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

Technical Information

Prosonic T FMU30

Ultrasonic Level Measurement
Compact transmitters for non-contact level measurement of fluids, pastes and coarse bulk materials

Application

- Continuous, non-contact level measurement in fluids, pastes, sullages and coarse bulk materials
- System integration via 4 to 20 mA
- Maximum measuring range:
  - 1½" sensor: 5 m (16 ft) in fluids
    2 m (6 ft) in bulk materials
  - 2" sensor: 8 m (26 ft) in fluids
    3.5 m (11 ft) in bulk materials

Features and benefits

- Quick and simple commissioning via menu-guided on-site operation with four-line plain text display; 7 languages selectable
- Envelope curves on the on-site display for simple diagnosis
- Linearization function (up to 32 points) for conversion of the measured value into any unit of length, volume or flow rate
- Non-contact measurement method minimizes service requirements
- Installation possible from thread G 1½“ or NPT 1½“ upwards
- Integrated temperature sensor for automatic correction of the temperature dependent sound velocity

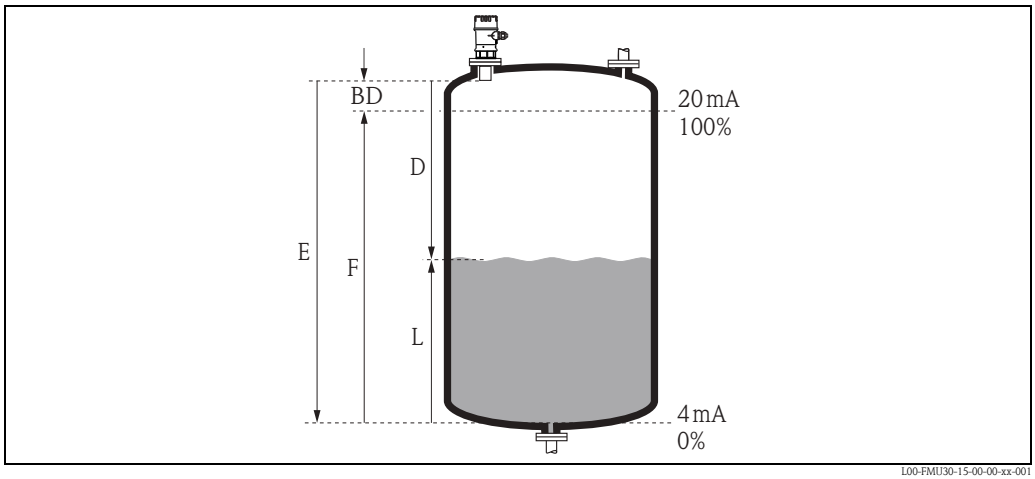
TI00440F/00/EN/15.14
71225633

Endress+Hauser
People for Process Automation

Table of contents

Function and system design

Measuring principle



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

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)

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 (NTC) compensates for changes in the velocity of sound caused by temperature changes.

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.

Calibration

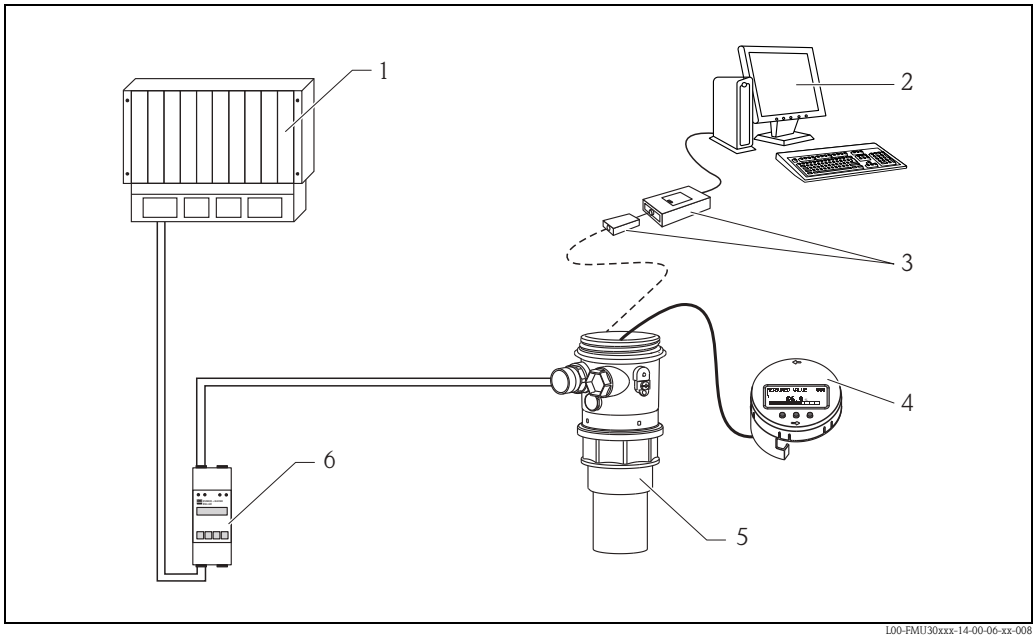
Enter the empty distance E and the span F to calibrate the device.

