

64/69

A practical guide to 64/69, covering the reader intent, the relationship to 64/69, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



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In the landscape of industrial process automation, the shift toward high-frequency radar level measurement has redefined accuracy and reliability in challenging environments. The 64/69 series represents the pinnacle of 80GHz Frequency Modulated Continuous Wave (FMCW) technology. These instruments are designed to address the inherent limitations of traditional 6GHz and 26GHz radar systems, providing narrow beam angles, high precision, and the ability to penetrate heavy dust or steam. This guide explores the engineering principles, application distinctions, and selection criteria for the 64/69 series of radar level meters.

| Measurement Principles of 80GHz FMCW Radar

To understand the performance of the 64/69 series, it is essential to distinguish between Pulse Radar and Frequency Modulated Continuous Wave (FMCW) technology. While older systems often utilized pulse-based time-of-flight measurements, the 64/69 series employs the FMCW principle, which offers significantly higher signal resolution.

| The FMCW Principle

In an FMCW system, the transmitter emits a continuous signal with a frequency that increases linearly over time—a process known as a frequency sweep or "chirp." The signal travels to the medium's surface, reflects, and returns to the receiver. Because the transmitter is constantly sweeping the frequency, there is a measurable difference between the frequency being emitted at the moment of reception and the frequency that was emitted when the signal first left the antenna.

This frequency difference (Δf) is directly proportional to the time delay (Δt), which in turn is proportional to the distance to the material surface. By using Fast Fourier Transform (FFT) algorithms, the instrument converts these frequency shifts into precise distance measurements. The high frequency of 80GHz allows for a much wider bandwidth sweep (up to 4GHz or 5GHz), which results in a finer range resolution and the ability to distinguish between the actual material level and parasitic reflections from internal tank structures.

| Advantages of High Frequency (80GHz)

The transition from 26GHz to the 80GHz range used by the 64/69 series provides two primary physical advantages:

1. **Beam Focusing:** At higher frequencies, the wavelength is shorter. This allows a small antenna to produce a very narrow beam. A typical 80GHz radar can achieve a beam angle as small as 3°, whereas a 26GHz radar with the same size antenna might have a beam angle of 10° to 15°.
2. **Signal Reflection:** Shorter wavelengths reflect more effectively off uneven surfaces, such as slanted solid piles or turbulent liquids. This increases the signal-to-noise ratio, ensuring a stable reading even when the return signal is weak.

| Distinguishing the 64 and 69 Models

While both models utilize the 80GHz FMCW platform, they are optimized for different physical states of matter and process conditions. For detailed technical specifications and to explore the full range of Welk instrumentation, visit the [Main Page](#).

| The 64 Series: Optimized for Liquids

The 64 model is specifically engineered for liquid level measurement. It is frequently deployed in the pharmaceutical, food and beverage, and chemical industries.

Small Process Connections: Because of the high frequency, the 64 can utilize 1-inch (25mm) or 1.5-inch thread connections while maintaining a focused beam. This is ideal for small vessels or dosing tanks where space is limited.

High Precision: The 64 typically offers an accuracy of $\pm 1\text{mm}$, making it suitable for inventory control and high-accuracy process monitoring.

Corrosion Resistance: It is often equipped with PTFE or PFA encapsulated antennas, providing a seamless, easy-to-clean surface that resists aggressive chemical vapors.

| The 69 Series: Optimized for Solids and Dust

The 69 model is the "powerhouse" for bulk solids, powders, and grains. It is designed to overcome the specific challenges of solid materials, such as low dielectric constants and heavy dust during filling cycles.

Long Range: The 69 series is capable of measuring distances up to 120 meters (approx. 393 feet), making it the standard choice for tall cement silos, grain elevators, and mining hoppers.

Dust Penetration: The 80GHz signal is less susceptible to attenuation by airborne particles compared to laser or ultrasonic alternatives.

Aimed Flanges: Many 69 models include an adjustable "swivel" flange or aiming device, allowing the user to point the radar beam at the discharge cone of a silo to ensure accurate tracking of the material level even at the bottom of the vessel.

| Technical Selection Criteria

Choosing between the 64/69 series requires an evaluation of the medium properties and the physical environment. The following table provides a practical comparison for selection.

