



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

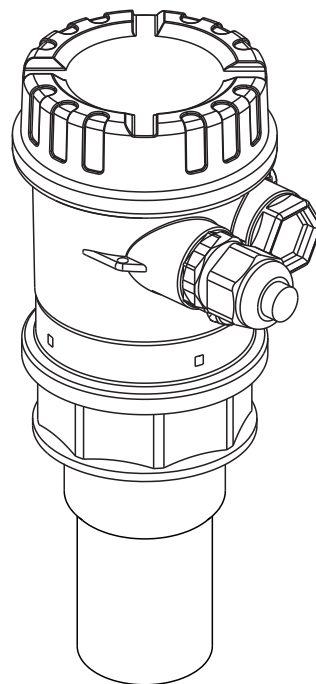
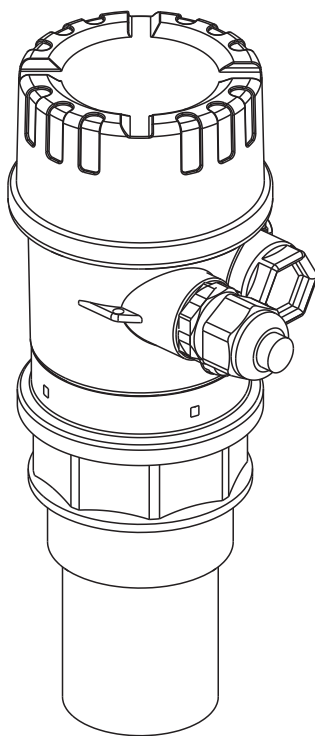


Solutions

Operating Instructions

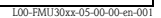
Prosonic T FMU30

Ultrasonic Level Measurement



KA290F/00/A2/12.09
71106912

$\overset{+}{\underset{\downarrow}{\bigcirc}}$ and $\overset{\mathbf{E}}{\bigcirc}$: increase contrast
 $\overset{-}{\underset{\downarrow}{\bigcirc}}$ and $\overset{\mathbf{E}}{\bigcirc}$: decrease contrast



This operating instructions describes the installation and commissioning of the Prosonic T ultrasonic level transmitter. It contains all the functions required for a normal measuring operation. Also, the instrument provides additional functions for optimising the measuring point and for converting the measured value. These functions are not included in this operating instructions.

You can find a **detailed description of all the device functions** in the operating instructions BA00388F/00/EN "Prosonic T - Description of Instrument Functions". This is located on the supplied documentation CD-ROM.

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1 Safety instructions

1.1 Designated use

The Prosonic T is a compact measuring device for continuous, non-contact level measurement. Depending on the sensor, the measuring range is up to 8 m (26 ft) in fluids and up to 3.5 m (11 ft) in bulk solids.

1.2 Installation, commissioning, operation

The instrument is fail-safe and is constructed to the state-of-the-art. It meets the appropriate standards and EC directives. However, if you use it improperly or other than for its designated use, it may pose application-specific hazards, e.g. product overflow due to incorrect installation or configuration. Installation, electrical connection, start-up, operation and maintenance of the measuring device must therefore be carried out exclusively by trained specialists authorised by the system operator. Technical personnel must have read and understood these operating instructions and must adhere to them. You may only undertake modifications or repair work to the device when it is expressly permitted by 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 work on the device.

Hazardous areas

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

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

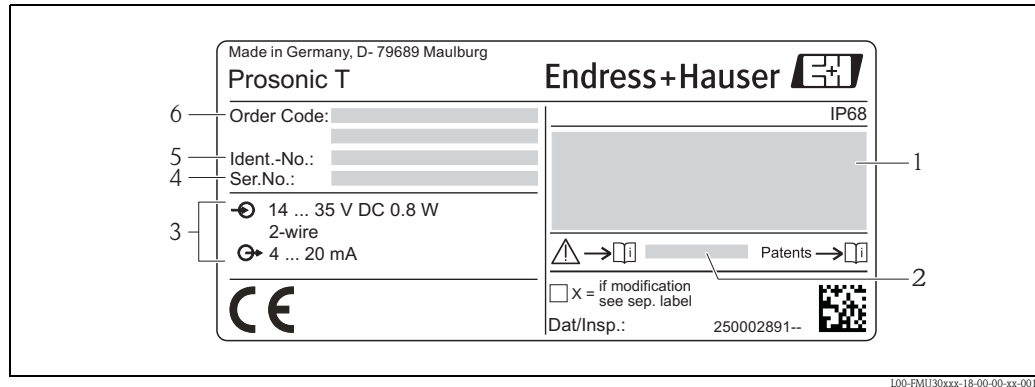
1.4 Notes on safety conventions and symbols

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

Safety conventions	
	Warning! A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
	Caution! Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	Note! A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned
Explosion protection	
	Device certified for use in explosion hazardous area If the device has this symbol embossed on its name plate it can be installed in an explosion hazardous area
	Explosion hazardous area Symbol used in drawings to indicate explosion hazardous areas. Devices located in and wiring entering areas with the designation "explosion hazardous areas" must conform with the stated type of protection.
	Safe area (non-explosion hazardous area) Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas
Electrical symbols	
	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	Grounded terminal A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	Protective grounding (earth) terminal A terminal which must be connected to earth ground prior to making any other connection to the equipment
	Equipotential connection (earth bonding) A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice

2 Identification

2.1 Nameplate



- 1 Designation according to Directive 94/9/EC and designation of the type of protection (only for certified device variants)
- 2 Reference to additional safety-relevant documentation (only for certified device variants)
- 3 Supply voltage
- 4 Serial number
- 5 Ident.-No.
- 6 Order Code

2.2 Product structure

Versions that mutually exclude one another are not marked.

010	Approval:	
	AA	Non-hazardous area
	BB	ATEX II 1/2G Ex ia IIC T5
	CA	CSA C/US General Purpose
	CB	CSA C/US IS CL.I Div.1 Gr.A-D
	IB	IEC Ex zone 0/1, Ex ia IIC T5 Ga/Gb
	NB	NEPSI zone 0/1, Ex ia IIC T5 Ga/Gb
	99	Special version
020	Display; Operating:	
	G	W/o; via spare part display FMU30
	H	Envelope curve display on site; push button
	Y	Special version
030	Electrical Connection:	
	E	Gland M20, IP68
	F	Thread G1/2, IP68
	G	Thread NPT1/2, IP68
	Y	Special version
040	Sensor; Max Range; Blocking Distance:	
	AA	1-1/2"; 5m liquid/2m solid; 0.25m
	AB	2"; 8m liquid/3.5m solid; 0.35m
	YY	Special version
050	Process Connection:	
	GGF	Thread ISO228 G1-1/2, PP
	GHF	Thread ISO228 G2, PP
	RGF	Thread ANSI MNPT1-1/2, PP
	RHF	Thread ANSI MNPT2, PP
	YYY	Special version
620	Accessory Enclosed:	
	RA	UNI flange 2"/DN50/50, PP max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	RB	UNI flange 2"/DN50/50, PVDF max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	RC	UNI flange 2"/DN50/50, 316L max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	RD	UNI flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	RE	UNI flange 3"/DN80/80, PVDF max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	RF	UNI flange 3"/DN80/80, 316L max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	RG	UNI flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	RH	UNI flange 4"/DN100/100, PVDF max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	RI	UNI flange 4"/DN100/100, 316L max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	R9	Special version
895	Marking:	
	Z1	Tagging (TAG), see additional spec.

You can fill in the options of the respective feature into the following table. The filled in options result in the complete order code.

	010	020	030	040	050	620	895
FMU30 -							

2.3 Scope of delivery

- Instrument according to the version ordered
- Accessories (→ 43)
- Brief operating instructions KA01054F/00/EN for quick commissioning
- Brief operating instructions KA00290F/00/A2 (basic setup/troubleshooting), housed in the instrument)
- For certified instrument versions: Safety Instructions, Control- or Installation drawings
- counter nut (PC): option 50, versions GGF/GHF → 7 "Product structure"
- sealing ring (EPDM): option 50, versions GGF/GHF → 7 "Product structure"
- for gland M20x1.5: cable gland
The cable gland is mounted on delivery.
- CD-ROM with further documentation, e. g.
 - Technical Information
 - Operating Instructions
 - Description of Instrument Functions

2.4 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.

2.5 Registered trademarks

FieldCare®

Trademark of Endress+Hauser Process Solutions AG.

ToF®

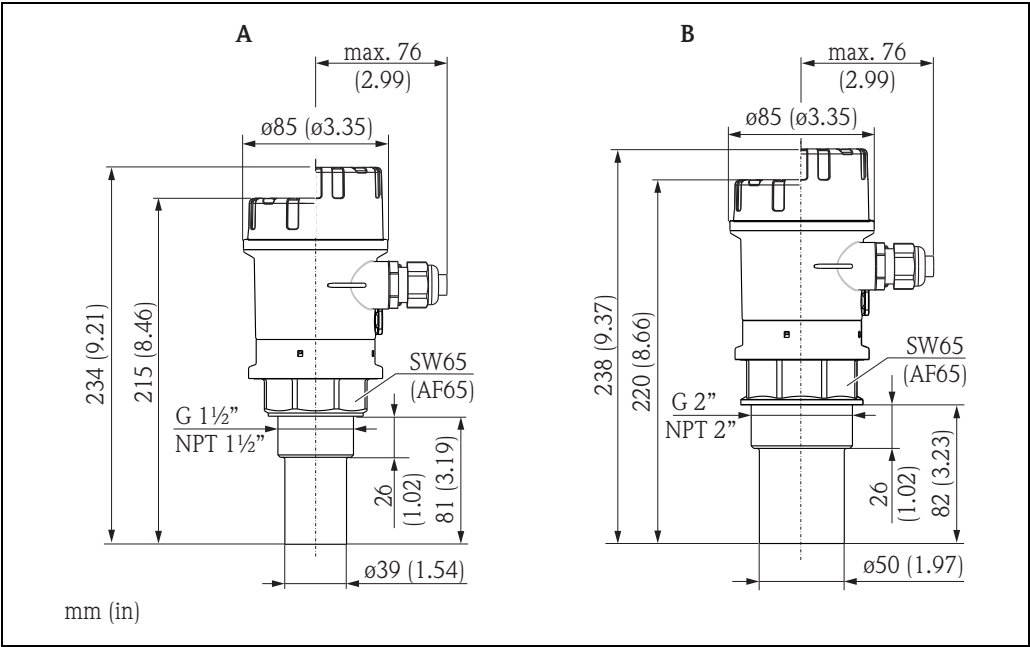
Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

PulseMaster®

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

3 Installation

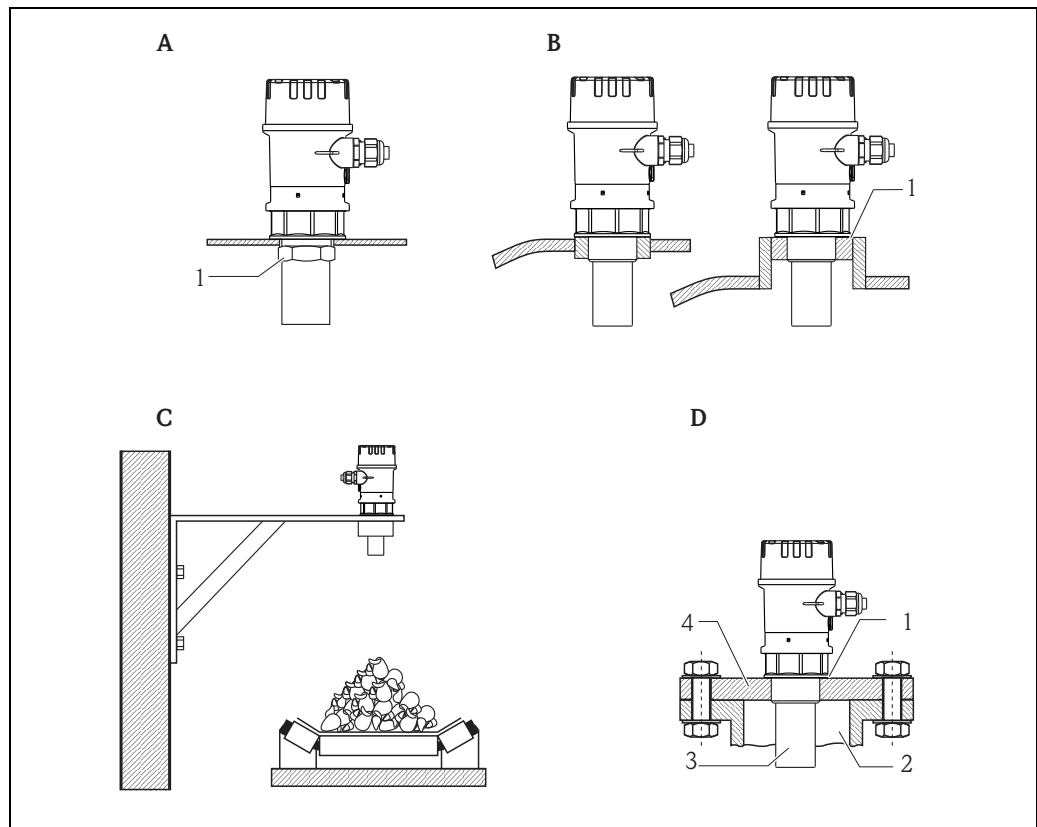
3.1 Design; dimensions



100-FM130xxx-06-00-00-xx-006

- A** Sensor 1 1/2"
B Sensor 2"

