Meranie výšky hladiny kvapalín od Endress+Hauser - špecialista na meranie hladiny - meracie prístroje - hladinomery - snímače hladiny - radar - Micropilot -ultrazvuk - Prosonic

Step by step

This selection and engineering guide provides information on different measuring principles for continuous level measurement in liquids as well as their application and installation.

The document specifically covers continuous level measurement. A separate selection guide is available for level limit detection (see the supplementary documentation on page 72).

Overview of measuring principles
First of all, we show you an overview of the Endress+Hauser measuring principles for continuous level measurement in liquids in diagrams on the first pages. Subsequently, you are introduced to the mode of functioning of the measuring principle and the respective product family.

Checklist
You should be aware of the application requirements for the correct selection of a suitable instrument. The checklist provides an overview and is supposed to help you to consider or record this data as completely as possible.

A

Selection of the measuring principle
The appropriate measuring principle is first selected according to the application and its criteria (tank, bypass, stilling well, etc.).
Select the principle which meets, if possible, all of the criteria required by you or your plant. The measuring principles are classified according to „non-contact“ and „contact“ criteria. The ideal measuring principle/ instrument is stated first and in a blue frame.
Max. technical data is always used.

B

Instrument selection
Now change to the area of the selected measuring principle where you can chose the appropriate instrument from a product family.
Compare your application and process data with the instrument data.

Engineering
After the selection of the optimum instrument check the installation instructions at the end of the respective measuring principle. They contain basic directions for the safe installation and use of the instrument. You will find more extensive engineering instructions in the respective Technical Information of the instrument.

C

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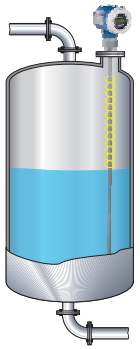
Meranie výšky hladiny kvapalín od Endress+Hauser - špecialista na meranie hladiny - meracie prístroje - hladinomery - snímače hladiny - radar - Micropilot -ultrazvuk - Prosonic

1. Overview of measuring principles

Radar
Micropilot works with high-frequency radar pulses which are emitted by an antenna and reflected from the product surface. The time of flight of the reflected radar pulse is directly proportional to the distance traveled. If the tank geometry is known, the level can be calculated from this variable.

Micropilot M
Non-contact, maintenance-free measurement also under extreme conditions. Unaffected by density, temperature, conductibility and humidity. No impairment by vapor pressure.

Process temperatures up to
+400 °C/+752 °F
Process pressures up to
160 bar/2320 psi



Guided radar
Levelflex M works with high-frequency radar pulses which are guided along a probe. As the pulse impacts the medium surface, the characteristic impedance changes and part of the emitted pulse is reflected. The time between pulse launching and receiving is measured and analyzed by the instrument and constitutes a direct measure for the distance between the process connection and the product surface.

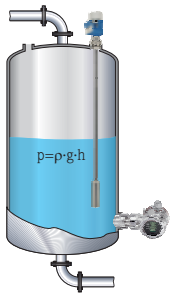
Levelflex M
Reliable and maintenance-free measurement in liquids, also in turbulent media and foam. Unaffected by density, temperature, conductibility and humidity. No impairment by vapor pressure.

Process temperatures up to
+400 °C/+752 °F
Process pressures up to
400 bar/5800 psi

Ultrasonics
Ultrasonic measurement is based on the time-of-flight principle. A sensor emits ultrasonic pulses, the surface of the media reflects the signal and the sensor detect it again.
The time of flight of the reflected ultrasonic signal is directly proportional to the distance traveled. With the known tank geometry the level can be calculated.

Prosonic S/M/T
Non-contact and maintenance-free measurement without impairment by product properties, e. g. dielectric constant, conductivity, density or humidity.

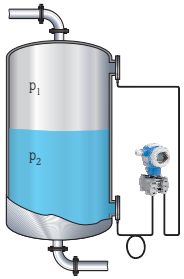
Process temperatures up to
+150 °C/+302 °F
Process pressures up to
4 bar/58 psi



Hydrostatics (pressure)
Hydrostatic level measurement in open tanks is based on the determination of the hydrostatic pressure which is generated by the height of the liquid column. The obtained pressure is thus a direct measure for the level.

Cerabar M/S, Deltapilot S
Unaffected by dielectric constant, foam, turbulence and obstacles. Condensate-proof, watertight and longtime stable Contite-measuring cell with optimized temperature shock behavior (Deltapilot S).

Process temperatures up to
+350 °C/+660 °F



Hydrostatics (differential pressure)
In closed, pressurized tanks, the hydrostatic pressure of the liquid column causes a difference in pressure. The same leads to a deflection of the measuring element which is proportionate to the hydrostatic pressure.

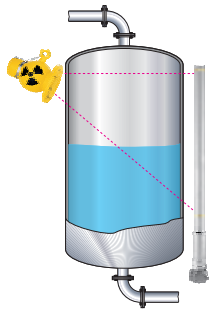
Deltabar S
Unaffected by dielectric constant, foam, turbulence and obstacles. High overload resistance.

Process temperatures up to
+350 °C/+660 °F
Process pressures up to
420 bar/6090 psi

Capacitance
The principle of capacitive level measurement is based on the capacitance change of a capacitor. The probe and the tank wall form a capacitor whose capacitance is dependent on the amount of product in the tank: an empty tank has a lower, a filled tank a higher capacitance.

Liquicap M/T
Exact measurement from the end of the probe to the process connection without any blocking distance. Very fast response times.
Unaffected by density, turbulence and vapor pressure.

Process temperatures up to
+200 °C/+392 °F
Process pressures up to
100 bar/1450 psi



Radiometrics
The gamma source, a cesium or cobalt isotope, emits radiation which is attenuated as it passes through materials. The measuring effect results from the absorption of radiation by the product to be measured which is caused by level changes.

Gammapilot M
Non-contact measurement from outside for all extreme applications, e. g. very corrosive, aggressive and abrasive media.

Any process temperature
Any process pressure

For more detailed information please contact our sales team or use the Applicator selection software.

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1. Overview of measuring principles

	Radar	Guided radar	Ultrasonics	Capacitance	Radiometrics	Hydrostatics (pressure)	Hydrostatics (differential pressure)
							
Process temperature **Process pressure**	–60…+400 °C/ –76…+752 °F/ –1…+160 bar/ –14.5…+2320 psi	–200…+400 °C/ –328…+752 °F –1…+400 bar/ –14.5…+5800 psi	–40…+150 °C/ –40…+302 °F 0.7…4 bar/ 10…58 psi	–80…+200 °C/ –112…+392 °F –1…+100 bar/ –14.5…+1450 psi	Unaffected by temperature and pressure	–70…+350 °C/–94…+660 °F n.a. (ambient pressure)	–70…+350 °C/ –94…+660 °F/ 420 bar/6090 psi
Measuring range	0.3…70 m/ 1…229 ft	0.2…35 m/ 0.7…110 ft (larger upon request)	0.25…20 m/ 0.8…65 ft	0.1…10 m/ 0.3…32 ft	0.05…2 m/ 0.2…6.6 ft, cascadable	10 mbar/ 0.15 psi … typically up to 10 bar/145 psi, 0.1…100 m/0.3…328 ft	100 mbar…40 bar/ 0.145 psi …580 psi 0.1…100 m/0.3…328 ft
Application limits	▪ Measurement up to abs. 0 %[1] ▪ DK < 1.4 ▪ Installation from below	▪ Measurement up to abs. 0 %[3] ▪ DK < 1.4 ▪ Strong mechanical stress in agitator applications	▪ Measurement up to abs. 0 %[1] ▪ Vapor pressure > 50 mbar/ 0.73 psi (+20 °C/+68 °F) ▪ Blocking distance ▪ Lateral installation or from below	▪ Agitator blade ▪ Alternating filling at < 30 µs/cm conductivity ▪ DK < 2.0	▪ Observe radiation protection laws ▪ Further information from our sales team	▪ Curing buildup ▪ Strong density fluctuations	▪ Curing buildup ▪ Vacuum and simultaneously temperatures > +200 °C/+392 °F (diaphragm seal) ▪ Strong density fluctuations
Function may be affected by	▪ Foam ▪ Extreme turbulent, boiling surfaces ▪ Conductive buildup on antenna connection ▪ Strong buildup formation	▪ Extreme buildup formation	▪ Foam ▪ Extreme turbulent, boiling surfaces ▪ Strong buildup or strong condensate at the sensor	▪ Plastic tank ▪ Extreme conductive buildup	▪ External radiation (gammagraphy)	▪ Dynamic pressure fluctuations by agitator or whirling	▪ Dynamic pressure fluctuations by agitator or whirling
Instrument accuracy	▪ C-band[2]: < 10 m: ±10 mm < 32 ft: ±0.4" ▪ K-band[2]: < 10 m: ±3 mm < 32 ft: ±0.12" ▪ Option: ±1 mm/0.04"	▪ < 10 m: ±3 mm < 32 ft: ±0.12" ▪ > 10 m: ±0.03 % > 32 ft: ±0.03 % of distance	▪ < 1 m: ±2 mm < 3.2 ft: ±0.08" ▪ > 1 m: ±0.2 % > 3.2 ft: ±0.2 % of distance	▪ 1 % of measuring distance	▪ ±1 % of measuring distance	▪ ±0.075 % of the set span	▪ ±0.075 % of the set span
Accuracy may be affected by	▪ Wall effects ▪ Interfering reflections (obstacles in the signal beam.)	▪ Interfering reflections by obstacles near the probe ▪ Extreme foam formation	▪ Higher vapor pressure may change the time of flight ▪ Temperature layers in the gas phase ▪ Interfering reflections ▪ Fast temperature change	▪ Conductivity < 30 µs/cm: changing dielectric constants ▪ Conductive buildup	▪ Extreme pressure fluctuations	▪ Density change ▪ Very fast temperature change ▪ Tk of capillaries and diaphragm seals (process and ambient temperature)	▪ Density change ▪ Tk of capillaries and diaphragm seals (process and ambient temperature)

[1] E. g. dish bottom, conical outlet

[2] C-band: 6 GHz
K-band: 26 GHz

[3] Measurement only up to the probe end

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2. Checklist

You should be familiar with all of the requirements of your application for the selection of the right instrument. The checklist on page 9 provides an overview of relevant process data and will help you to take the same into consideration. If we have not included all of the details, please supplement the list by your criteria.

The checklist is required both for the selection of the measuring principle and the selection of the instrument.

TIP
Copy this checklist and complete it to have all relevant data at your disposal in the selection process.

Radiometry is not included in detail in the following chapters. For specific information please contact our sales team.

The following table compares the individual measuring methods and is supposed to assist in a first preselection.

Selection guide	Radar	Guided radar	Ultrasonics	Hydrostatic (pressure/dp)	Capaci-tance
Condensate	O	+	O	+	+
Foam formation	O	+	O	+	O
Conductivity < 100 µs	+	+	+	+	O
Changing media (density)	+	+	+	–	+
Low DK	O	O	+	+	O
Viscosity	+	O	+	+	O
Buildup formation	+	O	+	O	O
Small tank (blocking distance)	O	O	O	+	+
Hygienic application (cleanability)	+	+	+	+	+
Pressurization	+	+	O	O	+
Simple maintenance (disassembly)	+	O	+	O	O
Independent of installation site	O	+	O	O	+
Unaffected by obstacles	O	+	O	+	+
Small tank (fast level change)	O	O	O	+	+
Vapor pressure > 50 mbar / +20 °C, > 0.73 psi / +68 °F)	+	+	O	+	+
CIP/SIP temperature cycles	+	+	+	O	+

+ = recommended
O = restricted (observe limits)
– = not recommended

		Please complete		Notes
Details of medium	Medium			
	Density	g/cm³		
	Conductivity	µS/cm		
	Dielectric constant (DK)			
	Resistance/e. g. coating			
Non-contact measurement		yes	no	
Process data	Process temperature	min.	max.	
	Process pressure	min.	max.	
	Vapor pressure	min.	max.	
Process connection	Type of connection / size			
Installation	Tank (height, Ø)	yes	no	
	Nozzle dimensions	mm / inch		
	Assembly position (from above/from below) [1]			
	Free space	min.	max.	
	Bypass (Ø)	yes	no	
	Stilling well (Ø)	yes	no	
Electric connection	2-wire	yes	no	
	4-wire	yes	no	
Digital communication	HART®, PROFIBUS®, FOUNDATION Fieldbus, relay			
Approvals	Ex (Ex ia/Ex d)	yes	no	
	WHG	yes	no	
	Shipbuilding	yes	no	
	EHEDG	yes	no	
	3A	yes	no	
Certificates/ manufacturer declarations	3.1	yes	no	
	NACE	yes	no	
	FDA-listed material	yes	no	
	SIL	yes	no	
	Calibration certificates	yes	no	
Special requirements				

[1] Only applicable to level measurement by pressure instruments

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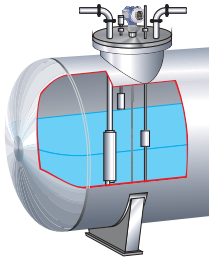
3. Selection of the measuring principle according to the application

