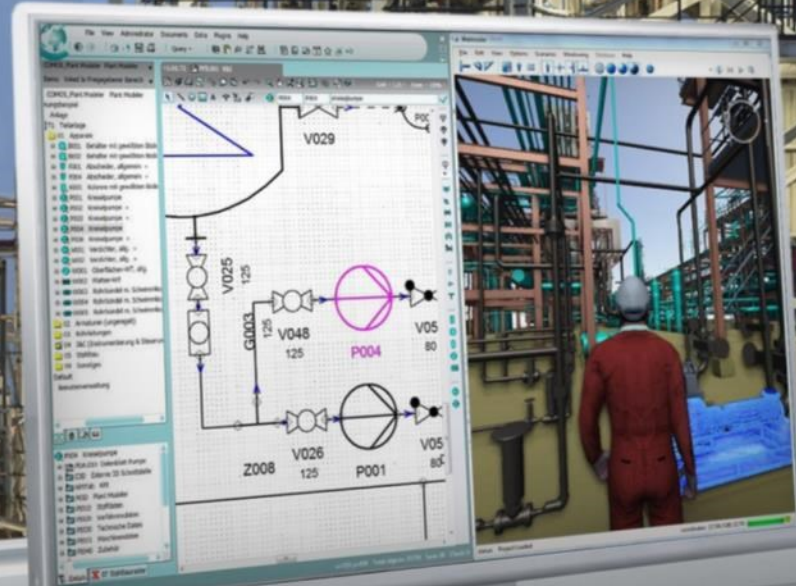


SIEMENS

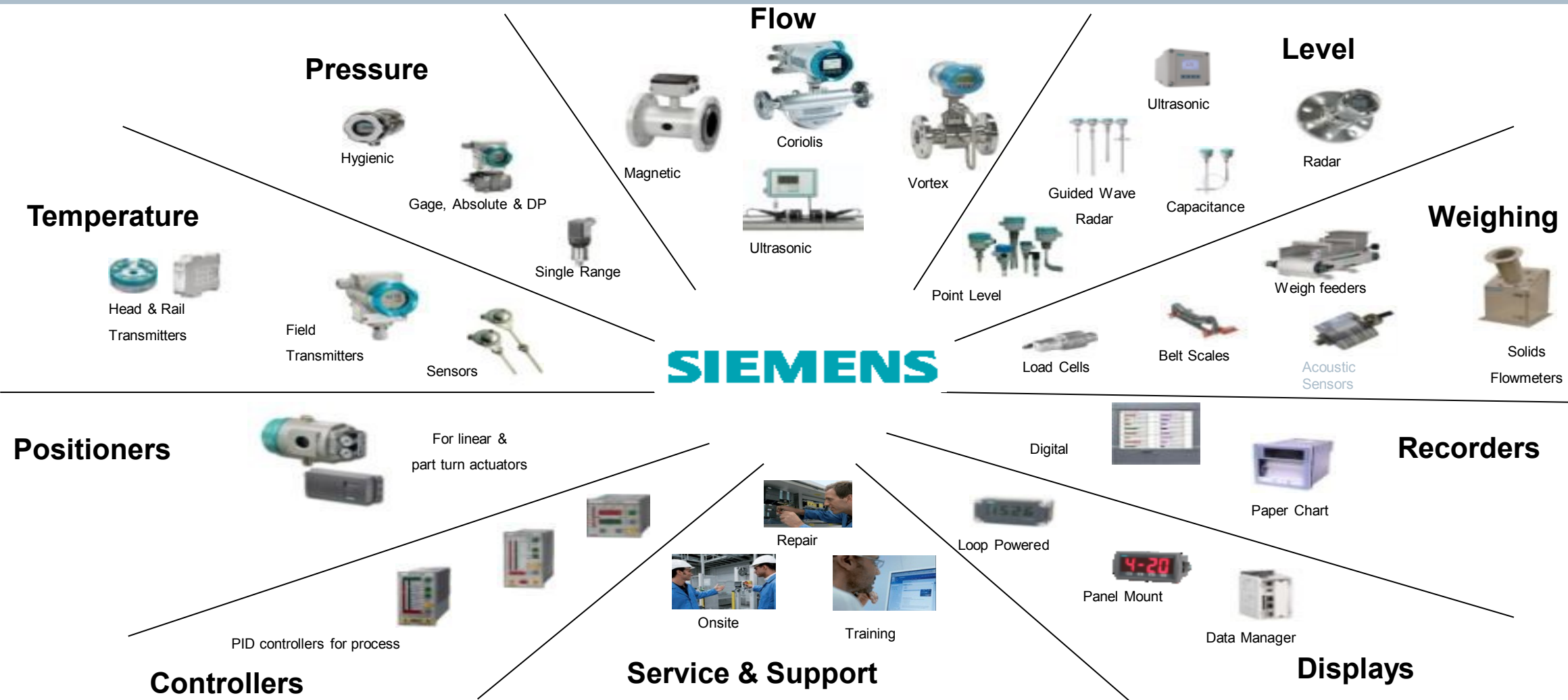


March 17, 2016

Mystery Solved: Selecting the Right Radar Antenna for Your Application

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Siemens Process Instruments



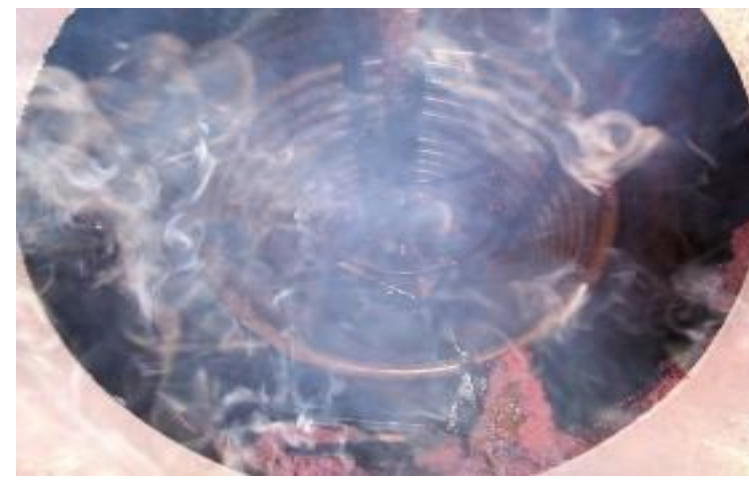
Agenda

- Review what applications are best suited for radar
- Recap commonalities from all radar types
- Discuss which frequencies (6 GHz, 25 GHz, 78 GHz) are best suited for what types of materials
