Effects of High-Concentration Helium Gas Exposure on Epson M-G370PDG0

1. Summary

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Background

In general, when MEMS devices are exposed to high concentrations of helium gas, the small helium molecules can penetrate the package sealing materials, potentially causing malfunction or performance drift. In addition, helium exposure resistance testing may be required for satellite launch applications. For these reasons, inquiries regarding the helium exposure resistance of our inertial measurement unit (IMU) have been increasing.

Purpose

We investigated the tolerance and sensor-characteristic impacts when Epson IMU M-G370PDG0 is exposed to high-concentration helium gas. We also conducted comparative evaluations against other manufacturers' MEMS 6-axis inertial sensors.

Conclusion

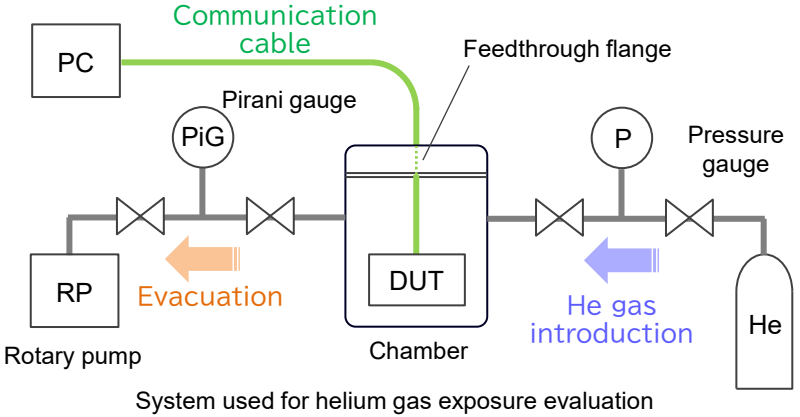
Epson IMU "M-G370PDG0" showed no functional loss or abnormal characteristics during or after 24-hour exposure to helium gas with a concentration above 99% at room temperature (within 24 hours after returning to atmospheric conditions). Additionally, as all products in our lineup employ the same packaging technology, they are considered to offer equivalent performance.

<Note>
This report presents evaluation results conducted to investigate the effects on Epson IMUs when exposed to helium gas. It does not guarantee airtight performance against helium gas.

2. Method / Conditions

DUT for Helium Exposure Evaluation

DUT	Quantity
Epson IMU "M-G370PDG0"	3 [pcs]
Competitor MEMS 6-axis inertial sensors	3 [pcs]



System used for helium gas exposure evaluation

Helium Gas Exposure Evaluation Procedure and Conditions

Ⅰ. Procedure

- Place the sample fixed to the jig inside the chamber (with the Z-axis oriented vertically upward).
- Seal the chamber airtight using the feedthrough flange, and connect the IMU's power supply and communication cables to an external measurement PC.
- Evacuate the air inside the chamber using a rotary pump down to 46 [Pa].
- Introduce helium gas into the chamber and adjust the internal pressure to approximately 1 [atm].
- Place the chamber system in an air-conditioned room and monitor the sensor output for 24 hours.

Ⅱ. Exposure Conditions

- Purity of helium gas used: 99.995% or higher.
- Helium gas pressure inside chamber: approx. 1 [atm]
- Ambient temperature of chamber installation: Room temperature (placed in an air-conditioned room)
- Exposure duration: 24 hours

