emcore®

Fiber Optic, MEMS and Ring Laser Gyro Solutions for Navigation & Inertial Sensing

Transforming Navigation

EMCORE is the largest independent inertial navigation provider in the industry offering a broad, complementary suite of advanced solutions for the Aerospace & Defense, Commercial, Industrial, and Marine markets. Our navigation solutions fulfill demanding applications ranging from tactical to navigational and strategic grades. EMCORE's state-of-the-art Fiber Optic and Ring Laser Gyro technologies, combined with our world-leading Quartz MEMS navigation products achieve higher performance than competing units and legacy designs, and are transforming navigation worldwide.

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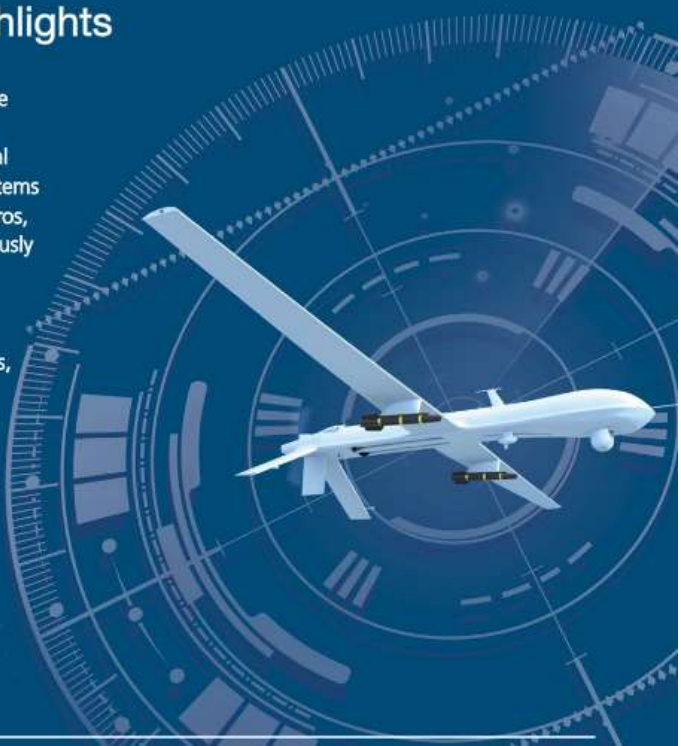
EMCORE Navigation Program Highlights

EMCORE designs and manufactures the world's highest-performance Fiber Optic Gyro (FOG), Ring Laser Gyro (RLG), and MEMS inertial sensors and systems. Our FOGs, Inertial Reference Units (IRU), Inertial Measurement Units (IMU), and FOG and RLG Inertial Navigation Systems (INS), combined with our world-leading Quartz MEMS (QMEMS) Gyros, Accelerometers, IMUs, and GPS/INS products, deliver clear, continuously improving performance advantages over competing products.

Our navigation solutions feature high bandwidth, high input rate, and low noise, combined with proprietary integrated optoelectronics, RLG, and QMEMS technologies to provide precise, reliable stabilization, geolocation, guidance, navigation, and control in critical Aerospace & Defense, and Commercial applications.

EMCORE's Navigation & Inertial Sensing programs have received multiple U.S. patents and have been qualified for many key Aerospace & Defense programs including equipment for navigation and flight control applications in United Launch Alliance (ULA) multistage space launch verhicles.



KEY CUSTOMER VALUE PROPOSITIONS

- Pioneer in the development of leading-edge FOG, RLG and QMEMS technology
- Trusted and reliable partner with more than 60 years of extensive experience
- Vertically-integrated manufacturing in the USA
- Innovative breakthrough products with unmatched performance for the price
- Multiple Raytheon Supplier Excellence Awards

Tactical, Navigational & Strategic-Grade Applications

- **Satellites and Space Launch Vehicles**
- **Defense** - UAVs, UUVs, UGVs, precision-guided munitions, torpedoes, weapons stabilization/targeting, ground vehicle, and man-portable warfighter applications
- **Civil Aerospace** - Commercial manned aircraft, rotorcraft
- **Industrial OEM** - Camera & antenna stabilization, ROV, robotic control
- **Energy & Infrastructure** - Pipeline inspection, wind turbine control, platform stabilization
- **Transportation** - Automotive testing, ride control

Quality and Reliability

- Superior on-time delivery & customer quality index
- Industry-leading reliability under the most demanding conditions
- High Mean Time Between Failure (MTBF) rating
- No recalibration or rebuilding

Open-Loop FOG Advantages

- Superior CSWaP (Cost, Size, Weight, and Power)
- Extremely affordable and easy to integrate
- Photonic Integrated Chip (PIC) technology with a groundbreaking planar optical chip for outstanding repeatability unit-to-unit

Closed-Loop FOG and RLG Advantages

- Highest performance levels for the most demanding applications ranging from high-end tactical to navigational and strategic grades
- Industry-leading in-run accuracy and Angle Random Walk (ARW) noise
- Numerous interfaces supported including Ethernet, SDLC, MIL-STD-1553 and custom solutions

Quartz MEMS Advantages

- Smaller size and lighter weight
- 1°/hr bias accuracy for tactical applications
- Excellent stability and superior noise level performance
- Superior shock and vibration tolerance
- No known modes of wear-out, no moving parts or friction
- Lower cost and long life

EMCORE Custom Design, Engineering and Manufacturing

EMCORE is a fully vertically-integrated manufacturer that designs and manufactures its inertial navigation products in the USA at our 7,000 square foot Indium Phosphide (InP) and Lithium Niobate ($LiNbO_3$) semiconductor wafer fabrication plant at our headquarters in Alhambra, CA, and at our design, fabrication and manufacturing facilities in Budd Lake, NJ, Concord, CA, and Tinley Park, IL.