Horizontal cylindrical storage tank



- Calm surface (e. g. bottom filling, filling via immersion tube or rare free filling from above)
- Accuracy 3…10 mm/0.12…0.4"
- Free space measurement (without stilling well, top mounted)
- Tank diameter up to 3 m/9.8 ft

Non-contact

Contact

Our proposal

	Radar Micropilot M	Ultrasonics Prosonic S/M	Guided radar Levelflex M	Hydrostatics Deltapilot S	Capacitance Liquicap M
					
Advantages	▪ For highly viscous media ▪ High resistance ▪ Universally usable (free adjustable measuring range)	▪ High resistance ▪ Self-cleaning effect ▪ Integrated alarm/level limit relay ▪ Free adjustable measuring range	▪ Unaffected by nozzle dimensions and tank obstacles ▪ DK starting at 1.4	▪ Unaffected by foam ▪ Unaffected by installation situation ▪ Unaffected by DK value	▪ Ground tube probe ▪ Unaffected by nozzle dimensions and tank obstacles ▪ Calibration not required in conductive liquids ▪ No blocking distance
Technical data ▪ Connection ▪ Accuracy ▪ Process temperature ▪ Process pressure ▪ Process connection ▪ Maximum measuring range	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF), 4-wire HART® ±3 mm/±0.12" –200…+400 °C/–328…+752 °F –1…+400 bar/–14.5…+5800 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 35 m/110 ft (rope), longer upon request	2-wire (HART®, PA, FF) ±0.1 %, (typ. 3…10 mm/0.12"…0.4") –10…+80 °C/14…+176 °F Ambient pressure Threads, flanges (DIN, ANSI, JIS) Typically up to 10 bar/145 psi (100 m/328 ft)	2-wire (HART®) ±1.0 % –80…+200 °C/–112…+392 °F –1…+100 bar/–14.5…+1450 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 10 m/32 ft (rope)
Application limits	▪ Strong formation of foam ➔ guided radar, hydrostatics ▪ Many obstacles ➔ guided radar, capacitance, hydrostatics ▪ Low DK value(< 1.4) ➔ hydrostatics	▪ Strong formation of foam ➔ guided radar, hydrostatics ▪ Vapor pressure ➔ radar, guided radar, capacitance ▪ Many obstacles ➔ guided radar, capacitance, hydrostatics	▪ Strong buildup formation (e. g. high viscosity, crystallizing media, etc.) ➔ radar, ultrasonics	▪ Density change ➔ guided radar, radar, ultrasonics ▪ Strong buildup formation ➔ radar, ultrasonics	▪ Changing, non-conductive liquids conductivity < 100 µS/cm ➔ guided radar, radar, ultrasonics ▪ Strong, conductive buildup formation ➔ radar, ultrasonics

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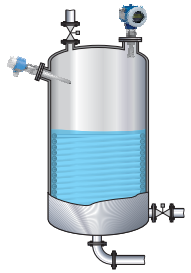
3. Selection of the measuring principle according to the application

Vertical storage tank



- Calm surface (e. g. bottom filling, filling via immersion tube or rare free filling from above)
- Accuracy 3…10 mm/0.12…0.4"
- Free space measurement (without stilling well/ bypass, top mounted)

Non-contact

Contact

	Our proposal **Radar** Micropilot M	**Ultrasonics** Prosonic S/M	**Guided radar** Levelflex M	**Hydrostatics** Deltapilot S / Cerabar S/M Deltabar S	**Capacitance** Liquicap M
					
Advantages	▪ For highly viscous media ▪ High resistance ▪ Universally usable (free adjustable measuring range)	▪ High resistance ▪ Self-cleaning effect ▪ Integrated alarm/level limit relay	▪ Unaffected by nozzle dimensions and tank obstacles ▪ DK starting at 1.4	▪ Unaffected by foam ▪ Unaffected by installation situation ▪ Unaffected by DK value ▪ Front-flush hygienic installation	▪ Unaffected by nozzle dimensions and tank obstacles ▪ Calibration not required in conductive liquids ▪ No blocking distance
Technical data ▪ Connection ▪ Accuracy ▪ Process temperature ▪ Process pressure ▪ Process connection ▪ Maximum measuring range	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF), 4-wire HART® ±3 mm/±0.12" –200…+400 °C/–328…+752 °F –1…+400 bar/–14.5…+5800 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 35 m/110 ft (rope), longer upon request	2-wire (HART®, PA, FF) ±0.075 % of the set span –70…+350 °C/–94…+660 °F 420 bar/6,092 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections Typically up to 10 bar/145 psi (100 m/328 ft)	2-wire (HART®) ±1.0 % –80…+200 °C/–112…+392 °F –1…+100 bar/–14.5…+1450 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 10 m/32 (rope)
Application limits	▪ Strong formation of foam ➔ guided radar, hydrostatics ▪ Many obstacles ➔ guided radar, capacitance, hydrostatics ▪ Low DK value (< 1.4) ➔ hydrostatics	▪ Strong formation of foam ➔ guided radar, hydrostatics ▪ Vapor pressure > 50mbar/0.73psi (20°C/+68°F) ➔ radar, guided radar, capacitance ▪ Many obstacles ➔ guided radar, capacitance, hydrostatics	▪ Strong buildup formation (e. g. high viscosity, crystallizing media, etc.) ➔ radar, ultrasonics	▪ Density change ➔ guided radar, radar, ultrasonics ▪ Strong buildup formation ➔ radar, ultrasonics	▪ Changing, non-conductive liquids conductivity < 100 µS/cm ➔ guided radar, radar, ultrasonics ▪ Strong, conductive buildup formation ➔ radar, ultrasonics

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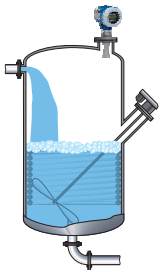
3. Selection of the measuring principle according to the application



Buffer tank

- Agitated surface (e. g. permanent free filling from above, mixing jets, slowly turning mixer, lateral installation)
- Free space measurement (without stilling well)
- Foam spots, islands
- Pressurized
- Fast temperature changes (cleaning)

Non-contact

Our proposal

Radar
Micropilot M

Ultrasonics
Prosonic S/M

Contact

Hydrostatics
Cerabar S / Deltabar S

Guided radar
Levelflex M

Capacitance
Liquicap M

	Radar Micropilot M	Ultrasonics Prosonic S/M	Hydrostatics Cerabar S / Deltabar S	Guided radar Levelflex M	Capacitance Liquicap M
Advantages	■ For highly viscous media ■ High resistance ■ Universally usable (free adjustable measuring range)	■ High resistance ■ Self-cleaning effect ■ Integrated alarm/level limit relay ■ Fast measuring frequency (4-wire)	■ Unaffected by foam ■ Unaffected by installation situation ■ Unaffected by DK value ■ Front-flush hygienic installation	■ Unaffected by nozzle dimensions and tank obstacles ■ DK starting at 1.4 ■ Unaffected by agitated surfaces	■ For small tanks with fast filling and discharging operations ■ Unaffected by nozzle dimensions and tank obstacles ■ No blocking distance
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF) ±0.075 % of the set span –70…+350 °C/–94…+660 °F 420 bar/6,092 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections Typically up to 10 bar/145 psi (100 m/328 ft)	2-wire (HART®, PA, FF), 4-wire HART® ±3 mm/±0.12" –200…+400 °C/–328…+752 °F –1…+400 bar/–14.5…+5800 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 35 m/110 ft (rope), longer upon request	2-wire (HART®) ±1.0 % –80…+200 °C/–112…+392 °F –1…+100 bar/–14.5…+1450 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 10 m/32 ft (rope)
Application limits	■ Strong formation of foam ➔ guided radar, hydrostatics ■ Many obstacles ➔ guided radar, capacitance, hydrostatics ■ Low DK value(< 1.4) ➔ hydrostatics	■ Strong formation of foam ➔ guided radar, hydrostatics ■ Vapor pressure > 50mbar/0.73psi (20°C/+68°F) ➔ radar, guided radar, capacitance ■ Many obstacles ➔ guided radar, capacitance, hydrostatics	■ Density change ➔ guided radar, radar, ultrasonics ■ Strong buildup formation ➔ radar, ultrasonics	■ Strong lateral load ➔ radar, ultrasonics, hydrostatics ■ Strong buildup formation (e. g. high viscosity, crystallizing media, etc.) ➔ radar, ultrasonics	■ Changing, non-conductive liquids conductivity < 100 µS/cm ➔ guided radar, radar, ultrasonics ■ Strong, conductive buildup formation ➔ radar, ultrasonics ■ Strong lateral load ➔ radar, ultrasonics, hydrostatics

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3. Selection of the measuring principle according to the application

Notes

Recipient tank (e. g. bottling facilities)

- Strongly foaming surface
- Pressurized
- Fast temperature changes (cleaning)
- Fast filling and discharging operations
- Tank < 1 m/3.2 ft in height

Contact

	Our proposal **Capacitance** Liquicap M	**Guided radar** Levelflex M	**Hydrostatics** Deltapilot S / Cerabar S/M
			
Advantages	■ For small tanks with fast filling and discharging operations ■ Unaffected by nozzle dimensions and tank obstacles ■ No blocking distance	■ Unaffected by nozzle dimensions and tank obstacles ■ DK starting at 1.4 ■ Unaffected by product properties (conductivity, density)	■ Unaffected by foam ■ Unaffected by installation situation ■ Unaffected by DK value ■ Front-flush hygienic installation
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-wire (HART®) ±1.0 % –80…+200 °C/–112…+392 °F –1…+100 bar/–14.5…+1450 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 10 m/32 ft (rope)	2-wire (HART®, PA, FF), 4-wire HART® ±3 mm/±0.12" –200…+400 °C/–328…+752 °F –1…+400 bar/–14.5…+5800 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 35 m/110 ft (rope), longer upon request	2-wire (HART®, PA, FF) ±0.075 % of the set span –40…+150 °C/–40…+302 °F 40 bar/580 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections Typically up to 10 bar/145 psi (100 m/328 ft)
Application limits	■ Changing, non-conductive liquids conductivity < 100 µS/cm ➔ hydrostatics	■ Extremely fast filling and discharging operations (response times < 0.7 sec) ➔ capacitance ■ Highly accurate measurements in the lower and upper area ➔ capacitance	■ Density change ■ Electronic dp-ratio head pressure : hydrostatic pressure max. 6 : 1

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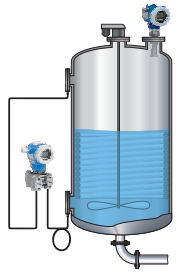
3. Selection of the measuring principle according to the application

Process tank with agitator



- Turbulent surface
- Single-stage agitator (< 60 RPM)
- Pressurized
- Free space measurement (without stilling well/bypass)
- Strong formation of foam

Non-contact

Our proposal

Radar
Micropilot M

Ultrasonics
Prosonic S/M

Contact

Our proposal

Hydrostatics
Deltabar S

	Radar Micropilot M	Ultrasonics Prosonic S/M	Hydrostatics Deltabar S
Advantages	■ For highly viscous media ■ Universally usable (free adjustable measuring range)	■ High resistance ■ Self-cleaning effect ■ Integrated alarm/level limit relay ■ Fast measuring frequency (4-wire)	■ Unaffected by foam ■ Unaffected by DK value ■ Unaffected by turbulent surfaces ■ Unaffected by obstacles and tank shape
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF) ±0.075 % of the set span –70…350 °C/–94…+660 °F 420 bar/6090 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections Max. 8…10 m/ 26…32 ft
Application limits	■ Strong formation of foam ➔ hydrostatics ■ Many obstacles ➔ hydrostatics ■ Low DK value (< 1.4) ➔ hydrostatics ■ Strong turbulences ➔ hydrostatics	■ Strong formation of foam ➔ hydrostatics ■ Vapor pressure > 50mbar/0.73psi (20°C/+68°F) ➔ radar ■ Many obstacles ➔ hydrostatics ■ Fast temperature changes ➔ radar ■ Strong turbulences ➔ hydrostatics	■ Density change ➔ radar, ultrasonics ■ Strong buildup formation ➔ radar, ultrasonics ■ Strongly fluctuating ambient temperatures (influence on capillary system) ➔ radar

3. Selection of the measuring principle according to the application

B

Stilling well

- Measurement in metal pipes (installed in the tank) e. g. immersion tube
- Nominal width typ. DN 40…DN 150

Non-contact

Contact

	Our proposal **Radar** Micropilot M	**Ultraschall** Prosonic S/M	**Guided radar** Levelflex M	**Capacitance** Liquicap M
				
