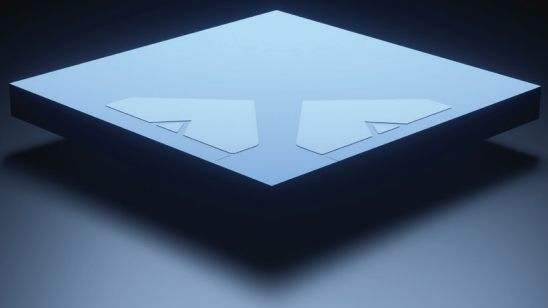
PIC INSIDE



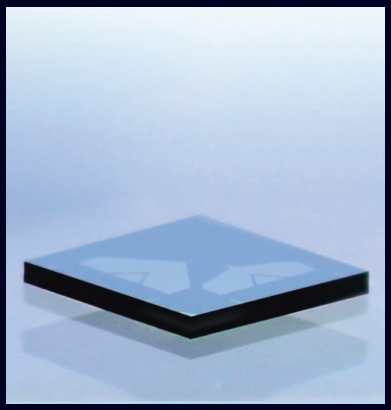
Ensuring Superior Inertial System Performance through Rigorous Testing

emcore®

A Revolution in Fiber Optic Gyro Technology

EMCORE builds precision sensors and systems drawing on experience gained from the design and production of more than 120,000 fiber optic gyros (FOGs) and an array of FOG-based inertial measurement units (IMUs) and inertial navigation systems (INS).

EMCORE's new patented photonic integrated chip (PIC) technology ushers in a renaissance in fiber optic technology. Coupled with cutting-edge accelerometers, this next-generation technology delivers higher precision and superior reliability. In addition, it will enable the scaleability required for autonomous system production.



Ensuring Performance through Rigorous Testing & Qualification

EMCORE's new PIC technology reinvents FOG technology with a groundbreaking integrated planar optical chip that replaces individual fiber optic components. EMCORE gyros and inertial systems with PIC Inside™ are designed to deliver:

- Flexible, modular designs for easy integration
- Outstanding unit-to-unit repeatability

EMCORE's revolutionary photonic chip technology overcomes numerous technological obstacles to meet the demanding requirements for autonomous platforms. Our PIC technology:

- Incorporates complex elements onto a chip to maintain or improve accuracy and performance, as well as simplify production and remove hand work from the process
- Provides precision, repeatability, and scalability in component manufacturing that ensures consistent performance and reliability in volume
- Enables precision FOG-based inertial systems to be built at scale for the first time

Testing at Part and Product Levels

EMCORE performed a wide range of component-level Design Validation Testing (DVT) as part of an intensive qualification program to deliver comprehensive product testing prior to release. The goal was to verify key performance parameters, environmental resilience, and the overall reliability requirements for the PIC Inside portfolio of products. Areas of testing included:

- Functional testing (including usability)
- Performance testing
- Reliability testing
- Environmental testing
- Mechanical testing
- Regression testing
- Mean Time Between Failure (MTBF) prediction

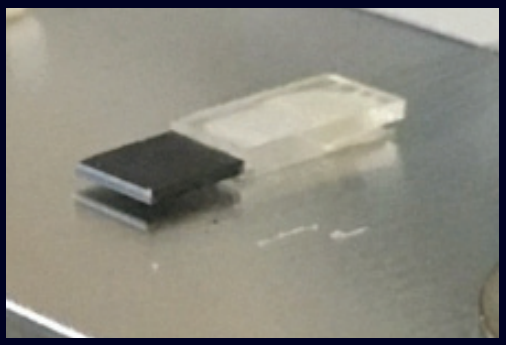
EMCORE meticulously tests our new PIC technology to ensure superior performance, accuracy, and reliability.

Part Level

Testing includes over temperature cycling, temperature and humidity, and shock and vibration – all run over multiple lots of parts to validate the repeatability and robustness of manufacturing.

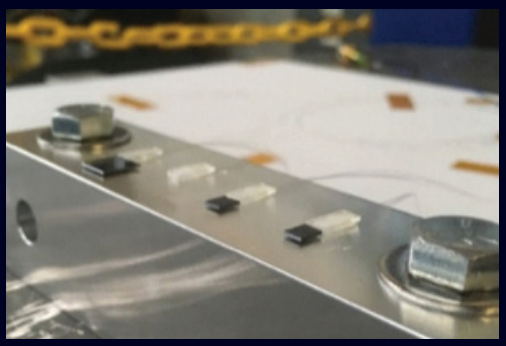
Product Level

Testing covers the complete set of performance specifications and environmental conditions, repeated over time to validate the design.



