

Radar Level Transmitter Datasheet

A practical guide to radar level transmitter datasheet, covering the reader intent, the relationship to radar level transmitter datasheet, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



level-measurement

Main topic: Radar Level Meters

<https://www.level-meters.com/products/radar-level-meters/>

In industrial process automation, selecting the correct instrumentation is a critical step in ensuring operational safety, efficiency, and accuracy. For non-contact level measurement, the radar level transmitter datasheet serves as the primary technical document used by engineers to match a device's capabilities with the specific requirements of a storage tank or process vessel. Understanding the nuances of these specifications is essential for avoiding common pitfalls such as signal loss, false echoes, or premature equipment failure.

Radar Level Meters utilize electromagnetic waves to determine the distance to a liquid or solid surface. Unlike ultrasonic sensors, which rely on sound waves and are affected by air temperature and pressure, radar signals travel at the speed of light and remain largely unaffected by the vapor space environment. This makes them the preferred choice for complex industrial applications in chemical processing, oil and gas, and wastewater treatment.

| Measurement Principles: Pulse vs. FMCW

Before evaluating a datasheet, it is important to understand the two primary measurement technologies used in modern radar level transmitters: Pulse Radar and Frequency Modulated Continuous Wave (FMCW).

| Pulse Radar

Pulse radar transmitters emit a high-frequency signal in short, concentrated bursts. The device measures the "Time of Flight" (ToF)—the time it takes for the pulse to travel to the material surface and back to the antenna. Because the speed of light is constant, the distance is easily calculated. Pulse radar is often favored for its lower power consumption and is suitable for many standard liquid level applications.

| FMCW Radar

FMCW (Frequency Modulated Continuous Wave) technology transmits a continuous signal with a constantly changing frequency. The reflection from the material surface is received and compared to the frequency being transmitted at that exact moment. The difference in frequency is directly proportional to the distance. FMCW radar generally offers higher accuracy and a better signal-to-noise ratio, making it superior for measuring solids, low-dielectric liquids, or surfaces with heavy turbulence.

| Key Specifications in a Radar Level Transmitter Datasheet

A comprehensive datasheet provides a wealth of data. To make an informed decision, engineers must focus on several critical parameters that dictate how the sensor will perform in the field.

| 1. Operating Frequency

The frequency of a radar transmitter (typically 6GHz, 26GHz, or 80GHz) determines its beam angle and sensitivity.

- 6GHz (C-band): Best for applications with heavy foam or steam, as the longer wavelength can penetrate these obstacles more effectively.
- 26GHz (K-band): A versatile middle-ground frequency suitable for most liquid applications.
- 80GHz (W-band): The modern standard for precision. Higher frequencies allow for much smaller antennas and narrower beam angles, which are essential for avoiding internal tank obstructions like agitators or ladders.

| 2. Beam Angle

The beam angle defines the spread of the radar signal. A narrow beam angle (e.g., 3° to 8°) is highly desirable in narrow tanks or vessels with complex internal geometries. If the beam is too wide, it may hit the tank wall or internal pipes, creating "false echoes" that can confuse the transmitter and lead to inaccurate readings.

| 3. Dielectric Constant (ϵ_r)

The dielectric constant of the medium is perhaps the most important factor in radar measurement. It represents the ability of a material to reflect electromagnetic waves.

- High Dielectric ($\epsilon_r > 10$): Materials like water or acids reflect signals strongly.
- Low Dielectric ($\epsilon_r < 2$): Materials like hydrocarbons, oils, or liquefied gases reflect very little energy.

When reviewing a radar level transmitter datasheet, check the "Minimum Dielectric Constant" specification. If the medium falls below this threshold, the radar may "see through" the liquid to the tank bottom instead of measuring the surface.

| 4. Measurement Range and Dead Zone

The measurement range specifies the maximum distance the radar can track (e.g., 30m/98ft or 120m/393ft). Equally important is the "Dead Zone" or "Blocking Distance" at the top of the sensor. This is the area immediately below the antenna where measurement is not possible. Engineers must ensure the maximum fill level of the tank does not enter this dead zone.

Practical Selection Table

The following table compares typical specifications found across different classes of radar level meters to assist in the initial screening process.