Advantages	■ Universally usable (free adjustable measuring range) ■ Measurement through ball valve ■ Measurement in low DK (< 1.9)	■ High resistance ■ Self-cleaning effect ■ Integrated alarm/level limit relay ■ Unaffected by stilling well material	■ Unaffected by the stilling well geometry ■ DK starting at 1.4 ■ Separable rod probe	■ Unaffected by stilling well geometry
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF), 4-wire HART® ±3 mm/±0.12" –200…+400 °C/–328…+752 °F –1…+400 bar/–14.5…+5800 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 35 m/110 ft (rope), longer upon request	2-wire (HART®) ±1.0 % –80…+200 °C/–112…+392 °F –1…+100 bar/–14.5…+1450 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 10 m/32 ft (rope)
Application limits	■ Large changes in the stilling well cross section ➔ guided radar, capacitance ■ Arrangement, size of equalizing openings ➔ guided radar, capacitance ■ Plastic stilling wells ➔ ultrasonics, guided radar	■ Vapor pressure > 50mbar/0.73psi (20°C/+68°F) ➔ radar	■ Contact between probe and stilling well ➔ radar, ultrasonics ■ Highly viscous products (> 1000 cst)	■ Changing, non-conductive liquids conductivity < 100 µS/cm ➔ guided radar, radar, ultrasonics

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3. Selection of the measuring principle according to the application

Bypass

- Measurement in metal pipes (installed outside the tank) e. g. displacer chambers or cage
- Nominal width typ. DN 40…DN 150/1.5"…6"

Non-contact

Contact

Our proposal

	Radar Micropilot M	Guided radar Levelflex M	Kapazitiv Liquicap M
			
Advantages	▪ Measurement through ball valve ▪ For highly viscous media ▪ High resistance ▪ Universally usable (free adjustable measuring range)	▪ Unaffected by nozzle dimensions and tank obstacles ▪ DK starting at 1.4 ▪ Unaffected by agitated surfaces	▪ For small tanks with fast filling and discharging operations ▪ Unaffected by nozzle dimensions and tank obstacles ▪ No blocking distance
Technical data ▪ Connection ▪ Accuracy ▪ Process temperature ▪ Process pressure ▪ Process connection ▪ Maximum measuring range	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-wire (HART®, PA, FF), 4-wire HART® ±3 mm/±0.12" –200…+400 °C/–328…+752 °F –1…+400 bar/–14.5…+5800 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 35 m/110 ft (rope), longer upon request	2-wire (HART®) ±1.0 % –80…+200 °C/–112…+392 °F –1…+100 bar/–14.5…+1450 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 4 m/13 ft (rod), 10 m/32 ft (rope)
Application limits	▪ Strong formation of foam ➔ guided radar, hydrostatics ▪ Many obstacles ➔ guided radar, capacitance, hydrostatics ▪ Low DK value (< 1.4) ➔ hydrostatics	▪ Strong buildup formation (e. g. high viscosity, crystallizing media, etc.) ➔ radar	▪ Changing, non-conductive liquids conductivity < 100 µS/cm ➔ guided radar, radar ▪ Strong, conductive buildup formation ➔ radar, hydrostatics

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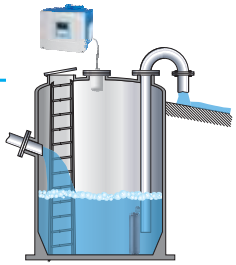
3. Selection of the measuring principle according to the application

Pump shaft/overfall construction/ rain water basin



- Many obstacles
- Risk of flooding, foam formation and turbulent surfaces
- Buildup on the sensor and contacting obstacles (ice formation in winter, suspended solids)
- Installation at open basins or underground
- Sludge formation due to suspended solids

Non-contact

Our proposal

Ultraschall
Prosonic S/M

Radar
Micropilot M

Contact

Our proposal

Hydrostatics
Waterpilot / Deltapilot S

	Ultraschall Prosonic S/M	Radar Micropilot M	Hydrostatics Waterpilot / Deltapilot S
Advantages	■ Flood-proof sensors ■ Self-cleaning effect, free of maintenance ■ Integrated alarm/level limit relay ■ Heated sensors against ice formation ■ Free adjustable measuring range	■ Universally usable (free adjustable measuring range) ■ Unaffected by temperature layers ■ Free of maintenance	■ Unaffected by obstacles / installation situation ■ Unaffected by foam formation ■ Simple commissioning, calibration is not required
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft	2-wire (HART®, PA, FF) ±0.1 % –10…80 °C/14…176 °F Ambient pressure Mounting clamp, cable mounting screw 10 bar/145 psi (100 m/328 ft)
Application limits	■ Strong formation of foam ➔ hydrostatics ■ Many obstacles ➔ hydrostatics	■ Strong formation of foam ➔ hydrostatics ■ Many obstacles ➔ hydrostatics	■ Risk of sludge formation/pollution (buildup) ➔ ultrasonics, radar

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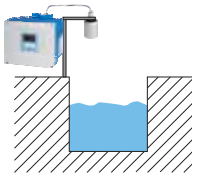
3. Selection of the measuring principle according to the application



Channel measurement (free flowing)

- Risk of flooding, foam formation
- Obstacles
- Condensate formation (icing in winter) on sensor and instrument
- Buildup on the sensor and contacting obstacles (ice formation in winter, suspended solids)
- Installation at open basins or underground

Non-contact

Our proposal

	Ultraschall Prosonic S/M	Radar Micropilot M
		
Advantages	■ Flood-proof sensors ■ Self-cleaning effect, free of maintenance ■ Integrated alarm/level limit relay ■ Heated sensors against ice formation ■ Free adjustable measuring range	■ Universally usable (free adjustable measuring range) ■ Unaffected by temperature layers ■ Free of maintenance
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-/4-wire (HART®, DP, PA, FF) ±2 mm/±0.08" +0.17 % of the distance –40…+105 °C/–40…+221 °F 0.7…4 bar/10…58 psi abs. Threads, Tri-Clamp, flanges (DIN, ANSI, JIS) 20 m/65 ft	2-wire (HART®, PA, FF) ±3 mm/±0.12" –60…+400 °C/–76…+752 °F –1…+160 bar/–14.5…+2320 psi Threads, flanges (DIN, ANSI, JIS), hygienic connections 70 m/229 ft
Application limits	■ Strong formation of foam ➔ hydrostatics ■ Many obstacles ➔ hydrostatics	■ Strong formation of foam ➔ hydrostatics ■ Many obstacles ➔ hydrostatics

Contact

	Hydrostatics Waterpilot / Deltapilot S
	
Advantages	■ Unaffected by obstacles / installation situation ■ Unaffected by foam formation ■ Simple commissioning, calibration is not required
Technical data ■ Connection ■ Accuracy ■ Process temperature ■ Process pressure ■ Process connection ■ Maximum measuring range	2-wire (HART®, PA, FF) ±0.1 % –10…80 °C/14…176 °F Ambient pressure Mounting clamp, cable mounting screw 10 bar/145 psi (100 m/328 ft)
Application limits	■ Risk of sludge accumulation / pollution (buildup formation) ➔ ultrasonics, radar ■ Installation not in flowing water ➔ ultrasonics, radar

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Radar

Required application data
- Pressure and temperature
- Dielectric constant of the medium (DK)/media group
- Required material compatibility
- Nozzle diameter/nozzle height
- Measuring range
- Required accuracy
- For stilling well/bypass: Internal pipe diameter

Application limits for radar level measurement
- T < -60 °C/-76 °F or T > +400 °C/+752 °F
- p > 160 bar/2320 psi
- Measuring range > 70 m/229 ft
- Dielectric constant < 1.4
- Process connection < 1½"

! For reliable measurement: Use a horn antenna whenever possible. In addition, this should have the largest possible diameter.

Dielectric constant εr (DK)
The reflection properties of a medium are determined by the dielectric constant (DK).
The following table shows the allocation of different DK values to media groups. If the dielectric constant of a medium is not known, we recommend to use a DK value of 1.9 for sizing in order to maintain a safe measurement.

Advantages
- Non-contact, maintenance-free measurement
- Unaffected by medium properties like density and conductivity
- For high temperatures up to +400 °C/+752 °C
- Measurement from outside of the tank

Media group	DK value	Examples
A	1.4…1.9	non-conductive liquids, e.g. liquified gas [1]
B	1.9…4	non-conductive liquids, e.g. benzene, oil, toluene …
C	4…10	e.g. concentrated acid, organic solvents, ester, analin, alcohol, acetone, …
D	Larger than 10	Conductive liquids, aqueous solutions, diluted acids and alkalis

- [1] Treat ammonia (NH3) like a medium of Group A, i.e. measurement in stilling wells always with FMR230
- Measuring range: Larger than 40 m/131 ft ➔ Micropilot M (additional option Code F/G) max. measuring range 70 m/229 ft
- Accuracy: More precise than 3 mm/0.12" ➔ Micropilot S (FMR5XX)

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4. Instrument selection within the measuring principle

Radar – process industry

	Micropilot M FMR230 C-band	Micropilot M FMR231 C-band	Micropilot M FMR240 K-band	Micropilot M FMR244 K-band	Micropilot M FMR245 K-band	Micropilot S FMR53x C-band	Micropilot S FMR540 K-band
							
Technical data							
■ Process pressure	–1…+160 bar/ –14.5…+2320 psi	–1…40 bar/ –14.5…+580 psi	–1…40 bar/ –14.5…+580 psi	–1…3 bar/ –14.5…+43.5 psi	–1…16 bar/ –14.5…+232 psi	–1…64 bar/ –14.5…+928 psi	–1…16 bar/ –14.5…+232 psi
■ Process temperature	–60…+400 °C/ –76…+752 °F	–40…+150 °C/ –40…+302 °F	–40…+150 °C/ –40…+302 °F	–40…+130 °C/ –40…+266 °F	–40…+150 °C/ –40…+302 °F	–40…+200 °C/ –40…+392 °F	–40…+200 °C/ –40…+392 °F
■ Accuracy	±10 mm/0.4"	±10 mm/0.4"	±3 mm/±0.12"	±3 mm/±0.12"	±3 mm/±0.12"	±1 mm/±0.04"	±1 mm/±0.04"
■ Process connection	DN 80 to DN 250	R 1½", DN 50 to DN 150, hygienic connections	R 1½", DN 50 to DN 150, Tri-Clamp	G 1½", 1½" NPT	DN 50 to DN 150, Tri-Clamp	DN 80 to DN 250	DN 80 to DN 200
■ Wetted parts	316L/1.4435, Alloy C, PTFE, ceramics, graphite, enamel, sealings	316L/1.4435, PPS, PTFE, PVDF, sealings	316L/1.4435, Alloy C, PTFE, sealings	PTFE, PVDF, Viton	PTFE,	316Ti/1.4571, PTFE, 316L/1.4435, HNBR, sealings	316L/1.4435, PTFE, PEEK, sealings
■ Measuring ranges	20 m/65 ft	20 m/65 ft	40 m/131 ft	25 m/82 ft	40 m/131 ft	25 m/82 ft	40 m/131 ft
■ Technical Information	TI 345F	TI 345F	TI 345F	TI 345F	TI 345F	TI 344F	TI 412F
Applications							
Horizontal storage tank cyl.	–	–	+	O	+	–	–
Vertical storage tank	O	O	+	+	+	O	+
Buffer tank	O	O	+	+	+	–	–
Recipient tank	–	–	–	–	–	–	–
Process tank	+	+	+	O	+	–	–
Stilling well	O	–	+	–	+	+*	+
Bypass	O	–	+	–	+	–	–
Pump shaft	–	–	+	+	+	–	–
Channel measurement	–	–	O	+	O	–	–
Directions	■ Aggressive media ➔ FMR231 ■ Nozzle < DN 150 ➔ FMR240/FMR231 ■ Many obstacles ➔ FMR240	■ Nozzle height >250 mm/10" ➔ FMR240/230 ■ Many obstacles ➔ FMR240	■ Aggressive media ➔ FMR245 ■ Ammonia ➔ Measurement in stilling wells with FMR230 ■ Strong buildup formation ➔ FMR230 with air purge	■ Ammonia ➔ Measurement in stilling wells with FMR230 ■ Strong buildup formation ➔ FMR230 with air purge	■ Ammonia ➔ Measurement in stilling wells with FMR230 ■ Strong buildup formation ➔ FMR230 with air purge	■ * Use planar antenna FMR532 (max. measuring range 38 m/125 ft) ■ Max. measuring range with custody transfer approval: 20 m/65 ft (planar) / 25 m/82 ft (horn)	■ Max. measuring range for custody transfer approval: 25 m/82 ft (parabolic) / 15 m/49 ft (horn)

+ = recommended O = restricted (observe limits) – = not recommended C-band = 6 GHz K-band= 26 GHz

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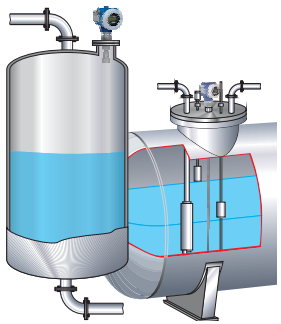
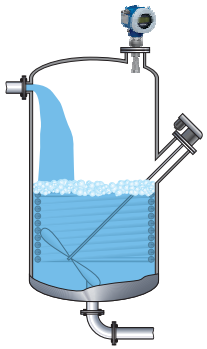
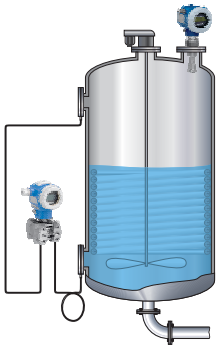
Radar – process industry

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot M FMR230/FMR231.