3.2 Installation variants

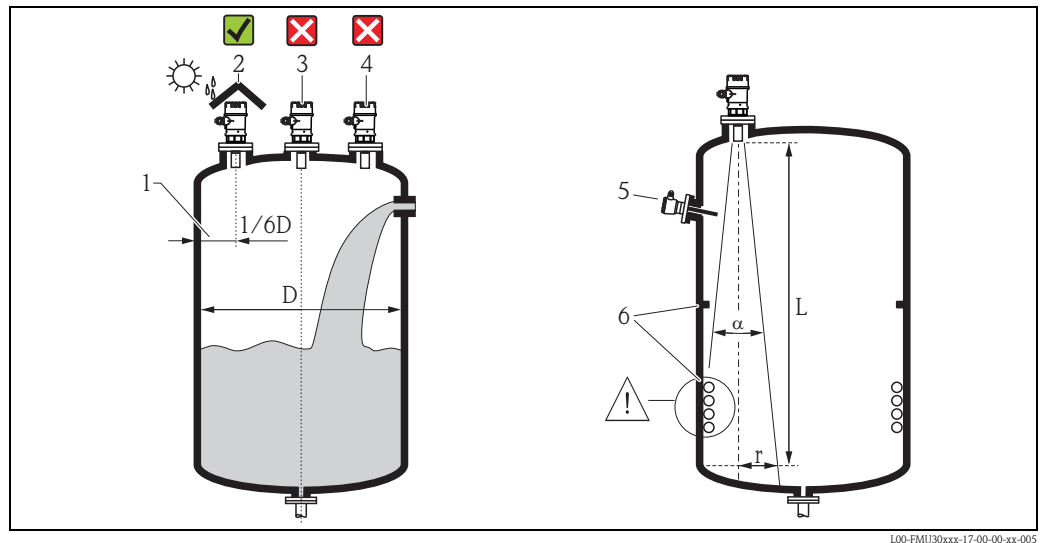


- A** Installation with counter nut
 1 counter nut (PC) supplied for G1½ and G2 instruments
- B** Installation with sleeve
 1 sealing (EPDM) supplied
- C** Installation with installation bracket
- D** Installation with screw in flange
 1 sealing (EPDM) supplied
 2 nozzle
 3 sensor
 4 screw in flange

For installation bracket or screw in flange → 43, "Accessories".

3.3 Installation conditions

3.3.1 Installation conditions for level measurements

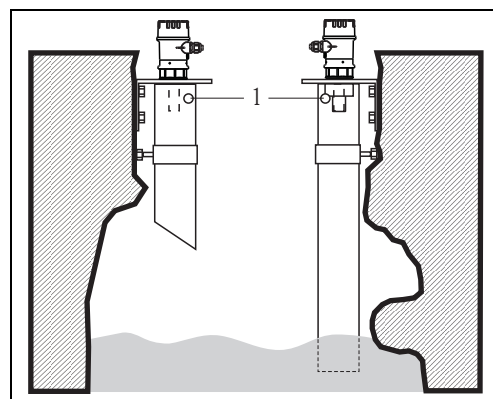


- Do not install the sensor in the middle of the tank (3). We recommend leaving a distance between the sensor and the tank wall (1) measuring $1/6$ of the tank diameter.
- Protect the device against direct sun or rain (2), e.g. with a weather protection cover, see the technical information TI00440F, chapter "Accessories".
- Avoid measurements through the filling curtain (4).
- For solid application where bulk solid cones appear, align the sensor membrane perpendicular to the surface.
- Make sure that equipment (5) such as limit switches, temperature sensors, etc. are not located within the emitting angle α . In particular, symmetrical equipment (6) such as heating coils, baffles etc. can influence measurement.
- Never install two ultrasonic measuring devices in a tank, as the two signals may affect each other.
- To estimate the detection range, use the 3 dB emitting angle α .

Sensor	α	$L_{\max}$	$r_{\max}$
1 1/2"	11°	5 m (16 ft)	0.48 m (1.6 ft)
2"	11°	8 m (26 ft)	0.77 m (2.5 ft)

3.3.2 Installation in narrow shafts

In narrow shafts with strong interference echoes, we recommend using an ultrasound guide pipe (e.g. PE or PVC wastewater pipe) with a minimum diameter of 100 mm (3.94 in). Make sure that the pipe is not soiled by accumulated dirt. If necessary, clean the pipe at regular intervals.



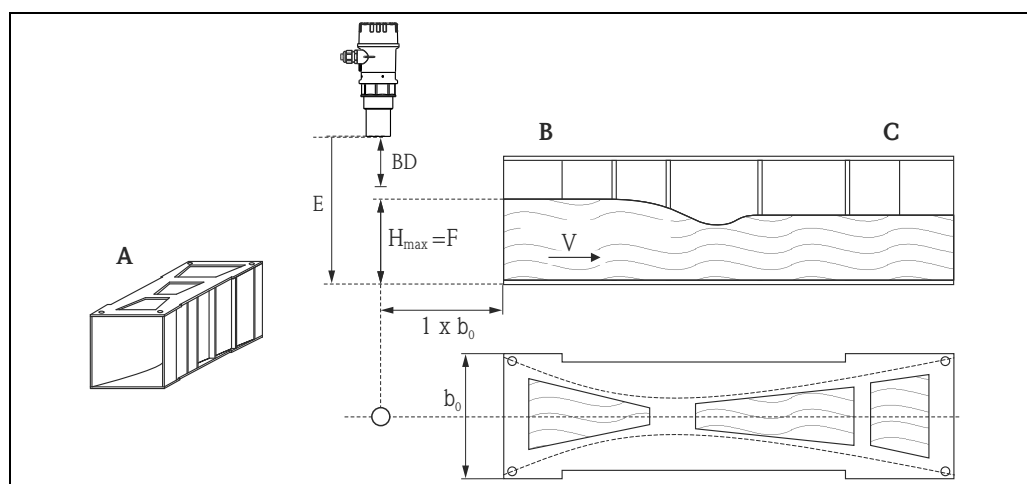
L00-FMU30xxxx-17-00-00-xx-010

1 Venting hole

3.3.3 Installation conditions for flow measurements

- Install the device at the inflow side (B), as close above the maximum water level $H_{\max}$ as possible (take into account the blocking distance BD).
- Position the instrument in the middle of the channel or weir.
- Align the sensor membrane parallel to the water surface.
- Keep to the installation distance of the channel or weir.

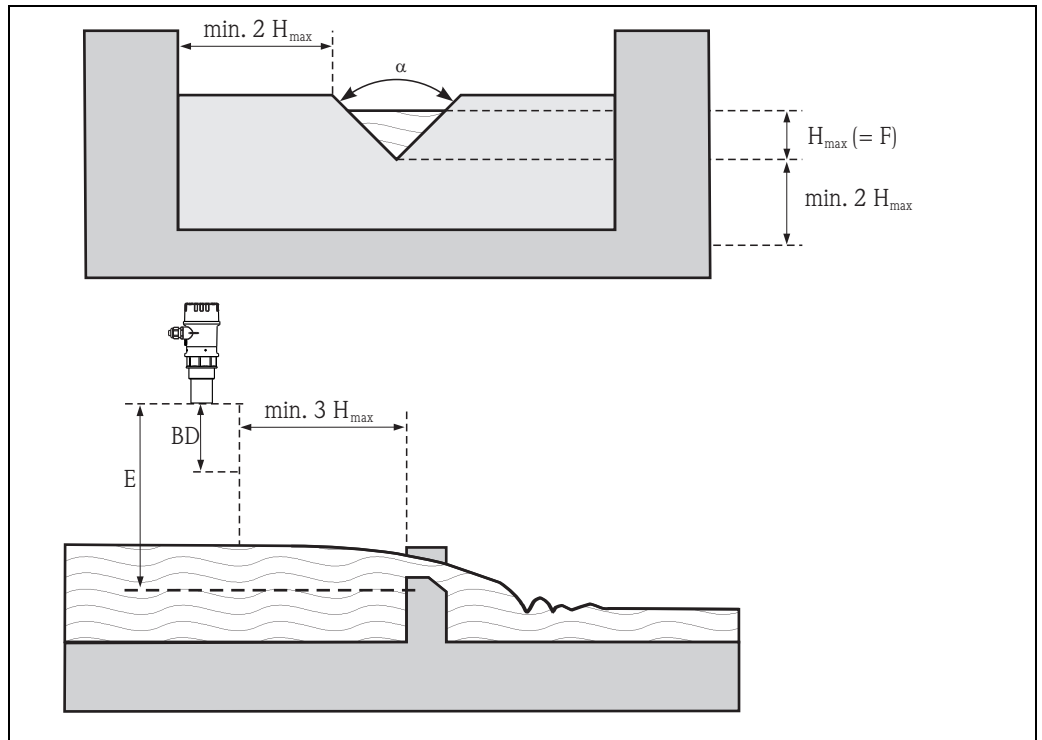
Example: Khafagi-Venturi flume



A0019607

A Khafagi-Venturi flume
B Inflow
C Outflow

BD Blocking distance
E Empty calibration
F Full calibration
V Direction of flow

Example: Triangular weir

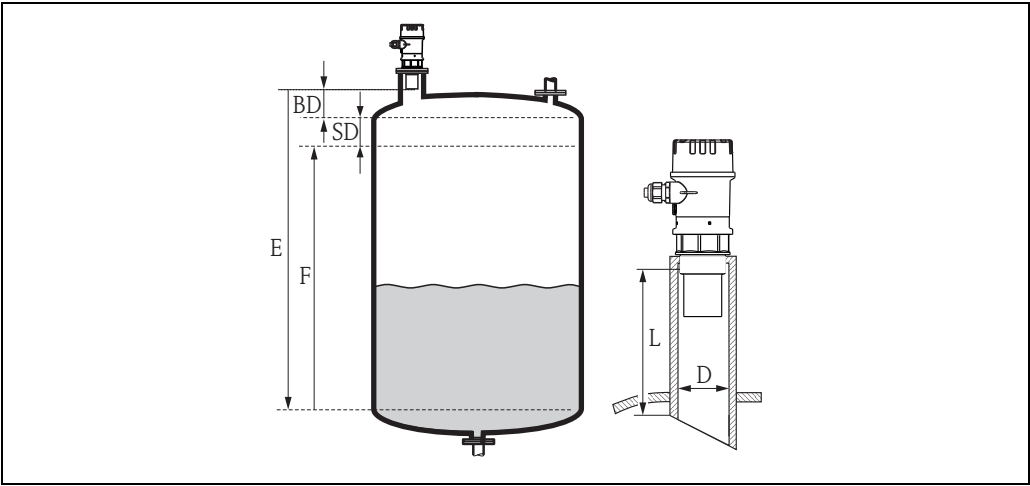
100-FMU30xxx-17-00-00-xx-012

BD Blocking distance
E Empty calibration
F Full calibration

3.4 Measuring range

3.4.1 Blocking distance, Nozzle mounting

Install the instrument at a height so that the blocking distance BD is not undershot, even at maximum fill level. Use a pipe nozzle if you cannot maintain the blocking distance in any other way. The interior of the nozzle must be smooth and may not contain any edges or welded joints. In particular, there should be no burr on the inside of the tank side nozzle end. Note the specified limits for nozzle diameter and length. To minimise disturbing factors, we recommend an angled socket edge (ideally 45°).



BD Blocking distance
SD Safety distance
E Empty calibration

F Full calibration (span)
D Nozzle diameter
L Nozzle length

	Maximum nozzle length mm (in)	
Nozzle diameter	1½" sensor	2" sensor
DN50/2"	80 (3.15)	–
DN80/3"	240 (9.45)	240 (9.45)
DN100/4"	300 (11.8)	300 (11.8)
DN150/6"	400 (15.7)	400 (15.7)
DN200/8"	400 (15.7)	400 (15.7)
DN250/10"	400 (15.7)	400 (15.7)
DN300/12"	400 (15.7)	400 (15.7)
Sensor characteristics		
Emitting angle α	11°	11°
Blocking distance (m [ft])	0.25 (0.8)	0.35 (1.1)
Max. range (m [ft]) in liquids	5 (16)	8 (26)
Max. range (m [ft]) in solids	2 (6.6)	3.5 (11)



Caution!
If the blocking distance is undershot, it may cause device malfunction.



Note!
In order to notice if the level approaches the blocking distance, you can specify a safety distance (SD). If the level is within this safety distance, the instrument outputs a warning or alarm message.

3.4.2 Safety distance

If the level rises to the safety distance SD, the device switches to warning or alarm status. The size of SD can be set freely in the **"Safety distance" (015)** function. The **"in safety distance" (016)** function defines how the device reacts if the level enters the safety distance.

