High Performance IMUs and Accelerometers

Small IMU   IMU   CAN interface   Accelerometer

Index

■ IMU Product Line-up

- M-G364 : High Stability IMU
- M-G354 : Wide Dynamic Range IMU
- M-V340 : Small and Light Weight IMU
- M-G550PC2 : Water and Dust Proof IMU with CAN Interface

			M-G364	M-G354	M-V340	M-G550PC2
Features			High Stability	Wide Range	Small and Light Weight	Water and Dust Proof
Interface			SPI/UART			CANopen
Gyroscope	Dynamic Range	deg/s	±100/±200	±450	±450	±150
	Bias Instability	deg/hr	2.2	3	3.5	3.5
	Angular Random Walk	deg/√Hz	0.09	0.2	0.17	0.1
Accelerometer	Dynamic Range	G	±3	±5	±5.8	±5
	Bias Instability	mG	0.05	0.07	0.05	0.1
Misalignment (Gyro / Accelerometer)		Deg	0.02/0.01	0.02/0.01	0.1/0.2	0.05/0.1
Operating Temperature		℃	−40 to +85			−40 to +70
Power Consumption		mA(typ)	18		16.5	26.5 @12V
Power Supply		V	3.3			9 to 30
Size		Mm	24x24x10		10x12x4	52x52x26
Weight		Grams	10		1	81
Functions			Delta Angle / Delta Velocity Output, External Trigger Input, etc		External Trigger Input, etc	IP67
Product Image						

Accelerometer Product Line-up

- M-A351AU : Built-in Type, UART Interface
- M-A351AS : Built-in Type, SPI Interface
- M-A550AC2 : Water and Dust Proof, CAN Interface
- M-A550AR2 : Water and Dust Proof, RS422 Interface

		M-A351AU	M-A351AS	M-A550AC2	M-A550AR2
Features		Built-in Type		Water and Dust Proof (IP67)	
Interface		UART	SPI	CANopen	RS422
Noise Density	uG/√Hz	0.5 (Average)			
Input Range	G	±5			
Axis		3Axis (X/Y/Z)			
Bandwidth	Hz	100	50	50	
Output Rate	Sps	1,000	500	500	
Resolution	uG/LSB	0.06			
Operating Temperature	℃	−20 to +85		−20 to +70	
Power Consumption	mA(typ)	20		24 @12V	16 @12V
Power Supply	V	3.3		9 to 30	
Size	mm	24x24x19		52x52x26	
Weight	grams	12		81	
Output Mode		Acceleration, Tilt Angle, Tilt Angle Speed (Selectable on each axis)			
Product Image					

■ Crystal Sensing Technology

By using crystal sensor element based on Epson's proprietary micro-fabrication technology, we realized compact, highly accurate, and highly stable IMU / accelerometer by making use of the exceptional properties of crystal material (high stability and low noise). In addition, by using superior processing technology to achieve high performance with low variation, we overcome the challenge of accuracy variability, and stable supply of final products.

