

M-G350-PD11

IMU (Inertial Measurement Unit)

■ GENERAL DESCRIPTION

The M-G350-PD11 is a small form factor inertial measurement unit (IMU) with 6 degrees of freedom: triaxial angular rates and linear accelerations, and provides high-stability and high-precision measurement capabilities with the use of high-precision compensation technology. A variety of calibration parameters are stored in a memory of the IMU, and are automatically reflected in the measurement data being sent to the application after the power of the IMU is turned on. With a general-purpose SPI/UART supported for host communication, the M-G350-PD11 reduces technical barriers for users to introduce inertial measurement and minimizes design resources to implement inertial movement analysis and control applications.

The features of the IMU such as high stability, high precision, and small size make it easy to create and differentiate applications in various fields of industrial systems.

■ FEATURES

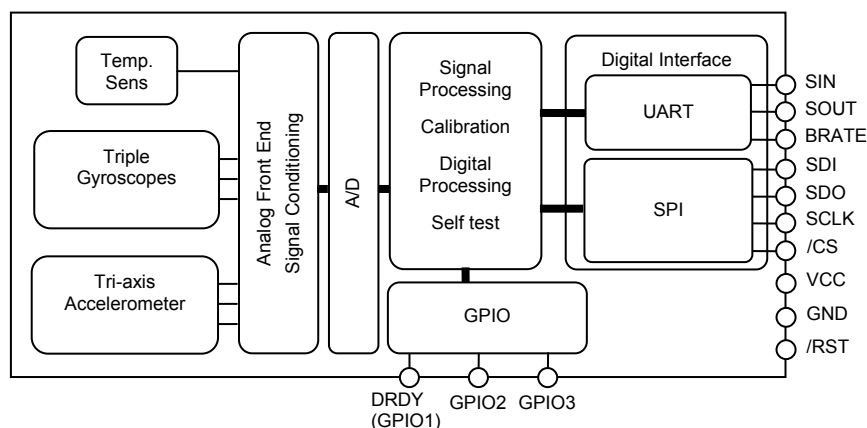
- Small Size, Lightweight : 24x24x10mm, 7grams
- Low-Noise, High-stability
 - Gyro Bias Instability : 6 deg/hr
 - Angular Random Walk : 0.2 deg/ $\sqrt{\text{hr}}$
- Initial Bias Error : to 0.5 deg/s (1σ)
- 6 Degrees Of Freedom
 - Triple Gyroscopes : ± 300 deg/s,
 - Tri-Axis Accelerometer : ± 3 G
- 16bit data resolution
- Digital Serial Interface : SPI / UART
- Calibrated Stability (Bias, Scale Factor, Axial alignment)
- Data output rate : to 1k Sps
- Calibration temperature range : -20°C to $+70^{\circ}\text{C}$
- Operating temperature range : -40°C to $+85^{\circ}\text{C}$
- Single Voltage Supply : 3.3 V
- Low Power Consumption : 30mA (Typ.)



■ APPLICATIONS

- Motion analysis and control
- Unmanned systems
- Navigation systems
- Vibration control and stabilization
- Pointing and tracking systems

■ FUNCTIONAL BLOCK DIAGRAM



■ SENSOR SECTION SPECIFICATION

$T_A=25^{\circ}\text{C}$, $V_{CC}=3.3\text{V}$, angular rate=0 deg/s, $\leq\pm 1\text{G}$, unless otherwise noted.