| Selection Table: 64 vs. 69

Feature	64 (Liquid Specialist)	69 (Solid Specialist)
Primary Media	Liquids, Slurries, Oils	Powders, Grains, Bulk Solids
Maximum Range	30m - 100m (depending on model)	120m
Accuracy	±1mm	±5mm
Beam Angle	3° to 8°	3° to 4°
Process Temperature	-40°C to +200°C	-40°C to +250°C
Process Pressure	-0.1 to 2.5 MPa	-0.1 to 0.3 MPa (standard)
Antenna Material	PTFE, PFA, Stainless Steel	Stainless Steel, Plastic Lens

| Key Evaluation Factors

- 1. Dielectric Constant (ϵ_r): The reflectability of the radar signal depends on the ϵ_r of the medium. Water has a high ϵ_r (~80), while plastic pellets or dry grains may have an ϵ_r as low as 1.5. The 64/69 series is highly sensitive, but for extremely low ϵ_r materials, the 69's focused beam is necessary to capture enough reflected energy.
- 2. Vessel Geometry: If the tank contains internal heating coils, agitators, or ladders, the narrow beam of the 80GHz radar is critical to "miss" these obstructions and hit the target medium.
- 3. Process Conditions: High pressure or extreme temperatures may require specific cooling fins or specialized seal materials. While the 64/69 series is robust, these environmental factors must be confirmed during the ordering process.

| Installation Considerations

Correct installation is the most significant factor in the long-term performance of the 64/69 radar series. Despite the advanced signal processing, physical placement remains paramount.

| Positioning and Orientation

Avoid the Center: Do not install the radar in the exact center of a dome-roofed tank. This can cause multiple reflections to converge at the receiver, creating false signals. Ideally, the sensor should be placed at 1/2 to 1/3 of the tank radius.

Distance from Walls: While the narrow beam allows for closer proximity to walls than 26GHz models, a minimum distance of 200mm (8 inches) is generally recommended to avoid interference from wall seams or build-up.

Nozzle Height: The antenna should ideally extend slightly beyond the bottom of the mounting nozzle. If the nozzle is very long, the internal reflections from the nozzle wall can interfere with the signal. In such cases, a 64/69 model with a nozzle extension or an integrated lens antenna is preferred.

| Obstructions and Agitators

If an agitator is present, the radar should be mounted in a position where the beam does not directly strike the blades. If this is unavoidable, the 64/69 series software includes a "False Echo Suppression" or "Echo Mapping" feature. This allows the instrument to record the static reflections from the agitator and ignore them during the measurement cycle.

| Limitations and Practical Constraints

While the 64/69 series is exceptionally versatile, engineers must be aware of specific limitations:

1. **Heavy Foam:** Extremely dense, thick foam (like shaving cream) can absorb the 80GHz signal rather than reflecting it. In applications with heavy foam, a hydrostatic level transmitter or a guided wave radar (GWR) may be more effective.
2. **Vacuum Conditions:** While radar works in a vacuum (unlike ultrasonic sensors), the mechanical seals of the 64/69 must be rated for vacuum service to prevent air ingress or damage to the electronics.

3. Condensation: While 80GHz radar handles condensation better than many technologies, heavy water droplets forming on the antenna lens can cause signal attenuation. Models with a convex lens design (common in the 64/69 series) encourage droplets to run off, but in extreme cases, an air purge system may be required.

| Frequently Asked Questions (FAQ)

Q: Can the 64 series be used for solids?

A: While technically possible for small containers of fine powder, it is not recommended. The 64 is optimized for the flat surfaces of liquids. The 69 is specifically designed with the signal processing power needed to handle the irregular, sloping surfaces of bulk solids.

Q: Does the 64/69 series require periodic calibration?

A: No. Radar level meters are non-mechanical and do not suffer from drift in the traditional sense. Once the "Zero" and "Full" points are mapped to the tank dimensions, the timing of the electromagnetic wave remains constant. Re-mapping may only be necessary if the internal structure of the tank changes.

Q: Is 80GHz radar safe for food production?

A: Yes, especially the 64 model. It is available with hygienic process connections (Tri-clamp) and FDA-approved PTFE materials, ensuring no entrapment areas for bacteria and compatibility with Clean-in-Place (CIP) processes.

Q: How does dust affect the 69 model?

A: High-frequency radar is significantly more robust in dust than ultrasonic or optical sensors. However, if the dust is extremely conductive and coats the antenna lens thickly, it may eventually attenuate the signal. The 69's air purge connection is designed to solve this specific issue by using a small amount of compressed air to keep the lens clean.

For engineers seeking to upgrade their level measurement capabilities, the 64/69 series offers a future-proof solution that combines precision with ease of installation. By selecting the model that aligns with the physical state of the media and following standard installation practices, facilities can achieve maintenance-free level monitoring for years. To view detailed mounting diagrams and ordering codes, please refer to the Main Page.