Allan Variance (Gyroscope)
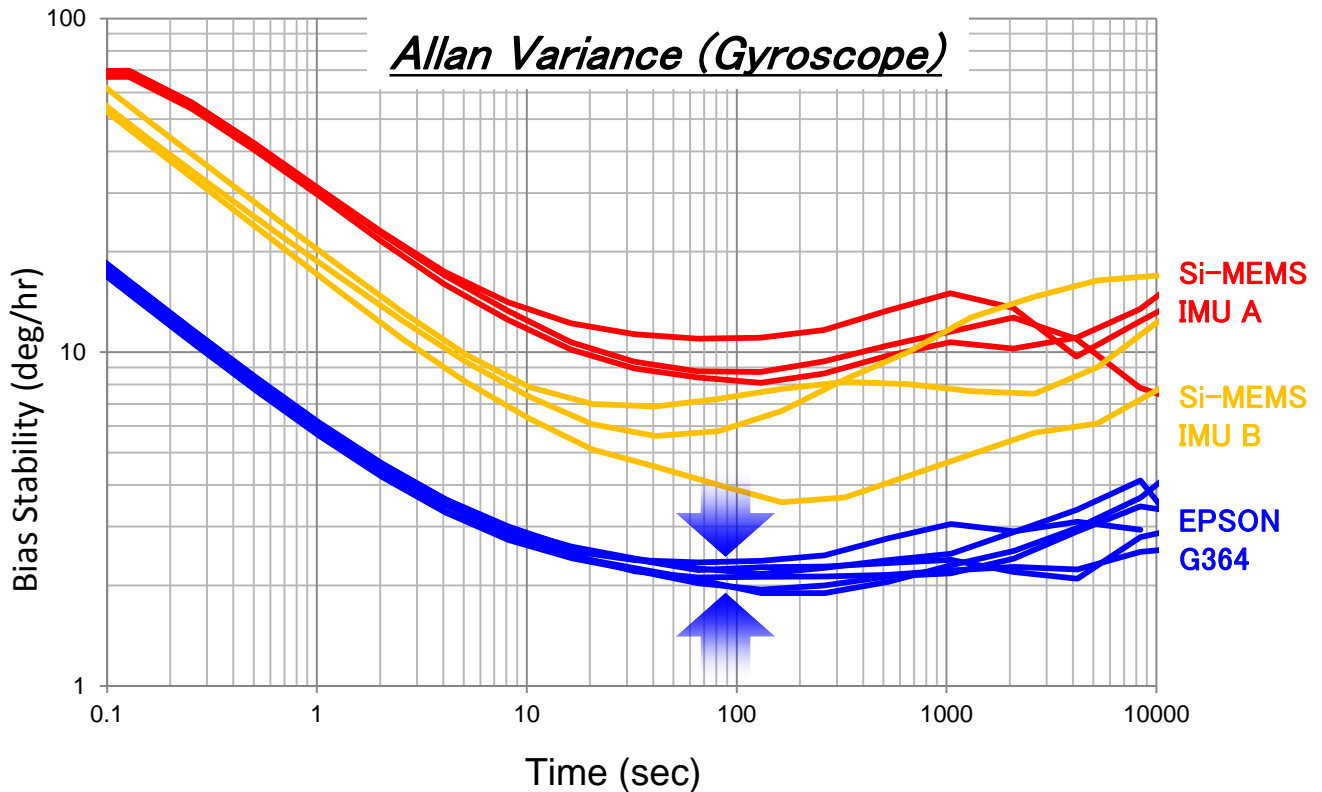
■ Low Power Dedicated SoC

EPSON's IMUs utilize dedicated SoC (System-on-Chip) to reduce power 50% and integrate 50% of the peripheral discrete components compared to our previous generation IMUs such as M-G350.

M-G364/354 Power Consumption: 18mA (typ) @ 3.3V

IMU
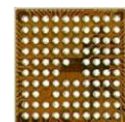
■ IMU (Inertial Measurement Unit)

A device which detects the inertial motion with high accuracy, composed of 3 axis gyroscope and 3 axis accelerometer. IMUs are mainly used for the purpose of measuring and controlling the motion or attitude of a moving body.

■ IMU and Sensor Device

In actual operating environments, the accuracy of sensor device output data deteriorates because of various external and internal influences (board variation, vibration & shock, misalignment, temperature change etc.), but the IMU has various correction functions to reduce errors and output stable and accurate sensing data.

Sensor Device

- PCB Board Variation
- Vibration Shock
- 3D Assembly Misalignment
- Temp. Change
- Real Data

Un-Calibrated Output Data

- Noise +Variation
- Real Data

IMU

- High Stiff Metal Case
- Anti-Vibration / Shock Structure
- Alignment Correction
- Bias Correction over temp.
- Real Data

Calibrated Output Data

- Real Data

Gyro Bias Data (Example)

Un-Calibrated

Calibrated

GYRO Bias [deg/s]

Temperature [℃]

Acceleration Bias Data (Example)

Calibrated

Un-Calibrated

ACCL Bias [mG]

Temperature [℃]

IMU

■ High Reliability G3X Platform

G3X Platform (M-G364/M-G354) is 1inch square small form factor, designed to bring out stable performance even under unstable environment.
New products planned for the future will also use the same G3X platform. The compatibility of hardware and software interfaces will bring the improvement of the performance simply by replacing the IMU, reducing the development cost, engineering resource, and evaluation time of the customer.

