Continuous level measurement in liquids and bulk solids
Selection and engineering guide for the process industry
Legend

- Continuous level measurement in liquids starting page 3

- Continuous level measurement in solids starting page 99
Step by step

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

The pamphlet contains two separate chapters: Level measurement in liquids and Level measurement in solids.

The first chapter specifically covers continuous measurement in liquids. A separate selection guide is available for point level detection (see the supplementary documentation CP00007F).

Overview of measuring principles
First of all, we show you an overview of the Endress+Hauser measuring principles for continuous level/interface 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.

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.

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.
## Contents

1. Overview of measuring principles .......................................................... 6

2. Checklist .............................................................................................. 12

3. Selection of the measuring principle according to the application 14

   - Horizontal cylindrical storage tank .................................................. 14
   - Vertical storage tank ........................................................................ 16
   - Buffer tank ........................................................................................ 18
   - Recipient tank (e.g. bottling facilities) ............................................... 20
   - Process tank with agitator ................................................................. 22
   - Stilling well ........................................................................................ 24
   - Bypass ............................................................................................... 26
   - Pump shaft / overfall construction / rain water basin ....................... 28
   - Channel measurement (free flowing) ............................................... 30
   - Interface measurement .................................................................... 32

   **IIoT Radar (not included in this selection guide): Cloud based IIoT level sensor for mobile applications or remote measuring points for liquids and bulk solids. Data transmission via cellular communication (NBloT, LTE-M and 2G fallback). Data management in SupplyCare Hosting and Netilion (E+H cloud services). Detailed information is available from our application specialists or at www.endress.com/FWR30.**

4. Instrument selection within the measuring principle .......................... 34

   - Radar ............................................................................................... 34
   - Guided radar .................................................................................... 68
   - Ultrasonics ....................................................................................... 74
   - Capacitance ...................................................................................... 80
   - Servo ............................................................................................... 84
   - Hydrostatics (pressure/differential pressure) .................................. 88

   **Radiometry: The radiometric measuring principle is not considered in this section. Please contact our application consultants in your country for detailed information.**
## 1. Overview of the measuring principles

<table>
<thead>
<tr>
<th>Segmentation</th>
<th>Point level</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquids</strong></td>
<td>Vibronics</td>
<td>Radar</td>
</tr>
<tr>
<td></td>
<td>Conductive</td>
<td>Guided radar</td>
</tr>
<tr>
<td></td>
<td>Capacitance</td>
<td>Ultrasonics</td>
</tr>
<tr>
<td></td>
<td>Float switch</td>
<td>Servo</td>
</tr>
<tr>
<td></td>
<td>Radiometrics</td>
<td>Hydrostatics(p + dp)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacitance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Radiometrics</td>
</tr>
<tr>
<td><strong>Bulk solids</strong></td>
<td>Vibronics</td>
<td>Radar</td>
</tr>
<tr>
<td></td>
<td>Capacitance</td>
<td>Guided radar</td>
</tr>
<tr>
<td></td>
<td>Paddle</td>
<td>Ultrasonics</td>
</tr>
<tr>
<td></td>
<td>Microwave barrier</td>
<td>Electromechanical level system</td>
</tr>
<tr>
<td></td>
<td>Capacitance</td>
<td>Radiometrics</td>
</tr>
</tbody>
</table>

### Process conditions*

*Radiometry not depicted*

Non-contact measurement from outside and, therefore, no application limits.
Endress+Hauser offers you a solution adapted to your application and tailored to your process requirements. You can select the best technology for your application from the wide product range of Endress+Hauser.

„You only pay what you really need.“

Endress+Hauser takes this statement seriously and offers a large number of different measuring principles which vary in price and functionality.
### 1. Overview of the measuring principles

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radar</strong></td>
<td>Micropilot works with either pulses or with Frequency Modulated Continuous Wave (FMCW). Pulse: High-frequency radar pulses which are emitted by an antenna and reflected from the product surface. The time between pulse launching and receiving is measured and analyzed by the instrument and constitutes a direct measure for the distance between the antenna and the surface of the medium. FMCW: Works with an FMCW continuous electromagnetic wave which is emitted from an antenna and reflected by the product surface.</td>
<td>The frequency change “Δf” is measured and the time and distance are calculated. Micropilot Non-contact, maintenance-free measurement also under extreme conditions. Unaffected by density, temperature, conductivity and humidity. No impairment by vapor pressure.</td>
</tr>
<tr>
<td><strong>Guided radar</strong></td>
<td>Levelflex 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.</td>
<td>Reliable and maintenance-free measurement in liquids, also in turbulent media and foam. Unaffected by density, temperature, conductivity and humidity. No impairment by vapor pressure. Measurement of interface and level.</td>
</tr>
<tr>
<td><strong>Ultrasonics</strong></td>
<td>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 detects 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.</td>
<td>Non-contact and maintenance-free measurement without impairment by product properties, e.g. dielectric constant, conductivity, density or humidity.</td>
</tr>
<tr>
<td><strong>Servo</strong></td>
<td>A small displacer is accurately positioned in a liquid medium using a servo motor. The displacer is then suspended on a measuring wire which is wound onto a finely grooved drum. When the displacer is lowered and touches a liquid, the weight of the displacer is reduced by liquid buoyancy force. As a result, torque in the magnetic coupling changes, which is measured by 6 Hall sensors.</td>
<td>The measurement is unaffected by medium properties like conductivity or dielectric constant and used for custody transfer applications</td>
</tr>
<tr>
<td><strong>Prosonic</strong></td>
<td></td>
<td>Process temperatures up to +105°C/+221°F  Process pressures up to 4bar/58psi</td>
</tr>
<tr>
<td><strong>Proservo</strong></td>
<td>The measurement is unaffected by medium properties like conductivity or dielectric constant and used for custody transfer applications.</td>
<td>Process temperatures up to +200°C/+392°F  Process pressures up to 25bar/362psi</td>
</tr>
</tbody>
</table>
### Overview measuring principles

<table>
<thead>
<tr>
<th>Hydrostatics (pressure)</th>
<th>Cerabar, Deltapilot</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Unaffected by dielectric constant, foam, turbulence and obstacles. Condensate-proof, watertight and long-term stable Contite measuring cell with optimized temperature shock behavior (Deltapilot).</td>
</tr>
<tr>
<td>- Process temperatures up to +400°C/+752°F</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrostatics (differential pressure)</th>
<th>Deltabar</th>
</tr>
</thead>
<tbody>
<tr>
<td>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 proportional to the hydrostatic pressure.</td>
<td>Unaffected by dielectric constant, foam, turbulence and obstacles. High overload resistance.</td>
</tr>
<tr>
<td>- Process temperatures up to +400°C/+752°F</td>
<td></td>
</tr>
<tr>
<td>- Process pressures up to 420bar/6,090psi</td>
<td></td>
</tr>
<tr>
<td>- Unaffected by ambient temperatures (Deltabar electronic dp)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Liquicap</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>- Process temperatures up to +200°C/+392°F</td>
<td></td>
</tr>
<tr>
<td>- Process pressures up to 100bar/1,450psi</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radiometry</th>
<th>Gammapilot</th>
</tr>
</thead>
<tbody>
<tr>
<td>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. The measuring system consists of a source and a compact transmitter as a receiver.</td>
<td>Compact transmitters in different measuring lengths, adaptable measuring ranges. Non-contact measurement from outside for all extreme applications, e.g. very corrosive, aggressive and abrasive media.</td>
</tr>
<tr>
<td>- Unaffected by media</td>
<td></td>
</tr>
<tr>
<td>- Any process temperature</td>
<td></td>
</tr>
<tr>
<td>- Any process pressure</td>
<td></td>
</tr>
<tr>
<td>- Unaffected by gammagraphy (Modulator)</td>
<td></td>
</tr>
</tbody>
</table>
### 1. Overview of the measuring principles

<table>
<thead>
<tr>
<th>Technology</th>
<th>Process temperature</th>
<th>Process pressure</th>
<th>Measuring range</th>
<th>Instrument accuracy</th>
<th>Function may be affected by</th>
<th>Accuracy may be affected by</th>
<th>Application limits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radar</strong></td>
<td>~196 to +450°C/</td>
<td>~1 to +2,320psi</td>
<td>0.1 to 80m/0.3 to 262ft</td>
<td>• 6GHz: ±6mm ±0.24&quot;</td>
<td>Foam</td>
<td>Wall effects, Interfering reflections/obstacles in the signal beam</td>
<td>• DC &lt; 1.2</td>
</tr>
<tr>
<td></td>
<td>~321 to +842°F</td>
<td></td>
<td></td>
<td>26GHz: ±2mm ±0.08&quot;</td>
<td>Extreme turbulent surfaces, Conductive build-up on antenna connection</td>
<td>Extreme pressure changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>~1 to +160bar/</td>
<td></td>
<td></td>
<td>80GHz: ±1mm/ ±0.04&quot;</td>
<td>Strong build-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tank Gauging</strong></td>
<td>~40 to +200°C/</td>
<td>~1 to +400bar/</td>
<td>0.8 to 70m/2.6 to 230ft</td>
<td>• 6GHz: ±0.5mm/±0.02&quot;</td>
<td>Turbulent surfaces, Foam</td>
<td>Obstacles, Wall effects, Bad stilling well quality</td>
<td>• DC &lt; 1.4, Measurement up to 0%², Lateral installation or from below</td>
</tr>
<tr>
<td>radar</td>
<td>~40 to +392°F</td>
<td>~14.5 to +5,800psi</td>
<td></td>
<td>26GHz: ±1mm/0.04&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Guided radar</strong></td>
<td>~196 to +450°C/</td>
<td>~1 to +400bar/</td>
<td>0.3 to 45m/1 to 148ft (longer upon request)</td>
<td>• 80GHz: ±0.5mm/ ±0.02&quot;</td>
<td>Extreme build-up formation</td>
<td>Interfering reflections by obstacles near the probe (not for coaxial probe)</td>
<td>• Measurement up to 0%², DC &lt; 1.4, Agitator applications, Lateral installation or from below</td>
</tr>
<tr>
<td></td>
<td>~40 to +221°F</td>
<td>~14.5 to +5,800psi</td>
<td></td>
<td></td>
<td></td>
<td>Extreme pressure changes</td>
<td></td>
</tr>
<tr>
<td><strong>Ultrasonics</strong></td>
<td>~40 to +105°C/</td>
<td>~1 to +400bar/</td>
<td>0.07 to 25m/0.2 to 82ft</td>
<td>• &lt; 15m: ±2mm &lt; 49ft: ±0.08&quot;</td>
<td>Foam</td>
<td>Higher vapor pressure may change the Time-of-Flight</td>
<td>• Measurement up to abs. 0%³</td>
</tr>
<tr>
<td></td>
<td>~40 to +221°F</td>
<td>~1 to +400bar/</td>
<td></td>
<td>• &gt; 15m: ±10mm &gt; 49ft: ±0.4&quot;</td>
<td></td>
<td>Temperature layers in the gas phase, Interfering reflections, Fast temperature change</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Up to ±0.025% of the set span</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. E.g. dish bottom, conical outlet  
2. Measurement only up to the probe end
<table>
<thead>
<tr>
<th>Servo</th>
<th>Capacitance</th>
<th>Radiometrics</th>
<th>Hydrostatics (pressure + differential pressure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>~200 to +200°C/ -329 to +392°F 0 to +25 bar/ 0 to +3625 psi</td>
<td>~80 to +200°C/ -112 to +392°F -1 to +100 bar/ -14.5 to +1450 psi</td>
<td>Unaffected by temperature and pressure</td>
<td>~70 to +400°C/ -94 to +752°F/ Ambient pressure 420 bar/6090 psi (dp)</td>
</tr>
<tr>
<td>up to 47m/154 ft</td>
<td>0.1 to 10 m/0.3 to 32 ft</td>
<td>0.05 to 20 m/0.16 to 66 ft</td>
<td>Up to 0.01 m (10 mbar/0.145 to 7000 bar/10.150)</td>
</tr>
<tr>
<td>±4 mm/0.02”</td>
<td>±1% of measuring distance</td>
<td>±1% of measuring distance</td>
<td>Up to ±0.025% of the set span</td>
</tr>
<tr>
<td>Extreme turbulent surface (use stilling well) High viscose medium</td>
<td>Plastic tank Extreme conductive build-up</td>
<td>External radiation (gammagraphy), solution with Gamma Modulator</td>
<td>Turbulent surfaces</td>
</tr>
<tr>
<td>Viscose medium Build-up</td>
<td>Conductivity &lt; 30 µS/cm: changing dielectric constants Conductive build-up</td>
<td>Extreme pressure fluctuations Extreme build-up</td>
<td>Density change Very fast temperature change Dynamic pressure, e.g. caused by agitator (dp)</td>
</tr>
<tr>
<td>Viscosity &gt; 5000 mPa s Lateral installation or from below</td>
<td>Agitator blade Changing, non-conductive media or conductivity between 1 to 100 µS/cm DC &lt; 2.0 Media diffusing through PTPE, e.g. chlorine</td>
<td>Non-contact measurement from outside and, therefore, no application limits Observe radiation protection regulations</td>
<td>Curing build-up Strong density fluctuations</td>
</tr>
</tbody>
</table>

3 Measurement is possible up to the blocking distance (BD) of the sensor
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.

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

TIP

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

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

<table>
<thead>
<tr>
<th>Selection guide</th>
<th>Radar</th>
<th>Guided radar</th>
<th>Ultrasonics</th>
<th>Hydrostatic</th>
<th>Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condensate</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Foam formation</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Conductivity 1 to 100µS/cm</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Changing media (density)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Low DC</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Viscosity</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Build-up formation</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Small tank (blocking distance)</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Hygienic application (cleanability)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Pressurization</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Simple maintenance (disassembly)</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Independent of installation site</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Unaffected by obstacles</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Small tank (fast level change)</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Vapor pressure &gt; 50mbar/+20°C, &gt; 0.73psi/+68°F)</td>
<td>+</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>CIP/SIP temperature cycles</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

+ = recommended        O = restricted (observe limits)        – = not recommended
<table>
<thead>
<tr>
<th>Details of medium</th>
<th>Medium</th>
<th>Please complete</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>g/cm³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>µS/cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dielectric constant (DC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance/e. g. coating</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-contact measurement</th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Process data</th>
<th>Process temperature</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Process pressure</td>
<td>min.</td>
<td>max.</td>
</tr>
<tr>
<td></td>
<td>Vapor pressure</td>
<td>min.</td>
<td>max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process connection</th>
<th>Type of connection/size</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Installation</th>
<th>Tank (height, Ø)</th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nozzle dimensions</td>
<td>mm/inch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assembly position (from above/from below)</td>
<td>min.</td>
<td>max.</td>
</tr>
<tr>
<td></td>
<td>Free space</td>
<td>min.</td>
<td>max.</td>
</tr>
<tr>
<td></td>
<td>Bypass (Ø)</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>Stilling well (Ø)</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electric connection</th>
<th>2-wire</th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-wire</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital communication</th>
<th>HART®, PROFIBUS®, Ethernet-APL, FOUNDATION™ fieldbus, relay</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Approvals</th>
<th>Ex (Ex ia/Ex d)</th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WHG</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>Shipbuilding</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>EHEDG</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Certificates/manufacturer declarations</th>
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<th>Special requirements</th>
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</tr>
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</table>

*31) Only applicable to level measurement by pressure instruments*
3. Selection of the measuring principle according to the application

## Non-contact

### Our proposal

<table>
<thead>
<tr>
<th>Radar Micropilot</th>
<th>Ultrasonics Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR5x</td>
<td>(separated)</td>
</tr>
<tr>
<td>FMR6xB</td>
<td>(compact)</td>
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<td></td>
<td>FMU90</td>
</tr>
<tr>
<td></td>
<td>(FDU9x)</td>
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<td></td>
<td>FMU4x</td>
</tr>
<tr>
<td></td>
<td>FMU30</td>
</tr>
</tbody>
</table>

### Advantages

- For highly viscous media
- High resistance
- Universally usable (free adjustable measuring range)
- Heartbeat Technology
- Remote access via Bluetooth®

- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Free adjustable measuring range

### Technical data

#### Radar
- Connection: 2- and 4-wire (HART®, PA, FF), Ethernet-APL
- Accuracy: ±1mm/±0.04" ±2mm/±0.08", ±0.2% of the distance
- Temperature: –196 to +450°C/–321 to +842°F
- Pressure: –1 to +160bar/–14.5 to +2,320psi
- Connections: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: 80m/262ft

#### Ultrasonics
- Connection: 2- and 4-wire (HART®, DP)
- Accuracy: ±0.1% (typ. 3 to 10mm/0.12" to 0.4")
- Temperature: –10 to +80°C/+14 to +176°F
- Pressure: Ambient pressure
- Connections: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: Typically up to 100m/328ft (10bar/145psi)

### Application limits

#### Radar
- Strong formation of foam
- Many obstacles
- Low DC value (< 1.2)
- guided radar, hydrostatics
- guided radar, capacitance, hydrostatics

#### Ultrasonics
- Strong formation of foam
- Vapor pressure
- Many obstacles
- guided radar, hydrostatics
- guided radar, capacitance
- guided radar, capacitance, hydrostatics

---

Please note:
- Radar continued on Page 34
- Ultrasonics continued on Page 74
Our proposal

- Radar
- Micropilot
- Ultrasonics
- Prosonic
- Guided radar
- Levelflex
- Hydrostatics
- Deltapilot
- Capacitance
- Liquicap

**Advantages**

- For highly viscous media
- High resistance
- Universally usable (free adjustable measuring range)
- Heartbeat Technology
- Remote access via Bluetooth®

- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Free adjustable measuring range
- Unaffected by changing media
- No impairment by the installations of tank baffles, nozzle dimensions, double reflection, coaxial probe, Heartbeat Technology
- Unaffected by foam
- Unaffected by installation situation
- Unaffected by DC value
- Density change
- Strong build-up formation

- Changing, non-conductive media or conductivity between 1 to 100µS/cm
- Strong, conductive build-up formation

**Technical data**

- 2-wire (HART®, PA, FF), 4-wire HART®
- ±2mm/±0.08”
- −196 to +450°C/−321 to +842°F
- −1 to +400bar/−14.5 to +5,800psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- 10m/33ft (rod), 45m/148ft (rope), 6m/20ft (coax), longer upon request

- 2-wire (HART®, PA, FF)
- ±0.1% (typ. 3 to 10mm/0.12” to 0.4”)
- −10 to +80°C/+14 to +176°F
- Ambient pressure Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Typically up to 100m/328ft (10bar/145psi)

- 2-wire (HART®)
- ±1.0%
- −80 to +200°C/−112 to +392°F
- −1 to +100bar/−14.5 to +1,450psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- 4m/13ft (rod), 10m/32ft (rope)

**Application limits**

- Strong formation
- Many obstacles
- Low DC value (< 1.2)

→ guided radar, radar, ultrasonics

- Strong build-up formation
- Low DC value (< 1.4)

→ hydrostatics

**Selection according to application**

- Horizontal cylindrical storage tank
  - Calm surface (e. g. bottom filling, filling via immersion tube or rare free filling from above)
  - Accuracy 3 to 10mm/0.12 to 0.4”
  - Measurement without stilling well, top mounted
  - Tank diameter up to 3m/9.8ft
  - Changing media
  - Installation from above

- Ground tube probe
- Unaffected by nozzle dimensions and tank obstacles
- Calibration not required in conductive liquids
- No blocking distance

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**Contact**

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Please note:
Guided radar continued on Page 68

Please note:
Hydrostatics continued on Page 88

Please note:
Capacitance continued on Page 80
Continuous level measurement in liquids

3. Selection of the measuring principle according to the application

### Non-contact

#### Our proposal

<table>
<thead>
<tr>
<th>Radar Micropilot</th>
<th>Ultrasonics Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR10/ FMR20</td>
<td>FMU90 (separated)</td>
</tr>
<tr>
<td>FMR5x</td>
<td>FMU4x (compact)</td>
</tr>
<tr>
<td>FMR6xB</td>
<td>FMU30</td>
</tr>
</tbody>
</table>

#### Advantages

- Non-contact and unaffected by head pressures
- Universally useable due to
  - Flexible measuring range
  - Changing, highly viscous or aggressive media (100% PTFE)
  - Remote access via Bluetooth®
  - Heartbeat Technology
  - High resistance
  - Self-cleaning effect of sensors
  - Integrated alarm/point level relay

#### Technical data

**Connection**
- 2-wire (HART®, PA, FF), Ethernet-APL
- ±1mm/±0.04" ±1 to +45°C/−32 to +842°F
- ±1 to +160bar/−14.5 to +2,320psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range 80m/262ft

**Accuracy**
- ±2mm/±0.08", +0.2% of the distance
- −40 to +105°C/−40 to +221°F
- +0.7 to +4bar/+10 to +58psi
- Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- 25m/82ft

**Process temperature**
- −80 to +400°C/−94 to +752°F
- up to +700bar/+10,500psi
- Threads, flanges (DIN, ANSI, JIS)
- Typically up to 100m/328ft

**Process pressure**
- ±0.025% of the set span
- −70 to +400°C/−94 to +752°F
- up to +700bar/+10,500psi
- Threads, flanges (DIN, ANSI, JIS)
- Typically up to 100m/328ft

**Process connection**
- 2-wire (HART®, PA, FF), 4-wire HART®
- ±2mm/±0.08" ±196 to +450°C/−321 to +842°F
- ±1.0%
- −1 to +400bar/−14.5 to +5,800psi
- Threads, flanges (DIN, ANSI, JIS)
- 4m/13ft (rod), 10m/32ft (rope)

#### Application limits

- Strong formation of foam
- Many obstacles
- Low DC value (< 1.2)

→ guided radar, hydrostatics
→ guided radar, capacitance, hydrostatics
→ guided radar, hydrostatics
→ guided radar, hydrostatics

Please note:
Radar continued on Page 34
Ultrasonics continued on Page 74
Selection according to application

Vertical storage tank
- Calm surface (e.g. bottom filling, filling via immersion tube or rare free filling from above)
- Accuracy 3 to 10mm/0.12 to 0.4”
- Measurement without stilling well/bypass

Our proposal

Hydrostatics
- Deltapilot, Cerabar, Deltabar
  - PMC/PMP51B
  - PMC/PMP71B
  - FMB5x, FMB7x
  - PMD55B, PMD75B, PMD78B
  - FMD71/FMD72

- Unaffected by DC values
- Unaffected by tank baffles
- Unaffected by foam
- Remote access via Bluetooth®
- Heartbeat Technology

Guided radar
- Leveflex
  - FMP5x

- Unaffected by nozzle dimensions and tank obstacles
- Heartbeat Technology

Capacitance
- Liquicap
  - FMISx

- Unaffected by nozzle dimensions and tank obstacles
- Calibration not required in conductive liquids
- No blocking distance

Technical data

- Connection
- 2-wire (HART®, PA, FF), Ethernet-APL
- 2-/4-wire (HART®, DP)
- 2-wire (analog, HART®, PA, FF)

- Accuracy
- ±1mm/±0.04”, ±2mm/±0.08”, ±0.2% of the distance
- ±0.025% of the set span
- ±2mm/±0.08”

- Process temperature
- –196 to +450°C/–321 to +842°F
- –40 to +105°C/–40 to +221°F

- Process pressure
- –1 to +160bar/–14.5 to +2,320psi
- +0.7 to +4bar/+10 to +58psi

- Process connection
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- Threads, flanges (DIN, ANSI, JIS), hygienic connections

- Maximum measuring range
- 80m/262ft
- 25m/82ft
- 2-/4-wire (HART®, PA, FF), 4-wire HART®
- 4m/13ft (rod), 10m/32ft (rope), 6m/20ft (coax), longer upon request

Contact

Please note:
- Guided radar continued on Page 68
- Hydrostatics continued on Page 88
- Capacitance continued on Page 80
3. Selection of the measuring principle according to the application

### Non-contact

#### Our proposal

<table>
<thead>
<tr>
<th><strong>Radar</strong></th>
<th><strong>Ultrasونics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FMR5x</strong></td>
<td><strong>FMR6xB</strong></td>
</tr>
<tr>
<td><strong>FDU9x</strong></td>
<td><strong>FMU90</strong></td>
</tr>
<tr>
<td><strong>FMU90</strong></td>
<td><strong>FMU4x</strong></td>
</tr>
</tbody>
</table>

**Advantages**

- Non-contact and unaffected by head pressures
- Universally useable due to
  - Flexible measuring range
  - Changing, highly viscous or aggressive media (100% PTFE)
  - Remote access via Bluetooth®
  - Heartbeat Technology

**Technical data**

- **Connection**: 2-/4-wire (HART®, PA, FF, Ethernet-APL)
- **Accuracy**: ±1mm/±0.04”
- **Process temperature**: –196 to +450°C/–321 to +842°F
- **Process pressure**: –1 to +160bar/–14.5 to +2,320psi
- **Process connection**: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- **Maximum measuring range**: 80m/262ft

**Application limits**

- Strong formation of foam
- Many obstacles in the radar beam
- Low DC value (< 1.2)
- guided radar, hydrostastics
- guided radar, capacitance, hydrostastics

- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Fast measuring frequency (4-wire)

**Technical data**

- **Connection**: 2-/4-wire (HART®, DP)
- **Accuracy**: ±2mm/±0.08”, +0.2% of the distance
- **Process temperature**: –40 to +105°C/–40 to +221°F
- **Process pressure**: +0.7 to +4bar/+10 to +58psi
- **Process connection**: Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- **Maximum measuring range**: 25m/82ft

**Application limits**

- Strong formation of foam
- Vapor pressure
- Many obstacles
- guided radar, hydrostastics
- radar, guided radar, capacitance
- guided radar, capacitance, hydrostastics

---

Please note:
Radar continued on Page 34

Please note:
Ultrasonics continued on Page 74
Selection according to application

Buffer tank

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

Our proposal

- Radar
- Micropilot
- Ultrasonics
- Prosonic
- Hydrostatics
- Cerabar, Deltabar
- Guided radar
- Levelflex
- Capacitance
- Liquicap

Advantages

- Non-contact and unaffected by head pressures
- Universally usable due to flexible measuring range
- Changing, highly viscous or aggressive media (100% PTFE)
- Remote access via Bluetooth®
- Heartbeat Technology
- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Fast measuring frequency (4-wire)
- Unaffected by foam
- Unaffected by installation situation
- Unaffected by DC value
- Electronic dp
- Remote access via Bluetooth®
- Heartbeat Technology
- Unaffected by nozzle dimensions and tank obstacles
- Unaffected by agitated surfaces
- Heartbeat Technology

