ECHODYNE

A Buyer's Guide to Evaluating Radar for Drone Detection

Selecting the right drone detection radar is a crucial decision, and real-world testing is the best way to ensure success. Lab results and data sheets don't always capture how radars perform in diverse, real-world conditions.

By simulating multiple drone scenarios, you'll gain critical insights into performance factors like detection accuracy, tracking reliability, and response speed—key metrics that directly affect your security outcomes.

Radar testing provides the clarity and confidence needed to evaluate each system's capabilities, ensuring you choose a solution that delivers actionable data and robust protection for your mission.

Recommended Drone Scenarios for Evaluating Radar

Scenario 1 - Hovering Drone: You should expect a radar to hold a track on a hovering drone at multiple ranges. To test this, hold the drone in a hover position for at least 60 seconds.

Scenario 2 - Drone Moving Erratically: You should expect a radar to be able to detect and hold a track on a drone rapidly changing direction. To test this, have the drone pilot move the drone up and down and in diamond and zig zag patterns.

Scenario 3 - Drone Entering Scene at Multiple Elevations: To verify comprehensive coverage and consistent radar detection and tracking of drones, have the drone approach from a few hundred meters out and just above horizon level then ascend before the final approach to the property.

Scenario 4 - Radar Integrated with Camera: For full zoom capability, pair a camera with a radar offering 1-5m range resolution. Lower angular accuracy requires targets to be closer for effective analytics and visual verification. Radar accuracy is just as critical as detection range, especially in sensor fusion.

Scenario 5 – Extremely Slow Flight Operations: Drones carrying load have an unbalanced center of weight and become unstable during fast flight. It's critical that the system can detect slower moving drones at speeds from 1 to 4m/s.

Scenario 6 - Drone Flying After Sunset: You should expect a radar to be able to detect and track a drone in all lighting conditions. It is recommended to pair a radar system with a thermal PTZ camera for nighttime threat confirmation and false positive reduction.

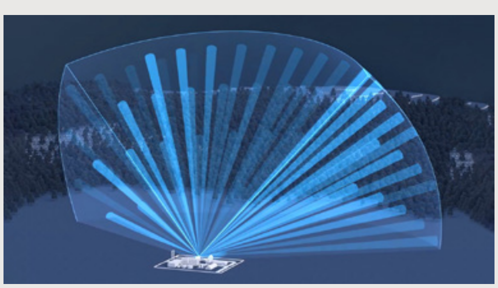
Scenario 7 - Drone Flying During Inclement Weather: High-performance radar will detect drones in extreme weather - rain, snow, wind storms, and more. While many drones will struggle in high wind, for example, others may not. It is prudent to test radar during common inclement weather events.

Scenario 8 - Dark Drone (aka Silent or RF Silent Drone): You should expect a radar to be able to detect and track a drone that does not have Remote ID and is not emitting a cataloged RF signal. Testing and verifying the radar will illuminate gaps in systems historically reliant on RF or Remote ID detection alone.

Scenario 9 - Drone Swarm: You should expect a radar to be able to detect and track multiple targets at a time. To test this, have 3 or more drones fly within the field of view simultaneously.

Key Observable Radar Performance Characteristics

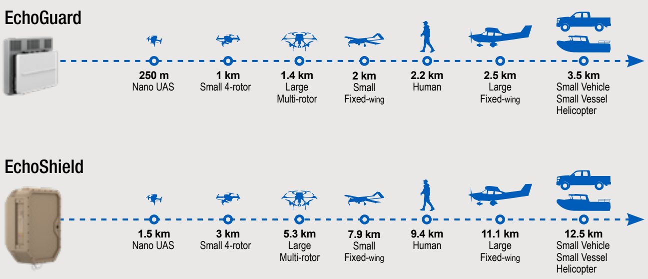
1 **Vertical Field of View:** It is critical to detect drones flying simultaneously high and low. To see both, a radar's vertical FoV should be at least 60 degrees or more, split between airspace, horizon, and fence line. Anything less will leave gaps in coverage.



2 **Accuracy of Target Location (aka range resolution, angular accuracy):** A 1-5 meter range resolution is necessary for these activities:
1) to determine precise object(s) location in 3D space, 2) to maximize zoom of a PTZ camera for visual verification, 3) for engagement of secondary camera analytics, and 4) when correlating radar targets with RF/RFID in a unified system.