| Parameter | Test Conditions / Comments | Min. | Typ. | Max. | Unit |
|---|---|-----------|---------------|----------|------------------------------------|
| GYRO SENSOR | | | | | |
| Sensitivity | | | | | |
| Dynamic Range | — | ± 300 | — | — | deg/s |
| Sensitivity | — | Typ-0.5% | 0.0125 | Typ+0.5% | (deg/s)/LSB |
| Temperature Coefficient | 1σ , $-20^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ | — | 10 | — | ppm/ $^{\circ}\text{C}$ |
| Nonlinearity | Best fit straight line | — | 0.1 | — | % of FS |
| Misalignment | 1σ , Axis-to-axis, $\Delta = 90^{\circ}$ ideal | — | ± 0.1 | — | deg |
| Bias | | | | | |
| Initial Error | $\pm 1\sigma$ | — | 0.5 | — | deg/s |
| Temperature Coefficient (Linear approximation) | 1σ , $-20^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ | — | 0.03 0.001 | — | (deg/s) / $^{\circ}\text{C}$ |
| In-Run Bias Stability | 1σ | — | 6 | — | deg/hr |
| Angular Random Walk | 1σ | — | 0.2 | — | deg/ $\sqrt{\text{hr}}$ |
| Linear Acceleration Effect | | | <0.01 | | (deg/s)/G |
| Noise | | | | | |
| Noise Density | 1σ , $f = 10$ to 20 Hz, no filtering | — | 0.004 | — | (deg/s) / $\sqrt{\text{Hz}}$, rms |
| Frequency Property | | | | | |
| 3 dB Bandwidth | — | — | 133 | — | Hz |
| ACCELEROMETERS | | | | | |
| Sensitivity | | | | | |
| Dynamic Range | — | ± 3 | — | — | G |
| Sensitivity | — | Typ-0.5% | 0.125 | Typ+0.5% | mG/LSB |
| Temperature Coefficient | 1σ , $-20^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ | — | 20 | — | ppm/ $^{\circ}\text{C}$ |
| Nonlinearity | $\leq 1\text{G}$, Best fit straight line | — | 0.1 | — | % of FS |
| Misalignment | 1σ , Axis-to-axis, $\Delta = 90^{\circ}$ ideal | — | 0.03 | — | deg |
| Bias | | | | | |
| Initial Error | $\pm 1\sigma$ | — | 8 | — | mG |
| Temperature Coefficient (Linear approximation) | 1σ , $-20^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ | — | 0.4 0.02 | — | mG/ $^{\circ}\text{C}$ |
| In-Run Bias Stability | 1σ | — | 0.1 | — | mG |
| Velocity Random Walk | 1σ | — | 0.04 | — | (m/sec) / $\sqrt{\text{hr}}$ |
| Noise | | | | | |
| Noise Density | 1σ , $f = 10$ to 20 Hz, no filtering | — | 0.1 | — | mG / $\sqrt{\text{Hz}}$, rms |
| Frequency Property | | | | | |
| 3 dB Bandwidth | — | — | 148 | — | Hz |
| TEMPERATURE SENSOR | | | | | |
| Scale Factor *1 | Output = -15214(0xC492) @ +25 $^{\circ}\text{C}$ | — | 0.0042725 | — | $^{\circ}\text{C}$ /LSB |

*1) This is a reference value used for internal temperature compensation. We provide no guarantee that the value gives an absolute value of the internal temperature.

Note) The values in the specifications are based on the data calibrated at the factory. The values may change according to the way the product is used.

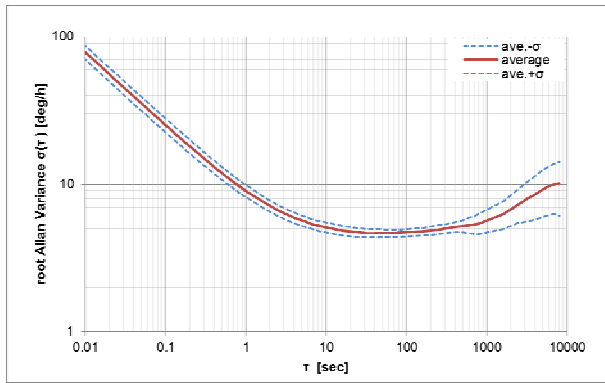
Note) The Typ values in the specifications are average values or 1σ values.

Note) Unless otherwise noted, the Max / Min values in the specifications are design values or Max / Min values at the factory tests.