Quality and Supply Chain Management

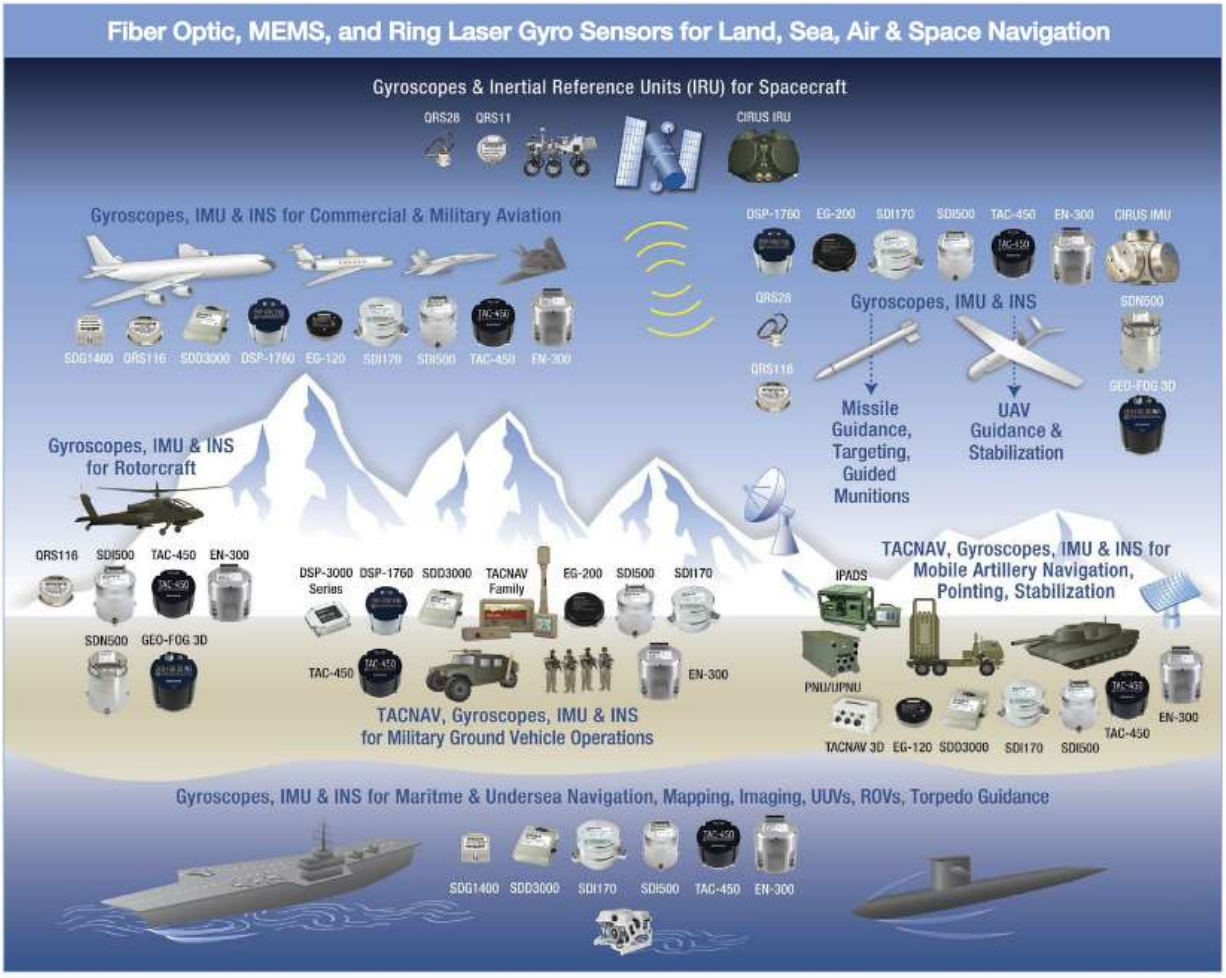
EMCORE is dedicated to the most stringent and demanding quality management systems to achieve the highest levels of on-time delivery and customer satisfaction possible. Our expert product engineering, management, and operations teams work in synergy to ensure a smooth and efficient quality assurance process from product development to supply chain management and inspection, and final assembly and shipping.

We are continuously driving improvement and training our team on systematic thinking and problem-solving tools to maintain a culture that designs and builds quality into all our products and processes.

ISO 9001 and AS9100 Certified

Our manufacturing facilities have all acquired and maintain ISO 9001 certification and we are AS9100 aerospace quality certified at our facilities in Budd Lake, NJ and Concord, CA.

EMCORE Aerospace & Defense Navigation Applications



Open-Loop Fiber Optic Gyro IMU & INS

EMCORE's FOG IMUs and INS portfolio has expanded to include the open-loop FOG-based products of KVH Industries acquired in 2022. Proven aboard autonomous platforms worldwide, they bridge the gaps in satellite navigation with precision data, very high bandwidth, low latency, and low drift.

TAC-450 Series FOG IMUs

The new TAC-450 line of IMUs are designed to deliver the highest level of performance in their class and feature our exclusive Photonic Integrated Chip (PIC) technology. Models include the TAC-450-360, TAC-450-340 and TAC-450-320 which enable customers to select the performance level that best fits the requirements of their application.

TAC-450-360

The TAC-450-360 IMU is one of the premier IMUs offered by EMCORE and is designed to deliver the highest level of performance for applications in which high bandwidth, low latency, and low drift are critical. The TAC-450-360 IMU is integrated with inertial-grade accelerometers and three axes of magnetometers to provide the high accuracy that leading autonomous and manned platforms demand.

TAC-450-340

The TAC-450-340 IMU is a versatile, high-performance IMU with robust performance and survivability. It also offers inertial-grade MEMS accelerometers for excellent performance for autonomous and manned platforms and integrates easily into the most demanding applications.

TAC-450-320

The TAC-450-320 IMU is a dependable, tactical-grade inertial system that's also affordable. It features inertial-grade MEMS accelerometers for outstanding performance as affordable as MEMS alternatives and is ideal for autonomous and unmanned commercial and defense applications.

Features/Benefits

- Extremely high bandwidth ≥1000 Hz (TAC-450-360)
- Exceptional precision–bias instability ≤0.05°/hr
- Flexible, user-friendly programmable data output rates from 1-1000 Hz
- Compact and lightweight for excellent SWaP
- High scale factor accuracy and bandwidth
- Three tactical-grade photonic FOGs (All models), and 3-axis magnetometer (TAC-450-360)
- Your choice inertial-grade MEMS accelerometers
- Rugged design for extreme environments, with excellent shock and vibration performance

EMCORE Photonic Integrated Chip (PIC) Technology

PIC INSIDE

EMCORE's Photonic Integrated Chip (PIC) reinvents FOG technology with a groundbreaking planar optical chip that replaces individual fiber optic components for easy integration and outstanding repeatability unit-to-unit.