- Cover the 7 basic antenna types and applications for each
- Show a few examples of “extreme” or unusual applications
- Summarize the 6 most important questions to ask in any radar level selection process



Application Challenges: When is it Best to Use Radar?

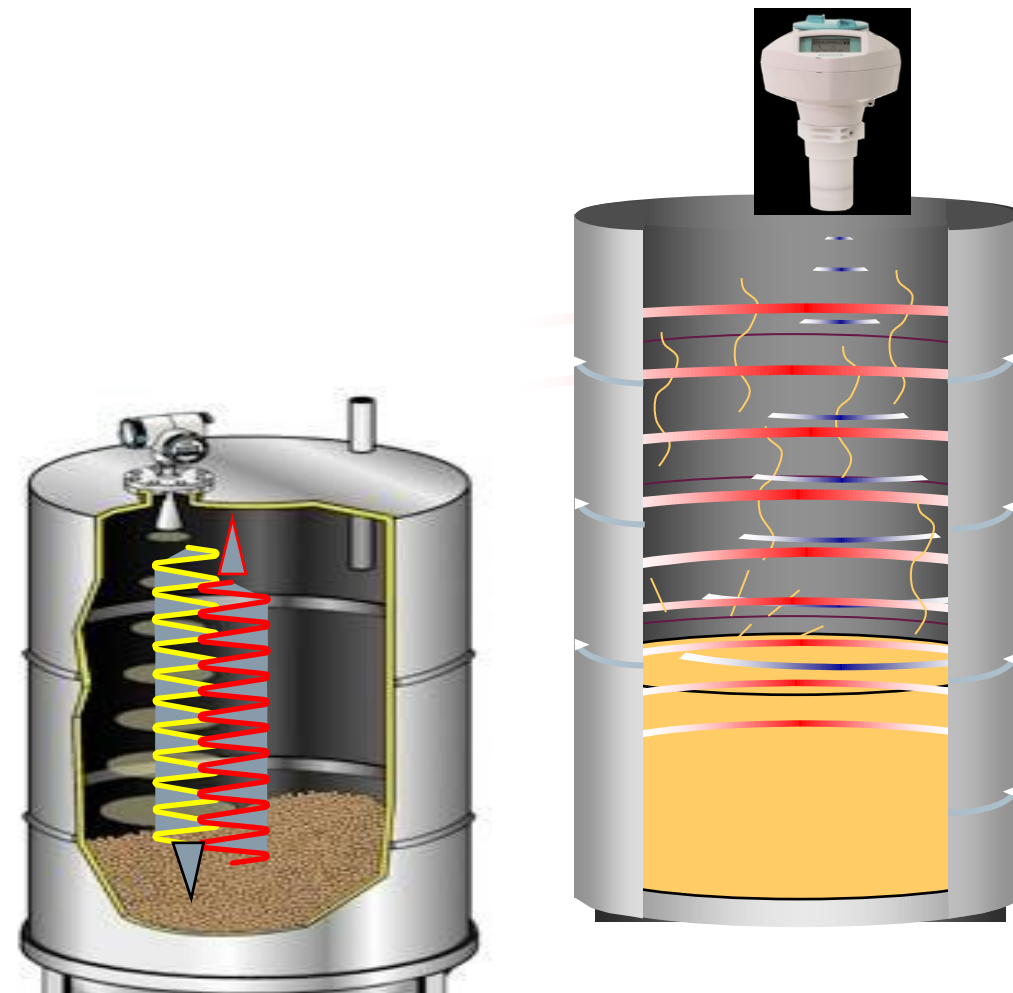
- High Temperature ($>100^{\circ}\text{C}$)
- Certain Vapors
- Severe Dust
- Light density Foam
- Absolute Vacuum
- **These are Radar applications**