There are three options:

- **Warning:** The device outputs an error message but continues measurement.
- **Alarm:** The device outputs an error message. The output signal assumes the value defined in the **"Output on alarm" (011)** function (MAX, MIN, user-specific value or holds the last value). As soon as the level drops below the safety distance, the device recommences measurement.
- **Self holding:** The device reacts in the same way as for an alarm. However, the alarm condition continues after the level drops below the safety distance. The device only recommences measurement when you cancel the alarm using the **"Ackn. alarm" (017)** function.

3.4.3 Range

The sensor range is dependent on the measuring conditions. Refer to Technical Information TI00440F/00/EN for an estimation. The maximum range is shown in the above diagram (valid for good conditions).

Sensor	Maximum range
1 1/2"	5 m (16 ft)
2"	8 m (26 ft)

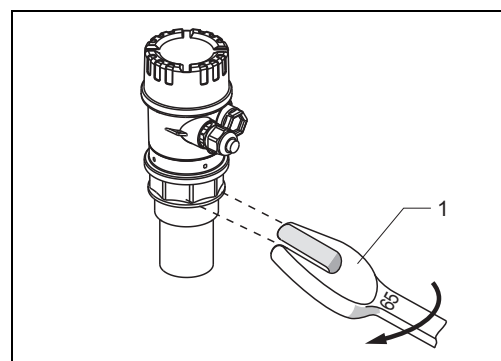
3.5 Installation hint



Caution!

Use only the screw-in piece to screw in the Prosonic T.

Screw the instrument at the screw-in piece using an 65AF spanner.



1 65 AF, max. torque 7 Nm (5.16 lbf ft)

L00-FMU30xxx-17-00-00-xx-009

3.6 Installation check

After installing the device, carry out the following checks:

- Is the device damaged (visual inspection)?
- Does the device correspond to the measuring point specifications for process temperature, process pressure, ambient temperature, measuring range etc.
- If available: Are the measuring point number and labelling correct (visual inspection)?
- Is the measuring device sufficiently protected against precipitation and direct sunlight?
- Are the cable glands tightened correctly?
- After aligning the housing, check the process seal at the nozzle or flange.

4 Wiring

4.1 Electrical connection



Caution!

Before connection please note the following:

- The power supply must be identical to the data on the nameplate.
- Switch off power supply before connecting up the instrument.
- Connect equipotential bonding to device ground terminal before connecting up the instrument
→ 18, "Potential matching".

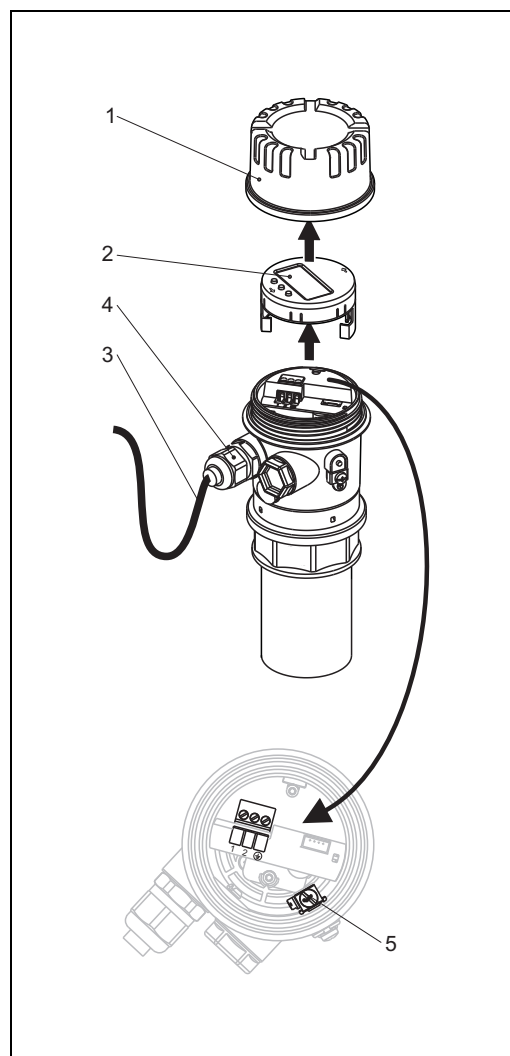


Warning!

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

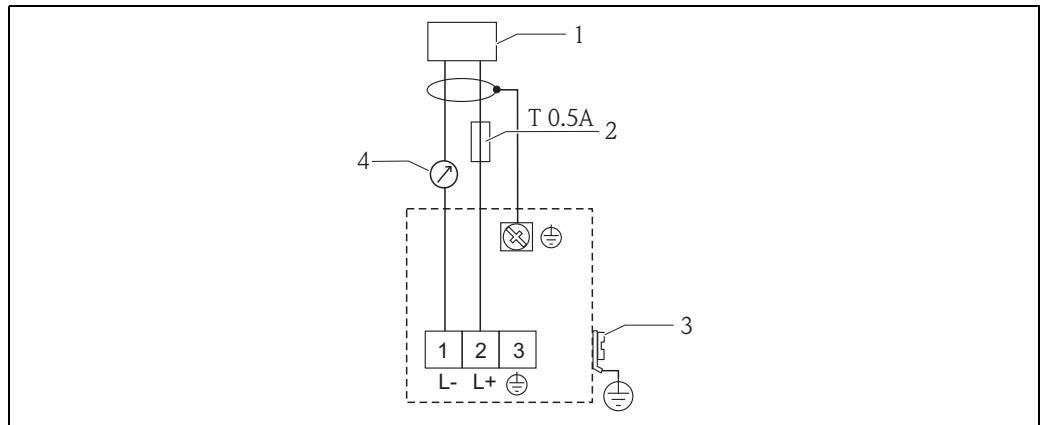
4.1.1 Wiring

1. Unscrew housing cover (1).
2. Remove display (2) if fitted.
3. Insert cable (3) through gland (4).
 - ⓘ Caution!
If possible, insert the cable from above and let a draining loop in order to avoid intrusion of humidity.
4. Installation cable screen to the grounding terminal (5) within the terminal compartment.
5. Make connection according to terminal assignment, → 17, "Terminal assignment".
6. Tighten cable gland (4).
7. Insert display (2) if fitted.
8. Screw on housing cover (1).
9. Switch on power supply.



L00-FMU30xxx-04-00-00-xx-008

4.2 Terminal assignment



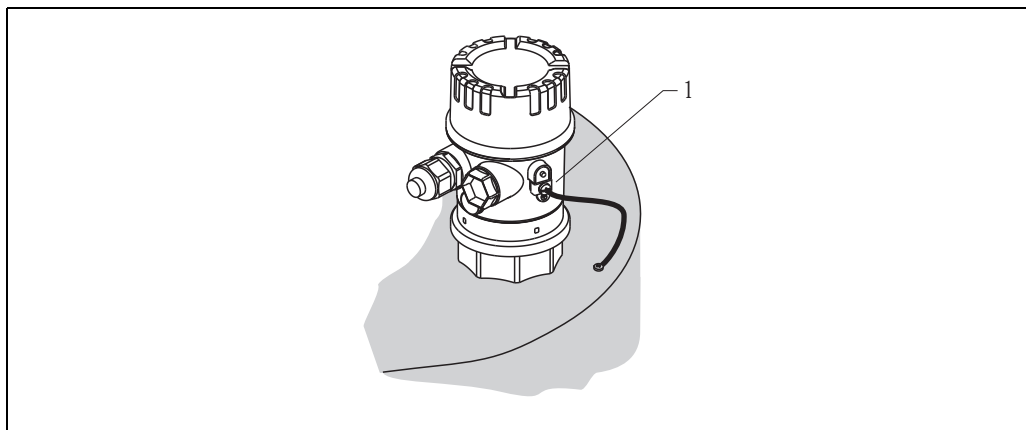
L00-FMU30xxx-04-00-00-de-015

- 1 Power
- 2 Fuse as per IEC 60127, T 0.5 A
- 3 Plant ground
- 3 4...20 mA

4.3 Supply voltage

The voltages across the terminals directly at the instrument: 14-35 V

4.4 Potential matching



L00-FMU30xxx-17-00-00-xx-014

1 External ground terminal of the device

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



Caution!

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



Note!

Since the housing is isolated from the tank by the plastic sensor, interference signals may occur if the potential matching line is not properly connected.

For optimum electromagnetic compatibility the potential matching line should be as short as possible and at least 2.5 mm² (14 AWG) in cross-section.

If increased electromagnetic interference is to be expected due to the installation conditions, we recommend usage of a ground strap.

4.5 Checking the connection

After wiring the device, carry out the following checks:

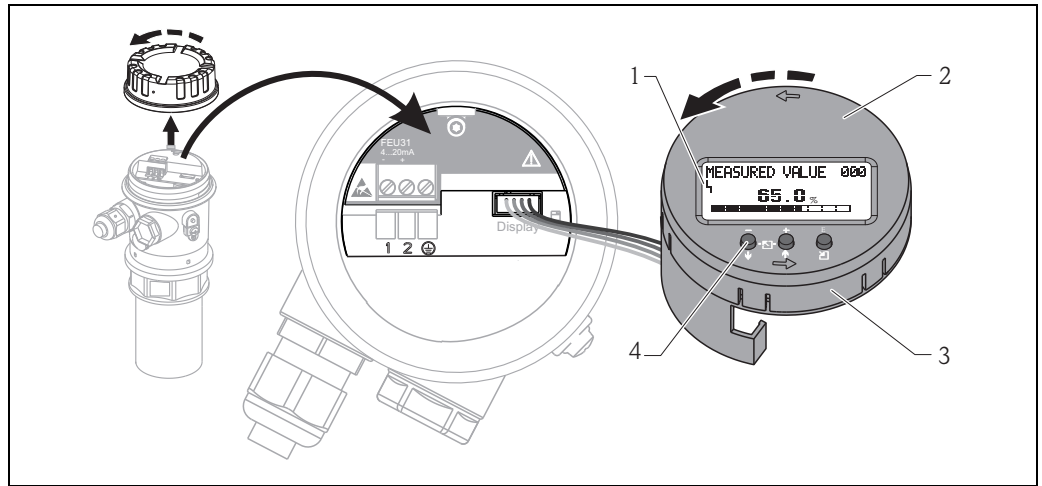
- Are the terminals correctly assigned?
- Is the cable gland tight?
- Is the housing cover fully screwed on?
- If power supply available: Does a display appear on the display module?

5 Operation

5.1 Display and operating elements

5.1.1 On-site display

The LCD module for display and operation is located beneath the housing cover. The measured value is legible through the transparent cover. Open the cover to operate the device.



L00-FMU30xxx-07-05-xx-xx-000

- 1 Display symbol
- 2 Display (rotatable)
- 3 Plug-in module
- 4 Function keys

5.1.2 Display appearance

measured value display

- 1. label
- 2. symbol
- 3. value
- 4. bargraph
- 5. unit
- 6. position in menu

group selection

- 1. selection list

Function with free parameter

- 1. label
- 2. help texts
- 3. position in menu

envelope curve

- 1. envelope curve

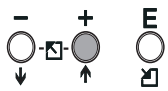
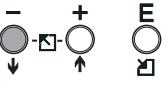
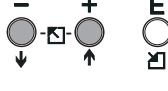
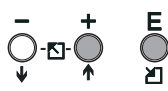
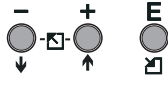
In the measured value display, the bargraph corresponds to the output. The bargraph is segmented in 10 bars. Each completely filled bar represents a change of 10% of the adjusted span.

5.1.3 Display symbols

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

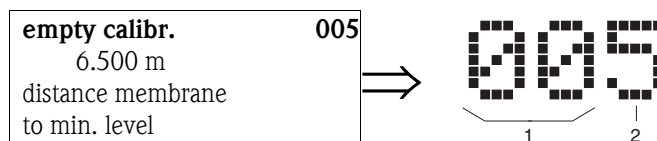
Sybmol	Meaning
	ALARM_SYMBOL This alarm symbol appears when the instrument is in an alarm state. If the symbol flashes, this indicates a warning.
	LOCK_SYMBOL This lock symbol appears when the instrument is locked, i.e. if no input is possible.

5.1.4 **Function of the keys**

Key(s) (The keys to press are displayed in grey.)	Meaning
	Navigate upwards in the selection list Edit numeric value within a function
	Navigate downwards in the selection list Edit numeric value within a function
	Navigate to the left within a function group
	Navigate to the right within a function group, confirmation.
 or 	Contrast settings of the LCD
	Hardware lock / unlock After a hardware lock, an operation of the instrument via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

5.2 Function codes

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



1 Function group

2 Function

The first two digits identify the function group:

- **basic setup** 00
- **safety settings** 01
- **temperature** 03

...