Applications

- Demanding autonomous platforms
- GNSS-aiding inertial navigation
- Antenna, camera, laser pointing, and stabilization
- EO/FLIR system stabilization
- Oil & gas exploration, maintenance
- Drilling and mining
- Mapping & surveying

GEO-FOG Series 3D INS

EMCORE's GEO-FOG INS are a rugged, high-accuracy INS and AHRS with exclusive PIC technology and embedded GNSS. With a data rate 10x faster than competing systems, the GEO-FOG 3D INS includes three EMCORE ultra-reliable PIC enhanced gyroscopes integrated with three low-noise, high-grade 16g accelerometers and a single antenna GNSS receiver. The GEO-FOG 3D Dual INS features two GNSS antennas on a fixed PTK baseline to offer increased heading, pitch, and roll accuracy for static and dynamic applications where a single antenna system can be problematic.

Features/Benefits

- Provides up to 8 mm positioning accuracy
- Embedded Trimble GNSS receiver
- 6 DoF IMU consisting of integrated FOGs and accelerometers
- Fully supports GPS, GLONASS, GALILEO, and BeiDou
- Innovative sensor fusion algorithm extracts more data than typical Kalman filters (GEO-FOG 3D Dual)

Applications

- Navigation and control
- Unmanned, manned autonomous systems
- IMU, GPS/INS integration
- Positioning and imaging
- Georeferencing and land surveying
- Stabilization and orientation

Open-Loop Fiber Optic Gyroscopes

EMCORE's field-proven precision open-loop FOGs offer easy integration with installation flexibility, and our Developer's Kit enables rapid prototyping. These high-performance gyroscopes provide precise pointing and rock-steady stabilization for land, sea, and aerial systems.

DSP 3000 Series Fiber Optic Gyroscopes (FOG)

DSP-3000

The workhorse of EMCORE's single-axis FOG series, EMCORE's DSP-3000 offers field-proven performance in a wide range of applications. Its compact, robust design, coupled with a choice of analog, digital, and digital RS-232 outputs, makes the DSP-3000 the most versatile fiber optic gyro available and an ideal solution for guidance and stabilization, low-cost IMUs, integrated GPS/INS, and AHRS.

DSP-3100

Designed for demanding applications requiring high-speed data output, the EMCORE DSP-3100 offers a powerful high-speed digital RS-422 interface with 1000 Hz asynchronous output in a package more compact than the EMCORE DSP-3400. With its industry-standard Samtec 26-pin connector, it offers a versatile package ideal for installations with tighter installation requirements while not sacrificing performance, reliability, or durability.

DSP-3400

The EMCORE DSP-3400 offers the reliability and robust design found in all members of the DSP-3000 series, but adds the benefits of a true digital RS-422 interface and a 1000 Hz synchronous output in a durable, shielded package. As a result, the DSP-3400, with its robust, modular design, is a powerful option for use in applications requiring FOG output to be transmitted over a longer distance.

Features/Benefits

- Single-axis FOG, modular design for 1, 2, or 3-axis configurations
- 1° per hour performance
- Exceptional bias stability and scale factor linearity – minimal temperature and power-up errors
- Excellent reliability: >55,000 hours MTBF, ground mobile

Applications

- Antenna/radar/optics stabilization
- Gun/turret stabilization
- IMU, GPS/INS integration
- AHRS integration
- Automated inventory tracking (DSP-3400)

EMCORE DSP Technology

EMCORE's DSP electronics improve FOG performance in critical areas such as scale factor and bias vs. temperature, scale factor linearity, and maximum input rate. EMCORE's exclusive DSP design overcomes the limitations of analog signal processing, eliminating temperature-sensitive drift and rotation errors.

DSP-1750 & DSP-1760 Fiber Optic Gyroscopes (FOG)

EMCORE's DSP-1750 and DSP-1760 take FOG technology to a new level of performance with the world's smallest precision FOGs, easy-to-integrate housings, or unhoused configurations for OEM applications. The navigation-grade DSP-1760 FOG includes EMCORE's breakthrough Photonic Integrated Chip (PIC) technology for improved reliability and repeatability and offers the versatility of 1, 2 or 3 axes configurations. The DSP-1750 gyro is available in both single- and dual-axis configurations. These gyros are ideal for a wide variety of commercial and defense applications with high bandwidth and extremely low noise performance.

Features/Benefits

- 1, 2, or 3 axes of high-performance FOGs with multiple configurations
- RS-422 digital interface (Asynchronous or Master Synchronous)
- Compact housed package; also available in unhoused OEM variant
- EMCORE's exclusive PIC technology for improved reliability

Applications

- Platform stabilization for land, sea, and aerial systems
- Navigation, guidance, and control systems
- Drilling and mining
- Stabilization and navigation for unmanned and manned applications

Fiber Optic Gyro IRU & IMU

EMCORE's FOG IRU & IMUs now include the products of the former L3Harris Space & Navigation, which has been the premier supplier of mission-critical precision pointing and navigation systems since the early days of the U.S. space program. This enables EMCORE to offer an even wider range of FOG inertial measurement unit products from tactical to navigational and strategic grade.

CIRUS Compact Inertial Reference Units (IRU) for Space (CIRUS & CIRUS-EX)

The CIRUS leverages over sixty years of experience and proven performance in systems deployed in space and is designed and qualified as the next-generation product. The CIRUS and CIRUS-EX rate sensors deliver two different strategic grades of performance combined with the benefits of a compact, low-cost system in an integral chassis. Both CIRUS and CIRUS-EX systems feature four FOG sensors in a fully redundant configuration.

Features/Benefits

- Two performance grades with lowest ARW <100 μ°/√hr
- Four gyros and dual A/B electronics provide Optimal redundancy for enhanced mission success
- Dual-redundant serial interfaces (MIL-STD-1553 and RS-422) to permit flexible I/O rates
- High-reliability Class S and K Rad-hard electronics
- Each sensor is individually power-selectable providing ultimate flexibility for the end user
- User-selectable thermal set points and capability to execute "on-station" commands for optimal situational awareness

Applications

- Spacecraft attitude control
- DoD, NASA and commercial missions

CIRUS-A High-Performance FOG IMU

The high-performance CIRUS-A FOG IMU is a state-of-the-art, strategic-grade inertial measurement unit for inertial navigation, guidance, pointing and stabilization of missile, space, sensor, ground, air, and marine applications. The CIRUS FOG IMU design simplifies the optical circuitry reducing the number of components while providing a significant performance improvement over standard military environments.

