# GNSSDO Use Case:

## Military 5G Networks

### Precision Timing for Mission-Critical Operations

The deployment of 5G networks has transformed communication infrastructure on the battlefield, improving speed, latency, reliability, bandwidth and edge capabilities. Military 5G networks enhance command and control, unmanned systems coordination and resilient mesh networking, all of which require precise timing for synchronization in dynamic, GNSS-denied environments. GNSS Disciplined Oscillators (GNSSDOs) provide stable references for Time Division Duplex (TDD) transmissions, accurate symbol timing and phase alignment across distributed 5G elements.

### Application Considerations for GNSSDOs in 5G Networks

- Dynamic Network Topologies: Mobile and ad hoc 5G deployments, common in military applications, require GNSSDOs that can maintain coherence without centralized control and that can support rapid synchronization across moving nodes.
- Spectral Purity for High-Order Modulation: Modern systems using high-order modulation schemes like 1024-QAM are highly sensitive to impairments in signal quality, so they require GNSSDOs with excellent phase noise performance.
- Phase and Time Synchronization: TDD-based 5G systems require tight phase alignment across all nodes in the network to avoid interference and ensure consistent quality of service.
- High-Stability Holdover: In GNSS-denied environments, the network must maintain sub-microsecond time accuracy to prevent performance degradation or network outages.
- Wide Temperature and Environmental Tolerance: GNSSDOs deployed in outdoor 5G equipment or on the battlefield must operate over a wide temperature range and in high shock and vibration environments.
- Size Weight and Power (SWaP): Commercial small cells and military edge 5G nodes often impose strict SWaP constraints on user equipment, requiring small, low-power GNSSDOs.

### Real World Scenario

A mobile command center sets up a 5G network to command-and-control (C2) unmanned vehicles and drones executing a surveillance mission in the area. GNSSDOs synchronize base stations, ensuring reliable, low-latency communication between the vehicle platforms and the C2 center.

| Performance Parameter | Microchip GNSSDO |
|---|---|
| **Holdover** | MD-015 MAC: 200 ns holdover over 24 hours<br>MD-015 CSAC: 1.5 µs holdover over 24 hours<br>MD-013: 1.5 µs holdover over 24 hours<br>MD-175/MD-178: 1.5 µs holdover over 24 hours |
| **Short-Term Frequency Stability** | MD-013 ULTRA CLEAN: 3E-13 ADEV at 1s tau, 6E-13 ADEV at 10s tau, 9E-13 ADEV at 100s tau<br>MD-013: < 7E-12 ADEV from 1–100s tau |
| **Low Phase Noise** | MD-013 ULTRA CLEAN: −119 dBc/Hz at 1 Hz offset, noise floor of −165 dBc/Hz<br>MD-177/MD-178: −135 dBc/Hz at 10 Hz offset, noise floor of −170 dBc/Hz |
| **Small SWaP** | MD-261: < 1 in. by 1 in. footprint, low power<br>MD-300: 1.5 in. by 2.5 in. footprint, low power |
| **Wide Temperature Range** | Most of our GNSSDOs are rated to operate from −40°C to 80°C |
| **Environmental Tolerance** | The MD-300 is our purpose-built harsh-environment GNSSDO that has excellent g-sensitivity, shock and vibration tolerance and low thermal transient response |

As 5G networks extend into increasingly dynamic environments, the need for reliable, precise time is more critical than ever. Our GNSSDOs deliver the necessary performance to meet these evolving challenges and to empower military 5G networks with precision and resilience. Whether you're building centralized hubs or ruggedized battlefield nodes, our GNSSDOs deliver the performance, flexibility, and reliability required to support the next generation of resilient communications infrastructure. Our GNSSDOs and custom solutions are backed by decades of experience as a world leader in developing advanced clock and timing systems. If our standard GNSSDO models do not meet your application-specific requirements, our team can work directly with you on a custom solution to fulfill your needs.


DS00006033A