Review of the Radar Technologies

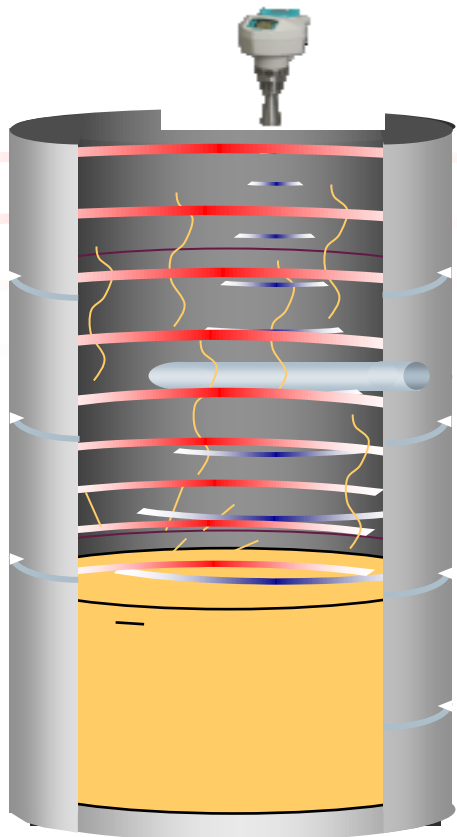
Two Technologies:

- Pulse principle
 - Time to target and return is directly related to distance
- FMCW (Frequency Modulated Continuous Wave or Phase Shift)
 - Sweep frequency transmit
 - Return echo is slightly out of phase with transmit
 - Phase difference is proportional to distance
- Neither method is better than the other

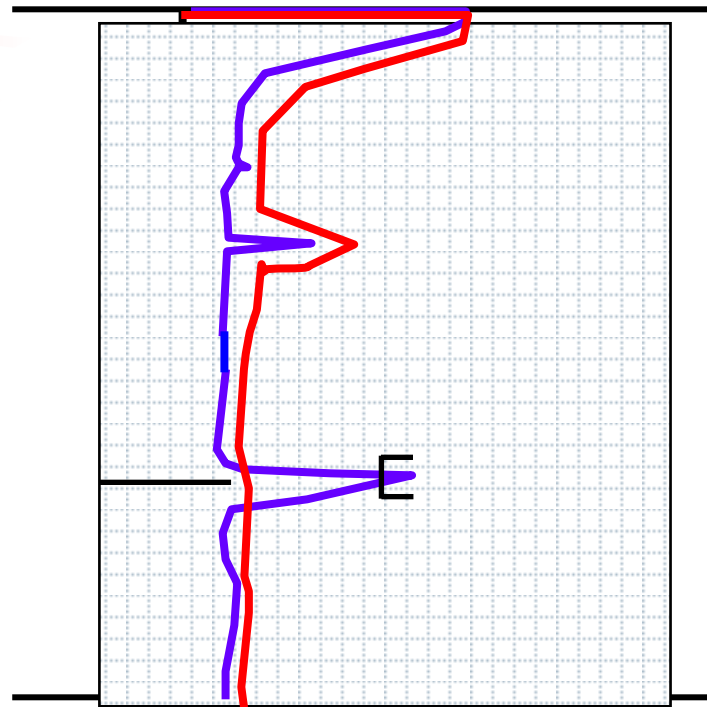


Process Intelligence Signal Processing

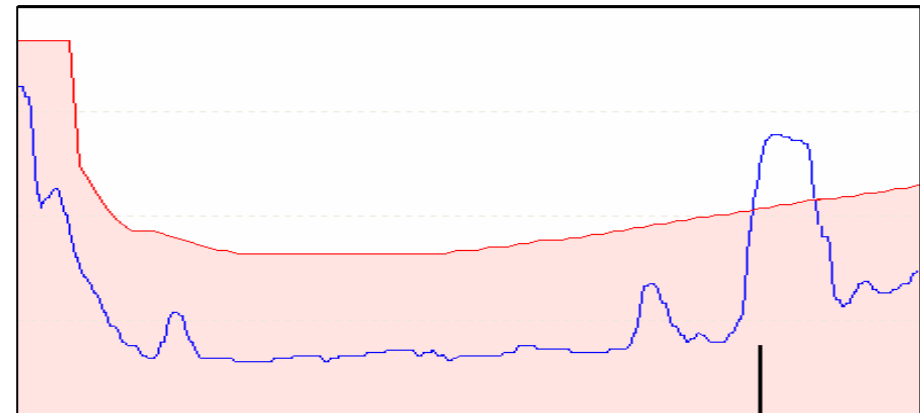
Quick Start Wizard – Plug & Play performance in minutes!
Over 1 million devices installed with the echo processing engine