Feature	26GHz Pulse Radar	80GHz FMCW Radar	Guided Wave Radar (GWR)
Primary Application	General liquid storage	Narrow tanks, solids, high precision	Low dielectric, interface measurement
Typical Beam Angle	8° – 20°	3° – 8°	N/A (Signal follows probe)
Standard Accuracy	±3 mm (0.12 in)	±1 mm (0.04 in)	±2 mm (0.08 in)
Max Range	30 m (98 ft)	120 m (393 ft)	75 m (246 ft)
Min. Dielectric (ϵ_r)	> 1.6	> 1.2	> 1.4
Pressure Rating	Up to 40 bar (580 psi)	Up to 160 bar (2320 psi)	Up to 400 bar (5800 psi)

Installation Considerations and Best Practices

Even the most advanced radar transmitter will fail if installed incorrectly. The datasheet will usually provide specific mounting guidelines that must be strictly followed.

Nozzle Geometry

The nozzle (the pipe segment where the radar is mounted) should be as short and wide as possible. If the nozzle is too long or narrow, the radar signal may reflect off the internal edges of the pipe before it even enters the tank. For 80GHz units, the impact of nozzle interference is greatly reduced, but it remains a factor for lower-frequency devices.

| Position and Orientation

- Avoid the Center: Do not mount the radar in the exact center of a domed-top tank. This can cause multiple reflections to converge at the antenna, resulting in signal interference.
- Distance from Wall: The sensor should be mounted at least 200mm (8 inches) away from the tank wall to prevent side-wall interference.
- Obstructions: Ensure the signal path is clear of inflow streams, agitator blades, and heating coils. If obstructions are unavoidable, most modern transmitters offer "False Echo Suppression" software to digitally map out and ignore these static reflections.

| Environmental Protection

For outdoor installations, a sunshade is recommended to prevent extreme temperature fluctuations from affecting the electronics. In high-humidity environments, ensure the cable glands are properly sealed and pointed downward to prevent moisture ingress into the housing.

| Limitations of Radar Technology

While radar is highly versatile, it is not a universal solution. Engineers should be aware of the following limitations often noted in the fine print of a datasheet:

1. Heavy Foam: Extremely thick, dense foam can absorb the radar signal entirely, preventing it from reaching the liquid surface. In such cases, a guided wave radar or a low-frequency (6GHz) radar may be more effective.
2. Vacuum Conditions: While radar works in a vacuum, the sealing materials (O-rings) and flange connections must be rated for vacuum service to prevent leaks.

3. Extremely Low Dielectrics: For materials like liquid nitrogen or certain solvents with $\epsilon_r < 1.4$, the reflected signal may be too weak for standard non-contact radar. A Guided Wave Radar (GWR), which uses a physical probe to guide the signal, is often the better alternative here.

| Frequently Asked Questions (FAQ)

Q: Can I use a radar level meter for both liquids and solids?

A: Yes, but the datasheet will often specify different ranges for each. Solids (like grain or plastic pellets) have uneven surfaces that scatter the signal, requiring a more powerful FMCW radar with specialized algorithms for solids handling.

Q: How does dust affect radar measurement?

A: Unlike ultrasonic sensors, radar signals are not significantly attenuated by dust. This makes radar the industry standard for cement silos and mining applications. However, heavy dust buildup on the antenna itself can eventually degrade the signal, so air purging systems are often recommended.

Q: What is the difference between 2-wire and 4-wire transmitters?

A: A 2-wire transmitter uses the same pair of wires for both power and the 4-20mA signal, which is ideal for saving wiring costs. A 4-wire transmitter has separate leads for power (often AC) and signal, providing more power for high-intensity signals or backlit displays.

Q: Is calibration required for radar level meters?

A: Radar units are typically factory-calibrated. Field "calibration" usually involves configuring the "Empty" and "Full" distances relative to the tank height. Because there are no moving parts, the devices do not suffer from mechanical drift.

| Conclusion

Carefully reviewing a radar level transmitter datasheet is the most effective way to ensure long-term reliability in level measurement. By matching the frequency, beam angle, and dielectric capabilities of the device to the specific process conditions—such as temperature, pressure, and tank geometry—engineers can minimize maintenance and maximize data accuracy. For complex applications, consulting with a professional manufacturer like Welk can provide additional insights into customized OEM/ODM solutions tailored to unique industrial requirements.