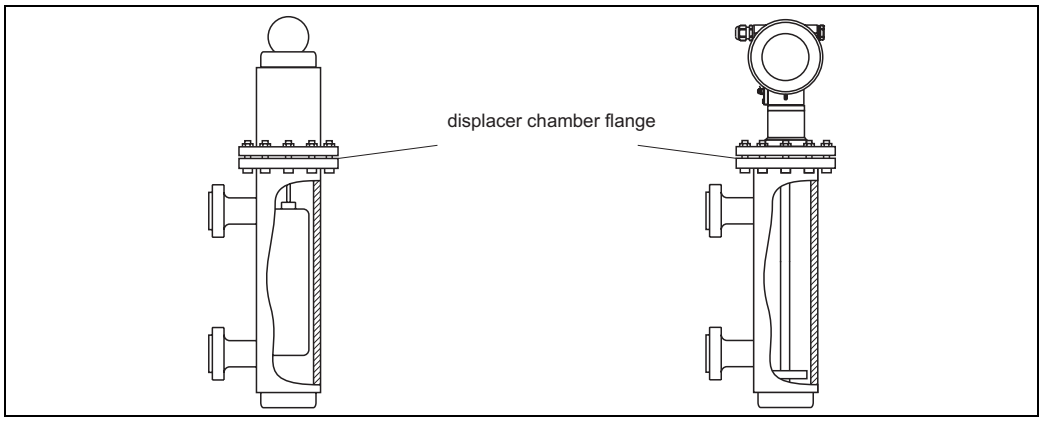
3.6.4 Replacing a displacement system in an existing displacer chamber

The Levelflex M is a perfect replacement for a conventional displacer system in an existing displacer chamber. In addition to the DIN and ANSI flanges, which are available as standard, Endress+Hauser also offers flanges that suit Fischer and Masoneilan displacer chamber (special product) for this purpose. Thanks to menu-guided local operation, commissioning the Levelflex M only takes a few minutes. Replacement is also possible when partially filled, and wet calibration is not required.

Your benefits:
- No moving parts, thus zero-maintenance operation.
- Not sensitive to process influences such as temperature, density, turbulence and vibrations.
- The rod probes can be shortened or replaced easily. In this way, the probe can be easily adjusted on site.



L00-FMP4xlxx-17-00-00-en-002

Planning instructions:
- In normal cases, use a rod probe. When installing into a metal displacement housing up to 150 mm (100 mm for interface), you have all the advantages of a coax probe.
- It must be ensured that the probe does not come into contact with the side wall. Where necessary, use a centering disk at the lower end of the probe ("Ordering structure", s. Seite 6).
- A centering disk must be adapted as accurately as possible to the internal diameter of the displacer chamber to also ensure perfect operation in the area of the probe end.

Additional information on interface measurement

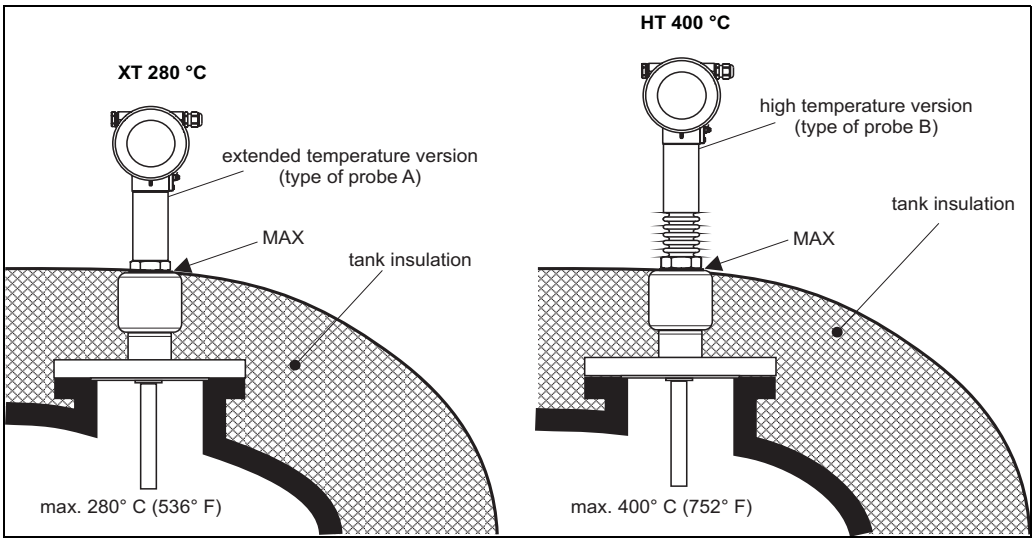
- The pipe may not exhibit any steps in diameter. Use the coax probe where necessary.
- In the case of rod probes, it must be ensured that the probe does not come into contact with the wall. If necessary, use a centering disk at the end of the probe.

Note!
A plastic centering disk has to be used for interface measurement ("Accessories", → 58).

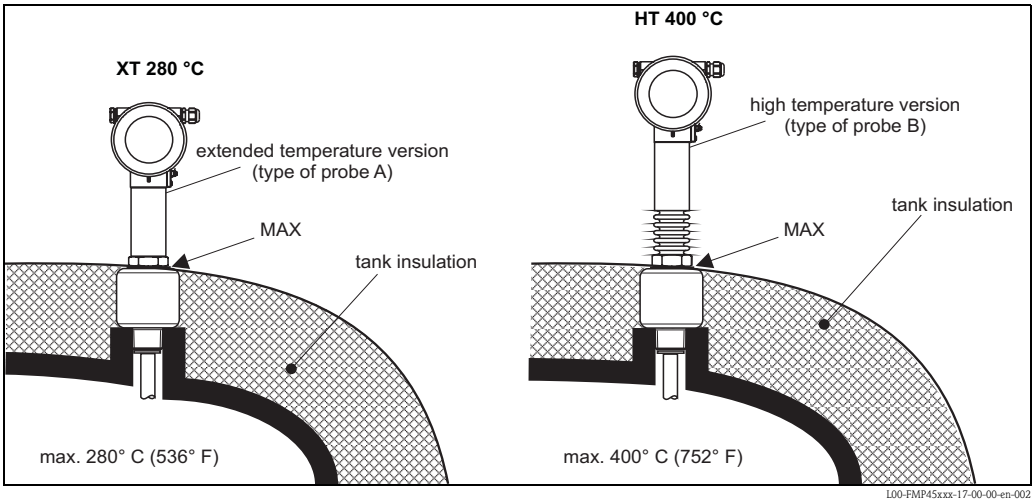
3.6.5 Installing with heat insulation

- If process temperatures are high (≥ 200 °C), FMP45 must be included in normal tank insulation to prevent the electronics heating up as a result of thermal radiation or convection.
- The insulation may not go beyond the points labeled "**MAX**" in the drawings.

Process connection with flange DN50 to DN100



Process connection with G1½" and 1½"NPT adapter



Note!
For saturated steam applications with FMP45 XT the process temperature should not exceed 200 °C (392 °F). For higher process temperatures use the HT version.

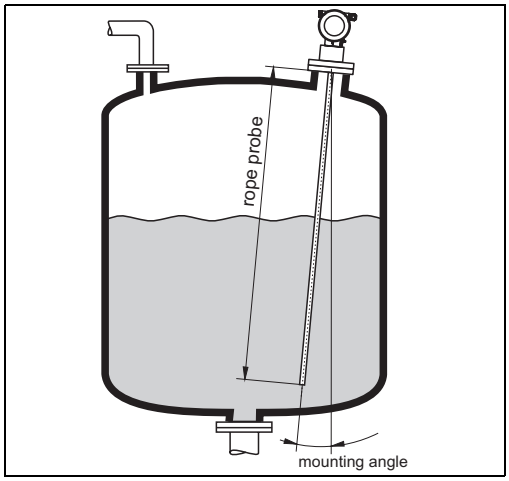
3.6.6 Notes on special mounting situations

Welding the probe into the vessel

Caution!
Before welding the probe into the vessel, it must be grounded by a low-resistive connection. If this is not possible, the electronics as well as the HF module must be removed. Otherwise the electronics may be damaged.

Installation at an angle

- For mechanical reasons, rod probes should be installed as vertically as possible.
- If installing at an angle, the probe length must be limited, depending on the angle of installation.
  – Up to 1 m = 30°
  – Up to 2 m = 10°
  – Up to 4 m = 5°

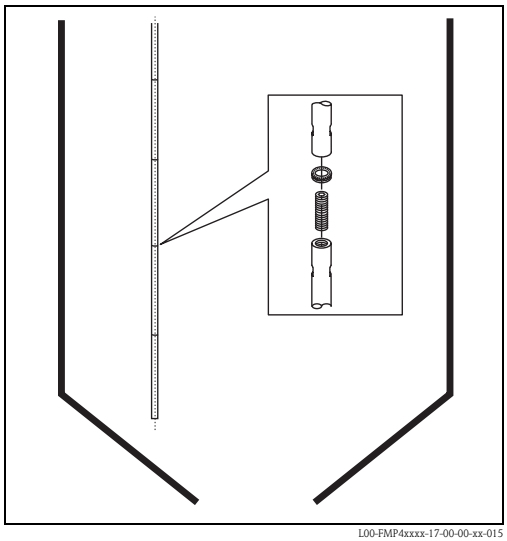


L00-FMP4xlxx-17-00-00-en-048

Separable probes

If there is little mounting space (distance to the ceiling), it is advisable to use separable rod probes (∅16 mm).

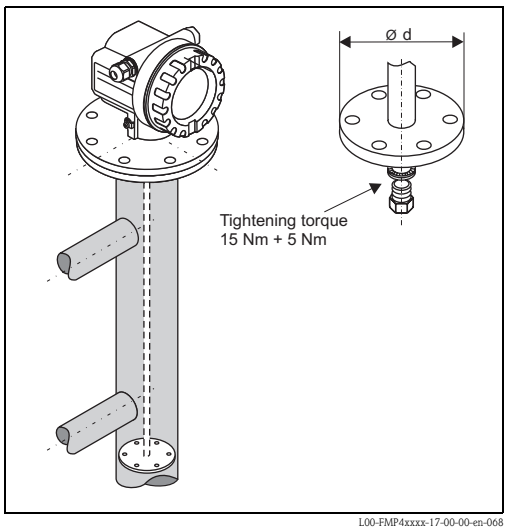
- max. probe length 10 m (394 in)
- max. sideways capacity 20 Nm
- probes are separable several times with the lengths:
  – 500 mm (19.68 in)
  – 1000 mm (39.37 in)
- torque: 15 Nm


L00-FMP4xxxx-17-00-00-xx-015

Centering of probe end

If the centering disk is mounted at the end of the probe end, it enables a reliable measuring.
See "Ordering structure", → 🖹 6.

- Centering disk for rod probes:
  – d = 45 mm (DN50 (2"))
  – d = 75 mm (DN80 (3") + DN100 (4"))

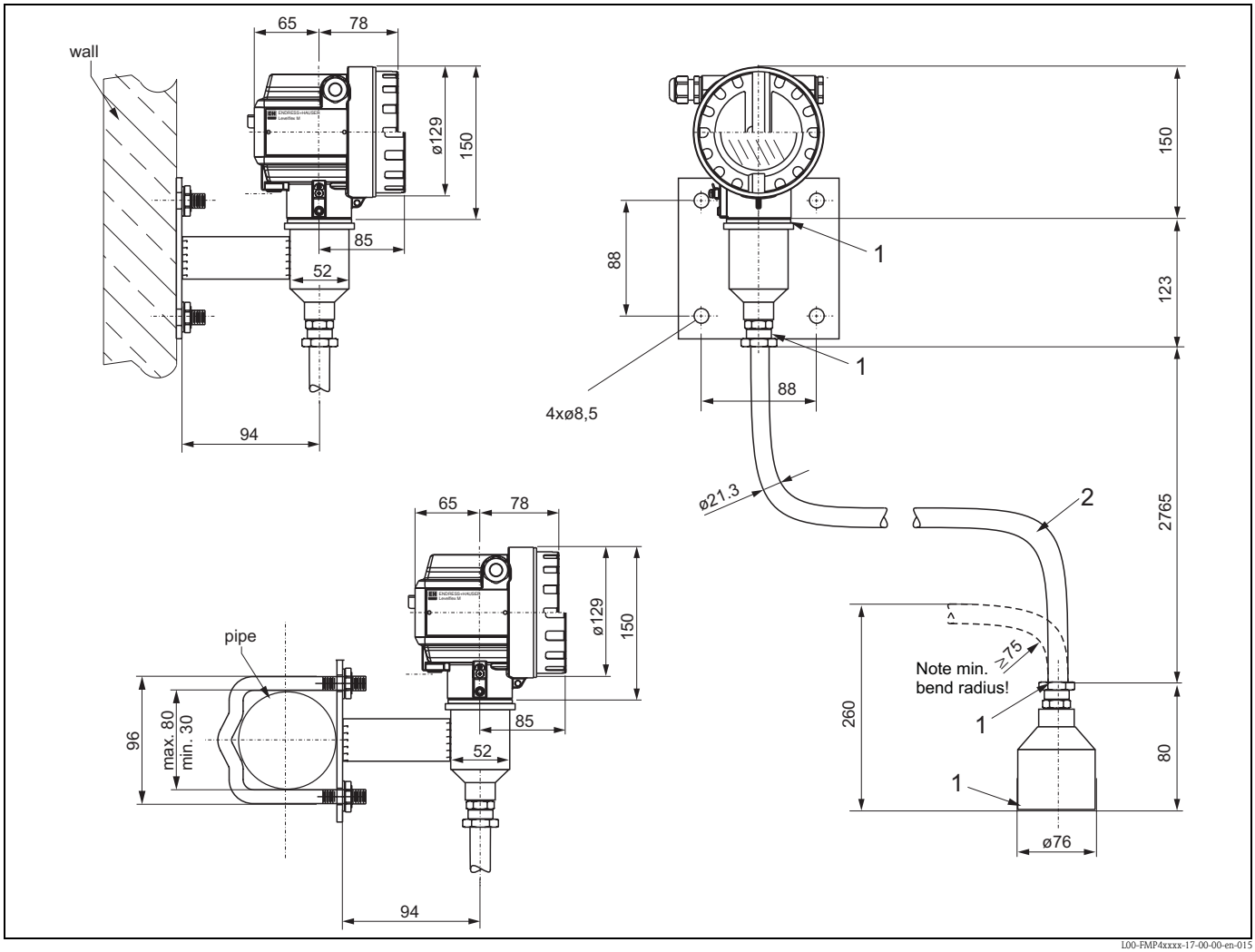


L00-FMP4xxxx-17-00-00-en-068

3.6.7 Installation with hard-to-reach process connections

Installation with remote electronics

- Wall and pipe bracket ist contained in the scope of delivery and is already mounted.
- When installing, please observe the instructions on Seite 18.
- Mount housing on a wall or pipe (vertically or horizontally) as shown in the diagram.



L00-FMP4xxxx-17-00-00-en-015

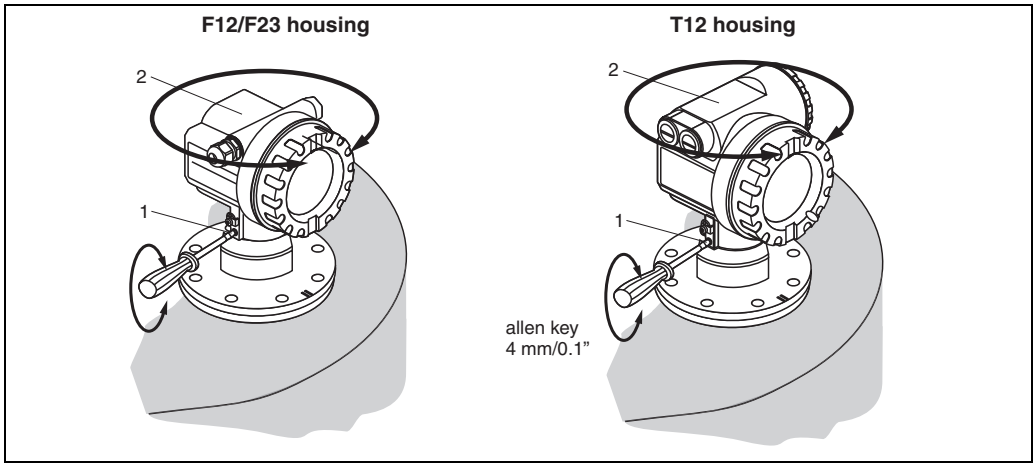
Note!
The protective hose cannot be disassembled at these points (1).

The ambient temperature for the connecting pipe (2) between the probe and the electronics must not exceed 105°C. For the remote electronics, temperatures up to 280 °C or 400 °C (depending on the device version) are admissible at the process connection. The version with remote electronics consists of the probe, a connecting cable and the housing. If they are ordered as a complete unit they are assembled when delivered.

3.6.8 Turning the housing

After mounting, you can turn the housing 350° in order make it easier to access the display and the connection compartment. Proceed as follows to turn the housing to the required position:

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



3.7 Post-installation check

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

- Is the measuring device damaged (visual inspection)?
- Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, measuring range, etc.?
- Are the measuring point number and labeling correct (visual inspection)?
- Is the measuring device adequately protected against rain and direct sunlight (s. Seite 56 ff.)?

4 Wiring

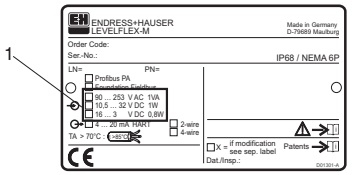
4.1 Quick wiring guide

Wiring in F12/F23 housing

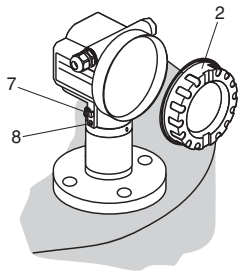
Caution!

Before connection please note the following:

- The power supply must be identical to the data on the nameplate (1).
- Switch off power supply before connecting up the device.
- Connect Equipotential bonding to transmitter ground terminal (7) before connecting up the device.
- Tighten the locking screw (8): It forms the connection between the probe and the housing ground potential.



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



EX

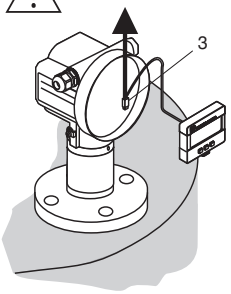
On devices supplied with a certificate, the explosion protection is designed as follows:

- Housing F12/F23 - Ex ia: Power supply must be intrinsically safe (not for dust-Ex).
- The electronics and the current output are galvanically separated from the probe circuit.

Connect up the Levelflex M as follows:

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

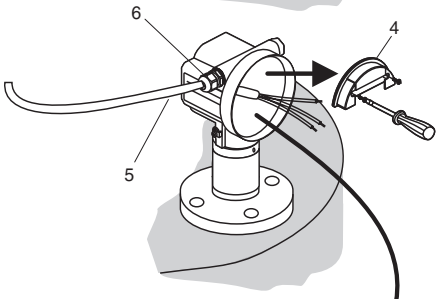
Unplug display connector!

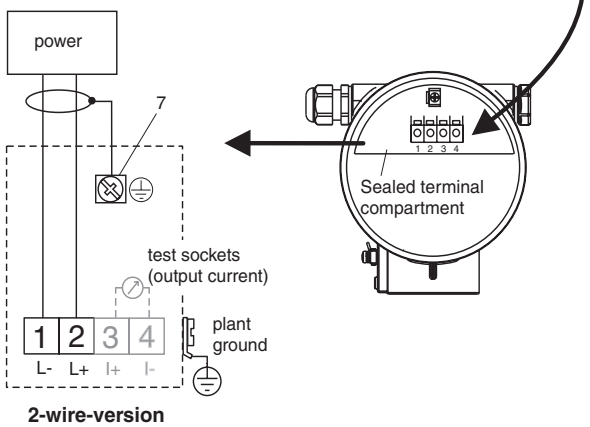


EX

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

- Make connection (see pin assignment).
- Re-insert terminal module.
- Tighten cable gland (6). Max. torque 10...12 Nm!
- Tighten screws on cover plate (4).
- Insert display if fitted.
- Screw on housing cover (2). (on dust-Ex torque ≈ 40 Nm).
- Switch on power supply.





2-wire-version

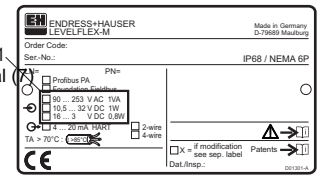
L00-FMP41Clx-04-00-00-en-001

Wiring in T12 housing

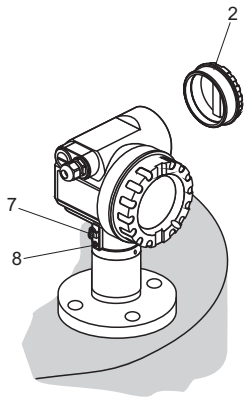
Caution!

Before connection please note the following:

- The power supply must be identical to the data on the nameplate (1).
- Switch off power supply before connecting up the device.
- Connect Equipotential bonding to transmitter ground terminal (7) before connecting up the device.
- Tigthen the locking screw (8):
  It forms the connection between the probe and the housing ground potential.