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.

Equipment architecture

The complete measuring system consists of:



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

On-site operation

- With display and operating module
- With a PC, Commubox FXA291 + ToF Adapter FXA291 and the operating software FieldCare

Input

Measured variable

The distance D between the sensor membrane and the product surface is measured, see also figure → 🖹 3.

Using the linearization 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

Measuring range

The measuring range is limited by the range of a sensor. The sensor range is, in turn, dependent on the operating conditions. To estimate the actual range, proceed as follows (see also the calculation example in the diagram):

1. Determine which of the influences shown in the following table are appropriate for your process.
2. Add the corresponding attenuation values.
3. From the total attenuation, use the diagram to calculate the range.

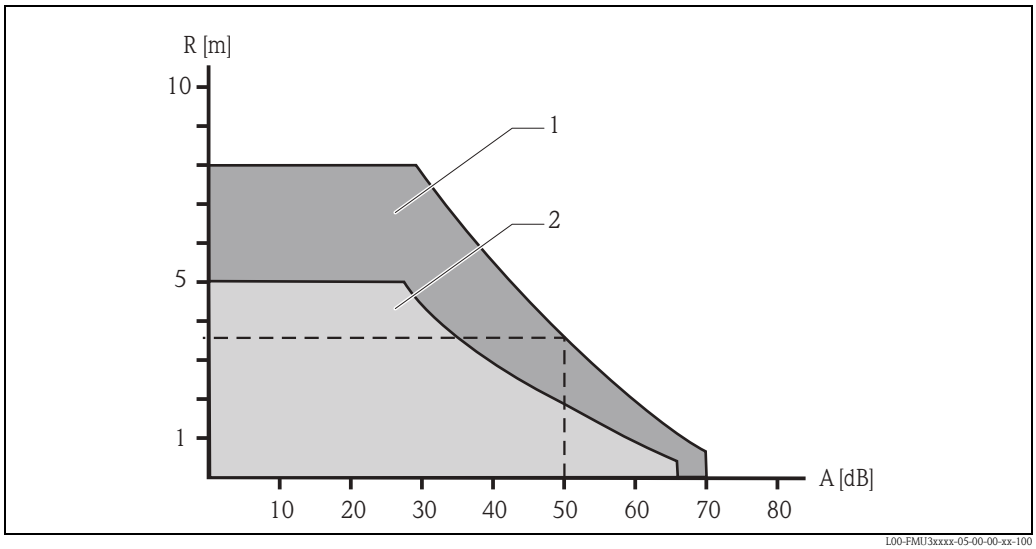
Fluid surface	Attenuation
Calm	0 dB
Waves	5 to 10 dB
Strong turbulence (e.g. stirrers)	10 to 20 dB
Foaming	Please contact your Endress+Hauser sales representative.

Bulk material surface	Attenuation
Hard, rough (e.g. rubble)	40 dB
Soft (e.g. peat, dust-covered clinker)	40 to 60 dB

Dust	Attenuation
No dust formation	0 dB
Little dust formation	5 dB
Heavy dust formation	5 to 20 dB

Filling curtain in detection range	Attenuation
None	0 dB
Small quantities	5 to 10 dB
Large quantities	10 to 40 dB

Temperature difference between sensor and product surface	Attenuation
to 20 °C (68 °F)	0 dB
to 40 °C (104 °F)	5 to 10 dB
to 60 °C (140 °F)	10 to 15 dB



1 *Sensor 2"*
2 *Sensor 1½"*
A *Attenuation (dB)*
R *Range (m)*

Example

■ Strong turbulence surface	approx. 50 dB	
■ No dust formation	0 dB	
■ Filling curtain in detection range	10 dB	
■ Temperature diff. < 20 °C (68 °F)	0 dB	
	approx. 50 dB	⇒ range approx. 3.5 m (11 ft) for FMU30 2" sensor

These measuring conditions have been taken into account during the calculation of the maximum measuring range in solid applications.

