INTRODUCTION
This document is a guideline for Guided Wave Radar (GWR) applications. Besides providing information on application advantages, product features, different types of applications, and probe styles, it also compares the Rosemount 5300 and 3300 Series GWRs to assist with radar device selection for optimal performance.

APPLICATION ADVANTAGES OF GUIDED WAVE RADAR
Advantages of Guided Wave Radar compared to other level technologies include:

- Measures level directly, and is not impacted by density, dielectrics, or conductivity changes
- Measures through heavy vapors
- Handles turbulent and low dielectric fluids
- Can measure through most foams
- Measures interface applications
- Measures solids, powders, and granules
- Measures in small tanks, geometrically difficult tanks, and long nozzles
- Has no moving parts
- Displacer and capacitance are easily replaced

ROSEMOUNT GUIDED WAVE RADAR PRODUCT FEATURES
There are two Guided Wave Radar products offered by Rosemount: the 3300 and the 5300 Series.

Common Features
The Rosemount 3300 Series and Rosemount 5300 Series are multivariable and can measure both level and interface, with a dual compartment head to protect electronics from moisture. The electronics housing can be rotated 360° and in most cases separated from an installed probe without opening the tank. Both provide application flexibility and are available with a full range of probe styles to meet application requirements. The configuration tools have installation wizards with waveform plots to provide easy and powerful configuration and service.

Rosemount 5300 Series superior performance
- Handles even the most challenging applications reliably, including process vessels, control and safety, extreme temperature and pressure
- Microwave innovations as Direct Switch Technology allow use over longer ranges, with lower dielectrics and higher accuracy, even with a single probe
- Enhanced configuration and diagnostic information through RadarMaster, EDDL-based and DTM-based user interface
- Probe end projection function provides reliable measurements in applications with low signal strength

Rosemount 3300 Series versatile and easy to use
- Handles most liquid storage and monitoring applications
APPLICATIONS

Industrial level measurements
Providing accurate and reliable measurement under process variations and with the ability to handle turbulence, vapors, coating, moisture, dust, foam and geometrically difficult vessels, GWR is a popular alternative for many applications.

Solid applications
The Rosemount 5303 transmitter measures solids with dielectric constants as low as 1.4 and a measuring range up to 160 ft. (50 m). Applications include powders and granules, silicon, plastic pellets, cement, fly ash, corn, and many more.

- It is virtually unaffected by dust, moisture, density changes, and temperature
- The shape of the material cone is not critical

Liquefied gases and refrigerants
Guided Wave Radar can handle heavy vapors, and it works well in low dielectric, turbulent applications. This makes it a good choice for liquefied gases including LNG, LPG, anhydrous ammonia, and refrigerants.

Easy replacement of mechanical devices
Guided Wave Radar is an ideal, low maintenance replacement for displacers, because it has no moving parts and is unaffected by density changes. The use of a single lead probe further ensures minimal maintenance since it is more tolerant of material coating. Guided Wave Radar is available with flanges that can match the proprietary cage flanges or major displacer manufacturers. A robust high pressure and temperature probe solution for the Rosemount 5300 Series is also available for these installations.

From this — to this...in minutes
Replacement of capacitance probes

Guided Wave Radar is an excellent replacement for capacitance probes since it requires no calibration and can handle heavy coating. It has a long-lasting microwave electronics that provides extended lifetime compared to capacitance probes.

Level and interface measurements

Guided wave radar measures both the level and interface level in separators, and settling and condensate tanks. The cost for wiring and installation is reduced because there is one tank penetration and a single pair of wires. There are some basic conditions which must be met in interface measurements:

• The lower dielectric fluid must be on top
• The two liquids must have a dielectric difference of at least 6
• The upper layer dielectric must be known (in-field determination is possible)

Demanding environments

The Rosemount 5300 Series handles low reflectivity, extreme temperatures and pressures, heavy product coating and saturated steam, making it a reliable alternative for applications such as distillation columns, feed-water tanks, and liquefied gases.
COMPARE AND SELECT ROSEMOUNT GUIDED WAVE RADARS

Both the 3300 and 5300 handles most liquid storage and monitoring applications. However the 5300 with its superior performance handles even the most challenging applications reliably, including process vessels, control and safety. The application conditions described here are where the 5300 is the right choice.

**Low Dielectrics with Single Probe**

Both level and interface measurements can be handled with a single lead probe in sticky fluids (e.g. crude oil, waxy oil), which would leave deposits on twin lead spacers. Probe End Projection provides a backup function for challenging applications such as plastic pellets and boiling hydrocarbons.

**Extended Measurement Range**

High dielectric materials, such as water based liquids, solids, ammonia, in vessels up to 165 ft (50 m).

Low dielectric (≤ 1.4) materials, such as liquefied gas, oil and solids, in vessels up to 82 ft (25 m).