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



Connect up the Levelflex M as follows:

EX

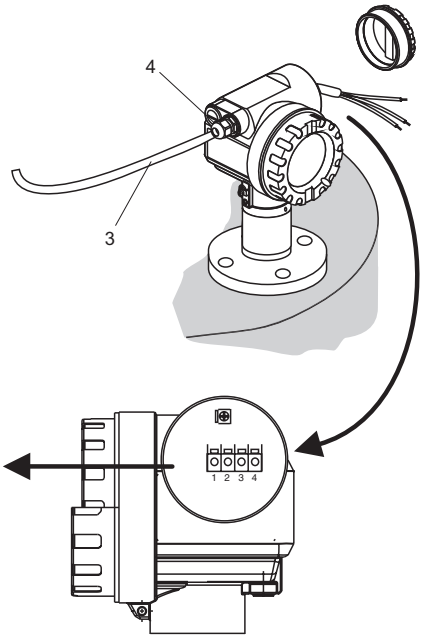
Before unscrew housing cover (2) at separate connection room turn off the power supply!

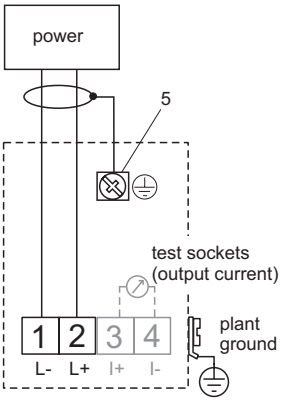
- Insert cable (3) through gland (4).
  A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).

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

EX

- Make connection (see pin assignment).
- Tighten cable gland (4).
  Max, torque 10 to 12 Nm!
- Screw on housing cover (2).
  (on dust-Ex torquet » 40 Nm)
- Switch on power supply.





2-wire-version

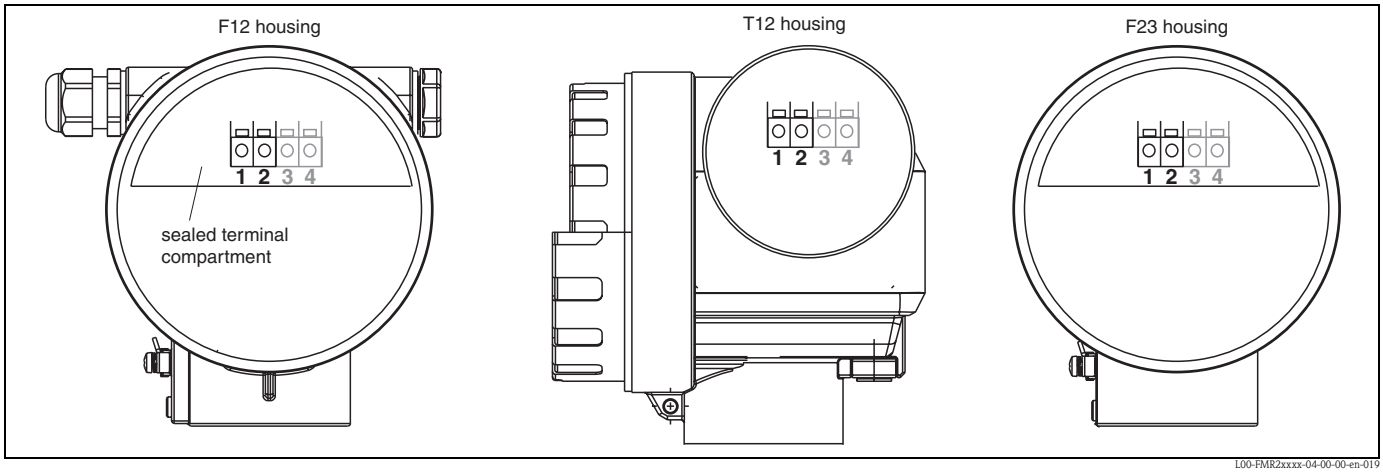
L00-FMP41Cxx-04-00-00-en-002

4.2 Connecting the measuring unit

Connection compartment

Three housing types are available:
- Aluminum housing F12 with additionally sealed connection compartment for:
  - Standard
  - Ex ia
- Aluminum housing T12 with separate connection compartment for:
  - Standard
  - Ex e
  - Ex d
  - Ex ia (with overvoltage protection)
- Stainless steel 316L (1.4435) housing F23 for:
  - Standard
  - Ex ia

After mounting, you can turn the housing 350° in order make it easier to access the display and the connection compartment.



The device data are given on the nameplate together with important information regarding the analog output and power supply. Housing rotation regarding the wiring see "Turning the housing", Seite 22.

HART load

Minimum load for HART communication: 250 Ω

Ground connection

A good ground connection has to be made to the ground terminal on the outside of the housing in order to achieve EMC immunity.

Cable gland

Type		Clamping area
Standard, Ex ia, IS	Plastic M20x1.5	5 to 10 mm
Ex em, Ex nA	Metal M20x1.5	7 to 10.5 mm

Terminals

For wire cross-sections of 0.5 to 2.5 mm^2

Cable entry

- Cable gland: M20x1.5 (only cable entry for Ex d)
- Cable entry: G½ or ½NPT

Supply voltage

HART, 2-wire

All the following values are terminal voltages directly at the device:

Communication		Current consumption	Terminal voltage
HART	standard	4 mA	16 V to 36 V
		20 mA	7.5 V to 36 V
	Ex ia	4 mA	16 V to 30 V
		20 mA	7.5 V to 30 V
	Ex em Ex d	4 mA	16 V to 30 V
		20 mA	11 V to 30 V
	Ex ic	4 mA	16 V ... 32 V
		20 mA	7,5 V ... 32 V
Fixed current, adjustable e.g. for solar power operation (measured value transferred at HART)	standard	11 mA	10 V to 36 V
	Ex ia	11 mA	10 V to 30 V
Fixed current for HART Multidrop mode	standard	4 mA[1)]	16 V to 36 V
	Ex ia	4 mA[1)]	16 V to 30 V

1) Start up current 11 mA.

HART residual ripple, 2-wire: $U_{ss} \leq 200$ mV

Current consumption

Communication	Output current	Current consumption	Power consumption
HART, 2-wire	3.6 to 22 mA[1)]	—	min. 60 mW, max. 900 mW

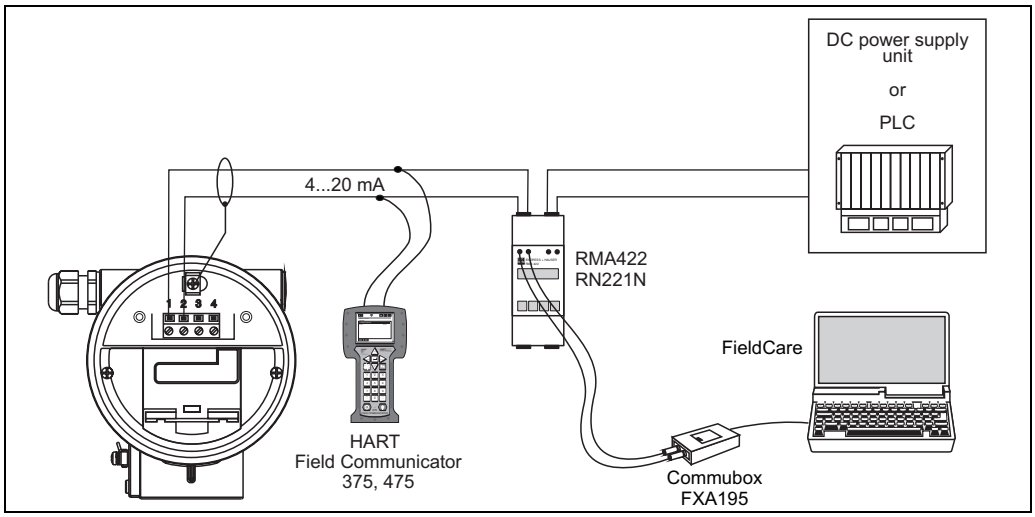
1) For HART-Multidrop: start up current is 11 mA.

Overvoltage protection

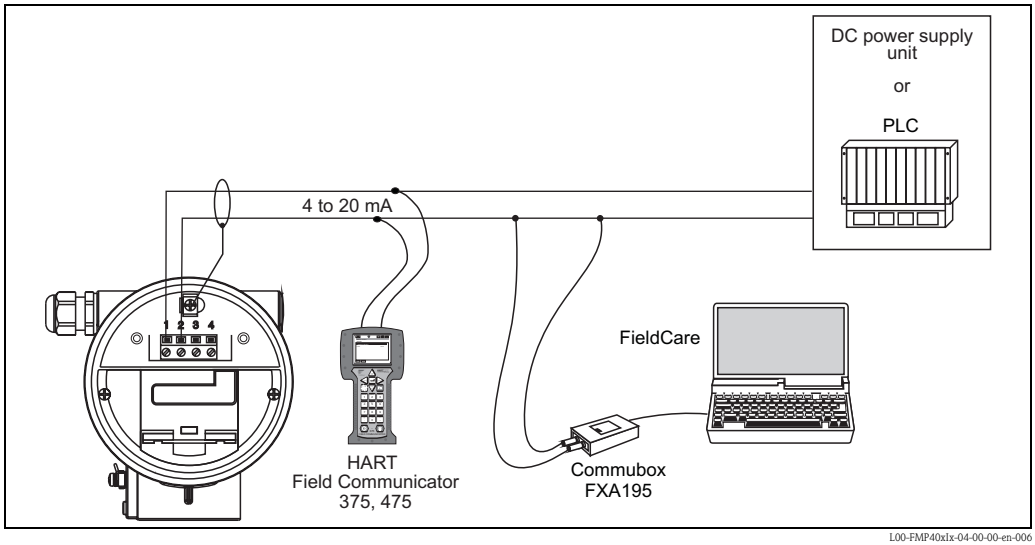
If the measuring device is used for level measurement in flammable liquids which requires the use of overvoltage protection according to EN/IEC 60079-14 or EN/IEC 60060-1 (10 kA, pulse 8/20 µs), the following applies:

- The measuring device is used with integrated overvoltage protection with 600V gas tube surge arrester in the T12 housing, refer to "Ordering structure", s. Seite 6 ff.
  or
- This protection is achieved by the use of other appropriate measures (external protection devices e.g. HAW562Z).

4.2.1 HART connection with Endress+Hauser RMA422 / RN221N



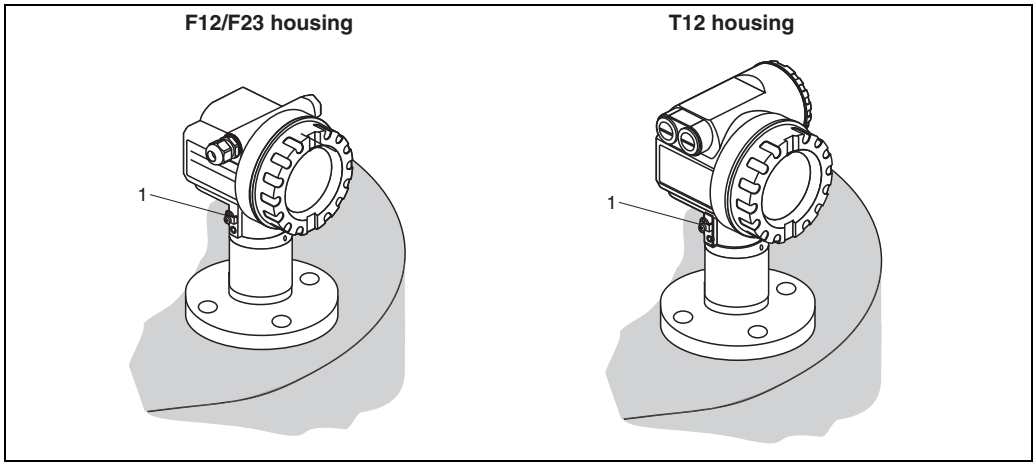
4.2.2 HART connection with other supply units



4.3 Recommended connection

4.3.1 Potential equalization

Connect the potential equalization to the external ground terminal (1) of the transmitter.



4.3.2 Wiring a shielded 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 hazardous areas (→ 75).

4.4 Degree of protection

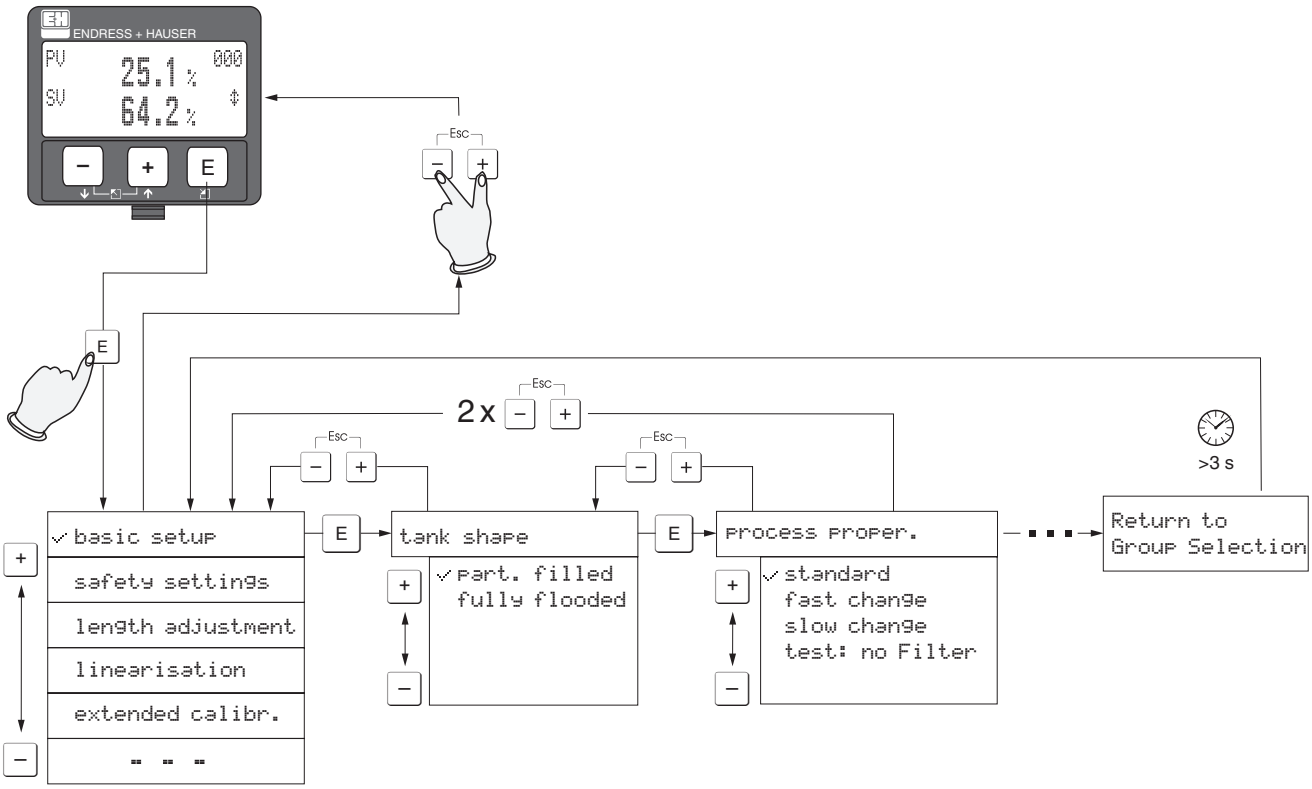
- With closed housing tested according to:
  – IP68, NEMA6P (24 h at 1.83 m under water)
  – IP66, NEMA4X
- With open housing: IP20, NEMA1 (also ingress protection of the display)

4.5 Post-connection check

After wiring the measuring device, perform the following checks:
- Is the terminal assignment correct (s. Seite 23 ff., 24)?
- Is the cable gland tight?
- Is the housing cover screwed tight?
- If power is supplied:
  Is the device ready for operation and is the liquid crystal display lit?

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 f**unction** (e.g. "tank shape (002)") is selected.

Note!
The active selection is marked by a ✔ in front of the menu text.

3.) Activate Edit mode with + or −.

Selection menus:

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

L00-FMP4xIxx-19-00-00-en-002

5.1.1 General structure of the operating menu

The operating menu is made up of two levels:

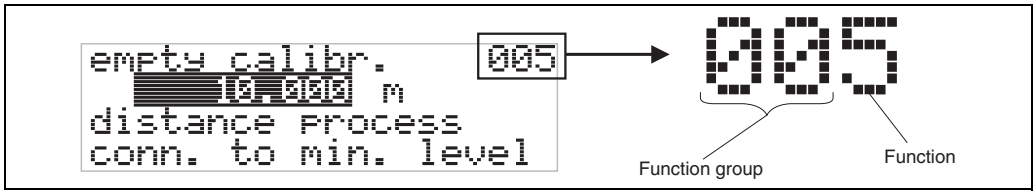
- **Function groups (00, 01, 03, …, 0C, 0D):**
  The individual operating options of the device are split up roughly into different function groups. The function groups that are available include: "**Basic Setup**", "**Safety Settings**", "**Output**", "**Display**", etc.
- **Functions (001, 002, 003, …, 0D8, 0D9):**
  Each function group consists of one or more functions. The functions perform the actual operation or configuration of the device. Numerical values can be entered here and parameters can be selected and saved. The functions available for the "**Basic Setup**" **(00)** function group include: "**Tank Properties**" **(002)**, "**Process Cond.**" **(004)**, "**Empty Calibr.**" **(005)**, etc.

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

1. Select the "**Basic Setup**" **(00)** function group.
2. Select the "**Tank Properties**" **(002)** function (where the tank level is selected).

5.1.2 Identifying the functions

For simple orientation within the function menus, for each function a position is shown on the display.



The first two digits identify the function group:

- **Basic setup** **00**
- **Safety Settings** **01**
- **Length Adjustment** **02**

...

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

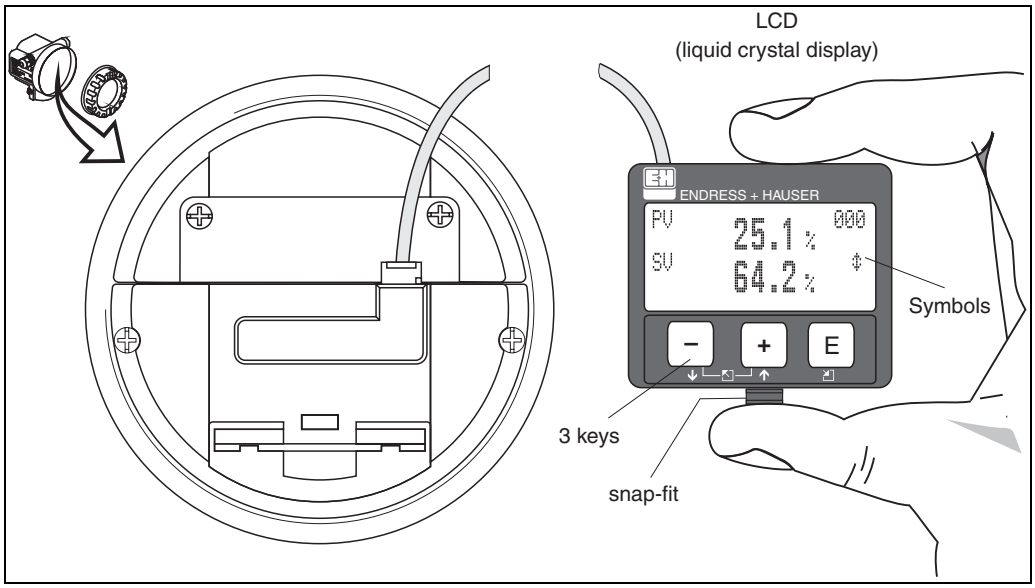
- **Basic setup** **00** → - **Tank Properties** **002**
  - **Process Properties** **004**
  ...

In the following section, the position is always indicated in brackets (e.g. "**Tank Properties**" **(002)**) after the function described.