G3X Platform（Case Side）

①Chassis GND
②Factory Calibrated IMU
③QR Code
④Serial Number
⑤Mounting Hole
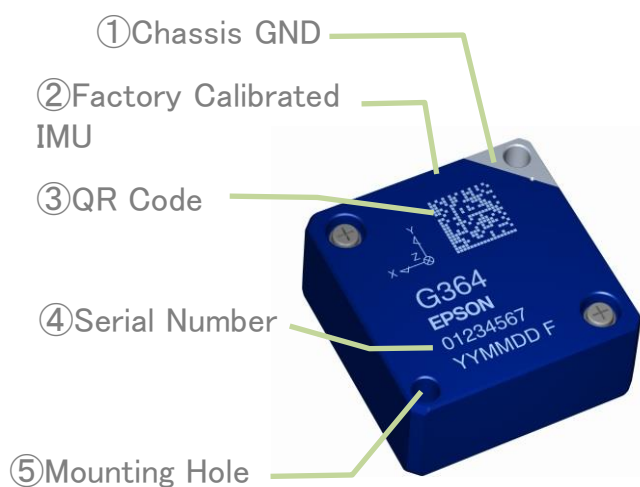
G3X Platform（Connector Side）

⑥High Reliability Metal Case
⑦Sensor Axis
⑧Anti-shock Structure
⑨Connector
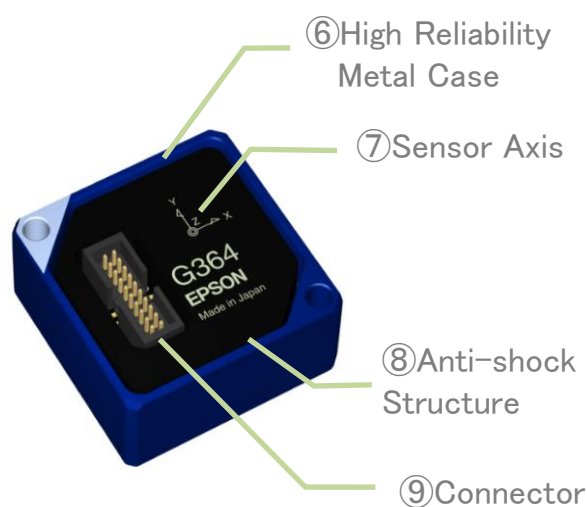
■ Robust IMU（CAN INTERFACE）

M-G550PC・M-A550AC are water and dust proof sensors with CAN interface.
Complex measurements such as synchronous measurement by multiple sensors can be easily constructed by simply connecting to a standard CAN controller. A wide range of applications from applied research applications to constant monitoring of outdoor structures are supported.

①Water Proof Case (IP67)
②CAN Connector
③ Sensor Axis
④LED Indicator
⑤Mounting Hole

Accelerometer

■ High Stability

M-A351 is equipped with a crystal element using micro-fabrication technology of high precision quartz material to enable customer to measure acceleration, tilt angle, or tilt angle speed with high stability. This is an ideal sensor for analysis and diagnosis of large-sized structures that need to capture small changes because of its inherent ability to capture highly stable measurements over a long period of time.
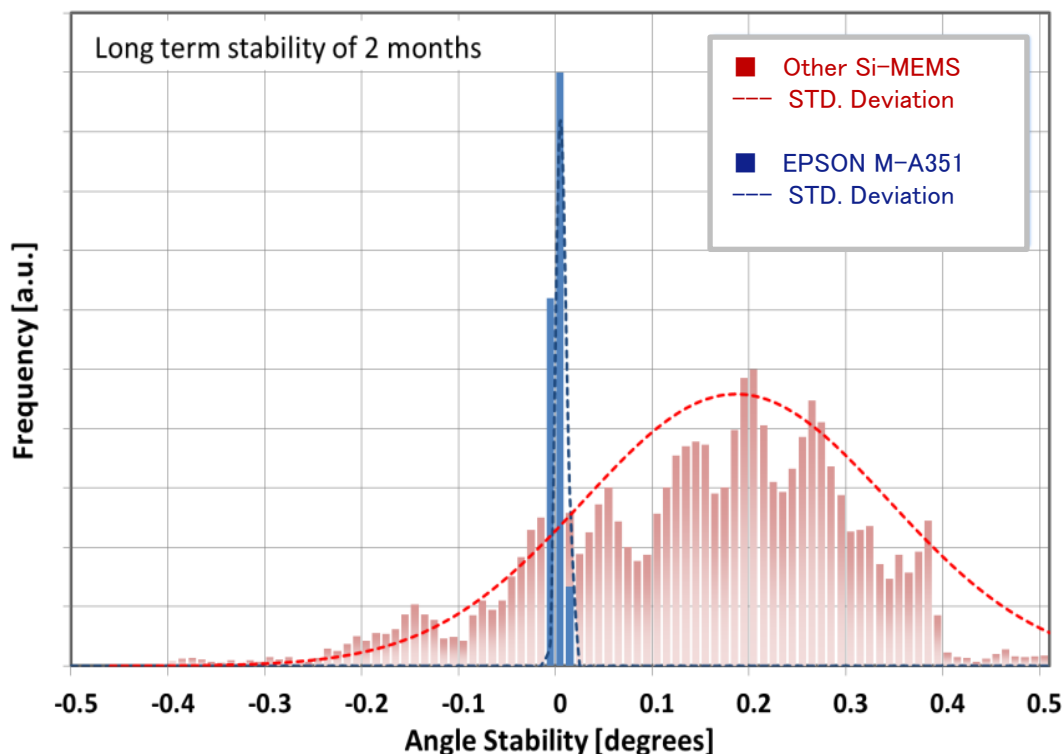
■ Low Noise and High Resolution