RECOMMENDED OPERATING CONDITION

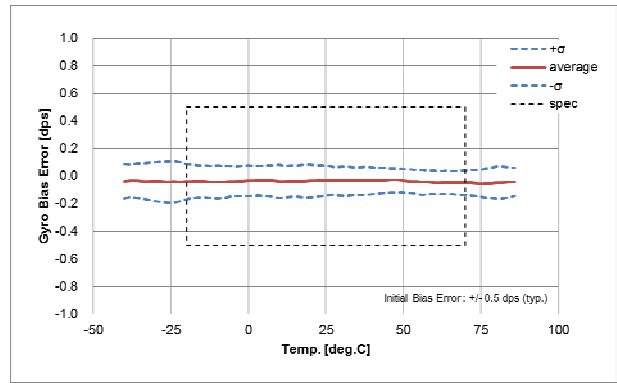
| Parameter | Condition | min | Typ | Max | Unit |
|-------------------------------|---------------------------------------|------|-----|-------------|------|
| VCC to GND | | 3.15 | 3.3 | 3.45 | V |
| Digital Input Voltage to GND | | GND | | VCC | V |
| Digital Output Voltage to GND | | -0.3 | | VCC +0.3 | V |
| Calibration temperature range | Performance parameters are applicable | -20 | | 70 | °C |
| Operating Temperature Range | | -40 | | 85 | °C |

TYPICAL PERFORMANCE CHARACTERISTICS



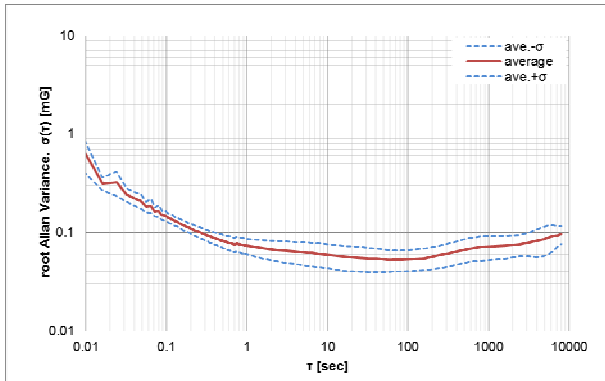
Data Output Rate: 125Sps
Average Filter TAP: N=16

Gyro Allan Variance Characteristic (N=9)



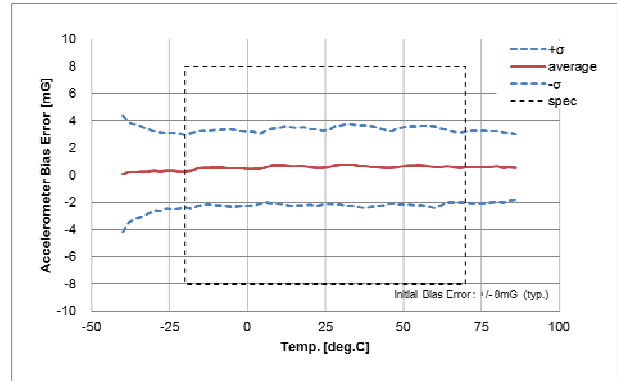
Initial Bias Error: +/- 0.5 dps (typ.)

Gyro Bias vs. Temperature Characteristic (N=40)



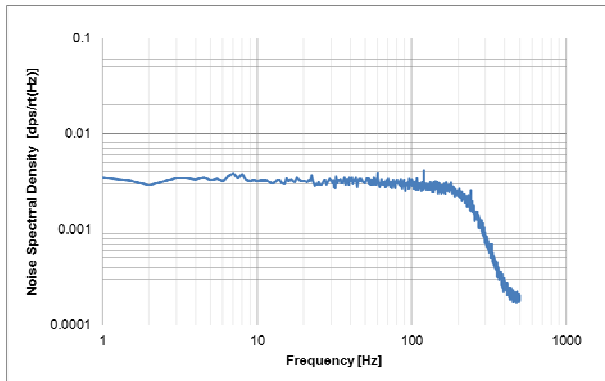
Data Output Rate: 125Sps
Average Filter TAP: N=16

Accelerometer Allan Variance Characteristic (N=9)