5.2 Display and operating elements

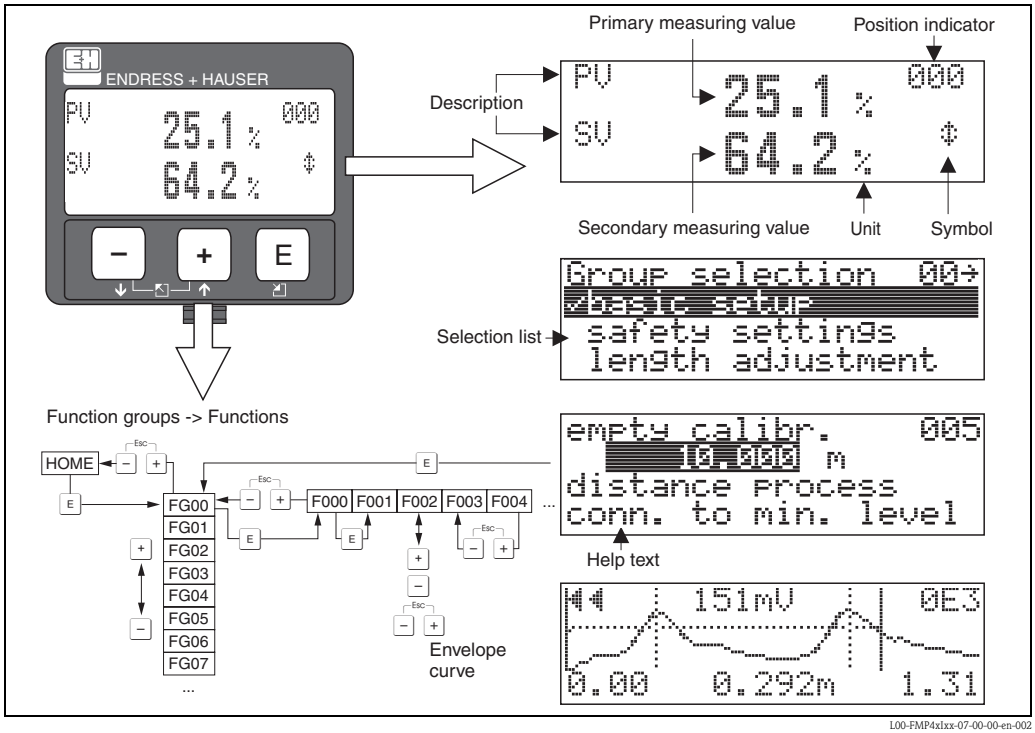
5.2.1 Liquid crystal display (LCD)

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



The VU331 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.

5.2.2 Display



5.2.3 Display symbols

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

Symbol	Meaning
	**ALARM_SYMBOL** This alarm symbol appears when the device is in an alarm condition. 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, PROFIBUS PA or FOUNDATION Fieldbus is in progress.

5.2.4 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 picklist. Edit the numeric values within a function.
− or ↓	Navigate downwards in the picklist. Edit the numeric values within a function.
Esc − + or ←	Navigate to the left within a function group.
E	Navigate to the right within a function group, confirmation.
+ and E or − and E	Contrast settings of the LCD.
+ and − and E	Hardware locking/unlocking Following hardware locking, it is not possible to operate the device via the display or communication! Unlocking can only be performed via the display. A release code must be entered to do so.

5.3 Local operation

5.3.1 Locking of the configuration mode

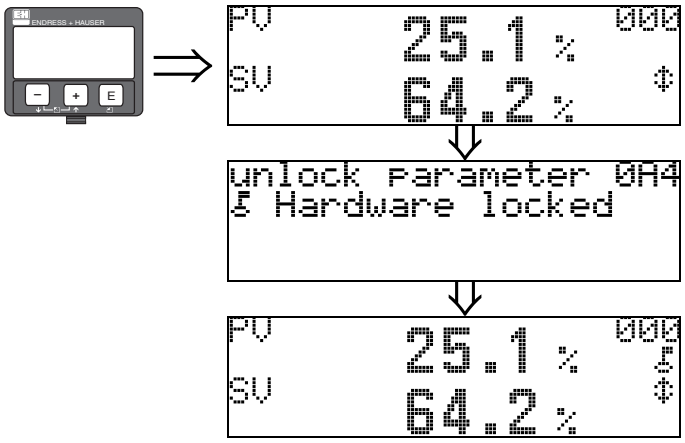
The Levelflex can be protected in two ways against unauthorized changing of device data, numerical values or factory settings:

Function "Unlock Parameter" (0A4):

A value **<>100** (e.g. 99) must be entered in the **in the "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 locking:

The device is locked by pressing the [+], [−] and [E] 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 [E] keys at the same time again. It is **not** possible to unlock the hardware by communication here. All parameters can be displayed even if the device is locked.



Press [+], [−] and [E] simultaneously

The LOCK_SYMBOL appears on the LCD

5.3.2 Unlocking the 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):

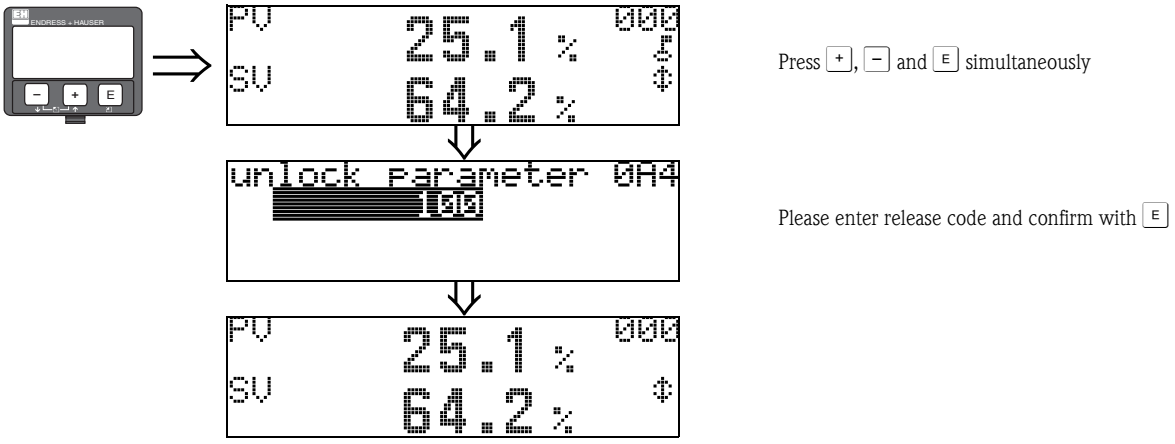
The Levelflex is released for operation by entering the release code (on the display or via communication)

100 = for HART devices

Hardware unlocking:

After pressing the [+], [−] and [E] keys at the same time, the user is asked to enter the release code

100 = for HART devices



Press [+], [−] and [E] simultaneously

Please enter release code and confirm with [E]

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

5.3.3 Factory settings (reset)

Caution!
A reset sets the device back to the factory settings. This can lead to an impairment of the measurement. Generally, you should perform 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

333 = reset customer parameters

This reset is recommended whenever a device with an unknown "history" is to be used in an application:
- The Levelflex is reset to the default values.
- **Customer-specific interference echo suppression is not deleted.**
- The mapping can be deleted in the "Cust. Tank Map" (**055**) function of the "Extended Calibr" (**05**) function group.
- A linearization is switched to "**Linear**" although the table values are retained. The table can be reactivated in the "**Linearization**" **(04)** function group.

List of functions that are affected by a reset:

- Tank Properties (002)
- Medium Propert. (003)
- Process Proper. (004)
- Empty Calibr. (005)
- Full Calibr. (006)
- Installation (007)
- Outp. on Alarm (010)
- Outp. on Alarm (011)
- Outp. Echo Loss (012)
- Delay Time (014)
- Safety Distance. (015)
- In Safety Dist. (016)
- Probe (032)
- PV Assignment (035)
- SV Assignment (036)
- TV Assignment (037)
- Level/Ullage (040)
- Linearization (041)
- Customer Unit (042)
- Max. Scale (046)
- Diameter Vessel (047)
- Range of Mapping (052)
- Start Mapping (053)
- Offset (057)
- Output Damping (058)
- Low Output Limit (062)
- Current Output Mode (063)
- Fixed Curr. Value (064)
- 4mA Value (068)
- Language (092)
- Back to Home (093)
- Format Display (094)
- No of Decimals (095)
- Sep. Character (096)
- Display Layout (098)
- Unlock Parameter (0A4)
- Application Param. (0A8)
- Medium Propert. 2 (018)

- The mapping can be deleted in the **"Cust. Tank Map" (055)** function of the **"Extended Calibr" (05)** function group.
- A complete "**Basic Setup**" **(00)** must be performed.

5.4 Displaying and acknowledging error messages

Type of error

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

The measuring system distinguishes between the following types of error:

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

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, Seite 62.

- The "**Diagnostics**" **(0A)** function group can display the current error as well as the last error that occurred.
- If several errors are pending, use [+] or [−] to scroll through the error messages.
- The last error to occur can be deleted in the "**Diagnostics**" **(0A)** function group "**Clear Last. Error**" **(0A2)** function.

5.5 HART communication

Apart from local operation, you can also configure the measuring device and view measured values by means of the HART protocol. There are two options available for operation:
- Operation via the Field Communicator 375, 475.
- Operation via the personal computer (PC) using an operating program (e.g. FieldCare: for connection, s. Seite 27 ff.).

5.5.1 Operation with the Field Communicator 375, 475

With the Field Communicator 375, 475 handheld terminal, you can configure all the device functions via menu operation.

Note!
Further information on the HART handheld terminal is given in the appropriate Operating Instructions included in the carrying case of the Field Communicator 375, 475.

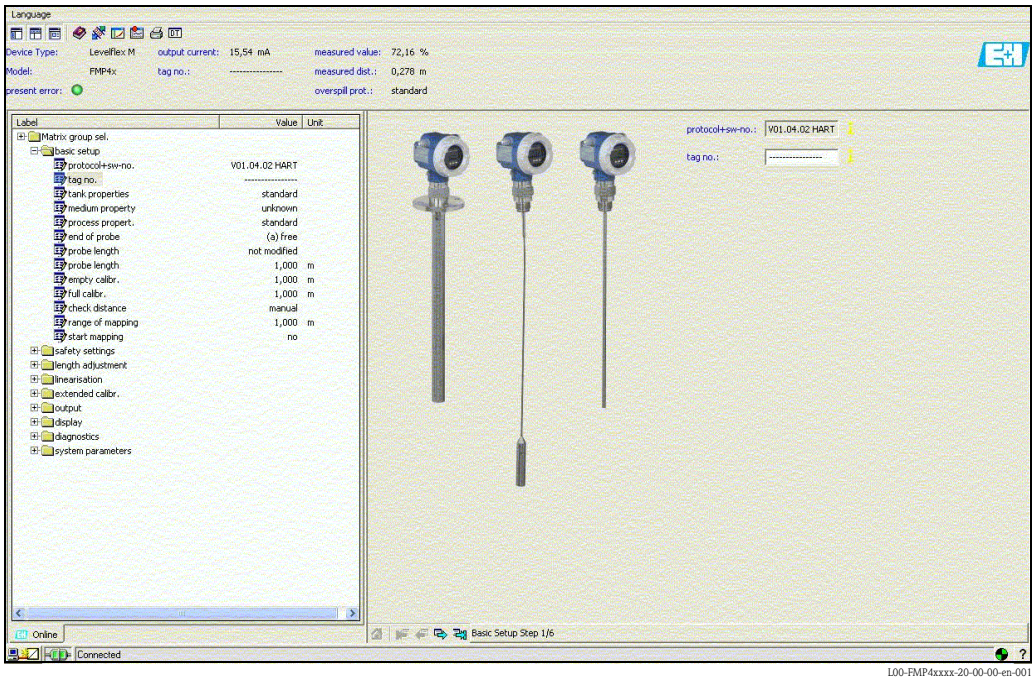
5.5.2 Endress+Hauser operating program

The operating program FieldCare is an Endress+Hauser Plant Asset Management Tool based on FDT technology. You can use Field-Care to configure all your 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:
- Online configuration of transmitters
- Signal analysis via envelope curve
- Tank linearization
- Loading and saving of device data (upload/download)
- Documentation of the measuring point

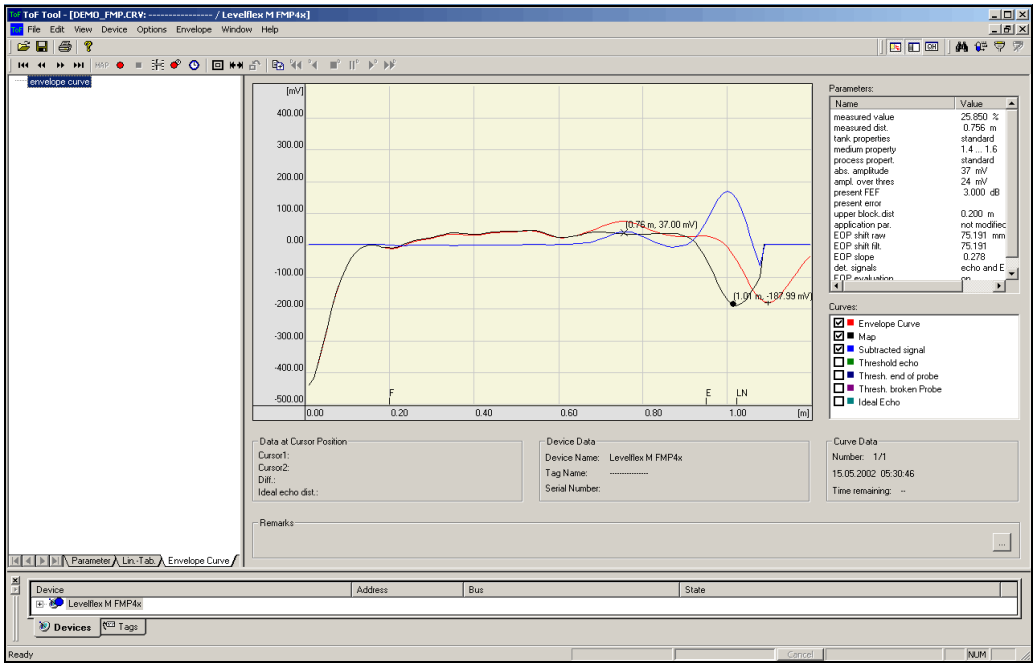
Connection options:
- HART via Commubox FXA195 and the USB port of a computer
- Commubox FXA291 with ToF Adapter FXA291 via service interface

Menu-guided commissioning



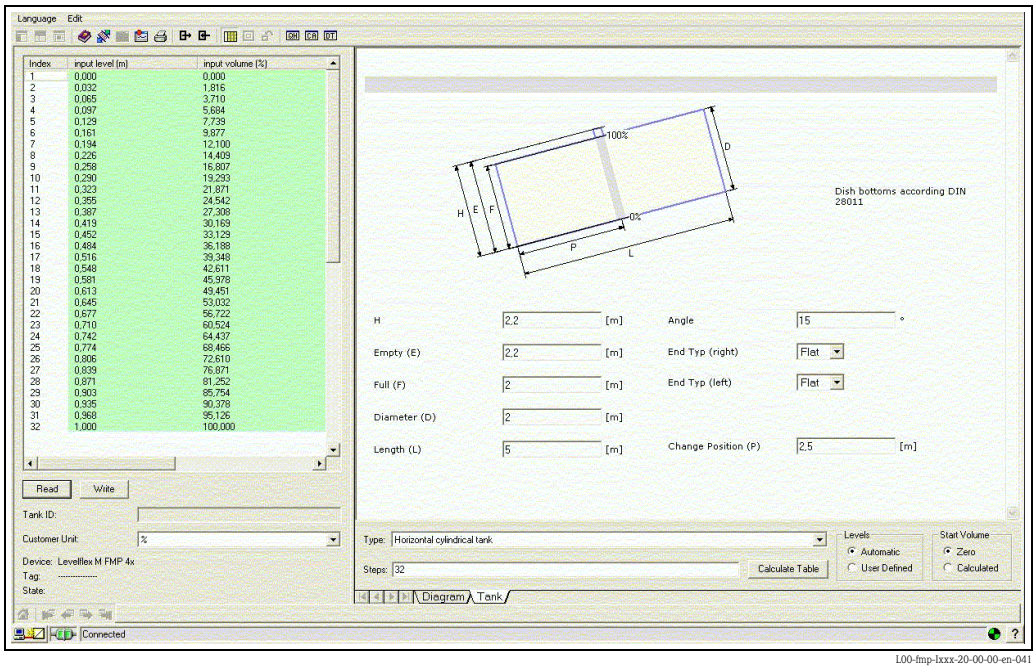
L00-FMP4xxxx-20-00-00-en-001

Signal analysis via envelope curve



L00-FMP4xxxx-20-00-00-en-007

Tank linearization



L00-fmp-lxxx-20-00-00-en-041

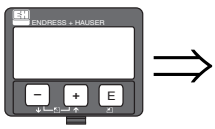
6 Commissioning

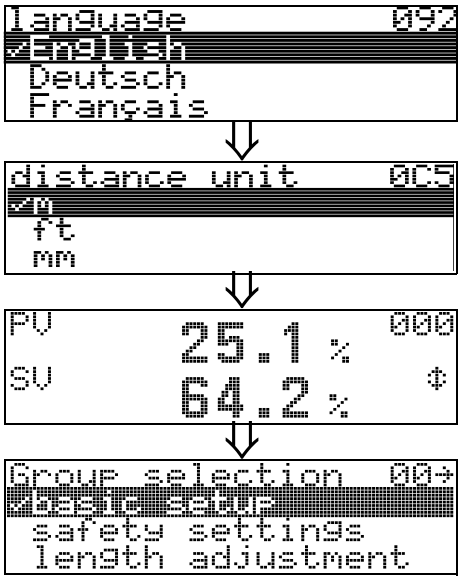
6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist "Post-installation check", → 22.
- Checklist "Post-connection check", → 28.

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 protocoll and language selection.





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

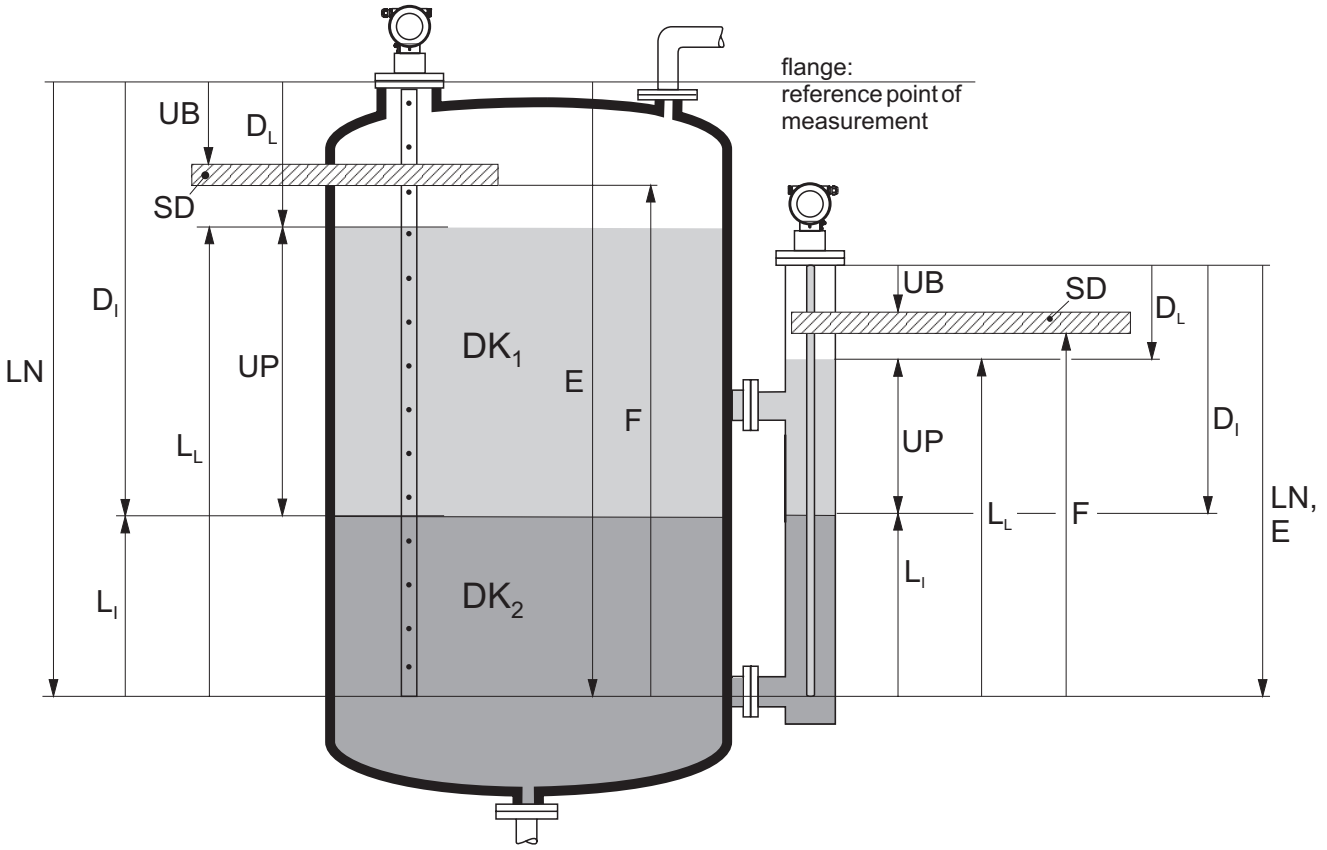
Select the basic unit
(this message appears the first time the device is switched on)

The current measured values PV (interface layer) and SV (level) are displayed in the standard settings

After E is pressed, you reach the group selection

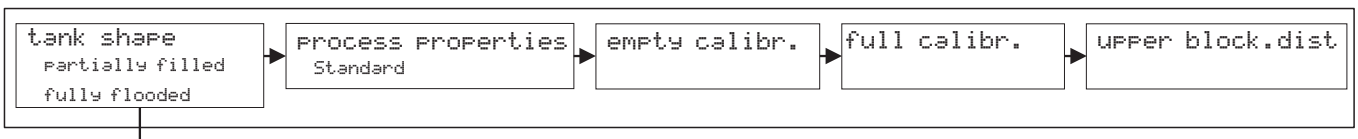
This selection enables you to perform the basic setup

6.3 Basic setup

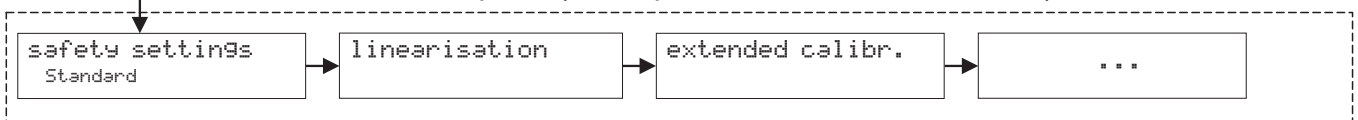


E = empty calibr. (= zero) - setting in 005
F = full calibr. (= span) - setting in 006
D_I = distance interface (distance flange / DK_2) - display in 0A6
L_I = level interface (distance probe end / DK_1) - display in 0A5
D_L = distance complete level - display in 0A5
L_L = level complete - display in 0A6
LN = probe length - setting in 033
UB = upper blocking distance - setting in 059
UP = thickness upper medium
SD = safety distance - setting in 015

basic setup (standard)



option (description see BA00366F/00/EN)



L00-FMP4xlxx-19-00-00-en-001

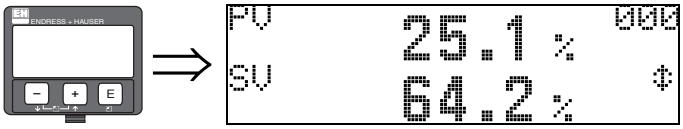
Caution!
The basic setup is sufficient for successful commissioning in most applications.
The Levelflex is precalibrated at the factory to the probe length ordered so that in most cases only the application parameters that automatically adapt the device to the measuring conditions need to be entered. For models with a current output, the factory adjustment for zero point "E" and span "F" is 4 mA and 20 mA. For digital outputs and the display module, the factory adjustment for zero point "E" and span "F" is 0 % and 100 %.
A linearization function with a maximum of 32 points, which is based on a table entered manually or semi-automatically, can be activated on site or via remote operation. This function makes it possible to convert the level to volume and mass units and has a uniform effect on the interface and the total level.
Complex measuring operations necessitate additional functions that the user can use to customize the Levelflex as necessary to suit his specific requirements. The functions available to do this are described in detail in BA00366F/00/EN.