M-A351 outputs digital 32bit data on each X/Y/Z axis with a resolution of 0.06uG/LSB. This accelerometer can detect slow vibration, small displacement, and high resolution angle and is suitable for structure health monitoring, seismic observation and earthquake detection.
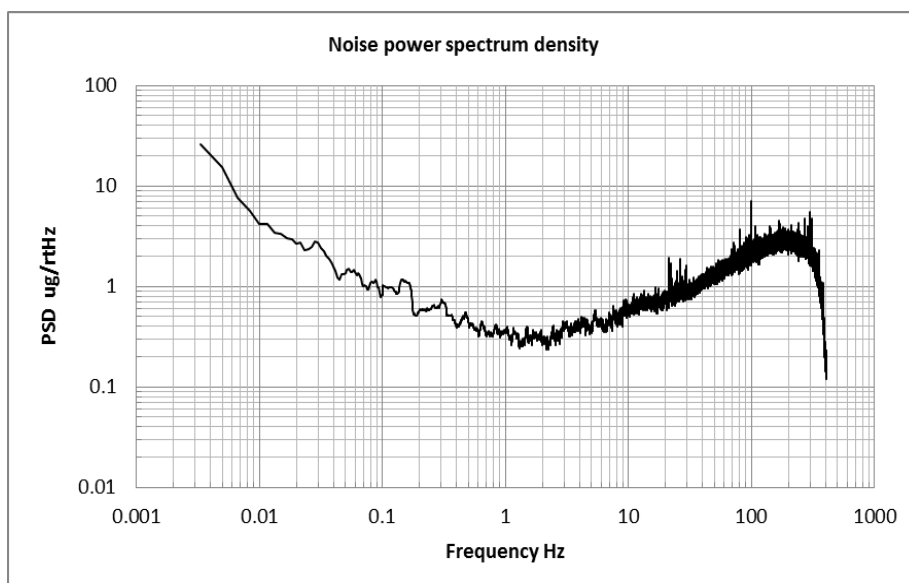
Accelerometer

■ Noise-Resilience and Direct-Digital-Conversion

M-A351 is a digital-frequency-change-type of Quartz based accelerometer. This accelerometer can output 32bit data (0.06uG/LSB) on each axis without any expensive analog components (such as high fidelity A/D converter) and is resilient to electricity noise problems typically associated with Si-MEMS-type accelerometers.