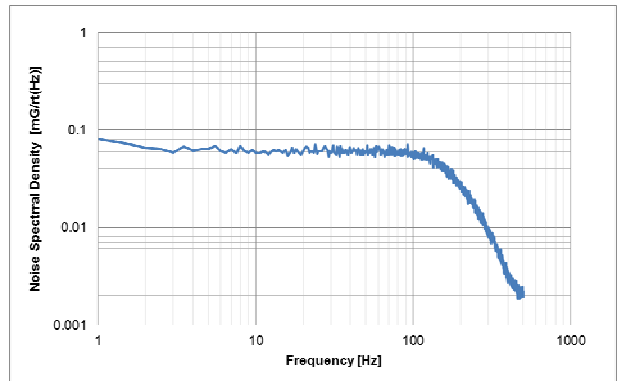


Initial Bias Error: +/- 0mG (typ.)

Accelerometer Bias vs. Temperature Characteristic (N=40)



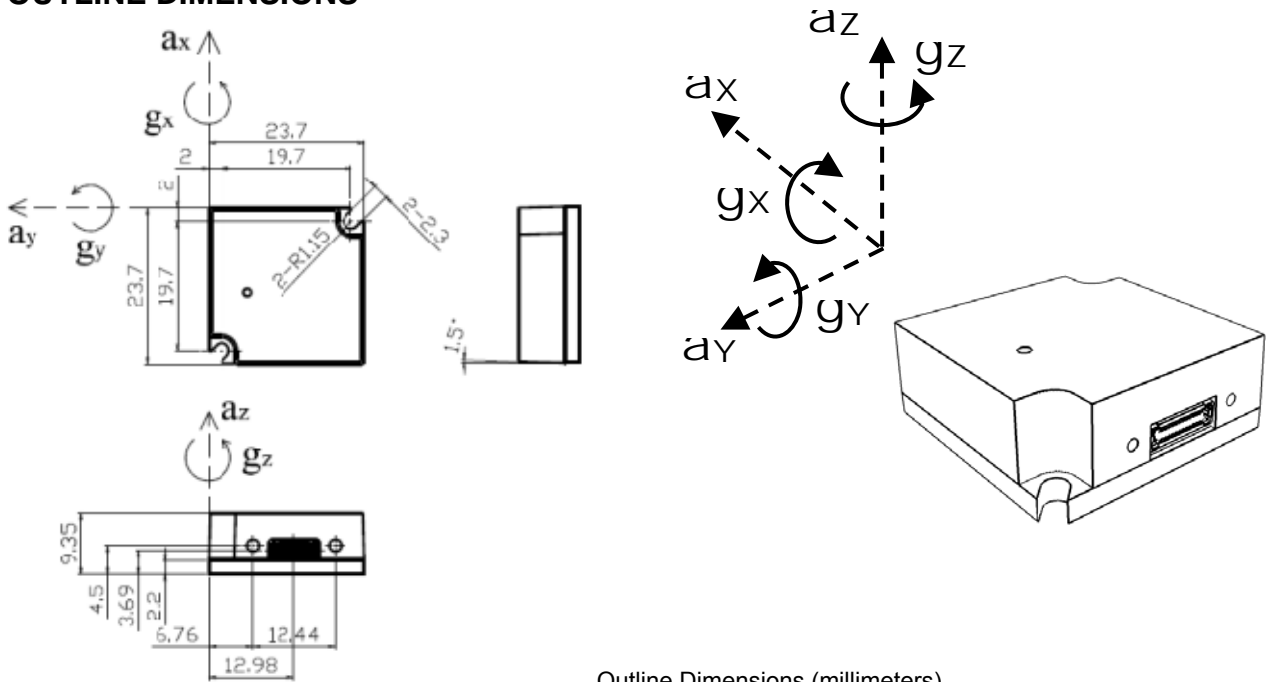
Gyro Noise Frequency Characteristic



Accelerometer Noise Frequency Characteristic

The product characteristics shown above are just examples and are not guaranteed as specifications.

■ OUTLINE DIMENSIONS



Outline Dimensions (millimeters)

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Document code:412136501
 First issue August, 2011 in Japan
 Revised Oct, 2012 in Japan
 Rev.20121023