Comply with the following instructions when configuring the functions in the "**Basic Setup**" **(00)**:
- Select the functions as described, Seite 29.
- Certain functions (e.g. starting an interference echo mapping (053)) prompt you to confirm your data entries. Press [+] or [−] to select "**YES**" and press [E] to confirm. The function is now started.
- If you do not press a key during a configurable time period (→ function group "**Display (09)**") an automatic return is made to the home position (measured value display).

Note!
- The device continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the envelope curve mode is active on the display, the measured values are updated in a slower cycle time. Thus, it is advisable to leave the envelope curve mode after the measuring point has been optimized.
- If the power supply fails, all preset and configured values remain safely stored in the EEPROM.
- All functions are described in detail, as is the overview of the operating menu itself, in **"BA00366F - Description of Instrument Functions"** on the enclosed CD-ROM.

6.4 Basic Setup with the VU331

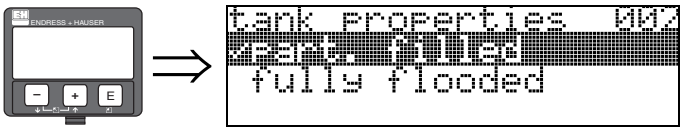
Function "Measured Value" (000)



This function displays the current measured value in the selected unit (see "**Customer Unit**" **(042)** function). The number of digits after the decimal point can be selected in the "**No. of Decimals.**" **(095)** function.
The standard settings for PV and SV assignment are as follows:
PV corresponds to the interface layer; SV = total level

6.4.1 Function group "Basic Setup" (00)

Function "Tank Properties" (002)



This function is used to select the tank properties.
Depending on the settings, the system searches for one (fully flooded) echo or 2 (partially filled) echoes.

Options:
- **Partially Filled**
- Fully Flooded

Partially Filled

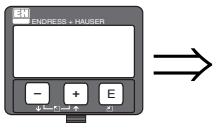
The system searches for 2 signals in the measuring range. The upper signal is assigned to the total level and the lower signal to the level of the interface layer. The difference between the two levels corresponds to the thickness of the upper medium (upper phase).

Fully Flooded

The biggest signal in the measuring range is evaluated. If the signal for the total level is within the upper blocking distance, the signal detected corresponds to the level of the interface layer. If an echo is not found, echo loss is detected.

Note!
- If "fully flooded" is selected, it is absolutely essential that the upper signal for the total level is within the upper blocking distance so that it is not evaluated incorrectly. The setting for the upper blocking distance is an integral part of the basic setup if "fully flooded" is selected.
- A change in the total level when "fully flooded" is selected impacts the accuracy.

Function "Process Propert." (004)

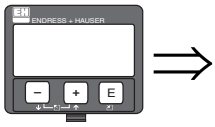


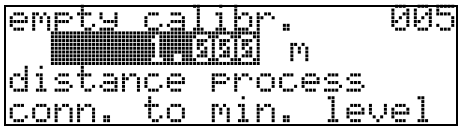
Use this function to adapt the device reaction to the filling speed in the tank. The setting influences an intelligent filter and affects the total level and interface layer level in the same way.

Options:
- **Standard**
- Fast change
- Slow change
- Test: no Filter

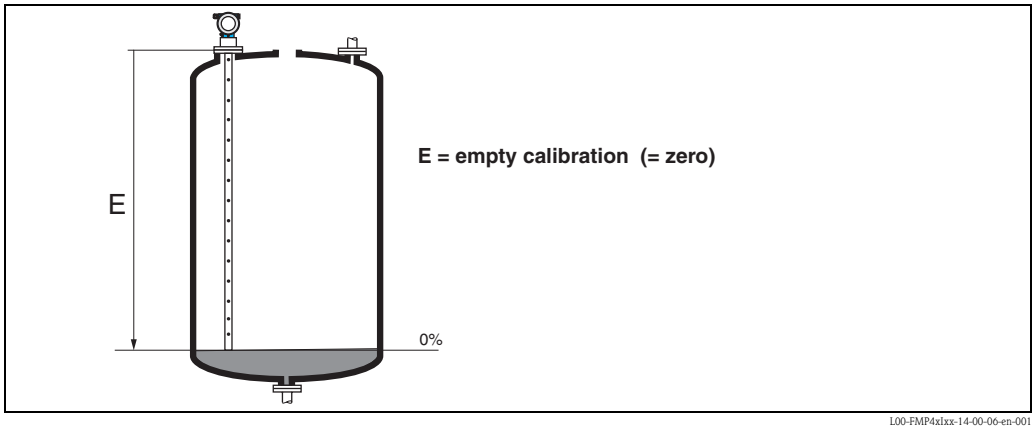
Options:	Standard	Fast Change	Slow Change	Test: No Filter
Application:	For all normal applications with low to medium filling speeds and sufficiently large tanks.	Small tanks, primarily with liquids, at high filling speeds.	Applications with slow to medium filling speeds.	Shortest reaction time: ■ For test purposes ■ Measurement in small tanks at high filling speeds, if "Fast Change" setting is too slow.
2-wire electronics:	Dead time: 4 s Rise time: 18 s	Dead time: 2 s Rise time: 5 s	Dead time: 6 s Rise time: 40 s	Dead time: 1 s Rise time: 0 s

Function "Empty Calibr." (005)



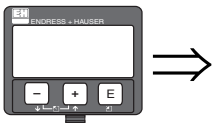


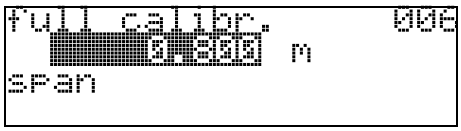
This function is used to enter the distance from the flange (reference point of the measurement) to the minimum level (= zero).



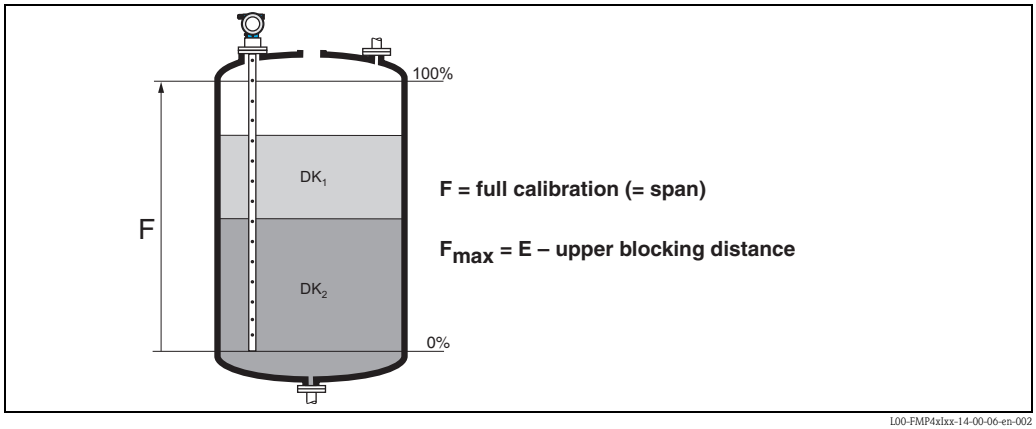
L00-FMP4xIxx-14-00-06-en-001

Function "Full Calibr." (006)





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



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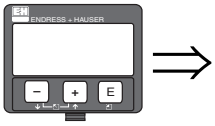
Note!
The useful measuring range is between the upper blocking distance and the probe end. The values for the empty distance "E" and span "F" can be set independently of the blocking distance.

Function "Upper Block. Dist" (059)



For rod probes with lengths of up to 8 m, the upper blocking distance is preset to 0.2 m on delivery.

Blocking distances and measuring range depending on probe type

At the lower end of the probe, accurate measuring is not possible, see section "Maximum measured error", Seite 45.

Probe type	LN [m] min	LN [m] max	UB [m] min
Rod probe in bypass	0,3	4	0,1 [1]
Rope probe in free field [2]	1	35 [3]	0.1[1]
Coax probe	0,3	4	0

1) The blocking distances indicated are preset.

2) Measurements in free field available on request.

3) Larger measuring range available on request.

Note!
Reliable measurement cannot be guaranteed within the blocking distance.

For applications in a stilling well

The upper blocking distance (UB) is preset to 100 mm if the parameter (Bypass/Pipe) is selected in the "**Tank Properties**" **(002)** function.

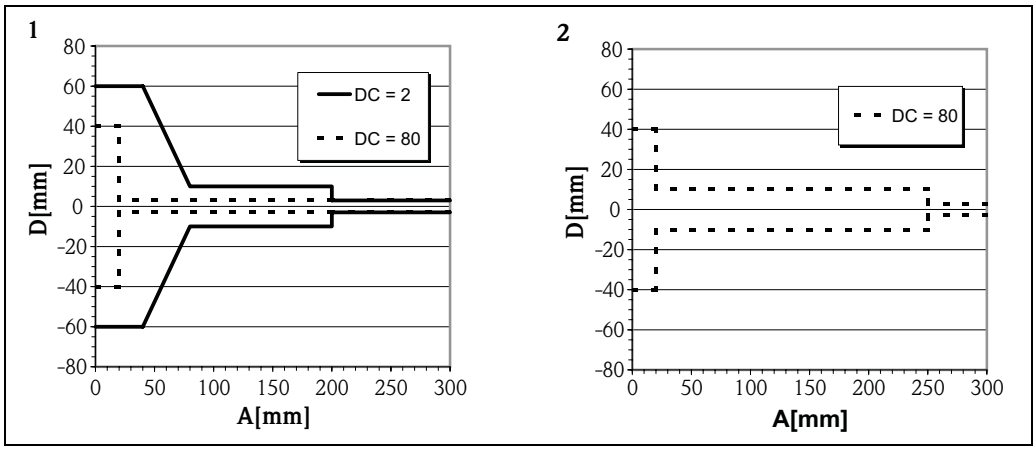
Maximum measured error

Typical data under reference operating conditions:
DIN EN 61298-2, percentage values in relation to the span.

Output:	Digital	Analog
Sum of non-linearity, non-repeatability and hysteresis	**Level (level and interface electronics versions):** **FMP45 measuring range:** – Up to 10 m: ± 3 mm – > 10 m: ± 0.03 % **FMP45 with coax probe:** – ±5 mm	± 0.06 %
	Interface (only "K" interface measurement electronics version): – Measuring range up to 10 m: ± 10 mm If the thickness of the interface is <60 mm, the interface can no longer be differentiated from the overall level such that both output signals are identical.	
Offset/zero point	± 4 mm	± 0.03 %

If the reference conditions are not met, the offset/zero point arising from the mounting situation may be up to ±12 mm for rope and rod probes. This additional offset/zero point can be compensated for by entering a correction (Function **"Offset" (057)**) during commissioning.

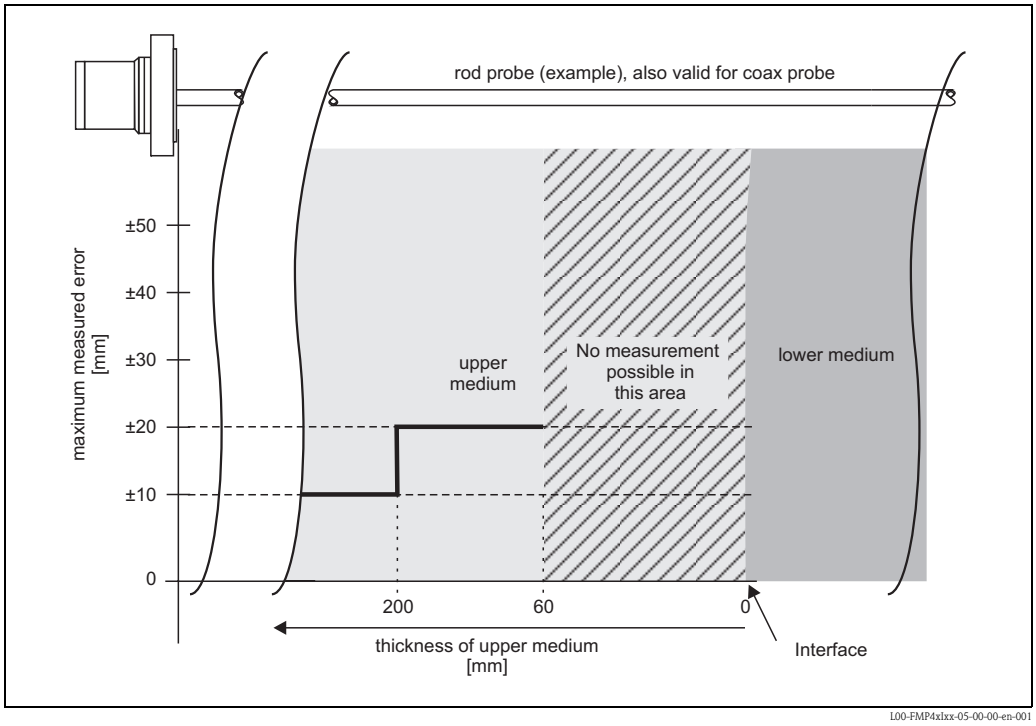
In the area around the lower probe end, the following measured error occurs for the level measurement (level and interface electronics version):



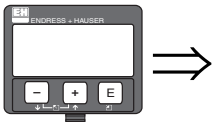
1 Rod and coax probe
2 Rope probe
A Distance from end of probe
D Sum of non-linearity, non-repeatability and hysteresis

If the DC value is less than 7 for rope probes, then measurement is not possible in the area of the tensioning weight (0 to 250 mm from end of probe; lower blocking distance).

Deviating from this, the following measured error occurs for thin interface layers (only "K" interface measurement electronics version):



Function "Medium Property" (003)



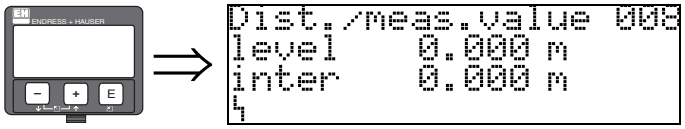
Use this function to enter the dielectric constant of the upper medium (upper phase).

Options:
- **2.00**

The tables below split the DC values by product group. However, it is not sufficient to assume a typical value. For accurate interface measurement, it is necessary to determine the DC of the upper medium (upper phase) as accurately as possible and enter the value in this function.
The DC of the upper medium must be known and constant. The DC can be determined with the aid of the "DC manual" CP00019F/00/EN. In addition, it is also possible to calculate the DC automatically in FieldCare if the interface thickness is available and known.

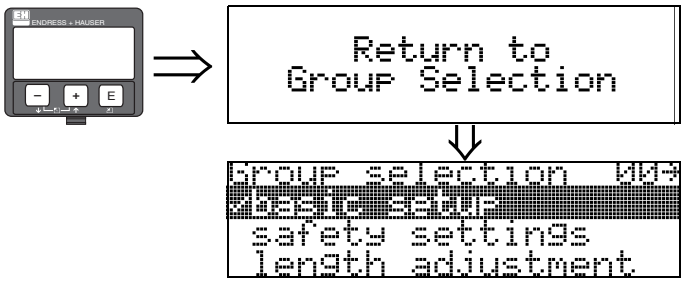
DC (Er)	Typical liquids	DC (Er)	Typical liquids
1.4 to 1.6	– Liquefied gases, e.g. N_2, CO_2	2.5 to 4	– Benzene, styrene, toluene – Furan – Naphthalene
1.6 to 1.9	– Liquefied gas, e.g. propane – Solvent – Freon – Palm oil	4 to 7	– Chlorobenzene, chloroform – Cellulose spray – Isocyanate, aniline
1.9 to 2.5	– Mineral oils, fuels	> 7	– Aqueous solutions (DC approx. 80) – Alcohols – Ammonia

"Distance/Measured Value" display (008)



The measured distances from the reference point to the product level and the interface are shown. Check whether the values correspond to the actual distances. The following cases can occur:

- Distances correct → continue with group selection
- Distance to level incorrect → empty tank/bypass and perform mapping over the entire probe length (see BA00366F/00/EN "Description of Instrument Functions").
- Distance to interface incorrect → check entry for "Medium Prop." (003).



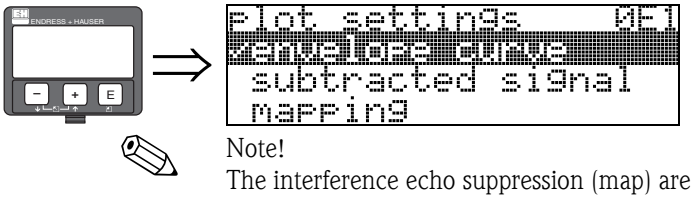
After 3 s, the following message appears

6.5 Envelope curve with VU331

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

6.5.1 Function "Plot Settings" (0E1)

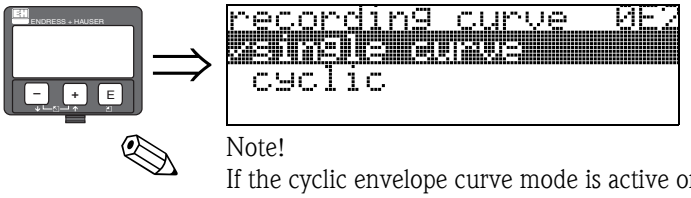
Here you can select which information is shown on the display:
- **Envelope curve**
- Substracted Signal
- Mapping



Note!
The interference echo suppression (map) are explained in BA00366F/00/EN "Description of Instrument Functions".