	Storage tank [1] Calm surface (e. g. bottom filling, filling via immersion tube or rare free filling from above)		**Buffer tank** [1] Agitated surface (e. g. permanent free filling from above, mixing jets)		**Tank with single-stage propeller agitator** [1] Turbulent surface, single-stage agitator <60 U/min./ <60 RPM		**Stilling well**	**Bypass**
								
	Horn/antenna diameter							
FMR230	150 mm/6"	200 mm/8" 250 mm/10"	150 mm/6"	200 mm/8" 250 mm/10"	150 mm/6"	200 mm/8" 250 mm/10"	80…250 mm/3…10"	80…250 mm/3…10" [2]
FMR231	Rod antenna	—	Rod antenna	—	Rod antenna	—	—	—
	Measuring range in m/ft							
Media group **A:** DK (εr) = 1.4…1.9 **B:** DK (εr) = 1.9…4 **C:** DK (εr) = 4…10 **D:** DK (εr) = > 10	B: 10/32 C: 15/49 D: 20/65	B: 15/49 C: 20/65 D: 20/65	B: 5/16 C: 7.5/25 D: 10/32	B: 7.5/25 C: 10/32 D: 125/41	B: 4/13 C: 6/20 D: 8/26	B: 6/20 C: 8/26 D: 10/32	A, B, C, D: 20/65	C, D: 20/65

[1] For media group A use stilling well (20 m/65 ft).
[2] Possible for media groups A and B, e. g. with a stilling well in the bypass.

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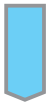
4. Instrument selection within the measuring principle

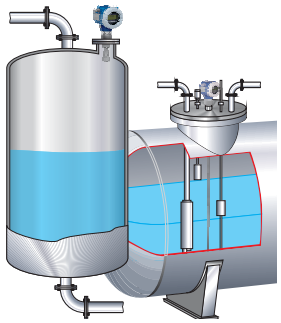
Measuring range in dependence on the type of tank, process conditions and medium for Micropilot M FMR240/FMR244/FMR245.

Standard:
Max. measuring range= 40 m/131 ft

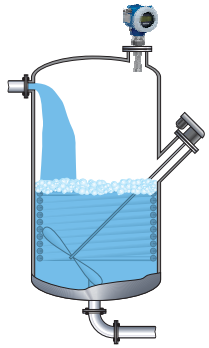


With additional option F (G):
Max. measuring range = 70 m/229 ft
Min. measuring range = 5 m/16 ft

Storage tank
Calm surface
(e. g. bottom filling, filling via immersion tube or rare free filling from above)



Buffer tank
Agitated surface
(e. g. permanent free filling from above, mixing jets, slowly turning mixer, lateral installation)



	Horn/antenna diameter							
FMR240	40 mm/1.5"	50 mm/2"	80 mm/3"	100 mm/4"	40 mm/1.5"	50 mm/2"	80 mm/3"	100 mm/4"
FMR244	40 mm/1.5"	—	—	—	40 mm/1.5"	—	—	—
FMR245	—	50 mm/2"	80 mm/3"	—	—	50 mm/2"	80 mm/3"	—
	Measuring range in m/ft							
Media group **A:** DK (Er) = 1.4…1.9 **B:** DK (Er) = 1.9…4 **C:** DK (Er) = 4…10 **D:** DK (Er) = > 10	A: 3/9.9; 5/16 B: 5/16; 8/26 C: 10/32; 15/49 D: 15/49; 25/82	A: 4/13; 8/26 B: 8/26; 12/39 C: 15/49; 25/82 D: 35/110; 40/131	A: 8/26; 10/32 B: 15/49; 20/65 C: 30/99; 40/131 D: 40/131; 60/197	A: 10/32; 15/49 B: 25/82; 30/99 C: 40/131; 45/148 D: 40/131; 70/229	B: 2/6.6 C: 4/13; 5/16 D: 7.5/25; 10/32	B: 3/9.9; 5/16 C: 7.5/25; 10/33 D: 10/32; 15/49	A: 2.5; 5/16 B: 5/16; 10/32 C: 10/32; 15/49 D: 15/49; 25/82	A: 5/16; 7.5/25 B: 10/32; 15/49 C: 15/49; 25/82 D: 25/82; 35/110

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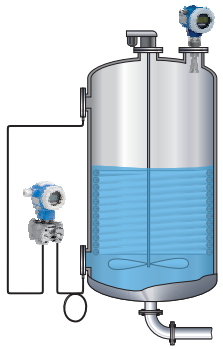
4. Instrument selection within the measuring principle

Measuring range depending on the type of tank, process conditions and medium for Micropilot M FMR240/FMR244/ FMR245.

Standard:
Max. measuring range = 40 m/131 ft

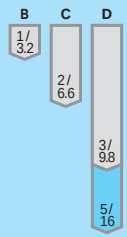
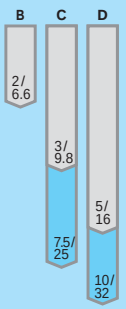
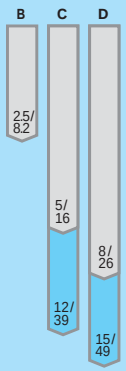
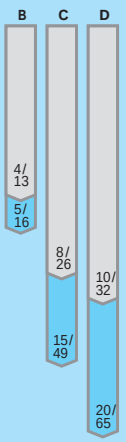
With additional option F (G):
Max. measuring range = 70 m/229 ft
Min. measuring range = 5 m/16 ft

Tank with single-stage propeller agitator
Turbulent surface, single-stage agitator
< 60 U/min. / <60 Rev/min.



Stilling well

Bypass

	Horn/antenna diameter					
FMR240	40 mm/1.5"	50 mm/2"	80 mm/3"	100 mm/4"	40…100 mm/1.5…4"	40…100 mm/1.5…4"
FMR244	40 mm/1.5"	—	—	—	40 mm/1.5"	—
FMR245	—	50 mm/2"	80 mm/3"	—	50…80 mm/2…3"	50…80 mm/ 2…3"
	Measuring range in m/ ft					
Media group **A:** DK (εr) = 1.4…1.9 **B:** DK (εr) = 1.9…4 **C:** DK (εr) = 4…10 **D:** DK (εr) = > 10						 For media groups A and B use Levelflex M with coax probe.

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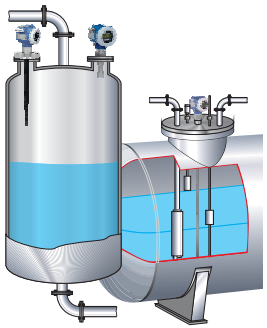
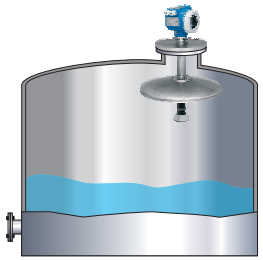
4. Instrument selection within the measuring principle

Measuring range depending on the type of tank, process conditions and medium for Micropilot S FMR530/531/532/533/540.

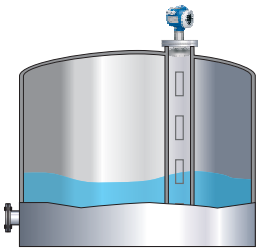
Storage tank
Highly accurate measurement



Storage tank
Highly accurate measurement



Stilling well
Highly accurate measurement



	Horn/antenna diameter						
FMR530			150 mm/6"	200 mm/ 250 mm 8" /10"			
FMR531	Rod antenna						
FMR532							150 mm/6"
FMR533						450 mm/18"	
FMR540		100 mm/4"			200 mm/8"		
	Measuring range in m/ ft						
Media group **A:** DK (Εr) = 1.4…1.9 **B:** DK (Εr) = 1.9…4 **C:** DK (Εr) = 4…10 **D:** DK (Εr) = > 10	B C D 10/32 15/49 20/65	B C, D 20/65 30/99	B 10/32	B C D 15/49 20/65 25/82	B, C, D 40/131	B, C, D 40/131	A, B, C, D 38/125

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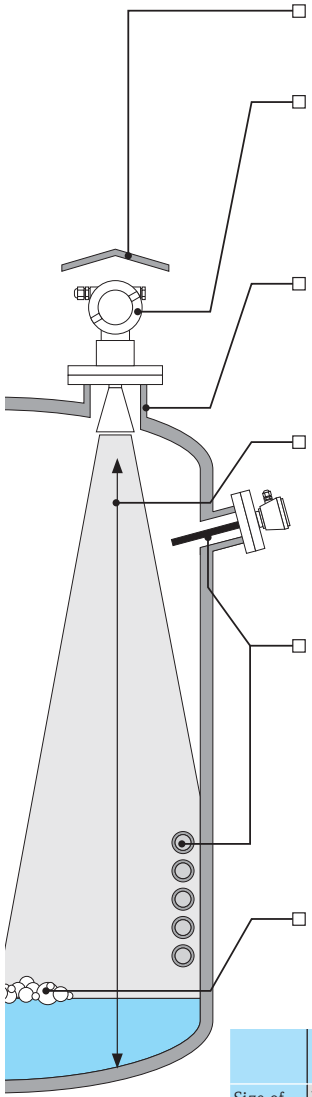
4. Instrument selection within the measuring principle

Installation instructions radar – free space



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

Installation
- Not in the center
- Not above the fillstream
- Distance to wall: ~1/6 of the tank diameter, at least, however, 30 cm/12" (6 GHz), or 15 cm/6" (26 GHz).
- If these conditions cannot be met: Use stilling well

Nozzle
- Horn antenna should protrude from the nozzle, otherwise use antenna extension.
- The inactive part of the rod antenna should be longer than the height of the nozzle. Please contact our application consultant if this is not possible.

Measuring range
- Measurement is possible up to the tip of the antenna, on principle, however, the end of the measuring range should not be closer than 50 mm/2" to the tip of the antenna because of corrosion and buildup formation.
- The measuring range starts where the radar beam meets the tank bottom. With dish bottoms or conical outlets, the level cannot be detected below this point.

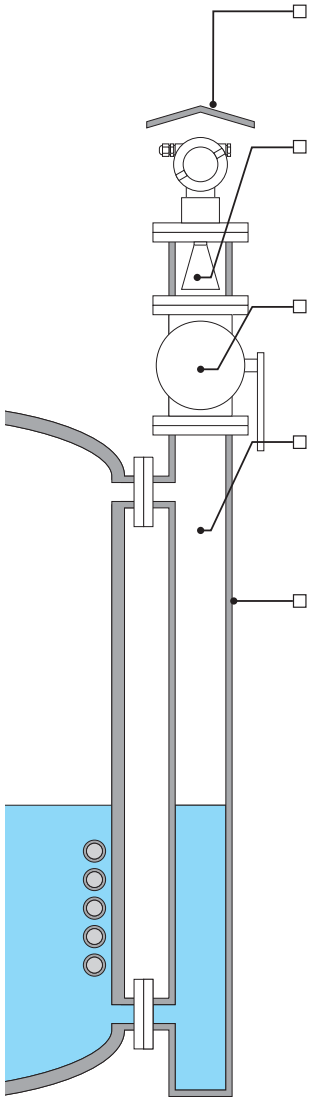
Tank installations
- Avoid any installations like limit switches, temperature sensors, etc. within the signal beam (see table below).
- Symmetrical installations, e.g. vacuum rings, heating coils, flow breakers, etc. may impair measurement.

Optimization options
- Size of antenna: The larger the antenna diameter the smaller the beam angle (see table below, the less interfirence echoes).
- A stilling well or a Levelflex M can always be used to avoid interference.

Foam of formation
- Radar pulses may be absorbed by foam.
- The surface of foam can reflect. Solution: Trial measurement with 6 GHz or e.g. Levelflex M or hydrostatic measurement.

	FMR230/530			FMR231	FMR533	FMR540	FMR240			
							FMR244	FMR245		FMR540
Size of antenna	DN 150 /6"	DN 200 /8"	DN 250 /10"	Rod antenna	Parabolic antenna		DN 40 /1.5"	DN 50 /2"	DN 80 /3"	DN 100 /4"
Beam angle	23°	19°	15°	30°	7°	4°	23°	18°	10°	8°

Installation instructions radar – bypass



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

Optimum horn size
- Select horn antenna as large as possible. In case of in-between sizes (e.g. 95 mm/3.7") use the next larger antenna and adapt it mechanically.

Ball valve
- Measurements through an open ball valve with full passage are possible.

Measuring range
- Measurement is possible up to the tip of the antenna, on principle, however, the end of the measuring range should not be closer than 50 mm/2" to the tip of the antenna because of corrosion and buildup formation.