Mounting of PIC fiber array

Substrate testing within housing



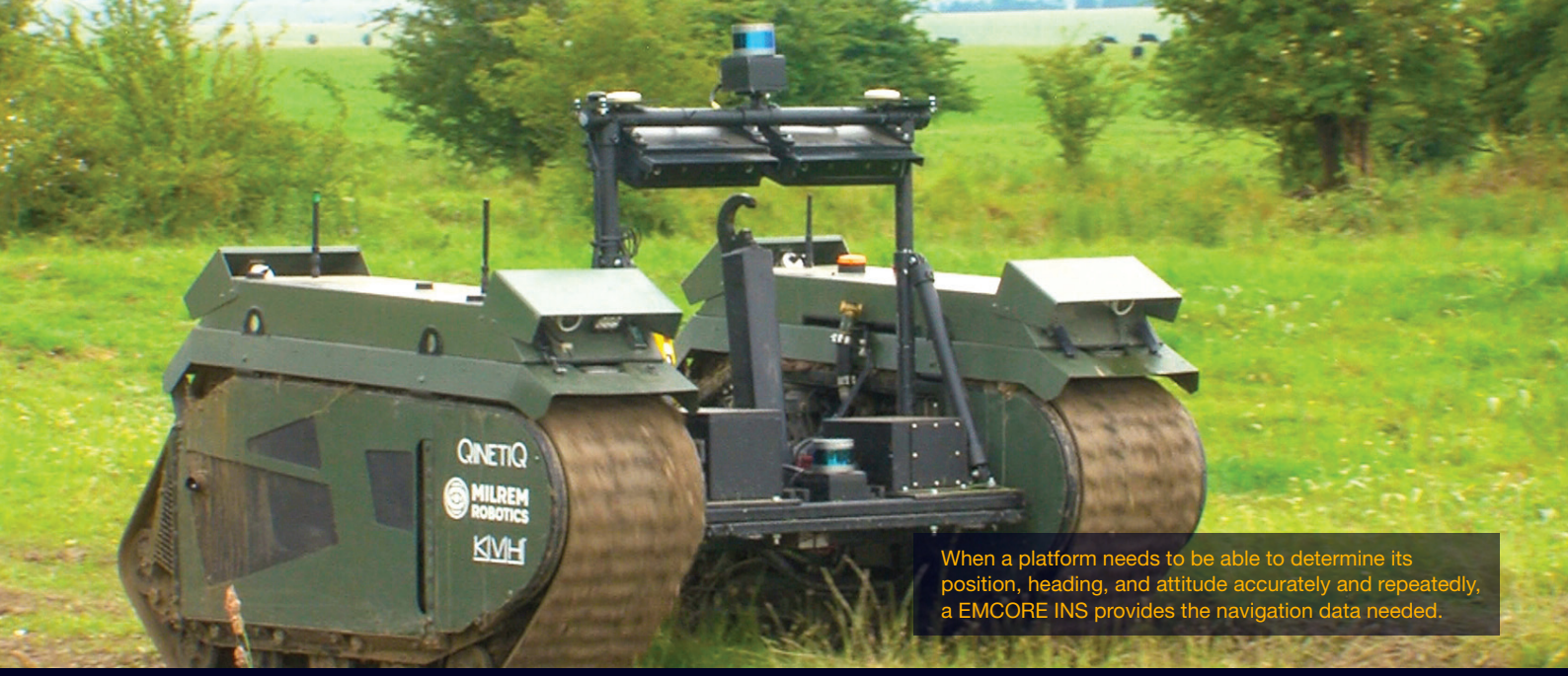
Sample fiber array and PIC prepared for testing

Testing Based on Industry Standards

PIC and fiber array environmental testing is based upon JEDEC Solid State Technology Association standards. Compliance with the requirement is verified by EMCORE engineers during product validation. Telcordia and MIL-STD-810H were also utilized during the test process both for the optical components and the finished product.