Technical data

- Connection
- Accuracy
- Process temperature
- Process pressure
- Process connection
- Maximum measuring range

2-wire (HART®, PA, FF) ±0.035% of the set span
-70 to +400°C/−94 to +752°F
up to +40bar/+580psi
Threads, flanges (DIN, ANSI, JIS), hygienic connections
Typically up to 100m/328ft

2-wire (HART®, PA, FF), 4-wire HART® ±2mm/±0.08”
−196 to +450°C/−321 to +842°F
−1 to +400bar/−14.5 to +5,800psi
Threads, flanges (DIN, ANSI, JIS), hygienic connections
10m/33ft (rod), 45m/148ft (rope), 6m/20ft (coax), longer upon request

2-wire (HART®)
±1.0%
−80 to +200°C/−112 to +392°F
−1 to +100bar/−14.5 to +1,450psi
Threads, flanges (DIN, ANSI, JIS), hygienic connections
4m/13ft (rod), 10m/32ft (rope)

Application limits

- Strong formation of foam
- Many obstacles in the radar beam
- Low DC value (<1.2)

→ guided radar, hydrostatics

- Strong formation of foam
- Vapor pressure

→ guided radar, hydrostatics

- Many obstacles

→ guided radar, capacitance

→ hydrostatics

→ hydrostatics

→ guided radar, capacitance

→ hydrostatics

- Density change
- Strong build-up formation
- Ratio head-pressure to level max. 6:1 for electronic dp

→ guided radar, radar, ultrasonics

→ radar, ultrasonics, bubble system

→ radar, guided radar, dp

→ radar, ultrasonics, hydrostatics

→ radar, ultrasonics

→ radar, ultrasonics

Please note:
Hydrostatics continued on Page 88

Guided radar continued on Page 68

Capacitance continued on Page 80
3. Selection of the measuring principle according to the application

### Non-contact

#### Our proposal

**Radar**

- **Micropilot**

- **FMR6xB**

#### Advantages

- Improved focusing due to small beam angle
- Reduced blocking distance < 0.1m
- Small antenna size and process connection
- Remote access via Bluetooth®
- Heartbeat Technology

#### Technical data

- **Connection**
- 2-wire (HART®, PA, Ethernet-APL)
- Accuracy: ±1mm/±0.04" ±196 to +450°C/−321 to +842°F
- Process pressure: −1 to +160bar/−14.5 to +2,321psi
- Process connection: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: 80m/262ft

#### Application limits

- Strong turbulences in combination with low DC and strong foam
  → guided radar

---

Please note: Radar continued on Page 34
Selection according to application

Recipient tank (e.g. bottling facilities)

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

Our proposal

- **Capacitance**
  - Liquicap
  - FM15x

- **Guided radar**
  - Levellflex
  - FMP5x

- **Hydrostatics**
  - Deltapilot, Deltabar, Cerabar
  - FMD71/FMD72
  - 2 x FMB50/FMB70
  - 2 x PMC/PMP51B, 2 x PMC/PMP71B

Contact

- **Capacitance**
  - Liquicap
  - FM15x

- **Guided radar**
  - Levellflex
  - FMP5x

- **Hydrostatics**
  - Deltapilot, Deltabar, Cerabar
  - FMD71/FMD72
  - 2 x FMB50/FMB70
  - 2 x PMC/PMP51B, 2 x PMC/PMP71B

- **Our proposal**
  - Radar
  - Micropilot
  - Capacitance
  - Liquicap
  - Guided radar
  - Levellflex
  - Hydrostatics
  - Deltapilot, Deltabar, Cerabar

**Advantages**

- Improved focusing due to small beam angle
- Reduced blocking distance < 0.1m
- Small antenna size and process connection
- Remote access via Bluetooth®
- Heartbeat Technology
- Fastest response times during filling and discharging operations
- Maximum tank exploitation – no blocking distance
- Unaffected by nozzle dimensions and tank baffles
- Unaffected by nozzle dimensions and tank obstacles
- Unaffected by product properties (conductivity, density)
- Heartbeat Technology
- Electronic dp
- Unaffected by foam
- Unaffected by installation situation
- Unaffected by DC value
- Fast response times
- Unaffected by ambient temperatures
- Changing, non-conductive media or conductivity between 1 to 100μS/cm
- Extremely fast filling and discharging operations (response times < 0.7sec)
- Highly accurate measurements in the lower and upper area
- DC starting at 1.4
- Density change
- Electronic dp-ratio head pressure to level max. 6:1

**Technical data**

- Connection
- Accuracy ±1mm/±0.04"
- Process temperature –196 to +450°C/–321 to +842°F
- Process pressure –1 to +160bar/–14.5 to +2,321psi
- Process connection Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range 80m/262ft

2-wire (HART®, PA, FF), 4-wire HART®
- ±2mm/±0.08"
- –196 to +450°C/–321 to +842°F
- –1 to +400bar/–14.5 to +5,800psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- 10m/33ft (rod), 45m/148ft (rope), 6m/20ft (coax), longer upon request

2-wire (HART®, PA, FF)
- ±0.05% of the set span
- –40 to +150°C/–40 to +302°F
- up to +40bar/+580psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Typically up to 100m/328ft

**Application limits**

- Strong turbulences in combination with low DC and strong foam → guided radar
- Changing, non-conductive media or conductivity between 1 to 100μS/cm → capacitance
- Density change → capacitance, guided radar
- Electronic dp → capacitance, guided radar
- Unaffected by nozzle dimensions and tank baffles → capacitance, guided radar
- Unaffected by nozzle dimensions and tank obstacles → capacitance, guided radar
- Unaffected by product properties (conductivity, density) → capacitance, guided radar
- Heartbeat Technology → capacitance, guided radar
- Fast response times → capacitance, guided radar
- Unaffected by ambient temperatures → capacitance, guided radar

Please note: Capacitance continued on Page 80
Please note: Guided radar continued on Page 68
Please note: Hydrostatics continued on Page 88
### Non-contact

#### Our proposal

**Radar**
- **Micropilot**
  - FMR5x
  - FMR6xB

**Ultrasonics**
- **Prosonic**
  - (separated) FMU90
  - (compact) FDU9x
  - FMU4x

#### Advantages

- **Non-contact** and unaffected by head pressures
- Universally useable due to
  - Flexible measuring range
  - Changing, highly viscous or aggressive media (100% PTFE)
  - Remote access via Bluetooth®
  - Heartbeat Technology

- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Fast measuring frequency (4-wire)

#### Technical data

- **Connection**
  - 2-wire (HART®, PA, FF, Ethernet-APL)
  - 2-/4-wire (HART®, DP)
- **Accuracy**
  - ±1mm/±0.04"
  - +0.2% of the distance
- **Process temperature**
  - –196 to +450°C/–321 to +842°F
  - –40 to +105°C/–40 to +221°F
- **Process pressure**
  - –1 to +160bar/–14.5 to +2,320psi
  - +0.7 to +4bar/+10 to +58psi
- **Process connection**
  - Threads, flanges (DIN, ANSI, JIS), hygienic connections
  - Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- **Maximum measuring range**
  - 80m/262ft
  - 25m/82ft

#### Application limits

- **Strong formation of foam**
- **Many obstacles**
- **Low DC value** (≤ 1.2)
- **Extreme turbulences**
  - → **hydrostatics**

- **Strong formation of foam**
- **Vapor pressure**
- **Many obstacles**
- **Fast temperature changes**
- **Strong turbulences**
  - → **hydrostatics**

- **Strong formation of foam**
- **Vapor pressure**
- **Many obstacles**
- **Fast temperature changes**
  - → **hydrostatics**

### Please note:

- Radar continued on Page 34
- Ultrasonics continued on Page 74
Process tank with agitator

- Agitated surface
- Single-stage agitator (< 60 RPM)
- Pressurized
- Free space measurement (without stilling well/bypass)
- Foam formation is possible depending on the application

Contact

Our proposal

Hydrostatics

Deltabar

PMD55B, PMD75B, PMD78B

FMD71/FMD72 (electronic dp)

- Unaffected by DC values
- Unaffected by tank baffles
- Unaffected by foam
- Unaffected by strongly fluctuating ambient temperatures
- Remote access via Bluetooth®
- Heartbeat Technology

Technical data

- Connection: 2-wire (HART®, PA, FF)
- Accuracy: ±0.035% of the set span
- Process temperature: -70 to +400°C/-94 to +752°F
- Process pressure: up to +40bar/+580psi
- Process connection: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: Typically up to 100m/328ft

Application limits

- Strong formation of foam
- Many obstacles
- Low DC value (< 1.2)
- Extreme turbulences → hydrostatics
- Vapor pressure
- Many obstacles
- Fast temperature changes
- Strong turbulences → hydrostatics → radar
- Density change
- Strong build-up formation → radar, ultrasonics

Please note:

Hydrostatics continued on Page 88
3. Selection of the measuring principle according to the application

### Non-contact

<table>
<thead>
<tr>
<th>Our proposal</th>
<th>Ultrasonics Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radar</strong></td>
<td><strong>Micropilot</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Guided radar</strong></td>
</tr>
<tr>
<td>Radar</td>
<td>Micropilot</td>
</tr>
<tr>
<td></td>
<td>Prosonic</td>
</tr>
<tr>
<td>FMR54</td>
<td>FMU90 (separated)</td>
</tr>
<tr>
<td>FMR62B</td>
<td>FDU9x (compact)</td>
</tr>
</tbody>
</table>

#### Advantages
- Non-contact and unaffected by head pressures
- Universally useable due to flexible measuring range
- Also with ball valve
- Remote access via Bluetooth®
- Heartbeat Technology
- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Unaffected by stilling well material

#### Technical data
- **Connection**
- **Accuracy** ±2mm/±0.08”
- **Process temperature** –196 to +450°C/–321 to +842°F
- **Process pressure** –1 to +160bar/–14.5 to +2,320psi
- **Process connection** Threads, flanges (DIN, ANSI, JIS), hygienic connections
- **Maximum measuring range** 70m/229ft
- **Application limits**
- Large changes in the stilling well cross section
- Arrangement, size of equalizing openings
- Plastic stilling wells
- DC starting at 1.4
- Stilling well > 12 m
- Guided radar, capacitance
- Guided radar, capacitance
- Ultrasonics, guided radar
- Float
- FMR54

#### Application limits
- Vapor pressure
- Guided radar

Please note:
- Radar continued on Page 34
- Ultrasonics continued on Page 74
Selection according to application

Stilling well

- Measurement in metal pipes (installed in the tank)
  e.g. immersion tube
- Nominal width typ. DN 40 to DN 150/1.5" to 6"

Our proposal

Radar
Micropilot
Ultrasonics
Prosonic
Guided radar
Levelflex
Capacitance
Liquicap

Advantages

- Non-contact and unaffected by head pressures
- Universally usable due to flexible measuring range
- Also with ball valve
- Remote access via Bluetooth®
- Heartbeat Technology
- High resistance
- Self-cleaning effect of sensors
- Integrated alarm/point level relay
- Unaffected by the stilling well material
- Unaffected by the stilling well geometry
- Divisible rod probe
- Heartbeat Technology
- Unaffected by the stilling well geometry

Technical data

- Connection
- Accuracy
- Process temperature
- Process pressure
- Process connection
- Maximum measuring range

FMP5x

- 2-wire (HART®, PA, FF), 4-wire HART® ±2mm/±0.08"
  −196 to +450°C/−321 to +842°F
  −1 to +400bar/−14.5 to +5,800psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
  10m/33ft (rod), 45m/148ft (rope), longer upon request

FM15x

- 2-wire (HART®)
  ±1.0%
  −80 to +200°C/−112 to +392°F
  −1 to +100bar/−14.5 to +1,450psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
  4m/13ft (rod), 10m/32ft (rope)

Contact

- Contact between probe and stilling well
- Highly viscous products (> 1000cst)
- Max. stilling well length 10m/33ft
- DC starting at 1.4
  → radar, ultrasonics
  → radar, ultrasonics
  → float

- Changing, non-conductive media or conductivity between 1 to 100μS/cm
  → guided radar, radar, ultrasonics

Please note:
Guided radar continued on Page 68
Capacitance continued on Page 80
3. Selection of the measuring principle according to the application

<table>
<thead>
<tr>
<th>Non-contact</th>
<th>Our proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Radar Micropilot</strong></td>
</tr>
<tr>
<td>Measurement with ball valve possible</td>
<td>FMR54</td>
</tr>
<tr>
<td>For highly viscous media (100% PTFE possible)</td>
<td><strong>Radar Micropilot</strong></td>
</tr>
<tr>
<td>Universally usable (free adjustable measuring range)</td>
<td>FMR62B</td>
</tr>
<tr>
<td>Remote access via Bluetooth®</td>
<td></td>
</tr>
<tr>
<td>Heartbeat Technology</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Technical data</strong></th>
<th><strong>2-wire (HART®, PA, FF)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>±2mm/±0.08&quot;</td>
</tr>
<tr>
<td>Accuracy</td>
<td>−196 to +450°C/−321 to +842°F</td>
</tr>
<tr>
<td>Process temperature</td>
<td>1 to +160bar/−14.5 to +2,320psi</td>
</tr>
<tr>
<td>Process pressure</td>
<td>Threads, flanges (DIN, ANSI, JIS), hygienic connections</td>
</tr>
<tr>
<td>Process connection</td>
<td>70m/229ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Application limits</strong></th>
<th><strong>2-wire (HART®, PA, Ethernet-APL)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong formation of foam</td>
<td>±2mm/±0.08&quot;</td>
</tr>
<tr>
<td>Many obstacles</td>
<td>−196 to +450°C/−321 to +842°F</td>
</tr>
<tr>
<td>Low DC value (&lt; 1.4)</td>
<td>1 to +160bar/−14.5 to +2,320psi</td>
</tr>
<tr>
<td>Bypass &gt; 12 m</td>
<td>Threads, flanges (DIN, ANSI, JIS), 70m/229ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Application limits</strong></th>
<th><strong>2-wire (HART®, PA, Ethernet-APL)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong formation of foam</td>
<td>guided radar, hydrostatics</td>
</tr>
<tr>
<td>Low DC value (&lt; 1.4)</td>
<td>guided radar, capacitance, hydrostatics</td>
</tr>
<tr>
<td>Bypass &gt; 12 m</td>
<td>FMR54</td>
</tr>
</tbody>
</table>

Please note:
Radar continued on Page 34
Selection according to application

**Bypass**
- Measurement in metal pipes (installed outside the tank)
- Replacement of displacer or float vessels, compensation vessels
- Nominal width typ. DN 40 to DN 150/1.5” to 6”

---

**Contact**

**Our proposal**

<table>
<thead>
<tr>
<th>Guided radar</th>
<th>Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levelflex</td>
<td>Liquicap</td>
</tr>
</tbody>
</table>

- No impairment by bypass connections
- Unaffected by changing media
- Safe operation in case of filling via upper connection („coaxial probe“)
- Heartbeat Technology

---

2-wire (HART®, PA, FF), 4-wire HART®
- ±2mm/±0.08”
- –196 to +450°C/–321 to +842°F
- –1 to +400bar/–14.5 to +5,800psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- 10m/33ft (rod), 45m/148ft (rope), longer upon request

- Strong build-up formation (e. g. high viscosity, crystallizing media, etc.)
- Low DC value (< 1.4)

- radar
- hydrostatics

---

2-wire (HART®)
- ±1.0%
- –80 to +200°C/–112 to +392°F
- –1 to +100bar/–14.5 to +1,450psi
- Threads, flanges (DIN, ANSI, JIS), hygienic connections
- 4m/13ft (rod), 10m/32ft (rope)

- For small tanks with fast filling and discharging operations
- Unaffected by nozzle dimensions and tank obstacles
- No blocking distance

---

Please note:
- Guided radar continued on Page 68
- Capacitance continued on Page 80
3. Selection of the measuring principle according to the application

<table>
<thead>
<tr>
<th>Non-contact</th>
<th>Our proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ultrasonics</strong></td>
<td><strong>Radar</strong></td>
</tr>
<tr>
<td>Prosonic</td>
<td>Micropilot</td>
</tr>
<tr>
<td>(separated)</td>
<td>(compact)</td>
</tr>
<tr>
<td>FMU9x</td>
<td>FMR10</td>
</tr>
<tr>
<td>FDU9x</td>
<td>FMR20</td>
</tr>
<tr>
<td>FMU4x</td>
<td>FMR60B</td>
</tr>
</tbody>
</table>

### Advantages
- Overspill-protected, heated sensors with self-cleaning effect
- Universal use due to flexible measuring range
- Operation and display at easily accessible mounting locations possible incl. integrated point level relay and integrated control functions
- Universally usable (free adjustable measuring range)
- Unaffected by temperature layers
- Free of maintenance
- Remote indicator and control
- Remote access via Bluetooth®

### Technical data

#### Ultrasonics
- **Connection**: 2-/4-wire (HART®, DP)
- **Accuracy**: ±2mm/±0.08", +0.2% of the distance
- **Process temperature**: –40 to +105°C/–40 to +221°F
- **Process pressure**: +0.7 to +4bar/+10 to +58psi
- **Process connection**: Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- **Maximum measuring range**: 25m/82ft

#### Radar
- **Connection**: 2-wire (HART®, PA, Modbus, Ethernet-APL)
- **Accuracy**: ±2mm/±0.08"
- **Process temperature**: –40 to +130°C/–40 to +266°F
- **Process pressure**: –1 to +3bar/–14.5 to +43psi
- **Process connection**: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- **Maximum measuring range**: 40m/130ft

### Application limits
- Strong formation of foam
- Many obstacles
- Strong condensation
- Icing of the antenna
- Risk of sludge formation/pollution
- Changing, non-conductive media or conductivity between 1 to 100µS/cm
- Strong, conductive build-up formation

→ hydrostatics

### Please note:
- Ultrasonics continued on Page 74
- Radar continued on Page 34
Selection according to application

**Pump shaft/overfall construction/rain water basin**

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

---

### Contact

#### Our proposal

**Hydrostatics**

*Deltapilot/Waterpilot*

- Unaffected by tank baffles, mounting situation and foam
- Operation and display possible at easily accessible mounting locations

- Connection: 2-/4-wire (HART®, DP)
- Accuracy: ±2mm/±0.08", +0.2% of the distance
- Process temperature: –40 to +105°C/–40 to +221°F
- Process pressure: +0.7 to +4bar/+10 to +58psi
- Process connection: Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- Maximum measuring range: 25m/82ft

**Capacitance**

*Liquicap*

- For small tanks with fast filling and discharging operations
- Unaffected by nozzle dimensions and tank obstacles
- No blocking distance

- Connection: 2-wire (HART®, PA, Modbus, Ethernet-APL)
- Accuracy: ±2mm/±0.08"
- Process temperature: –40 to +130°C/–40 to +266°F
- Process pressure: –1 to +3bar/–14.5 to +43psi
- Process connection: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: 40m/130ft

**Ultrasonics**

*Prosonic*

- Changing, non-conductive media or conductivity between 1 to 100µS/cm
- Strong, conductive build-up formation

---

### Technical data

#### Hydrostatics

- Connection: 2-/4-wire (HART®, DP)
- Accuracy: ±2mm/±0.08", +0.2% of the distance
- Process temperature: –40 to +105°C/–40 to +221°F
- Process pressure: +0.7 to +4bar/+10 to +58psi
- Process connection: Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- Maximum measuring range: 25m/82ft

#### Capacitance

- Connection: 2-wire (HART®, PA, Modbus, Ethernet-APL)
- Accuracy: ±2mm/±0.08"
- Process temperature: –40 to +130°C/–40 to +266°F
- Process pressure: –1 to +3bar/–14.5 to +43psi
- Process connection: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: 40m/130ft

#### Ultrasonics

- Connection: 2-wire (HART®)
- Accuracy: ±1.0%
- Process temperature: –80 to +200°C/–112 to +392°F
- Process pressure: –1 to +100bar/–14.5 to +1,450psi
- Process connection: Threads, flanges (DIN, ANSI, JIS), hygienic connections
- Maximum measuring range: 4m/13ft (rod), 10m/32ft (rope)

---

Please note:

Hydrostatics continued on Page 88

Capacitance continued on Page 80
3. Selection of the measuring principle according to the application

Non-contact

Our proposal

### Ultrasonics
- **Prosonic**

#### FMU90
- (separated)

#### FDU9x

#### FMUx

#### FMR10

#### FMR20

#### FMR60B

### Radar
- **Micropilot**

#### FMU4x

#### (compact)

#### FMR20

#### FMR60B

### Advantages
- No flow impairment
- Overspill-protected, heated sensors with self-cleaning effect
- Operation and display at easily accessible mounting locations possible incl. integrated point level relay and preprogrammed flow curves
- Universally usable (free adjustable measuring range)
- Unaffected by temperature layers
- Free of maintenance
- Remote indicator and control
- Remote access via Bluetooth®
- Unaffected by obstacles / installation situation
- Unaffected by foam formation
- Simple commissioning, calibration is not required

### Technical data

#### Connection
- 2-/4-wire (HART®, DP)

#### Accuracy
- ±2mm/±0.08”, ±0.2% of the distance
- −40 to +105°C/−40 to +221°F
- +0.7 to +4bar/+10 to +58psi
- Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
- 25m/82ft

#### 2-wire (HART®, PA, Modbus, Ethernet-APL)
- ±2mm/±0.08’
- −40 to +130°C/−40 to +266°F
- −1 to +3bar/−14.5 to +43psi
- Threads, flanges (DIN, ANSI, JIS), 40m/130ft

#### Application limits
- Strong formation of foam
- Many obstacles

### Please note:
- Ultrasonics continued on Page 74
- Radar continued on Page 34
Selection according to application

Channel measurement (free flowing)

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

Our proposal

- Ultrasonics
- Prosonic
- Radar
- Micropilot
- Hydrostatics
- Waterpilot/Deltapilot

Advantages

- No flow impairment
- Overspill-protected, heated sensors with self-cleaning effect
- Operation and display at easily accessible mounting locations possible incl. integrated point level relay and preprogrammed flow curves
- Universally usable (free adjustable measuring range)
- Unaffected by temperature layers
- Free of maintenance
- Remote indicator and control
- Remote access via Bluetooth®

- 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)

±2mm/±0.08”, +0.2% of the distance
–40 to +105°C/–40 to +221°F
+0.7 to +4bar/+10 to +58psi
Threads, Tri-Clamp, flanges (DIN, ANSI, JIS)
25m/82ft

2-wire (HART®, PA, Modbus, Ethernet-APL)

±2mm/±0.08”
–40 to +130°C/–40 to +266°F
–1 to +3bar/–14.5 to +43psi
Threads, flanges (DIN, ANSI, JIS), 40m/130ft

2-wire (analog, HART®, PA, FF)

±0.1%
–10 to +80°C/+14 to +176°F
+0,1 to +20bar/1.45 to 290psi
Mounting clamp, cable mounting screw
200m/656ft (20bar/290psi)

Application limits

- Strong formation of foam
- Many obstacles → hydrostatics
- Strong formation of foam
- Narrow channel (<0.5m)
- Icing of the antenna → hydrostatics
- → ultrasonics, hydrostatics
- Risk of sludge accumulation/pollution (build-up formation)
- Restricted installation in flowing water → ultrasonics, radar
- → ultrasonics, radar

Contact

Hydrostatics

Waterpilot/Deltapilot

FMB53 FMX21

Please note:

Hydrostatics continued on Page 88
3. Selection of the measuring principle according to the application

**Contact**

**Guided radar Levelflex**

FMP51/52/54

**Multiparameter Levelflex**

FMP55

**Advantages**
- Simultaneous acquisition of interface layer and total level
- Not affected by the density of the medium
- No wet calibration required
- Direct replacement of displacers in existing displacer chambers
- Probes can be shortened (rod)

**Technical data**

- **Connection**
  - 2-wire (HART®/PA), 4-wire
- **Accuracy**
  - ±2mm/±0.08” (overall level);
  - ±10mm/±0.39” (interface level)
- **Process temperature**
  - –196°C to +450°C/–321°F to +842°F
- **Process pressure**
  - –1 to +400bar/–14.5 to +5,800psi
- **Process connection**
  - Threads, flanges (DIN, ANSI, JIS), hygiene connections
- **Maximum measuring range**
  - 6m/20ft (coax), 10m/33ft (rope/rod), longer upon request

**Application limits**

- Dielectric constant (DC value) of the upper medium must be determined
- DC value changes of the upper medium influence accuracy
- DC value of the upper medium may be max. 10
- Difference of the DCs between the two media must be >10
- For interface measurement, the thickness of the upper phase must be min. 60mm/2.36”
- Emulsion layers up to max. 50mm/1.97” allowable

Please note:
Guided radar continued on Page 68
Interface measurement

1. Interface liquid/liquid
2. With emulsion layer
3. Multiphase measurement

Recommendation

Guided radar
Levelflex
Multiparameter Levelflex
Capacitance Liquicap
Radiometrics Gammapilot

Advantages

- Simultaneous acquisition of interface layer and total level
- Not affected by the density of the medium
- No wet calibration required
- Direct replacement of displacers in existing displacer chambers
- Probes can be shortened (rod)

- Simultaneous acquisition of interface layer and overall level, also in case of emulsions
- Precise and reliable measurement
- Independent of medium density
- Wet calibration not required
- PTFE-coated probe

Technical data

- Connection
- Accuracy
- Process temperature
- Process pressure
- Process connection
- Maximum measuring range

Applications

- Dielectric constant (DC value) of the upper medium must be determined
- DC value changes of the upper medium influence accuracy
- DC value of the upper medium may be max. 10
- Difference of the DCs between the two media must be >10
- For interface measurement, the thickness of the upper phase must be min. 60mm/2.36"
- Emulsion layers up to max. 50mm/1.97" allowable

Please note:
Capacitance continued on Page 80
4. Instrument selection within the measuring principle

Radar

**Required application data**
- Pressure and temperature
- Dielectric constant of the medium (DC)/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**
- Temperature up to -196°C/-321°F
- Temperature up to +450°C/+842°F
- Pressure up to 160bar/2320psi
- Measuring range up to 80m/262ft
- Dielectric constant from 1.2
- Process connection from ¾”

**Advantages**
- Non-contact, maintenance-free measurement
- Unaffected by medium properties like density and conductivity
- For high temperatures up to +450°C/+842°F
- Measurement from outside of the tank

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

**Absorption**
The following media can absorb the radar signal from 80 GHz sensors depending on pressure, temperature and the concentration of the respective medium:
- Aceton (Dimethylketon)
- Dichloromethane/Methylene Chloride
- Ethylene oxide
- Methyl Ethyl Ketone
- Methyl Isobutyl Ketone (MIBK)
- Propylene oxide
- SMR (Xylene 30 %, Toluene 30 %, Acetone 40 %)
- Silicon tetrachloride
- Trichlorosilane
- Tetrafluoroethane
- Toluol
- VCM (Vinyl Chloride Monomer)
- Ammonia
- Ethyl Acetate
- Acetic Acid
- Acrylnitiril
**Endress+Hauser DC App**

The app offers comfortable access to several thousand DC values for all kinds of different media. You can search by the name of the medium or the chemical formula. The autocomplete functionality helps you if you don’t know the exact spelling of the name of your medium.