Recommendations for the bypass
- Metallic (without plastic or enamel coating)
- The bypass pipe must be smooth inside (averaged roughness Ra ≤ 6.3 µm).
- Constant diameter
- In transitions, caused for example by ball valves or joining of individual pipe pieces, gaps of max. 1 mm/0.04" are permitted.

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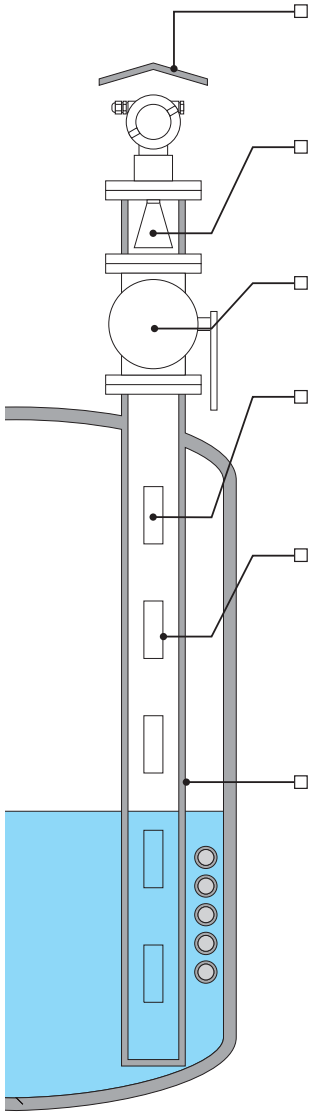
4. Instrument selection within the measuring principle

Installation instructions radar – stilling well



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

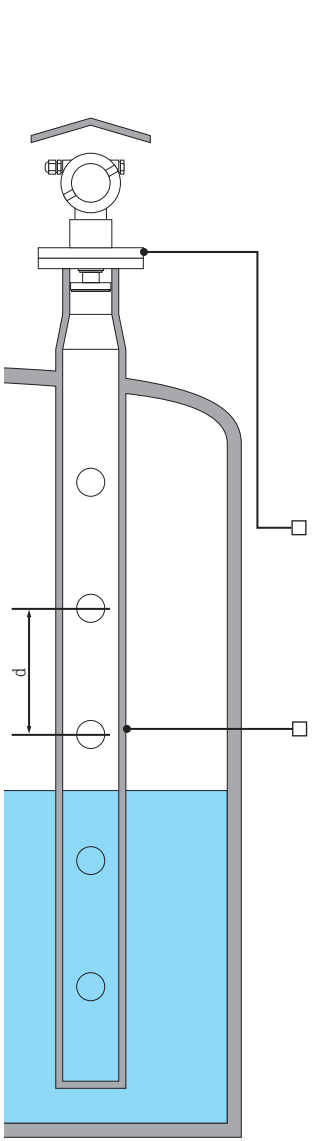
Optimum horn size
- Select horn antenna as large as possible. In case of in-between sizes (e. g. 95 mm/3.7") use the next larger antenna and adapt it mechanically.

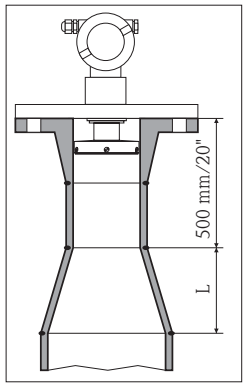
Ball valve (if available)
- Measurements through an open ball valve with full passage are possible.

Measuring range
- Measurement is possible up to the tip of the antenna, on principle, however, the end of the measuring range should not be closer than 50 mm/2" to the tip of the antenna because of corrosion and buildup formation.

Slots / holes
- As few holes / slots as possible
- Slot width or hole diameter max. $^1/_{10}$ of pipe diameter
- Deburred
- Length and number do not affect the measurement.
- Slots / holes 180° offset (not 90°)

Recommendations for stilling wells
- Metallic (without enamel coating, plastic upon request)
- Constant diameter
- Welding seam as even as possible and placed in the axis of the slots
- The stilling well must be smooth inside (averaged roughness Ra ≤ 6,3 µm)
- Do not weld through the wall of the pipe, the inside of the pipe must remain smooth.
- In transitions, caused for example by ball valves or joining of individual pipe pieces, gaps of max. 1 mm/0.04" are permitted.





Instructions for Endress+Hauser UNI flanges in FMR532
- Endress+Hauser UNI flanges are designed with a pitch circle diameter compatible with DIN, ANSI and JIS counter flanges
- UNI flanges have been designed for **unpressurized** operation or atmospheric pressure (1 bar/14.5 psi absolute pressure). The number of flange bolts has been partly reduced.

Recommendations for stilling wells
- Metallic (without enamel coating, plastic upon request)
- Constant diameter
- Hole diameter max. $^1/_{10}$ of pipe diameter.
- Spacing between holes min. 30 cm/12".
- For **FMR532 (planar antenna)** a gradual delatation (DN 150/6" to DN 200/8", DN 200/8" to DN 250/10", DN 250/10" to DN 300/12") can even be accepted. In such cases, the upper pipe end must have a minimum length of 500 mm/20" prior to dilatation. Length L of the delatation must be an additional 300 mm/12" or for DN 250 to DN 300 450 mm/18".
- Larger pipe delatation (e. g. DN 150 to DN 300) is possible, if length L of the delatation amounts to 450 mm/18".
- Ideally, a gauge nozzle is used as upper pipe end.
- Rectangular pipe dilatation is not permitted.

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4. Instrument selection within the measuring principle

Guided radar

C

Required application data
- Pressure and temperature
- Dielectric constant (DK εr) of the medium
- Required material compatibility
- Nozzle diameter: DN, PN, nozzle height
- Measuring range

Application limits for Levelflex M guided level radar
- T < –200 °C/–328 °F and T > +400 °C/+752 °F
- p > 400 bar/5800 psi
- Measuring range > 35 m/110 ft (larger upon request)
- Dielectric constant < 1.4
- Process connection < ¾"

Dielectric constant εr (DK)
The reflection properties of a medium are determined by the dielectric constant (DK).
The following table shows the allocation of different DK values to media groups. If the dielectric constant of a medium is not known, we recommend to use a DK value of 1.9 for sizing in order to maintain a safe measurement.

Advantages
- Unaffected by medium surface (agitated surface, foam)
- Unaffected by tank obstacles
- Additional measuring safety through End of Probe (EOP) recognition
- DK starting at 1.6 without stilling well (1.4 for coax probe)

C

Media group	DK (εr)	Typical liquids	Measuring range FMP40 metallic uninsulated probes	Measuring range FMP41C	Measuring range FMP43	Measuring range FMP45
1	1.4…1.6	▪ Liquefied gases, e. g. N_2, CO_2	4 m/13 ft only coax probes or stilling well, bypass	4 m/13 ft when installed in metallic pipes	—	4 m/13 ft Coax probe and when installed in metallic pipes
2	1.6…1.9	▪ Liquified gas, e. g. propane ▪ Solvent ▪ Frigen / Freon ▪ Palm oil	25…30 m/82… 99 ft	9 m/30 ft	4 m/13 ft	25 m/82 ft
3	1.9…2.5	▪ Mineral oils ▪ Fuel	30…35 m/ 99… 110 ft	12 m/39 ft	4 m/13 ft	30 m/99 ft
4	2.5…4	▪ Benzene, styrene, toluol ▪ Furan ▪ Naphthalene	35 m/110 ft	16 m/52 ft	4 m/13 ft	35 m/110 ft
5	4…7	▪ Chlorobenzene, chloroform ▪ Nitrocellulose lacquer ▪ Isocyan, aniline	35 m/110 ft	25 m/82 ft	4 m/13 ft	35 m/110 ft
6	>7	▪ Aqueous solutions ▪ Alcohols ▪ Acids, lyes	35 m/110 ft	30 m/99 ft	4 m/13 ft	35 m/110 ft

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4. Instrument selection within the measuring principle

Guided radar – process industry

	Levelflex M FMP40	Levelflex M FMP41C	Levelflex M FMP43	Levelflex M FMP45
				
Technical data				
■ Process pressure	–1…40 bar/–14.5…+580 psi	–1…40 bar/–14.5…+580 psi	–1…16 bar/–14.5…+232 psi	–1…400 bar/–14.5…+5800 psi
■ Process temperature	–40…150 °C/–40…302 °F	–40…+200 °C/–40…+392 °F	–20…+150 °C/–4…+302 °F	–200…400 °C/–328…752 °F
■ Accuracy	±3 mm/±0.12" (0.03 % starting 10 m/32 ft)	±5 mm/±0.02" (0.05 % starting 10 m/32 ft)	±3 mm/±0.12"	±3 mm/±0.12" (0.03 % starting 10 m/32 ft), ±5 mm/±0.02" (Koax)
■ Process connection	G/NPT ¾" and 1½", DN 40…150	Tri-Clamp 1½" to 3", DIN 11851, DN 40 … DN 150	Tri-Clamp, DIN 11851, SMS, DIN 11864, NEUMO	G/NPT 1½", DN 50 … DN 100
■ Wetted parts	Rope: 316, rod and coax: 316L/1.4435, sealings: PTFE	PTFE, PFA	316L/1.4435, PEEK, sealings	Rope: 316, rod and coax: 316L/1.4435, ceramics, Graphite, C22/2.4602
■ Measuring ranges	0.3…4 m/1…13 ft (rod, coax) 1…35 m/3.2…110 ft (rope) longer upon request	0.3…4 m/1…13 ft (rod) 1…30 m//3.2…99 ft (rope)	0.3…4 m/1…13 ft longer upon request	0.3…4 m/1…13 ft (rod, coax) 1…35 m/3.2…110 ft (rope) longer upon request
■ Technical Information	TI 358F	TI 386F	TI 424F	TI 386F
Applications				
Horizontal storage tank cyl.	+*	–	O	+*
Vertical storage tank	+	+	+	+
Buffer tank	+	+	+	+
Recipient tank	O	O	+	–
Process tank	–	–	–	–
Stilling well	+	O	–	+
Bypass	+	O	–	+
Pump shaft	–	–	–	–
Channel measurement	–	–	–	–
Directions	■ * use coax probe ■ Aggressive media ➔ FMP41C	■ High process temperatures (> 150 °C/302 °F) can favor diffusion of the process medium into the probe coating which may lead to a limited lifetime. ➔ FMP45		■ * use coax probe

+ = recommended O = restricted (observe limits) – = not recommended

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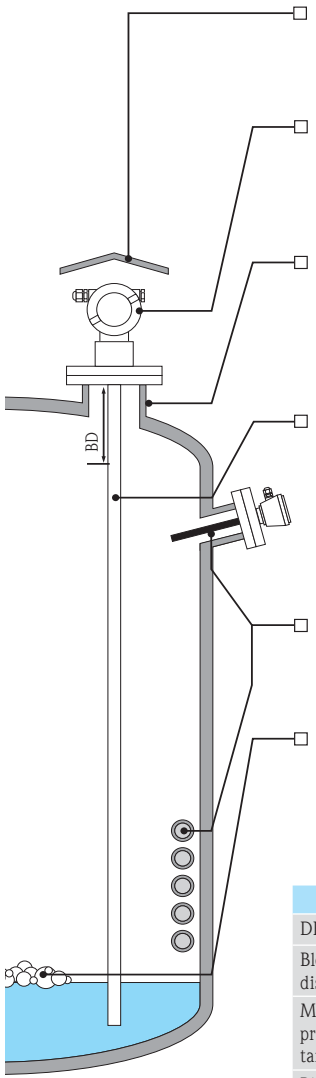
4. Instrument selection within the measuring principle

Installation instructions guided radar – free field



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

Installation
- Not in the center
- Not above the fillstream
- Any wall distance, avoid wall contact

Nozzle
- Nozzles with DN 40 … DN 150 and nozzle heights up to 150 mm/6" are to be preferred.
- For rope probes in nozzles with > 150 mm/6" in height, an HMP40 rod extension must be used.

Measuring range
- Smallest measuring range: 300 mm/12"
- Largest measuring range: 35 m/110 ft (larger upon request)
- For minimum distance probe end ⇔ tank bottom see table below.

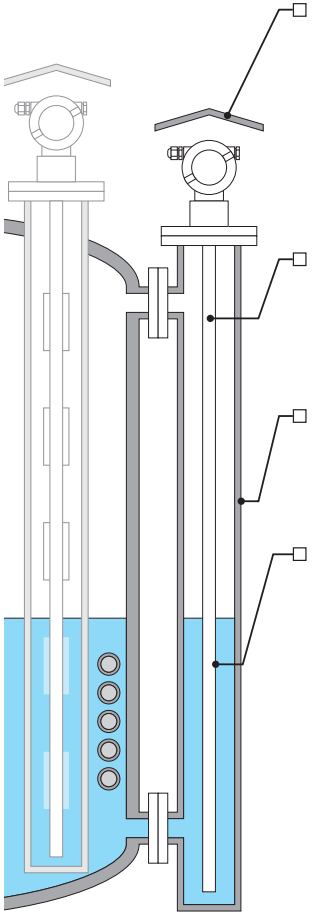
Tank installations
- Distance to obstacles min. 300 mm/12"
- During commissioning enterference echos can be suppressed

Turbulent surface / foam
- Turbulent surfaces do not affect measurement.
- Foam layers of up to approx. 100 mm/4" do not affect measurement. Higher foam thickness may result in too small readings.