Features/Benefits

- Strategic-grade performance for a variety of applications
- Performance enhances all EO/IR Platforms ability to identify and defeat air and ground threats

Applications

- Platform stabilization
- Pointing applications
- Missile guidance systems
- Vehicle/platform navigation
- Northfinder applications

EN-300 Precision FOG IMU

EMCORE's EN-300 Precision FOG IMU is a higher accuracy inertial system that is form, fit, and function compatible with a legacy equivalent, but with the better performance needed for GPS denied navigation, precise targeting, and line-of-sight stabilization. This state-of-the-art design incorporates EMCORE's proprietary integrated optics to enhance accuracy, providing up to ten times better performance than competing systems.

Features/Benefits

- Three-axis, precision closed-loop FOG IMU using EMCORE's proprietary FOG transceiver
- More than double the fiber length of legacy IMUs
- Three precision MEMS accelerometers with greater dendulocity than legacy designs
- Factory programmable I/O with exceptional flexibility and performance options that can be tailored to customer requirements

Applications

- UAVs
- Dismounted soldier
- Oil and gas exploration
- Ground vehicle navigation
- Aeronautics and civil aviation
- Far target pointing-stabilization
- Applications where GPS unavailable

Ring Laser Gyro Battlefield INS

EMCORE's product line now includes the advanced Ring Laser Gyro-based products of the former L3Harris Space & Navigation, which has supplied the highest performance, reliability, and quality pointing and position capability for land navigation including artillery/radar positioning & pointing systems and battlefield/artillery survey systems.

Position & Navigation Unit, Universal Position & Navigation Unit (PNU / UPNU)

The PNU / UPNU provides the Multiple Launch Rocket System (MLRS) and High-Mobility Artillery Rocket System (HIMARS) programs with the highest performance, reliability and quality pointing and position capability, paving the way for the future direction of the land navigation systems. Utilizing advanced sensors, electronics, software, and aiding (GPS and odometer), the PNU / UPNU family delivers precisely what the Army of tomorrow needs — a system designed to remain operationally effective and affordable to support well into the future.

Features/Benefits

- High-performance RL-34 ring laser gyros (0.18 mils RMS sec lat)
- Common architecture and components (Paladin, Firefinder, Air Surveillance Radar, IPADS CPNU)
- Impervious to jamming (inertial mode) and resistant to jamming (GPS-aided mode)
- Combat-proven, high-reliability MTBF and low Mean Time to Repair (MTTR)

Applications

- Mobile multiple launch artillery rocket systems
- Aiming and navigation of launcher ground vehicles
- High-precision pointing of launcher pods and rockets

Dynamic Reference Unit-Hybrid Replacement (DRU-H-R)

The DRU-H-R is an advanced precision delivery subsystem that provides accurate vehicle position and attitude data and operates on Paladin and Firefinder, both playing critical roles in supporting U.S. ground forces in all phases of active combat operations. The EMCORE S&N DRU-H-R design upgraded system performance by using high accuracy, combat-proven inertial sensors currently fielded on the MLRS and HIMARS weapon systems, and the IPADS survey system.

Features/Benefits

- High-performance RL-34 ring laser gyros (0.18 mils RMS sec lat)
- Common architecture and components (MLRS, HIMARS, IPADS)
- Impervious to jamming (inertial mode) and resistant to jamming (GPS-aided mode)
- Combat-proven heritage; fully qualified/U.S. government tested

Applications

- Self-propelled howitzers, counter-fire radar, air surveillance radar
- Aiming and navigation of howitzer and radar ground vehicles
- High-precision pointing of howitzer gun tube and radar array

Improved Position and Azimuth Determining System (IPADS)

EMCORE's Improved Position and Azimuth Determining System (IPADS) is an inertial surveying system developed to meet today's demanding U.S. Army and Marine Corps survey needs. Survey operations functionality, navigational accuracy, transportability, survivability and affordability requirements drove the system design. IPADS provides significant enhancements for today's Army and Marine Corps survey teams with all components housed in a robust frame with easy component access and stability, facilitating a two-person transfer between vehicles and aircraft.

Features/Benefits

- High-precision common survey enables efficient mass fires
- Common architecture and components (MLRS, HIMARS, Firefinder, Paladin and Long-Range Air Surveillance Radar)
- Navigation aids (compass rose and digital maps)
- In-vehicle and offset survey
- Combat-proven
- High reliability MTBF, low Mean Time to Repair (MTTR)
- GPS, non-GPS and international versions available

Application/Specifications

Survey Control Point (SCP) Accuracy

- 3.6 m CEP, 1.6 m PE, 75 km radial distance (GPS-denied)
- 1.8 m CEP, 0.8 m PE, unlimited distance (GPS-available)

Orienting Line (OL) Accuracy

- 0.4 mils PE (GPS-denied)
- 0.2 mils PE (GPS-available)

TACNAV® Tactical Navigation

Assured Position, Navigation and Timing (A-PNT) demands resilient inertial-based navigation systems and the battle-proven, unjammable family of TACNAV® systems from EMCORE. TACNAV inertial tactical navigation systems are solutions deployed by the U.S. Army and militaries around the world for battlefield navigation of a wide variety of mililtary ground vehicles. As militaries demand assured A-PNT solutions independent of satellite data, they look to TACNAV for accurate navigation with and without GNSS.

TACNAV® Light/GPS

Maintaining 100% situational awareness is vital to all military crews. Designed specifically to meet the requirements of light military vehicles, EMCORE's TACNAV® Light/GPS delivers a powerful suite of features that brings a new level of flexibility, reliability, and performance to light vehicle navigation. With EMCORE's Moving Map Display (MMD) and the Universal Multilingual Display (UMD), the TACNAV Light/GPS offers:

- The ability to create and store waypoints and routes, and view vehicle travel in real time
- Intuitive easy-to-read displays of heading, position, distance, and direction to waypoint
- Easy use thanks to the touchscreen MMD screen

Features/Benefits

- Compass-based system with embedded GPS
- Heading 2.5° RMS
- Positioning accuracy within 5 meters CEP with valid GPS
- Without GPS, positioning accuracy 2-3% distance traveled
- Commander's MMD for route, waypoint entry
- Driver's UMD with steer-to functionality

TACNAV® 3D - NOW with PIC Technology

The FOG-based TACNAV® 3D tactical inertial navigation system provides an assured position, navigation, and timing system with an embedded GNSS and optional Chip-Scale Atomic Clock (CSAC). TACNAV 3D also has EMCORE's new exclusive Photonic integrated Chip (PIC) technology, which delivers even more reliability while maintaining or improving accuracy and performance. TACNAV 3D's modular tactical design means it functions as a standalone inertial navigation solution, and as the core of an A-PNT-capable multi-functional battlefield management system.