---

### Dielectric constant (DC value) Compendium

<table>
<thead>
<tr>
<th>Media group</th>
<th>DC value</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1.2 to 1.4</td>
<td>Butane, liquid nitrogen, liquefies hydrogen</td>
</tr>
<tr>
<td>A*</td>
<td>1.4 to 1.9</td>
<td>non-conducting liquids, e. g. liquified gas&lt;sup&gt;1)&lt;/sup&gt;</td>
</tr>
<tr>
<td>B*</td>
<td>1.9 to 4</td>
<td>non-conductive liquids, e. g. benzene, oil, toluene, ...</td>
</tr>
<tr>
<td>C</td>
<td>4 to 10</td>
<td>e. g. concentrated acid, organic solvents, esters, aniline, alcohol, acetone, ...</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 10</td>
<td>conducting liquids, e.g. aqueous solutions, diluted acids and alkalis</td>
</tr>
</tbody>
</table>

- Measuring range:
  - Micropilot FMR10/FMR20 up to 20m/66ft
  - Micropilot FMR5x up to 40m/131ft. Larger than 40m/131ft → Micropilot with option “advanced dynamics” max. measuring range 70m/229ft
  - Micropilot FMR6xB up to 80m/262ft
  - Accuracy: More precise than 1mm/0.04" → Micropilot FMR6xB, or on request

<sup>1)</sup> Treat ammonia (NH₃) like a medium of group A, i.e. measurement in stilling wells always with FMR54. Alternatively, measurement with guided radar FMP54 respectively FMP51 including option “gastight feedthrough”

* not for Micropilot FMR10/FMR20
4. Instrument selection within the measuring principle

### Radar – process industry

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Micropilot FMR10 26GHz</th>
<th>Micropilot FMR20 26GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process pressure</td>
<td>–1 to +3bar/–14.5 to +43.5psi</td>
<td>–1 to +3bar/–14.5 to +43.5psi</td>
</tr>
<tr>
<td>Process temperature</td>
<td>–40 to +60°C/–40 to +140°F</td>
<td>–40 to +80°C/–40 to +176°F</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±5mm/±0.2&quot;</td>
<td>±2mm/±0.08&quot;</td>
</tr>
<tr>
<td>Process connection</td>
<td>G 1&quot;, 1&quot; NPT, G 1½&quot;, 1½&quot; NPT</td>
<td>G 1&quot;, 1&quot; NPT, G 1½&quot;, 1½&quot; NPT, G 2&quot;, 2&quot; NPT, DN 80 to DN 150/3&quot; to 6&quot;</td>
</tr>
<tr>
<td>Wetted parts</td>
<td>PVDF, PBT</td>
<td>PVDF, PBT</td>
</tr>
<tr>
<td>Measuring ranges</td>
<td>up to 12m/39.4ft with mounted flooding tube protection</td>
<td>20m/66ft</td>
</tr>
<tr>
<td>Gastight feedthrough</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Technical Information</td>
<td>TI01266F</td>
<td>TI01267F</td>
</tr>
</tbody>
</table>

| Applications |
|----------------|-------------------------|
| Horizontal storage tank cyl. | — |
| Vertical storage tank | + |
| Buffer tank | — |
| Recipient tank | — |
| Process tank | — |
| Stilling well | — |
| Bypass | — |
| Pump shaft | O |
| Channel measurement | O |

<table>
<thead>
<tr>
<th>Application limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC &lt; 4</td>
</tr>
<tr>
<td>Turbulent surfaces</td>
</tr>
<tr>
<td>Ammoniacal gas phase</td>
</tr>
<tr>
<td>Strong build-up formation</td>
</tr>
<tr>
<td>Only PTFE resistant</td>
</tr>
<tr>
<td>Custody transfer measurement</td>
</tr>
<tr>
<td>FMR5x, FMR6x, FMR5x, FMR54 in stilling well, FMR54 with air purge, FMR52, 62B, FMR540, NMR8x</td>
</tr>
</tbody>
</table>

+ = recommended  O = restricted (observe limits)  – = not recommended
### Instrument selection within the measuring principle

**Radar – process industry**

**Technical data**

- **Process pressure**
  - –1 to +3 bar / –14.5 to +43.5 psi
- **Process temperature**
  - –40 to +60°C / –40 to +140°F
- **Accuracy**
  - ±5 mm / ±0.2”
- **Process connection**
  - G 1”, 1” NPT, G 1½”, 1½” NPT
- **Wetted parts**
  - PVDF, PBT
- **Measuring ranges**
  - up to 12 m / 39.4 ft with mounted flooding tube protection
- **Technical Information**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Frequency</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Micropilot FMR60B 80GHz</strong></td>
<td>80GHz</td>
<td>-1 to +3 bar / –14.5 to +43.5 psi</td>
</tr>
<tr>
<td><strong>Micropilot FMR51 26GHz</strong></td>
<td>26GHz</td>
<td>–1 to +160 bar / –14.5 to +2320 psi</td>
</tr>
<tr>
<td><strong>Micropilot FMR52 26GHz</strong></td>
<td>26GHz</td>
<td>–1 to +25 bar / –14.5 to +362.5 psi</td>
</tr>
</tbody>
</table>

**Applications**

- Horizontal storage tank cyl.
- Vertical storage tank
- Buffer tank
- Recipient tank
- Process tank
- Still well
- Bypass
- Pump shaft
- Channel measurement

**Application limits**

- **DC < 4**
- Turbulent surfaces
- Ammoniacal gas phase
- Strong build-up formation
- Only PTFE resistant
- Custody transfer measurement

<table>
<thead>
<tr>
<th>Applications</th>
<th>FMR5x, FMR6x</th>
<th>FMR5x</th>
<th>FMR54 in stilling well, FMR54 with air purge, FMR52, 62B, FMR540, NMR8x</th>
<th>FMR54 in stilling well, FMR54 with air purge, FMR52, 62B, FMR540, NMR8x</th>
<th>FMR54 in stilling well, FMR54 with air purge, FMR540, NMR8x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammoniacal gas phase</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Strong build-up formation</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Only PTFE resistant</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Custody transfer measurement</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>–</td>
</tr>
</tbody>
</table>

**Applications**

- Ammoniacal gas phase
- Strong build-up formation
- Only PTFE resistant
- Custody transfer measurement
### 4. Instrument selection within the measuring principle

#### Radar – process industry

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Micropilot FMR53 6GHz</th>
<th>Micropilot FMR54 6GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Process pressure</td>
<td>–1 to +40bar/–14.5 to +580psi</td>
<td>–1 to +160bar/–14.5 to +2320psi</td>
</tr>
<tr>
<td>■ Process temperature</td>
<td>–40 to +150°C/–40 to +302°F</td>
<td>–196 to +400°C/–321 to +752°F</td>
</tr>
<tr>
<td>■ Accuracy</td>
<td>±6mm/0.24&quot;</td>
<td>±6mm/0.24&quot;</td>
</tr>
<tr>
<td>■ Process connection</td>
<td>R 1½&quot;, DN 50 to DN 150/2&quot; to 6&quot;</td>
<td>DN 80 to DN 250/3&quot; to 10&quot;</td>
</tr>
<tr>
<td>■ Wetted parts</td>
<td>316L/1.4435, PTFE, PVDF, sealings</td>
<td>316L/1.4435, Alloy C, PTFE, ceramics, graphite, sealings</td>
</tr>
<tr>
<td>■ Measuring ranges</td>
<td>20m/65ft</td>
<td>20m/65ft</td>
</tr>
<tr>
<td>■ Gastight feedthrough</td>
<td>Optional Tl01041F</td>
<td>Standard Tl01041F</td>
</tr>
<tr>
<td>■ Technical Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal storage tank cyl.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Vertical storage tank</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Buffer tank</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Recipient tank</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Process tank</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Stilling well</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Bypass</td>
<td>–</td>
<td>0</td>
</tr>
<tr>
<td>Pump shaft</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Channel measurement</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Application limits</td>
<td>Nozzle height &gt; 250mm /9.8&quot;</td>
<td>Free space with nozzle &lt; DN 150/6&quot;</td>
</tr>
<tr>
<td></td>
<td>Low DC</td>
<td>Stilling well with ball valve</td>
</tr>
<tr>
<td></td>
<td>➔ FMR51, 52, 54, 60B, 62B</td>
<td>Hygiene requirements</td>
</tr>
<tr>
<td></td>
<td>➔ FMR51, 52, 53, 60B, 62B</td>
<td>➔ FMR51, 52, 62B</td>
</tr>
<tr>
<td></td>
<td>➔ FMR63B</td>
<td>➔ FMR63B</td>
</tr>
</tbody>
</table>

+ = recommended  
O = restricted (observe limits)  
– = not recommended
### Instrument selection within the measuring principle

#### Micropilot FMR60B 80GHz
- Process pressure: –1 bis +16bar/-14.5 to +232psi
- Process temperature: –40 bis +200°C/-40 to +392°F
- Accuracy: ±6mm/0.24"
- Process connection: G and NPT ¾” and 1-½”
- Wetted parts: PTFE, 316L, sealings
- Measuring ranges: 50m/164ft
- Gastight feedthrough: Optional TI01683F

#### Micropilot FMR62B 80GHz
- Process pressure: –1 bis +160bar/-14.5 to +2,321psi
- Process temperature: –196 bis +450°C/-321 to +842°F
- Accuracy: ±6mm/0.24"
- Process connection: G, MNPT ¾”, 1-½”, DN 50 to DN 150/2” to 6”
- Wetted parts: PTFE, 316L, sealings
- Measuring ranges: 80m/262ft
- Gastight feedthrough: Optional TI01684F

#### Micropilot FMR63B 80GHz
- Process pressure: –1 bis +25bar/-14.5 to +363.6psi
- Process temperature: –40 bis +200°C/-40 to +392°F
- Accuracy: ±1mm/0.04"
- Process connection: G, MNPT ¾”, 1-½”, DN 50 to DN 150/2” to 6”
- Wetted parts: PTFE, 316L, sealings
- Measuring ranges: 80m/262ft
- Gastight feedthrough: Optional TI01685F

#### Applications
- Horizontal storage tank
- Vertical storage tank
- Buffer tank
- Recipient tank
- Process tank
- Stillig well
- Bypass
- Pump shaft
- Channel measurement

#### Application limits
- Nozzle height: >250mm/9.8”
- Low DC: → FMR51, 52, 54, 60B, 62B
- Free space with nozzle < DN 150/6”
- Stilling well with ball valve
- Hygiene requirements: → FMR51, 52, 63B
- Bypass/stilling well
- High pressure/high temperature: → FMR62B high temperature
- High pressure/high temperature

#### Technical Information
- –1 to +40bar/–14.5 to +580psi
- –40 to +150°C/–40 to +302°F
- ±6mm/0.24"
- R 1½", DN 50 to DN 150/2” to 6”
- 316L/1.4435, PTFE, PVDF, sealings
- 20m/65ft

- –1 to +160bar/-14.5 to +2,321psi
- –196 to +400°C/-321 to +752°F
- ±6mm/0.24"
- DN 80 to DN 250/3” to 10”
- 316L/1.4435, Alloy C, PTFE, ceramics, graphite, sealings
- 20m/65ft

- –1 bis +16bar/-14.5 to +232psi
- –40 bis +200°C/-40 to +392°F
- ±1mm/0.04"
- G and NPT ¾” and 1-½”
- PTFE, 316L, sealings
- 50m/164ft

- –1 bis +160bar/-14.5 to +2,321psi
- –196 bis +450°C/-321 to +842°F
- ±1mm/0.04"
- G, MNPT ¾”, 1-½”, DN 50 to DN 150/2” to 6”
- PTFE, 316L, sealings
- 80m/262ft

- –1 bis +25bar/-14.5 to +363.6psi
- –40 bis +200°C/-40 to +392°F
- ±1mm/0.04"
- Tri-Clamp, DIN 11851, NEUMO, PTFE, PEEK
- 80m/262ft

#### Application limits
- Nozzle height: >250mm/9.8”
- Low DC: → FMR51, 52, 54, 60B, 62B
- Free space with nozzle < DN 150/6”
- Stilling well with ball valve
- Hygiene requirements: → FMR51, 52, 63B
- Bypass/stilling well
- High pressure/high temperature: → FMR62B high temperature
- Bypass/stilling well >12m/39ft

#### Optional features
- TI01683F
- TI01684F
- TI01685F
4. Instrument selection within the measuring principle

**Radar – Tank Gauging**

<table>
<thead>
<tr>
<th>Micropilot FMR532 6GHz/custody transfer</th>
<th>Micropilot FMR540 26GHz/custody transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical data</td>
<td>Technical data</td>
</tr>
<tr>
<td>• Process pressure</td>
<td>• Process pressure</td>
</tr>
<tr>
<td>–1 to +40bar/–14.5 to +580psi</td>
<td>–1 to +16bar/–14.5 to +232psi</td>
</tr>
<tr>
<td>• Process temperature</td>
<td>• Process temperature</td>
</tr>
<tr>
<td>–40 to +150°C/–40 to +302°F</td>
<td>–40 to +200°C/–40 to +392°F</td>
</tr>
<tr>
<td>• Accuracy</td>
<td>• Accuracy</td>
</tr>
<tr>
<td>±1mm/±0.04&quot;</td>
<td>±1mm/±0.04&quot;</td>
</tr>
<tr>
<td>• Process connection</td>
<td>• Process connection</td>
</tr>
<tr>
<td>DN 80 to DN 250/3&quot; to 10&quot;</td>
<td>DN 80 to DN 250/3&quot; to 10&quot;</td>
</tr>
<tr>
<td>• Wetted parts</td>
<td>• Wetted parts</td>
</tr>
<tr>
<td>316Ti/1.4571, PTFE, 316L/1.4435, HNBR, sealings</td>
<td>316L/1.4435, PTFE, PEEK, sealings</td>
</tr>
<tr>
<td>• Measuring ranges</td>
<td>• Measuring ranges</td>
</tr>
<tr>
<td>25m/82ft</td>
<td>40m/131ft</td>
</tr>
<tr>
<td>• Gastight feedthrough</td>
<td>• Gastight feedthrough</td>
</tr>
<tr>
<td>Standard T1003444F</td>
<td>Standard T1000412F</td>
</tr>
<tr>
<td>• Technical Information</td>
<td>• Technical Information</td>
</tr>
</tbody>
</table>

**Applications**

<table>
<thead>
<tr>
<th>Horizontal storage tank cyl.</th>
<th>Vertical storage tank</th>
<th>Buffer tank</th>
<th>Recipient tank</th>
<th>Process tank</th>
<th>Stilling well</th>
<th>Bypass</th>
<th>Pump shaft</th>
<th>Channel measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>−</td>
<td>O</td>
<td>–</td>
<td>−</td>
<td>−</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
</tr>
</tbody>
</table>

**Application limits**

<table>
<thead>
<tr>
<th>• Free space and many baffles</th>
<th>FMR540</th>
<th>• Stilling wells</th>
<th>FMR532</th>
</tr>
</thead>
</table>

+ = recommended  
O = restricted (observe limits)  
– = not recommended
### Technical data

- **Process pressure:** –1 to +40bar/–14.5 to +580psi
- **Process temperature:** –40 to +150°C/–40 to +302°F
- **Accuracy:** ±1mm/±0.04"
- **Process connection:** DN 80 to DN 250/3" to 10"
- **Wetted parts:** 316Ti/1.4571, PTFE, 316L/1.4435, HNBR, sealings
- **Measuring ranges:** 25m/82ft
- **Gastight feedthrough:** Standard
- **Technical Information:** TI00344F

---

Vacuum to +16bar/vacuum to +232psi

- **Process pressure:** –1 to +16bar/–14.5 to +232psi
- **Process temperature:** –40 to +200°C/–40 to +392°F
- **Accuracy:** ±1mm/±0.04"
- **Process connection:** DN 80 to DN 250/3" to 10"
- **Wetted parts:** 316L/1.4435, PTFE, PEEK, sealings
- **Measuring ranges:** 40m/131ft
- **Gastight feedthrough:** Standard
- **Technical Information:** TI00412F

---

Vacuum to +25bar/vacuum to +362psi

- **Process pressure:** Vacuum to +25bar/vacuum to +362psi
- **Process temperature:** –40 to +150°C/–40 to +302°F
- **Accuracy:** ±0.5mm/0.02"
- **Process connection:** DN 100 to DN 300/4" to 12"
- **Wetted parts:** 316L, PTFE
- **Measuring ranges:** 40m/131ft
- **Gastight feedthrough:** Standard
- **Technical Information:** TI01253G

### Applications

- Horizontal storage tank cyl.
- Vertical storage tank
- Buffer tank
- Recipient tank
- Process tank
- Stilling well
- Bypass
- Pump shaft
- Channel measurement

### Application limits

- **Stilling well**
- **DC < 1.9**
- **→ NMR84**
- **→ Proservo NMS8x**

- **Free space**
- **DC < 1.4**
- **→ NMR81**
- **→ Proservo NMS8x**
- **→ Proservo NMS8x**

- **Existing stilling wells with non-ideal measuring conditions**
- **→ NMR81**
- **→ Proservo NMS8x**
- **→ Proservo NMS8x**
4. Instrument selection within the measuring principle

### Measuring range in dependence on the type of tank

Process conditions and medium for Micropilot FMR10/FMR20

<table>
<thead>
<tr>
<th></th>
<th>Storage tank (vertical)</th>
<th>Pump shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calm surface (e.g. bottom filling)</td>
<td>Agitated surface (e.g. permanent free filling from above)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Antenna diameter</th>
<th>Measuring range in m/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(A) FMR10</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40mm/1.5&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40mm/1.5&quot;</td>
<td></td>
</tr>
<tr>
<td><strong>(B) FMR20</strong></td>
<td>80mm/3&quot;</td>
<td>40mm/1.5&quot;</td>
</tr>
<tr>
<td></td>
<td>80mm/3&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Standard: Max. measuring range = 20m/60ft
Instrument selection within the measuring principle

Measuring range in dependence on the type of tank

- **Storage tank (vertical)**
  - Calm surface (e.g. bottom filling)
  - Agitated surface (e.g. permanent free filling from above)

- **Channel**
  - Calm surface (e.g. bottom filling with slightly moving surface)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>40mm/1.5&quot;</td>
<td>8/26</td>
<td>15/49</td>
</tr>
<tr>
<td>80mm/3&quot;</td>
<td></td>
<td>20/60</td>
</tr>
</tbody>
</table>

Antenna diameter

- **FMR10**
  - 40mm/1.5"
- **FMR20**
  - 40mm/1.5" 80mm/3"
### Continuous level measurement in liquids

#### 4. Instrument selection within the measuring principle

**Measuring range in dependence on the type of tank**

<table>
<thead>
<tr>
<th>Process conditions and medium for Micropilot FMR51/FMR52</th>
</tr>
</thead>
</table>

**Storage tank / Channel measurement**

<table>
<thead>
<tr>
<th>Calm surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. bottom filling, filling via immersion tube or rare free filling from above)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Horn/antenna diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR51</td>
</tr>
<tr>
<td>40mm/1.5&quot;</td>
</tr>
<tr>
<td>50mm/2&quot;</td>
</tr>
<tr>
<td>80mm/3&quot;</td>
</tr>
<tr>
<td>100mm/4&quot;</td>
</tr>
<tr>
<td>FMR52</td>
</tr>
<tr>
<td>—</td>
</tr>
<tr>
<td>50mm/2&quot;</td>
</tr>
<tr>
<td>80mm/3&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Media group</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: DC = 1.4 to 1.9</td>
</tr>
<tr>
<td>B: DC = 1.9 to 4</td>
</tr>
<tr>
<td>C: DC = 4 to 10</td>
</tr>
<tr>
<td>D: DC = &gt; 10</td>
</tr>
</tbody>
</table>

**Measuring range in m/ft**

<table>
<thead>
<tr>
<th>Media group</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: DC = 1.4 to 1.9</td>
</tr>
<tr>
<td>B: DC = 1.9 to 4</td>
</tr>
<tr>
<td>C: DC = 4 to 10</td>
</tr>
<tr>
<td>D: DC = &gt; 10</td>
</tr>
</tbody>
</table>

| Standard: Max. measuring range = 40m/131ft |
| With application package "Advanced dynamics": Max. measuring range = 70m/229ft |
| Min. measuring range = 5m/16ft |

<table>
<thead>
<tr>
<th>FMR51 Horn/antenna diameter</th>
<th>40mm/1.5&quot;</th>
<th>50mm/2&quot;</th>
<th>80mm/3&quot;</th>
<th>100mm/4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media group A</td>
<td>3/9</td>
<td>5/16</td>
<td>10/32</td>
<td>15/49</td>
</tr>
<tr>
<td>Media group B</td>
<td>8/26</td>
<td>12/39</td>
<td>15/49</td>
<td>25/82</td>
</tr>
<tr>
<td>Media group C</td>
<td>10/32</td>
<td>15/49</td>
<td>20/65</td>
<td>30/99</td>
</tr>
<tr>
<td>Media group D</td>
<td>25/82</td>
<td>30/99</td>
<td>40/131</td>
<td>70/229</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FMR52 Horn/antenna diameter</th>
<th>—</th>
<th>50mm/2&quot;</th>
<th>80mm/3&quot;</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media group A</td>
<td>8/26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media group B</td>
<td>12/39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media group C</td>
<td>15/49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media group D</td>
<td>20/65</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**With application package "Advanced dynamics":**

Max. measuring range = 70m/229ft

Min. measuring range = 5m/16ft
Instrument selection within the measuring principle

### Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR51/FMR52

<table>
<thead>
<tr>
<th>Storage tank / Channel measurement</th>
<th>Buffer tank / Pump shafts / Open basins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm surface (e.g. bottom filling, filling via immersion tube or rarely free filling from above)</td>
<td>Agitated surface (e.g. permanent free filling from above, mixing jets, slowly turning mixer, lateral installation)</td>
</tr>
</tbody>
</table>

#### Horn/antenna diameter

- **FMR51**:
  - 40mm/1.5" 50mm/2" 80mm/3" 100mm/4"

- **FMR52**:
  - 50mm/2" 80mm/3"

#### Measuring range in m/ft

<table>
<thead>
<tr>
<th>Media group</th>
<th>Measuring range in m</th>
<th>Measuring range in ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.4 to 1.9 DC</td>
<td>2/6.6</td>
</tr>
<tr>
<td>B</td>
<td>1.9 to 4 DC</td>
<td>4/13 5/16 7.5/25</td>
</tr>
<tr>
<td>C</td>
<td>4 to 10 DC</td>
<td>5/16 5/16 10/32 15/49</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 10 DC</td>
<td>7.5/25 10/32 15/49 25/85</td>
</tr>
</tbody>
</table>

### Table

<table>
<thead>
<tr>
<th>Diameter (mm/&quot;&quot;)</th>
<th>40mm/1.5&quot;</th>
<th>50mm/2&quot;</th>
<th>80mm/3&quot;</th>
<th>100mm/4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>40mm/1.5&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50mm/2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80mm/3&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100mm/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Instrument selection within the measuring principle

### Measuring range in dependence on the type of tank

Process conditions and medium for Micropilot FMR51/FMR52

**Tank with single-stage propeller agitator**
Turbulent surface, single-stage agitator < 60 RPM

<table>
<thead>
<tr>
<th>Horn/antenna diameter</th>
<th>FMR51</th>
<th>FMR52</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40mm/1.5&quot;</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>50mm/2&quot;</td>
<td>50mm/2&quot;</td>
</tr>
<tr>
<td></td>
<td>80mm/3&quot;</td>
<td>80mm/3&quot;</td>
</tr>
<tr>
<td></td>
<td>100mm/4&quot;</td>
<td>—</td>
</tr>
</tbody>
</table>

**Media group**
- **A**: DC = 1.4 to 1.9
- **B**: DC = 1.9 to 4
- **C**: DC = 4 to 10
- **D**: DC = > 10

<table>
<thead>
<tr>
<th>Measuring range in m/ft</th>
<th>Media group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>2/6.6</td>
</tr>
<tr>
<td></td>
<td>3/9.8</td>
</tr>
<tr>
<td></td>
<td>5/16</td>
</tr>
<tr>
<td></td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>2/6.6</td>
</tr>
<tr>
<td></td>
<td>3/9.8</td>
</tr>
<tr>
<td></td>
<td>5/16</td>
</tr>
<tr>
<td><strong>With application</strong></td>
<td></td>
</tr>
<tr>
<td><strong>package</strong></td>
<td></td>
</tr>
<tr>
<td><strong>“Advanced dynamics”</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Max. measuring</strong></td>
<td></td>
</tr>
<tr>
<td><strong>range</strong></td>
<td><strong>range</strong></td>
</tr>
<tr>
<td><strong>40m/131ft</strong></td>
<td><strong>70m/229ft</strong></td>
</tr>
<tr>
<td><strong>Min. measuring</strong></td>
<td><strong>range</strong></td>
</tr>
<tr>
<td><strong>range</strong></td>
<td></td>
</tr>
<tr>
<td><strong>5m/16ft</strong></td>
<td></td>
</tr>
</tbody>
</table>

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

**With application package “Advanced dynamics”:**
Max. measuring range = 70m/229ft
Min. measuring range = 5m/16ft
Instrument selection within the measuring principle

Measuring range in dependence on the type of tank
Process conditions and medium for Micropilot FMR51/FMR52

Tank with single-stage propeller agitator
Turbulent surface, single-stage agitator
< 60 RPM

Stilling well
Bypass

<table>
<thead>
<tr>
<th></th>
<th>FMR51</th>
<th>FMR52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horn/antenna diameter</td>
<td>40mm/1.5&quot;</td>
<td>50mm/2&quot;</td>
</tr>
<tr>
<td></td>
<td>50mm/2&quot;</td>
<td>80mm/3&quot;</td>
</tr>
<tr>
<td></td>
<td>40 to 100mm/1.5 to 4&quot;</td>
<td>50 to 80mm/2 to 3&quot;</td>
</tr>
</tbody>
</table>

Measuring range in m/ft
Media group
A: DC = 1.4 to 1.9
B: DC = 1.9 to 4
C: DC = 4 to 10
D: DC > 10

For media groups A and B use Levelflex with coax probe.
4. Instrument selection within the measuring principle

Radar – process industry

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR53/FMR54

<table>
<thead>
<tr>
<th>Storage tank(^1)</th>
<th>Calm surface (e.g. bottom filling, filling via immersion tube or rare free filling from above)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer tank(^1)</td>
<td>Agitated surface (e.g. permanent free filling from above, mixing jets)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Horn/antenna diameter</th>
<th>FMR53</th>
<th>FMR54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod antenna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rod antenna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150mm/6(^\prime)</td>
<td></td>
<td>200mm/8(^\prime)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250mm/10(^\prime)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measuring range in m/ft</th>
<th>Media group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A: DC = 1.4 to 1.9</td>
</tr>
<tr>
<td></td>
<td>B: DC = 1.9 to 4</td>
</tr>
<tr>
<td></td>
<td>C: DC = 4 to 10</td>
</tr>
<tr>
<td></td>
<td>D: DC = &gt; 10</td>
</tr>
<tr>
<td>B</td>
<td>10/32</td>
</tr>
<tr>
<td>C</td>
<td>15/49</td>
</tr>
<tr>
<td>D</td>
<td>20/65</td>
</tr>
</tbody>
</table>

\(^1\) For media group A use stilling well (20m/65ft).
\(^2\) Possible for media groups A and B, e.g. with a stilling well in the bypass.
Instrument selection within the measuring principle

<table>
<thead>
<tr>
<th>Tank with single-stage propeller agitator(^1)</th>
<th>Stilling well</th>
<th>Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbulent surface, single-stage agitator (&lt; 60, \text{RPM})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Tank with single-stage propeller agitator image]</td>
<td>![Stilling well image]</td>
<td>![Bypass image]</td>
</tr>
</tbody>
</table>

### Rod antenna

<table>
<thead>
<tr>
<th>Media group</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>1.4 to 1.9</td>
<td>1.9 to 4</td>
<td>4 to 10</td>
<td>&gt; 10</td>
</tr>
</tbody>
</table>

### Measuring range in m/ft

<table>
<thead>
<tr>
<th>Media group</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>4/13</td>
<td>6/20</td>
<td>6/20</td>
<td>6/20</td>
</tr>
</tbody>
</table>

1. Horn/antenna diameter

<table>
<thead>
<tr>
<th>Media group</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>20/65</td>
<td>20/65</td>
<td>20/65</td>
<td>20/65</td>
</tr>
</tbody>
</table>

1. For example, 80 to 250 mm/3 to 10".

---

1. \(^1\) Media group based on tank and process conditions.