Host Side

M-A351

| Freq. Change | $\triangle f$ | Digital Processor |
| | | Freq. Counter |

Digital-out
SPI / UART → CPU

Analog sensor elements

| Cap. Change | $\triangle v$ | Op-Amp |

Analog-out → Analog Filter **+** A/D Converter
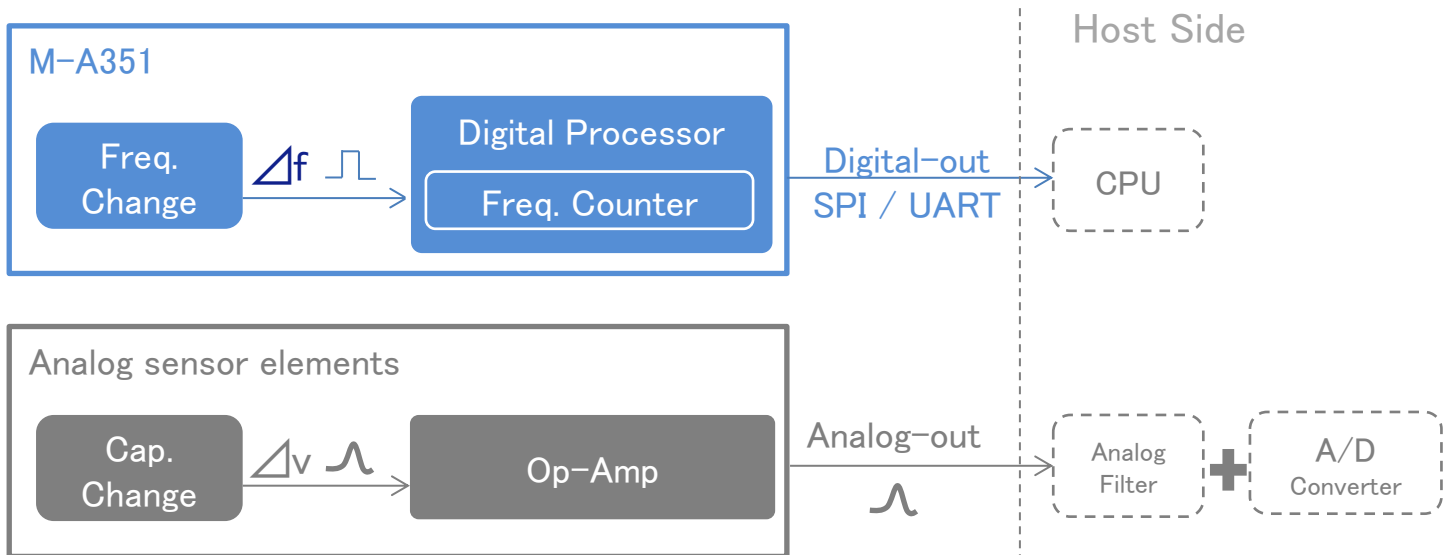
■ Acceleration, Tilt Angle, Angle Speed

M-A351 has programmable output selection (Acceleration/Tilt Angle/Angle Speed) for a wide variety of applications and use cases. This digital type of sensor will decrease cost, size, and development schedule.

①Acceleration

Ay
Ax
Az

②Tilt Angle

θ
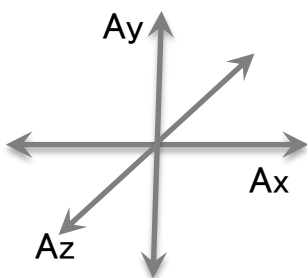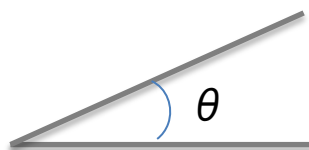
③Angle Speed

IMU
(Inertial Measurement Unit)

High Stability IMU

■ GENERAL DESCRIPTION

The M-G364 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 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-G364 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, 10grams
- Rugged Metal Body / High Vibration Resistance
- Low-Noise, High-Stability
    - Gyro Bias Instability   : 2.2 deg/hr
    - Angular Random Walk   : 0.09 deg/$\sqrt{}$ hr
- Initial Bias Error   : 0.1 deg/s (1 σ)
- 6 Degrees Of Freedom
    - Triple Gyroscopes   : ±100 ／±200 deg/s *
    - Tri-Axis Accelerometer   : ±3 G
- 16/32bit Data Resolution
- Digital Serial Interface   : SPI / UART
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)
- Data Output Rate   : to 2,000 Sps
- External Trigger Input / External Counter Reset Input
- Delta Angle/Delta Velocity Output
- Calibration & Operating Temperature Range   : −40°C to +85°C
- Single Voltage Supply   : 3.3 V
- Low Power Consumption   : 18mA (Typ.)

    (*The gyro dynamic range is determined by part number ordering code)

■ APPLICATIONS

- Antenna and Platform Stabilization
- Camera Gimbals
- Motion Analysis and Control
- Navigation Systems
- Vibration Control and Stabilization
- Pointing and Tracking Systems

■ FUNCTIONAL BLOCK DIAGRAM

IMU M-G364
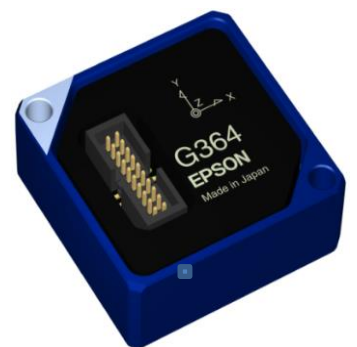
High Stability IMU

■ SENSOR SECTION SPECIFICATION

T_A=25° C, VCC=3.3V, angular rate=0 deg/s, ≤±1G, unless otherwise noted.