Operating frequency

1½" sensor	2" sensor
approx. 70 kHz	approx. 50 kHz

Output

Output signal

4 to 20 mA

Signal on alarm

Error information can be accessed via the following interfaces:
- On-site display (error symbol, error code and plain text description)
- Current output, signal on error can be selected (e.g. according to NAMUR recommendation NE43)

Output damping

Freely selectable, 0 to 255 s

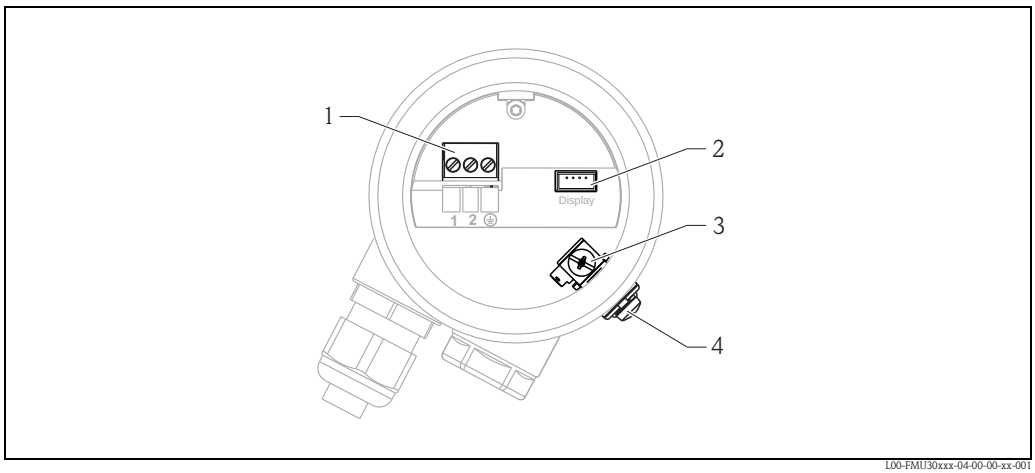
Linearization

The linearization function of the instrument allows conversion of the measured value into any unit of length or volume. In open channels or measuring weirs, also a flow linearization is possible (calculation of the flow from the measured level).
The linearization table for calculating the volume in an horizontal cylindrical tank is preprogrammed. You can also enter any number of other tables containing up to 32 value pairs either manually or semi-automatically (by filling the vessel under controlled conditions).

Power supply

Terminal compartment

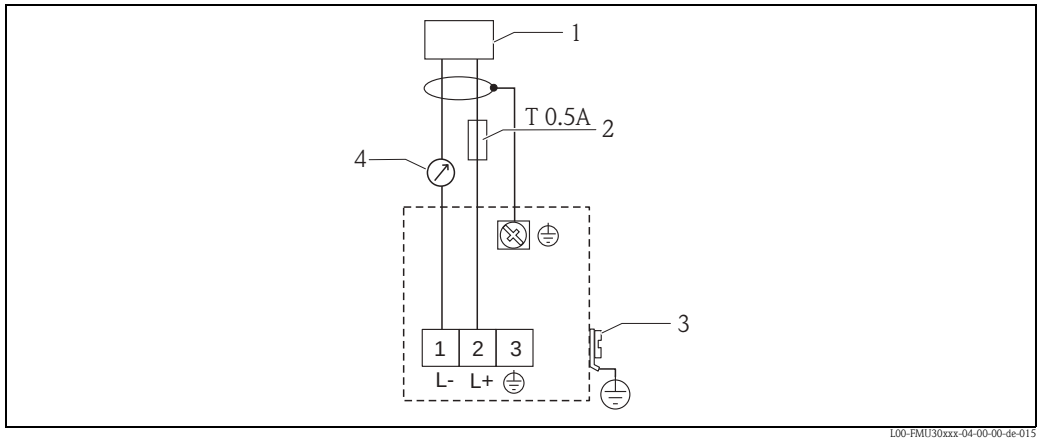
The terminals are located underneath the housing cover.