---

2. Horn/antenna diameter based on tank and process conditions.
4. Instrument selection within the measuring principle

**Radar – process industry**

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR60B

- **Storage tank**
  - Calm product surface
  - (e.g. intermittent filling, filling from bottom, immersion tubes)

- **Buffer tank**
  - Moving surface
  - (e.g. continuous filling from above, mixing jets)

### Antenna diameter

<table>
<thead>
<tr>
<th>FMR60B</th>
<th>Media group (DC)</th>
<th>Measuring range in m/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A0: 1.2 to 1.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A: 1.4 to 1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B: 1.9 to 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C: 4 to 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D: &gt; 10</td>
<td></td>
</tr>
</tbody>
</table>

### Measuring range in m/ft

- **Integrated, PEEK, 20mm/0.75in**
- **Integrated, PEEK, 40mm/1.5in**
- **Encapsulated, PVDF, 40mm/1.5in**
- **Drip-off, PTFE, 50mm/2in**
- **Integrated, PEEK, 40mm/1.5in**
Instrument selection within the measuring principle

C

Radar – process industry
Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR60B

- **Storage tank**
  - Calm product surface
    - (e.g. intermittent filling, filling from bottom, immersion tubes)

- **Buffer tank**
  - Moving surface
    - (e.g. continuous filling from above, mixing jets)

- **Process tank with agitator**
  - Turbulent surface
    - (e.g. filling from above, agitators, baffles)

---

**Antenna diameter**
- Integrated, PEEK, 20mm/0.75in
- Integrated, PEEK, 40mm/1.5in
- Encapsulated, PVDF, 40mm/1.5in
- Drip-off, PTFE, 50mm/2in

---

**Measuring range in m/ft**

- **Media group (DC)**
  - A0: 1.2 to 1.4
  - A: 1.4 to 1.9
  - B: 1.9 to 4
  - C: 4 to 10
  - D: > 10

---

<table>
<thead>
<tr>
<th>Encapsulated, PVDF, 40mm/1.5in</th>
<th>Drip-off, PTFE, 50mm/2in</th>
<th>Integrated, PEEK, 20mm/0.75in</th>
<th>Integrated, PEEK, 40mm/1.5in</th>
<th>Encapsulated, PVDF, 40mm/1.5in</th>
<th>Drip-off, PTFE, 50mm/2in</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0 13</td>
<td>A0 13</td>
<td>A0 13</td>
<td>A0 13</td>
<td>A0 13</td>
<td>A0 13</td>
</tr>
<tr>
<td>3/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
</tr>
<tr>
<td>3/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
</tr>
<tr>
<td>3/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
</tr>
<tr>
<td>3/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
</tr>
</tbody>
</table>

---

**Process tank with agitator**
- Turbulent surface
  - (e.g. filling from above, agitators, baffles)
4. Instrument selection within the measuring principle

**Radar – process industry**

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR62B

**Storage tank**
Calm product surface
(e. g. intermittent filling, filling from bottom, immersion tubes)

**Antenna diameter**

<table>
<thead>
<tr>
<th>FMR62B</th>
<th>Drip-off, PTFE, 50mm/2in</th>
<th>PTFE cladded flush mount, 50mm/2in</th>
<th>PTFE cladded flush mount, 80mm/3in</th>
<th>Horn, 316L, 65mm/2.6 in</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Media group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A0: DC  = 1.2 to 1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A:  DC  = 1.4 to 1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B:  DC  = 1.9 to 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C:  DC  = 4 to 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D:  DC  = &gt; 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Measuring range in m/ft**

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>73</td>
<td>12/39</td>
<td>23/75</td>
<td>40/131</td>
<td>50/164</td>
</tr>
<tr>
<td>A</td>
<td>22/72</td>
<td>40/131</td>
<td>50/148</td>
<td>80/262</td>
<td>118/366</td>
</tr>
<tr>
<td>B</td>
<td>20/58</td>
<td>45/148</td>
<td>58/190</td>
<td>72/236</td>
<td>231/658</td>
</tr>
<tr>
<td>C</td>
<td>20/58</td>
<td>45/148</td>
<td>58/190</td>
<td>72/236</td>
<td>231/658</td>
</tr>
<tr>
<td>D</td>
<td>20/58</td>
<td>45/148</td>
<td>58/190</td>
<td>72/236</td>
<td>231/658</td>
</tr>
</tbody>
</table>
**Instrument selection within the measuring principle**

**Buffer tank**

Moving surface
(e.g. continuous filling from above, mixing jets)

---

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC = 1.2 to 1.4</td>
<td>DC = 1.4 to 1.9</td>
<td>DC = 1.9 to 4</td>
<td>DC = 4 to 10</td>
<td>DC &gt; 10</td>
</tr>
<tr>
<td></td>
<td>4/13</td>
<td>13/43</td>
<td>28/92</td>
<td>64/144</td>
<td>7/23</td>
</tr>
<tr>
<td></td>
<td>12/36</td>
<td>2/75</td>
<td>45/148</td>
<td>60/197</td>
<td>45/148</td>
</tr>
<tr>
<td></td>
<td>11/36</td>
<td>2/75</td>
<td>45/148</td>
<td>60/197</td>
<td>45/148</td>
</tr>
</tbody>
</table>

---

Drip-off, PTFE, 50mm/2in

PTFE cladded flush mount, 50mm/2in

PTFE cladded flush mount, 80mm/3in

Horn, 316L, 65mm/2.6in
4. Instrument selection within the measuring principle

Radar – process industry

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR62B

Process tank with agitator
Turbulent surface
(e.g. filling from above, agitators, baffles)

Horn/antenna diameter

<table>
<thead>
<tr>
<th>Media group</th>
<th>Measuring range in m/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0: DC = 1.2 to 1.4</td>
<td>2/7</td>
</tr>
<tr>
<td>A: DC = 1.4 to 1.9</td>
<td>7/23</td>
</tr>
<tr>
<td>B: DC = 1.9 to 4</td>
<td>12/34</td>
</tr>
<tr>
<td>C: DC = 4 to 10</td>
<td>6/20</td>
</tr>
<tr>
<td>D: DC = &gt; 10</td>
<td>6/20</td>
</tr>
</tbody>
</table>

Drip-off, PTFE, 50mm/2in
PTFE cladded flush mount, 50mm/2in
PTFE cladded flush mount, 80mm/3in
Horn, 316L, 65mm/2.6in
Instrument selection within the measuring principle

Stilling well
Calm medium surface (e.g. bottom filling, filling via immersion tube or rare filling from above)

Bypass
Moving medium surface (e.g. permanent free filling from above, mixing jets)

PTFE cladded flush mount, 80mm/3in

A0, A, B, C, D

A0, A, B, C, D

A0, A, B, C, D

A0, A, B, C, D

20/66

20/66

20/66

20/66
4. Instrument selection within the measuring principle

Radar – process industry

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR63B

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

<table>
<thead>
<tr>
<th>Antenna</th>
<th>FMR63B</th>
<th>Media group (DC)</th>
<th>Messbereich in m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Integrated,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PEEK, 20mm/0.75in</td>
<td>A0: 1.2 to 1.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cladded, PEEK, 20mm/0.75in</td>
<td>A: 1.4 to 1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cladded, PEEK, 40mm/1.5in</td>
<td>B: 1.9 to 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PTFE cladded flush mount, 50mm/2in</td>
<td>C: 4 to 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PTFE cladded flush mount, 80mm/3in</td>
<td>D: &gt; 10</td>
<td></td>
</tr>
</tbody>
</table>

![Diagram showing storage tank and radar measurement setup](image_url)
**Buffer tank**
Moving surface (e.g. continuous filling from above, mixing jets)

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>A</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>B</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
</tr>
</tbody>
</table>

**Integrated, PEEK, 20mm/0.75in**

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>A</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>B</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
</tr>
</tbody>
</table>

**Cladded, PEEK, 20mm/0.75in**

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>A</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>B</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
</tr>
</tbody>
</table>

**Cladded, PEEK, 40mm/1.5in**

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>A</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>B</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
</tr>
</tbody>
</table>

**PTFE cladded flush mount, 50mm/2in**

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>A</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>B</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
</tr>
</tbody>
</table>

**PTFE cladded flush mount, 80mm/3in**

<table>
<thead>
<tr>
<th>Media group</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>A</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
<td>1/5</td>
</tr>
<tr>
<td>B</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
<td>8/24</td>
</tr>
</tbody>
</table>
4. Instrument selection within the measuring principle

**Radar – process industry**

Measuring range in dependence on the type of tank, process conditions and medium for Micropilot FMR63B

**Process tank with agitator**
- Turbulent surface
- (e.g. filling from above, agitators, baffles)

### Antenna

<table>
<thead>
<tr>
<th>FMR63B</th>
<th>Integrated, PEEK, 20mm/0.75in</th>
<th>Cladded, PEEK, 20mm/0.75in</th>
<th>Cladded, PEEK, 40mm/1.5in</th>
<th>PTFE cladded flush mount, 50mm/2in</th>
<th>PTFE cladded flush mount, 80mm/3in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media group (DC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A0: 1.2 to 1.4</td>
<td>A: 1.4 to 1.9</td>
<td>B: 1.9 to 4</td>
<td>C: 4 to 10</td>
<td>D: &gt; 10</td>
<td></td>
</tr>
</tbody>
</table>

### Measuring range in m/ft

<table>
<thead>
<tr>
<th>Media group (DC)</th>
<th>A0</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0: 1.2 to 1.4</td>
<td>1.5/15</td>
<td>3/15</td>
<td>3/10</td>
<td>5/16</td>
<td></td>
</tr>
<tr>
<td>A: 1.4 to 1.9</td>
<td>1.5/15</td>
<td>3/15</td>
<td>3/10</td>
<td>5/16</td>
<td></td>
</tr>
<tr>
<td>B: 1.9 to 4</td>
<td>1.5/15</td>
<td>3/15</td>
<td>3/10</td>
<td>5/16</td>
<td></td>
</tr>
<tr>
<td>C: 4 to 10</td>
<td>1.5/15</td>
<td>3/15</td>
<td>3/10</td>
<td>5/16</td>
<td></td>
</tr>
<tr>
<td>D: &gt; 10</td>
<td>1.5/15</td>
<td>3/15</td>
<td>3/10</td>
<td>5/16</td>
<td></td>
</tr>
</tbody>
</table>
Notes
Measuring range in dependence on the type of tank

Process conditions and medium for Micropilot 532/540

<table>
<thead>
<tr>
<th>Storage tank</th>
<th>Storage tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly accurate measurement, custody transfer</td>
<td>Highly accurate measurement, custody transfer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Horn/antenna diameter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR532</td>
<td></td>
</tr>
<tr>
<td>FMR540</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100mm/4&quot;</td>
</tr>
<tr>
<td></td>
<td>200mm/250mm 8'/10&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Media group</th>
<th>Measuring range in m/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: DC = 1.4 to 1.9</td>
<td>B: 20/65, 23/75 *, 30/99</td>
</tr>
<tr>
<td>B: DC = 1.9 to 4</td>
<td>C: 26/85 *, 40/131</td>
</tr>
<tr>
<td>C: DC = 4 to 10</td>
<td>D: 25/82</td>
</tr>
<tr>
<td>D: DC = &gt; 10</td>
<td></td>
</tr>
</tbody>
</table>

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

Custody transfer NMi and PTB

Custody transfer NMi

Custody transfer PTB
Instrument selection within the measuring principle

**Stilling well**
Highly accurate measurement, custody transfer

- 150mm/200mm/250mm/300mm
- $6''/8''/10''/12''$

- **Media group**
  - A: DC = 1.4 to 1.9
  - B: DC = 1.9 to 4
  - C: DC = 4 to 10
  - D: DC $> 10$

- **FMR532**
  - 150mm/200mm/250mm/300mm
  - $6''/8''/10''/12''$

- **FMR540**
  - 100mm/200mm/250mm
  - $4''/8''/10''$

---

*Note: Diagonal lines indicate a special selection.*
4. Instrument selection within the measuring principle

**Measuring range in dependence on the type of tank**

Process conditions and medium for Micropilot S NMR81//NMR84

### Storage tank
Highly accurate measurement, custody transfer

<table>
<thead>
<tr>
<th>Antenna diameter</th>
<th>NMR81</th>
<th>NMR84</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50mm/2&quot;</td>
<td>80mm/3&quot;</td>
</tr>
</tbody>
</table>

### Measuring range in m/ft

<table>
<thead>
<tr>
<th>Media group</th>
<th>Measuring range in m/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: DC = 1.4 to 1.9</td>
<td>4/13, 8/26, 20/66, 30/98, 60/197, 70/230</td>
</tr>
<tr>
<td>B: DC = 1.9 to 4</td>
<td>30/98, 60/197, 70/230, *</td>
</tr>
<tr>
<td>C: DC = 4 to 10</td>
<td>30/98, 60/197, 70/230, *</td>
</tr>
<tr>
<td>D: DC = &gt; 10</td>
<td>30/98, 60/197, 70/230, *</td>
</tr>
</tbody>
</table>

### Standard:
Max. measuring range = 30m/97ft

* For devices with Weight+Measure approval:
  Maximum measuring range: 30m (97ft)

Custody transfer with NMi and PTB 30m/98ft
Instrument selection within the measuring principle

Stilling well
Highly accurate measurement, custody transfer

100mm/150mm/200mm/250mm/300mm
4"/6"/8"/10"/12"

A, B, C, D

Custody transfer with NMi
35m/115ft

Custody transfer with PTB
30m/98ft
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, 30cm/12" (6GHz) or 15cm/6" (26GHz/80GHz)
- If these conditions cannot be met: Use stilling well
- Lateral installation on request

**Nozzle**
- FMR51/54 horn antenna should protrude from the nozzle. Please note the max. nozzle length, otherwise use antenna extension
- FMR50/52 note the max. nozzle length
- FMR5x note the max. nozzle length, depending on nozzle diameter and antenna
- 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
- Please note the information in the Technical Documentation

**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 50mm/2" to the tip of the antenna because of corrosion and build-up 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 interference echoes)
- A stilling well or a Levelflex 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 Levelflex or hydrostatic measurement

<table>
<thead>
<tr>
<th>Version</th>
<th>10</th>
<th>20</th>
<th>54</th>
<th>50</th>
<th>51</th>
<th>50</th>
<th>51</th>
<th>50</th>
<th>51</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna</td>
<td>DN40</td>
<td>DN40</td>
<td>DN80</td>
<td>DN150</td>
<td>DN200</td>
<td>DN250</td>
<td>DN40</td>
<td>DN50</td>
<td>DN80</td>
</tr>
<tr>
<td>Beam angle</td>
<td>30°</td>
<td>12°</td>
<td>12°</td>
<td>23°</td>
<td>19°</td>
<td>15°</td>
<td>23°</td>
<td>18°</td>
<td>10°</td>
</tr>
<tr>
<td>Max. nozzle length without extension</td>
<td>140/6</td>
<td>365/14</td>
<td>880/35</td>
<td>205/8.1</td>
<td>290/11.5</td>
<td>380/15</td>
<td>500/20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** depending on nozzle diameter, as well as mounting inside or outside the nozzle
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. 95mm/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 50mm/2” to the tip of the antenna because of corrosion and build-up formation

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

<table>
<thead>
<tr>
<th>60B</th>
<th>62B</th>
<th>63B</th>
<th>540</th>
<th>NMR81</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN40</td>
<td>DN50</td>
<td>DN65</td>
<td>DN50*</td>
<td>DN50</td>
</tr>
<tr>
<td>8”</td>
<td>6”</td>
<td>4”</td>
<td>6”</td>
<td>7”</td>
</tr>
<tr>
<td>1850/74</td>
<td>2200/87</td>
<td>3200/126</td>
<td>2200/87</td>
<td>1850/74</td>
</tr>
</tbody>
</table>

* with flooding protection tube

1 Drip-off antenna
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. 95mm/3.7") use the next larger antenna and adapt it mechanically (inner diameter of stilling well = diameter of horn)

- **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 50mm/2" to the tip of the antenna because of corrosion and build-up 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 ≤ 6.3µm)
  - 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. 1mm/0.04" are permitted
Instructions for Endress+Hauser UNI flanges in FMR54/FMR532/NMR84

- 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. 1/7 of pipe diameter and not bigger than 30 mm/1.2"
- Spacing between holes min. 30 cm/12"
- For FMR54/FMR532/NMR84 (planar antenna) a gradual widening (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 the widening. Length (L) of the widening must be an additional 300 mm/12" or for DN 250/10" to DN 300/12" 450 mm/18"
- Larger pipe widening (e.g. DN 150/6" to DN 300/12") is possible, if length (L) of the widening amounts to 450 mm/18"
- Ideally, a gauge nozzle is used as upper pipe end
- Rectangular pipe widening is not permitted
4. Instrument selection within the measuring principle

Guided radar

**Required application data**

**Level measurement**

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

**Additional for interface measurement**

- Dielectric constant (DC) of both liquids

**Application limits for guided level radar**

- Temperature up to -196°C/-321°F
- Temperature up to +450°C/+842°F
- Pressure up to +400bar/+5,800psi
- Measuring range up to 45m/148ft (longer upon request)
- Dielectric constant from 1.4
- Process connection from ¾”
- Measuring range up to 10m/32ft for interface measurement (upon request)

**Dielectric constant (DC)**

The reflection properties of a medium are determined by the dielectric constant (DC).

The following table shows the allocation of different DC values to media groups. If the dielectric constant of a medium is not known, we recommend to use a DC value of 1.9 for sizing in order to maintain a safe measurement.

<table>
<thead>
<tr>
<th>Media group</th>
<th>DC</th>
<th>Typical liquids</th>
<th>FMP50</th>
<th>FMP51</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.4 to 1.6</td>
<td>Liquified gases, e.g. N₂, CO₂</td>
<td>4m/13ft</td>
<td>6m/20ft not with rope</td>
</tr>
<tr>
<td>2</td>
<td>1.6 to 1.9</td>
<td>Liquified gas, e.g. propane, Solvent, Frigen / Freon, Palm oil</td>
<td>12m/39ft</td>
<td>25 to 30m/82 to 98ft</td>
</tr>
<tr>
<td>3</td>
<td>1.9 to 2.5</td>
<td>Mineral oils, Fuel</td>
<td>12m/39ft</td>
<td>30 to 45m/98 to 148ft</td>
</tr>
<tr>
<td>4</td>
<td>2.5 to 4</td>
<td>Benzene, styrene, toluol, Furan, Naphthalene</td>
<td>12m/39ft</td>
<td>45m/148ft</td>
</tr>
<tr>
<td>5</td>
<td>4 to 7</td>
<td>Chlorobenzene, chloroform, Nitrocellulose lacquer, Isocyan, aniline</td>
<td>12m/39ft</td>
<td>45m/148ft</td>
</tr>
<tr>
<td>6</td>
<td>&gt;7</td>
<td>Aqueous solutions, Alcohols, Acids, lyes</td>
<td>12m/39ft</td>
<td>45m/148ft</td>
</tr>
</tbody>
</table>
### Advantages
- Unaffected by medium surface (agitated surface, foam)
- Unaffected by tank obstacles
- Additional measuring safety through End-of-Probe (EoP) recognition
- DC starting at 1.6 without stilling well (1.4 for coax probe)

<table>
<thead>
<tr>
<th>Media group</th>
<th>Max. measuring ranges</th>
<th>FMP52</th>
<th>FMP53</th>
<th>FMP54</th>
<th>FMP55</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td></td>
<td>1.4 to 1.6</td>
<td>4m/13ft</td>
<td>6m/20ft not with rope</td>
<td>6m/20ft not with rope</td>
</tr>
<tr>
<td>Typical liquids</td>
<td></td>
<td>1.6 to 1.9</td>
<td>6m/20ft</td>
<td>25 to 30m/82 to 98ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Mineral oils</td>
<td></td>
<td>1.9 to 2.5</td>
<td>6m/20ft</td>
<td>30 to 45m/98 to 148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Liquified gases</td>
<td></td>
<td>2.5 to 4</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Liquified gas, e.g. propane</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Frigen / Freon</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Palm oil</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Solvent</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Aqueous solutions</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Acids, lyes</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
<tr>
<td>Alcohols</td>
<td></td>
<td>&gt;7</td>
<td>6m/20ft</td>
<td>45m/148ft</td>
<td>10m/33ft</td>
</tr>
</tbody>
</table>
4. Instrument selection within the measuring principle

### Guided radar – process industry

**Technical data**
- **Process pressure**
  - 1 to +6 bar
  - 14.5 to +87 psi
- **Process temperature**
  - 20 to +80 °C
  - 6 to +176 °F
- **Accuracy**
  - < 15 m/49 ft: ±2 mm/0.08"
- **Process connection**
  - G/NPT ¾"
- **Wetted parts**
  - Rope/rod: 316L, PPS
- **Measuring ranges**
  - 0.3 to 10 m/1 to 33 ft (rod),
  - 1 to 45 m/3.2 to 148 ft (rope)
- **Gastight feedthrough**
- **Technical Information**

<table>
<thead>
<tr>
<th>Applications</th>
<th>Levefflex FMP50</th>
<th>Levefflex FMP51</th>
<th>Levefflex FMP52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal storage tank cyl.</td>
<td>0</td>
<td>+*</td>
<td>0</td>
</tr>
<tr>
<td>Vertical storage tank</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Buffer tank</td>
<td>0</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Recipient tank</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Process tank</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stilling well</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Bypass</td>
<td>0</td>
<td>+</td>
<td>0</td>
</tr>
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<td>Pump shaft</td>
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<td>-</td>
</tr>
<tr>
<td>Channel measurement</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Interface measurement</td>
<td>-</td>
<td>+**</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application limits</th>
<th>Levefflex FMP52</th>
<th>Levefflex FMP51, FMP54</th>
<th>Levefflex FMP52</th>
<th>Levefflex FMP55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggressive media</td>
<td>→ FMP52</td>
<td>→ FMP51, FMP54</td>
<td>→ FMP52</td>
<td>→ FMP55</td>
</tr>
<tr>
<td>High pressure/temperatures &gt; 80°C/176°F, 6 bar/87 psi</td>
<td>→ FMP52</td>
<td>→ FMP51, FMP54</td>
<td>→ FMP52</td>
<td>→ FMP55</td>
</tr>
<tr>
<td>Interface with emulsion</td>
<td>→ FMP52</td>
<td>→ FMP51, FMP54</td>
<td>→ FMP52</td>
<td>→ FMP55</td>
</tr>
<tr>
<td>High process temperatures (&gt; 150°C)</td>
<td>Possible diffusion through the probe coating</td>
<td>Limited lifetime</td>
<td>Interface with emulsion</td>
<td>→ FMP55</td>
</tr>
</tbody>
</table>

+ = recommended  
O = restricted (observe limits)  
- = not recommended
Instrument selection within the measuring principle

**Guided radar – process industry**

### Technical data

- **Process pressure**: -1 to +6 bar / -14.5 to +87 psi
- **Process temperature**: -20 to +80 °C / -4 to +176 °F
- **Accuracy**: < 15 m / 49 ft: ±2 mm / 0.08"
- **Process connection**: G/NPT ¾"
- **Wetted parts**: Rope/rod: 316L, PPS
- **Measuring ranges**: 0.3 to 4 m / 1 to 13 ft (rod), 0.3 to 12 m / 1 to 39 ft (rope)
- **Gastight feedthrough**: —
- **Technical Information**: TI01000F

### Guided radar – process industry

- **Process pressure**: -1 to +4 bar / -14.5 to +58 psi
- **Process temperature**: -40 to +200 °C / -40 to +392 °F
- **Accuracy**: < 15 m / 49 ft: ±2 mm / 0.08"; > 15 m / 49 ft: ±10 mm / 0.4"
- **Process connection**: G/NPT ¾" and 1½"
- **Wetted parts**: Rope: 316, rod and coax: 316L, Alloy C (C22 / 2.4602), ceramics
- **Measuring ranges**: 0.3 to 10 m / 1 to 33 ft (rod), 1 to 45 m / 3.2 to 148 ft (rope), 0.3 to 6 m / 1 to 20 ft (coax)
- **Optional**: —
- **Technical Information**: TI01001F