	Rope probe		Rod probe		Coax probe	
DK (εr)	1.6…7	>7	1.6…7	>7	1.6…7	>7
Blocking distance top	200 mm/ 8"	100 mm/ 4"	200 mm/ 8"	100 mm/ 4"	0 mm	0 mm
Min. distance of probe end from tank bottom	100 mm/ 4"	100 mm/ 4"	100 mm/4" (FMP43 10 mm/0.4")	100 mm/ 4"	50 mm/ 2"	50 mm/ 2"
Blocking distance BD (mm/") depending on the type of probe and medium						

If the DK value in rope probes is < 7, measurement is not possible in the tensioning weight area (0…250 mm/10" from the end of the probe – lower blocking distance). Less accurate measurement is possible in the lower area of the probe.

Installation instructions guided radar – stilling well/bypass



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

Measuring range
- Smallest measuring range: 300 mm/12"
- Largest measuring range: 4 m/13 ft (larger upon request)

Pipe diameter
- Pipes of DN 40 … DN 150 are to be preferred, these diameters do not have any top blocking distance, measurement is possible up to the bottom edge of the process connection.

Bypass / measuring tube
- Metallic pipe
- No special requirements of bypass pipe or stilling well.
- Welding seams protruding internally up to approx. 5 mm/0.2" do not impair measurement.

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4. Instrument selection within the measuring principle

Ultrasonics

Required application data
- Pressure and temperature
- Vapor pressure of the medium (at 20 °C/68 °F)
- Required material compatability
- Nozzle diameter/nozzle height
- Measuring range
- Required accuracy
- For bypass / stilling well: Internal pipe diameter

Application limits for ultrasonic level measurement in liquids
- T < –40 °C/-40 °F or T > 105 °C/221 °C
- p < 0.7 bar/10 abs. and p > 4 bar/58 psi abs.
- Measuring range > 20 m/65 ft
- Vapor pressure > 50 mbar/0.73 psi (20 °C/68 °F)
- Process connection < 1½"
- Strong temperature fluctuations in the measuring range can affect the accuracy.

Vapor pressure of the medium(20 °C/68 °F)
The vapor pressure of the medium at 20 °C/68 °F is an indication for the accuracy of ultrasonic level measurement. If the vapor pressure at 20 °C/68 °F is lower than 50 mbar/0.73 psi, ultrasonic measurement is recommended. If the vapor pressure at 20 °C/68 °F is above 50 mbar/0.73 psi, the accuracy of the measurement will be affected. To achieve the highest accuracy results, radar level measurement is recommended.

Advantages
- Non-contact, maintenance-free measurement
- Unaffected by product properties, e.g. DK, density, etc.
- Calibration without filling or discharging
- Self-cleaning effect of sensors due to moved transmitting diaphragm

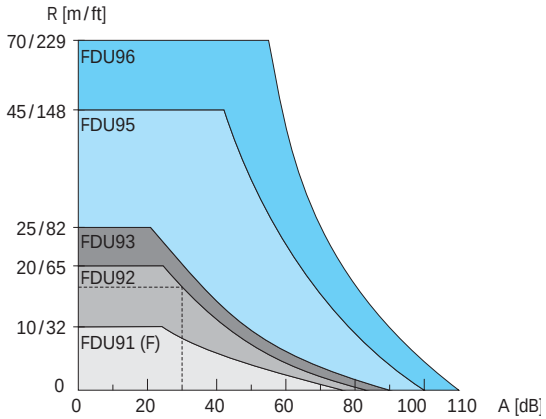
Damping caused by process (differing from reference conditions)

Surface of liquid		Filling curtain in the detection range		Δ-Temp. sensor ⇔ medium surface	
Calm	0 dB	None	0 dB	Up to 20 °C/ 68 °F	0 dB
Waves	5…10 dB	Small quantities	5…10 dB	Up to 40 °C/ 104 °F	5…10 dB
Strong turbulence	10…20 dB	Large quantities	10…40 dB	Up to 80 °C/ 176 °F	10…20 dB
Foam	Ask Endress+Hauser	—	—	—	—

For applications, the sum of dampings (dB) and thus the range (m/ft) can be determined in the diagram from the table.

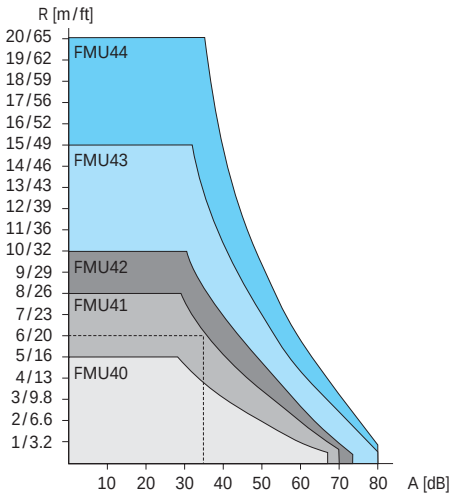
Vapor pressure	Examples
< 50 mbar/0.73 psi (20 °C/68 °F)	Water, water solutions, water-solids solutions, dilute acids (hydrochloric acid, sulphuric acid, …), dilute lyes (caustic soda solution, …), oils, fats, lime water, sludges, pastes, …
> 50 mbar/0.73 psi (20 °C/68 °F)	Ethanol, acetone, ammonia, … For best accuracy results ➔ radar

Range calculation and sensor selection Prosonic S FDU9x



Example (for FDU92):
- Very turbulent surface: 20 dB
- Small quantities of filling curtain in the detection range: 10 dB
- Total: 30 dB ➔ range approx. 16 m/52 ft

Range calculation and selection of sensor for Prosonic M FMU4x



Example (for FMU41):
- Very turbulent surface: 20 dB
- Δ-Temp. sensor ⇔ medium surface approx. 60 °C/140 °F: 15 dB
- Total: 35 dB ➔ range approx. 6 m/20 ft

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4. Instrument selection within the measuring principle

Ultrasonics – process industry

	Prosonic M FMU40	Prosonic M FMU41	Prosonic M FMU42	Prosonic M FMU44	Prosonic S FMU90/95 FDU91	Prosonic S FMU90/95 FDU91F	Prosonic S FMU90/95 FDU92
							
Technical data							
■ Process pressure ■ Process temperature ■ Accuracy	0.7…3 bar/10…43.5 psi –40…+80 °C/–40…+176 °F ±2 mm/±0.08" or 0.2 % of distance	0.7…3 bar/10…43.5 psi –40…+80 °C/–40…+176 °F ±2 mm/±0.08" or 0.2 % of distance	0.7…2.5 bar/10…36 psi –40…+80 °C/–40…+176 °F ±4 mm/±0.16" or 0.2 % of distance	0.7…2.5 bar/10…36 psi –40…+80 °C/–40…+176 °F ±4 mm/±0.16" or 0.2 % of distance	0.7…4 bar/10…58 psi –40…+80 °C/–40…+176 °F ±2 mm/±0.08" + 0.17 % of distance	0.7…4 bar/10…58 psi –40…+105 °C/–40…+221 °F ±2 mm/±0.08" + 0.17 % of distance	0.7…4 bar/10…58 psi -40…+95 °C/–40…+203 °F ±4 mm/±0.16" or 0.2 % of distance
■ Process connection	G/NPT 1½"	G/NPT 2"	DN 80/100, ANSI 3"/4", JIS 10K/80 (100)	DN 100/150/200, ANSI 4"/6"/8", JIS 10K/100 (150/200)	G/NPT 1" (and accessories)	G/NPT 1" (and accessories), Tri-Clamp DN 80	G/NPT 1" (and accessories)
■ Wetted parts	PVDF/EPDM	PVDF/EPDM	PVDF	PVDF	PVDF	316L	PVDF
■ Measuring ranges	0.25…5 m/0.8…16 ft	0.35…8 m/1.1…26 ft	0.4…10 m/1.3…32 ft	0.5…20 m/1.6…65 ft	0.3…10 m/1…32 ft	0.3…10 m/1…32 ft	0.4…20 m//1.3…65 ft
■ Level limit detection	—	—	—	—	1. 3 or 6 relays	1.3 or 6 relays	1.3 or 6 relays
■ Technical Information	TI 365F	TI 365F	TI 365F	TI 365F	TI 396 / TI 397	TI 396 / TI 397	TI 396 / TI 397
Applications							
Horizontal storage tank cyl.	+	O	O	–	+	+	O
Vertical storage tank	+	+	+	+	+*	+*	+*
Buffer tank	+	O	–	–	+	+	–
Recipient tank	–	–	–	–	–	–	–
Process tank	+	+	+	+	+	+	+
Stilling well	+	+	+	+	+	+	+
Bypass	–	–	–	–	–	–	–
Pump shaft	O	O	O	O	+	O	+
Channel measurement	O	O	O	O	+	O	+
Directions	■ For higher resistance ➔ FMU42/44/FDU9x ■ Larger sensor if foam / high turbulence possible ➔ FMU41/FDU91 ■ Fast filling and discharging rate ➔ FMU90 + FDU9x ■ Level limit detection ➔ FMU90 + FDU9x	■ For higher resistance ➔ FMU42/44/FDU9x ■ Larger sensor if foam / high turbulence possible ➔ FMU42/FDU91 ■ Fast filling and discharging rate ➔ FMU90 + FDU9x ■ Level limit detection ➔ FMU90 + FDU9x	■ Larger sensor if foam / high turbulence possible ➔ FMU44/FDU92 ■ Fast filling and discharging rate ➔ FMU90 + FDU9x ■ Level limit detection ➔ FMU90 + FDU9x	■ Fast filling and discharging rate ➔ FMU90 + FDU9x ■ Level limit detection ➔ FMU90 + FDU9x	■ Larger sensor if foam / high turbulence possible ➔ FDU92 ■ Flange-flush assembly ➔ FDU91F ■ * For tank farms scanner FMU95	■ Larger sensor if foam / high turbulence possible ➔ FDU92 ■ *For tank farms scanner FMU95	■ *For tank farms scanner FMU95

+ = recommended O = restricted (observe limits) – = not recommended

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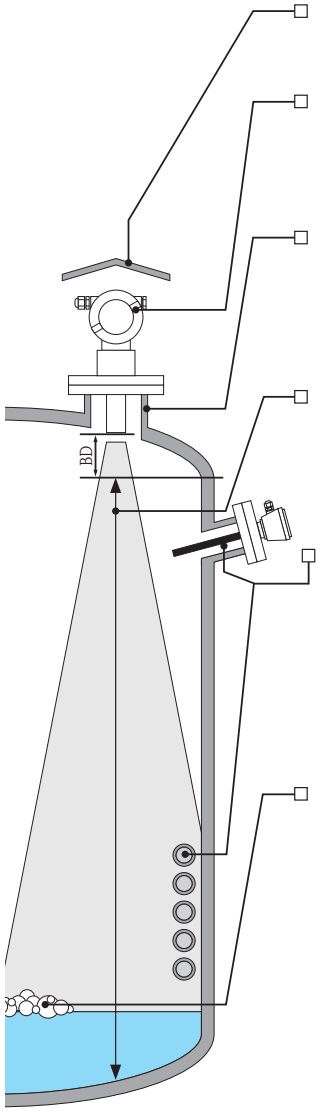
4. Instrument selection within the measuring principle

Installation instructions ultrasonics – free space



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics (Prosonic M/S).

Installation
- Not in the center
- Not above the fillstream
- Distance to wall: ~1/6 of the tank diameter (min. 30 cm/12")
- If these conditions cannot be met: Check stilling well.

Nozzle
- The sensor membrane should be below the nozzle, if this is not possible, please compare the dimensions of the nozzle with the table below.
- Please contact Endress+Hauser if nozzle dimensions are different.

Measuring range
- Measurement is possible up to the blocking distance (BD) of the sensor.
- The measuring range begins where the ultrasonic beam meets the tank bottom. With dish bottoms or conical outlets, the level cannot be be detected below this point.