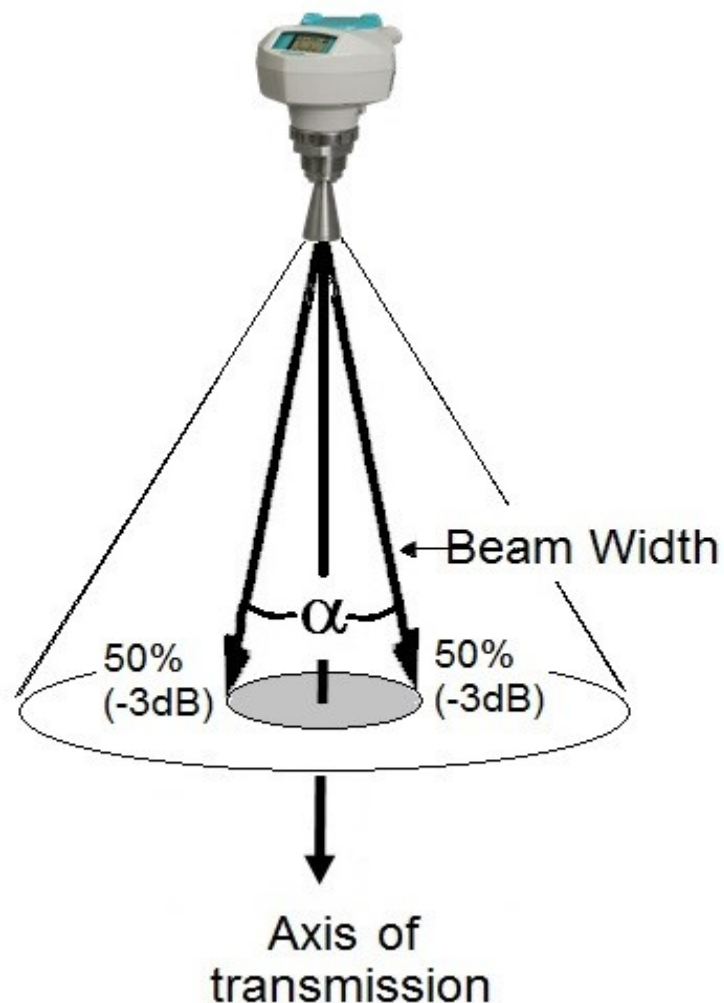
“Process Intelligence”



- **Dynamic threshold (TVT):** adapts **automatically** to changing conditions such as condensation, buildup, or product dielectric changes
- **Auto False Echo Suppression:** algorithm provides **reliability** even in case of false echo signals from obstacles
- **Echo algorithms for liquids:** CLEF algorithm provides **reliability** at tank bottom area for low dielectric materials such as oils/fats & hydrocarbons



Echo Ranging Theory

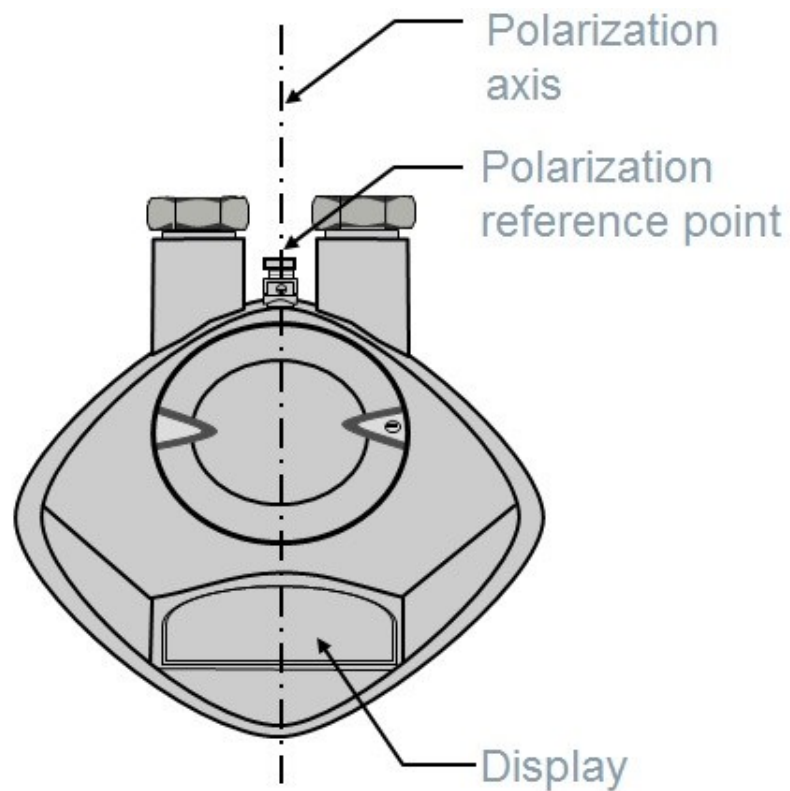


Beam angle definition – Twice the angle at which off-axis transmission is 3dB less than, or half the power of, the transmission axis

10 to 1 rule

Beam angles considerations are not as relevant since the development of auto false echo suppression

Mounting Considerations



Nearest
Tank
Wall

Polarization reference point

- For best results on a vessel with obstructions, orient the front or back of the device toward the obstructions.