PIC INSIDE

Features/Benefits

- High-performing EMCORE IMU for reliable 100% situational awareness even when GPS/GNSS is unavailable
- Extremely accurate heading, dead reckoning navigation, and orientation at a lower cost than competing systems
- E1 Pulse Per Second (PPS) timing assurance during loss of GPS/GNSS
- Full 3D navigation provides dynamic heading/pitch and roll, and altitude/distance and bearing to waypoint
- Designed for easy integration with Battlefield Management Systems (BMS), including the optional two-way Iridium® satellite communications for short duration burst messaging
- Receives and transmits both Ethernet and CANbus signals, and RS-422
- Horizontal and vertical positional accuracy even when GPS/GNSS is blocked, jammed, or unavailable
- Inertial sensors not reliant on compass heading

TACNAV® Tactical Navigation

TACNAV® Universal Multilingual Display (UMD)

EMCORE's TACNAV® Universal Multilingual Display (UMD) offers robust tactical display technology capable of presenting navigation and other critical information in multiple languages. With its versatility and affordability, the TACNAV UMD is ideal for any military vehicle requiring a user-friendly interface for its tactical navigation system.

Features/Benefits

- Rugged, active dot-matrix design, delivering unparalleled clarity and flexibility
- User-friendly interface with easy-to-read icons, messages, and pop-up menus
- Generation III NVG (night vision goggle)-compatible
- Four "soft keys" for easy operation
- Interchangeable with both Commander's and Driver's Displays, reducing logistics and cost

TACNAV® Light for Non-Turreted Light Vehicles

On the battlefield, maintaining situational awareness is vital to crews of all military vehicles, not just heavy combat forces. Yet light vehicles don't need all of the extras that "big budget" navigation systems bring. EMCORE's TACNAV® Light is a field-proven digital compass-based battlefield navigation system that is type-classified by U.S. SOCOM for non-turreted vehicles.

Features/Benefits

- One of the lowest cost tactical navigation systems available
- GPS backup and enhancement, vehicle position, hull azimuth, and steer-to/cross-track error displays
- Compass for the highest degree of accuracy and unjammable position and navigation information

TACNAV® TLS Turreted Vehicles

EMCORE's TACNAV® TLS equips turreted military vehicles with an easy-to-integrate, versatile battle management, tactical navigation, and targeting solution. This affordable system supports an array of military vehicles, including cavalry, reconnaissance, armored personnel carriers, and light armored vehicles.

Features/Benefits

- Continuous, jam-proof position data
- Far target location, GPS backup and enhancement, hull and turret azimuth, and steer-to/cross-track error displays
- Dead reckoning and odometer interface for accuracy to within 2-3% of distance traveled

TACNAV® Moving Map Display (MMD)

The rugged TACNAV® Moving Map Display (MMD) offers real-time moving map technology for EMCORE's TACNAV family of tactical navigation systems. The MMD provides an easy-to-use graphical navigation capability for military vehicles by combining available internal or external GPS/GNSS with TACNAV's inertial or compass-guided navigation solution. Developed for demanding battlefield conditions, the MMD's touchscreen is viewable in all lighting conditions.

Features/Benefits

- Position, heading, speed, cross track error, distance, and bearing to waypoint
- Locally stored navigation information on either a satellite or topographic map in multiple languages
- Fixed-mount display ruggedized to withstand demanding military environment

Closed-Loop Fiber Optic Gyroscopes

EMCORE's closed-loop FOG technology is designed for fast, accurate navigation and gyrocompassing, and low noise line-of-sight stabilization. Our long-standing leadership in the development of highly-accurate defense and military-grade fiber optic components has paved the way for the development of more accurate and economical FOG components.

EMCORE-Hawkeye™ EG-200 Fiber Optic Gyroscope

NON ITAR

The EMCORE-Hawkeye™ EG-200 Fiber Optic Gyro is a superior device in regards to weight and form factor for tactical applications. It incorporates fully-integrated optics and next-generation Field Programmable Gate Array (FPGA) electronics that deliver higher accuracy, optical drift stability, lower noise, greater efficiency and reliability, combined with low cost. The EG-200 can be calibrated internally for better thermal effect.

Features/Benefits

- Closed-loop design for improved drift stability, higher linearity, and greater flexibility
- Digital and analog outputs to accommodate the widest variety of installation parameters
- Bandwidth to 300 Hz
- More economical than competing systems

Applications

- Platform, camera and antenna Stabilization
- Robotic control
- UAVs
- Ground vehicle & dismounted soldier
- Spacecraft

EMCORE-Hawkeye™ EG-120 Fiber Optic Gyroscope

NON ITAR

The EMCORE-Hawkeye™ Series EG-120 FOG module is an ultra-compact, state-of-the-art design that is the smallest, most affordable closed-loop FOG available on the market today. At approximately 1/2 the weight with 1/3 the power requirements of current generation FOGs, the EG-120 delivers the industry's best Size, Weight and Power (SWaP) compared to competing products.

Features/Benefits

- Smallest, most affordable closed-loop FOG available
- Closed-loop design for improved drift stability, higher linearity, and greater flexibility
- Fully-Integrated optics and next-generation Field Programmable Gate Array (FPGA) electronics
- Bandwidth to 250 Hz

Applications

- Platform, camera, antenna and gun stabilization systems
- Robotic control
- UAVs
- Ground vehicle & dismounted soldier
- Spacecraft

EMCORE Hawkeye™ EG-1300 Fiber Optic Gyroscope (FOG)

The EMCORE-Hawkeye™ EG-1300 Fiber Optic Gyro is a superior device in regards to weight and form factor for navigational-grade applications. Its advanced integrated optics and closed-loop FPGA electronics deliver much higher accuracy, lower noise, and greater efficiency than competing technologies. The EG-1300 can be calibrated internally for better thermal effect and has both digital and analog outputs, along with separation of the electronics from the FOG's sensing coil assembly to accommodate the widest variety of installation parameters.