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

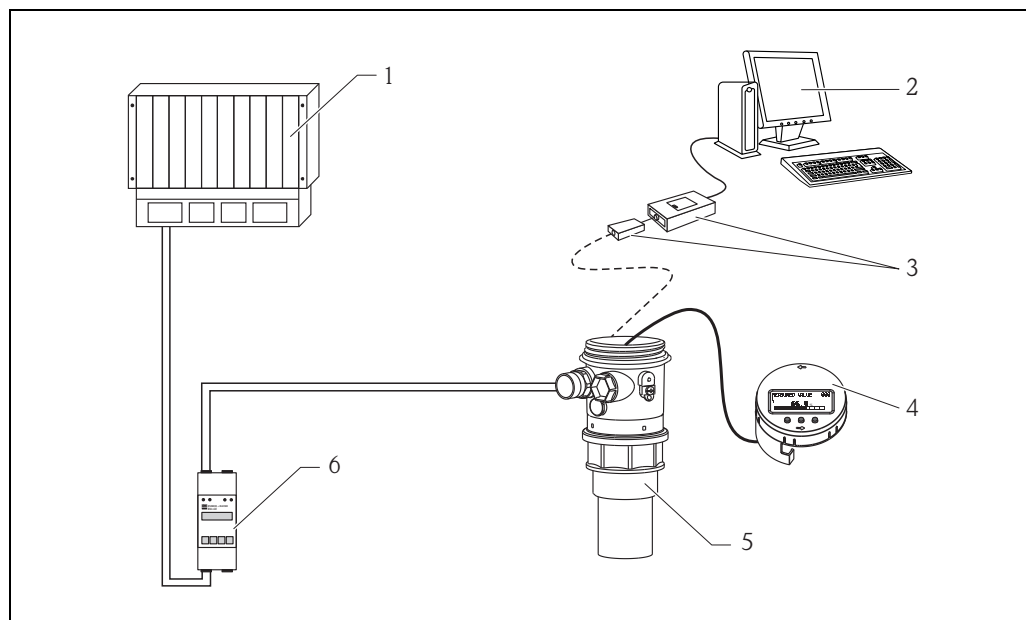
- **basic setup** 00 → ■ **tank shape** 002
- **medium property** 003
- **process cond.** 004

...

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

5.3 Operating options

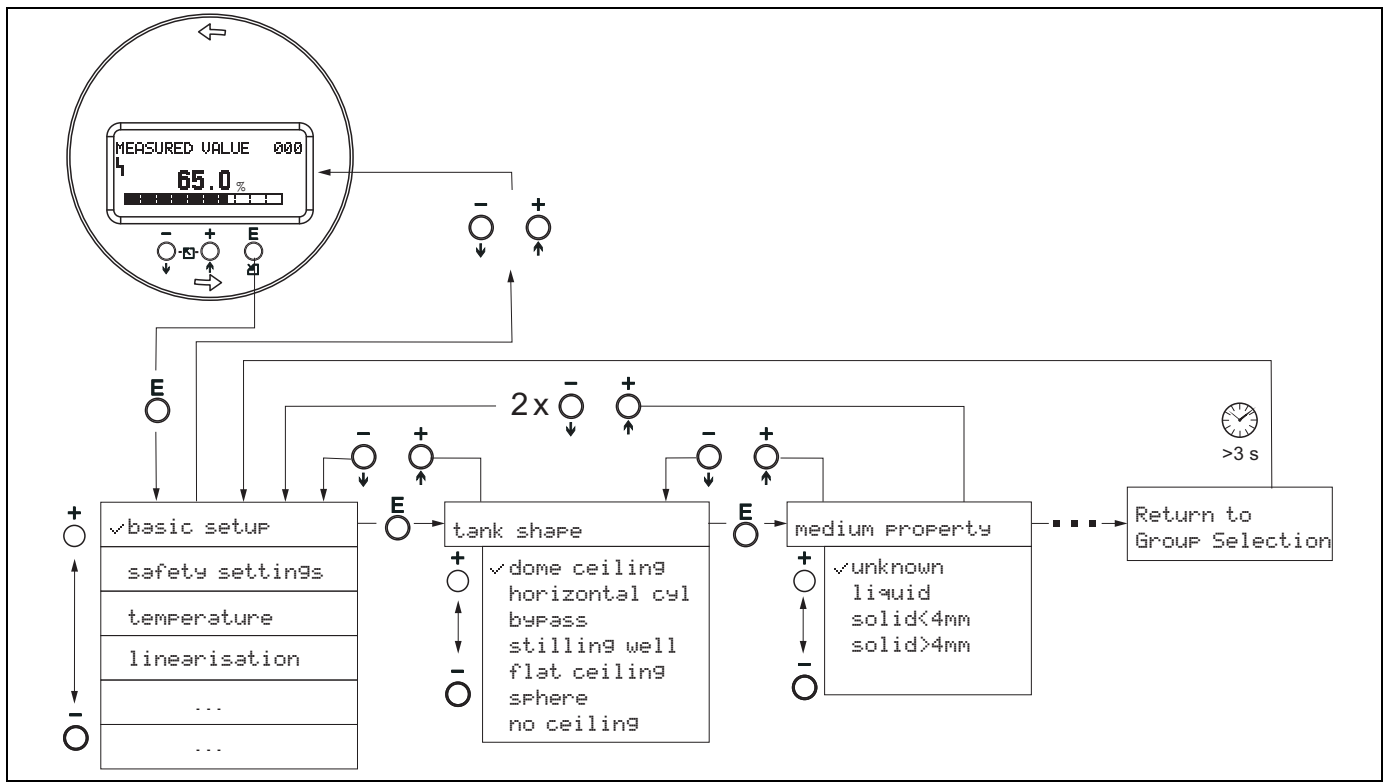
The complete measuring system consists of:



L00-FMU30xxx-14-00-06-xx-008

- 1 PLC (programmable logic controller)
- 2 Computer with operating tool (e.g. FieldCare)
- 3 Commubox FXA291 and ToF Adapter FXA291
- 4 Operating and display module
- 5 Prosonic FMU30
- 6 Transmitter power supply unit RMA42 or RN221N

5.4 Operation using the on-site display



L00-FMU130xxx-19-00-00-en-018

1. Change from Measured Value Display to **Group Selection** by pressing E.
2. Press - or + to select the required **Function Group** and confirm by pressing E. 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** with - oder + .
- b. E confirms selection; ✓ appears in front of the selected parameter.
- c. E confirms the edited value; system quits edit mode.
- d. + and - interrupts selection; system quits edit mode.

Typing in numerals and text

- a. Press + or - to edit the first character of the **numeral / text**.
 - 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. If a ← symbol appears at the cursor, press E to return to the previous character (e.g. for correction of entries).
 - e. + and - interrupts selection; system quits edit mode.
4. Press E to select the next **function**.
 5. Press + and - once; return to previous **function**. Press + and - twice; return to **Group Selection**.
 6. Press + and - to return to **Measured value display**.

5.5 Operation using FieldCare

FieldCare is Endress+Hauser's FDT based Plant Asset Management Tool. It can configure all intelligent field devices in your plant and supports you in managing them. By using status information, it also provides a simple but effective means of checking their health.

- Supports Ethernet, HART, PROFIBUS, FOUNDATION Fieldbus etc.
- Operates all Endress+Hauser devices
- Operates all third-party actuators, I/O systems and sensors supporting the FDT standard
- Ensures full functionality for all devices with DTMs
- Offers generic profile operation for any third-party fieldbus device that does not have a vendor DTM

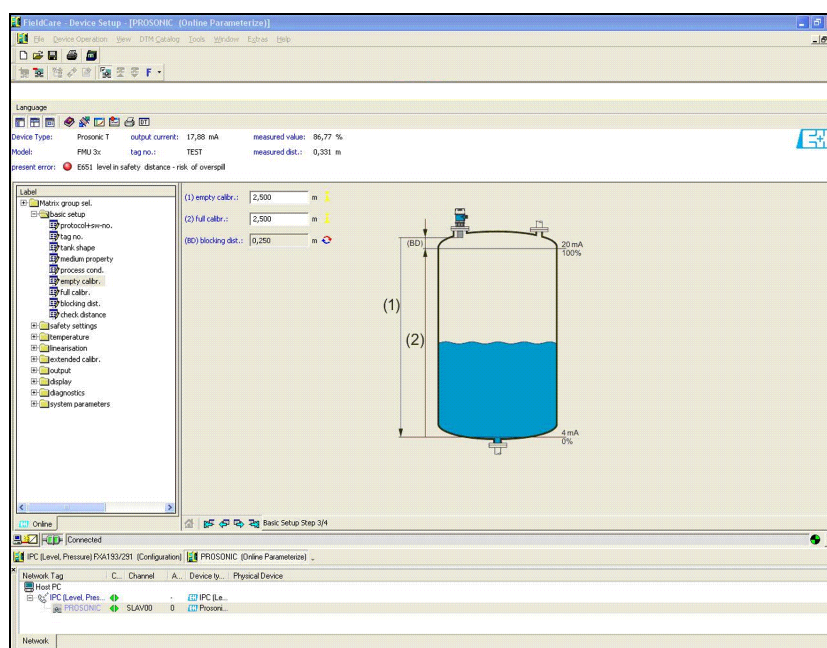
Connection for FMU30:

- Commubox FXA291 and ToF adapter FXA291 (available as accessory)

Using the following functions:

- Signal analysis via envelope curve
- Linearisation table (graphically supported creation, editing, importing and exporting)
- Loading and saving of instrument data (Upload/Download)
- Documentation of measuring point

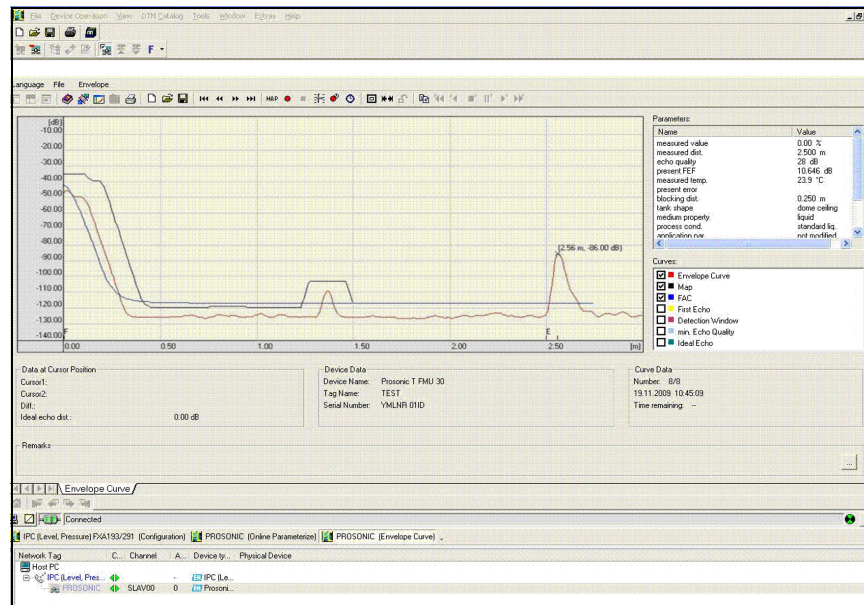
5.5.1 Menu guided commissioning



- You can find the function groups and functions of the device in the **navigation bar**.
- You can find the input fields for the parameters in the **main window**.
- If you click on a parameter name, the **Help pages** open with precise explanations of the required input.

5.5.2 Envelope curve display

The FieldCare offers easy analysis of the envelope curve via the "Envelope" menu:



5.6 Lock/unlock configuration

5.6.1 Software security locking

Enter a number $\neq 100$ in the "unlock parameter" (0A4) function in the "diagnostics" (0A) function group.

The  symbol appears on the display. Inputs are no longer possible.

If you try to change a parameter, the device jumps to the "unlock parameter" (0A4) function. Enter "100"

Now change the parameters.

5.6.2 Hardware security locking

Press - and + and E simultaneously.

Inputs are no longer possible.

If you try to change a parameter, the following appears:

```
unlock parameter 0A4
& Hardware locked
```

L00-fmrz0a4-20-00-00-en-001

Press - and + and E simultaneously. The "unlock parameter" (0A4) function appears.

Enter "100"

Now change the parameters.



Note!

A hardware locking can **only** be unlocked again via the display by pressing the - and + and E keys at the same time again. It is **not** possible to unlock the hardware by communication.

5.7 Resetting the customer parameters

It is advisable to reset the customer parameters if you want to use a device with an unknown history.

Effects of resetting:

- All customer parameters are reset to their default values.
- Customer interference echo suppression is **not** deleted.
- Linearisation is switched to "**linear**", but the table values are kept. The table can be switched back on in the "**linearisation**" (04) function group in the "**linearisation**" (041) function.

In order to carry out the reset, enter the number "333" in the "**reset**" (0A3) function in the "**diagnostics**" (0A) function group.



Caution!

A reset may lead to impairment of the measurement. As a rule, a basic calibration is required after a reset.



Note!

The default values of each parameter are shown in bold in the menu overview in the appendix.

5.8 Resetting an interference echo suppression (tank map)

It is always advisable to reset the interference echo suppression (tank mapping) when:

- a device with an unknown history is used
- an incorrect suppression was input.

Proceed as follows:

1. Switch to the "**extended calibr.**" (05) function group and to the "**selection**" (050) function.
2. Select "**extended map.**"
3. Then proceed to the "**cust. tank map**" (055) function.
4. Select
 - "**reset**", to delete (reset) the existing interference echo suppression.
 - "**inactive**" to deactivate an existing interference echo suppression. The suppression remains saved.
 - "**active**" to reactivate an existing interference echo suppression.

6 Commissioning

Commission the device in the following stages:

- Installation check
- Power-up device
- Basic calibration
- Measuring signal check using the envelope curve

The chapter describes the commissioning process using the on-site display. Commissioning using FieldCare operating program is identical.