Side Lobes

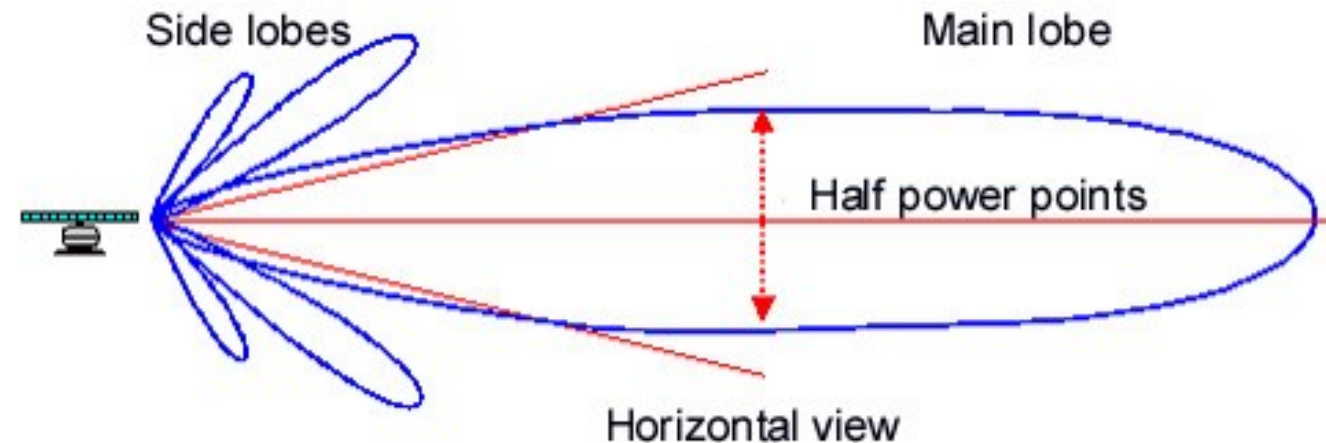
Any antenna will have side lobes

A function of the antenna aperture distribution

Generally, larger horn antenna have a narrower beam angle, but also have narrow side lobes and generally more of them

Antenna lobes are 3 dimensional

Care should be taken in narrow applications, such as nozzles, to account for false echoes caused by side lobes



3 Major Frequency Groups

6 GHz

- liquids
- some light foam applications



24, 25 or 26 GHz

- optimized for liquids
- limited number of solid applications



78 GHz

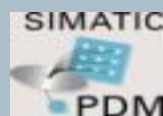
- optimized for dry bulk solids
- works well in dusty applications



SITRANS LR250 Family

25GHz Pulse Radar Liquid Level Transmitter Field proven LR250 family

- LR250 Released May 2007
- Maximum range 65ft
- Available with Stainless or Hastelloy C wetted materials
- SIL 2 (functional safety)
- Threaded PVDF antenna for corrosive applications to 33 ft.10m
- Flanged Encapsulated Antenna FEA
- Hygienic Encapsulated Antenna HEA
- Industrial communications (HART/Profibus/Foundation Fieldbus)
- Hazardous Area approvals
- 3mm accuracy



SITRANS LR250 (liquids) & LR260 (solids) Open Horn Antenna

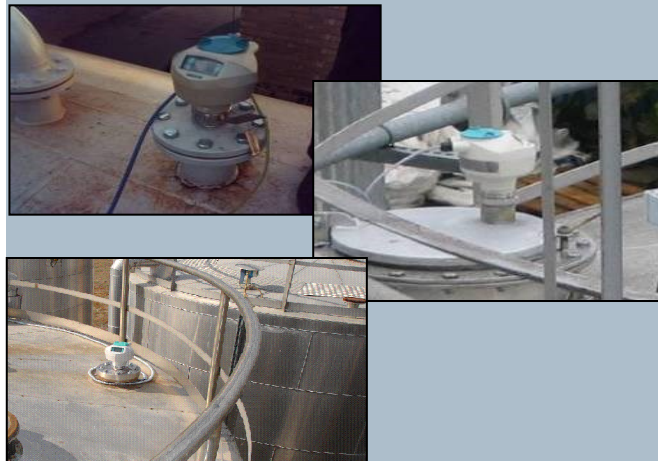
Chemical

- Solvents
- Alkali Resin
- Polyether Liquid
- Acetonitrile
- Toluene
- Ethyl Acetate