The PIC and fiber array are the core of the optical circuit upgrade. These parts were individually tested as well as in complete gyros to validate the design.

To maximize product availability and ensure cost controls, two suppliers were selected to partner with EMCORE to engineer a suitable component; each tested and qualified for use in EMCORE products.

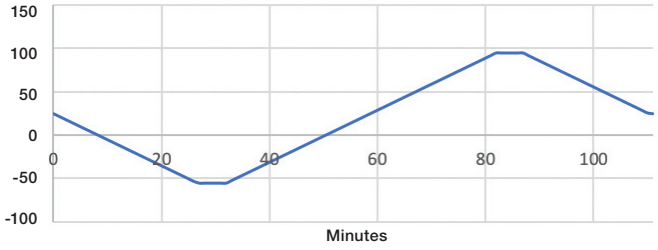


When a platform needs to be able to determine its position, heading, and attitude accurately and repeatedly, a EMCORE INS provides the navigation data needed.

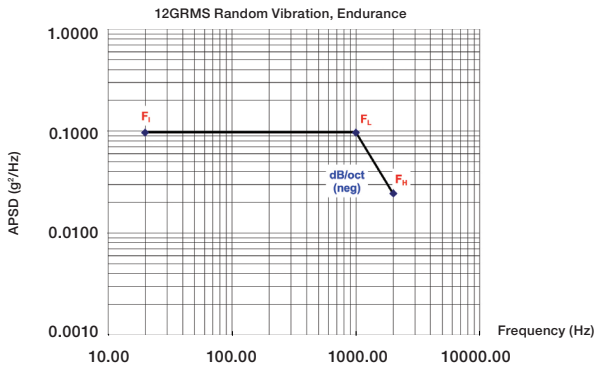
Shock, Vibration, and Humidity Testing

The PIC and the fiber array were subjected to industry-standard semiconductor temperature and humidity testing. Shock testing consisted of components being mounted to a fixture that mimicked the actual manufacturing process. In addition, both were also subjected to mechanical shock and vibration testing, mounting and substrate testing, and strength testing.

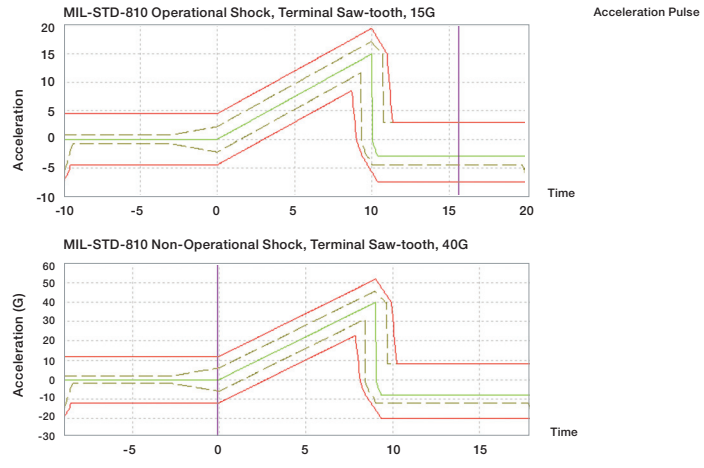
Accelerated Life Testing Profile



Performance/ Endurance Vibration Profile



Composite Shock



Mapping and surveying requires precision positioning and reliable stabilization.

Underwater applications require inertial navigation that keeps your platform on track even when GPS/GNSS is unavailable.

High-performance Accelerometers Deliver Enhanced Inertial Performance

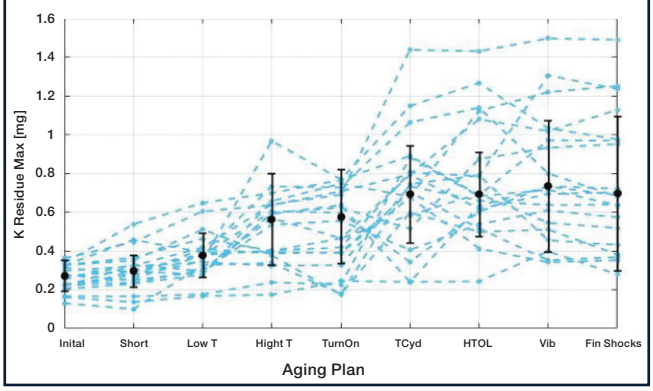
In addition to the extensive testing of the PIC and the fiber array, EMCORE further improves the performance of its PIC Inside products with the addition of high-performance accelerometers. EMCORE inertial products are available with a choice of 2g, 10g, 30g, and 100g accelerometers and deliver enhanced performance in:

- Improved Velocity Random Walk (VRW)
- Enhanced Long-term Bias Repeatability
- Improved Long-term Scale Factor Repeatability
- Improved Reliability
- Greater Scale Factor vs Temperature
- Enhanced Scale Factor Non-Linearity
- Better Input Range
- Improved Bias Instability

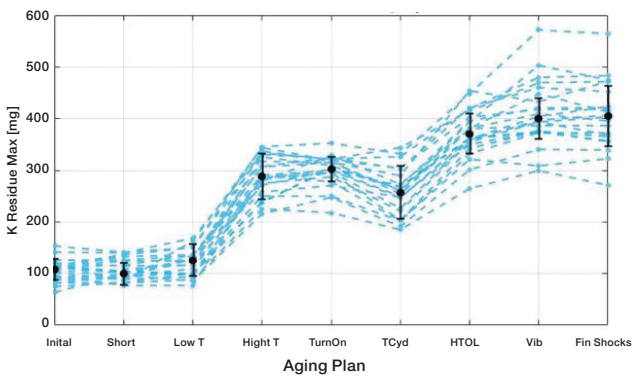
Accelerometer Performance Table

Aging Plan Steps	Conditions
Turn On - Turn On	100 times ON/OFF at 20°C
Short-term Stability	Powered for at least 8 hrs
Low Temperature Storage	Unpowered 72h at -55°C
High Temperature Storage	Unpowered 10 days at -85°C
Temperature Cycling	Unpowered 100 Cycles [-40°C, 125°C]
High Temperature Operating Life (HTOL)	Powered 10 days 85°C
Vibrations	Unpowered 20g rms, 3 axis 20 min, 20 Hz - 2 kHz
Shock	Unpowered, 5 shocks, 6 directions, 500g, 0.2ms

Bias Repeatability Results



Scale Factor Repeatability Results



Reliability & Performance You Can Count On

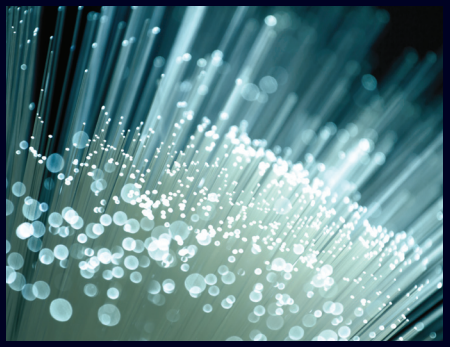
EMCORE inertial sensor products featuring PIC Inside technology and improved high-performance accelerometers deliver outstanding performance, reliability, and repeatability.

Making Autonomy Affordable

EMCORE's innovative photonic chip technology overcomes numerous technological obstacles to meet the demanding requirements for autonomous vehicles – including mass producibility. The consistency of components and manufacturing ensures steady performance and reliability vital for the eventual mass production of affordable precision FOG-based inertial sensors to serve the autonomous automotive industry.

About Us

EMCORE Corporation is a leading provider of advanced mixed-signal products that serve the aerospace & defense, communications, and sensing markets. Our best-in-class components and systems support a broad array of applications including navigation and inertial sensing, defense optoelectronics, broadband communications, optical sensing, and specialty chips for telecom and data center. We leverage industry-leading Photonic Integrated Chip (PIC), Quartz MEMS, Lithium Niobate, and Indium Phosphide chip-level technology to deliver state-of-the-art component and system-level products across our end-market applications. EMCORE has vertically-integrated manufacturing capability at its facilities in Alhambra, CA, Budd Lake, NJ, Concord, CA, and Tinley Park, IL. Our manufacturing facilities maintain ISO 9001 quality management certification, and we are AS9100 aerospace quality certified at our facilities in Budd Lake and Concord.



Contact Us

EMCORE delivers the accuracy, reliability, repeatability, and performance that successful autonomous navigation requires. Contact EMCORE Inertial Navigation Sales for more information on how to get EMCORE's reliable, high performing FOGs and FOG-based inertial systems enhancing your next project.

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