### Guided radar – process industry

- **Process pressure**: -1 to +4 bar / -14.5 to +58 psi
- **Process temperature**: -50 to +200 °C / -58 to +392 °F
- **Accuracy**: < 15 m / 49 ft: ±2 mm / 0.08"
- **Process connection**: Tri-Clamp 1½" to 3"
- **Wetted parts**: PTFE, PFA
- **Measuring ranges**: 0.3 to 4 m / 1 to 13 ft (rod), 1 to 45 m / 3.2 to 148 ft (rope), 0.3 to 6 m / 1 to 20 ft (coax)
- **Optional**: —
- **Technical Information**: TI01001F

### Guided radar – process industry

- **Process pressure**: -1 to +16 bar / -14.5 to +232 psi
- **Process temperature**: -20 to +150 °C / -4 to +302 °F
- **Accuracy**: < 15 m / 49 ft: ±2 mm / 0.08"
- **Process connection**: Tri-Clamp, DIN 11851, SMS, DIN 11864, NEUMO
- **Wetted parts**: 316L / 1.4435, PEEK
- **Measuring ranges**: 0.3 to 6 m / 1 to 20 ft (rod)
- **Optional**: —
- **Technical Information**: TI01002F

### Guided radar – process industry

- **Process pressure**: -1 to +160 bar / -14.5 to +2320 psi
- **Process temperature**: -196 to +450 °C / -321 to +842 °F
- **Accuracy**: < 15 m / 49 ft: ±2 mm / 0.08"; > 15 m / 49 ft: ±10 mm / 0.4", ±5 mm / ±0.02" (coax)
- **Process connection**: G/NPT 1½", DN 50 to DN 100 / 2" to 4"
- **Wetted parts**: Rope: 316, rod and coax: 316L, ceramics, graphite, Alloy C (C22 / 2.4602)
- **Measuring ranges**: 0.3 to 10 m / 1 to 33 ft (rod), 1 to 45 m / 3.2 to 148 ft (rope), 0.3 to 6 m / 1 to 20 ft (coax)
- **Optional**: —
- **Technical Information**: FMP52

### Applications

- **Horizontal storage tank cyl.**
- **Vertical storage tank**
- **Buffer tank**
- **Recipient tank**
- **Process tank**
- **Stilling well**
- **Bypass**
- **Pump shaft**
- **Channel measurement**
- **Interface measurement**

### Application limits

- **Aggressive media**
- **High pressure/temperatures**
- **Aggressive media**
- **Interface with emulsion**
- **Aggressive media**
- **High process temperatures**
- **Interface with emulsion**

### Instruments

- **Levellflex FMP53**
- **Levellflex FMP54**
- **Levellflex FMP55**

### Symbols

- **Aggressive media**
- **Interface with emulsion**

---

* = use coax probe  
** = use coax system in favor (coax probe, bypass, stilling well)  
*** = coax system required (coax probe, bypass, stilling well)
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 to DN 150/1.5” to 6” and nozzle heights up to 150mm/6” are to be preferred
  - For rope probes in nozzles with > 150mm/6” in height, an HMP40 rod extension must be used

- **Measuring range**
  - Smallest measuring range: 300mm/12”
  - Largest measuring range: 45m/148ft (longer upon request)
  - For minimum distance probe end ↔ tank bottom see table below
  - Measurement is possible up to the blocking distance (BD), on principle

- **Tank installations**
  - Distance to obstacles min. 300mm/12”
  - During commissioning interference echoes can be suppressed

- **Turbulent surface/foam**
  - Turbulent surfaces do not affect measurement
  - Foam layers of up to approx. 100mm/4” do not affect measurement. Higher foam thickness may result in too small readings (depending on DC value)

---

**Blocking distance (BD) and minimal distance from the tank bottom**

- **Blocking distance top**:  
  - Coax probe: 0mm/0”
  - Rope or rod probe ≤ 8m/26ft: 200mm/8”
    - Rope or rod probe > 8m/26ft: 0.025 x probe length

- Minimal distance from tank bottom: > 10mm/0.4”

* The blocking distance (BD) is preset from the factory. Depending from the application these settings can be adjusted.

---

If the DC value in rope probes is < 7, measurement is not possible in the tensioning weight area (0 to 250mm/10” from the end of the probe - lower blocking distance). Less accurate measurement is possible in the lower area of the probe.
Instrument selection within the measuring principle

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: 300mm/12"
- Largest measuring range: 10m/33ft (longer upon request)

**Pipe diameter**
- Pipes of DN 40 to DN 150/1.5" to 6" 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. 5mm/0.2" do not impair measurement
- Wall contact by rod probes must be excluded. Use a centering disk at the end of the probe, if required

**Additional instructions for interface measurement**
- Rod probes can be installed up to a diameter of 100mm/4". For larger diameters, a coax probe is recommended
- The pipe must not have any gradation
- In case of interface layer measurement, the centering disk must be of plastic material
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 compatibility
- Nozzle diameter/nozzle height
- Measuring range
- Required accuracy
- For bypass/stilling well: Internal pipe diameter

**Application limits for ultrasonic level measurement in liquids**
- Temperature up to –40°C/–40°F
- Temperature up to 105°C/221°F
- Pressure from +0.7bar/+10psi up to +4bar/58psi
- Measuring range up to 25m/82ft
- Vapor pressure up to 50mbar/0.73psi (20°C/68°F)
- Process connection from 1½''
- Strong temperature fluctuations in the measuring range can affect the accuracy

**Damping caused by process**

<table>
<thead>
<tr>
<th>Surface of liquid</th>
<th>Filling curtain in the detection range</th>
<th>Δ-Temp. sensor ↔ medium surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm</td>
<td>None</td>
<td>Up to 20°C/68°F</td>
</tr>
<tr>
<td>Waves</td>
<td>Small quantities (FDU9x = 5 dB)</td>
<td>Up to 40°C/104°F</td>
</tr>
<tr>
<td>Strong turbulence</td>
<td>Large quantities (FDU9x = 5 to 20 dB)</td>
<td>Up to 80°C/176°F</td>
</tr>
<tr>
<td>Foam</td>
<td>Ask Endress+Hauser</td>
<td>—</td>
</tr>
</tbody>
</table>

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

**Range calculation and sensor selection Prosonic S FDU9x**

Example (for FDU92):
- Very turbulent surface: 20dB
- Small quantities of filling curtain in the detection range: 5dB
- Δ-Temperature up to 40°C/104°F: 10dB

Total: 35dB
→ range approx. 15m/49ft from diagram
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 50mbar/0.73psi, ultrasonic measurement is recommended. If the vapor pressure at 20°C/68°F is above 50mbar/0.73psi, 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. DC, density, etc.
- Calibration without filling or discharging
- Self-cleaning effect due to vibrating sensor diaphragm

<table>
<thead>
<tr>
<th>Vapor pressure</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50mbar/0.73psi (20°C/68°F)</td>
<td>Water, water solutions, water-solids solutions, dilute acids (hydrochloric acid, sulphuric acid, ...), dilute lyes (caustic soda solution, ...), oils, fats, lime water, sludges, pastes, ...</td>
</tr>
<tr>
<td>&gt; 50mbar/0.73psi (20°C/68°F)</td>
<td>Ethanol, acetone, ammonia, ... For best accuracy results → radar</td>
</tr>
</tbody>
</table>

**Range calculation and selection of sensor for Prosonic M FMU4x and FMU30**

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

Example (for FMU30 2" sensor):
- Strong turbulence surface: approx. 20dB
- No dust formation: 0dB
- Filling curtain in detection range: 10dB
- Total: approx. 30dB → range approx. 7.8m/26ft from diagram
4. Instrument selection within the measuring principle

## Ultrasonics – process industry

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Prosonic FMU30</th>
<th>Prosonic FMU40/41</th>
<th>Prosonic FMU42, FMU44</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Process pressure</td>
<td>+0.7 to +3bar/ +10 to +44psi</td>
<td>+0.7 to +3bar/ +10 to +44psi</td>
<td>+0.7 to +2.5bar/ +10 to +36psi</td>
</tr>
<tr>
<td>• Process temperature</td>
<td>-20 to +60°C/-4 to +140°F</td>
<td>-40 to +80°C/-40 to +176°F</td>
<td>-40 to +80°C/-40 to +176°F</td>
</tr>
<tr>
<td>• Accuracy</td>
<td>±3mm/±0.12” or 0.2% of distance</td>
<td>±2mm/±0.08” or 0.2% of distance</td>
<td>±2mm/±0.08” or +0.17% of distance</td>
</tr>
<tr>
<td>• Process connection</td>
<td>G/NPT 1½” or 2”</td>
<td>G/NPT 1½” or 2”</td>
<td>G/NPT 1”</td>
</tr>
</tbody>
</table>

| Wetted parts           | PP/EPDM       | PVDF/EPDM       | PVDF |
| Measuring ranges       | 0.25 to 5m/0.8 to 16ft (1½”) | 0.25 to 5m/0.8 to 16ft (FMU40) | 0.4 to 3m/1.3 to 10ft (FMU42) |
|                        | 0.35 to 8m/1.1 to 26ft (2”) | 0.35 to 8m/1.1 to 26ft (FMU41) | 0.5 to 20m/1.6 to 65ft (FMU44) |

| Point level detection  | — TI00440F | — TI01456F/TI01457F | — TI01458F/TI01460F |
| Technical Information  |              |                   |                     |

<table>
<thead>
<tr>
<th>Applications</th>
<th>1½”</th>
<th>2”</th>
<th>FMU40</th>
<th>FMU41</th>
<th>FMU42</th>
<th>FMU44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal storage tank</td>
<td>+</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical storage tank</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffer tank</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>O</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Recipient tank</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Process tank</td>
<td>O</td>
<td>O</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Stilling well</td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bypass</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pump shaft</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Channel measurement</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application limits</th>
<th>For higher resistance</th>
<th>Foam/strong turbulence possible</th>
<th>Fast filling and discharging rate</th>
<th>Point level detection</th>
<th>For higher resistance</th>
<th>Foam/strong turbulence possible</th>
<th>Fast filling and discharging rate</th>
<th>Point level detection</th>
<th>For higher resistance</th>
<th>Foam/strong turbulence possible</th>
<th>Fast filling and discharging rate</th>
<th>Point level detection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FMU42, FDU9x</td>
<td>FMU30 (2”), FMU42, FDU91</td>
<td>FMU42, FDU90 + FDU9x</td>
<td>FMU42, FDU9x</td>
<td>FMU42, FDU91</td>
<td>FMU42, FDU90 + FDU9x</td>
<td>FMU42, FDU90 + FDU9x</td>
<td>FMU42, FDU9x</td>
<td>FMU42, FDU91</td>
<td>FMU42, FDU90 + FDU9x</td>
<td>FMU42, FDU90 + FDU9x</td>
<td>FMU42, FDU9x</td>
</tr>
</tbody>
</table>

+ = recommended          O = restricted (observe limits)  – = not recommended
### Instrument selection within the measuring principle

#### Ultrasonics – process industry
- **Prosonic FMU30**
- **Prosonic FMU40/41**
- **Prosonic FMU42**
- **Prosonic FMU44**
- **Prosonic FMU90/95, FDU90**
- **Prosonic FMU90/95, FDU91**
- **Prosonic FMU90/95, FDU91F**
- **Prosonic FMU90/95, FDU92**

#### Technical data
- **Process pressure**
  - +0.7 to +3bar/
  - +10 to +58psi
- **Process temperature**
  - +10 to +44psi
- **Accuracy**
  - –20 to +60°C/–4 to +140°F
- **Process connection**
  - ±3mm/±0.12” or 0.2% of distance
- **Wetted parts**
  - G/NPT 1½” or 2”
- **Measuring ranges**
  - PP/EPDM
  - 0.25 to 5m/0.8 to 16ft
  - (1½”)
  - 0.35 to 8m/1.1 to 26ft
  - (2”)
  - –
- **Point level detection**
  - TI00440F
  - +0.7 to +3bar/
  - +10 to +58psi
  - –40 to +80°C/–40 to +176°F
  - ±2mm/±0.08” or 0.2% of distance
  - G/NPT 1½” or 2”
  - PVDF/EPDM
  - 0.25 to 5m/0.8 to 16ft
  - (FMU40)
  - 0.35 to 8m/1.1 to 26ft
  - (FMU41)
  - –
- **Technical Information**
  - TI01456F/TI01457F
  - +0.7 to +2.5bar/
  - +10 to +36psi
  - –40 to +80°C/–40 to +176°F
  - ±2mm/±0.08” or 0.17% of distance
  - DN 80/100/150/200,
  - ANSI 3”/4”/6”/8”, JIS 10K/80 (100)/80 (150/200)
  - PVDF/EPDM/Viton
  - 0.4 to 10m/1.3 to 32ft
  - (FMU42)
  - 0.5 to 20m/1.6 to 65ft
  - (FMU44)
  - –
- **TI01458F/TI01460F**
  - +0.7 to +4bar/
  - +10 to +58psi
  - –40 to +80°C/–40 to +176°F
  - ±2mm/±0.08” or 0.17% of distance
  - G/NPT 1”
  - (accessory flange FAX50)
  - PVDF
  - 0.07 to 3m/0.2 to 9.6ft
  - 1, 3 or 6 relays
  - TI00397F/TI00398F/TI01469F
- **TI00397F/TI00398F/TI01470F**
  - +0.7 to +4bar/
  - +10 to +58psi
  - –40 to +80°C/–40 to +221°F
  - ±2mm/±0.08” or 0.17% of distance
  - G/NPT 1”
  - (accessory flange FAX50),
  - Tri-Clamp DN 80
  - 316L
  - 0.3 to 10m/1 to 32ft
  - 1, 3 or 6 relays
  - TI00397F/TI00398F/TI01471F
- **TI00397F/TI00398F/TI01472F**
  - +0.7 to +4bar/
  - +10 to +58psi
  - –40 to +95°C/–40 to +203°F
  - ±2mm/±0.08” or 0.2% of distance
  - G/NPT 1”
  - (accessory flange FAX50)
  - PVDF
  - 0.3 to 20m/1.3 to 65ft
  - 1, 3 or 6 relays

#### Applications
- 1½”
- 2”
- FMU40
- FMU41
- FMU42
- FMU44

#### Foam/strong turbulence possible
- +
- –
- +
- –
- +
- –
- +
- –
- +

#### For tank farm
- +
- –
- +
- –
- +
- –
- +
- –
- +

#### Flange-flush assembly
- +
- –
- +
- –
- +
- –
- +
- –
- +

#### For tank farm
- +
- –
- +
- –
- +
- –
- +
- –
- +

#### Scanner FMU95
- +
- –
- +
- –
- +
- –
- +
- –
- +
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

- **Installation**
  - Not in the center
  - Not above the fillstream
  - Distance to wall: ~1/6 of the tank diameter (min. 30cm/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 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 build-up 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/“)

<table>
<thead>
<tr>
<th>Max. nozzle length (mm/“)</th>
<th>FMU40</th>
<th>FMU41</th>
<th>FMU42</th>
<th>FMU44</th>
<th>Sensor type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 50 /2”</td>
<td>80</td>
<td>240</td>
<td>240</td>
<td>250</td>
<td>50</td>
</tr>
<tr>
<td>DN 80 /3”</td>
<td>240</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>340/250</td>
</tr>
<tr>
<td>DN 100 /4”</td>
<td>300</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>390/300</td>
</tr>
<tr>
<td>DN 150 /6”</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>390/300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beam angle</th>
<th>BD (m/ft)</th>
<th>Sensor type</th>
</tr>
</thead>
<tbody>
<tr>
<td>11°</td>
<td>0.25/0.8</td>
<td>50</td>
</tr>
<tr>
<td>11°</td>
<td>0.35/1.15</td>
<td>340/250</td>
</tr>
<tr>
<td>9°</td>
<td>0.4/1.3</td>
<td>300</td>
</tr>
<tr>
<td>11°</td>
<td>0.5/1.6</td>
<td>390/300</td>
</tr>
<tr>
<td>12°</td>
<td>0.07/0.23</td>
<td>400</td>
</tr>
<tr>
<td>9°</td>
<td>0.3/1</td>
<td>390/300</td>
</tr>
<tr>
<td>12°</td>
<td>0.3/1</td>
<td>300</td>
</tr>
<tr>
<td>11°</td>
<td>0.4/1.3</td>
<td>400</td>
</tr>
</tbody>
</table>

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

1 Mounted at backside thread  2 Mounted at frontside thread

---
Instrument selection within the measuring principle

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

- **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 (>10mm/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. 1mm/0.04"
  - Recommended minimum inner diameter >80mm/3".
  - Please observe sensor dimensions to choose the right inner diameter

Separate instrumentation with FMU9x
4. Instrument selection within the measuring principle

Capacitance

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

Starting from a conductivity of 100µS/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**
- Temperature up to –80°C/–112°F
- Temperature up to +200°C/+392°F
- Pressure up to 100bar/1,450psi
- Measuring range up to 10m/3.2ft

---

**Operating range of Liquicap**

<table>
<thead>
<tr>
<th>Conductivity (µS/cm)</th>
<th>e.g. water-based liquids, aqueous solutions of salts, acids, lyes, aqueous dispersions and emulsions, waste water, electrolytes, beverages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10⁴</td>
<td></td>
</tr>
<tr>
<td>10³</td>
<td></td>
</tr>
<tr>
<td>10²</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10⁻¹</td>
<td></td>
</tr>
<tr>
<td>10⁻²</td>
<td></td>
</tr>
<tr>
<td>10⁻³</td>
<td></td>
</tr>
</tbody>
</table>

The accuracy is unaffected by the conductivity and the DC value (dielectric constant)

Factory calibration for 0% and 100%

The accuracy is dependent on the DC value and the conductivity of the medium. Measurement not recommended, select another measuring principle.

Factory calibration for 0%

The accuracy is dependent on the DC value.
### Capacitance - process industry

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Liquicap FMI51</th>
<th>Liquicap FMI52</th>
<th>Liquicap FMI21</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Process pressure</td>
<td>-1 to +100bar/</td>
<td>-1 to +100bar/</td>
<td>-1 to +10bar/</td>
</tr>
<tr>
<td></td>
<td>-14.5 to +1,450psi</td>
<td>-14.5 to +1,450psi</td>
<td>-14.5 to +145psi</td>
</tr>
<tr>
<td>• Process temperature</td>
<td>-80 to +200°C/</td>
<td>-80 to +200°C/</td>
<td>-40 to +100°C/</td>
</tr>
<tr>
<td></td>
<td>-112 to +392°F</td>
<td>-112 to +392°F</td>
<td>-40 to +212°F</td>
</tr>
<tr>
<td>• Accuracy</td>
<td>±1%</td>
<td>±1%</td>
<td>±1%</td>
</tr>
<tr>
<td>• Process connection</td>
<td>Thread ½&quot; to 1½&quot;, flanges</td>
<td>Thread ½&quot; to 1½&quot;, flanges</td>
<td>Thread 1½&quot;</td>
</tr>
<tr>
<td></td>
<td>EN, ANSI, JIS, hygienic</td>
<td>EN, ANSI, JIS, hygienic</td>
<td>316L, PP, carbon fiber</td>
</tr>
<tr>
<td>• Wetted parts</td>
<td>316L, PFA, PTFE</td>
<td>316L, PFA, FEP</td>
<td>316L, PP, carbon fiber</td>
</tr>
<tr>
<td>• Measuring ranges</td>
<td>Rod probe up to 4m/13ft</td>
<td>Rope probe up to 10m/32ft</td>
<td>up to 2.5m/8.2ft</td>
</tr>
<tr>
<td>• Gastight feedthrough</td>
<td>Optional T100401F</td>
<td>Optional T100401F</td>
<td>—</td>
</tr>
<tr>
<td>• Technical Information</td>
<td>+</td>
<td>+</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applications</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal storage tank cyl.</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Vertical storage tank</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Buffer tank</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Recipient tank</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Process tank</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stilling well</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bypass</td>
<td>*</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Pump shaft</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Channel measurement</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Interface measurement</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application limits</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Insufficient clearance towards ceiling</td>
<td></td>
<td></td>
<td>Changing, non-conductive media or conductivity between 1 to 100µS/cm</td>
</tr>
<tr>
<td>• Changing, non-conductive media or conductivity between 1 to 100µS/cm</td>
<td></td>
<td></td>
<td>Changing, non-conductive media or conductivity between 1 to 100µS/cm</td>
</tr>
<tr>
<td>• Highly viscous liquids &gt; 2000cst</td>
<td></td>
<td></td>
<td>—</td>
</tr>
</tbody>
</table>

+ = recommended  
0 = restricted (observe limits)  
– = not recommended
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 „Build-up compensation“ mode may be selected
Notes
4. Instrument selection within the measuring principle

Servo (tank gauging)

**Required application data**
- Pressure and temperature
- Medium density
- Required material compatibility
- Nozzle diameter
- Measuring range
- Required accuracy
- For stilling well: Internal pipe diameter

**Application limits for servo level measurement**
- Temperature up to –200°C/–328°F
- Temperature up to +200°C/+392°F
- Pressure up to 25bar/362.5psi
- Process connection from 3”
- Viscosity from 5000mPS s

**Advantages**
- Unaffected by dielectric constant
- Unaffected by conductivity
- Multiparameter measurement: Level, density, interface

---

For reliable measurement

Use a stilling well whenever possible.
### Instrument selection within the measuring principle

<table>
<thead>
<tr>
<th>Proservo NMS80</th>
<th>Proservo NMS81</th>
<th>Proservo NMS83</th>
</tr>
</thead>
</table>

- **Servo – Tank Gauging**
- **Technical data**
  - **Process pressure**: 0.2 to +6 bar / 0 to +25 bar
  - **Process temperature**: –200 to +200°C / –328 to +392°F
  - **Accuracy**: ±0.4 mm / 0.02"
  - **Process connection**: DN 80 to DN 150 / 3" to 6"
  - **Wetted parts**: 316L, Alloy C276, PTFE
  - **Measuring ranges**: 36 m / 118 ft
  - **Gastight feedthrough**: Standard
  - **Technical Information**: TI01248G

- **Servo – Tank Gauging**
- **Technical data**
  - **Process pressure**: 0 to +6 bar / 0 to +87 psi
  - **Process temperature**: –200 to +200°C / –328 to +392°F
  - **Accuracy**: ±0.4 mm / 0.02"
  - **Process connection**: DN 80 to DN 150 / 3" to 6"
  - **Wetted parts**: 316L, Alloy C276, PTFE
  - **Measuring ranges**: 47 m / 154 ft
  - **Gastight feedthrough**: Standard
  - **Technical Information**: TI01249G

- **Servo – Tank Gauging**
- **Technical data**
  - **Process pressure**: 0 to +6 bar / 0 to +87 psi
  - **Process temperature**: –200 to +200°C / –328 to +392°F
  - **Accuracy**: ±0.4 mm / 0.02"
  - **Process connection**: DN 80 to DN 150 / 3" to 6"
  - **Wetted parts**: 316L, 316 polished, PTFE
  - **Measuring ranges**: 22 m / 72 ft
  - **Gastight feedthrough**: Standard
  - **Technical Information**: TI01250G

### Applications

- Horizontal storage tank cyl.
- Vertical storage tank
- Buffer tank
- Recipient tank
- Process tank
- Stilling well
- Bypass
- Pump shaft
- Channel measurement

### Application limits

- Turbulent condition
- High viscosity
- Requires min. difference of 0.100 g/ml between layers

→ Guide wires or stilling well
→ PTFE displacer or NMR81

### Notes

+ = recommended  
O = restricted (observe limits)  
– = not recommended
4. Instrument selection within the measuring principle

**Measuring range in dependence on the type of tank**

Process conditions and medium for Proservo NMS80/NMS81/NMS83

**Storage tank**
Highly accurate measurement, custody transfer

**Stilling well**
Highly accurate measurement, custody transfer

<table>
<thead>
<tr>
<th>Measuring wire material</th>
<th>A: 316L</th>
<th>B: Alloy 276C</th>
<th>C: PFA &gt; 316L</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Storage tank</th>
<th>NMS80</th>
<th>NMS81</th>
<th>NMS83</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range in m/ft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>36/118</td>
<td>22/72</td>
<td>16/52</td>
<td>22/72</td>
</tr>
</tbody>
</table>

*Standard: Max. measuring range = 30m/97ft*

* Custody transfer range
Notes
4. Instrument selection within the measuring principle

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**
- Temperature up to –70°C/–94°F or
  Temperature up to +400°C/+752°F
- Pressure up to +420bar/+6,090psi

**Advantages**
- Unaffected by surface foam
- Unaffected by tank obstacles/tank geometries
- Simple engineering
- Established technology
- Remote access via Bluetooth®
- Heartbeat Technology
4. Instrument selection within the measuring principle

### Hydrostatics – process industry

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Cerabar PMC51B</th>
<th>Cerabar PMP51B</th>
<th>Deltapilot FMB50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process pressure</td>
<td>100mbar to 40bar/0.15 to 600psi</td>
<td>400mbar to 400bar/6 to 6,000psi</td>
<td>100mbar to 10bar/1.5 to 145psi</td>
</tr>
<tr>
<td>Process temperature</td>
<td>–40 to +100°C/–40 to +212°F</td>
<td>–70 to +400°C/–94 to +752°F</td>
<td>–10 to +100°C/+14 to +212°F</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.075% (0.055% optional)</td>
<td>±0.075% (0.055% optional)</td>
<td>±0.2% (0.1% optional)</td>
</tr>
<tr>
<td>Process connection</td>
<td>Thread, flange, hygienic connections 316L, Al₂O₃, sealings, PVDF</td>
<td>Thread, flange, hygienic connections 316L, Alloy, Tantal, Monel, Gold</td>
<td>Thread, flange, hygienic connections 316L, Alloy</td>
</tr>
<tr>
<td>Wetted parts</td>
<td>316L, Al₂O₃, sealings, PVDF</td>
<td>316L, Alloy, Tantal, Monel, Gold</td>
<td>Metal welded</td>
</tr>
<tr>
<td>Gastight feedthrough</td>
<td>Ceramics</td>
<td>Metal welded</td>
<td>—</td>
</tr>
<tr>
<td>Measuring cell</td>
<td>—</td>
<td>—</td>
<td>Contite, condensate-proof, water-tight, metal welded</td>
</tr>
<tr>
<td>Technical Information</td>
<td>TI01506P</td>
<td>TI01508P</td>
<td>TI00437P</td>
</tr>
</tbody>
</table>

### Applications

- Horizontal storage tank cyl.:
  - 0 = recommended
  - O = restricted (observe limits)
  - – = not recommended

- Vertical storage tank:
  - + = recommended
  - – = not recommended

- Buffer tank:
  - 0 = recommended
  - – = not recommended

- Recipient tank:
  - + = recommended
  - – = not recommended

- Process tank:
  - 0 = recommended
  - – = not recommended

- Stilling well:
  - – = not recommended

- Bypass:
  - – = not recommended

- Pump shaft:
  - – = not recommended

- Channel measurement:
  - – = not recommended

### Application limits

- If pressurized, possibly use differential pressure measurement with two pressure transmitters (electronic dp). Observe ratio head pressure to hydrostatic pressure

- If pressurized, possibly use differential pressure measurement with two pressure transmitters (electronic dp). Observe ratio head pressure to hydrostatic pressure

- If pressurized, possibly use differential pressure measurement with two pressure transmitters. Observe ratio head pressure to hydrostatic pressure

+ = recommended
O = restricted (observe limits)
– = not recommended
Instrument selection within the measuring principle

**Cerabar PMC71B**

- **Process pressure**: 100mbar to 40bar/1.5 to 600psi
- **Process temperature**: -40 to +150°C/−40 to +302°F
- **Accuracy**: ±0.075% (0.055% optional)
- **Process connection**: Thread, flange, hygienic connections
- **Wetted parts**: 316L, Al₂O₃, sealings, PVDF, Standard Ceramics
- **Model**: TI01507P

**Cerabar PMP71B**

- **Process pressure**: 400mbar to 700bar/6 to 10,500psi
- **Process temperature**: -70 to +400°C/−94 to +752°F
- **Accuracy**: ±0.075% (0.055% optional)
- **Process connection**: Thread, flange, hygienic connections
- **Wetted parts**: 316L, Alloy, Tantal, Monel, Gold, Standard Metal welded
- **Model**: TI01509P

**Deltapilot FMB70**

- **Process pressure**: 100mbar to 10bar/1.5 to 145psi
- **Process temperature**: -10 to +100°C/+14 to +212°F
- **Accuracy**: ±0.2% (0.1% optional)
- **Process connection**: Thread, flange, hygienic connections
- **Wetted parts**: 316L, Alloy, Standard Contite, condensate-proof, water-tight, metal welded
- **Model**: TI00416P

**Applications**

- **Horizontal storage tank**
- **Vertical storage tank**
- **Buffer tank**
- **Recipient tank**
- **Process tank**
- **Stilling well**
- **Bypass**
- **Pump shaft**
- **Channel measurement**

**Application limits**

- If pressurized, possibly use differential pressure measurement with two pressure transmitters. Apply ratio head pressure to hydrostatic pressure.