Petrochemical / Oil & Gas

- Gasoline
- Methanol
- Fuel Oils
- Palm Oil
- Carbon Liquid
- Lube Oils



New Antenna – New Target Applications

SITRANS LR250 Threaded PVDF Antenna

Chemical

- Hydrochloric acid
- Sulphuric acid
- Aluminum Chloride
- Aluminum Hydroxide
- Phenol



Water / Waste Water

- Water Treatment Chemicals
- Sodium Hypochlorite
- Sodium Chloride
- Chlorine liquid



APPLICATION NOTE – With 2" antenna (small horn body) use caution in applications with low DK, foam, agitation or changeable conditions due to signal strength/measurement range/Dielectric constant limitations.

New Antenna, New Target Applications

SITRANS LR250 Flanged Encapsulated Antenna

Chemical

- Hydrochloric acid
- Sulphuric acid
- Aluminum Chloride
- Aluminum Hydroxide
- Phenol
- Nitric Acid
- Solvent storage



Environmental / Power

- Water Treatment Chemicals
- Sodium Hypochlorite
- Sodium Chloride
- Chlorine liquid
- Liquid Alum
- Bulk Chemical Storage
- Salt Water



Solutions with higher specification, longer range, chemically resistant antenna

SITRANS LR250

Flanged Encapsulated Antenna (FEA)

- Flanged connections (Stainless Steel) 316L
 - ASME Class 150 -
 - Sizes 2", 3", 4" & 6"

Flanged Encapsulated antenna

- Degrees 338F
- Pressures up to 232psi* (Max)
- 66ft measurement range
- Fully encapsulated antenna design (rugged and stable)
- 2" to 6"
- ASME flanges
- Works well with low-dK materials

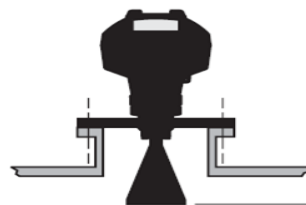


TFM 1600 PTFE Lens

SITRANS LR250

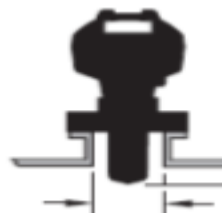
Antenna Size vs. Measurement Range Guidelines

Horn Antenna



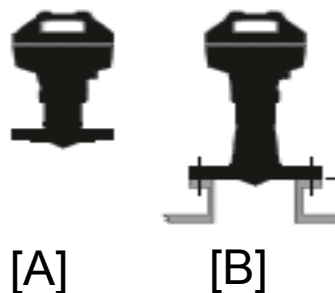
Antenna Size		Distance	Dielectric (DK)	Beam Angle
1 1/2 (40mm)		10m (33ft)	>3	19 degrees
1 1/2 (40mm)	stillpipe only	20m (33ft)	>1.6	19 degrees
2" (50mm)		20m (66ft)	>1.6	15 degrees
3" (80mm)		20m (66ft)	>1.6	10 degrees
4" (100mm)		20m (66ft)	>1.6	8 degrees

Threaded PVDF Antenna



Antenna Size		Distance	Dielectric (DK)	Beam Angle
2" (50mm)		10m (33ft)	>3	19 degrees
2" (50mm)	Stillpipe only	20m (33ft)	>1.6	19 degrees

Flanged Encapsulated Antenna



Process Conn. Size		Distance	Dielectric (DK)	Beam Angle
2" (50mm) [A]		10m	>3	12.6 degrees
2" (50mm) [A]	Stillpipe only	20m	>1.6	12.6 degrees
3" (80mm) [B]		20m	>1.6	9.6 degrees
4" (100mm) [B]		20m	>1.6	9.6 degrees
6" (150mm) [B]		20m	>1.6	9.6 degrees

SITRANS LR250 Hygienic Encapsulated Antenna

Liquid level measurement for Food, Beverage and Pharmaceutical applications requiring Sanitary Approvals such as EHEDG, 3A and Aseptic.

Fully Encapsulated Horn Antenna

- TFM 1600 PTFE lens
- Process Temp * -40 to 338 °F
- Pressure * -14.5 to 232 psi
- Excellent performance with low dielectric (dK) materials

Industry Leading range of standard Process connection types

- 2" up to 4"
- DIN 11864 (Aseptic)
- DIN 11851 (Milk coupling)
- ISO 2852 (Tri Clamp)
- Tuchenhagen F & N