Features/Benefits

- Precise navigation (1 mile/hour without GPS)
- Fast, precise gyrocompassing to 1 milliradian
- Separate electronics and sensor modules for greater installation flexibility
- Bandwidth to 500 Hz
- More economical than competing systems

Applications

- Navigational-grade applications
- Unmanned Aerial Vehicle (UAV) guidance
- Missile guidance
- Aeronautics and aviations

MEMS IMU & GPS/INS

EMCORE's MEMS IMUs and Navigation Systems (GPS/INS), based on our Systron Donner Quartz MEMS technology, deliver unprecedented performance in their class. They are designed for a wide variety of high-precision Commercial, Industrial, Marine, and Defense Applications.

SDI500 Tactical Grade IMU

The SDI500 IMU outperforms other MEMS IMUs and delivers comparable performance to older, costlier optical IMUs in a lower power, smaller, and lighter form factor. With 1°/hr gyro bias, 1 mg accelerometer bias stability and very low 0.02°/√hr Angle Random Walk (ARW) over wide temperature ranges, the SDI500 is designed to achieve the demanding performance levels required in sophisticated systems applications and is well-suited for use by Integrators and OEMs.

Features/Benefits

- Excellent bias stability
- Unprecedented low angle random walk values
- Superior vibration performance
- Miniature, small footprint size (19 in.³)
- Multiple data formats/output interfaces

Applications

- Missile & torpedo guidance, control & targeting
- Precision guided munitions
- Defense fixed wing and helicopter
- UAVs and UUVs
- Tank turret stabilization
- Platform stabilization

SDC500 Quartz MEMS Inertial Measurement Unit (License Free)

The compact SDC500 IMU meets commercial aerospace, industrial and marine application needs globally. It is available in several performance-cost options ranging from 1°/hr gyro and 1 mg accelerometer to 20°/hr gyro and 5 mg accelerometer bias over temperature, shock, and vibration environments. The SDC500 is constructed with EMCORE's latest generation quartz gyros, quartz accelerometers, and high-speed signal processing to achieve outstanding precision performance.

Features/Benefits

- 1 to 20°/hr gyro bias over temperature options
- 19 in.³ compact size
- 12 g rms, vibration operating performance environment (20-2,000 Hz random)
- Greater than 100,000 hr MTBF

Applications

- General aviation / flight control
- Precision AHRS
- GPS-aided navigation
- Autonomous vehicles and ROVs
- Aerial & marine geomapping
- Commercial pipeline inspection
- Mining / agriculture

SDI170 Tactical Grade IMU

EMCORE's SDI170 IMU is designed as a performance-compatible inertial system that is form, fit, and functional with a legacy RLG-based IMU product, but with superior overall performance, versatility, and a significantly higher MTBF rating over ruggedized environments. The tactical performance of the SDI170 IMU is based on EMCORE's mature, proven, dependable, and accurate quartz MEMS inertial sensor technology in our SDI500 tactical-grade IMU.

Features/Benefits

- 1°/hr gyro & 1 mg accel bias over temperature
- 0.02°/√hr angle random walk–5X better than RLG-based IMU it is designed to replace
- <1 second start-up time to valid data
- <33 in.³ rugged size
- 20 year lifetime without recalibration, greater than 100,000 hour MTBF

Applications

- Precision AHRS
- GPS-aided navigation systems
- Autonomous & remotely operated vehicles
- Tactical weapons: missile & torpedo guidance, control & targeting

SDN500 GPS/INS Tactical Grade Navigation System

Our most advanced MEMS GPS/INS tactical grade system, the compact SDN500 combines latest generation quartz gyros, quartz accelerometers, high-speed signal processing, and a 48-channel Coarse/Acquisition (C/A) code GPS receiver into a powerful, tightly coupled guidance and navigation system. There is also an option to utilize a Selective Availability Anti-Spoofing Module (SAASM) GPS receiver. Our proprietary quartz MEMS inertial sensors maintain position and attitude accuracy in the event of loss of GPS tracking. The low-power SDN500 is designed for integrator and OEM use in the latest demanding, smaller, and more scalable system applications.

Features/Benefits

- Adaptable, modular 25 in.³ compact size for packaging flexibility, weighs < 1.6 lbs.
- 48-Channel GPS tracking for improved coverage
- Less than 35 second Time to First Fix (TTFF) from cold
- Enhanced 100 Hz position data
- Customer programmable output data rates

Applications

- UAVs
- Defense fixed wing and helicopter
- Missile guidance control & targeting
- Precision guided munitions
- Platform stabilization

IMU Competitive Comparisons

EMCORE MEMS IMUs VS. COMPETITOR

	EMCORE SDI500 & SDI170		Honeywell HG1700	
Parameter	**Gyro Channels**	**Acceleration Channels**	**Gyro Channels**	**Acceleration Channels**
Performance				
Bias	1°/hr - 10°/hr	1.0 mg - 2.0 mg	1°/hr - 5°/hr	1.0 mg - 3.0 mg
Bias In-Run Stability	1°/hr - 2°/hr	100 µg - 200 µg	N/A	N/A
Random Walk (Noise)	<0.02°/√hr	100 µg/√Hz	<0.125 - 0.5°/√hr	0.65 FPS/√hr
Data Rates	600 Hz (Control) / 100 Hz (Guidance) - other rates available		600 Hz (Control) / 100 Hz (Guidance)	
Physical & Environmental				
Operating Temperature Range	-55 °C to +85 °C		-54 °C to +85 °C	
Dimensions	SDI500 2.9"D x 2.9"H, SDI170 3.5"D x 2.9"H		HG1700 AG 3.5"D x 2.86"H	
Weight	SDI500 1.3 lbs, SDI170 1.95 lbs		HG1700 AG <2 lbs	
Volume	SDI500 19 cubic in., SDI170 33 cubic in.		HG1700 AG 33 cubic in.	

EMCORE EN-300 FOG IMU VS. COMPETITOR

	EMCORE EN-300		Northrop Grumman LN-200	
Parameter	**Gyro Channels**	**Acceleration Channels**	**Gyro Channels**	**Acceleration Channels**
Performance				
Bias	0.1°/hr - 0.4°/hr	300 µg	0.5°/hr - 3°/hr	300 µg - 3.0 mg
Bias In-Run Stability	0.02°/hr - 0.08°/hr	0.1 mg	N/A	N/A
Random Walk (Noise)	<0.008°/√hr - 0.03°/√hr	0.025 m/s/√hr	<0.07°/√hr - 0.15°/√hr	N/A
Bandwidth	≤1800 Hz		N/A	
Physical & Environmental				
Operating Temperature Range	-40 °C to +71 °C		-54 °C to +71 °C	
Dimensions	3.5"D x 3.35"L		3.5"D x 3.35"L	
Weight	<1.8 lbs		<1.65 lbs	
Volume	33 cubic in.		<35 cubic in.	