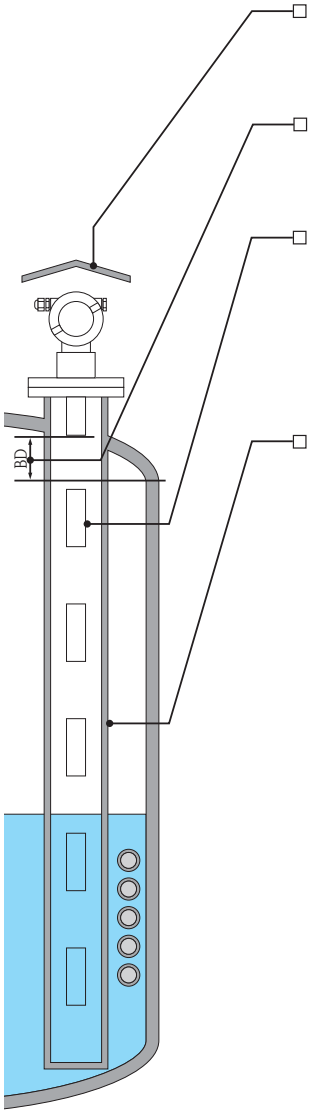
Tank installations
- Avoid any installations like limit switches, temperature sensors, etc. within the signal beam (see table).
- Symmetrical installations, i.e. heating coils, flow breakers, etc. can also interfere with the measurement.

Optimization options
- Use a sensor with a smaller beam angle.
- A stilling well or a sound guiding tube can always be used to avoid interference. Please clarify buildup tendency of the medium.

Formation of foam
- Ultrasonic signals may be absorbed by foam.
- The surface of foam can reflect. Solution: Trial measurement with ultrasonics or e. g. hydrostatic measurement.

Max. nozzle length (mm/")	Sensor type						
	FMU40	FMU41	FMU42	FMU44	FDU91	FDU91F	FDU92
DN 50 /2"	80						
DN 80 /3"	240	240	250		340	340	
DN 100 /4"	300	300	300		390	390	
DN 150 /6"	400	400	400	400	400	400	400
Beam angle	11°	11°	11°	11°	9°	12°	11°
BD (m)	0.25	0.35	0.4	0.5	0.3	0.3	0.4

Recommended nozzle dimensions, nozzle length from sensor diaphragm, beam angle (3 dB)



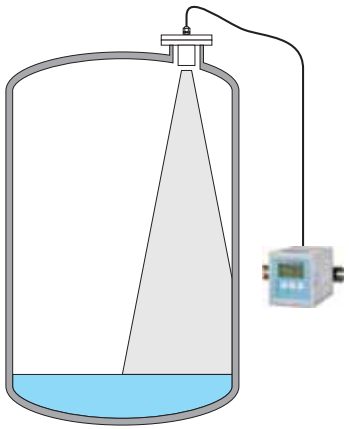
Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics (Prosonic M/S).

Measuring range
- Measurement is possible up to the blocking distance (BD) of the sensor.

Slots / holes (for stilling wells)
- Slot width or diameter of holes max. 1/10 of pipe diameter
- Deburred
- Length and number do not affect the measurement.
- At least one ventilation hole (> 10 mm/0.4") is to be provided in the blocking distance of the sensor

Recommendations for stilling wells
- Any rigid pipe (metal, glass, plastics, ...)
- The stilling well must be smooth inside.
- Constant diameter
- Applicable to stilling wells: Do not weld through the wall of the pipe, the inside of the pipe must remain smooth.
- The assembly of individual pipe pieces may only cause a gap of max. 1 mm/0.04".
- Recommended minimum inner diameter >80 mm/3". Please observe sensor dimensions to choose the right inner diameter.

Separate instrumentation with FMU9x



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4. Instrument selection within the measuring principle

Capacitance

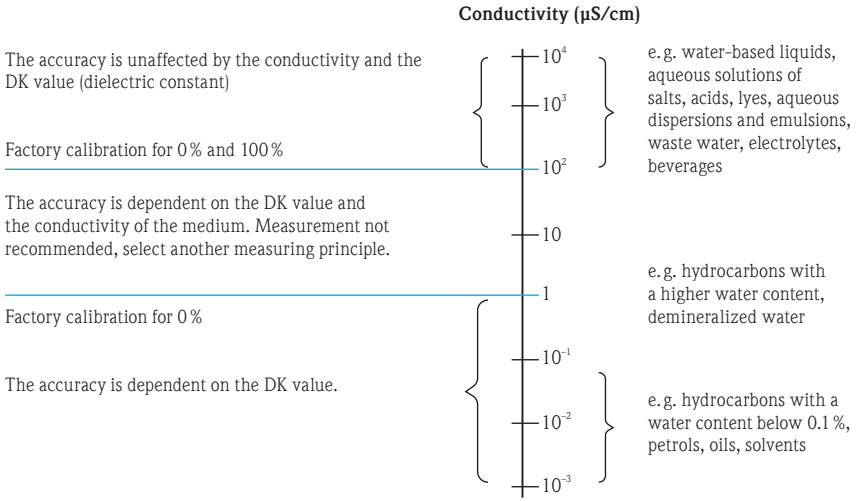
Required application data
- Pressure and temperature
- Conductivity/dielectric constant of the medium (DK)/ media group
- Required material compatibility
- Measuring range
- Required accuracy
- Mounting position

Starting from a conductivity of 100 µS/cm the measured value is not affected by the dielectric constant and the conductivity of the medium.
The following table describes different media.

For reliable measurement:
Provide proper ground connection between process connection and tank. If required, establish ground connection by potential compensation line. In plastic tanks, use probe with a ground tube or double rod probe Liquicap T, if possible.

Application limits for capacitance level measurement
- T < –80 °C/–112 °F or T > +200 °C/+392 °F
- p > 100 bar/1450 psi
- Measuring range > 10 m/3.2 ft

Operating range of Liquicap M



Capacitance – process industry

	Liquicap M FMI51	Liquicap M FMI52	Liquicap T FMI21
			
Technical data			
▪ Process pressure	–1…100 bar/-14.5…1450 psi	–1…100 bar/-14.5…1450 psi	–1…10 bar/-14.5…145 psi
▪ Process temperature	–80…+200 °C/–112…+392 °F	–80…+200 °C/–112…+392 °F	–40…+100 °C/–40…+212 °F
▪ Accuracy	±1 %	±1 %	±1 %
▪ Process connection	Thread ½"…1½", Flanges EN, ANSI, JIS, hygienic	Thread ½"…1½", Flanges EN, ANSI, JIS, hygienic	Thread 1½"
▪ Wetted parts	316L, PFA, PTFE	316L, PFA, FEP	316L, PP, carbon fiber
▪ Measuring ranges	Rod probe up to 4 m/13 ft	Rope probe up to 10 m/32 ft	to 2.5 m/8.2 ft
▪ Technical Information	TI 401F	TI 401F	TI 393F
Applications			
Horizontal storage tank cyl.	+	O	+
Vertical storage tank	+	+	+
Buffer tank	+	–	–
Recipient tank	+	–	–
Process tank	+	–	–
Stilling well	+	O	–
Bypass	+	O	–
Pump shaft	–	–	–
Channel measurement	–	–	–
Directions	▪ Insufficient clearance towards ceiling ▪ Changing, non-conductive media, conductivity < 100 µS/cm	▪ Changing, non-conductive media, conductivity < 100 µS/cm	▪ Changing, non-conductive media, conductivity < 30 µS/cm ▪ Highly viscous liquids > 2000 cst

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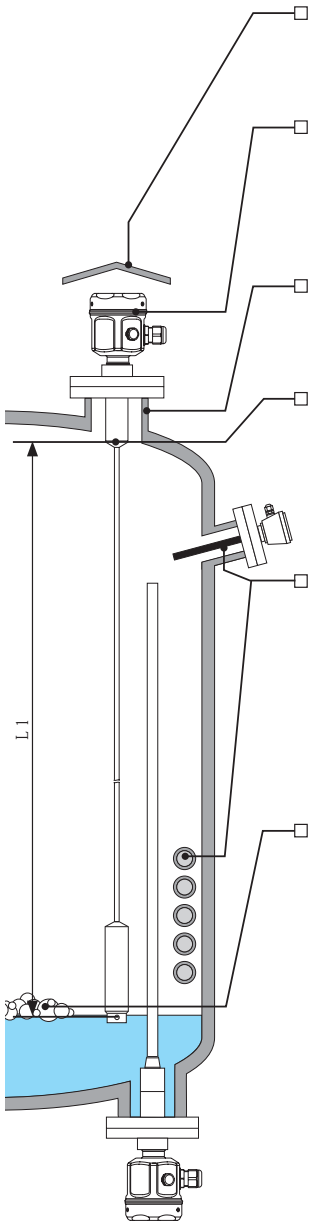
4. Instrument selection within the measuring principle

Installation instructions capacitance



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

Installation
- Not above the fillstream
- Establish proper ground connection between sensor and tank wall.
- Use ground tube in non-conductive tanks (e.g. of plastic material).

Nozzle
- Use inactive length for installation in a nozzle.

Measuring range
- Measuring range L1 possible from the tip of the probe to the process connection.
- Particularly suited to small tanks in fast filling and discharging operations.

Tank installations
- Obstacles do not affect the measurement.

Foam of formation
- In slight foam formation, the „Buildup compensation“ mode may be selected.

Notes

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Hydrostatics (pressure/differential pressure)

Required application data
- Pressure and temperature
- Medium density
- Required material compatibility
- Process connection
- Measuring range
- Required accuracy
- Ambient conditions (temperature change, moisture, …)

Application limits for hydrostatic level measurement
- T < –70 °C/–94 °F or T > +350 °C/+660 °F
- p > 420 bar/6090 psi

Advantages
- Unaffected by surface foam
- Unaffected by tank obstacles / tank geometries
- Simple engineering
- Established technology

Notes

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4. Instrument selection within the measuring principle

Hydrostatics – process industry

	Cerabar M PMC45	Cerabar M PMP46/48	Cerabar S PMC71	Cerabar S PMP75	Deltapilot S FMB70	Deltapilot S DB51/52	Waterpilot FMX167
							
Technical data							
■ Process pressure	10 mbar …40 bar/ 0.15 …580 psi	100 mbar …40 bar 1.5 …580 psi	5 mbar …40 bar 0.07 …580 psi	40 mbar …400 bar 0.58…5800 psi	5 mbar …10 bar/ 0.07…145 psi	5 mbar …10 bar/ 0.07…145 psi	100 mbar …20 bar 0.15 …290 psi
■ Process temperature	–40…+125 °C/ –40…+257 °F	–40…+350 °C/ –40…+660 °F	–40…+150 °C/ –40…+302 °F	–40…+350 °C/ –40…+660 °F	–10…+100 °C/ 14…+212 °F	–10…+80 °C/ 14…+176 °F	–10…70 °C 14…+158 °F
■ Accuracy	±0.2 % (0.1 % option)	±0.2 %	±0.075 % (0.005 % option)	±0.075 %	±0.1 %	±0.2 % (0.1 % option)	±0.2 %
■ Process connection	Thread, flange, hygienic connections	Thread, flange, hygienic connections	Thread, flange, hygienic connections	Thread, flange, hygienic connections	Thread, flange, hygienic connections	Thread, flange	Mounting clamp, cable mounting screw
■ Wetted parts	316L, Al_2O_3, sealings , PVDF	316L, Alloy, Tantal, PTFE	316L, Al_2O_3, sealings, PVDF	316L, Alloy, Tantal, PTFE	316L, Alloy	316L, Alloy, PE, FEP	316L, Al_2O_3, FKM, EPDM, PE, FEP
■ Technical Information	TI 399P	TI 399P	TI 383P	TI 383P	TI 416P	TI 257P	TI 351P
Applications							
Horizontal storage tank cyl.	O	O	O	O	O	+	–
Vertical storage tank	+	+	+	+	+	+	–
Buffer tank	O	O	O	O	O	O	–
Recipient tank	O	–	O	–	O	O	–
Process tank	O	O	O	O	O	–	–
Stilling well	–	–	–	–	–	–	–
Bypass	–	–	–	–	–	–	–
Pump shaft	–	–	–	–	–	+*	+
Channel measurement	–	–	–	–	–	O	O
Directions	■ Measuring cell: ceramics ■ If pressurized, possibly use differential pressure measurement with two pressure transmitters (electronic dp). Observe ratio head pressure : hydrostatic pressure	■ Measuring cell: Metal welded ■ If pressurized, possibly use differential pressure meas-urement with two pressure transmitters (electronic dp). Observe ratio head pressure : hydrostatic pressure ■ PMP46: Hygienic connections PMP48: Thread, flange connections	■ Measuring cell: ceramics ■ If pressurized, possibly use differential pressure meas-urement with two pressure transmitters (electronic dp). Observe ratio head pressure : hydrostatic pressure	■ Measuring cell: Metal welded ■ If pressurized, possibly use differential pressure meas-urement with two pressure transmitters (electronic dp). Observe ratio head pressure : hydrostatic pressure	■ Measuring cell: Contite, condensate-proof, water-tight, metal welded ■ If pressurized, possibly use differential pressure meas-urement with two pressure transmitters. Observe ratio head pressure : hydrostatic pressure	■ Measuring cell: Contite, condensate-proof, water-tight, metal welded ■ If pressurized, possibly use differential pressure meas-urement with two pressure transmitters (electronic dp). Observe ratio head pressure : hydrostatic pressure ■ DB51: Rope variant DB52: Rod variant	■ Measuring cell: ceramics

+ = recommended O = restricted (observe limits) – = not recommended

*In case of an open tank or shaft use DB53 with mounting clamp.