6.1 Power up instrument

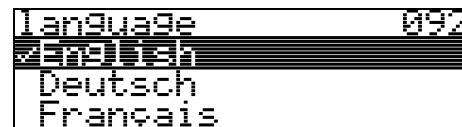
After switching on the supply voltage, the instrument is first initialised. Then the following appear for approximately five seconds:

- Device type
- Software version

Press E to exit this display.

On first power-up, you are requested to select the language for the display texts. Available language:

- English
- Deutsch
- Français
- Español
- Italiano
- Nederlands
- Japanese



L00-4mrx092-20-00-00-en-001

Then you are requested to select the unit of length for your measurements. Available unit of length:

- m
- ft
- mm
- inch



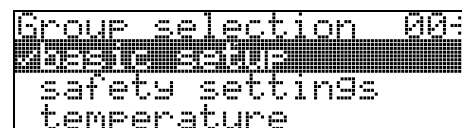
L00-4mrx0c5-20-00-00-en-001

A measured value is displayed. This is NOT equivalent to the level in your tank. Firstly carry out a basic calibration.



L00-4mrx000-20-00-00-en-001

Press E to switch to the group selection.
Press E again to start the basic calibration.



L00-4mrx0g00-20-00-00-en-001

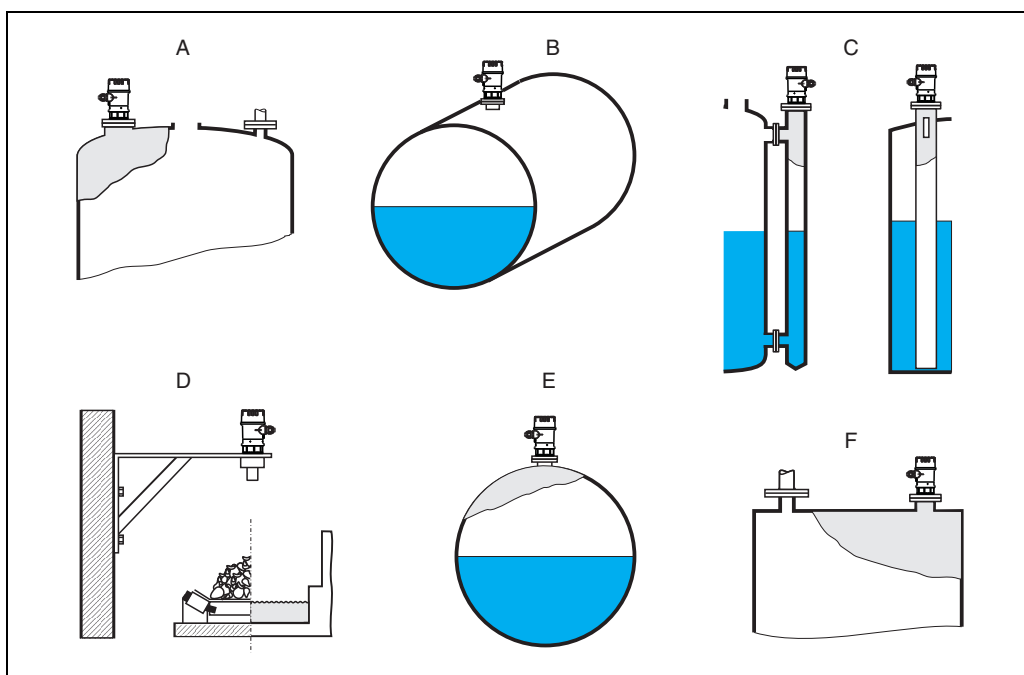
6.2 Basic calibration

The **"Basic setup" (00)** function group lists all the functions which are required for a standard measurement task to commission the instrument. When you have completed your input for a function, the next function appears automatically. In this way, you are guided through the complete calibration.

6.2.1 Measuring point settings

Function "tank shape" (002)

In this function, select one of the following options:



100-FMU130xxx-14-00-06-xx-001

- A** dome ceiling
- B** horizontal cyl.
- C** bypass, stilling well/ultrasonic guide pipe
- D** no ceiling, e.g. dumps, open levels, channels, weirs
- E** sphere
- F** flat ceiling

Function "medium property" (003)

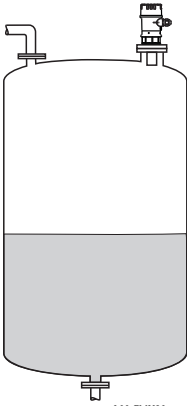
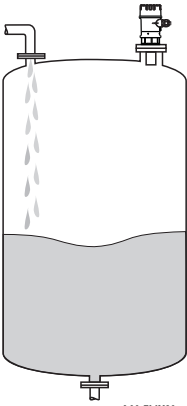
Set the medium type in this function.

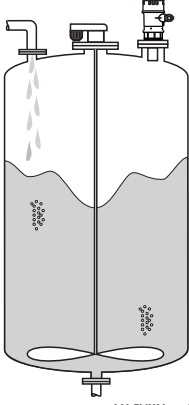
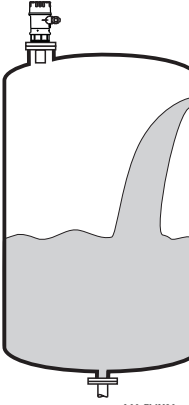
You have the following options:

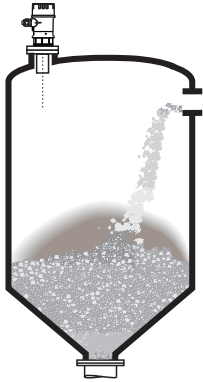
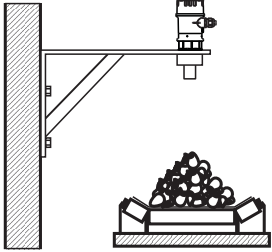
- unknown (e.g. pasty media such as greases, creams, gels etc.)
- liquid
- solid, grain size < 4 mm, (fine)
- solid, grain size > 4 mm, (coarse)

Function "process conditions" (004)

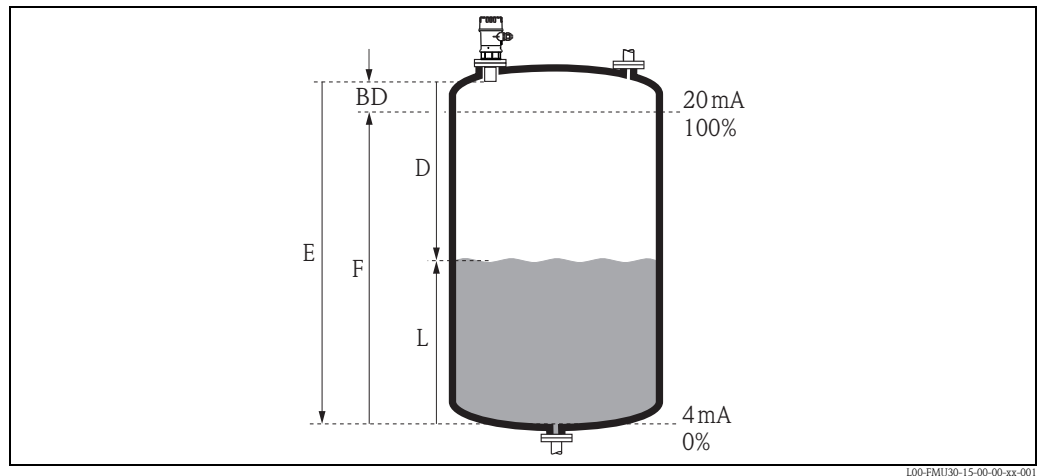
For this function, you have the following options:

standard liquids	calm surface	turb. surface
For all fluid applications which do not fit in any of the following groups.	Storage tanks with immersion tube or bottom filling	Storage / accumulation tanks with uneven surface due to free filling, mixing nozzles or small bottom stirrers
		
The filters and output damping are set to average values.	The averaging filters and output damping are set to large values. -> Stable measured value -> Accurate measurement -> Slow reaction time	Special filters for stabilising the input signal are activated. -> Stable measured value -> Medium reaction time

add. agitator	fast change	standard solid
Moving surfaces (poss. with vortex formation) due to agitators	Rapid level change, particularly in small tanks	For all bulk solids applications which do not fit in any of the following groups.
		
Special filters for stabilising the input signal are set to large values. -> Stable measured value -> Medium reaction time	The averaging filters are set to small values. -> Rapid reaction time -> Possibly unstable measured value	The filter and output damping are set to average values.

solid dusty	conveyor belt	Test: no filter
Dusty bulk solids	Bulk solids with rapid level change	All the filters can be switched off for purposes of service and diagnosis.
 L00-FMU30xxx-14-00-00-xx-007	 L00-FMU30xxx-14-00-00-xx-005	
The filters are set to detect even relatively weak signals.	The averaging filters are set to small values. -> Rapid reaction time -> Possibly unstable measured value	All filters off

6.2.2 Empty and full calibration



BD Blocking distance
E Empty distance
L Level

D Distance from sensor membrane - product surface
F Span (full distance)

Function "empty calibration" (005)

In this function, enter the distance *E* from the sensor membrane to the minimum level (zero point).



Caution!

With dished boiler heads or conical outflows, the zero point should not be deeper than the point at which the ultrasonic wave impinges on the tank bottom.

Function "blocking distance" (059)

In this function the blocking distance (*BD*) of the sensor is displayed.



Caution!

When entering the full calibration (span), please take into account, that the maximum level may not project into the blocking distance (*BD*).



Note!

After basic calibration, enter a safety distance (*SD*) in the "**safety distance**" (015) function. If the level is within this safety distance, the instrument signals a warning or an alarm, depending on your selection in the "**in safety distance**" (016) function.

Function "full calibration" (006)

In this function, enter the span *F*, i.e. the distance from the minimum level to the maximum level.

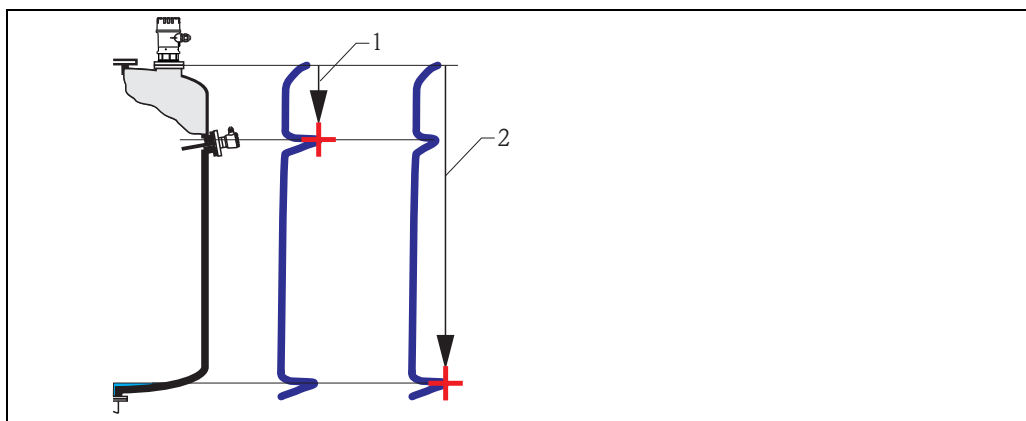
6.2.3 Interference echo suppression (tank mapping)

Function "dist./measured value" (008)

In the **"dist./meas.value" (008)** function, the measured distance D from the sensor membrane to the product surface is displayed together with level L. Check these values.

Function "check distance" (051)

The mapping is initialized by this function.



1 Distance too small

2 Distance = ok

Select

- **"distance=ok"** if the correct distance is displayed. Any echoes closer to the sensor will be suppressed by the following interference echo suppression.
- **"dist. too small"** if the displayed distance is too small. In this case, the signal comes from an interference echo which will be suppressed.
- **"dist. too big"** if the displayed distance is too large. This error cannot be cancelled by suppressing the interference echo. This means that the following two functions are skipped. Check the application parameters **"tank shape" (002)**, **"medium property" (003)** and **"process cond." (004)** and the **"empty calibr." (005)** in the **"basic setup" (00)** function group.
- **"dist. unknown"** if you do not know the actual distance. This means that the following two functions are skipped.
- **"manual"** if you want to specify the suppression area yourself in the following function.

Function "range of mapping" (052)

The suggested suppression area is displayed in this function. The reference point is always the sensor membrane. You can still edit the value. With manual suppression, the default value is 0 m.



Caution!

The suppression range must end 0.3 m (1 ft) in front of the echo of the actual level. With an empty tank, do not enter E but E – 0.3 m.

Function "start mapping" (053)

You have the following options for this function:

- **off:** Nothing is suppressed.
- **on:** Starts suppression.



Note!

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

Function dist./measured value (008)

After suppression, the measured distance D from the sensor membrane to the product surface is displayed together with the level. Check that the values correspond to the actual level and/or the actual distance.

The following cases may occur:

- Distance correct – Level correct -> End of basic calibration
- Distance incorrect – Level incorrect -> An additional interference echo suppression must be carried out. Go back to the "**check distance**" (051) function.
- Distance correct – Level incorrect -> Check the value of the "**empty calibr.**" (005) function.

Return to group selection

After the interference echo suppression the basic setting is finished and the instrument jumps automatically back into the group selection.