MEMS Gyros & Multi-Axis Sensors

EMCORE's line of MEMS Gyroscopes and Multi-Axis Rate Sensors, based on our Systron Donner Quartz MEMS technology, deliver high reliability and low total cost of ownership, with no wear-out modes or calibration intervals required. Customers can select performance levels to match their requirements ranging from 0.5 to 20 degrees per hour bias stability with exceptionally low noise, small size, high bandwidth and reliability.

SDD3000 Single-Axis Precision Digital Gyroscope

NON ITAR

The SDD3000 is our high-performance, digital, single-axis gyroscope. Incorporating an advanced Quartz MEMS sensing element, it is optimized for applications that require low noise and excellent stability over changes in temperature and vibration. Boasting a small size, light weight, and very low power consumption, the SDD3000 is truly a leader in its performance class.

Features/Benefits

- Exceptionally low noise <0.01°/√hr (ARW)
- Bias in-run stability <0.5°/hr
- Robust shock & vibration tolerance, 40g shock operating /150g shock survival
- RS-232 or RS-422 digital output
- Compact 8.0 in.^{3} size

Applications

- UUV, UGV and UAV
- Camera and platform stabilization
- Tank turret stabilization
- Missile targeting
- Commercial transport

QRS116 Single-Axis Tactical Grade Analog Gyroscope

NON ITAR

The QRS116 utilizes an advanced Quartz MEMS inertial sensing element that delivers groundbreaking levels of low angle random walk, bias stability, and vibration performance. The QRS116 is a compact angular rate sensor ideally suited for applications in tactical, aerospace, and mission-critical instrumentation. The QRS116 features exceptionally low noise, fast start-up, a simple electrical interface, and no moving parts ensuring long service life and high MTBF.

Features/Benefits

- Exceptional bias stability
- Unprecedented low angle random walk values
- Superior vibration performance
- Compact industry-standard package (Same as QRS11)
- Rugged, compact package integrates easily

Applications

- UAV, UGV and ROV
- Tank turret stabilization
- Defense fixed wing and helicopter
- Camera and platform stabilization
- Antenna stabilization

QRS28 Multi-Axis Gyroscope

NON ITAR

With one of the industry's smallest form factors, QRS28 couples two of our robust quartz MEMS rate sensors for unprecedented capabilities in wide bandwidth, repeatable bias performance over temperature, and ruggedness in most environments. It is especially suited for demanding applications that require reliable performance such as missile seeker gimbal stabilization, as well as high volume commercial applications, where small size and low power consumption are required.

Features/Benefits

- Dual axis capabilities in small form factor
- Miniature size: only 25 gm (1.05" x 0.71" diameter)
- Hermetically sealed In stainless steel cylinder
- High reliability
- DC Input/high-level DC analog output

Applications

- Tank turret stabilization
- Missile targeting
- Platform, antenna and camera stabilization
- Spacecraft

SDG1400 Single-Axis Analog Gyroscope

For the most demanding commercial and aerospace applications, the SDG1400 offers class-leading performance and stability in a small, rugged package. Utilizing an advanced Quartz MEMS inertial sensing element, it provides superior bias stability and repeatability. The SDG1400 has no moving parts and exceptional MTBF performance. A commercial off-the-shelf product, it gives fast start-up, very low noise, and high bandwidth, making it ideal for critical commercial and aerospace applications.

NON ITAR

Features/Benefits

- Superior bias stability and repeatability
- Miniature solid-state package, small footprint
- Low noise
- Wide operating temperature limits
- Internal temperature sensors
- RoHS compliant

Applications

- BizJet
- Commercial transport
- Platform, antenna and camera stabilization
- UUV and ROV
- Robotic control

SDG500 Single-Axis Analog Gyroscope

Featuring performance advantages over other gyros in its class, the SDG500 is a completely self-contained angular rate sensor. Utilizing a Quartz MEMS inertial sense element housed in a compact, rugged aluminum case, it provides virtually unlimited life. An on-board temperature sensor allows the user to enhance performance via thermal modeling and correction. With a simple DC input and high-level DC output, the SDG500 will integrate quickly and simply into your designs.

NON ITAR

Features/Benefits

- Exceptional bias stability
- Superior vibration performance
- Low noise
- Miniature size, small footprint
- DC input/high-level DC output
- RoHS compliant

Applications

- BizJet
- Commercial transport
- Ride control, automotive testing
- Robotic control
- Wind turbine control
- UUV and ROV

QRS14 Single-Axis Analog Gyroscope

The QRS14 is an exceptionally capable solid-state gyroscope expressly designed for use in a broad range of applications. Featuring solid-state quartz MEMs technology, this unit combines excellent vibration and noise performance, and virtually unlimited life. Enclosed in a compact housing, the QRS14 provides a DC voltage input, and analog DC voltage output proportional to the rotational rate.

NON ITAR

Features/Benefits

- Exceptional rugged design
- Solid-state MEMS design, long life
- Internal power regulation
- High reliability
- Wide temperature range

Applications

- Ride control
- Wind turbine control
- Platform, antenna and camera stabilization
- Robotic control
- Commercial transport
- Automotive testing

Key Performance Specifications

MEMS GYRO SPECIFICATIONS

Parameter	SDG500	SDG1400	QRS116	SDD3000	QRS28
Performance					
Bias Over Temperature	≤5°/sec	≤1°/sec	20°/hr	1.0°/hr	ZROTC +/- 1.88°/sec
Bias In-Run Stability	<20°/hr	<6°/hr	3°/hr	0.5°/hr	N/A
Output Noise	≤0.005°/sec/√Hz (DC to 100 Hz)	≤0.1°/√hr (<0.0017°/sec/√Hz)	≤0.002°/sec/√Hz	0.01°/√hr	≤0.005°/sec/√hz
Bandwidth	60 Hz ±15 Hz	50 Hz ±10 Hz	>60 Hz	N/A	110 Hz ±10 Hz
Physical & Environmental					
Operating Temperature Range	-40 °C to +85 °C	-55 °C to +85 °C	-55 °C to +85 °C	-20 °C to +60 °C	-55 °C to +85 °C
Dimensions	1.28" x 1.28" x .75"	1.4" x 1.6" x .67"	1.49" x 1.49" x .645"	3.1" x 3.25" x 0.96"	0.71" x 0.71" x 1.05"
Weight	≤25 grams	<60 grams	≤60 grams	<227 grams	25 grams