L00-FMU30xxx-04-00-00-xx-001

1 Terminals
2 Optional: display
3 Internal earth terminal
4 External earth terminal

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

- Connect the connecting line to the screw terminals (line cross-sections of 0.25 to 2.5 mm² (24...14 AWG)) in the terminal compartment.
- A standard installation cable is sufficient for the connection.
- Protective circuitry against reverse polarity, RFI and over-voltage peaks is built into the device (see also Technical Information TI00241F/00/EN "EMC Test Procedures")

Supply voltage	14-35 V
Terminals	Cable cross-section: 0.25 to 2.5 mm2 (24 to 14 AWG)
Cable entry	G ½" or ½" NPT
Cable gland	M20x1.5 (recommended cable diameter 6 to 10 mm (0.24 to 0.39 in))
Power consumption	51 mW to 800 mW
Current consumption	3.6 to 22 mA

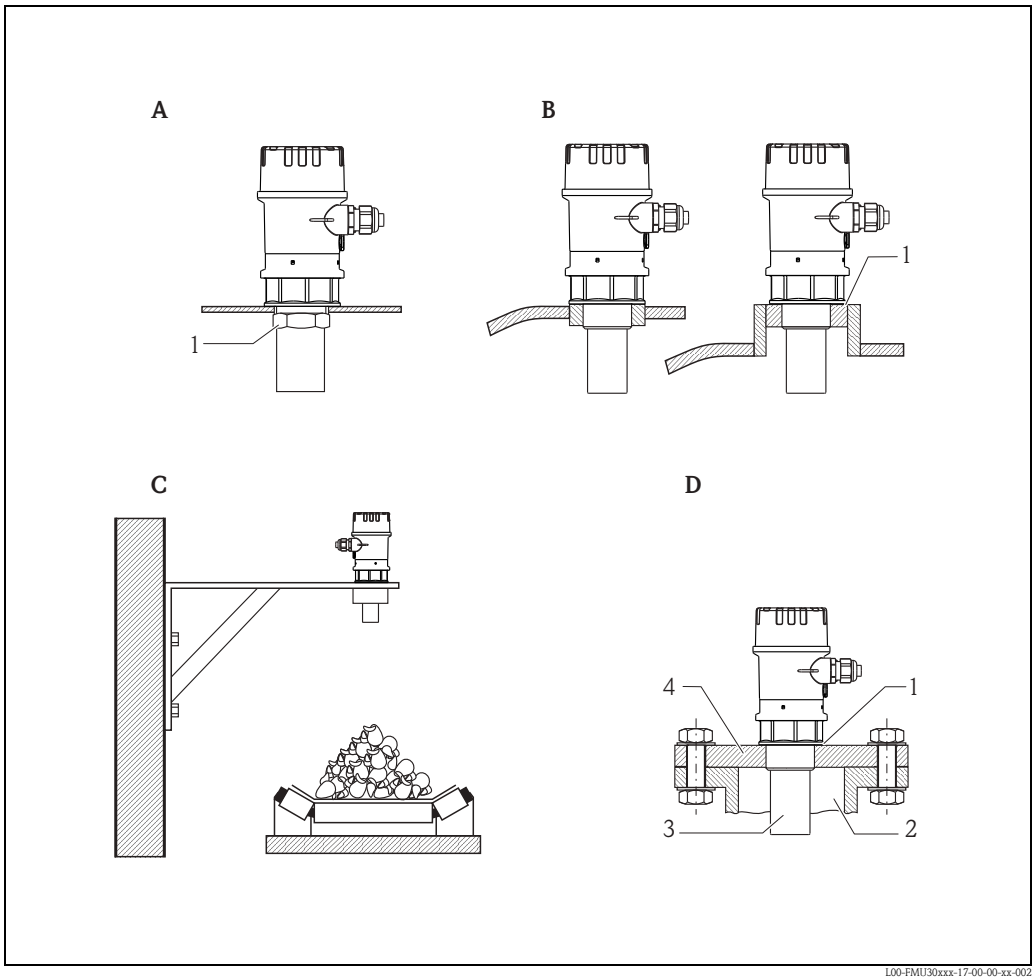
Performance characteristics

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 = dome ceiling – Medium property = liquid – process conditions = standard liquid
Measured value resolution	1 mm (0.04 in)
Pulse frequency	max. 0.5 Hz The exact values are dependent on the type of device and the parameter settings.
Maximum measuring error[1) 2)]	±0.2 % of the maximum span of the sensor