• See operating manual for pressure/temperature curves

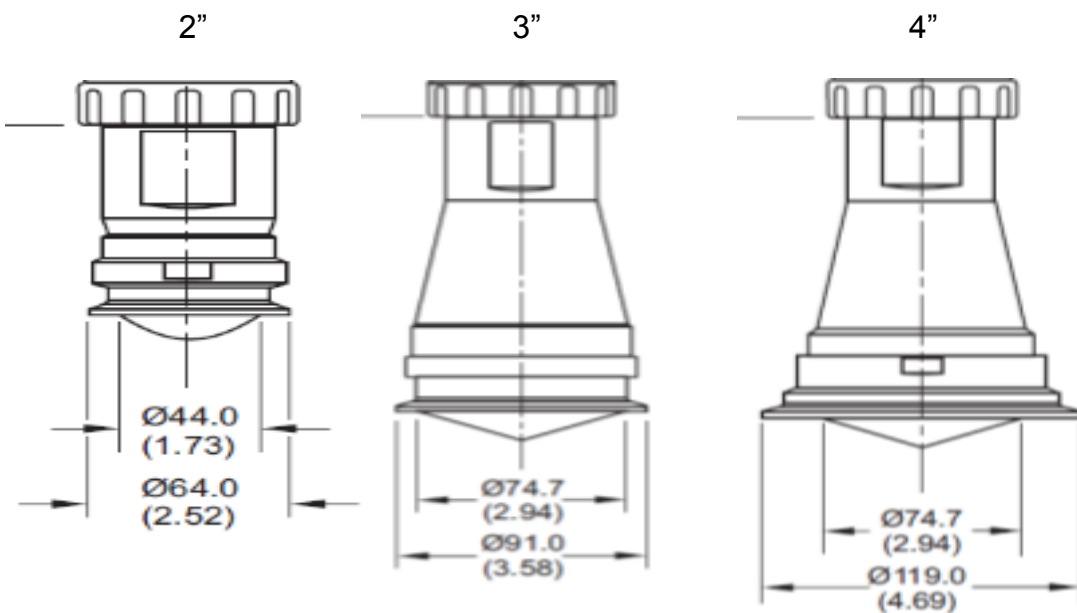


SITRANS LR250 Hygienic Encapsulated Antenna

ISO 2852 (tri-clamp)

Measurement Range:

- 33ft for 2"
- 66ft for 3" & 4"



Compliant Materials



• Picture shown with accessories (available to purchase separately)

* See operating manual for pressure/temperature curves

SITRANS LR250 HEA typical applications



Compliant Materials



- Picture shown with accessories (available to purchase separately)

Food & Beverage

- Sodium hydroxide (caustic)
- Food coloring/additives
- CIP chemicals storage
- Dairy
- Syrups/liquid sugars
- Fruit juices
- Brewing



Pharma / Life Sciences

- Water treatment chemicals
- De-min water
- Biotech processes
- Culture research
- Cosmetics
- Medicines
- SIP chemical storage



Solutions with easy clean, sanitary or hygienic requirements and aggressive or corrosive chemicals

SITRANS LR560

Microwave Radar for solids applications

Low cost, extremely reliable level measurement

- 2-wire, 78 GHz pulse radar
- Very narrow (4 degree) beam angle
- Two measurement ranges
 - 131 ft
 - 328 ft
- Ideal for extreme dust and high temperatures to 392° F
- 2.5" lens antenna (no horn)
- Integral air purge port