6.5.2 Function "Recording Curve" (0E2)

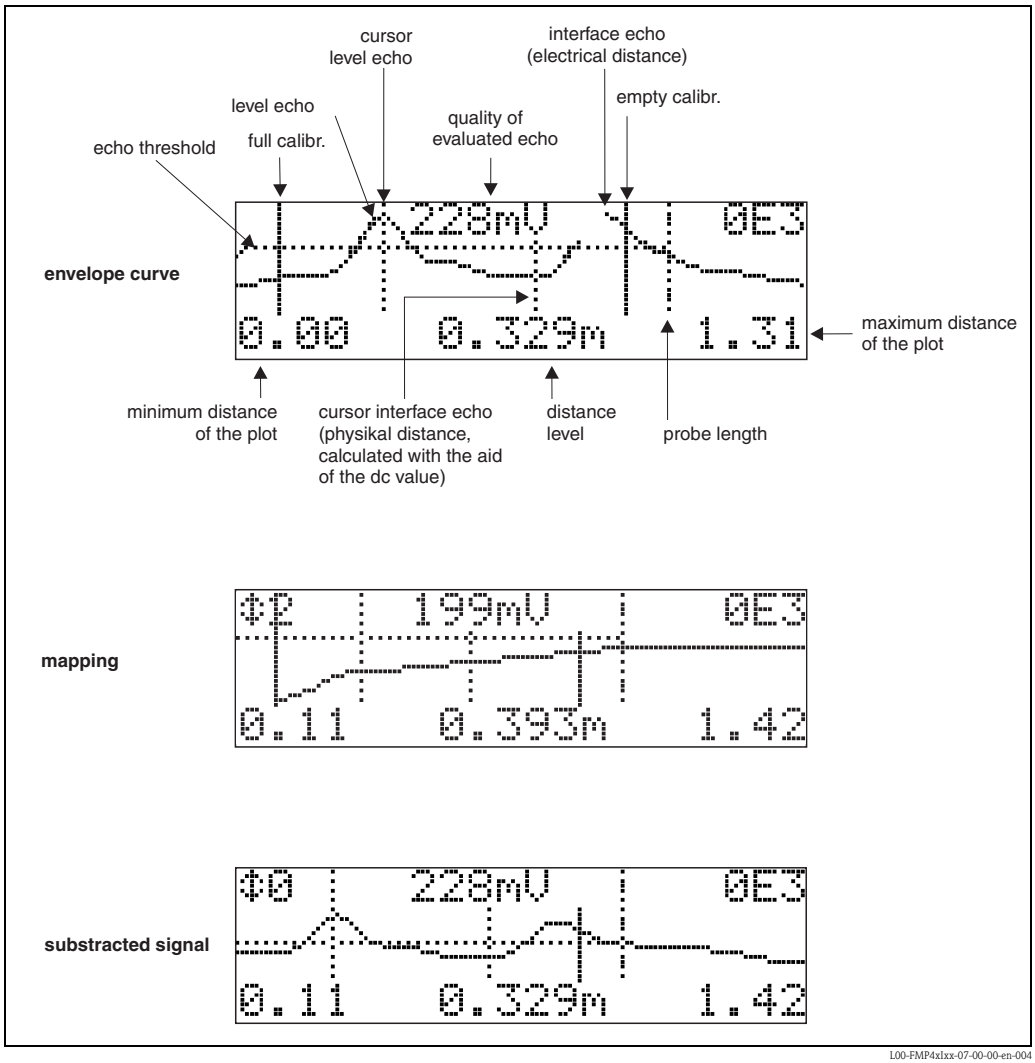
This function determines whether the envelope curve is read as
- **Single Curve** or
- Cyclic



Note!
If the cyclic 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 optimized.

6.6 Function "Envelope Curve Display" (0E3)

You can take the following information from the envelope curve display in this function:



The difference curve (substracted signal) is generated from the difference between the envelope curve and the mapping, and is used to determine levels and for additional calculations.

6.6.1 Envelope curve

The Levelflex emits individual pulses in quick succession and scans their reflection with a slightly variable delay. The energy values received are ordered by their time-of-flight. The graphic representation of this sequence is known as an "envelope curve".

6.6.2 Mapping (empty curve) and difference curve

To suppress interference signals, the envelope curve is not directly evaluated in the Levelflex.
The mapping (empty curve) is first subtracted from the envelope curve.
The system looks for level echoes in the resulting difference curve.
Difference curve = envelope curve - mapping (empty curve)
The mapping (empty curve) should be a good representation of the probe and the empty tank or silo. Ideally, only the signals from the medium being measured remain in the difference curve.

6.6.3 Mapping

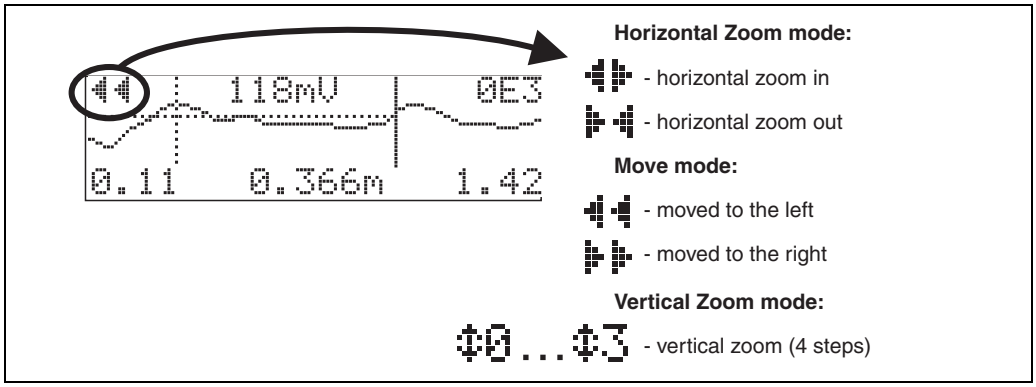
- Factory mapping
  Mapping (empty curve) is already available in the device when the device is delivered.
- Customer mapping
  In a partially filled state, the distance up to 10 cm before the actual total level can be mapped (range of mapping = actual distance from total level – 10 cm), or values > LN can be mapped in the case of empty tanks.
- Dynamic mapping
  It is not static like factory and customer-specific interference echo suppression. Instead, it follows directly from static mapping and constantly adapts to the changing features of the probe environment during ongoing operation. Thus, dynamic mapping does not have to be recorded explicitly.

6.6.4 Echo threshold

Maximum points in the difference curve are only accepted as reflection signals if they are above a specified threshold. This threshold depends on the location and is automatically calculated from the ideal echo curve of the probe used. The calculation of the threshold in question depends on the "Installation" customer parameter in the extended calibration function.

6.6.5 Navigation in the envelope curve display

With the aid of the navigation, the envelope curve can be scaled horizontally and vertically, or moved to the right or to the left. The navigation mode that is currently active is indicated by an icon in the top left-hand corner of the display.

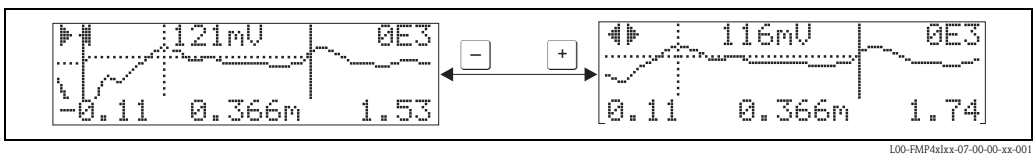


L00-FMP4xIxx-07-00-00-en-005

Horizontal Zoom mode

Press [+] or [–], to get to the envelope curve navigation. You are in the Horizontal Zoom mode. or is displayed.

You now have the following options:
- [+] increases the horizontal scale.
- [–] reduces the horizontal scale.

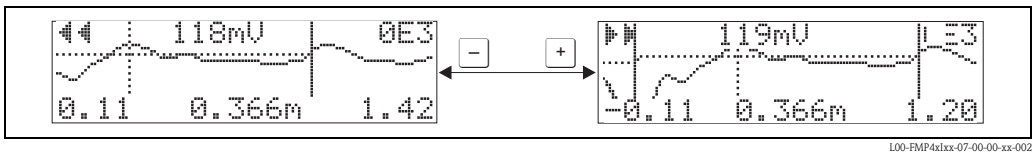


L00-FMP4xIxx-07-00-00-xx-001

Move mode

Then press [E] to get to the Move mode. or is displayed.

You now have the following options:
- [+] moves the curve to the right.
- [−] moves the curve to the left.



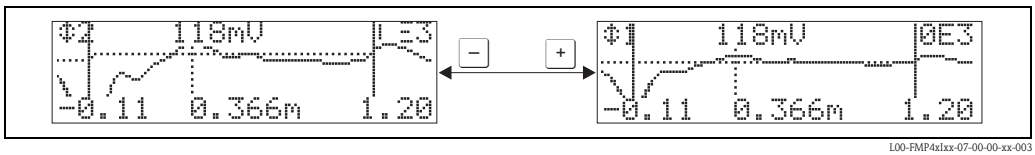
L00-FMP4xlxx-07-00-00-xx-002

Vertical Zoom mode

Press [E] again to get to the Vertical Zoom mode. ⇳1 is displayed.

You now have the following options:
- [+] increases the vertical scale.
- [−] reduces the vertical scale.

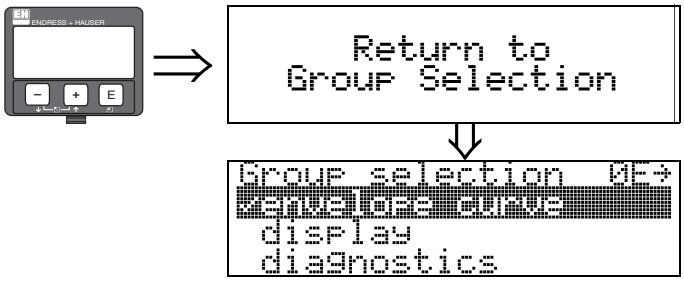
The display symbol indicates the zoom mode that is currently active (⇳0 to ⇳3).



L00-FMP4xlxx-07-00-00-xx-003

Ending the navigation

- By pressing [E] repeatedly, you change cyclically between the different modes of the envelope curve navigation system.
- By pressing [+] and [−] simultaneously, you leave the navigation. The zoom and shift settings configured are retained. The Levelflex does not use the standard display until you activate the "**Recording Curve**" function **(0E2)** again.



After 3 s, the following message appears

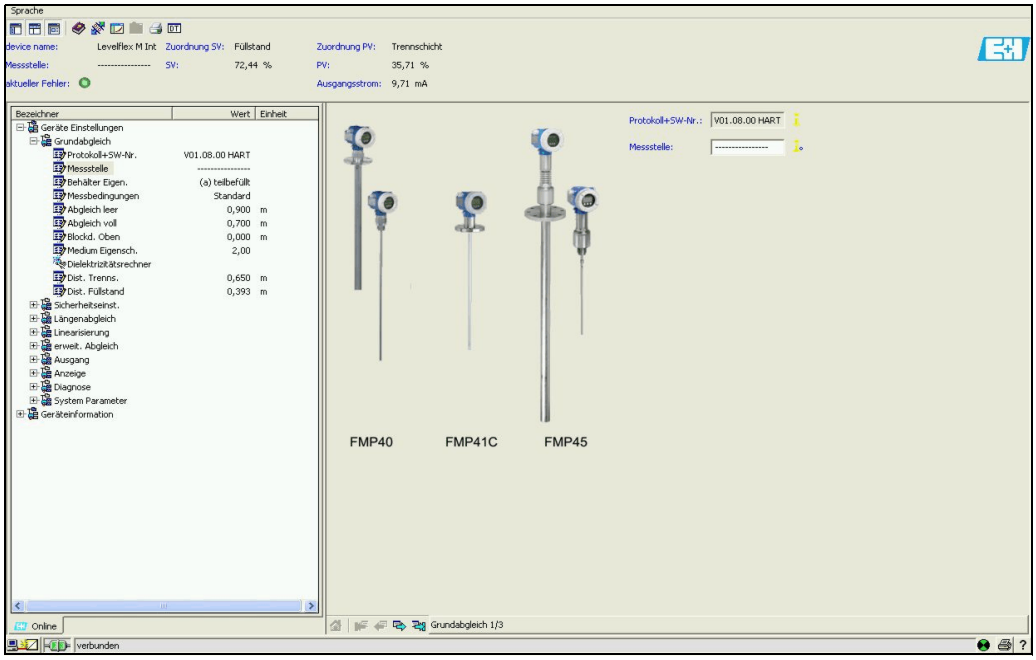
6.7 Basic Setup with the Endress+Hauser operating program

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

The following display appears on the screen:

Basic Setup step 1/3:

- Measuring point



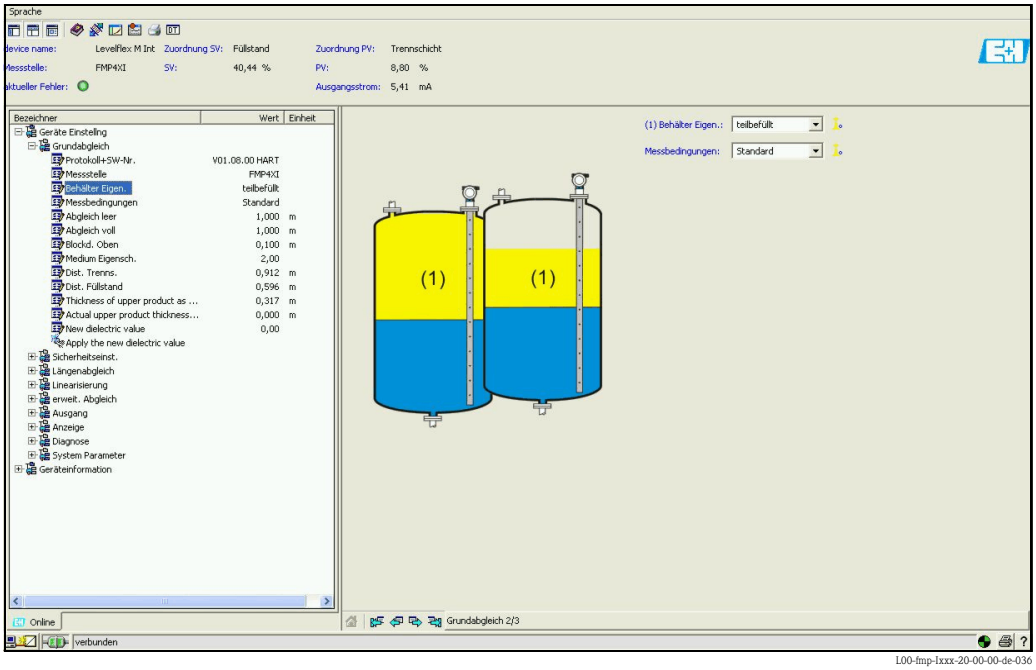
L00-fmp-1xxx-20-00-00-de-035

- With the button you move to the next screen display.

Note!
Each parameter that is changed must be confirmed with the RETURN key!

Basic Setup step 2/3:

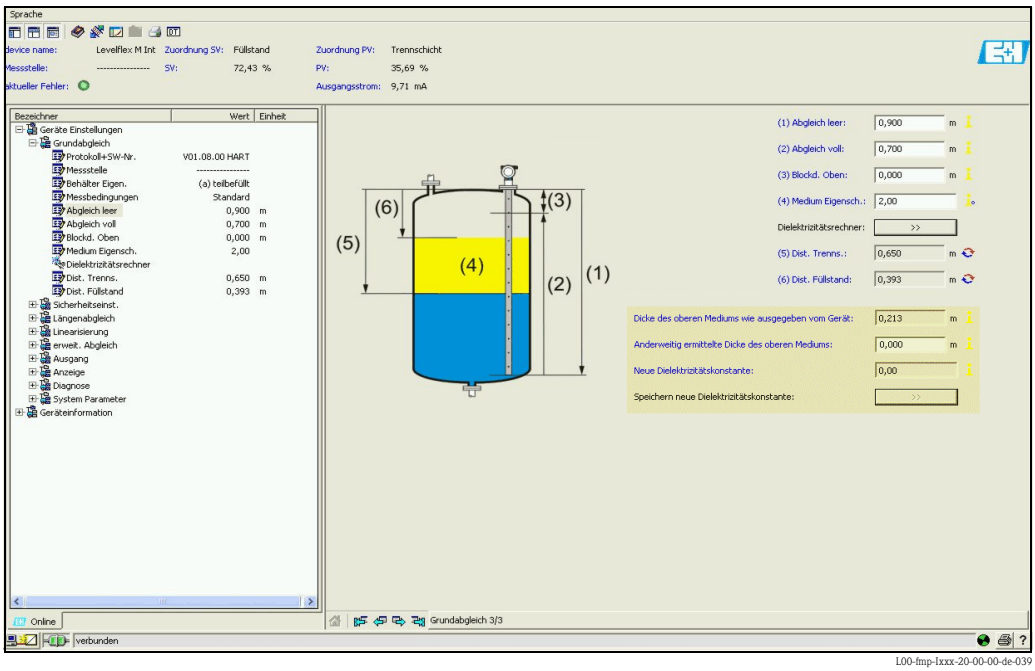
- Enter the application parameters:
  - Tank shape
  - Medium property



L00-fmp-lxxx-20-00-00-de-036

Basic Setup step 3/3:

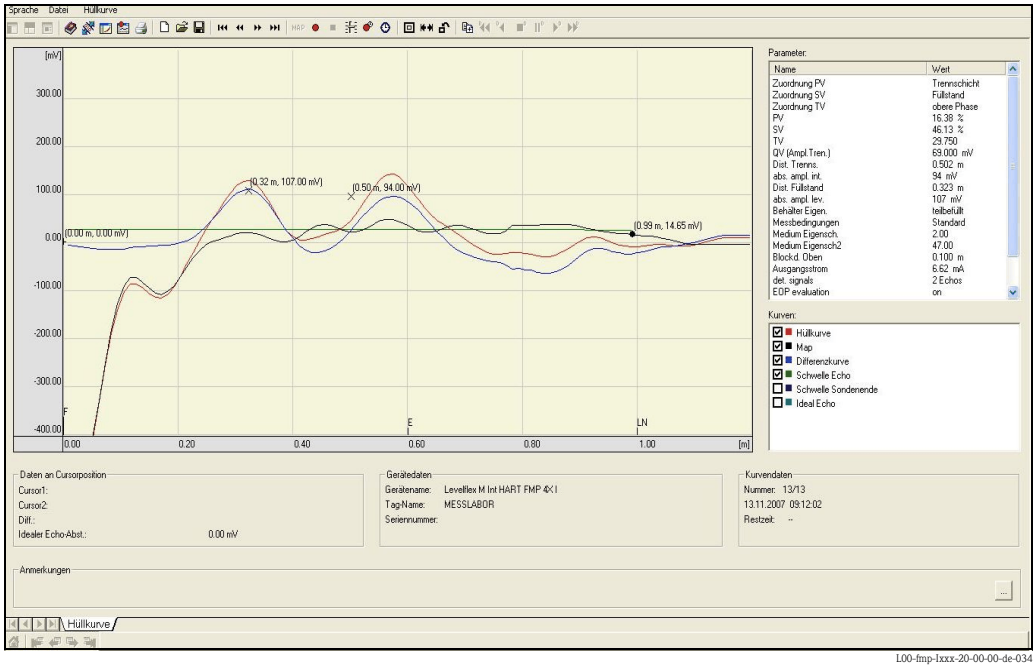
- Enter the application parameters:
  - Empty calibration
  - Full calibration
  - Upper blocking distance
  - Medium property
  - Dist. Level



L00-fmp-lxxx-20-00-00-de-039

6.7.1 Signal analysis via envelope curve

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



L00-fmp-1xxx-20-00-00-de-034

6.7.2 User-specific applications (operation)

For details of setting the parameters of user-specific applications, see separate documentation BA00366F/00/EN "Description of Instrument Functions" on the enclosed CD-ROM.

7 Maintenance

The Levelflex M measuring device requires no special maintenance.

7.1 Exterior cleaning

When exterior-cleaning the Levelflex M, always use cleaning agents that do not attack the surface of the housing and the seals.

7.2 Repairs

The Endress+Hauser repair concept assumes that the measuring devices have a modular design and that customers are able to undertake repairs themselves ("Spare Parts", → 66). Please contact Endress+Hauser Service for further information on service and spare parts.

7.3 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 genuine 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 version.
- Document all repair work and conversions.

7.4 Replacement

After a complete Levelflex M or electronic module has been replaced, the parameters can be downloaded into the device again via the communication interface. As a prerequisite, the data have to have been uploaded to the PC beforehand using FieldCare.
Measurement can continue without having to carry out a new calibration.

- You may have to activate linearization (see BA00366F/00/EN on the enclosed CD-ROM.)
- New interference echo suppression (see Basic Setup)

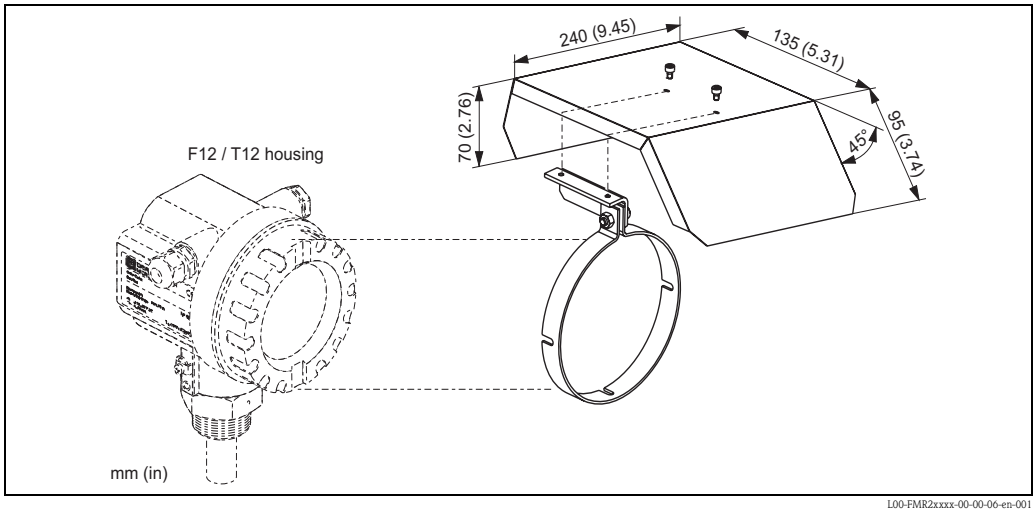
After a probe or the electronics have been replaced, a new calibration must be carried out. This is described in the repair instructions.