---

**Technical data**

- **Process pressure**
- **Process temperature**
- **Accuracy**
- **Process connection**
- **Wetted parts**
- **Gastight feedthrough**
- **Measuring cell**
- **Technical Information**
4. Instrument selection within the measuring principle

### Hydrostatics – process industry

<table>
<thead>
<tr>
<th>Waterpilot</th>
<th>Deltapilot</th>
<th>Deltabar</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMX11/FMX21</td>
<td>FMB51/52/53</td>
<td>PMD55B</td>
</tr>
</tbody>
</table>

#### Technical data
- **Process pressure**: 100mbar to 20bar, 0.15 to 290psi
- **Process temperature**: –10 to +70°C, –10 to +140°F
- **Accuracy**: ±0.2% (0.1% optional)
- **Process connection**: Mounting clamp, cable mounting screw
- **Wetted parts**: 316L, Al2O3, FKM, EPDM, PE, FEP, PUR
- **Gastight feedthrough**: Ceramics
- **Measuring cell**: Contite, condensate-proof, water-tight, metal welded
- **Technical Information**: TIO0351P/TIO0431P

<table>
<thead>
<tr>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal storage tank cyl.</td>
</tr>
<tr>
<td>Vertical storage tank</td>
</tr>
<tr>
<td>Buffer tank</td>
</tr>
<tr>
<td>Recipient tank</td>
</tr>
<tr>
<td>Process tank</td>
</tr>
<tr>
<td>Stilling well</td>
</tr>
<tr>
<td>Bypass</td>
</tr>
<tr>
<td>Pump shaft</td>
</tr>
<tr>
<td>Channel measurement</td>
</tr>
</tbody>
</table>

#### Application limits
- **Pressurized tanks**
- **Pressurized tanks**
- **Pressurized tanks**
- **Impulse-piping required**
- **If pressurized, possibly use Deltabar FMD71/FMD72 electronic dp. Observe ratio head pressure to hydrostatic pressure**

+ = recommended  
O = restricted (observe limits)  
– = not recommended
### Instrument selection within the measuring principle

#### Deltabar FMD71/FMD72
- Pressure range: 100 mbar to 40 bar (1.5 to 600 psi)
- Temperature range: -40 up to +150°C / -40 up to +302°F
- Single sensor ±0.05%
- System ±0.07%
- Thread, flange, flush-mounted hygienic connections
  - 316L, Alloy C276
- Standard: Metal welded, Ceraphire ceramics
- Model: TI01033P

#### Deltabar PMD75B
- Pressure range: 10 mbar to 250 bar (0.15 to 3,750 psi)
- Temperature range: -40 to +110°C / -40 to +230°F
- ±0.05% (0.035% optional)
- Oval flange (¼ to 18 NPT), IEC 61518
- 316L, Alloy, Monel, Tantal, Gold
- Standard: Metal welded
- Model: TI01511P

#### Deltabar PMD78B
- Pressure range: 100 mbar to 40 bar (1.5 to 600 psi)
- Temperature range: -40 up to +400°C / -40 up to +752°F
- ±0.1%
- Thread, flange, hygienic connections
  - 316L, Alloy, Monel, Tantal, PTFE, Gold
- Standard: Metal welded
- Model: TI01512P

### Technical data

- **Process pressure**
- **Process temperature**
- **Accuracy**
- **Process connection**
- **Wetted parts**
- **Gastight feedthrough**
- **Measuring cell**

**Technical Information**

- 100 mbar to 40 bar / 1.5 to 600 psi
- -40 up to +150°C / -40 up to +302°F
- Single sensor ±0.05%
- System ±0.07%
- Thread, flange, flush-mounted hygienic connections
  - 316L, Alloy C276

**Standard**

- Metal welded, Ceraphire ceramics
- Model: TI01033P

### Applications

- Horizontal storage tank
- Vertical storage tank
- Buffer tank
- Recipient tank
- Process tank
- Stilling well
- Bypass
- Pump shaft
- Channel measurement

### Application limits

- Pressurized tanks
  - FMB51: Rope variant
  - FMB52: Rod variant
- Impulse-piping required
  - If pressurized, possibly use Deltabar FMD71/FMD72 electronic dp. Observe ratio head pressure to hydrostatic pressure

### Observations

- Observe ratio head pressure to hydrostatic pressure
- Impulse-piping required
- If pressurized, possibly use Deltabar FMD71/FMD72 electronic dp. Observe ratio head pressure to hydrostatic pressure
- Possibly use Deltabar FMD71/FMD72 electronic dp. Observe ratio head pressure to hydrostatic pressure

*with blank flange*
Installation instructions hydrostatics (pressure)

Open tanks

- **Weather protection cover**
  - Recommended for outside installation to avoid strong temperature changes of electronics

- **Installation from the top (FMB51/52)**
  - When installing rod and cable 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 5cm/2” below that

- **Installation from below (PMC51B, PMP51B, FMB50, PMC71B, PMP71B, 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

---

4. Instrument selection within the measuring principle
Open wells or basins (FMB53/FMX21)

- **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 FMX21, the cable must end in a dry room.

- **Mounting clamp/cable mounting screw**
  - The carrier cable is fastened by a 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 1mm/0.04" larger than the external diameter of the selected sensor.
  - An additional weight may be ordered as an accessory.
4. Instrument selection within the measuring principle

**Installation instructions hydrostatics** (differential pressure)

**Closed tanks with Deltabar FMD71/FMD72**
- **electronic dp**
  - LP (low pressure) install sensor above the maximum measuring point
  - HP (high pressure) if possible, install sensor below the minimum measuring point
  - In case of outdoor installation it is recommended to mount the transmitter at a position where it is protected against the environment
  - 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

**Closed tanks with PMD78B**
- **(diaphragm seal plus side)**
  - Always connect the minus side above the maximum level
  - Install Deltabar PMD78B 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 PMD75B/PMD55B (pressure piping)
- Always connect the minus side above the maximum level
- Always install Deltabar PMD75B/Deltabar PMD55B 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 PMD75B/ PMD55B (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 PMD75B/Deltabar PMD55B 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
4. Instrument selection within the measuring principle

**Installation instructions hydrostatics** (differential pressure)

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

**Endress+Hauser Applicator**

Further installation instructions are presented in the "Sizing Diaphragm Seal" Applicator
Continuous level measurement in bulk solids
Selection and engineering guide for the process industry
Step by step

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

The pamphlet contains two separate chapters: Level measurement in liquids and Level measurement in solids.

The second chapter specifically covers continuous measurement in bulk solids. A separate selection guide is available for point level detection (see the supplementary documentation CP00007F).

Overview of measuring principles
First of all, we show you an overview of the Endress+Hauser measuring principles for continuous level measurement in solids 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.

Selection of the measuring principle
The appropriate measuring principle is first selected according to the application and its criteria (Silo/bunker, slim/narrow silos, mechanical conveyor systems, crusher and stockpiles).
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.

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.
Contents

1. Overview of measuring principles ................................................................. 102

2. Checklist ........................................................................................................ 108

3. Selection of the measuring principle according to the application
   • Silo/bunker ........................................................................................................ 110
   • Slim, narrow silos (ratio H/D ≥ 8) .............................................................. 112
   • Stockpiles ....................................................................................................... 114
   • Mechanical conveyor systems (e.g. conveyor belt) .................................... 115
   • Crusher ......................................................................................................... 116
   • IIoT Radar (not included in this selection guide): Cloud based IIoT level sensor for mobile applications or remote measuring points for liquids and bulk solids. Data transmission via cellular communication (NBIoT, LTE-M and 2G fallback). Data management in SupplyCare Hosting and Netilion (E+H cloud services). Detailed information is available from our application specialists or at www.endress.com/FWR30.

4. Instrument selection within the measuring principle .................................... 118
   • Radar ........................................................................................................... 118
   • Guided radar .............................................................................................. 122
   • Ultrasonics ................................................................................................. 126
   • Electromechanical level system ................................................................ 132
   • Radiometry: The radiometric measuring principle is not considered in this section. Please contact our application consultants in your country for detailed information.
1. Overview of the measuring principles

### Segmentation

<table>
<thead>
<tr>
<th>Liquids</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point level</td>
<td>Radar</td>
</tr>
<tr>
<td>Vibronics</td>
<td>Guided radar</td>
</tr>
<tr>
<td>Conductive</td>
<td>Ultrasonics</td>
</tr>
<tr>
<td>Capacitance</td>
<td>Hydrostatics (p + dp)</td>
</tr>
<tr>
<td>Float switch</td>
<td>Capacitance</td>
</tr>
<tr>
<td>Radiometrics</td>
<td>Radiometrics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bulk solids</th>
<th>Electromechanical level system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibronics</td>
<td>Radiometrics</td>
</tr>
<tr>
<td>Capacitance</td>
<td>Paddle</td>
</tr>
<tr>
<td>Paddle</td>
<td>Microwave barrier</td>
</tr>
<tr>
<td>Microwave barrier</td>
<td>Radiometrics</td>
</tr>
</tbody>
</table>

* Radiometry not depicted

Non-contact measurement from outside and, therefore, no application limits.
Endress+Hauser offers you a solution adapted to your application and tailored to your process requirements. You can select the best technology for your application from the wide product range of Endress+Hauser.

„You only pay what you really need.“

Endress+Hauser takes this statement seriously and offers a large number of different measuring principles which vary in price and functionality.
1. Overview of the measuring principles

**Radar**
Micropilot works with either pulses or with Frequency Modulated Continuous Wave (FMCW). Pulse: High-frequency radar pulses which are emitted by an antenna and reflected from the product surface. The time between pulse launching and receiving is measured and analyzed by the instrument and constitutes a direct measure for the distance between the antenna and the surface of the medium. FMCW: Works with an FMCW continuous electromagnetic wave which is emitted from an antenna and reflected by the product surface. The frequency change “Δf” is measured and the time and distance are calculated.

**Micropilot**
Non-contact, maintenance-free measurement also under extreme conditions. Unaffected by the density of bulk solids, temperature, dust formation and humidity.

**Guided radar**
Levelflex works with radar pulses guided along a probe. As the pulses meet the medium surface, part of the emitted pulse is reflected due to a change of the DC value between the air and the medium. 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**
Robust, non-maintenance measurement in solids. Unaffected by the density of bulk solids, temperature, dust formation and humidity and almost unaffected by baffles.

**Ultrasonics**
Prosonic works with ultrasonic pulses which are emitted by a sensor, reflected by the surface of the medium due to a change of the density between the air and the medium and again acquired by the sensor. The required Time-of-Flight is a measure for the distance travelled in the empty part of the silo. This value is deducted from the overall height of the silo to yield the level.

**Prosonic**
Non-contact measurement free of maintenance without impairment by product properties, e.g. dielectric constant or humidity. Unaffected by build-up due to the self-cleaning effect of sensors using diaphragm vibration.
**Overview measuring principles**

**Electromechanical level system**

A weight is lowered on a measuring tape. As it meets the surface of the bulk solids, the tensile force of the weight is reduced. This change is recognized, the instrument reverses the sense of rotation of the motor and rewinds the tape. A pulse generator counts the rotations in a non-contact manner as the weight is lowered. Each counted pulse corresponds to an exactly defined distance. If this distance is deducted from the overall distance (height of the vessel), the level results.

**Silopilot**

Robust system for safe measurements also in extremely dusty environments and low density media. Unaffected by product properties and DC value.

**Radiometry**

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 as the level changes. The measuring system consists of a source and a compact transmitter as a receiver.

**Gammapilot**

Compact transmitter in different measuring lengths, adaptable to the measuring range. Non-contact measurement from outside, for all extreme applications, e.g. very abrasive, corrosive and aggressive media:

- Unaffected by media
- Any process temperature
- Any process pressure
- Unaffected by gammagraphy (Modulator)
### 1. Overview of the measuring principles

<table>
<thead>
<tr>
<th>Process temperature*</th>
<th>Process pressure</th>
<th>Measuring range</th>
<th>Instrument accuracy Surfaces of bulk solids affect accuracy</th>
<th>Function may be affected by</th>
<th>Application limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>−40 to +450°C/ −40 to +842°F</td>
<td>−1 to +16bar/ −14.5 to +232psi</td>
<td>0.3 to 125m/1 to 410ft</td>
<td>Up to 2m/78&quot;: ±20mm/0.8&quot; From 2m/78&quot;: ±3mm/0.12&quot;</td>
<td>Strong build-up formation Surface of bulk solids (grain size/angled surface) Conductive build-up on the antenna Strong fluidization Baffles causing interfering reflections</td>
<td>DC &lt; 1.6 Baffles in the beam cone Filling curtain in the beam cone Angled surface/funnel with a reflecting, smooth surface</td>
</tr>
<tr>
<td>−40 to +150°C/ −40 to +302°F</td>
<td>−1 to +16bar/ −14.5 to +232psi</td>
<td>0.2 to 45m/0.7 to 148ft</td>
<td>&lt; 15m/49ft: ±2mm/0.08&quot; &gt; 15m/49ft: ±10mm/0.4&quot;</td>
<td>Build-up formation Baffles in the immediate vicinity of the probe Strong fluidization</td>
<td>DC &lt; 1.4 Coarse-grained (&gt; 20mm/0.8&quot;) and abrasive media Extreme tensile forces Measurement in the filling curtain</td>
</tr>
</tbody>
</table>

*At the process connection
### Overview measuring principles

#### Radar
- Guided radar

#### Ultrasonics
- FMU4x
- FMU9x
- FDU9x
- Measuring range:
  - 0.07 to 45m / 0.2 to 148 ft
  - ±2mm / 0.08”, ±0.2% of measuring distance

#### Electromechanical level system
- FMU9x
- FMU20
- Measuring range:
  - 0.85 to 70m / 2.8 to 230 ft (special design up to 90m / 295 ft)
  - ±5cm / 2” (FMM50)
  - ±2.5cm / 1” (FMM20)
  - ±1% of measuring distance

#### Radiometrics
- FMU9x
- FMU50
- Measuring range:
  - ±1% of measuring distance
  - Unaffected by process temperature and pressure

### Application limits
- DC < 1.6
- Baffles in the beam cone
- Filling curtain in the beam cone
- Angled surface/funnel with a reflecting, smooth surface
- Extreme tensile forces if the risk of collapsing product accumulation on walls prevails
- Non-contact measurement from outside and, therefore, no application limits
- Observe radiation protection laws

### Limits of operating conditions
- DC < 1.4
- Coarse-grained (> 20mm / 0.8”) and abrasive media
- Extreme tensile forces
- Measurement during filling

### Summary

- Overview of application areas
- Limits of operating conditions
2. Checklist

You need to know your specific application requirements for a correct selection. The checklist opposite provides an overview of relevant process data and is supposed to help you to take these into consideration. If we have not included all of the data, please supplement this list with your criteria.

The checklist is used 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 readily available for the selection.

Notes
<table>
<thead>
<tr>
<th>Name of medium</th>
<th>Please complete</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>g/l (kg/m³)</td>
<td></td>
</tr>
<tr>
<td>Grain size (min/max)</td>
<td>mm/inch</td>
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</tr>
<tr>
<td>Rel. dielectric constant (DC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tacky/build-up forming</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Extreme dust formation</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Abrasive</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Condensate formation</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Corrosive</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Non-contact measurement</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Applications</td>
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<td></td>
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<tr>
<td>Silos/bunkers</td>
<td>yes / no</td>
<td></td>
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<tr>
<td>Slim, narrow silos (H/D ≥ 8)</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Stockpiles</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Mechanical conveyor systems (e. g. conveyor belt)</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Crusher</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Process conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluidization</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Pneumatic filling</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Product accumulation on walls</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Formation of angled surfaces, outflow funnels</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Max. measuring distance</td>
<td>m/feet</td>
<td></td>
</tr>
<tr>
<td>Process data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process pressure</td>
<td>min. / max.</td>
<td></td>
</tr>
<tr>
<td>Temperature at the housing</td>
<td>min. / max.</td>
<td></td>
</tr>
<tr>
<td>Temperature at the process connection</td>
<td>min. / max.</td>
<td></td>
</tr>
<tr>
<td>Process temperature</td>
<td>min. / max.</td>
<td></td>
</tr>
<tr>
<td>Process connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threaded connection</td>
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<td></td>
</tr>
<tr>
<td>Flange</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Ø</td>
<td></td>
</tr>
<tr>
<td>Pressure requirements</td>
<td>min. / max.</td>
<td></td>
</tr>
<tr>
<td>Hygiene requirements</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete ceiling</td>
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<td></td>
</tr>
<tr>
<td>Thickness of concrete ceiling</td>
<td>mm/inch</td>
<td></td>
</tr>
<tr>
<td>Electric connection</td>
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<td></td>
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<tr>
<td>2-wire 4 to 20mA</td>
<td>yes / no</td>
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</tr>
<tr>
<td>4-wire DC, AC</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Surface requirements</td>
<td></td>
<td></td>
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<tr>
<td>FDA-listed materials</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Approvals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex (dust/gas)</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Special requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme external vibration</td>
<td>yes / no</td>
<td></td>
</tr>
<tr>
<td>Digital communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROFIBUS® PA, PROFIBUS® DP, HART®, FOUNDATION™ fieldbus, Ethernet-APL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other items</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3. Selection of the measuring principle according to the application

#### Non-contact

<table>
<thead>
<tr>
<th><strong>Our proposal</strong></th>
<th><strong>Radar</strong></th>
<th><strong>Ultrasonics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FMR20</td>
<td>FMR66B</td>
</tr>
<tr>
<td></td>
<td>FMR67B</td>
<td>FMR67B</td>
</tr>
</tbody>
</table>

#### Advantages
- **Radar**
  - Micropilot
  - Unaffected by density of bulk solids, temperature, humidity and filling noise
  - For corrosive and abrasive media
  - Easy installation for large measuring ranges
  - Remote access via Bluetooth®
  - Heartbeat Technology

- **Ultrasonics**
  - Prosonic
  - Separate instrumentation
  - Connection of up to 10 sensors
  - Attractive price, e.g. silo farms
  - Self-cleaning effect of sensors
  - Corrosive and abrasive media
  - Relay output for point levels
  - Unaffected by the density of bulk solids, humidity and dielectric constant

#### Technical data

- **Connection**
  - 2-wire (HART®, PA, Ethernet-APL)
  - ±3mm/±0.12”
  - –40 to +450°C/–40 to +842°F
  - –1 to +16bar/–14.5 to +232psi
  - 1.6
  - DN 80, DN 100, DN 150, DN 200, DN 250, assembly bracket
  - 125m/410ft

- **Process temperature**
  - ±2mm/±0.08”, ±0.2% of measured distance
  - –40 to +150°C/–40 to +302°F
  - +0.7 to +3bar/+10 to +44psi
  - Threads, flanges (DIN, ANSI, JIS), wall and assembly arm, assembly bracket
  - 45m/148ft

- **Process pressure**
  - 2-/4-wire (4-20mA HART®, DP)
  - –20 to +230°C/–4 to +446°F
  - –1 to +16bar/–14.5 to +232psi
  - ¾", 1½", DN 40 to DN 150
  - 45m/148ft

- **Process connection**
  - 4-wire, 4-20mA, relay
  - ±2.5cm/±1” (FMM20), ±5cm/±2” (FMM50)
  - –20 to +230°C/–4 to +446°F
  - +0.8 to +3bar/+11.6 to +44psi
  - DN 100 PN 16 (hole size)
  - 70m/230ft (special design up to 90m/295ft)

- **Max. measuring range**
  - 2-wire (HART®, PA, Ethernet-APL)
  - ±3mm/±0.12”
  - –40 to +450°C/–40 to +842°F
  - –1 to +16bar/–14.5 to +232psi
  - 1.6
  - DN 80, DN 100, DN 150, DN 200, DN 250, assembly bracket
  - 125m/410ft

- **Process connection**
  - 4-wire, 4-20mA, relay
  - ±2.5cm/±1” (FMM20), ±5cm/±2” (FMM50)
  - –20 to +230°C/–4 to +446°F
  - +0.8 to +3bar/+11.6 to +44psi
  - DN 100 PN 16 (hole size)
  - 70m/230ft (special design up to 90m/295ft)

#### Application limits

- **Radar**
  - DC value < 1.6
  - Risk of strong build-up formation
  - Angled surface/ funnel with a reflecting, smooth surface
  - > ultrasonics, electrom. level system
  - > use of purge air
  - > ultrasonics
  - > guided radar, electrom. level system

- **Ultrasonics**
  - DMU90/95 (separated) (compact)
  - > radar, electrom. level system
  - > radar, guided radar
  - > radar, guided radar, electrom. level system
  - > radar, guided radar, electrom. level system

*At the process connection*

ellow note: Radar continued on Page 118

ellow note: Ultrasonics continued on Page 126
Selection according to application

Silos/bunkers
- Filling via mechanical or pneumatic conveyance
- Free field measurement
- Fluidization possible

Our proposal
- Radar
- Micropilot
- Ultrasonics
- Prosonic
- Guided radar
- Levelflex
- Electromechanical level system
- Silopilot

Advantages
- Unaffected by the density of bulk solids, temperature, humidity and filling noise
- For corrosive and abrasive media
- Easy installation for large measuring ranges
- Remote access via Bluetooth®
- Heartbeat Technology
- Separate instrumentation
- Connection of up to 10 sensors
- Attractive price, e.g. silo farms
- Self-cleaning effect of sensors
- Corrosive and abrasive media
- Relay output for point levels
- Unaffected by the density of bulk solids, humidity and dielectric constant
- Unaffected by silo geometries and the shape of the angled surfaces
- Unaffected by the density of bulk solids, temperature, humidity and filling noise
- Unaffected by dust, e.g. in pneumatic filling
- Heartbeat Technology
- Unaffected by low density of bulk solids and DC value
- Easy installation

Technical data
- Connection: 2-wire (HART®, PA, Ethernet-APL), 2-/4-wire (4-20mA HART®, DP)
- Accuracy: ±3mm/±0.12", ±2mm/±0.08", ±0.2% of measured distance
- Process temperature*: –40 to +450°C/–40 to +842°F, –40 to +150°C/–40 to +302°F
- Process pressure: –1 to +16bar/–14.5 to +232psi, +0.7 to +3bar/+10 to +44psi
- Min. DC value: 1.6, 1.4
- Process connection: DN 80, DN 100, DN 150, DN 200, DN 250, threads, flanges (DIN, ANSI, JIS), wall and assembly arm, assembly bracket
- Maximum measuring range: 2-wire (HART®, PA, FF), 4-wire HART® < 15m/49ft: ±2mm/0.08", > 15m/49ft: ±10mm/0.4” ~40 to +150°C/~40 to +302°F; –1 to +16bar/~14.5 to +232psi, 1.4, ¾", 1½", DN 40 to DN 150 45m/148ft 70m/230ft (special design up to 90m/295ft) 4-wire, 4-20mA, relay ±2.5cm/±1" (FMM20), ±5cm/±2" (FMM50) ~20 to +230°C/-4 to +446°F +0.8 to +3bar/+11.6 to +44psi; – DN 100 PN 16 (hole size) 45m/148ft

Application limits
- DC value < 1.6
- Risk of strong build-up formation
- Angled surface/ funnel with a reflecting, smooth surface
- Ultrasonics, electrom. level system
- Use of purge air
- Ultrasonics
- Guided radar, electrom. level system
- Guided radar, electrom. level system
- Radar, electrom. level system
- Radar, ultrasonics
- Radar, ultrasonics, electrom. level system
- Radar with purge air, ultrasonics
- Radar, electrom. level system
- Ultrasonics, electrom. level system
- Radar, electrom. level system
- Magnetostrictive level system
- Ultrasonics, electrom. level system
- Radar, ultrasonics
- Ultrasonics, electrom. level system
- Radar, ultrasonics
- Guided radar, electrom. level system
- Radar, electrom. level system
- Radar, ultrasonics
- Radar, ultrasonics
- Guided radar, radar, ultrasonics