3. Results

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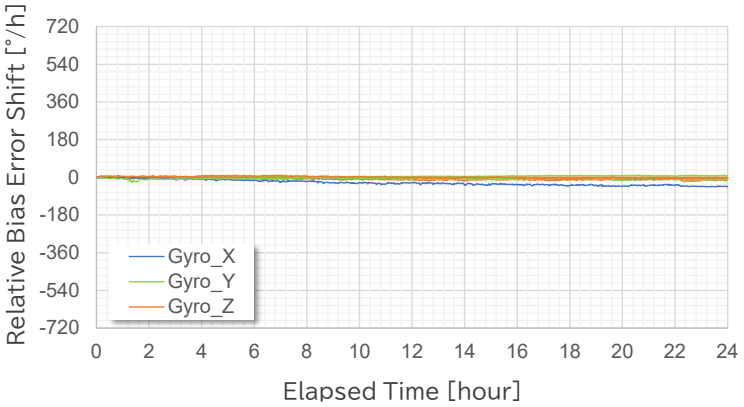
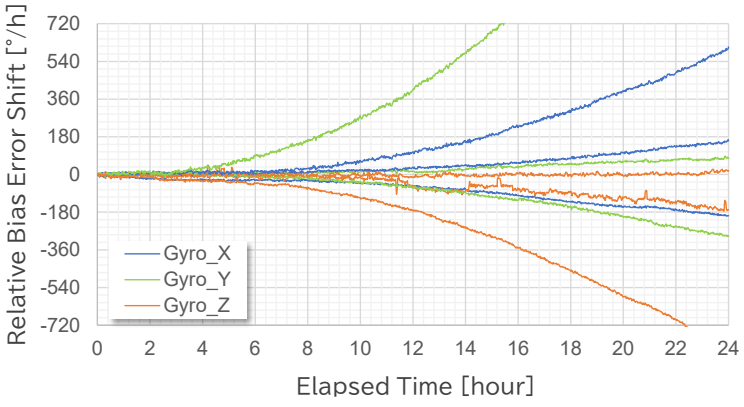
Relative Gyroscope Bias Shift During Helium Gas Exposure

◆ Epson
M-G370PDG0: 3 pcs × 3 axes



The bias shift during helium gas exposure remained within the normally observed level, and no significant bias shift was observed.

◆ Competitor
MEMS 6-axis inertial sensors: 3 pcs × 3 axes



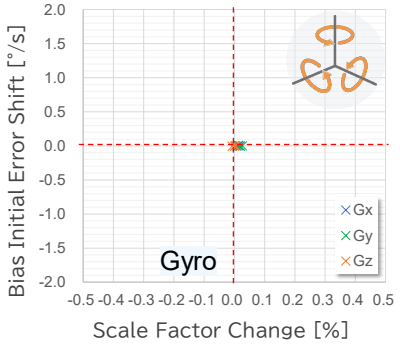
During helium gas exposure, large bias shifts were observed.

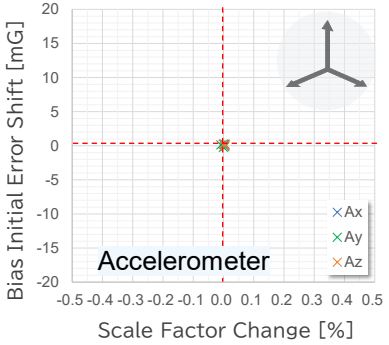
3. Results

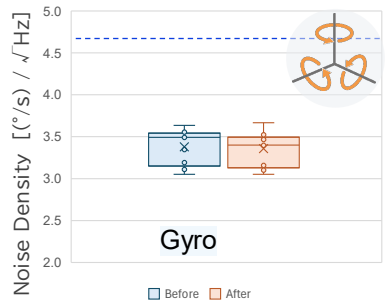
Characteristic Changes After Helium Gas Exposure (Within 24 Hours After Atmospheric Release)

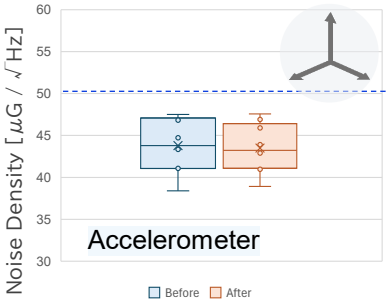
In the competitor MEMS 6-axis inertial sensors, changes were observed particularly in the gyroscope bias and scale factor. In contrast, no significant characteristic changes were observed in the Epson IMU.