8 Accessories

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

8.1 Weather protection cover

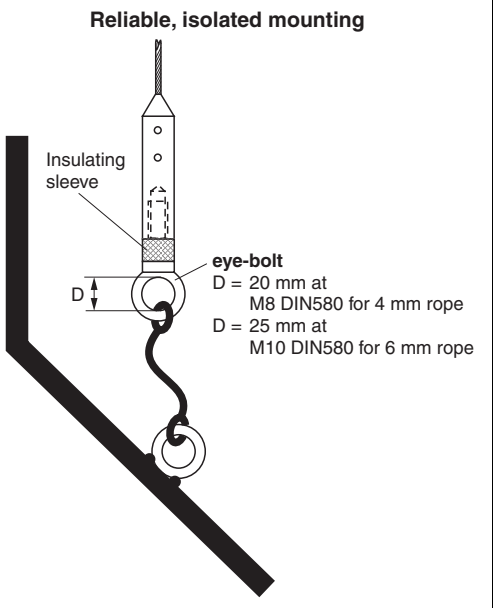
A weather protection cover made of stainless steel is available for outdoor installation (order code: 543199-0001). The shipment includes the protection cover and tension clamp.



L00-FMR2xxxx-00-00-06-en-001

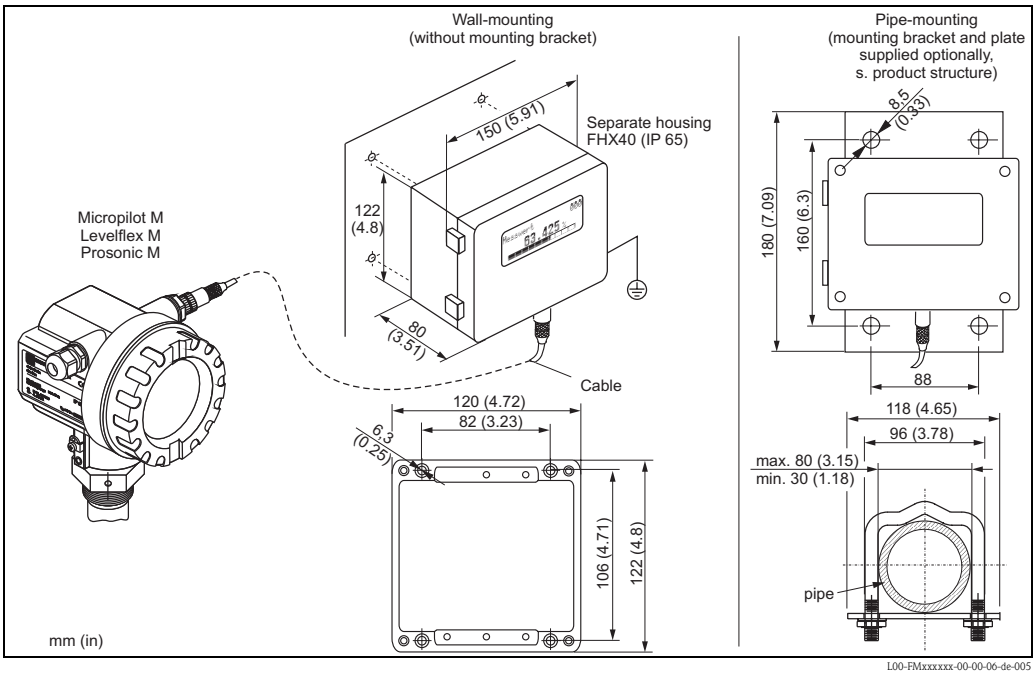
8.2 Mounting-kit isolated

Mounting-kit	Order-No.	
for 4mm rope probe	52014249	
for 6mm rope probe	52014250	
If a rope probe has to be fixed and a secure grounded mounting is not possible, we recommend using the insulating sleeve made of PEEK GF-30 with accompanying DIN 580 eye-bolt made of stainless steel. Max. process temp. 150 °C. Due to the risk of electrostatic charge, the insulating sleeve is not suitable for use in hazardous areas. In these cases the fixing must be reliably grounded (→ 🖹 20).		



L00-FMP4xxxx-17-00-00-en-036

8.3 Remote display and operation FHX40



Technical data (cable and housing) and product structure:

Max. cable length	20 m (65 ft)
Temperature range	-30 °C to +70 °C (-22 °F to +158 °F)
Degree of protection	IP65/67 (housing); IP68 (cable) acc. to IEC 60529
Materials	Housing: AlSi12; cable glands: nickle plated brass
Dimensions [mm (in)]	122x150x80 (4.8x5.9x3.2) / HxWxD

010	**Approval:**				
	A	Non-hazardous area			
	2	ATEX II 2G Ex ia IIC T6			
	3	ATEX II 2D Ex ia IIIC T80°C			
	G	IECEx Zone1 Ex ia IIC T6/T5			
	S	FM IS Cl. I Div.1 Gr. A-D, zone 0			
	U	CSA IS Cl. I Div.1 Gr. A-D, zone 0			
	N	CSA General Purpose			
	K	TIIS Ex ia IIC T6			
	C	NEPSI Ex ia IIC T6/T5			
	Y	Special version, TSP-No. to be spec.			
020		**Cable:**			
		1	20m / 65ft (> for HART)		
		5	20m / 65ft (> for PROFIBUS PA/FOUNDATION Fieldbus)		
		9	Special version, TSP-No. to be spec.		
030			**Additional option:**		
			A	Basic version	
			B	Mounting bracket, pipe 1"/ 2"	
			Y	Special version, TSP-No. to be spec.	
FHX40 -					Complete product designation

For connection of the remote display FHX40 use the cable which fits the communication version of the respective device.

8.4 Centering disks

If the probes with rod version are used in stilling well or bypass, it must be ensured that the probe does not come into contact with the wall. The centering disk fixes the rod probe in the middle of the pipe.

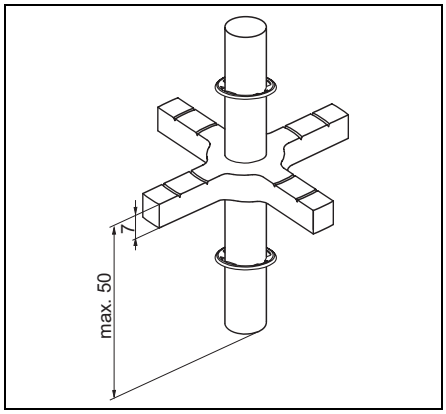
8.4.1 Centering disk PEEK Ø1.89 - 3.74 inch

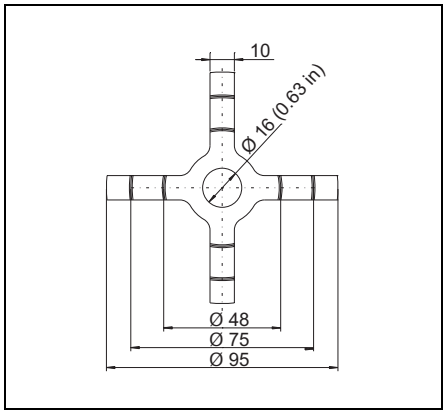
The centering disk is suitable for probes with a rod diameter of Ø 0.63in and can be used in pipes from DN40 (1½") up to DN100 (4"). Markings on the 4-leg centering disk ensure a simple tailoring. Hence the centering disk can be adapted to the pipe diameter.
See also Operating Instruction BA00377F/00/A2.

- PEEK (statically dissipative)
- Measuring range: –60 °C to +200 °C

Order-no. 71069064

Note!
If the centering disk is inserted in an bypass, it must be positioned below the lower bypass outlet. The has to be accounted for when choosing the probe length.
Generally, the centering disk should not be mounted higher than 50 mm from the probe end.
It is recommended not to insert the PEEK centering disk in the measuring range of the rod probe.



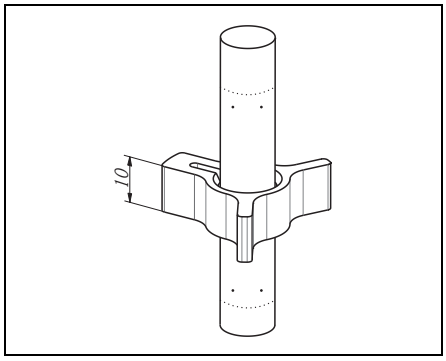


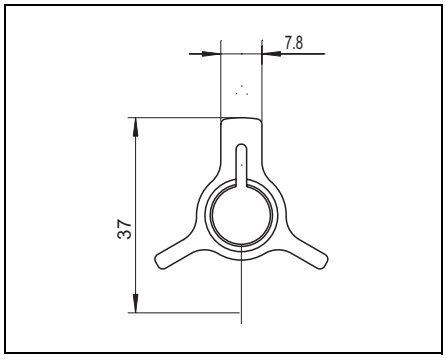
8.4.2 Centering disk PFA Ø1.46 inch

The centering disk is suitable for probes with a rod diameter of 0.63 inch (also coated rod probes) and can be used in pipes from DN40 (1½") upto DN50 (2").
See also Operating Instruction BA00378F/00/A2.

- Measuring range.: -200 °C to +150 °C

Order-no. 71069065





8.5 Commubox FXA195 HART

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

8.6 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.

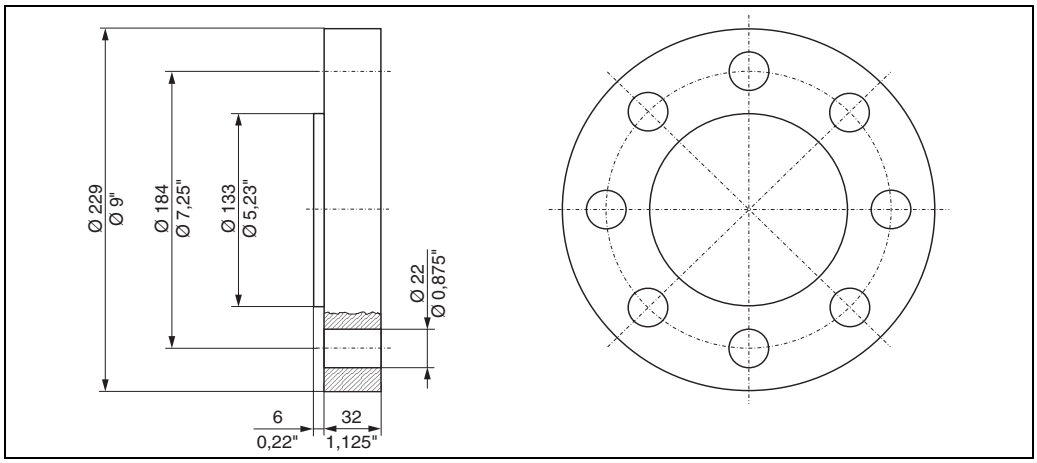
Note!
For the device you need the "ToF Adapter FXA291" as an additional accessory.

8.7 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.

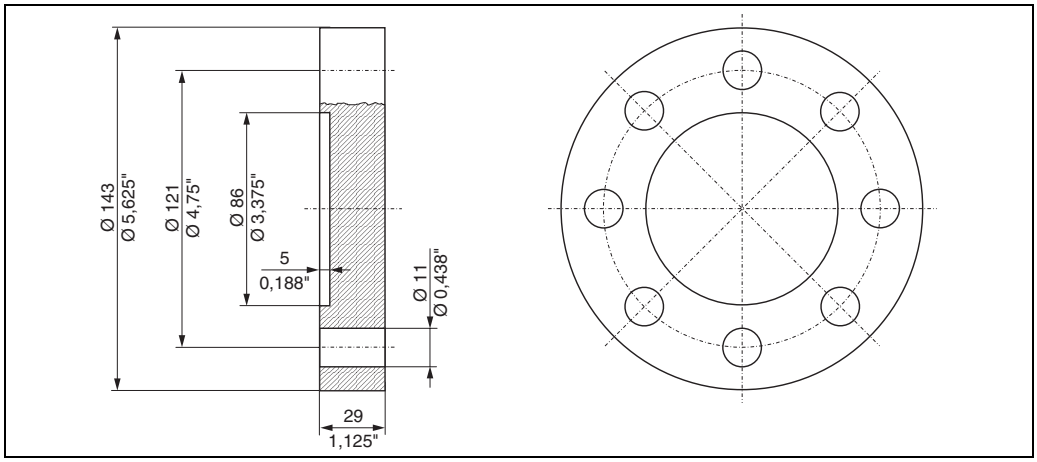
8.8 Special process connection

8.8.1 Fisher flange 249B/259B (MVTF N0123)



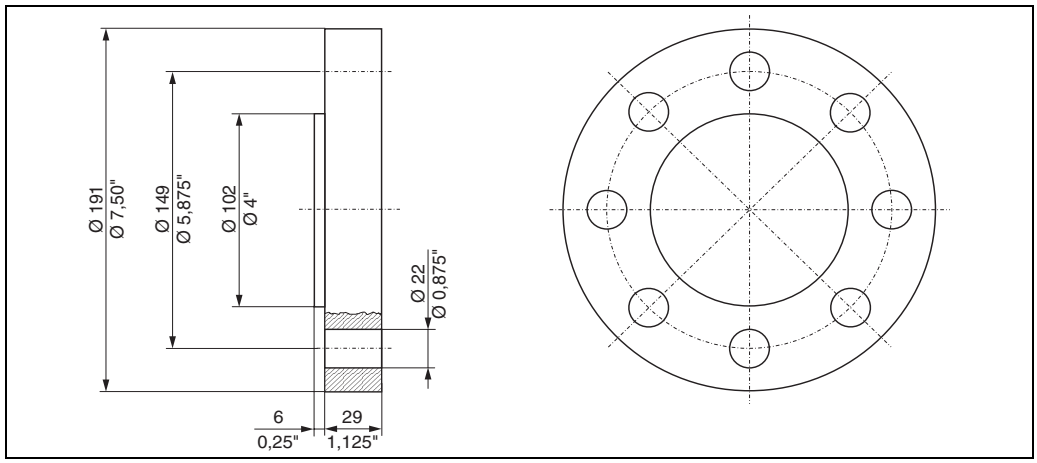
L00-FMP45xxx-00-00-06-en-001

8.8.2 Fisher flange 249C (MVTF N0124)



L00-FMP45xxx-00-00-06-en-002

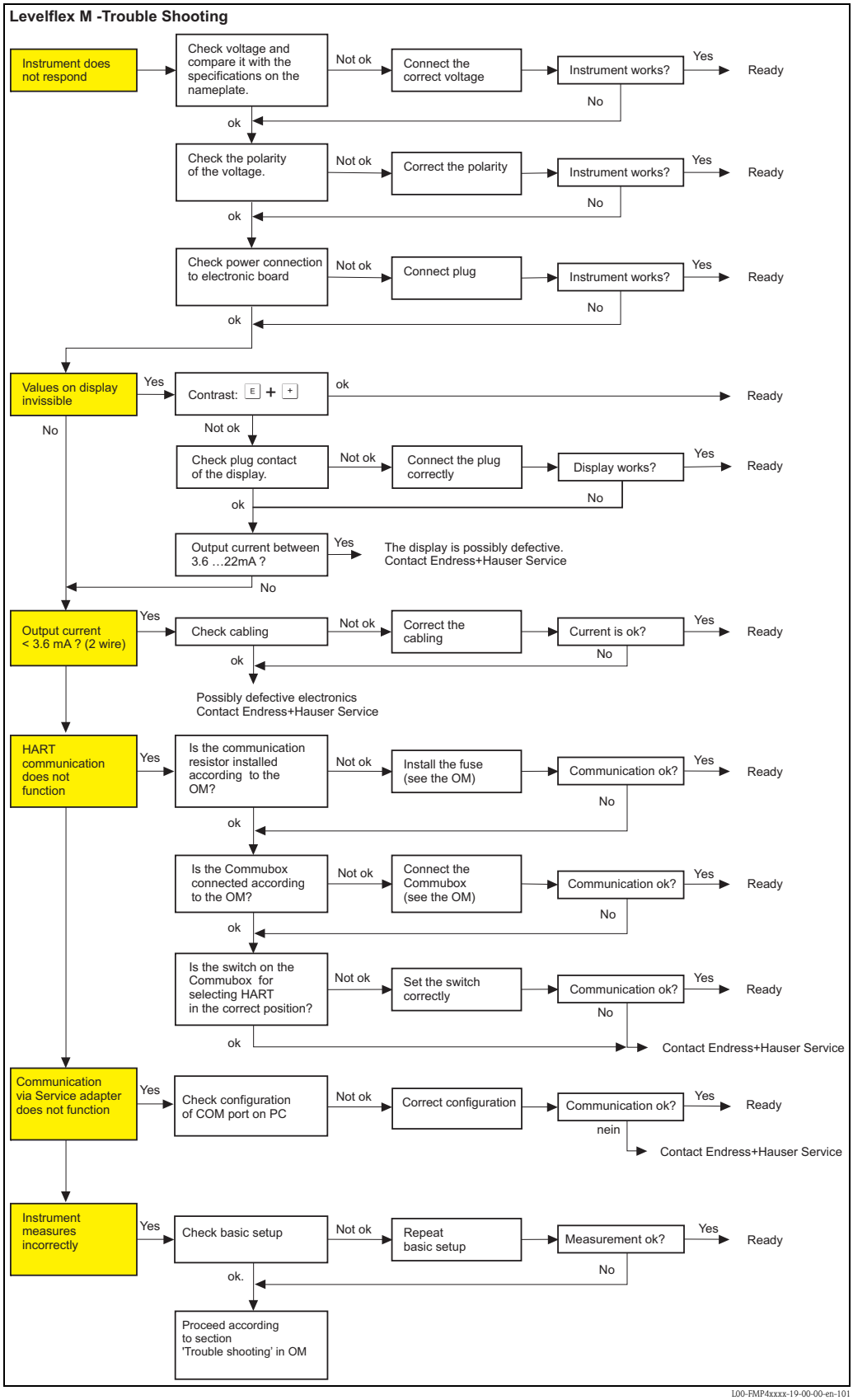
8.8.3 Masoneillan flange (MVTF N0125)



L00-FMP45xxx-00-00-06-en-003

9 Troubleshooting

9.1 Troubleshooting instructions

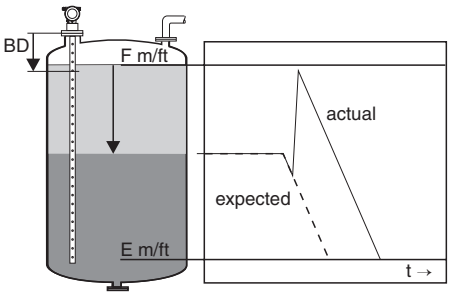
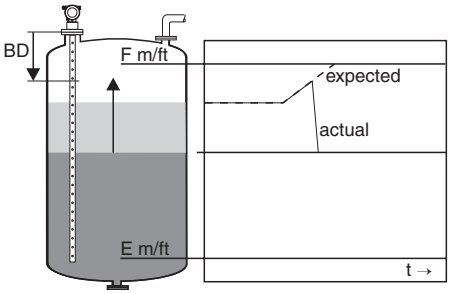
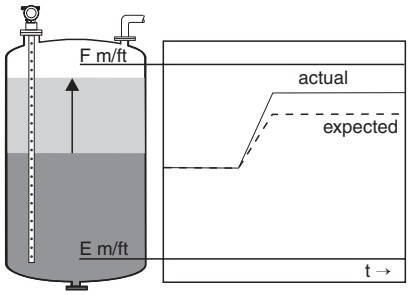


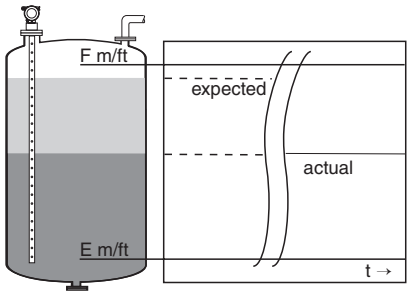
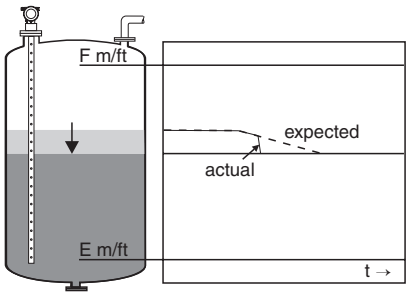
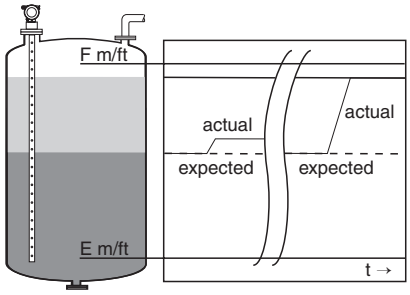
9.2 System error messages