6.3 Envelope curve

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

6.3.1 Function "plot settings" (0E1)

In this function, select whether you want to display

- just the envelope curve
- The envelope curve and the echo evaluation line FAC
- The envelope curve and interference echo suppression (map)



Note!

The FAC and the interference echo suppression (map) are explained in BA00388F "Prosonic T – Description of Instrument Functions"

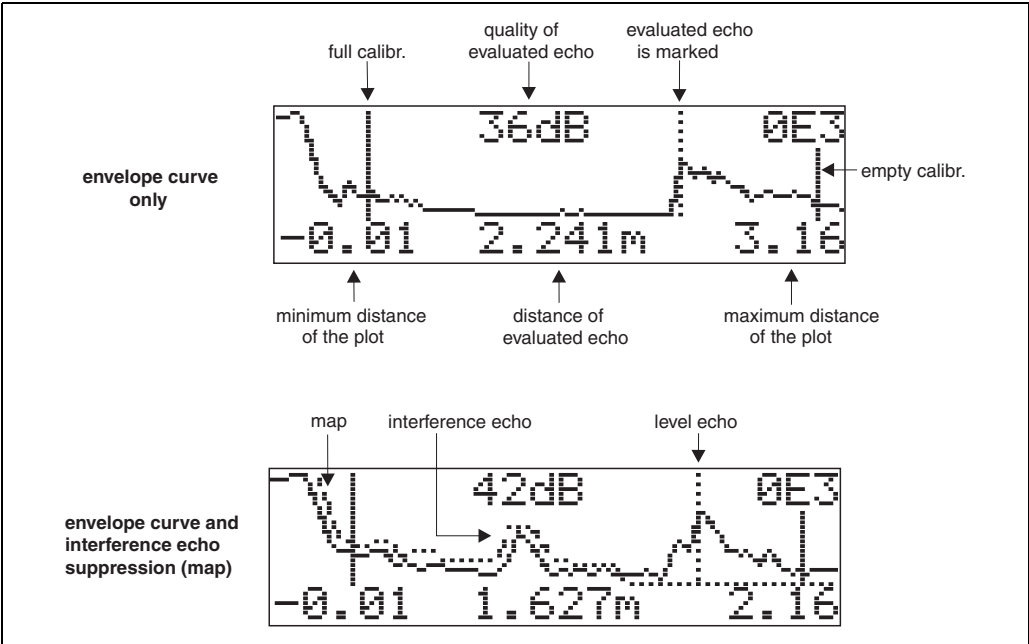
6.3.2 Function "recording curve" (0E2)

In this function, specify whether you want to display

- an individual envelope curve
- The current envelope curve, with cyclical refreshment.

6.3.3 Function "envelope curve display" (0E3)

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



L00-FMU4xxxx-07-00-00-en-003

Check that the following conditions are fulfilled:

- The echo quality at the end of measuring range should be at least 10dB.
- There should be practically no interference echoes in front of the level signal.
- If interference echoes cannot be avoided, they must be below the suppression curve.

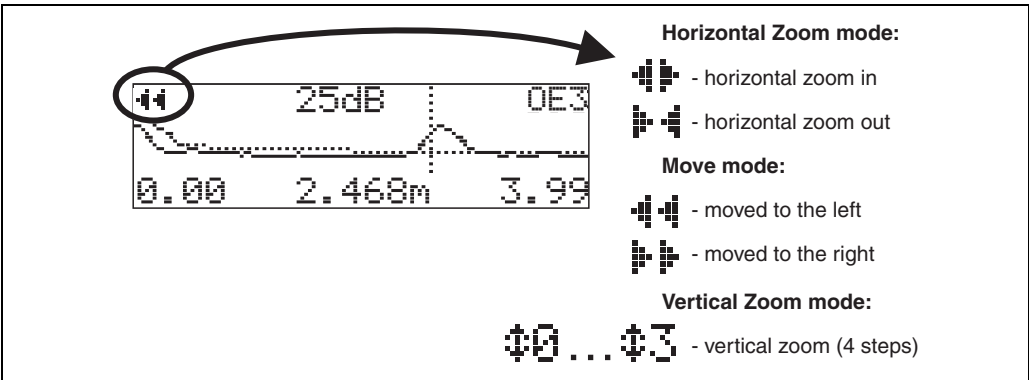


Note!

If the cyclical envelope curve display is still active on the display, the measured value is updated at a slower cycle time. We therefore advise you to exit the envelope curve display after optimising the measuring point. To do this, press E. (The instrument does not leave the envelope curve display automatically.)

6.3.4 Navigation in the envelope curve display

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

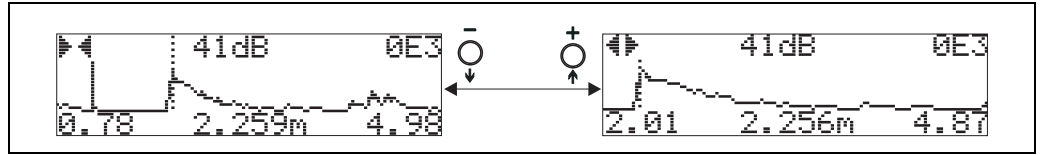


L00-FMxxxxx-07-00-00-en-004

Horizontal Zoom mode

Firstly, go into the envelope curve display. Then press + or - to switch to the envelope curve navigation. You are then in Horizontal Zoom mode. Either  or  is displayed.

- + increases the horizontal scale.
- - reduces the horizontal scale.

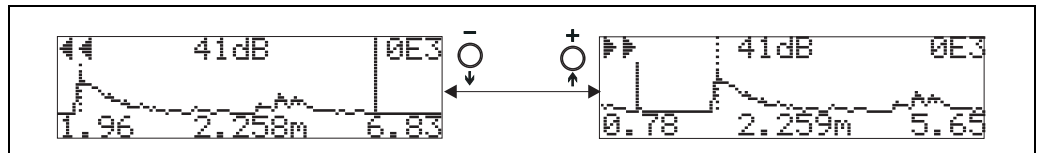


L00-FMU3xxxx-07-00-00-xx-007

Move mode

Then press E to switch to Move mode. Either  or  is displayed.

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



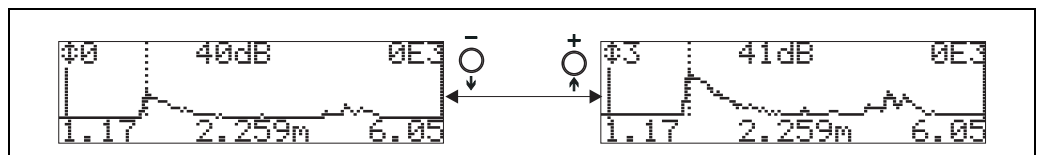
L00-FMU3xxxx-07-00-00-xx-008

Vertical Zoom mode

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

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

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



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Exiting the navigation

- Press E again to run through the different modes of the envelope curve navigation.
- Press + and - to exit the navigation. The set increases and shifts are retained. Only when you reactivate the "recording curve" (0E2) function the display settings return to their standard values.

7 Troubleshooting

7.1 System error messages

7.1.1 Current error

Errors which the instrument detects during commissioning or operation are displayed:

- In the **"measured value" (000)** function
- In the **"diagnostics" (0A)** function group in the **"present error" (0A0)** function
Only the highest priority error is displayed; in the case of multiple errors, you can scroll between the different error messages by pressing + or -.

7.1.2 Last error

The last error is displayed in the **"diagnostics" (0A)** function group in the **"previous error" (0A1)** function. This display can be deleted in the **"clear last error" (0A2)** function.

7.1.3 Types of error

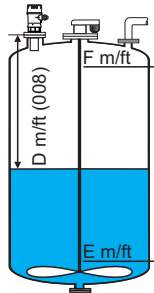
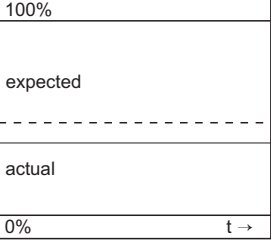
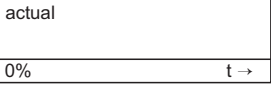
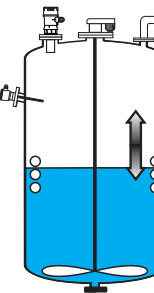
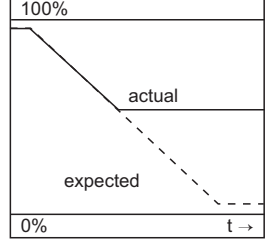
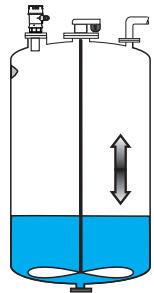
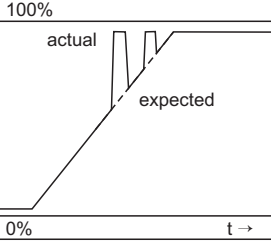
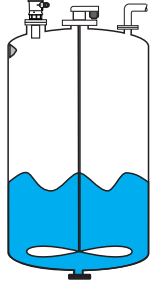
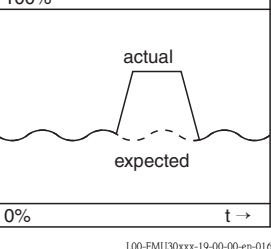
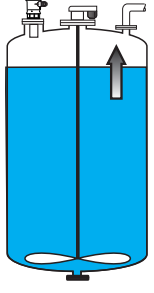
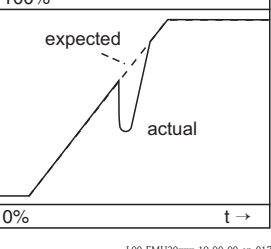
Type of error	Symbol	Meaning
Alarm (A)	 continuous	The output signal assumes a value which can be set using the "output on alarm" (010) function: ■ MAX: 110%, 22mA ■ MIN: -10%, 3.8mA ■ Hold: last value is on hold ■ User-specific value
Warning (W)	 flashing	The device continues measurement. An error message is displayed.
Alarm/Warning (E)	You can define whether the error should behave as an alarm or as a warning.	

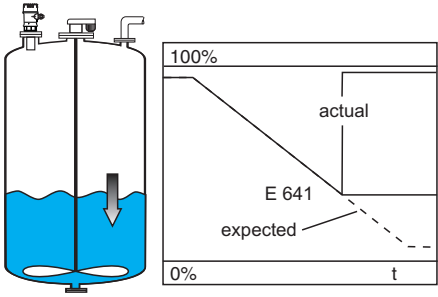
7.1.4 Error codes

Code	Error description	Action
A102 A110 A152 A160	checksum error	Reset; If alarm still present after reset, replace electronics
A106	downloading	Wait; Message disappears after load sequence
A111 A113 A114 A115 A121 A125 A155 A164 A171	electronics defect	Reset; Check system for EMC, improve as necessary If alarm still present after reset, replace electronics
A116	download error	Check connection; Restart download
A231	sensor defect	Check connection, if necessary replace HF module or electronics
A281	interruption temperature sensor	Exchange sensor
A502	Sensor type not detected	Exchange sensor and/or electronics

Code	Error description	Action
A521	new sensor type detected	Reset
A661	Sensor overtemperature	
A671	Linearisation incomplete	Activate linearisation table
E641	no usable echo	Check basic calibration
E651	level in safety distance – risk of overspill	Error disappears when the level leaves the safety distance. Possibly reset the lock. [" safety settings " (01) function group, " ackn. alarm " (017) function]]
W103	initialising	If the message does not disappear after several seconds, replace the electronics
W153	initialising	Wait a few seconds; if error is still displayed, switch the power off and on again
W512	recording of mapping	Alarm disappears after a few seconds
W601	linearisation curve not monotone	Correct table (enter monotonously increasing table)
W611	less than 2 linea-risation points	Enter additional value pairs
W621	simulation on	Switch simulation mode off [" output " (06) function group, " simulation " (065) function]]
W681	current out of range (3.8 to 20.5 mA)	Carry out basic calibration; check linearisation
W691	Filling noise detected, level ramp is active	

7.2 Application errors

Error	Example	Elimination
Measured value (00) is incorrect but measured distance (008) is correct	  L00-FMU30xxx-19-00-00-en-019	1. Check empty calibration (005) and full calibration (006). 2. Check linearisation – level/ullage (040) – max. scale(046) – diameter vessel(047) – linearisation table
Measured value (000) and measured distance (008) are incorrect	  L00-FMU30xxx-19-00-00-en-019	1. For measurements in bypass or stilling well: Select the according option in the "tank shape" (002) function. 2. Carry out interference echo suppression.
No change in measured value on filling/emptying	  L00-FMU30xxx-19-00-00-en-014	1. Carry out interference echo suppression. 2. Clean sensor if necessary 3. If necessary, select better installation position 4. If necessary due to wide interference echoes, set function "detection window" (0A7) to "off".
With an uneven surface (e.g. filling, emptying, running agitator) the measured value may jump sporadically to higher levels	  L00-FMU30xxx-19-00-00-en-015   L00-FMU30xxx-19-00-00-en-016	1. Carry out interference echo suppression 2. Set the process cond. (004) to "calm surface" or "add. agitator" 3. Increase output damping (058). 4. If necessary, select a different installation position and/or a larger sensor
On filling/emptying the measured value drops	  L00-FMU30xxx-19-00-00-en-017	1. Check tank shape (002), e.g. "dome ceiling" or "horizontal cyl." 2. If possible, do not select a central installation position 3. Possible user stilling well/echo guide pipe

Error	Example	Elimination
E 641 (echo loss)	 The diagram shows a vertical tank with a liquid level. A sensor is mounted at the top, pointing down into the liquid. To the right of the tank is a graph with '100%' at the top and '0%' at the bottom. The x-axis is labeled 't' for time. A solid line labeled 'actual' starts at 100% and decreases linearly. A dashed line labeled 'expected' starts at 100% and decreases more steeply. The label 'E 641' is placed between the two lines. Below the graph is the text 'L00-FMU30xxx-19-00-00-en-020'.	1. Check application parameters (002), (003) and (004) 2. If necessary, select a different installation position and/or a larger sensor 3. Align the sensor parallel to the product surface (particularly for bulk solids applications)

8 Maintenance and repairs

8.1 Exterior cleaning

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

8.2 Repairs

The Endress+Hauser repair concept assumes that the measuring devices have a modular design and that customers are able to undertake repairs themselves →  41, "Spare Parts". For more information on service and spare parts, contact the Service Department at Endress+Hauser.