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4. Instrument selection within the measuring principle

	Deltabar S PMD75	Deltabar S FMD77	Deltabar S FMD78
			
Technical data			
■ Process pressure	1 mbar…40 bar/ 0.1…580 psi	10 mbar…16 bar/ 0.15…232 psi	10 mbar…16 bar/ 0.15…232 psi
■ Process temperature	–40…+125 °C/ –40…+257 °F	–40…+350 °C/ –40…+660 °F	–70…+350 °C/ –94…+660 °F
■ Accuracy	±0.075 % (0.005 % option)	±0.075 %	±0.075 %
■ Process connection	Oval flange (¼…18 NPT), IEC 61518	Flanges	Thread, flange, hygienic connections
■ Wetted parts	316L, Alloy, Monel, Tantal	316L, Alloy, Monel, Tantal, PTFE	316L, Alloy, Monel, Tantal, PTFE
■ Technical Information	TI 382P	TI 382P	TI 382P
Applications			
Horizontal storage tank cyl.	O	O	O
Vertical storage tank	O	O	O
Buffer tank	+	+	O
Recipient tank	–	–	–
Process tank	+	+	+
Stilling well	–	–	–
Bypass	O	–	O
Pump shaft	–	–	–
Channel measurement	–	–	–
Directions	■ Measuring cell: Metal welded	■ Measuring cell: Metal welded	■ Measuring cell: Metal welded

+ = recommended O = restricted (observe limits) – = not recommended

Notes

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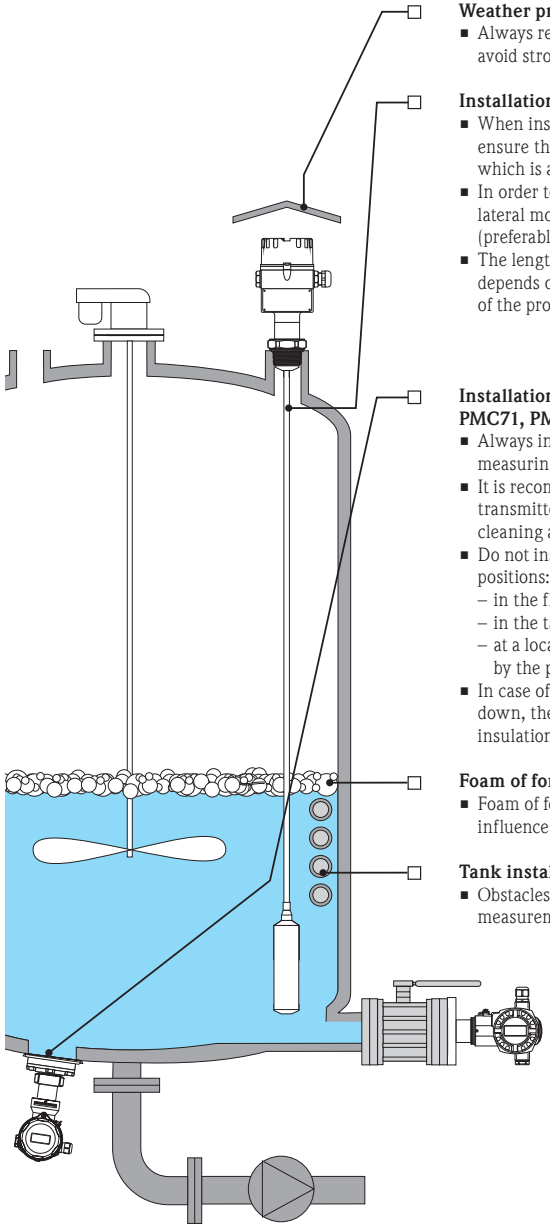
4. Instrument selection within the measuring principle

Installation instructions hydrostatics (pressure)

open tanks



Weather protection cover
- Always recommended for outside installation to avoid strong temperature changes of electronics.

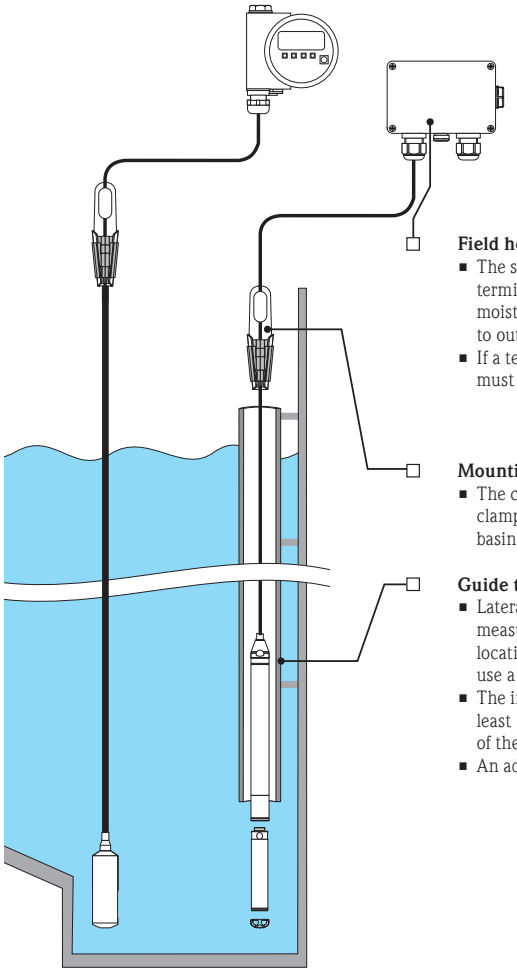
Installation from the top (DB51/52)
- When installing rod and rope versions, please ensure that the head of the probe is at a location which is as free of flow as possible.
- In order to protect the probe against contact by lateral movements, install probe in a guide tube (preferably of plastics) or use an anchoring device.
- The length of the carrier cable or the probe rod depends on the envisaged level zero point. The tip of the probe should be at least 5 cm/2" below that.

Installation from below (PMC45, PMP46/48, PMC71, PMP75, FMB70)
- Always install the instrument below the lowest measuring point.
- It is recommended to install the pressure transmitter behind a stop valve to facilitate easy cleaning and functioning checks.
- Do not install the instrument in the following positions:
  - in the flow of product as it is filled
  - in the tank outlet
  - at a location in the tank which might be affected by the pressure impulses of the agitator.
- In case of media which might cure as they cool down, the instrument must be included in the insulation.

Foam of formation
- Foam of formation does not have any noticeable influence on hydrostatic level measurement.

Tank installations
- Obstacles do not affect hydrostatic level measurement.

open wells or basins (DB53 / FMX167)



Field housing / terminal box
- The sensor is connected to a field housing or terminal box via a carrier cable. Both offer optimum moisture and condensate protection and are suited to outdoor installation.
- If a terminal box is not used in FMX167, the cable must end in a dry room.

Mounting clamp / cable mounting screw
- The carrier cable is fastened by an mounting clamp/cable mounting screw above the well or basin.

Guide tube
- Lateral movement of the level probe might cause measuring errors. Therefore, install the probe in a location which is free of flow and turbulences or use a guide tube.
- The internal diameter of the guide tube should be at least 1 mm/0.04" larger than the external diameter of the selected sensor.
- An additional weight my be ordered as an accessory.

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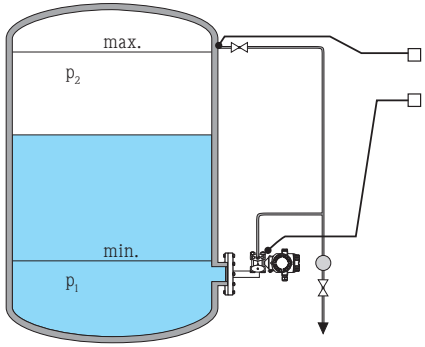
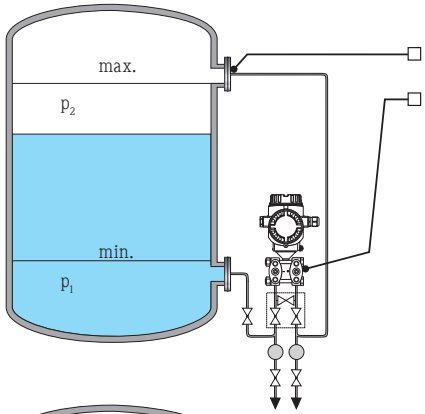
4. Instrument selection within the measuring principle

Installation instructions hydrostatics (differential pressure)



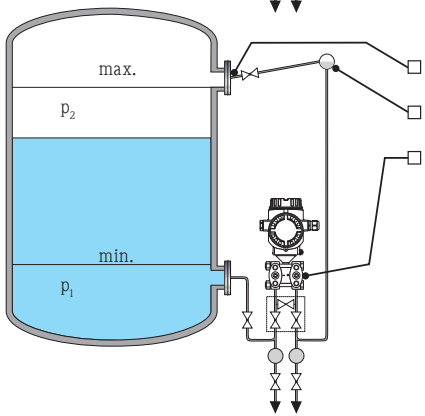
Closed tanks with FMD77 (diaphragm seal plus side)

- Always connect the minus side above the maximum level.
- Install Deltabar S FMD77 directly at the tank below the lower measuring connection.
- Generally speaking, the installation of separators and discharge valves makes sense to collect deposits, pollution or liquids in the upper pressure piping and to remove them.
- Calibrate at operating temperature.



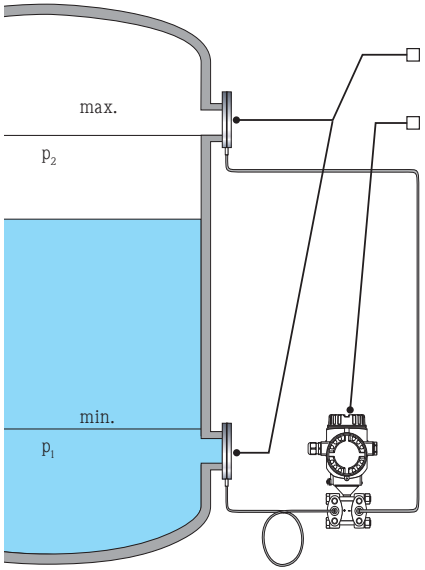
Closed tanks with PMD75 (pressure piping)

- Always connect the minus side above the maximum level.
- Always install Deltabar S PMD75 below the lower measuring connection so that the lower pressure piping is always filled with liquid.
- Generally speaking, the installation of separators and discharge valves makes sense to collect deposits, pollution or liquids in pressure piping and to remove them.
- Calibrate at operating temperature.



Closed vapor-pressurized tanks with PMD75 (pressure piping)

- Always connect the minus side above the maximum level.
- The filled condensate vessel safeguards constant pressure on the minus side.
- Always install Deltabar S PMD75 below the lower measuring connection so that the lower pressure piping is always filled with liquid.
- In case of measurements in media with a solids content, e. g. polluted liquids, the installation of separators and discharge valves makes sense to collect deposits and remove them.
- Calibrate at operating temperature.

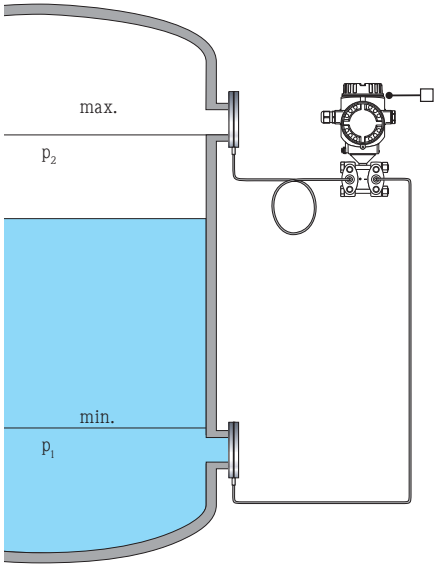


Closed tanks with FMD78 (capillary diaphragm seal)

- Level measurement is only safeguarded between the upper edge of the lower and the lower edge of the upper diaphragm seal.
- In vacuum applications, it is recommended to install the pressure transmitter below the lower diaphragm seal. This will avoid a vacuum load of the diaphragm seal caused by the presence of filling oil in the capillaries.

Optimizing measures

- In order to avoid additional pressure fluctuations and a defective instrument, the capillaries should be installed free of vibrations.
- The capillaries may not be installed in the vicinity of heating or cooling pipes which would impair exact measuring results.
- It is recommended to insulate the capillaries in a colder or warmer environment.
- In case of two-sided diaphragm seal systems, the ambient temperature and the length of both capillaries should be identical.
- Two identical diaphragm seals (e. g. diameter, material, etc.) should always be used for the minus and plus side.



Installation of the pressure transmitter above the lower diaphragm seal

- If the pressure transmitter is installed above the lower diaphragm seal, the maximum height (see Technical Information) may not be exceeded.
- The maximum difference in height depends on the density of the filling oil and the lowest pressure which may occur in the diaphragm seal of the plus side (empty tank) at any time.

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