Code	Description	Possible cause	Remedy
A102	Checksum error general reset & new calibr. required	Device was switched off before data could be stored; EMC problem EEPROM defective	Reset Avoid EMC problems; if alarm prevails after reset, exchange electronics
W103	Initializing - please wait	EEPROM storage not yet finished	Wait a few seconds; If error prevails, exchange electronics
A106	Downloading - please wait	Processing data download	Wait until warning disappears after the download procedure
A110	Checksum error general reset & new calibr. required	Device was switched off before the data were saved EMC problem EEPROM defective	Reset Avoid EMC problems; if alarm prevails after reset, exchange electronics
A111	Electronics defective	RAM defective	Reset If alarm prevails after reset, exchange electronics
A113	Electronics defective	ROM defective	Reset If alarm prevails after reset, exchange electronics
A114	Electronics defective	EEPROM defective	Reset If alarm prevails after reset, exchange electronics
A115	Electronics defective	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 defective	No factory calibration available, EEPROM deleted	Contact service
W153	Initializing - please wait	Initialization of electronics	Wait a few seconds; if warning prevails, switch off device and switch it on again
A160	Checksum error general reset & new calibr. required	Device was switched off before the data were saved EMC problem EEPROM defective	Reset Avoid EMC problems; If alarm prevails after reset, exchange electronics
A164	Electronics defective	Hardware problem	Reset If alarm prevails after reset, exchange electronics
A171	Electronics defective	Hardware problem	Reset If alarm prevails after reset, exchange electronics
A221	Probe pulse deviation from average values	HF module or cable between HF module and electronics defective	Check contacts on HF module If fault cannot be eliminated: Replace HF module
A261	HF cable defective	HF cable defective or HF connector removed	Check HF connector, replace cable if defective
W275	Offset too high	Temperature at the electronics too high or HF module defective	Check temperature, replace HF module if defective
W512	Recording of mapping - please wait	Mapping active	Wait a few seconds until alarm disappears
W601	Linearization ch1 curve not monotone	Linearization not monotone increasing	Correct table

Code	Description	Possible cause	Remedy
W611	Less than 2 linearization points for channel 1	Number of linearization coordinates entered < 2	Correct table
W621	Simulation ch. 1 on	Simulation mode is switched on	Switch off simulation mode
E641	No usable echo channel 1 Check calibr.	Echo lost due to application conditions or buildup, probe defective	Check basic setup Clean probe (cf. Operating Instructions)
W650	Signal/noise ratio too low or no echo	Noise amplitude too high	Eliminate electromagnetic interference
E651	Level in safety distance – risk of overspill	Level in safety distance	Alarm will disappear as soon as the level leaves safety distance Perform a reset if necessary
A671	Linearization ch1 not complete, not usable	Linearization table is in edit mode	Switch on linearization table
W681	Current ch1 out of range	Current out of valid range (3.8 mA to 20.5 mA)	Check calibration and linearization

9.3 Application errors

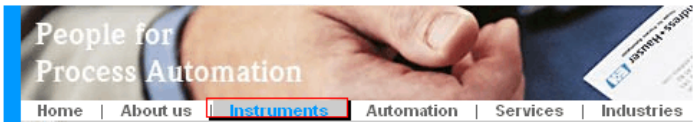
Error	Output	Possible cause		Remedial action
A warning or alarm is pending	Depends on configuration	See table of error messages (Seite 62)		See table of error messages (Seite 62)
When "fully flooded" is selected in "Tank Properties" (002), the measured value jumps during draining operations		The total level is detected outside the "Upper Block Distance" (059).	Yes ®	Increase "Upper Block Dist." (059) "Partially Filled" setting in "Tank Properties" (002)
When "Partially Filled" is selected in "Tank Properties" (002), the measured value jumps during filling operations		The total level runs into the set "Upper Block Distance" (059).	Yes ®	Reduce "Upper Block Dist." (059)
Slope error in interface measured value		Wrong DK value set in "Medium Properties" (003)	Yes ®	Check the DK value setting in "Medium Properties" (003).

Error	Output	Possible cause		Remedial action
The measured values for the interface and the total level are identical		Echo threshold for the total level too high	Yes ®	Check the DC value setting in "Medium Properties" (003).
If the interface layers are thin, the total level jumps to the interface level		The thickness of the upper phase is less than 60 mm.	Yes ®	Interface measurement is only possible if the thickness of the interface is greater than 60 mm.
Interface measured value jumps		Emulsion layer present	Yes ®	Emulsion layer affects the measurement. Please contact Endress+Hauser.

9.4 Spare Parts

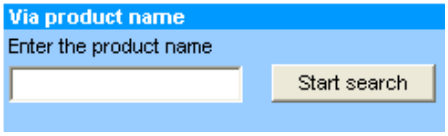
An overview of the spare parts for your device is available in the internet at www.endress.com. To obtain information on the spare parts, proceed as follows:

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

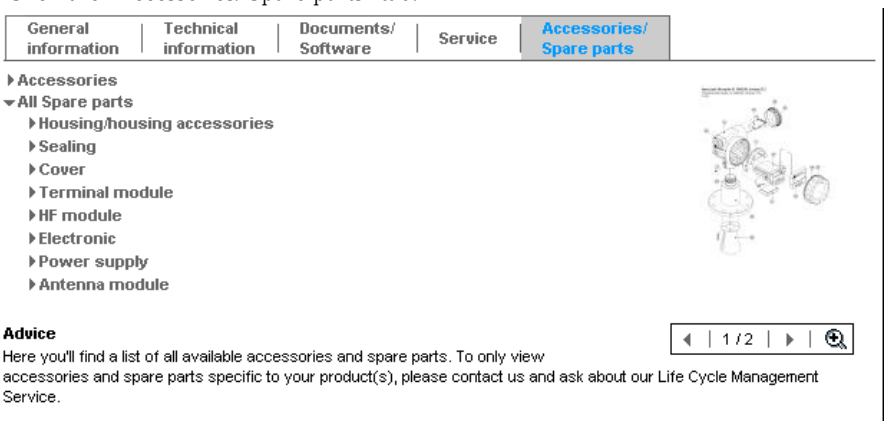


3. Enter the product name into the "product name" field.

Endress+Hauser product search



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



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

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

9.5 Return

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

- Remove all residue which may be present. Pay special attention to the grooves for seals and crevices which could contain fluid residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.
- Always enclose a duly completed "Declaration of Contamination" form (a copy of the "Declaration of Contamination" is included at the end of these Operating Instructions). 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 properties of the fluid
- A description of the application
- A description of the error that occurred (specify error code if possible)
- Operating duration 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 modifications	HART	Description of Device Functions
02.2008	01.08.00	Original software. Operated via: – FieldCare – HART-Communicator 375 with Rev. 1, DD 1.	BA365F/00/en/03.08 71060887 BA365F/00/en/03.09 71074945 BA00365F/00/EN/13.10 71120318	BA366F/00/en/01.08 71060890

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 Input

Measured variable	The measured variable is the distance between the reference point (see Fig., Seite 12) and the product surface. The level is calculated taking into account the empty distance entered "E". Alternatively, the level can be converted to other variables (volume, mass) by means of linearization (32 points).

10.1.2 Output

Output signal	4 to 20 mA (invertible) with HART protocol
Signal on alarm	Failure information can be accessed via the following interfaces: ■ Local display: – Error symbol (s. Seite 32) – Plain-text display ■ Current output, failsafe mode can be selected (e.g. according to NAMUR Recommendation NE43) ■ Digital interface
Linearization	The Levelflex M linearization function enables the measured value to be converted into any desired length or volume units and mass or %. Linearization tables for volume calculation in cylindrical tanks are preprogrammed. Any other tables with up to 32 value pairs can be input manually or semi-automatically. The creation of a linearization table with FieldCare is particularly convenient.

10.1.3 Performance characteristics

Reference operating conditions	■ Temperature = +20 °C ±5 °C ■ Pressure = 1013 mbar abs. ±20 mbar ■ Humidity = 65 % ±20 % ■ Reflection factor ≥ 0.8 (surface of the water for coax probe, metal plate for rod and rope probe with min. 1 m ∅) ■ Flange for rod or rope probe ≥ 30 cm ∅ ■ Distance to obstructions ≥ 1 m ■ For interface measurement: – Coax probe – DC of the lower medium = 80 (water) – DC of the upper medium = 2 (oil)
Maximum measured error	Is in the Function group "Basic Setup" (00) as of Seite 42.
Resolution	■ Digital: 1 mm ■ Analog: 0.03 % of the measuring range
Reaction time	The reaction time depends on the configuration. Shortest time: ■ 2-wire electronics: 1 s

Influence of ambient temperature

The measurements are carried out in accordance with EN 61298-3:
- Digital output:
  - Average T_K: 0.6 mm/10 K, max. ±3.5 mm over the entire temperature range -40 °C to +80 °C

2-wire:
- Current output (additional error, in relation to the span of 16 mA):
  - **Zero point (4 mA)**
    Average T_K: 0.032 %/10 K, max. 0.35 % over the entire temperature range -40 °C to +80 °C
  - **Span (20 mA)**
    Average T_K: 0.05 %/10 K, max. 0.5 % over the entire temperature range -40 °C to +80 °C

Influence of gas phase

High pressures reduce the propagation velocity of the measuring signals in the gas/vapor above the fluid. This effect depends on the kind of gas/vapor and of its temperature. This results in a measuring error that gets bigger as the distance increases between the device zero point (flange) and product surface. The following table illustrates this measured error for a few typical gases/vapors (with regard to the distance; a positive value means that too large a distance is being measured):

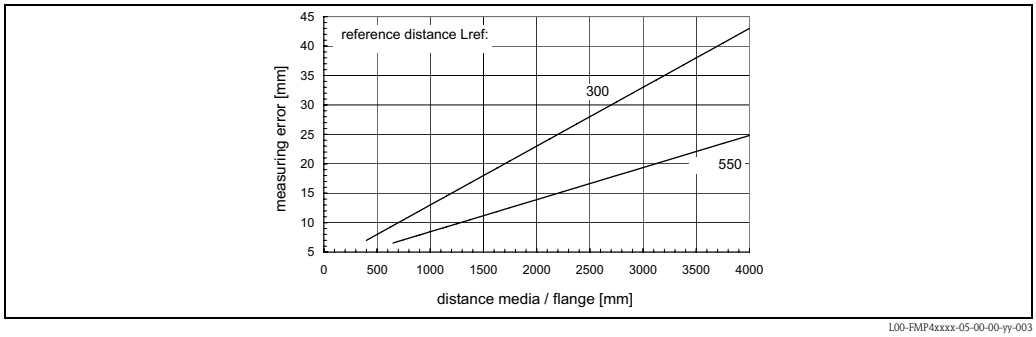
Gaslayer	Temperature		Pressure					
	°C	°F	1 bar (14.5 psi)	10 bar (145 psi)	50 bar (725 psi)	100 bar (1450 psi)	200 bar (2900 psi)	400 bar (5801 psi)
Air	20	68	0,00 %	0,22 %	1,2 %	2,4 %	4,9 %	9,5 %
	200	392	-0,01 %	0,13 %	0,74 %	1,5 %	3,0 %	6,0 %
	400	752	-0,02 %	0,08 %	0,52 %	1,1 %	2,1 %	4,2 %
Hydrogen	20	68	-0,01 %	0,10 %	0,61 %	1,2 %	2,5 %	4,9 %
	200	392	-0,02 %	0,05 %	0,37 %	0,76 %	1,6 %	3,1 %
	400	752	-0,02 %	0,03 %	0,25 %	0,53 %	1,1 %	2,2 %

Gaslayer	Temperature		Pressure				
	°C	°F	1 bar (14.5 psi)	10 bar (145 psi)	50 bar (725 psi)	100 bar (1450 psi)	200 bar (2900 psi)
Water (saturated steam)	100	212	0,20 %	-	-	-	-
	180	356	-	2,10 %	-	-	-
	263	507	-	-	8,6 %	-	-
	310	592	-	-	-	22,0 %	-
	364	691	-	-	-	-	58 %

Installing FMP45 with Gasphase Compensation (Coax only)

Application

For level measurement in steam applications at high pressures and temperatures.
At high pressures and temperatures, the speed at which microwave signals are propagated in steam (polar media) is reduced above the liquid being measured. Automatic gas phase compensation allows this physical effect to be corrected from a measurement technology point of view.
The accuracy of measurement is the higher the larger the reference Lref and the smaller the measuring range is:



If there are fast changes in pressure, there may be an additional error, since the measured reference distance is filtered with twice the time constant of the level measurement.
In addition, condition of imbalance (e.g. due to heating) may cause density and pressure gradients within the medium and condensation of steam at the probe. As a result, the level readings at different locations inside the tank may very slightly.
Caused by this application influences the measuring error may be increased by a factor up to 2 to3.

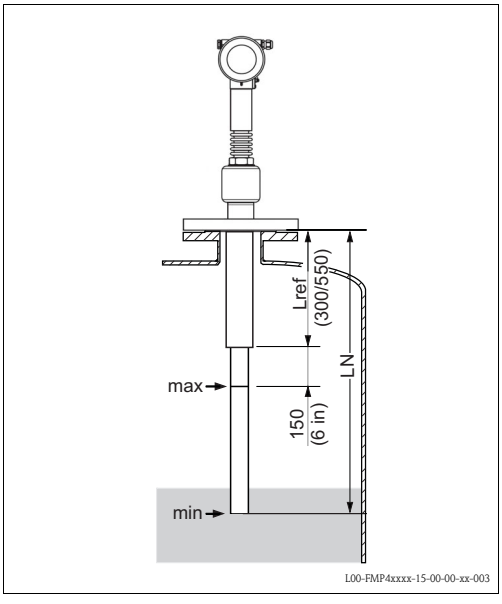
Note!
Coax probes with reference reflection can be installed in any tank (free in the tank or into a bypass). Coax probes are completely mounted and adjusted ex work. After mounting they are ready for use, additional settings are not necessary.

Installation

This version of Levelflex M generates a reference reflection in the distance Lref from the flange (→ 6, "Ordering structure" option U: 300 mm/11"; option V: 550 mm/21"). The reference reflection must be at least 150 mm above the highest level. By means of the shift of the reference reflection the actual propagation speed is measured and the level value will be automatically corrected.

Limitations for coax probes

Maximum probe length LN	LN ≤ 4000 mm
Minimum probe length LN	LN > Lref + 200 mm
Reference distance Lref	300 mm / 550 mm
Maximum level relative to sealing surface of flange:	Lref + 150 mm
Minimum DC-value of medium:	DC > 7



10.1.4 Operating conditions: environment

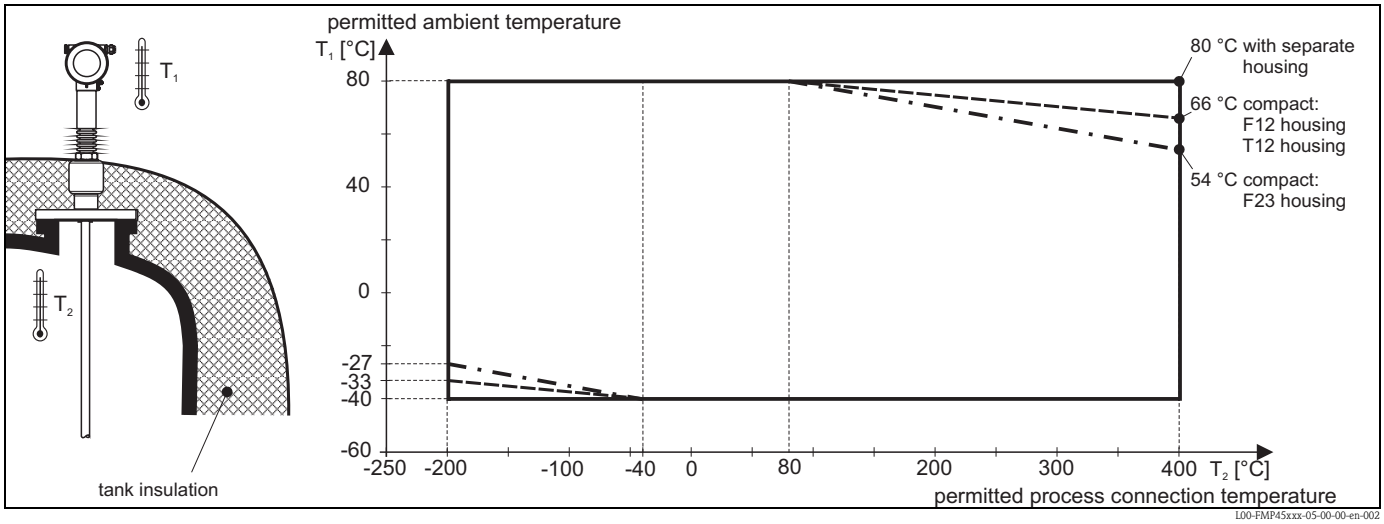
Ambient temperature range

Ambient temperature at the electronics: –40 °C to +80 °C. The function of the LCD display is restricted at T_A < –20 °C and T_A > +60 °C. A weather protection cover should be used for outdoor operation if the device is exposed to direct sunlight.

Ambient temperature limits

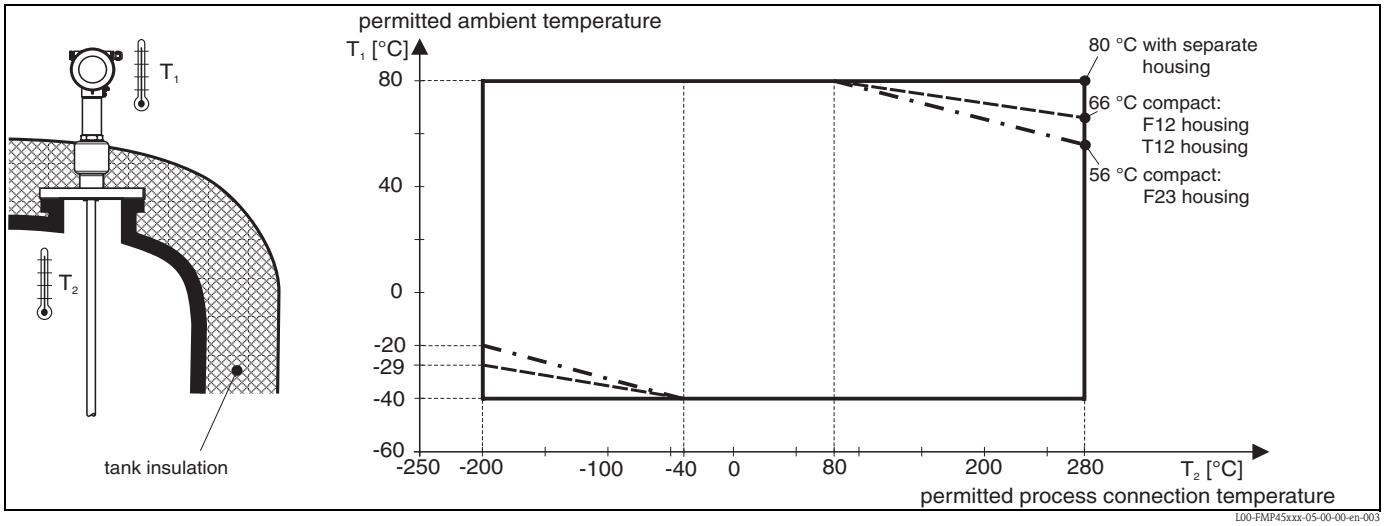
FMP45 (HT 400 °C)

If the temperature (T_2) at the process connection is below –40 °C or above +80 °C, the permitted ambient temperature (T_1) is limited as shown in the following diagram (temperature derating):



FMP45 (XT 280 °C)

If the temperature (T_2) at the process connection is below –40 °C or above +80 °C, the permitted ambient temperature (T_1) is limited as shown in the following diagram (temperature derating):



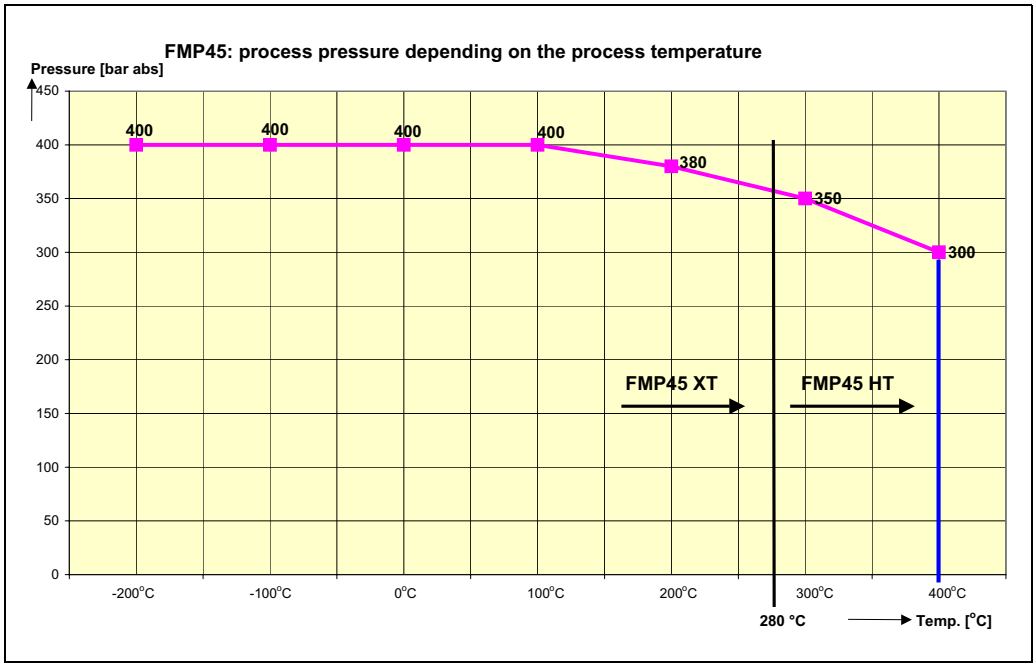
Note!
For saturated steam applications with FMP45 XT the process temperature should not exceed 200 °C (392 °F). For higher process temperatures use the HT version.