MEMS IMU SPECIFICATIONS

	SDI500/SDC500		SDI170	
Parameter	Gyro Channels	Acceleration Channels	Gyro Channels	Acceleration Channels
Performance				
Bias Over Temperature	1°/hr - 20°/hr	1.0 mg - 5.0 mg	1°/hr - 3°/hr	1.0 mg - 2.0 mg
Bias In-Run Stability	1°/hr - 5°/hr	100-400 µg	1°/hr - 1.5°/hr	100-200 µg
Angle/Velocity Random Walk (Noise)	0.02°/√hr - 0.04°/√hr	100 µg/√Hz - 200 µg/√Hz	<0.02°/√hr	100 µg/√Hz - 120 µg/√Hz
Data Rates	SDI500: 2400, 1200, 600 Hz (Control) SDI500: 400, 200, 100 Hz (Guidance) SDC500: 1200, 600, 400, 200, 100, 1 Hz (Input or Output) SDC500: 2400 Hz (Output Only)		600 Hz (Control) / 100 Hz (Guidance) - other rates available	
Physical & Environmental				
Operating Temperature Range	-55 °C to +85 °C		-55 °C to +85 °C	
Dimensions	2.9"D x 2.9"H		3.5"D x 2.9"H	
Weight	1.3 lbs		1.95 lbs	
Volume	19 cubic in.		33 cubic in.	

FIBER OPTIC GYRO SPECIFICATIONS

Parameter	DSP-3000 Series	DSP-1760	EG-120 (Digital)	EG-200	EG-1300
Performance					
Bias Over Temperature	≤6°/hr (Digital)	≤1.5°/hr	≤20°/hr	≤20°/hr (<0.8°/hr Compensated)	0.1°/hr (Typical)
Bias In-Run Stability	≤1°/hr (Digital)	≤0.1°/hr	≤1.0°/hr	≤1.0°/hr	≤0.01°/hr (Digital)
Angle Random Walk	≤0.067°/√hr (Digital)	≤0.012°/√hr	≤0.04°/√hr	≤0.04°/√hr	≤0.002°/√hr
Bandwidth	440 Hz	≥440 Hz (Housed) ≥1000 H (Unhoused)	250 Hz	300 Hz	500 Hz
Physical & Environmental					
Operating Temperature Range	-40 °C to +75 °C	-40 °C to +75 °C	-40 °C to +75 °C	-40 °C to 75 °C	-40 °C to +70 °C
Dimensions	3.5"L x 2.3"W x 1.3"H (3000 & 3400) 3.5"L x 2.6"W x 1.0"H (3100)	3.5"D x 2.9"H	2.36"D x 0.83"H	3.3" x 3.3" x 0.8"	3.6"D x 1.3"H Sensor 3.3" x 3.3" x 0.8" Electronics
Weight	0.44 lbs - 0.66 lbs		0.17 lbs, 0.08 kg	0.28 lbs, 0.127 kg	0.83 lbs, 0.38 kg

Key Performance Specifications *(Continued)*

FOG IMU & IRU SPECIFICATIONS

Parameter	TAC-450-360		EN-300-3		CIRUS-A		CIRUS & CIRUS-EX IRU
	Gyro Channels	Accel Channels	Gyro Channels	Accel Channels	Gyro Channels	Accel Channels	Gyro Channels
Performance							
Bias Over Temperature	≤0.7°/hr	≤375 µg	0.2°/hr	300 µg	-	-	-
Bias In-Run Stability	≤0.05°/hr	15–150 µg	0.04°/hr	0.1 mg	0.001°/hr	160 µg	0.0003°/hr
Random Walk (Noise)	≤0.012°/√hr	34-340 µg/√Hz	0.015°/√hr	0.025 m/s/√hr	0.0008°/√hr	-	0.00019°/√hr - 0.000125°/√hr
Scale Factor	≤50 ppm	≤300 ppm	100 ppm	200 ppm	<10 ppm	<300 ppm	35 ppm Max (3 Typical)
Bandwidth	≥1000 Hz		<1000 Hz		>500 Hz		> 500 Hz (programmable)
Physical & Environmental							
Operating Temperature Range	-40 °C to +75 °C		-40 °C to +75 °C		-40 °C to +40 °C		-23 °C to +41 °C
Dimensions	3.5"D x 2.5"H		3.5"D x 3.35"H		11.9"L x 11.1"W x 5.9"H		CIRUS: 14.1" x 8.55" CIRUS EX: 14.35" x 8.75"
Weight	1.54 lbs		<1.8 lbs		18 lbs		34 lbs (CIRUS); 37 lbs (CIRUS-EX)
Volume			33 cubic in.		Approx. 780 cubic in.		CIRUS: Approx. 784 cubic in CIRUS-EX: Approx. 866 cubic in.

FOG INS SPECIFICATIONS

Parameter	GEO-FOG 3D	GEO-FOG 3D Dual
Performance		
Axes	3	3
Horizontal Position Accuracy	0.8 m	0.5 m
Velocity Accuracy	0.007 m/s	0.005 m/s
Heading Accuracy	0.05°	0.01°
Pitch and Roll Accuracy	0.01°	0.01°
Shock Tolerance	25 g	25 g
Physical & Environmental		
Dimensions	3.55"H x 3.47"D	3.55"H x 3.47"D
Weight	1.7 lbs	7.0 lbs
MTBF	>36,000 hours	>36,000 hours

MEMS GPS/INS SPECIFICATIONS

Parameter	SDN500 INS/GPS
Performance	
Axes	3
Position (SEP)	3.9 m
Velocity (1 sigma, horiz/vert)	0.1/0.1 m/s
Heading (1 sigma, in motion)	1.5 mrad + d (1) (0.086°)
Pitch and Roll (1 sigma)	1.0 mrad (0.057°)
Shock Tolerance	20 g, 11 ms
Physical & Environmental	
Dimensions	2.9"D x 3.80"H
Weight	<1.6 lbs
Volume	25 cubic in.

BATTLEFIELD/ARTILLERY/RADAR RLG INS SPECIFICATIONS

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