◆ Epson IMU M-G370PDG0: 3 pcs × 6 axes

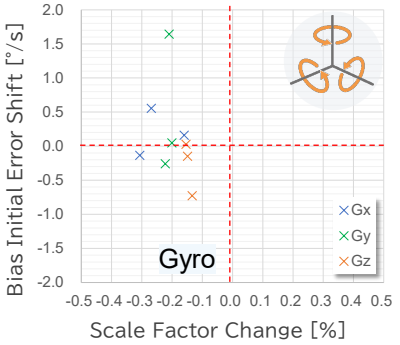


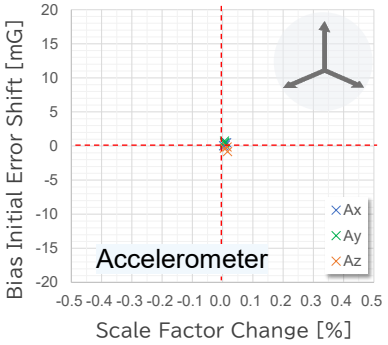


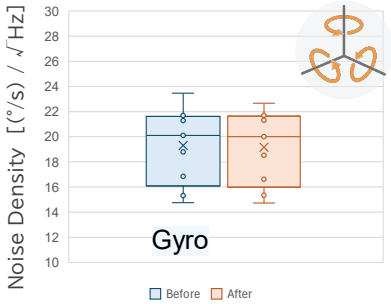


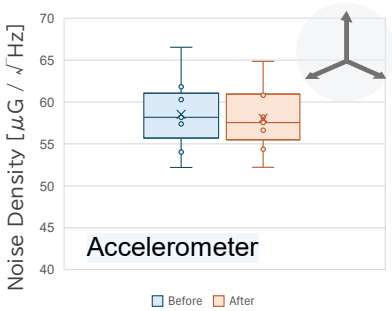


◆ Competitor MEMS 6-axis inertial sensors: 3 pcs × 6 axes









M-G370PDG0

View Product Info

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The M-G370PDG0 is a compact 6-DoF inertial measurement unit (IMU) with three-axis gyroscope and accelerometer sensors, offering high stability and accuracy through advanced compensation technology. It supports versatile SPI and UART interfaces, reducing integration barriers and enabling efficient implementation of inertial motion analysis and control with minimal design effort.

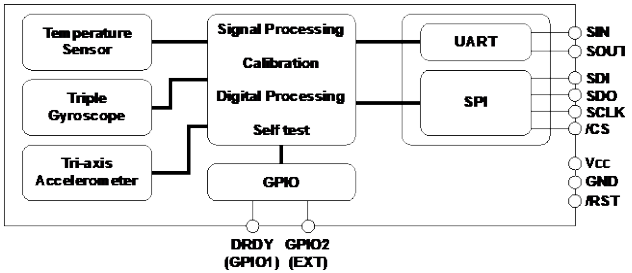
Features

- Small Size, Lightweight: 24 x 24 x 10mm, 10 grams
- Low-Noise, High-Stability
  - Gyro Bias Instability : 0.8 ˚/h
  - Angular Random Walk : 0.06 ˚/√ h
- Initial Bias Error : 360 ˚/h (1σ) / 2 mG (1σ)
- 6 Degrees Of Freedom
  - Triple Gyroscopes : ±450 ˚/s
  - Tri-Axis Accelerometer : ±8 G/±16 G
- 16/32-bit Data Resolution
- Digital Serial Interface : SPI / UART
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)
- Data Output Rate : 2k Sps (Max.)
- External Trigger Input / External Counter Reset Input
- Delta Angle / Delta Velocity Output
- Operating Temperature Range : -40 ℃ to +85 ℃
- Single Voltage Supply : 3.3 V
- Low Power Consumption : 16 mA (Typ.)

Application

- Antenna Platform Stabilization
- Camera Gimbals
- Navigation Systems
- Vibration Control and Stabilization
- Pointing and Tracking Systems
- Autonomous Vehicle

Block Diagram

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