SITRANS Radar: Frequency, beam angle and skip

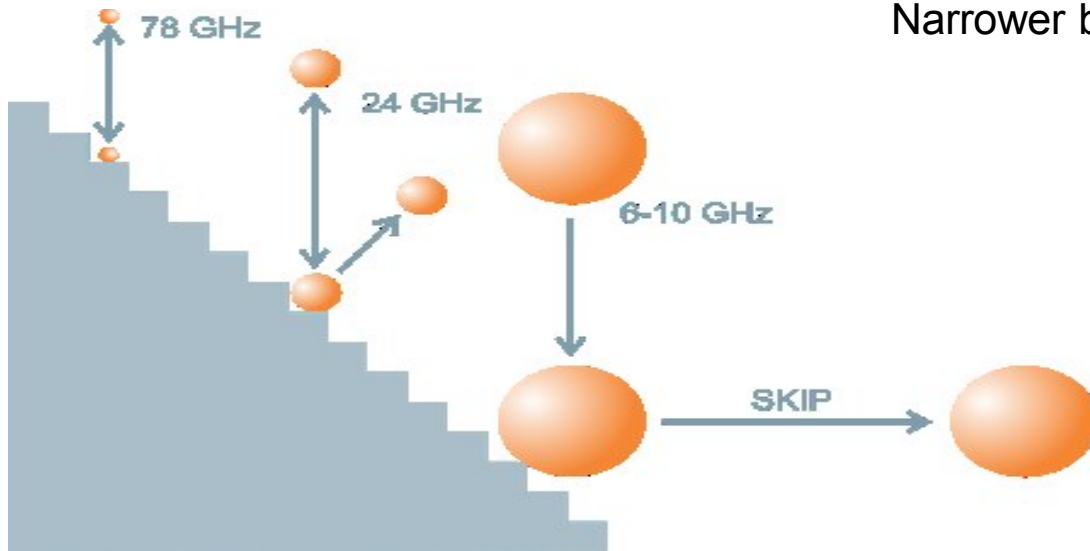
- **3 frequencies:**

- 6GHz
- 25GHz
- 78GHz



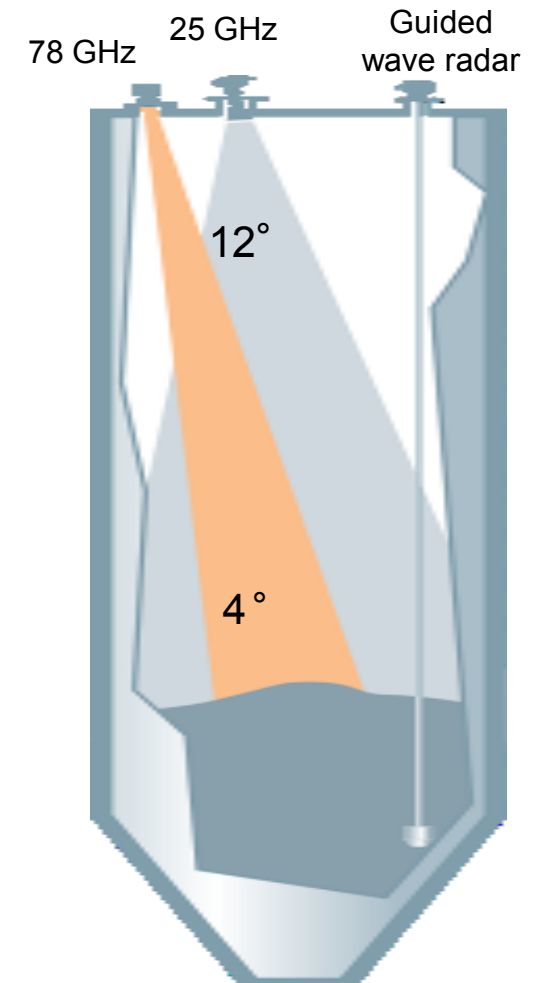
Smaller Antenna
Easier installation

- **SKIP & Beam angle**



Higher frequency
Less skip

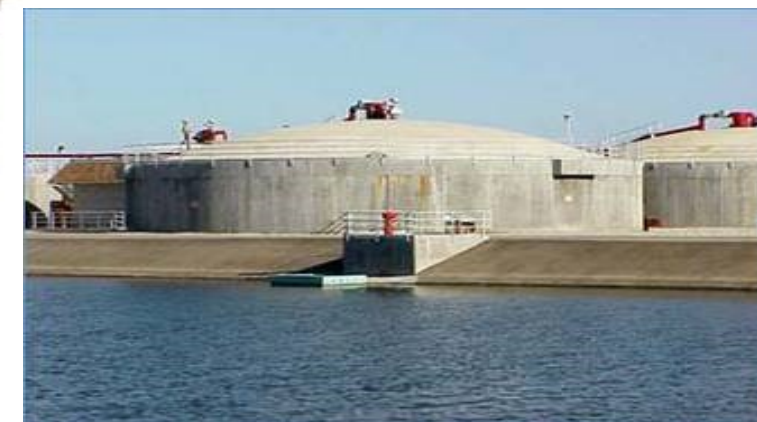
Higher frequency
Narrower beam



SITRANS Probe LR and LR200 rod antennas for liquids – bulk storage

SITRANS Probe LR and LR200 (6GHz)

- Cost effective choice with Probe LR
- Work well in high-condensation environments
- Polypropylene Rod only
- Shielded rod aids installation
- Simple programming
- Key Wastewater applications
 - Wetwells, chemical storage
 - Large tanks due to large beam angle



Specialty Radar Application: 6 GHz with sliding waveguide Anaerobic Digester

The conditions in a digester make level measurement particularly challenging.

- Foamy
- Dirty
- Sticky
- Vapor Layers
- Gas Layers
- Condensation



- Radar not effected by environmental changes
- Patented sliding waveguide allows for cleaning
- Generally requires classified approvals



SITRANS Radar Antenna – Summary

Liquids Radar transmitters

- Complete application coverage
- Simple Retrofit with 2 wire devices
- Very Low DK/Long Range applications

Simple Set up with User Friendly Quick Start Menus

- Cost effective
- No need for Instruction manuals

Process Intelligence

- Tried, tested and experienced
- Over a million field installations

Integrated & Well connected - Compatible on Host systems

- Compatible with SIMATIC PDM
- Emerson AMS
- FDT/DTM Platforms



With all of the different antennas available, how do you decide:

Which is the best for my application?



Application Basics – 6 Key Questions

- 1. What is the material to measure? Liquid, slurry, or solids?**
- 2. What is the dielectric constant (dK) of the material?**
- 3. What are the temperature and pressure ranges?**
- 4. What is the Area Classification? (general purpose, intrinsically safe, explosion proof)**
- 5. Is it an open air or closed vessel application?**
- 6. What material is the vessel made of?**

Questions?



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