Typical measuring error[2)]	Include linearity, repeatability, and hysteresis Better than: ±3 mm (±0.12 in) or 0.2 % of measuring distance* * whichever 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 (1 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 your Endress+Hauser sales representative.

1) according to EN 61298-2
2) with reference operating conditions

Installation

Installation variants

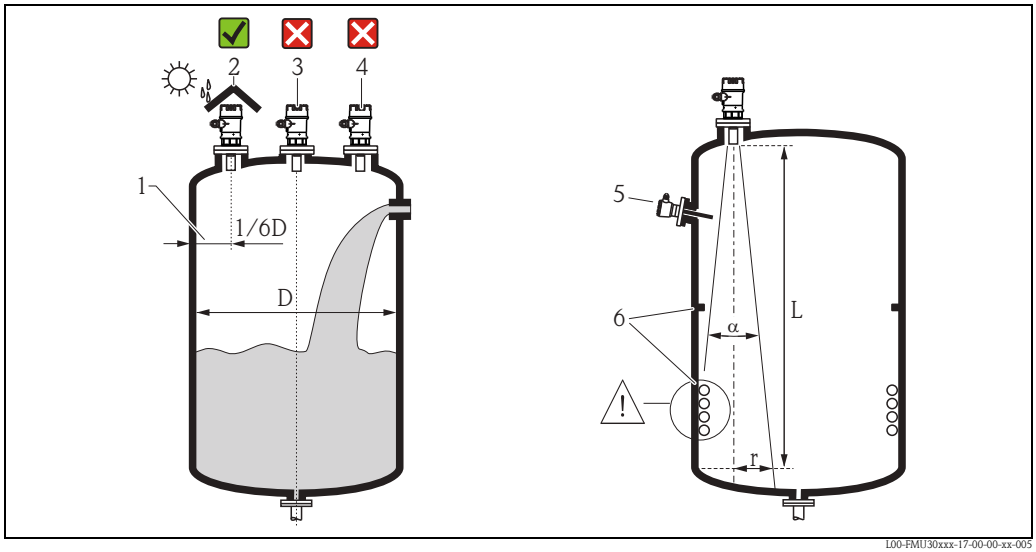


L00-FMU30xxx-17-00-00-xx-002

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 → 22, "Accessories".

Installation conditions for level measurements

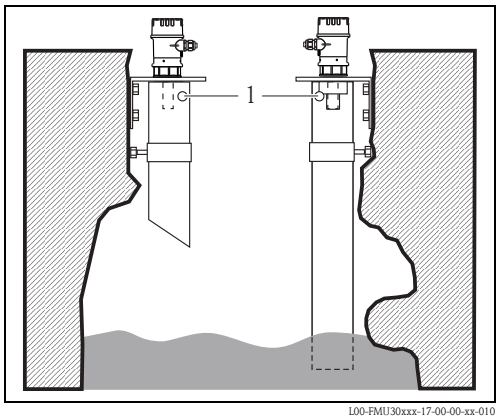


- Do not install the sensor in the middle of the tank (3). We recommend leaving a distance between the sensor and the tank wall (1) measuring 1/6 of the tank diameter.
- Protect the device against direct sun or rain (2) → 📄 26 "Weather protection cover".
- Avoid measurements through the filling curtain (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}
1½"	11°	5 m (16 ft)	0.48 m (1.6 ft)
2"	11°	8 m (26 ft)	0.77 m (2.5 ft)

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.



1 Venting hole

Instruments International

Endress+Hauser
Instruments International AG
Kaegenstrasse 2
4153 Reinach
Switzerland

Tel.+41 61 715 81 00
Fax+41 61 715 25 00
www.endress.com
info@ii.endress.com

Endress+Hauser

People for Process Automation

TI00440F/00/EN/15.14
71225633
SGML+FM10

71225633