Please note:
- Guided radar continued on Page 122
- Electrom. level system continued on Page 132
### 3. Selection of the measuring principle according to the application

#### Non-contact

<table>
<thead>
<tr>
<th><strong>Our proposal</strong></th>
<th><strong>Radar</strong></th>
<th><strong>Micropilot</strong></th>
<th><strong>Ultrasons</strong></th>
<th><strong>Prosonic</strong></th>
</tr>
</thead>
</table>
| **Advantages**   | · Unaffected by the density of bulk solids, temperature, humidity and filling noise  
· For corrosive and abrasive media  
· Easy installation for large measuring ranges  
· Remote access via Bluetooth®  
· Heartbeat Technology | **FMR66B** | **FMR67B** | **FMU90/95** | **(getrennt) FDU93/95** | **(compact) FMU4x** |
| **Technical data** | **Connection**  
· 2-wire (HART®, PA, Ethernet-APL)  
125m/410ft | **Accuracy**  
±3mm/±0.12”  
−40 to +50°C/−40 to +122°F  
−1 to +16bar/−14.5 to +232psi | **Process temperature**  
1.6 | **Min. DC value**  
1.6 | **Process pressure**  
DN 80, DN 100, DN 150, DN 200, DN 250, assembly bracket | **Maximum measuring range**  
125m/410ft | **Connection**  
2-/4-wire (4-20mA HART®, DP)  
45m/148ft | **Accuracy**  
±2mm/±0.08”, ±0.2% of measured distance  
−0.3 to +3bar/−4.4 to +44psi | **Process temperature**  
–40 to +150°C/−40 to +302°F | **Min. DC value**  
–40 to +150°C/−40 to +302°F | **Process pressure**  
–1 to +16bar/−14.5 to +232psi | **Maximum measuring range**  
125m/410ft | **Connection**  
2-/4-wire (4-20mA HART®, DP)  
45m/148ft | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
2-wire (HART®, PA, FF), 4-wire HART®  
<15m/49ft: ±2mm/0.08”; >15m/49ft: ±10mm/0.4” | **Accuracy**  
>15m/49ft: ±10mm/0.4” | **Process temperature**  
–40 to +150°C/−40 to +302°F | **Min. DC value**  
–40 to +150°C/−40 to +302°F | **Process pressure**  
–1 to +16bar/−14.5 to +232psi | **Maximum measuring range**  
45m/148ft | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) | **Connection**  
4-wire, 4-20mA, relay | **Accuracy**  
±2.5cm/±1”, ±5cm/±2” | **Process temperature**  
–20 to +230°C/−4 to +446°F | **Min. DC value**  
–20 to +230°C/−4 to +446°F | **Process pressure**  
+0.8 to +3bar/+11.6 to +44psi | **Maximum measuring range**  
70m/230ft (special design up to 90m/295ft) |

**Application limits**

<table>
<thead>
<tr>
<th><strong>Radar</strong></th>
<th><strong>Micropilot</strong></th>
<th><strong>Ultrasons</strong></th>
<th><strong>Prosonic</strong></th>
</tr>
</thead>
</table>
| · DC value < 1.6  
· Risk of strong build-up formation  
· Angled surface/funnel with a reflecting, smooth surface | · ultrasonics, electrom. level system  
· use of purge air  
· guided radar, electrom. level system | · Temperatures  
> 150°C/302°F  
· Media with strong dust formation during filling  
· Extreme filling noise  
· Angled surface/funnel with a reflecting, smooth surface  
· Measuring range > 35m/110ft in powdery products | · radar, electrom. level system  
· radar, guided radar  
· radar, guided radar  
· radar, guided radar, electrom. level system  
· radar, guided radar, electrom. level system  
· radar, guided radar, electrom. level system |

**Please note:**

- Radar continued on Page 118
- Ultrasonics continued on Page 126

---

*At the process connection*
Selection according to application

**Slim, narrow silos, vessels**

- Filling via mechanical or pneumatic conveyance
- Fluidization possible
- Ratio $H/D \geq 8$

---

**Contact**

**Our proposal**

- **Guided radar**
  - **Levelflex**
  - **FMP56**
  - **FMP57**

- Unaffected by silo geometries and the shape of the angled surfaces
- Unaffected by the density of bulk solids, temperature, humidity and filling noise
- Unaffected by dust, e.g. in pneumatic filling
- Heartbeat Technology

- **Electromechanical level system**
  - **Silopilot**
  - **FMM50**
  - **FMM20**

- Unaffected by low density of bulk solids and DC value
- Easy installation

---

**Technical data**

- **Connection**
  - 2-wire (HART®, PA, Ethernet-APL)
  - 4-wire (4-20mA HART®, DP)

- **Accuracy**
  - ±3mm/±0.12" (2-wire)
  - ±2mm/±0.08", ±0.2% of measured distance (4-wire)

- **Process temperature**
  - –40 to +450°C/–40 to +842°F
  - –40 to +150°C/–40 to +302°F

- **Process pressure**
  - –1 to +16bar/–14.5 to +232psi
  - –0.3 to +3bar/–4.4 to +44psi

- **Min. DC value**
  - 1.6
  - —

- **Process connection**
  - DN 80, DN 100, DN 150, DN 200, DN 250, assembly bracket
  - Threads, flanges (DIN, ANSI, JIS), wall and assembly arm, assembly bracket
  - ¾", 1½", DN 40 to DN 150
  - DN 100 PN 16 (hole size)
  - 45m/148ft

- **Maximum measuring range**
  - 2-wire (HART®, PA, FF), 4-wire HART®
  - < 15m/49ft: ±2mm/0.08"; > 15m/49ft: ±10mm/0.4”
  - –40 to +150°C/–40 to +302°F
  - –1 to +16bar/–14.5 to +232psi
  - ±2.5cm/±1" (FMM20), ±5cm/±2" (FMM50)
  - –20 to +230°C/–4 to +446°F
  - +0.8 to +3bar/+11.6 to +44psi
  - 45m/148ft

---

**Application limits**

- DC value < 1.6
- Risk of strong build-up formation
- Angled surface/funnel with a reflecting, smooth surface
  - → ultrasonics, electrom. level system
  - → use of purge air
  - → ultrasonics
  - → guided radar, electrom. level system

- Temperatures > 150°C/302°F
- Media with strong dust formation during filling
- Extreme filling noise
- Angled surface/funnel with a reflecting, smooth surface
  - Measuring range > 35m/110ft in powdery products
  - → radar, electrom. level system
  - → radar, guided radar
  - → radar, guided radar, electrom. level system
  - → radar, electrom. level system

- Abrasive, grained, lumpy products (> 20 mm/0.8”), probe damage
- Max. tensile forces on the rope = 35kN (observe ceiling load)
- Extreme build-up formation on the probe
- High temperatures 150°C/302°F
- DC < 1.4
- Measuring range > 45m/148ft powdery products
- Low density (< 10g/l)
  - → radar, ultrasonics
  - → radar, ultrasonics, electrom. level system
  - → radar with purge air, ultrasonics
  - → radar, electrom. level system
  - → ultrasonics, electrom. level system
  - → radar, electrom. level system
  - → electrom. level system

- Risk of weight being buried
- Strong mechanical wear to be expected
- Measurement during filling
  - → radar, ultrasonics
  - → radar, ultrasonics
  - → guided radar, radar, ultrasonics

---

Please note:
Guided radar continued on Page 122
Electrom. level system continued on Page 132
3. Selection of the measuring principle according to the application

**Stockpiles**
- Filling via conveyor belts/derrick-type belts
- Level measurement for conveyor belt control
- The most varied grain sizes
- May be exposed to environmental conditions (e.g. wind)

---

### Non-contact

#### Our proposal

<table>
<thead>
<tr>
<th>Radar</th>
<th>Micropilot</th>
<th>Ultrasonics</th>
<th>Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR20</td>
<td>FMR67B</td>
<td>FMR67B</td>
<td>(separated)</td>
</tr>
<tr>
<td></td>
<td>FMR66B</td>
<td></td>
<td>(compact)</td>
</tr>
</tbody>
</table>

#### Advantages
- Unaffected by the density of bulk solids, temperature, humidity, filling noise and weather impairment
- Purge air connection is standard (FMR57)
- Easy installation with alignment facility
- Remote access via Bluetooth®
- Heartbeat Technology
- Separate instrumentation
- Connection of up to 10 sensors
- Self-cleaning effect of sensors
- Robust sensor (vibration)
- Relay output for point levels
- Unaffected by the density of bulk solids, humidity and dielectric constant
- Easy assembly/overall size (under conveyor belt derricks)
- Good price/performance ratio

#### Technical data
- **Connection**: 2-/4-wire (HART®, PA, Ethernet-APL)
- **Accuracy**: ±3mm/±0.12", ±2mm/±0.08", ±0.2% of measured distance
- **Process temperature**: –40 to +450°C/-40 to +842°F
- **Process pressure**: –1 to +16bar/–14.5 to +232psi
- **Min. DC value**: 1.6
- **Maximum measuring range**: 125m/410ft
- **Maximum measuring range**: 45m/148ft

#### Application limits
- DC value < 1.6
- Risk of strong build-up formation
- Poor access to the instrument
- Ultrasonics
- Use of purge air
- Ultrasonics
- Ultrasonics, separated instrumentation
- Media with strong dust formation during filling
- Angled surface/funnel with a reflecting, smooth surface
- Extreme filling noise
- Radar
- Ultrasonics with alignment facility, radar
- Radar

---

* At the process connection

Please note: Radar continued on Page 118

Please note: Ultrasonics continued on Page 126
Selection according to application

### Mechanical conveyor systems
(e.g. conveyor belts)

- Monitoring of belt load
- Monitoring of feed points
- Strong abrasion (→ non-contact)
- Fast response times required
- Vibration possible

---

**Non-contact**

<table>
<thead>
<tr>
<th>Radar Micropilot</th>
<th>Ultrasonics Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR67B</td>
<td>FMU90/95</td>
</tr>
<tr>
<td>FMR66B</td>
<td>FDU93/95</td>
</tr>
</tbody>
</table>

#### Our proposal

- **Radar**
  - FMR67B
  - FMR66B

- **Ultrasonics**
  - FMU90/95
  - FDU93/95

#### Advantages

- Radar Micropilot
  - Unaffected by the density of bulk solids, temperature, humidity, filling noise and weather impairment
  - Purge air connection is standard (FMR67B)
  - Easy installation with alignment facility
  - Remote access via Bluetooth®
  - Heartbeat Technology

- Ultrasonics Prosonic
  - Separate instrumentation
  - Self-cleaning effect of sensors
  - Robust sensor (vibration)
  - Relay output for point levels
  - Up to 3 measurements/sec
  - Easy assembly under conveyor belt derricks (overall size) and above the conveyor belt/crusher

#### Technical data

<table>
<thead>
<tr>
<th>Radar Micropilot</th>
<th>Ultrasonics Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>2-/4-wire (4-20mA HART®, DP)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±2mm/±0.08&quot;, ±0.2% of measured distance</td>
</tr>
<tr>
<td>Process temperature*</td>
<td>-40 to +150°C/−40 to +302°F</td>
</tr>
<tr>
<td>Process pressure</td>
<td>+0.7 to +3bar/+10 to +44psi</td>
</tr>
<tr>
<td>Min. DC value</td>
<td>Threads, flanges (DIN, ANSI, JIS), wall and assembly arm, assembly bracket</td>
</tr>
<tr>
<td>Process connection</td>
<td>45m/148ft</td>
</tr>
<tr>
<td>Maximum measuring range</td>
<td>125m/410ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radar Micropilot</th>
<th>Ultrasonics Prosonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>2-wire (HART®, PA, Ethernet-APL)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±3mm/±0.12&quot;</td>
</tr>
<tr>
<td>Process temperature*</td>
<td>−40 to +450°C/−40 to +842°F</td>
</tr>
<tr>
<td>Process pressure</td>
<td>−1 to +16bar/−14.5 to +232psi</td>
</tr>
<tr>
<td>Min. DC value</td>
<td>1.6</td>
</tr>
<tr>
<td>Process connection</td>
<td>DN 80, DN 100, DN 150, DN 200, DN 250, assembly bracket</td>
</tr>
<tr>
<td>Maximum measuring range</td>
<td>125m/410ft</td>
</tr>
</tbody>
</table>

#### Application limits

- Radar Micropilot
  - Risk of build-up formation
  - Use of purge air

- Ultrasonics Prosonic
  - Observe blocking distance
  - Strong vibration, please use separated instrumentation

---

* At the process connection

Please note: Radar continued on Page 118

Please note: Ultrasonics continued on Page 126
3. Selection of the measuring principle according to the application

**Crusher**
- Monitoring of crusher level
- Strong abrasion (non-contact)
- High mechanical load (non-contact)
- Fast response times required
- Vibration possible

<table>
<thead>
<tr>
<th>Non-contact</th>
</tr>
</thead>
</table>

**Our proposal**

<table>
<thead>
<tr>
<th>Radar Micropilot</th>
<th>Ultrasonics Prosonic (separated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMR67B</td>
<td>FMU90/95</td>
</tr>
<tr>
<td>FMR66B</td>
<td>FDU93</td>
</tr>
<tr>
<td>FDU92</td>
<td></td>
</tr>
</tbody>
</table>

**Advantages**
- Unaffected by the density of bulk solids, temperature, humidity, filling noise and weather impairment
- Purge air connection is standard (FMR67B)
- Easy installation with alignment facility
- Remote access via Bluetooth®
- Heartbeat Technology

**Technical data**
- **Connection**
  - 2-wire (HART®, PA, Ethernet-APL)
  - 2-/4-wire (4-20mA HART®, DP)
- **Accuracy**
  - ±3mm/±0.12" ±2mm/±0.08", ±0.2% of measured distance
- **Process temperature**
  - –40 to +450°C/–40 to +842°F
  - –40 to +150°C/–40 to +302°F
- **Process pressure**
  - –1 to +16bar/–14.5 to +232psi
  - +0.7 to +3bar/+10 to +44psi
- **Min. DC value**
  - 1.6
  - –
- **Process connection**
  - DN80, DN100, DN150, DN200, DN250, assembly bracket
  - Threads, flanges (DIN, ANSI, JIS), wall and assembly arm, assembly bracket
- **Maximum measuring range**
  - 125m/410ft
  - 45m/148ft

**Application limits**
- Risk of build-up formation
  - Risk of build-up formation → use of purge air
- Possibly protection against mechanical damage (e.g. mount higher or protect by a grid)

* At the process connection

Please note:
- Radar continued on Page 118
- Ultrasonics continued on Page 126
4. Instrument selection within the measuring principle

Radar

Required application data
- Measuring range (min/max)
- DC value of the medium (DC)/media group
- Grain size
- Nozzle diameter/nozzle height
- Pressure and temperature

Application limits for level measurement by radar instruments in bulk solids
- Temperature up to –40°C/–40°F
- Temperature up to +450°C/+842°F
- Pressure up to +16bar/+232psi
- Measuring range up to 125m/410ft
- Dielectric constant from 1.6 e.g. Aerosil, Perlite
- Process connection from DN 80/3”

Dielectric constant (DC)
The reflection properties of a medium are determined by the DC value. The following table describes the allocation of different DC values to groups of media. For very loose or loosened bulk solids, the respectively lower group is applicable.

<table>
<thead>
<tr>
<th>Media group</th>
<th>DC value</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.6 to 1.9</td>
<td>Plastic granulate, white lime, special cement, sugar</td>
</tr>
<tr>
<td>B</td>
<td>1.9 to 2.5</td>
<td>Cement, gypsum</td>
</tr>
<tr>
<td>C</td>
<td>2.5 to 4</td>
<td>Cereal, seeds, ground stones, sand</td>
</tr>
<tr>
<td>D</td>
<td>4 to 7</td>
<td>Naturally moist (ground) stones, ores, salt</td>
</tr>
<tr>
<td>E</td>
<td>&gt; 7</td>
<td>Metal powder, carbon black, carbon dust</td>
</tr>
</tbody>
</table>

Reduction of the max. possible measuring range by:
- Media with poor reflection properties (low DC value)
- Large angle of repose
- Extremely loose surface of bulk solids, e.g. bulk solids with a low density in pneumatic filling. Please use the respectively lower media group in this case
- Build-up formation (particularly if moisture is present in the process)

Endress+Hauser App für DK-Werte
Die App bietet einen bequemen Zugang zu mehreren tausend DK-Werten für viele unterschiedliche Medien.

Dielectric constant (DC value)
Compendium
**Radar**

- Non-contact, maintenance-free measurement
- Unaffected by product properties like density
- Unaffected by temperature, filling noise and dust development
- Unaffected by vessel materials
- Freely adjustable measuring range

---

**Non-contact**

<table>
<thead>
<tr>
<th>Micropilot</th>
<th>Micropilot</th>
<th>Micropilot</th>
<th>Micropilot</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FMR20</strong></td>
<td><strong>FMR57</strong></td>
<td><strong>FMR66B</strong></td>
<td><strong>FMR67B</strong></td>
</tr>
<tr>
<td>▪ Smaller silos, vessels, bunkers, stockpiles up to max. measuring range 10m/32.8ft</td>
<td>▪ Silos, open stockpiles with highly dust-generating media</td>
<td>▪ Smaller silos, vessels, bunkers, stockpiles up to max. measuring range 40m/131ft</td>
<td>▪ High and narrow silos</td>
</tr>
<tr>
<td></td>
<td>▪ Stockpiles, bunkers with measuring ranges &gt; 30m/98ft</td>
<td>▪ Very abrasive bulk solids</td>
<td>▪ Large bunkers with measuring ranges up to 125m/410ft</td>
</tr>
<tr>
<td></td>
<td>▪ High, narrow silos/cells</td>
<td></td>
<td>▪ Open stockpiles with high dust</td>
</tr>
<tr>
<td></td>
<td>▪ High temperatures up to 400°C/752°F</td>
<td></td>
<td>▪ High temperature up to 450°C/842°F</td>
</tr>
<tr>
<td></td>
<td>▪ Very abrasive bulk solids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Optional alignment seal
- Optional assembly bracket

---

-1 to +3bar/ -14.5 to +43psi
-40 to +80°C/ -40 to +176°F
Horn, plated with PVDF

10m/32.8ft

≥2
±5 mm/0.2" Rear thread G1, NPT1, flange DN 80 to DN 150/ 3" to 6" PVDF

50m/164ft (horn) 70m/230ft (parabolic)
≥1,6
±15mm/0.6” Thread 1½ (G, NPT), DN 80 to DN 250/3” to 10”, DN 200 to DN 250/8” to 10” 316L /1.4435/1.4404

-1 to +16bar/ -14.5 to +232psi
-40 to +400°C/ -40 to +752°F
Horn: DN 80/3”, DN 100/4” Parabolic: DN 200/8”, DN 250/10”

30m/98ft

≥1,6
±3mm/0.12” Assembly bracket, DN 80 to DN 150/ 3” to 6” PVDF

-1 to +16bar/ -14.5 to +232psi
-40 to +80°C/ -40 to +176°F
Horn, plated with PVDF

125m/410ft

≥1,6
±3mm/0.12” Flanges DN 80 to DN 250/3” to 10” 316L, 1.4435, PTFE (PP, Alu) sealings

* At the process connection
4. Instrument selection within the measuring principle

**Installation instructions – radar**

**Installation**
- Not centered [3]
- Not above filling curtain [4]
- Distance to the wall [1]: \( \approx 1/6 \) of vessel diameter, at least however 20cm/7.9”

**Weather protection cover**
- Always recommended for installation outside (solar radiation and rain) [2]

**Connection for purge air or plating**
- Connection for purge air:
  - FMR57, already integrated. In case of strong dust generation, clogging of the antenna is avoided. Not possible for FMR66B.
  - FMR67B with optional adapter or integrated
- Horn plating: FMR57, FMR51, see accessories

**Baffles in vessels**
- Make sure that baffles [1] like limit switches, struts, etc. are not within the beam cone (see also the beam angle table in this respect (next page))
- Symmetrically arranged baffles [2], e.g. discharge aids etc. may impair measurements

**Optimizing measures**
- Size of antenna: The larger the antenna the smaller the beam angle and the lower the interfering echoes
- Interference echo suppression: Electronic suppression of interfering echoes optimizes the measurement
- Inclined installed metallic plates [3] disperse the radar signals and reduce interfering echoes

**Alignment**
- Serves the avoidance of interfering reflection and improved measurement since the measurement can be aligned to the angle of repose
- An alignment of the instrument is recommended
  - FMR57 with optional alignment device
  - FMR66B, FMR51 with optional alignment seal or assemble bracket
  - FMR67B with optional alignment seal, device or alignment

**Measurement in plastic vessels**
If the external wall of the vessel consists of a non-conductive material (e.g. GFK), microwaves may also be reflected by external interfering sources, e.g.
- Metal lines/pipes
- Conductors
- Grids

Ensure during installation that the beam cone of the radar instrument for bulk solids is free of any interfering sources.
Beam angle
The beam angle is defined as the angle $\alpha$ at which the energy density of the radar waves assumes half the value of the max. energy density (3dB width). Radar waves are also emitted outside of the beam cone and may be reflected by interfering sources.

Cone diameter ($W$) in dependence on the type of antenna, beam angle ($\alpha$) and distance ($D$).

<table>
<thead>
<tr>
<th>Distance ($D$)</th>
<th>Cone diameter ($W$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5m/16ft</td>
<td>0.70m/2.29ft</td>
</tr>
<tr>
<td>10m/32ft</td>
<td>1.40m/4.58ft</td>
</tr>
<tr>
<td>15m/49ft</td>
<td>2.09m/6.87ft</td>
</tr>
<tr>
<td>20m/65ft</td>
<td>2.79m/9.16ft</td>
</tr>
<tr>
<td>25m/82ft</td>
<td>3.50m/11.65ft</td>
</tr>
<tr>
<td>30m/98ft</td>
<td>4.16m/13.65ft</td>
</tr>
<tr>
<td>35m/114ft</td>
<td>4.86m/15.64ft</td>
</tr>
<tr>
<td>40m/125ft</td>
<td>5.20m/17.06ft</td>
</tr>
<tr>
<td>45m/139ft</td>
<td>5.60m/18.37ft</td>
</tr>
<tr>
<td>50m/155ft</td>
<td>6.00m/19.64ft</td>
</tr>
<tr>
<td>55m/168ft</td>
<td>6.40m/20.87ft</td>
</tr>
<tr>
<td>60m/180ft</td>
<td>6.80m/22.10ft</td>
</tr>
<tr>
<td>65m/192ft</td>
<td>7.20m/23.33ft</td>
</tr>
<tr>
<td>70m/205ft</td>
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</tr>
<tr>
<td>75m/217ft</td>
<td>8.00m/25.79ft</td>
</tr>
<tr>
<td>80m/230ft</td>
<td>8.40m/26.99ft</td>
</tr>
<tr>
<td>85m/242ft</td>
<td>8.80m/28.19ft</td>
</tr>
<tr>
<td>90m/255ft</td>
<td>9.20m/29.39ft</td>
</tr>
<tr>
<td>95m/268ft</td>
<td>9.60m/30.59ft</td>
</tr>
<tr>
<td>100m/328ft</td>
<td>10.00m/31.79ft</td>
</tr>
</tbody>
</table>

Distance (D)

<table>
<thead>
<tr>
<th>Antenna</th>
<th>80mm/3&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>with/without flooding protection tube</td>
<td>12°</td>
</tr>
</tbody>
</table>

Cladded Drip-off
40mm/1.5" 50mm/2"
8° 6°

Horn antenna
80mm/3"
100mm/4"
200mm/8"
250mm/10"
10° 8° 4° 3,5°

Parabolic antenna
FMR20 Antenna
80mm/3" with/without flooding protection tube

FMR66B Cladded Drip-off
40mm/1.5" 50mm/2" 50mm/2.5" 80mm/3"
8° 6° 6°

Horn antenna
80mm/3" Horiz. Parabolic antenna
80mm/3" 100mm/4" 200mm/8" 250mm/10"
10° 8° 4° 3,5°

with/without flooding protection tube

Size of antenna

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<tr>
<th>FMR20 Antenna</th>
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with/without flooding protection tube

Size of antenna

| FMR20 Antenna | 80mm/3" |
4. Instrument selection within the measuring principle

Guided radar

**Required application data**

**Level measurement**
- Measuring range
- Consider ceiling load by max. tensile force at the point of measurement
- Calculation of tensile force by Endress+Hauser
- DC value (DC) of the product
- Pressure and temperature
- Resistance requirements
- Existing nozzle diameter: DN, PN, nozzle height

**Application limits for guided level radar**
- \(T < -40{}^\circ\text{C} / -40{}^\circ\text{F}\) and \(T > 150{}^\circ\text{C} / 302{}^\circ\text{F}\) (higher temperatures upon request)
- \(p > 16\text{bar} / 232\text{psi}\)
- Measuring range > 45m/148ft (longer upon request)
- Dielectric constant < 1.4

**Dielectric constant (DC)**
The reflection properties of a medium are determined by the dielectric constant (DC).

<table>
<thead>
<tr>
<th>Media group</th>
<th>DC</th>
<th>Typical bulk solids</th>
<th>Max. measuring range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Metallic</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>** uninsulated probes**</td>
</tr>
<tr>
<td>1*</td>
<td>1.4</td>
<td>Plastic powder</td>
<td>20 to 25m/66 to 82ft</td>
</tr>
<tr>
<td>2</td>
<td>1.6</td>
<td>Plastic granulates, White lime, special cement</td>
<td>25 to 30m/82 to 99ft</td>
</tr>
<tr>
<td>3</td>
<td>1.9</td>
<td>Cement, gypsum</td>
<td>30 to 45m/99 to 148ft</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
<td>Flour</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>Ground stones, Sand</td>
<td>45m/148ft</td>
</tr>
<tr>
<td>6</td>
<td>&gt; 7</td>
<td>Metal powder, Carbon black, Carbon dust</td>
<td>45m/148ft</td>
</tr>
</tbody>
</table>

For very loose or loosened bulk solids, the respectively lower group is applicable.

Reduction of the max. possible measuring range by:
- Extremely loose surface of bulk solids, e.g. bulk solids with a low density in case of pneumatic filling
- Build-up formation, particularly of humid products.