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

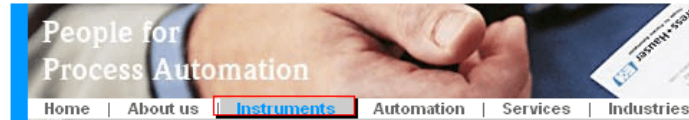
8.4 Replacement

After a complete instrument or electronic module has been replaced, the parameters can be downloaded into the instrument again via the communication interface. Prerequisite to this is that the data were uploaded to the PC beforehand using FieldCare. Measurement can continue without having to carry out a new setup. Only a linearisation and a tank map (interference echo suppression) have to be recorded again.

8.5 Spare Parts

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

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



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

Endress+Hauser product search

Via product name
Enter the product name

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

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

▶ Accessories
 ▼ All Spare parts

- ▶ Housing/housing accessories
- ▶ Sealing
- ▶ Cover
- ▶ Terminal module
- ▶ HF module
- ▶ Electronic
- ▶ Power supply
- ▶ Antenna module



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

◀ | 1 / 2 | ▶ | 🔍

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

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

8.6 Return

Returning devices

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

8.7 Disposal

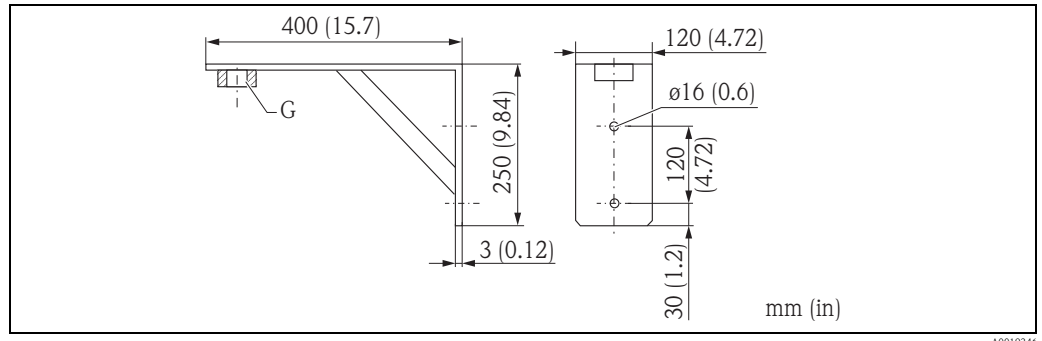
In case of disposal please separate the different components according to their material consistence.

8.8 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.

9 Accessories

9.1 Installation bracket

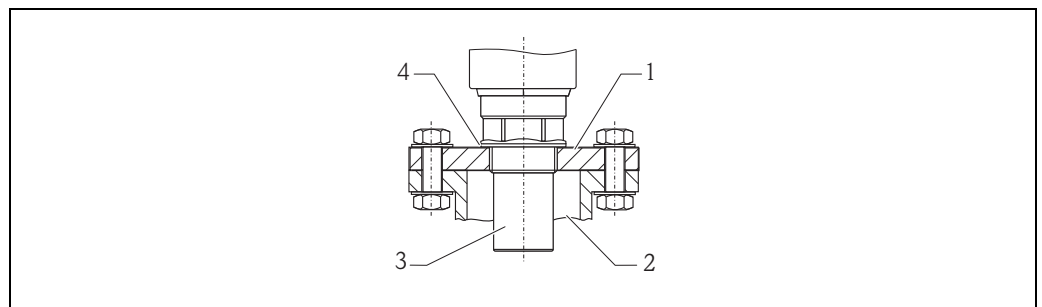


A0019346

- G1½: Order No. 942669-0000
- G2: Order No. 942669-0001

suited for NPT 1½" and 2" as well

9.2 Screw in flange



A0019281

- 1 Screw in flange
- 2 Nozzle
- 3 Sensor
- 4 Sealing ring EPDM (supplied)

Screw in flange FAX50

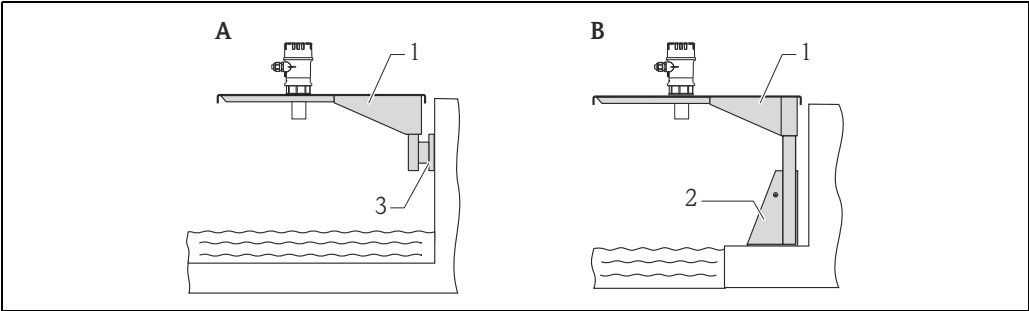
015	Material:	
	BR1	DN50 PN10/16 A, steel flange EN1092-1
	BS1	DN80 PN10/16 A, steel flange EN1092-1
	BT1	DN100 PN10/16 A, steel flange EN1092-1
	JF1	2" 150lbs FF, steel flange ANSI B16.5
	JG1	3" 150lbs FF, steel flange ANSI B16.5
	JH1	4" 150lbs FF, steel flange ANSI B16.5
	JK2	8" 150lbs FF, PP max 3bar abs/44psia flange ANSI B16.5
	XIF	UNI flange 2"/DN50/50, PVDF max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XIG	UNI flange 2"/DN50/50, PP max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XIJ	UNI flange 2"/DN50/50, 316L max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XJF	UNI flange 3"/DN80/80, PVDF max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XJG	UNI flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XJJ	UNI flange 3"/DN80/80, 316L max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XKF	UNI flange 4"/DN100/100, PVDF max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XKG	UNI flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XKJ	UNI flange 4"/DN100/100, 316L max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XLF	UNI flange 6"/DN150/150, PVDF max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XLG	UNI flange 6"/DN150/150, PP max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XLJ	UNI flange 6"/DN150/150, 316L max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XMG	UNI flange DN200/200, PP max 4bar abs/58psia, suitable for DN200 PN16/10K 200
	XNG	UNI flange DN250/250, PP max 4bar abs/58psia, suitable for DN250 PN16/10K 250
	YYY	Special version

020	Sensor Connection:	
	A	Thread ISO228 G3/4
	B	Thread ISO228 G1
	C	Thread ISO228 G1-1/2
	D	Thread ISO228 G2
	E	Thread ANSI NPT3/4
	F	Thread ANSI NPT1
	G	Thread ANSI NPT1-1/2
	H	Thread ANSI NPT2
	Y	Special version

The filled in options result in the complete order code.

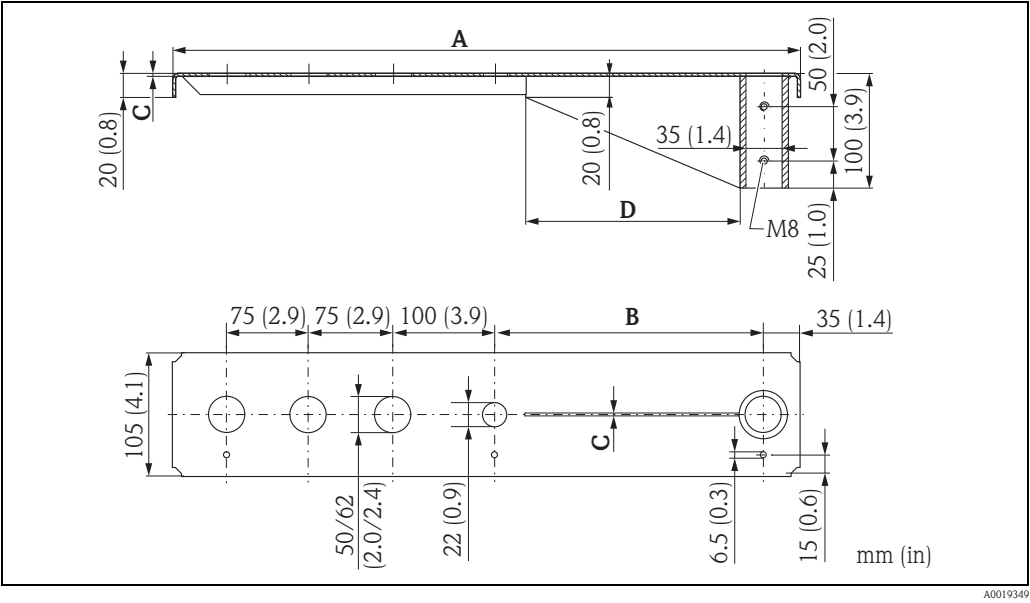
	015	020
FAX50 -		

9.3 Cantilever with mounting frame or wall bracket



- A** Installation with cantilever and wall bracket
- B** Installation with cantilever and mounting frame
- 1** Cantilever
- 2** Mounting frame
- 3** Wall bracket

Cantilever



A	B	C	D	for Sensor	Material	Order Code
585 (23)	250 (9.84)	2 (0.08)	200 (7.87)	1½"	316Ti (1.4571)	52014132
					galv. steel	52014131
				2"	316Ti (1.4571)	52014136
					galv. steel	52014135
1085 (42.7)	750 (29.5)	3 (0.12)	300 (11.8)	1½"	316Ti (1.4571)	52014134
					galv. steel	52014133
				2"	316Ti (1.4571)	52014138
					galv. steel	52014137

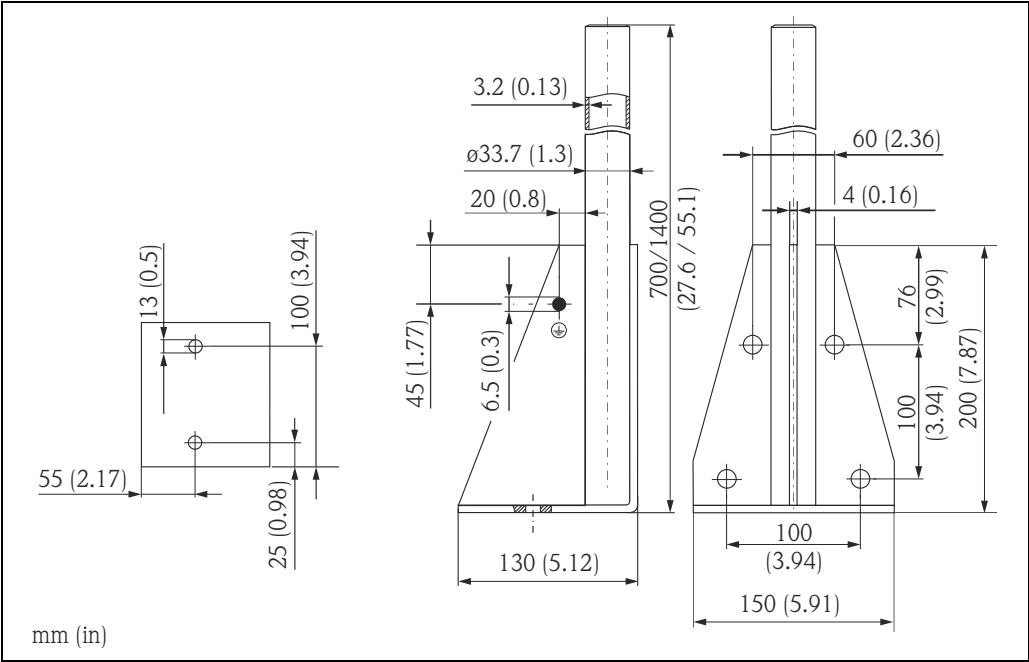
mm (in)

- The 50 mm (2.17 in) or 62 mm (2.44 in) orifices serve for the mounting of the 1½" or 2" sensor, respectively.
- The 22 mm (0.87 in) orifice may be used for an additional sensor.