Storage temperature	-40 °C to +80 °C
Degree of protection	■ With closed housing tested according to: – IP68, NEMA6P (24 h at 1.83 m under water) – IP66, NEMA4X ■ With open housing: IP20, NEMA1 (also ingress protection of the display)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20 to 2000 Hz, 1 $(m/s^2)^2/Hz$
Cleaning the probe	Depending on the application, contamination or build-up can accumulate on the probe. A thin, even layer only influences measurements slightly. Thick layers can dampen the signal and then reduce the measuring range. Severe, uneven build-up, adhesion e.g. through crystallization, can lead to incorrect measurement. In this case, we recommend that you use a non-contact measuring principle, or check the probe regularly for soiling.
Electromagnetic compatibility (EMC)	Electromagnetic compatibility to EN 61326 and NAMUR Recommendation EMC (NE21). Details are provided in the Declaration of Conformity. A standard installation cable is sufficient if only the analog signal is used. Use a shielded cable when working with a superimposed communication signal (HART). When installing the probes in metal and concrete tanks and when using a coax probe: ■ Interference emission to EN 61326 - x series, Class A equipment. ■ Interference immunity to EN 61326 - x series, requirements for industrial areas and NAMUR Recommendation NE21 (EMC) The measured value can be affected by strong electromagnetic fields when installing rod and rope probes without a shielding/metal wall, e.g. plastic, and in wooden silos. ■ Interference emission to EN 61326 - x series, Class A equipment. ■ Interference immunity: the measured value can be affected by strong electromagnetic fields.

10.1.5 Operating conditions: process

Process temperature range

The maximum permitted temperature at the process connection (see Figure for measuring point) is determined by the process connection ordered:



Note!
For saturated steam applications with FMP45 XT the process temperature should not exceed 200 °C (392 °F). For higher process temperatures use the HT version.

Process pressure limits

The specified range may be reduced by the selected process connection. The pressure rating (PN) specified on the flanges refers to a reference temperature of 20 °C, for ASME flanges 100 °F. Observe pressure-temperature dependency.

Please refer to the following standards for the pressure values permitted for higher temperatures:
- EN 1092-1: 2001 Tab. 18
  With regard to their temperature stability properties, the materials 1.4404 and 1.4435 are grouped under 13E0 in 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

Dielectric constant

- Rod probe: $\varepsilon r \geq 1.6$, when installing in pipes DN ≤ 150 mm: $\varepsilon r \geq 1.4$
- Coax probes: $\varepsilon r \geq 1.4$

10.1.6 Mechanical construction

Material

See TI00386F/00/EN, chapter "Material (not in contact with process)" and "Material (in contact with process)".

Probe length tolerance

Rod probes				
over (m / ft)		1 (3.2)	3 (9.8)	6 (20)
up to (m / ft)	1 (3.2)	3 (9.8)	6 (20)	
admissible tolerance (mm / in)	- 5 (- 0.2)	- 10 - 0.4)	- 20 (- 0.8)	- 30 (- 1.2)

Weight

	XT version (max. 280 °C)		HT version (max. 400 °C)	
	Rod probe	**Coax probe**	**Rod probe**	**Coax probe**
Weight with F12 or T12 housing	Approx. 8.5 kg + Approx. 1.6 kg/m Probe length + Weight of flange	Approx. 8.5 kg + Approx. 3.5 kg/m Probe length + Weight of flange	Approx. 9.5 kg + Approx. 1.6 kg/m Probe length + Weight of flange	Approx. 9.5 kg + Approx. 3.5 kg/m Probe length + Weight of flange
Weight with F23 housing	Approx. 12 kg + Approx. 1.6 kg/m Probe length + Weight of flange	Approx. 12 kg + Approx. 3.5 kg/m Probe length + Weight of flange	Approx. 13 kg + Approx. 1.6 kg/m Probe length + Weight of flange	Approx. 13 kg + Approx. 3.5 kg/m Probe length + Weight of flange

10.1.7 Certificates and approvals

CE mark

The measuring system meets the legal requirements of the applicable EC guidelines. These are listed in the corresponding EC Declaration of Conformity together with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

Manufacturer declaration

Permitted pressures, temperatures and load cycles as per EN 13445 and AD- data sheet S2 (for FMP45).

Ex approval

The devices are certified for use in hazardous areas. The safety instructions to be observed are enclosed and referenced on the nameplate:

- Europe: EC type-examination certificate, Safety Instructions XA
- USA: FM Approval, Control Drawing
- Canada: CSA Certificate of Compliance, Control Drawing
- China: NEPSI Explosion Protection Certificate of Conformity, Safety Instructions XA
- Japan: TIIS Certificate for Ex-apparatus

Assignment of the certificates (XA, ZD, ZE) to the device:

Feature		Variant	ZE256F	ZD117F	ZD116F	ZD114F	ZD113F	ZD083F	ZD082F	ZD081F	ZD080F	ZD021F	ZD110F	ZD109F	ZD107F	ZD106F	ZD078F	ZD077F	ZD076F	ZD075F	XA386F	XA380F	XA379F	XA378F	XA376F	XA330F	XA217F	XA216F	XA215F	XA213F	XA212F	XA211F	XA173F	XA172F	XA168F	XA167F	XA166F	XA165F	XA164F
10 Approval:	Non-hazardous area	A																																				
	NEPSI Ex emb (ia) IIC T6	C																							X														
	Non-hazardous area, WHG	F	X																																				
	ATEX II 3G Ex nA II T6	G																								X													
	NEPSI Ex ia IIC T6	I																					X	X															
	NEPSI Ex d(ia) IIC T6	J																				X																	
	TIIS Ex d (ia) IIC T1	K																																				
	TIIS Ex d (ia) IIC T2	L																																				
	FM DIP Cl.II Div.1 Gr. E-G N.I.	M															X																					
	CSA General Purpose	N																																				
	CSA DIP Cl.II Div.1 Gr. G + coal dust, N.I.	P						X																														
	*NEPSI DIP	Q																																				
	NEPSI Ex nA II T6	R																			X																	
	FM IS Cl.I,II,III Div.1 Gr. A-G N.I., zone 0, 1, 2	S										X	X	X	X	X			X	X																		
	FM XP Cl.I,II,III Div.1 Gr. A-G, zone 1, 2	T															X																					
	CSA IS Cl.I,II,III Div.1 Gr. A-D, G + coal dust, N.I., zone 0, 1	U		X	X	X	X			X	X																											
	CSA XP Cl.I,II,III Div.1 Gr. A-D, G + coal dust, N.I., zone 1, 2	V							X																													
	ATEX II 1/2G Ex ia IIC T6/IECEx Zone0/1	1																									X	X		X	X						X	X
	ATEX II 1/2D/IEC Ex td A20/21, Alu blind cover	2																									X		X			X	X	X				
	ATEX II 1/2G Ex emb (ia) IIC T6/IECEx	3																																	X			
	ATEX II 1/3D/IEC Ex td A20/22 [1]	4																									X		X			X	X	X				
	ATEX II 1/2G Ex ia IIC T6, ATEX II 1/3D	5																									X		X			X						
	ATEX II 1/2G Ex ia IIC T6, WHG	6	X																									X	X		X	X					X	X
	ATEX II 1/2G Ex d (ia) IIC T6/IEC Ex d (ia) IIC T6	7																																		X		
	ATEX II 1/2G Ex ia IIC T6, ATEX II 1/3D, WHG	8	X																								X		X				X					
50 Power supply Output:	2-wire 4-20mA SIL HART	B			X		X		X		X			X		X		X		X	X	X		X	X	X	X		X	X		X	X	X		X		X
	2-wire PROFIBUS PA	D		X		X			X	X		X	X		X		X	X		X	X	X		X	X	X	X		X	X		X	X		X	X	X	
	2-wire FOUNDATION Fieldbus	F		X		X			X	X		X	X		X		X	X		X	X	X		X	X	X	X		X	X		X	X		X	X	X	
	4-wire 90-250VAC 4-20mA SIL HART	G						X									X																		X			
	4-wire 10.5-32VDC 4-20mA SIL HART	H						X									X																		X			
	2-wire 4-20mA HART, Interface	K			X		X		X		X			X		X		X		X	X	X		X	X	X	X		X	X		X	X	X		X		X
80 Housing:	F12 Alu, coated IP68 NEMA6P	A						X		X	X	X					X		X	X	X		X	X		X								X	X		X	X
	F23 316L IP68 NEMA6P	B				X	X					X			X	X					X		X	X		X				X	X	X						
	T12 Alu, coated IP68 NEMA6P,	C							X									X			X	X			X								X			X	X		
	T12 Alu, coated IP68 NEMA6P + OVP	D		X	X							X	X	X							X		X	X		X	X	X	X										
90 Cable entry:	thread M20 (EEx d > thread M20)	2																			X	X	X	X	X													
	thread G1/2	3																			X	X	X	X	X													
	thread NPT1/2	4																			X	X	X	X	X													
	Plug M12	5																			X		X	X														
	Plug 7/8"	6																			X		X	X														

1) Housing F12/F23/T12-OVP: In combination with electronics B, D or F supply intrinsically safe.
** in preparation*

Overfill protection	WHG. See "Ordering structure", → 📄 6 (ZE00256F/00/DE). SIL 2, for 4 to 20 mA output (see SD00174F/00/EN "Functional Safety Manual").
Telecommunications	Complies with "Part 15" of the FCC rules for an "Unintentional Radiator". All probes meet the requirements for a "Class A Digital Device". In addition, all probes in metallic tanks as well as the coax probe meet the requirements for a "Class B Digital Device".
Standards and guidelines applied	The European directives and standards applied can be taken from the associated EC Declarations of Conformity. In addition, the following also applied for Levelflex M: EN 60529 Protection class of housing (IP-code) NAMUR – international user association of automation technology in process industries. ■ NE21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment. ■ NE43 Standardization of the signal level for the failure information of digital transmitters.
Pressure Equipment Directive	The FMP45 corresponds to the 97/23/EC Directive (Pressure Equipment Directive). It is a pressure accessory with a volume < 0.1 l in accordance with Category I. Conformity assessment was carried out as per Module A, the design as per EN 13445 and AD 2000 technical specifications. FMP45 is not suitable for use with unstable gases at nominal pressures above 200 bar.
Steam boiler approval	The FMP45 is approved as a limiting device for high water (HW) and low water (LW) for liquids in containers which are subject to the requirements of EN12952-11 and EN12953-9 (certified by TÜV Nord). See "Ordering structure", → Seite 6 ff.. Further information can be found in the safety instructions for steam boiler approval (SD00288F/00/EN).

10.1.8 Additional documentation

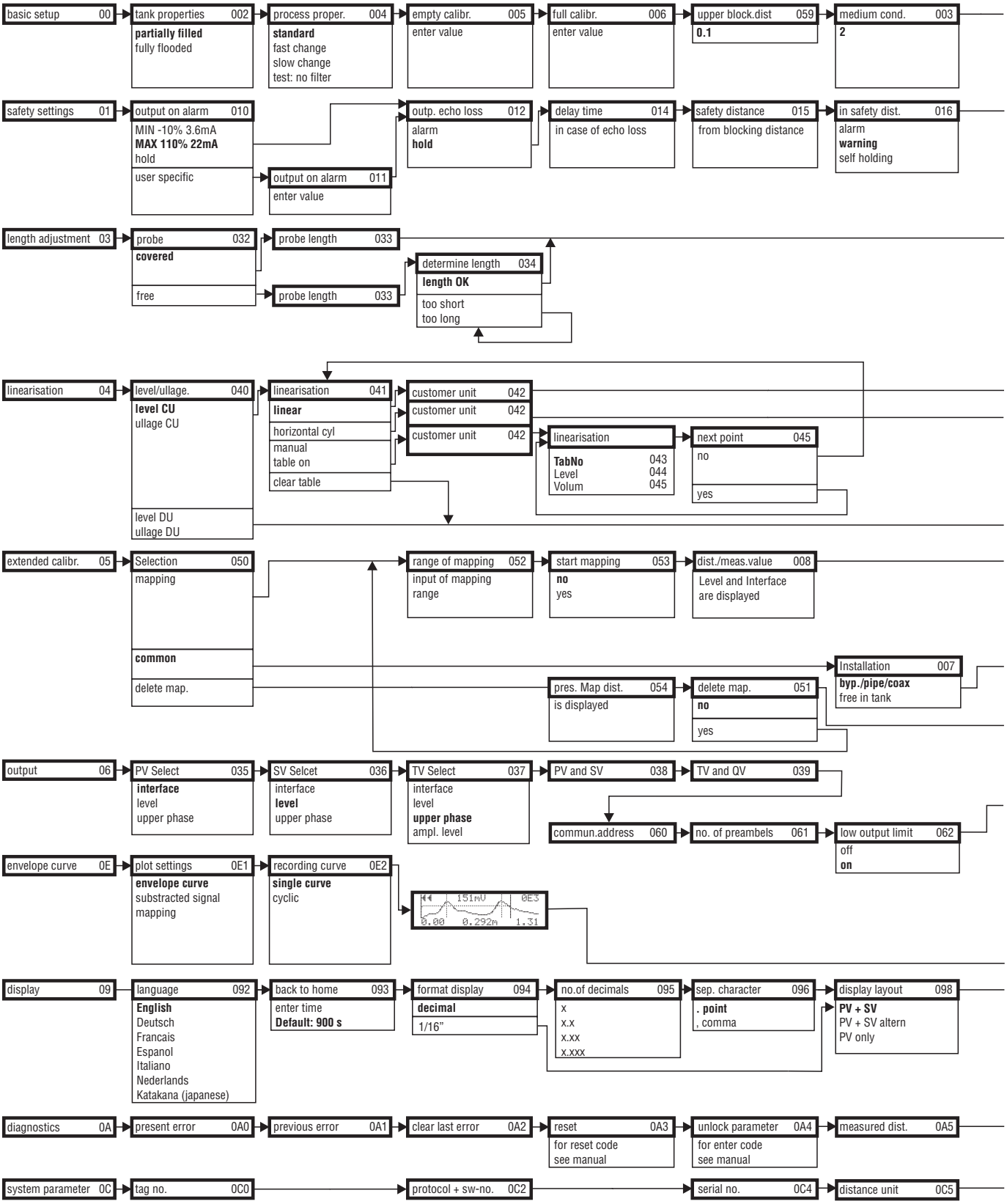
Additional documentation

This additional documentation can be foun on our product pages on www.endress.com.

- Technical Information (TI00386F/00/EN)
- Safety Manual "Functional safety manual" (SD00174F/00/EN)
- Certificate "Allgemeine bauaufsichtliche Zulassung" (approval from the German Institute of Structural Engineering) (ZE00256F/00/DE)
- Safety instruction for steam boiler approval (SD00288F/00/EN)

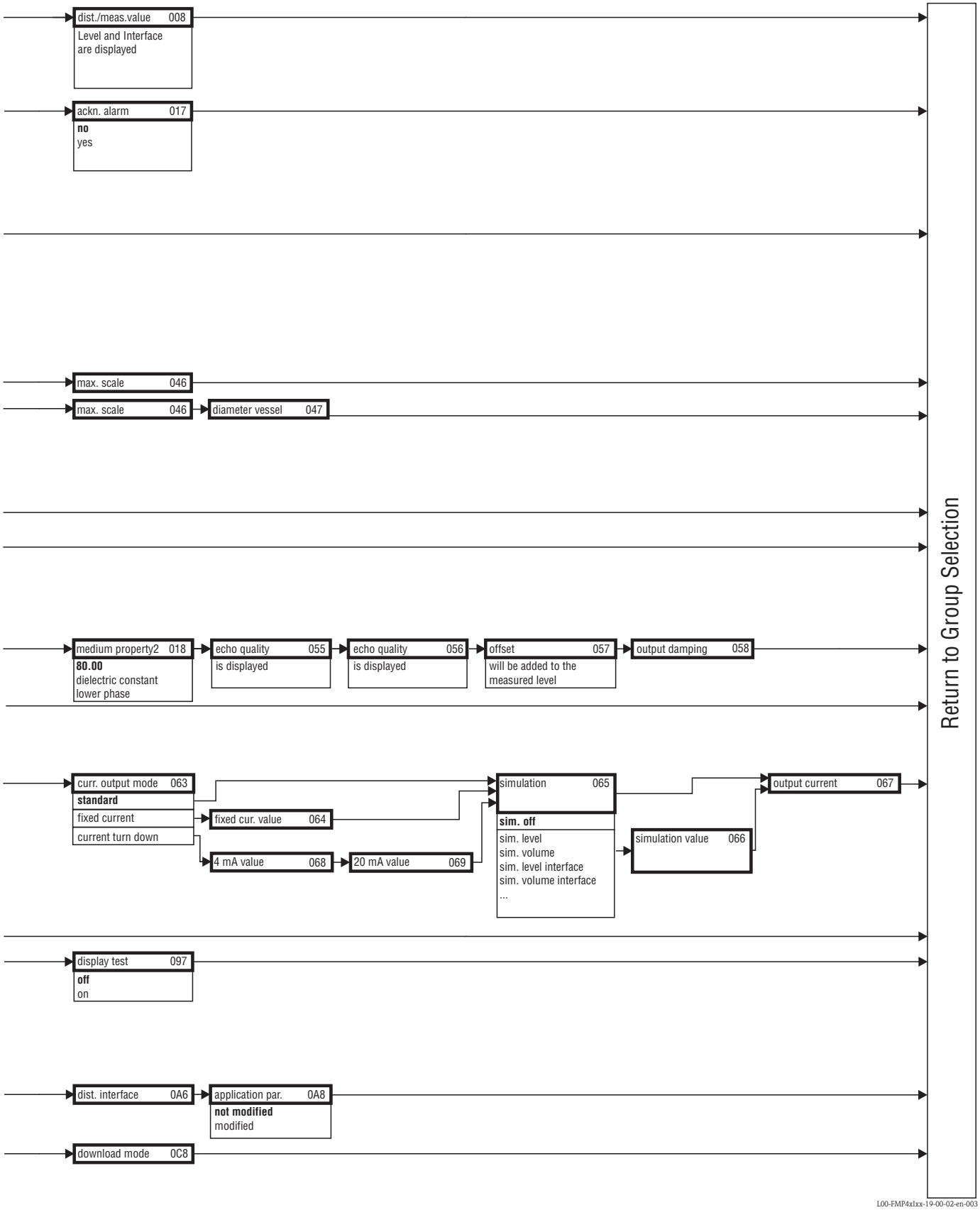
11 Appendix

11.1 HART operating menu (display module)



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

L00-FMP4xIxx-19-00-01-en-003


dist./meas.value 008
Level and Interface are displayed
ackn. alarm 017
no
yes
max. scale 046
max. scale 046
diameter vessel 047
medium property2 018
80.00
dielectric constant
lower phase
echo quality 055
is displayed
echo quality 056
is displayed
offset 057
will be added to the measured level
output damping 058
curr. output mode 063
standard
fixed current
current turn down
fixed cur. value 064
4 mA value 068
20 mA value 069
simulation 065
sim. off
sim. level
sim. volume
sim. level interface
sim. volume interface
...
simulation value 066
output current 067
display test 097
off
on
dist. interface 0A6
application par. 0A8
not modified
modified
download mode 0C8
Return to Group Selection
L00-FMP4xIxx-19-00-02-en-003

11.2 Patents

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

- US 5,661,251 ≙ EP 0 780 664
- US 5,827,985 ≙ EP 0 780 664
- US 5,884,231 ≙ EP 0 780 665
- US 5,973,637 ≙ EP 0 928 974

Index

Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

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

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

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

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

Process data/ *Prozessdaten*

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

Medium and warnings
Warnhinweise zum Medium

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

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

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

Description of failure / *Fehlerbeschreibung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____

_____

Address / *Adresse*

_____

_____

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

_____

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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