*Media group 1: Take into account restrictions for strongly damping media e.g. ground material, wheat bran, silicic acid
Guided radar

- Unaffected by product surface (e.g. angled surface)
- Unaffected by baffles in the silo
- Additional safety for measurements by EoP** evaluation
- Safe measurements also during filling

Typical applications

- Powdery solids
- Plastic granulates
- High and narrow silos
- Reflecting surfaces

Special features

- Exchangeable probes (rope)
- Coated rope probes (for cereal, flour)
- Measurement during filling

Technical data

| Process pressure | -1 to +16 bar/ 14.5 to +232 psi |
| Max. Measuring range | -40 to +120°C/ -40 to +248° F |
| DC value | 1.4 |
| Accuracy | < 15 m/ 49 ft: ±2 mm/ 0.08"; > 15 m/ 49 ft: ±10 mm/ 0.4" |
| Process connection | ¾" (G, NPT), adapter flange |
| Process-contacting materials | 304, 1.4301 |

Contact

Levelflex FMP56

Levelflex FMP57

Typical applications

- Powdery solids
- Plastic granulates
- High and narrow silos
- Reflecting surfaces

Special features

- Exchangeable probes (rope)
- Coated rope probes (for cereal, flour)
- Measurement during filling

Technical data

| Process pressure | -1 to +16 bar/ 14.5 to +580 psi |
| Max. Measuring range | -40 to +150°C/ -40 to +302° F |
| DC value | 4 m/ 13 ft |
| Accuracy | 1.4 |
| Process connection | 1½" (G, NPT), flange |
| Process-contacting materials | 304, 1.4301 |

* At the process connection

** The patented End-of-Probe (EoP) algorithm enables Levelflex to provide accurate and reliable level measurement in media with a low DC value (flour, cement, lime, PE granulates, PP granulates and various powders) also during pneumatic filling and fluidized discharge.
Installation instructions – guided radar

Probe selection
- Use rope probes for bulk solids in normal circumstances. Rod probes are only suited to short measuring ranges up to approx. 2m/6.5ft in bulk solids. This is particularly true for applications in which the probe is installed laterally and inclined and only for light and free-flowing bulk solids
- In case of large silos, the lateral load on the rope may be so high that a rope with a plastic jacket must be used. We recommend a PA-coated rope for milled products like cereal, wheat and flour

Installation
- Do not install rod and rope probes in the filling curtain [2]
- Install rod and rope probes at a distance to the wall [B], so that in case of build-up on the wall a distance to the probe of at least 100mm/4" remains
- Install rod and rope probes with the largest possible distance to baffles. In case of distances < 300mm/12", an interference echo suppression must be included in commissioning
- When rod and rope probes are installed in plastic vessels, the minimum distance of 300mm/12" is also applicable to metallic parts outside of the vessel
- Rod and rope probes may not contact metal vessel walls or bottoms. The minimum distance of the probe end to the bottom of the vessel is applicable [C]: > 10mm/0.4". For exceptions see the section "Fixation of rope probes"
- Avoid bending the rope probe sharply during installation or operation (e.g. by product movements against the wall of the silo) by the selection of a suitable point of installation

Weather protection cover
- Always recommended for installation outside (solar radiation and rain) [1]

Installation in concrete silos
- In concrete silos, the largest possible distance [B] of the probe to the concrete wall - min. 0.5m/19.7" - is to be observed. Optimum ≥ 1m/39"
- The installation into a concrete ceiling must be flush with its bottom edge

Expansion of rope probes by tension and temperature
- 6mm/0.23" rope probe
  - Elongation by tension: At max. permissible tensile load (30kN) = 13mm (0.5")/m rope length
  - Elongation by temperature increase from 30°C/86°F to 150°C/302°F = 2mm (0.08")/m (ft) rope length
- 4mm/0.16" rope probe
  - Elongation by tension: At max. permissible tensile load (12kN) = 11mm (0.4")/m rope length
  - Elongation by temperature increase from 30°C/86°F to 150°C/302°F = 2mm (0.08")/m rope length
Fixation of rope probes
- The fixation of the probe end may be required if otherwise the probe contacts the silo wall, the cone, the baffles/struts or other parts at times or if the probe converges closer than 0.5m/19.7” to a concrete wall. The probe weight provides an internal thread for this purpose:
  - 4mm/0.16” rope: M 14
  - 6mm/0.23” rope: M 20
- Please use preferably the 6mm/0.23” rope probe because of its higher tensile-loaded capacity when fixing a rope probe
- The point of fixation must either be reliably grounded or reliably insulated. If a fixation with reliable grounding is not possible, the insulated lug offered as an accessory may be used
- The rope must be loose to avoid extremely high tensile loads and the risk of breakage. Adjust the rope to a length which exceeds the required measuring range so that the rope slackens in the middle ≥ 1cm (0.4”)/m rope length!

Tensile load
- Bulk solids exert tensile forces on rope probes. Their intensity increases with:
  - The length of the probe or max. cover
  - The density of the product
  - The diameter of the silo and
  - The diameter of the probe rope
- The diagrams in the Technical Information TI01004F show typical loads in frequently occurring bulk solids as reference values. The calculations take the following conditions into account:
  - Freely suspended probe (end of probe not fixed)
  - Freely flowing bulk solids (mass flow).
  The core flow cannot be calculated.
In case of collapsing product accumulation on walls higher loads may occur
- The tensile force values contain a safety factor of 2 (compensation of the fluctuation range in freely flowing bulk solids)
- Since the tensile forces largely depend on the flow properties of the product, a higher safety factor is required for sluggishly flowing products and if a risk of product accumulation on walls exists. Use rather a 6mm/0.23” rope than 4mm/0.16” in critical cases
- The same forces also act on the ceiling of silos. The tensile forces are larger on fixed ropes, but they cannot be calculated. Please observe the tensile-loaded capacity of the probes or ensure that this capacity is not exceeded
- If the max. tensile load is exceeded, please verify whether a non-contact ultrasonic or level radar instrument should be used for the application
4. Instrument selection within the measuring principle

Ultrasonics

**Required application data**
- Measuring range
- Product grain size
- Product surface (soft, hard)
- Dust-generating product (strong, low)
- Filling curtain in the measuring range
- Nozzle diameter/nozzle height
- Pressure and temperature

**Application limits for ultrasonic level measurement in solids**
- Temperature up to –40°C/–40°F
- Temperature up to +150°C/+302°F (higher temperatures on request)
- Pressure from +0.7bar/+10psi up to +3bar/44psi (relative)
- Measuring range up to 45m/148ft (ideal conditions)
- Process connection from 1½"
- Strong temperature fluctuations in the measuring range can affect the accuracy

**Damping caused by process**

<table>
<thead>
<tr>
<th>Product surface</th>
<th>Filling curtain in the detection range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard, rough (e. g. gravel)</td>
<td>40dB</td>
</tr>
<tr>
<td>Soft (e. g. peat, dust-covered clinker)</td>
<td>40 to 60dB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dust</th>
<th>Δ-Temp. sensor ↔ product surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>No dust generation</td>
<td>Up to 20°C/68°F</td>
</tr>
<tr>
<td>Low dust generation</td>
<td>Up to 40°C/104°F</td>
</tr>
<tr>
<td>Strong dust generation</td>
<td>Up to 80°C/176°F</td>
</tr>
</tbody>
</table>

For different applications, the max. measuring distance can be estimated from the sum of dampings (dB) and the range diagram (see also example below).

**Range calculation and sensor selection Prosonic S FDU9x**

Example (for FDU91):
- Silo with rubble: +40dB
- Low dust generation: +5dB
- Small quantities of filling curtain in the detection range: +5dB

Total: +50dB
→ range approx. 5m/16ft from diagram
Sensor alignment
- Angled surfaces are formed in silos for bulk solids. These cause the ultrasonic signal to be laterally reflected which can lead to a reduced signal intensity

Remedial measures:
→ The sensors should be aligned as vertically as possible in relation to the product surface
→ This is facilitated by the FAU40 alignment device or the assembly bracket

Advantages
- Non-contact, maintenance-free measurement
- Unaffected by product properties, e.g. DC value, density, etc.
- Calibration without filling or discharging
- Self-cleaning effect of sensors due to moved sensor diaphragm
- Separate instrumentation options in rough ambient conditions
- Cost-effective instrumentation for silo farms with FMU95 multichannel system

Example (for FMU43):
- Product surface hard, rough: +40dB
- Low dust generation: +5dB
- Small quantities of filling curtain in the detection range: +5dB

Total: +50dB
→ range approx. 7m/23ft from diagram
4. Instrument selection within the measuring principle

**Ultrasonics**
- Non-contact, maintenance-free measurement
- Unaffected by dielectric constant, density or humidity
- Unaffected by build-up due to the self-cleaning effect of sensors by diaphragm vibration

**Typical applications**
- Coarse to fine-grained materials in silos, on belts, stockpiles and in crushers
- Rough process conditions (vibration, build-up, corrosion, abrasion)
- Low structural heights

**Special features**
- Separate instrumentation up to 300m/984ft
- Up to 6 additional point level, alarm outputs
- Automatic recognition of connected sensors
- Up to 10 sensors can be connected → attractive price in silo farms
- 4 to 20mA HART® or PROFIBUS® DP

**Technical data**

<table>
<thead>
<tr>
<th></th>
<th>FDU90</th>
<th>FDU91</th>
<th>FDU91F</th>
<th>FDU92</th>
<th>FDU93</th>
<th>FDU95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process pressure from +0.7 to +4bar/ +58psi</td>
<td>+80°C/ +176°F</td>
<td>+80°C/ +176°F</td>
<td>+105°C/ +221°F</td>
<td>+95°C/ +203°F</td>
<td>+3bar/ +43.5psi</td>
<td>+1.5bar/ +22psi</td>
</tr>
<tr>
<td>Process temperature* from -40 to +80°C/ +176°F</td>
<td>+80°C/ +176°F</td>
<td>+105°C/ +221°F</td>
<td>+95°C/ +203°F</td>
<td>+3bar/ +43.5psi</td>
<td>+1.5bar/ +22psi</td>
<td>+150°C/ +302°F</td>
</tr>
<tr>
<td>Max. Measuring range</td>
<td>1.2m/ 3.9ft</td>
<td>5m/ 16ft</td>
<td>5m/16ft</td>
<td>10m/ 32ft</td>
<td>15m/ 49ft</td>
<td>45m/ 150ft</td>
</tr>
<tr>
<td>Blocking distance</td>
<td>0.07m/ 0.23ft</td>
<td>0.3m/ 1ft</td>
<td>0.3m/1ft</td>
<td>0.4m/ 1.3ft</td>
<td>0.6m/ 2ft</td>
<td>0.7m/2.3ft (0.9m/2.9ft***)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±2mm/0.08&quot;, ±0.2% of measuring distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process connection</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;, Tri-Clamp, collar flange</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>front side</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Process-contacting materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>front side</td>
<td>PVDF</td>
<td>PVDF</td>
<td>316L</td>
<td>PVDF</td>
<td>UP, Alu, PTFE</td>
<td>UP, 316L**, PE</td>
</tr>
<tr>
<td>Beam angle α</td>
<td>12°</td>
<td>9°</td>
<td>12°</td>
<td>11°</td>
<td>4°</td>
<td>5°</td>
</tr>
</tbody>
</table>

* At the process connection
** High temperature = 150°C/302°F
### Instrument selection within the measuring principle

**Prosonic M**

<table>
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<tr>
<th>FMU40</th>
<th>FMU41</th>
<th>FMU42</th>
<th>FMU43</th>
<th>FMU44</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical applications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse to fine-grained materials in recipient tanks, on belts at feed points</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring range up to 10m/32ft</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Special features</strong></td>
<td></td>
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</tr>
<tr>
<td>Compact instrumentation (2 or 4-wire)</td>
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<td></td>
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</tr>
<tr>
<td>Attractive price</td>
<td></td>
<td></td>
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<tr>
<td>Robust aluminum housing</td>
<td></td>
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</tr>
<tr>
<td>4 to 20mA HART®, PROFIBUS® PA or FF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technical data</strong></td>
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<td><strong>FMU42</strong></td>
<td><strong>FMU43</strong></td>
<td><strong>FMU44</strong></td>
</tr>
<tr>
<td>Process pressure</td>
<td>+0.7 to +3bar/10 to +43.5psi</td>
<td>+0.7 to +2.5bar/10 to +36psi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process temperature*</td>
<td></td>
<td></td>
<td></td>
<td>-40 to +80°C/0 to +176°F</td>
</tr>
<tr>
<td>Max. Measuring range (solid)</td>
<td>2m/6ft</td>
<td>3.5m/11ft</td>
<td>5m/16ft</td>
<td>7m/22ft</td>
</tr>
<tr>
<td>Blocking distance</td>
<td>0.25m/0.8ft</td>
<td>0.35m/1.15ft</td>
<td>0.4m/1.3ft</td>
<td>0.6m/2ft</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±2mm/0.08&quot; or ±0.2% of measuring distance***</td>
<td>±4mm/0.15&quot; or ±0.2% of measuring distance***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process connection</td>
<td>1.5&quot;</td>
<td>2&quot;</td>
<td>DN 80/3&quot;; DN 100/4&quot;; assembly bracket</td>
<td>DN 100/4&quot;; assembly bracket</td>
</tr>
<tr>
<td>Process-contacting materials</td>
<td>PVDF, EPDM</td>
<td>PVDF, EPDM</td>
<td>PVDF, EPDM or Viton, flange PP, PP, PP, 316L</td>
<td>UP/316L, EPDM, flange PP, PP, PP, 316L</td>
</tr>
<tr>
<td>Beam angle α</td>
<td>11°</td>
<td>11°</td>
<td>9°</td>
<td>6°</td>
</tr>
</tbody>
</table>

* At the process connection

*** The higher value is applicable
Installation instructions – ultrasonics

Installation
- Not centered [3]
- Not above filling curtain [4]
- Distance to wall: ~1/6 of the vessel diameter, at least however 20cm/7.9” [1]
- If 2 or several sensors are used in one vessel, please use separate instrumentation (FMU90/95 + FDU9x)

Weather protection cover
- Always recommended for installation outside (solar radiation and rain) [2]

Nozzle
- The sensor diaphragm should protrude from the nozzle. If this is not possible, please compare the dimensions of the nozzle with the table: Nozzle length (next page)

Measuring range
- Measurement is possible up to the blocking distance (BD) on principle
- The measuring range starts where the ultrasonic lobe meets the bottom of the silo. In dished or torispherical heads or conical outlets, levels below this point cannot be detected

Silo baffles
- Make sure that baffles [1] like limit switches, struts, etc. are not within the beam cone (see also the beam angle table in this respect [a])
- Symmetrically arranged baffles [2], e.g. discharge aids etc. may impair measurements

Optimizing measures
- Use a sensor with a smaller beam angle. → The smaller the beam angle the lower the occurrence of interfering echoes
- Interference echo suppression: Electronic suppression of interfering echoes optimizes the measurement
- Plates installed in an inclined manner [3] disperse the signal and can avoid interfering echoes

Alignment
- Serves the avoidance of interfering reflections and improved measurements since the measurement can be aligned to the angled surface (accessory FAU40 or assembly bracket)

---

<table>
<thead>
<tr>
<th>Beam angle α</th>
<th>FMU 40</th>
<th>FMU 41</th>
<th>FMU 42</th>
<th>FMU 43</th>
<th>FMU 44</th>
<th>FDU 90</th>
<th>FDU 91</th>
<th>FDU 91F</th>
<th>FDU 92</th>
<th>FDU 93</th>
<th>FDU 95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lmax (m/ft)</td>
<td>2/</td>
<td>3.5/</td>
<td>5/</td>
<td>7/</td>
<td>10/</td>
<td>12/</td>
<td>9/</td>
<td>12/</td>
<td>5/</td>
<td>10/</td>
<td>15/</td>
</tr>
<tr>
<td>rmax (m/ft)</td>
<td>6</td>
<td>11</td>
<td>16</td>
<td>22</td>
<td>32</td>
<td>3.9</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>32</td>
<td>49</td>
</tr>
<tr>
<td>Blocking distance (m/ft)</td>
<td>0.19/</td>
<td>0.34/</td>
<td>0.39/</td>
<td>0.37/</td>
<td>1.96/</td>
<td>0.13/</td>
<td>0.39/</td>
<td>0.53/</td>
<td>0.96/</td>
<td>0.52/</td>
<td>1.96/</td>
</tr>
<tr>
<td></td>
<td>0.6/</td>
<td>1.1</td>
<td>1.3</td>
<td>1.2</td>
<td>6.4</td>
<td>0.4</td>
<td>1.3</td>
<td>1.7</td>
<td>3.1</td>
<td>1.7</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td>0.25/</td>
<td>0.35/</td>
<td>0.4/</td>
<td>0.6/</td>
<td>0.5/</td>
<td>0.07/</td>
<td>0.3/</td>
<td>0.3/</td>
<td>0.4/</td>
<td>0.6/</td>
<td>(0.9/</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.9*</td>
</tr>
</tbody>
</table>

* High temperature = 150°C/302°F
## Instrument selection within the measuring principle

<table>
<thead>
<tr>
<th>Nozzle Ø</th>
<th>FMU 40</th>
<th>FMU 41</th>
<th>FMU 42</th>
<th>FMU 43</th>
<th>FMU 44</th>
<th>Max. nozzle length in mm/inch (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN50/2&quot;</td>
<td>80/</td>
<td>3.15</td>
<td></td>
<td></td>
<td></td>
<td>50/ 1.97 1)</td>
</tr>
<tr>
<td>DN80/3&quot;</td>
<td>740/</td>
<td>9.45</td>
<td>9.45</td>
<td>9.84</td>
<td></td>
<td>390/ 1.54 1), 250/ 1.98 2)</td>
</tr>
<tr>
<td>DN100/4&quot;</td>
<td>300/</td>
<td>11.8</td>
<td>11.8</td>
<td>11.8</td>
<td></td>
<td>390/ 1.54 1), 300/ 1.98 2)</td>
</tr>
<tr>
<td>DN150/6&quot;</td>
<td>400/</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>400/ 1.54 1), 300/ 1.98 2)</td>
</tr>
<tr>
<td>DN200/8&quot;</td>
<td>400/</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>400/ 1.54 1), 300/ 1.98 2)</td>
</tr>
<tr>
<td>DN250/10&quot;</td>
<td>400/</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>400/ 1.54 1), 300/ 1.98 2)</td>
</tr>
<tr>
<td>DN300/12&quot;</td>
<td>400/</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>15.8</td>
<td>400/ 1.54 1), 300/ 1.98 2)</td>
</tr>
</tbody>
</table>

### Beam angle α
- 11°
- 11°
- 9°
- 6°
- 12°
- 12°
- 11°
- 4°
- 5°

### Blocking distance (m/ft)
- 0.25/0.8
- 0.35/1.15
- 0.4/1.3
- 0.6/2
- 0.5/1.6
- 0.07/0.23
- 0.3/1
- 0.3/1
- 0.4/2
- 0.6/2.3
- 0.7/1.6
- 1.6/5.2

---

**Options for installation**

**Prosonic M FMU4x**
- Universal flange installation
- Assembly bracket installation

- Mounting options:
  - e.g. Zone 20
  - Zone 20 Zone 0

**Prosonic S FDU9x**
- FDU9x
- FDU91F
- FDU90 1)
- FDU90 1)

---

*Applicable to flush flange installation, for assembly via G/NPT 1" starting DN100 see FDU91

1) Mounted at backside thread of the Sensor FDU90
2) Mounted at frontside thread of the Sensor FDU90
4. Instrument selection within the measuring principle

Electromechanical level system

**Required application data**
- Measuring range
- Consider ceiling load by max. tensile force at the point of measurement
- Product grain size
- Pressure and temperature
- Resistance requirements
- Nozzle height

**Application limits for the electromechanical level system**
- Temperature up to –20°C/–4°F
- Temperature up to +230°C/+446°F
- Pressure up to 3bar/43.5psi
- Measuring range up to 70m/230ft (optional 90m/295ft)
- Tensile force max 500N

**Recommendation concerning the selection**
The following aspects should be observed in the selection of the sensing weight:
- The sensing weight may neither sink into the product nor slide off the angled surface during the measuring operation
- The sensing weight must be able to withstand the chemical properties of the product and the temperature prevailing in the bunker/silo

<table>
<thead>
<tr>
<th>Model</th>
<th>Sensing weight</th>
<th>Application</th>
<th>Temperature</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMM50</td>
<td>Normal weight, cylindrical with removable spike</td>
<td>Coarse bulk solids, e.g. coal, ore or stones and granulates</td>
<td>Complete temperature range</td>
<td>Steel, stainless steel</td>
</tr>
<tr>
<td>FMM50</td>
<td>Umbrella weight</td>
<td>Very light and loose bulk solids, e.g. flour or carbon dust</td>
<td>Max. 150°C/302°F</td>
<td>Steel or stainless steel with Polyester</td>
</tr>
<tr>
<td>FMM50</td>
<td>Bag weight</td>
<td>Bunkers with mills downstream</td>
<td>Max. 150°C/302°F</td>
<td>Bag made of Polyester, stainless steel</td>
</tr>
<tr>
<td>FMM50</td>
<td>Cage weight</td>
<td>Fine-grained bulk solids</td>
<td>Complete temperature range</td>
<td>Steel, stainless steel</td>
</tr>
<tr>
<td>FMM50</td>
<td>Oval float</td>
<td>Granulates</td>
<td>Max. 60°C/140°F</td>
<td>Rigid PVC</td>
</tr>
<tr>
<td>FMM50</td>
<td>Bell weight</td>
<td>Light and loose bulk solids</td>
<td>Complete temperature range</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>FMM20</td>
<td>Normal weight, cylindrical with removable spike</td>
<td>Granulates and compacted bulk solids</td>
<td>Max. 150°C/302°F</td>
<td>Steel, stainless steel</td>
</tr>
<tr>
<td>FMM20</td>
<td>Normal weight, cylindrical</td>
<td>Granulates and compacted bulk solids</td>
<td>Max. 70°C/158°F</td>
<td>Plastics</td>
</tr>
<tr>
<td>FMM20</td>
<td>Umbrella weight</td>
<td>Very light and loose bulk solids, e.g. flour or carbon dust</td>
<td>Max. 150°C/302°F</td>
<td>Steel or stainless steel with Polyester</td>
</tr>
<tr>
<td>FMM20</td>
<td>Bag weight</td>
<td>Bunkers with mills downstream</td>
<td>Max. 150°C/302°F</td>
<td>Polyester, stainless steel</td>
</tr>
</tbody>
</table>
### Instrument selection within the measuring principle

#### Sensing weights FMM20
1. Stainless steel sensing weight
2. Plastic sensing weight
3. Bag weight
4. Umbrella weight

#### Sensing weights FMM50
1. Cylindrical sensing weight with spike
2. Umbrella weight
3. Bag weight
4. Cage weight
5. Oval float
6. Bell weight

<table>
<thead>
<tr>
<th>Weight</th>
<th>Ex</th>
<th>Special features</th>
</tr>
</thead>
</table>
| 3.5kg/8lbs | Yes | In case of downstream crusher or mill facility
→ use “tape breakage” signal function or cage weight |
| 3.8kg/8.3lbs, 3.9kg/8.6lbs | Yes | Large square surface
→ avoids deep immersion into the product |
| 0.25kg/0.5lbs (empty), 3.5kg/8lbs (full) | Yes | Tie the bag so that the content cannot escape |
| 3.5kg/8lbs | Yes | Avoids subsequent damage since the weight cannot enter the discharging facility |
| 3.5kg/8lbs (full) | Yes | If the umbrella cannot be used any more in high temperatures or special product properties |
| 4.3kg/9.5lbs | Yes | In case of downstream crusher or mill facility
→ use “tape breakage” signal function |
| 1.5kg/3.3lbs | Yes | Dust-Ex not permitted |
| 1.5kg/3.3lbs | Yes | In case of downstream crusher or mill facility
→ use “tape breakage” signal function |
| 1.5kg/3.3lbs | Yes | Large square surface
→ avoids deep immersion into the product |
| 0.25kg/0.5lbs (empty), 1.5kg/3.3lbs (full) | Yes | Tie the bag so that the content cannot escape |
### 4. Instrument selection within the measuring principle

#### Electromechanical level system

- Unaffected by product properties
- Light bulk solids
- Unaffected by DC value

<table>
<thead>
<tr>
<th>Typical applications</th>
<th>Special features</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunkers and silos with powdery, fine-grained or coarse-grained bulk solids</td>
<td>Easy commissioning</td>
<td>+0.8 to +3bar/+12 to +43.5psi &lt;br&gt;-20 to +230°C/−4 to +446°F &lt;br&gt;70m/230ft &lt;br&gt;±5cm/±2&quot; or ±1 pulse &lt;br&gt;Max. 500N &lt;br&gt;On counterflange DN100 PN16 Alu, steel or stainless steel (301 modified, 304, 316, 316TI), Polyester, PVC &lt;br&gt;−40 to +70°C/−40 to +158°F &lt;br&gt;4 to 20mA / relay ATEX II 1/2D IP67</td>
</tr>
<tr>
<td>Bunkers and silos for light bulk solids, e.g. cereals, plastics granulate, powder</td>
<td>Easy commissioning</td>
<td>+0.8 to +1.1bar/+12 to +16psi &lt;br&gt;−20 to +150°C/−4 to +302°F &lt;br&gt;32m/105ft &lt;br&gt;±2.5cm/±1&quot; or ±1 pulse &lt;br&gt;Max. 150N &lt;br&gt;On counterflange DN100 PN16 Alu, steel or stainless steel (301 modified, 304, 316, 316TI) plastic, polyester &lt;br&gt;−40 to +60°C/−40 to +140°F &lt;br&gt;0/4 to 20mA / relay ATEX II 1/2D IP67</td>
</tr>
</tbody>
</table>

* At the process connection
**Installation instructions – electromechanical level system**

**Installation**
- Not in the filling curtain or in the area of collapsing product accumulation on walls
- Measuring point as close to the center of the slope as possible
- The sensing weight may neither sink into the product nor slide off the angled surface during the measuring operation
- Max. angle of inclination 2°

**Weather protection cover**
- Always recommended for installation outside (solar radiation and rain)

**Compressed air connection**
- Already integrated and the penetration of dust can be avoided in case of strong dust generation

**Tank baffles**
- The measurement section should not pass baffles and struts at too close a distance. The measuring tape must not touch any baffles and struts

*1 Accumulation (product build-up on the wall of the vessel)
*2 Choose a measuring point located approximately in the middle of the slope
Applicator Selection Software
Product selection guide
www.endress.com/applicator

www.addresses.endress.com