For the mounting of the cantilever can be used:

- mounting frame → 46
- wall bracket → 46

9.4 Mounting Frame

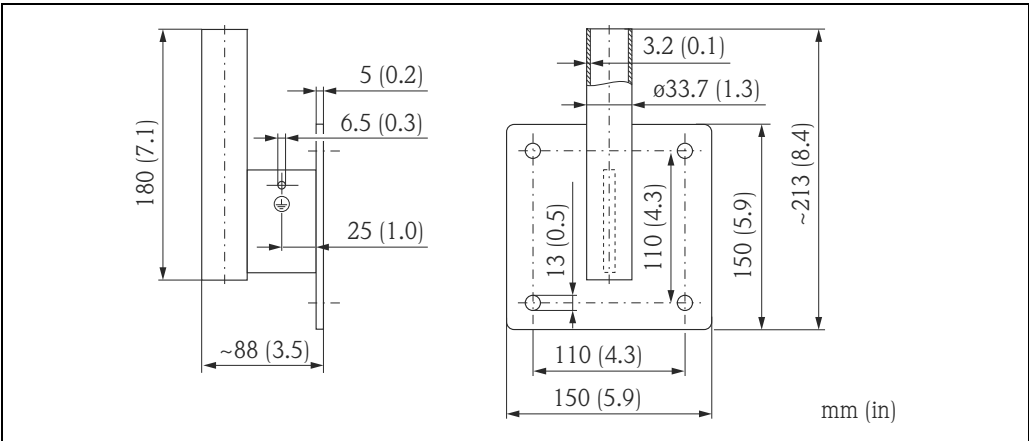


A0019279

Height	Material	Order Code
700 (27.6)	galv. steel	919791-0000
700 (27.6)	316Ti (1.4571)	919791-0001
1400 (55.1)	galv. steel	919791-0002
1400 (55.1)	316Ti (1.4571)	919791-0003

mm (in)

9.5 Wall Bracket



A0019350

Material	Order Code
galv. steel	919792-0000
316Ti (1.4571)	919792-0001

9.6 Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field instruments 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 FMU30 you need the "ToF Adapter FXA291" as an additional accessory.

9.7 ToF Adapter FXA291

The ToF Adapter FXA291 connects the Commubox FXA291 via the USB interface of a personal computer or a notebook to the FMU30.

For details refer to KA00271F/00/A2.

10 Technical Data

10.1 Technical data at a glance

10.1.1 Input

Measured variable	The distance D between the sensor membrane and the product surface is measured. Using the linearisation function, the device uses D to calculate: ■ level L in any units ■ volume V in any units ■ flow Q across measuring weirs or open channels in any units
-------------------	--

Maximum range/blocking distance

Sensor	BD	Max. range fluids ¹⁾	Max. range bulk materials
1½"	0.25 m (0.8 ft)	5 m (16 ft)	2 m (6.6 ft)
2"	0.35 m (1.1 ft)	8 m (26 ft)	3.5 m (11 ft)

1) The actual range is dependent on the measuring conditions. Refer to Technical Information TI00440F/00/EN for an estimation.

10.1.2 Output

Output signal	4 to 20 mA
---------------	------------

Signal on alarm	■ Error symbol, error code and plain text description on the on-site display ■ Current output (configurable)
-----------------	---

10.1.3 Power supply

Terminals	Cable cross-section: 0.25 to 2.5 mm (20 to 14 AWG)
-----------	--

Cable entry	■ Cable gland M20x1.5 (recommended cable diameter 6 to 10 mm (0.24 to 0.39 in)) ■ Cable entry G½ or ½ NPT
-------------	--

Supply voltage	14 to 35 V
----------------	------------

There may be additional restrictions for devices with an explosion protection certificate. Refer to the notes in the appropriate safety instructions (XA).

Power consumption	51 mW to 800 mW
-------------------	-----------------

10.1.4 Performance characteristics

Reaction time	The reaction time depends on the parameter settings. The minimum value is: min. 2 s
Reference operating conditions	■ Temperature = +20 °C (68 °F) ■ Pressure = 1013 mbar abs. (15 psi abs.) ■ Humidity = 50 % ■ Ideal reflective surface (e.g. calm, smooth fluid surface) ■ No interference reflections within signal beam ■ Set application parameters: – Tank shape = flat ceiling – Medium property = liquid – process conditions = calm surface
Measured value resolution	1 mm (0.04 in)
Measuring error	Typical specifications for reference operating conditions (include linearity, repeatability, and hysteresis): ± 3 mm (±0.12 in) or 0.2 % of set measuring distance (empty calibration)¹ ¹whichever is greater
Influence of the vapor pressure	The vapor pressure at 20 °C (68 °F) gives a hint on the accuracy of the ultrasonic level measurement. If the vapor pressure at 20 °C (68 °F) is below 50 mbar (0.73 psi), ultrasonic level measurement is possible with a very high accuracy. This is valid for water, aqueous solutions, water-solid-solutions, dilute acids (hydrochloric acid, sulfuric acid, ...), dilute bases (caustic soda, ...), oils, greases, slurries, pastes, ... High vapor pressures or outgassing media (ethanol, acetone, ammonia, ...) can influence the accuracy. If conditions like these are present, please contact the Endress+Hauser support.

10.1.5 Environment

Ambient temperature	-20 °C to +60 °C (-4 °F to +140 °F) Use a protective cover, in order to protect the sensor from direct sun or rain, see the Technical Documentation TI00440F/00/EN.
---------------------	--

Storage temperature	-40 °C to +80 °C (-40 °F to +176 °F)
---------------------	--------------------------------------

Climate class	DIN EN 60068-2-38 (Test Z/AD) DIN/IEC 68 T2-30Db
---------------	--

Ingress protection	■ With closed housing, tested according to – IP 68 (24h at 1.83m (6.0 ft) under water surface) – IP 66 ■ With open housing: IP 20 (also ingress protection of the display)
--------------------	---

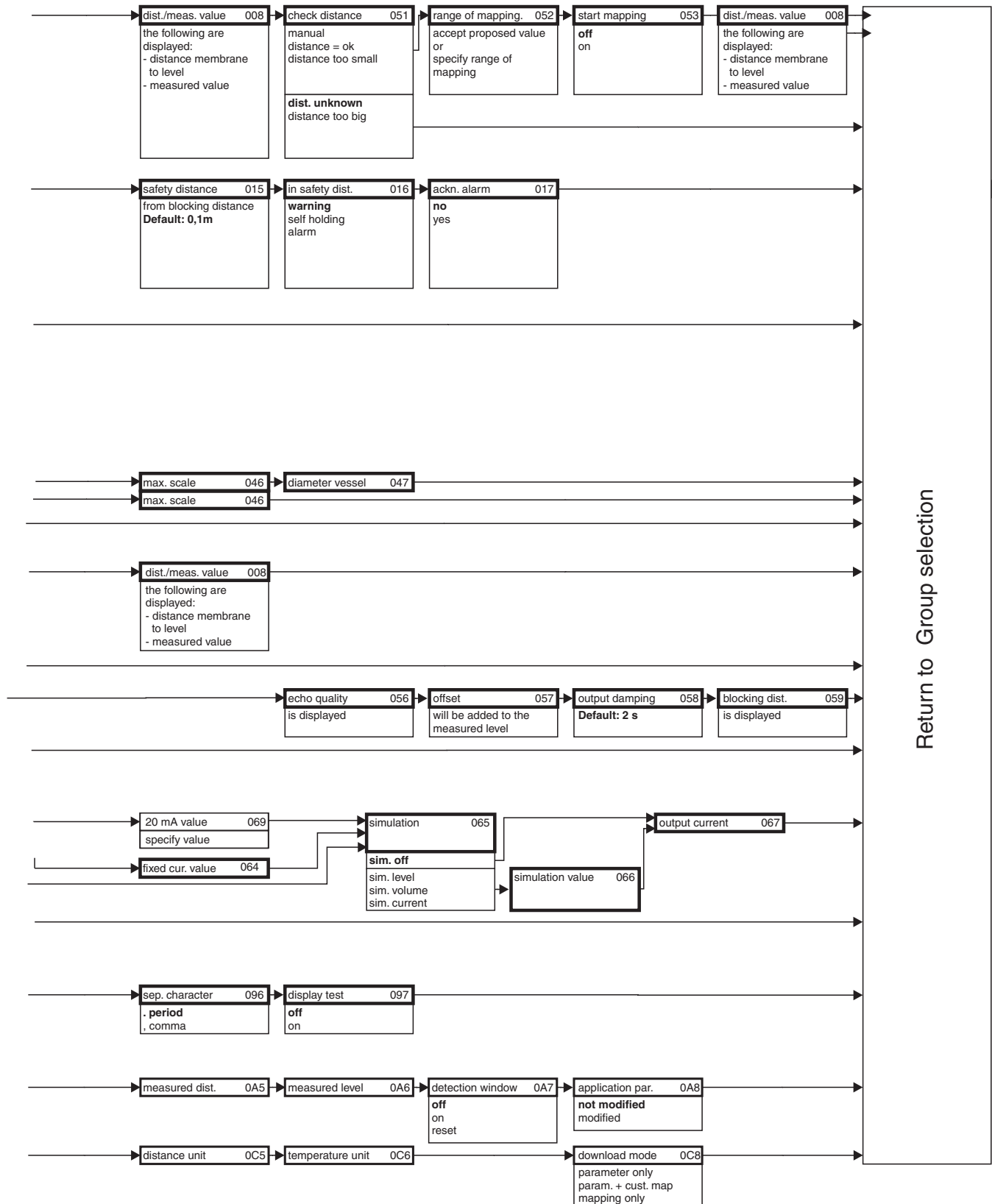
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: 20...2000 Hz, 1 (m/s ²) ² /Hz; 3 x 100 min
----------------------	--

Electromagnetic compatibility (EMC)	■ Electromagnetic compatibility to EN 61326. For details refer to the declaration of conformity. ■ With regard to interference immunity the requirements for "industrial environment" are met. ■ Influence of EMC < 1 % FS
-------------------------------------	---

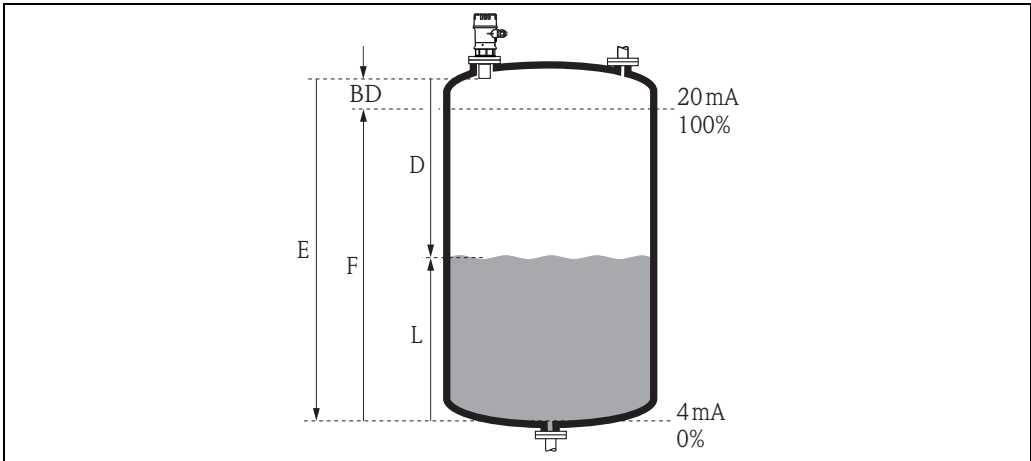
10.1.6 Process

Process temperature	-20 °C to +60 °C (-4 °F to +140 °F) A temperature sensor is integrated in the sensor for correction of the temperature-dependent time-of-flight.
---------------------	---

Process pressure	0.7 bar to 3bar abs. (10.15 psi to 43.5 psi)
------------------	--



11.2 Measuring principle



BD Blocking distance
E Empty distance
L Level
D Distance from sensor membrane - product surface
F Span (full distance)

Sensor	BD	Max. range fluids	Max. range bulk materials
1½"	0.25 m (0.8 ft)	5 m (16 ft)	2 m (6.6 ft)
2"	0.35 m (1.1 ft)	8 m (26 ft)	3.5 m (11 ft)

11.2.1 Time-of-flight method

The sensor of the instrument transmits ultrasonic pulses in the direction of the product surface. There, they are reflected back and received by the sensor. The instrument measures the time *t* between pulse transmission and reception. The instrument uses the time *t* (and the velocity of sound *c*) to calculate the distance *D* between the sensor membrane and the product surface:

$D = c \cdot t / 2$

As the device knows the empty distance *E* from a user entry, it can calculate the level as follows:

$L = E - D$

An integrated temperature sensor compensates for changes in the velocity of sound caused by temperature changes.

11.2.2 Interference echo suppression

The interference echo suppression feature on the instrument ensures that interference echos (e.g. from edges, welded joints and installations) are not interpreted as a level echo.

11.2.3 Calibration

Enter the empty distance *E* and the span *F* to calibrate the device.

11.2.4 Blocking distance

Span *F* may not extend into the blocking distance *BD*. Level echos within the blocking distance cannot be evaluated due to the transient characteristics of the sensor.

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