**Extreme temperatures and pressures**

The Rosemount 5300 Series have heavy-duty probe options with multiple layers of protection to meet applications from boilers to cryogenics.
High pressure saturated steam
The Dynamic Vapor Compensation option dynamically compensates for changes in the vapor space dielectric, minimizing accuracy errors associated with varying pressure and/or temperature.

Disturbing electromagnetic interface
The Smart Galvanic Interface and enhanced transient protection design result in a more stable microwave performance. This improves the EMI performance and provides a more robust, safe measurement with minimized effects from outside disturbances.

Safety applications
The Rosemount 5300 Series is Safety Integrated System suitable.

FOUNDATION™ fieldbus
The Rosemount 5300 Series is available with FOUNDATION™ fieldbus.

TABLE 2. Compare and Select Rosemount Guided Wave Radars

<table>
<thead>
<tr>
<th></th>
<th>Rosemount 5300 Series - Superior Performance &amp; Functionality</th>
<th>Rosemount 3300 Series - Versatile and Easy-to-Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Accuracy</td>
<td>± 3 mm, and improved ambient temperature effect</td>
<td>± 5 mm</td>
</tr>
<tr>
<td>Max/Min Temperature / Pressure</td>
<td>-320 to 752 °F (-196 to 400 °C) / -14 to 5000 psig (-1 to 345 bar)</td>
<td>-40 to 302 °F (-40 to 150 °C) / -14 to 580 psig (-1 to 40 bar)</td>
</tr>
<tr>
<td>Communications</td>
<td>HART, FOUNDATION Fieldbus, Modbus</td>
<td>4–20 mA analog/HART®, Modbus</td>
</tr>
<tr>
<td>Customized Configuration Tools</td>
<td>RadarMaster, AMS, Delta V and other FF hosts, Field communicator, DTM compliant(1)</td>
<td>Radar Configuration Tools, AMS, Field communicator, DTM compliant(1)</td>
</tr>
<tr>
<td>Enhanced EDDL / DTM capabilities</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SIL 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Direct Switch Technology</td>
<td>Provides 2-5 times stronger signal than any other GWR</td>
<td>No</td>
</tr>
<tr>
<td>Maximum Measuring Range</td>
<td>164 ft (50 m) for DC 6</td>
<td>77 ft (23.5 m) for DC 2.4 for twin and 7.5 for single</td>
</tr>
<tr>
<td>Lowest Dielectric Constant (DC)</td>
<td>1.2 with coaxial probe</td>
<td>1.4 with coaxial probe</td>
</tr>
<tr>
<td></td>
<td>1.4 with other probes</td>
<td>1.6 with twin probe up to 33 ft (10 m)</td>
</tr>
<tr>
<td></td>
<td>twin up to 82 ft (25 m) or, single up to 49 ft (15 m)</td>
<td>2.5 with single probe up to 36 ft (11 m)</td>
</tr>
<tr>
<td>Probe End Projection</td>
<td>Yes! Good for low DC and long ranges such as plastics, pellets, or boiling hydrocarbons</td>
<td>No</td>
</tr>
<tr>
<td>Smart Galvanic Interface</td>
<td>Gives improved EMI performance, good for non-metallic tanks</td>
<td>No</td>
</tr>
<tr>
<td>Modular Design</td>
<td>Yes! All probes can be used with all electronics</td>
<td>Partly. All rigid probes for short range electronics and all flexible probes for long range electronics</td>
</tr>
<tr>
<td>Dynamic Vapor Compensation</td>
<td>Yes! Good for steam compensation in boilers.</td>
<td>No</td>
</tr>
<tr>
<td>Increased Diagnostic Capabilities</td>
<td>Yes including signal quality metrics, and advanced full tank detection</td>
<td>No</td>
</tr>
<tr>
<td>Upper Transition Zone</td>
<td>4.3 - 7.1 in. (11 - 18 cm) depending on probe style and dielectric value</td>
<td>3.9 - 19.7 in. (10 - 50 cm) depending on probe style and dielectric value</td>
</tr>
<tr>
<td>Power Supply</td>
<td>16 - 30 Vdc for IS</td>
<td>11 - 30 Vdc for IS</td>
</tr>
<tr>
<td></td>
<td>20 - 42 Vdc for Ex d</td>
<td>16 - 42 Vdc for Ex d</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Enhanced including detection of product build-up on probe</td>
<td>Standard</td>
</tr>
<tr>
<td>Probe Materials</td>
<td>SST, Alloy C-276, Alloy 400, PTFE covered SST</td>
<td>SST, PTFE covered SST</td>
</tr>
<tr>
<td>Applications</td>
<td>Even for the toughest applications, including long range and low DC storage with a single probe, and process vessels and control</td>
<td>Most liquid storage and monitoring applications</td>
</tr>
</tbody>
</table>

(1) For configuration in FieldCare™, PACTWare™, Yokogawa® FieldMate/PRM.
PROBE STYLES

There are five different probe styles for Rosemount GWRs. The single lead is the preferred choice for most applications. With the 5300 superior performance it is possible to use single probes in more applications. This means lowered costs, less maintenance, and reduced inventory. The following guidelines should be used to choose the appropriate probe for the Rosemount GWRs.