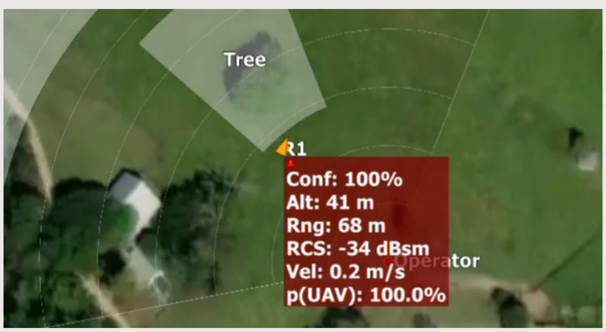
Note: Avoid double tasking radars. There are trade-offs in accuracy, range, classification, and FoV when looking for ground and air targets simultaneously.

3 **Range of detection & classification:** The radar's range of detection and classification must provide enough warning for the security team to react. The range of detection requirements will be informed by your location and risk evaluation. For many critical infrastructure and high security sites, 800 m minimum detection for commonly used uncrewed aerial vehicles (UAV) is preferred.



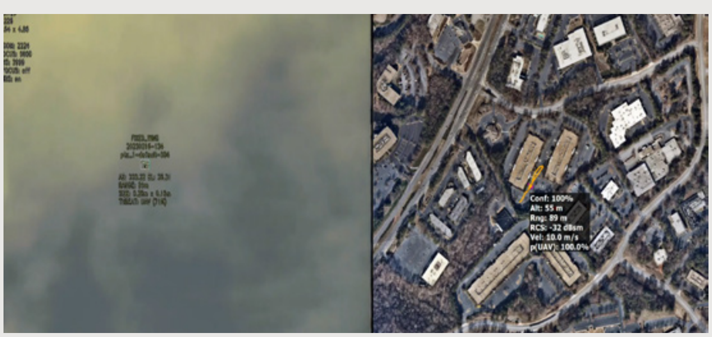
4 **Separation of targets:** For most accurate and complete situational awareness, radar should have range resolution of 5 meters, or better. Commonly, small form factor radars have a range resolution between 10 and 20 meters and, as such, can NOT distinguish between multiple drones flying close together. Cameras slewed by imprecise radar will struggle to zoom into a target until it is too close to the facility for security to act.

5 **Object classification:** Distinguishing between birds, drones and manned aircraft is essential for limiting false positives. The radar should have micro-Doppler capability and advanced algorithms to appropriately distinguish drones, other aircraft, and birds, for example.



6 **Track update rate:** Holding an accurate track on a drone requires a high track update rate. Radar with a track update rate of less than 8 hertz will struggle to track both fast moving & hovering drones and may drop tracks on critical targets. Additionally, a high data update rate ensures smooth and consistent camera slewing for "eyes on confirmation."

7 **Future proofing:** Choosing software defined radar ensures you receive regular performance updates (tuning, classification, range and accuracy) that keep pace with the evolution of threats. Choosing a solid-state, easy-to-set-up radar lowers operational burden and maintenance over the lifetime of use (true portability in radars should mean the radar can be up and running in less than twenty minutes.)



Note: Further Reduce False Alarms with Camera Analytics - When paired with a solid-state radar with excellent range resolution (aka angular accuracy), a PTZ camera with analytics provides an essential visual and data verification before an alarm sounds.

Note: Spinning Radar vs. Solid State Radar – Due to the inherent motion, spinning radars are often limited to a 1-3hz track update rate (less than half of the recommended 10hz), which impairs track accuracy and smooth camera slewing. Spinning radars also have parts and pieces, making them prone to downtime and maintenance.

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Radar Evaluation Worksheet

Use this page as a template or inspiration for creating your own evaluation form. Streamline scoring and data evaluation by establishing a simple rating system, such as 1-5, 1-10 or a ranked list. Ensure each evaluator has a copy of the worksheet during field testing and encourage them to capture their observations in real time for the most accurate and actionable insights.

	Echodyne	Radar B	Radar C
1. Hovering			
2. Erratic			
3. Multiple Elevations			
4. Radar + Camera			
5. Slow			
6. Nighttime			
7. Inclement Weather			
8. Dark Drone			
9. Drone Swarm			