Common Uses for Single Rigid and Flexible Probes
- Only option for powders and granules
- Can be used in sticky and viscous media
- Is the preferred choice for bypass chambers

Avoid using with restrictive nozzles or when the probe could come in contact with metallic objects in the vessel.

Common Uses for Coaxial Probes
- Acts as a mini stilling well, isolating the probe from external conditions and obstacles
- In low dielectric and high turbulent applications
- Where foam requires isolation from liquid surface
- Where there is contact with a metallic object
- Where the probe may contact inlet fluid flow or internal tank structures

Avoid using with sticky, viscous, coating media and in submerged applications.

Common Uses for Twin Rigid and Flexible Probes
- Where top-of-foam measurement is desired
- If the coaxial probe cannot be used
- If guidelines recommend outside installation and/or if the dielectric is too low for a single probe

Avoid using with media that coats and where the probe may contact walls or obstacles.
## GUIDED WAVE RADAR PROBE SELECTION GUIDE

<table>
<thead>
<tr>
<th>Maximum length&lt;sup&gt;1&lt;/sup&gt;</th>
<th>9'-10&quot; (3m)</th>
<th>9'-10&quot; (3m)</th>
<th>77'-1&quot; (23.5m)</th>
<th>165' (50m)</th>
<th>165' (50m)</th>
<th>9'-10&quot; (3m)</th>
<th>9'-10&quot; (3m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Dielectric Constant at Maximum Range</td>
<td>2.5&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;3&lt;/sup&gt;</td>
<td>7.5</td>
<td>6&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.2&lt;sup&gt;4&lt;/sup&gt;</td>
<td>2.4</td>
</tr>
<tr>
<td>Minimum Dielectric Constant</td>
<td>2.5&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;3&lt;/sup&gt;</td>
<td>2.5</td>
<td>1.4</td>
<td>1.4&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.2&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.6</td>
</tr>
</tbody>
</table>

### Measurements
- **Level**
- **Interface (liquid/liquid)**

### Process Medium Characteristics
- **Changing Density**
- **Changing Dielectric<sup>2</sup>**
- **Wide pH Variations**
- **Pressure Changes**
- **Temperature Changes**
- **Condensing Vapors**
- **Bubbling/Boiling Surfaces**
- **Foam (Mechanical Avoidance)**
- **Foam (Measurement of Top of Foam)**
- **Foam (Measurement of Foam & Liquid)**
- **Clean Liquids**
- **Materials with Very Low Dielectric**
- **Coating, Sticky Liquids**
- **Viscous Liquids**
- **Crystallizing Liquids**
- **Solids, Granules, Powders<sup>3</sup>**
- **Fibrous Liquids**

### Tank Environment Considerations
- **Probes Will Be Close (<12in/30cm) to Tank Wall / Disturbing Object**
- **Probe Might Touch Tank Wall or Disturbing Objects**
- **Turbulence**
- **Turbulent Conditions Causing Breaking Forces**
- **Tall, Narrow Nozzles**
- **Angled or Slanted Surfaces (Viscous or Solids Materials)**
- **Liquid or Vapor Spray May Touch Probe Above Surface**
- **Disturbing Electromagnetic Interference in Tank**
- **Cleanability of Probe**

1. Overall distance of flexible probes is limited with low dielectric material
2. For overall level applications, a changing dielectric has no affect on the measurements, for interference applications a changing dielectric in top fluid will degrade accuracy
3. See Tech note 00803-0100-4811 (Guided Wave Radar for Solid Applications) and PDS 00813-0100-4530 for details
4. Probe end projection may allow lower dielectric constant in longer ranges, consult factory
5. 1.7 if installing in metallic bypass for stilling well
6. 1.6 for HP probe or 2.0 for HTHP probe
7. 1.4 for HP probe or 2.0 for HTHP probe
8. 1.25 if installed in bypass or stilling well
REFERENCES
For more information see the following documents
(click title to open document, or visit
www.rosemount.com):

Product Data Sheets
Rosemount 5300 Series Superior Performance Guided Wave Radar Level and Interface Transmitter
(Document No. 00813-0100-4530)
Rosemount 3300 Series Guided Wave Radar Level and Interface Transmitter (Document No. 00813-0100-4811)

Technical Notes
Replacing Displacers with Guided Wave Radar (Document No. 00840-2200-4811)
Measuring Ammonia with Radar (Document No. 00840-0100-4811)
Guided Wave Radar in Solid Level Applications (Document No. 00840-2300-4811)

Handbooks and Brochures
The Engineer’s Guide to Level Measurement (Document No. 00805-0100-1034)
Level Instrumentation for the Refining Industry (Document No. 00805-0100-1031)
Rosemount Process Level Instrumentation (Document No. 00803-0100-4161)

Proven Results
View and download Rosemount Process Level Proven Results on:

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