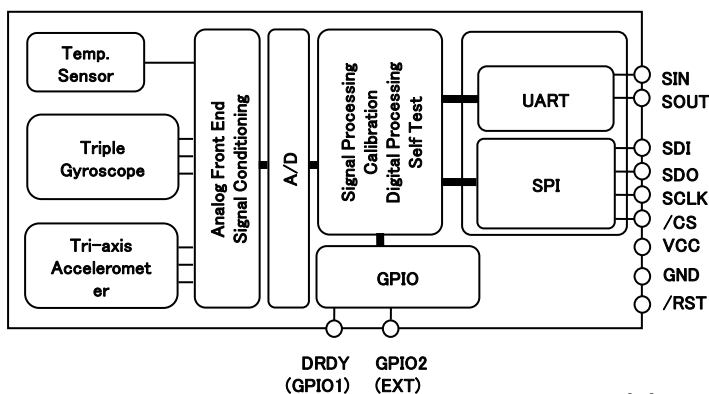| Parameter	Test Conditions / Comments	Min.	Typ.	Max.	Unit
GYRO SENSOR					
Sensitivity					
Dynamic Range [3]	-	-	±100 ╱±200	-	deg/s
Scale Factor [3]	16bit	Typ-0.2%	0.00375 ╱0.0075	Typ+0.2%	(deg/s)/LSB
Temperature Coefficient	1 σ, −40°C ≤ T_A ≤ +85°C	-	15	-	ppm/°C
Nonlinearity	1 σ, Best fit straight line	-	0.05	-	% of FS
Misalignment	1 σ, Axis-to-axis, Δ = 90° ideal	-	0.02	-	deg
Bias					
Initial Error	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.1	-	deg/s
Temperature Coefficient (Linear approximation)	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.0005	-	(deg/s)/°C
In-Run Bias Stability	Average		2.2		deg/hr
Angular Random Walk	Average	-	0.09	-	deg/√hr
Linear Acceleration Effect	Average		0.005		(deg/s)/G
Noise					
Noise Density	Average , f = 10 to 20 Hz	-	0.002	-	(deg/s)/√Hz , rms
Frequency Property					
3 dB Bandwidth	-	-	200	-	Hz
ACCELEROMETERS					
Sensitivity					
Dynamic Range	-	±3	-	-	G
Scale Factor	16bit	Typ-0.2%	0.125	Typ+0.2%	mG/LSB
Temperature Coefficient	1σ, −40°C ≤ T_A ≤ +85°C	-	15	-	ppm/°C
Nonlinearity	1 σ,≤ 1G, Best fit straight line	-	0.1	-	% of FS
Misalignment	1 σ, Axis-to-axis, Δ = 90° ideal	-	0.01	-	deg
Bias					
Initial Error	1 σ, −40°C ≤ T_A ≤ +85°C	-	5	-	mG
Temperature Coefficient (Linear approximation)	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.02	-	mG/°C
In-Run Bias Stability	Average	-	0.05	-	mG
Velocity Random Walk	Average	-	0.025	-	(m/sec)/ √hr
Noise					
Noise Density	Average, f = 10 to 20 Hz	-	0.06	-	mG/√Hz , rms
Frequency Property					
3 dB Bandwidth	-	-	200	-	Hz
TEMPERATURE SENSOR					
Scale Factor [1,2]	Output = 2634(0x0A4A) @ +25°C	-	-0.0037918	-	°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.
*2) This is the temperature scale factor for the upper 16bit (TEMP_HIGH).
*3) The parameter is fixed and determined by part number option selected at the time of order.
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.

Wide Dynamic Range IMU

■ GENERAL DESCRIPTION

The M-G354 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-G354 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, 10grams
- Rugged Metal Body / High Vibration Resistance
- Low-Noise, High-Stability
  - Gyro Bias Instability   : 3 deg/hr
  - Angular Random Walk   : 0.2 deg/$\sqrt{}$ hr
- Initial Bias Error   : 0.1 deg/s (1σ)
- 6 Degrees Of Freedom
  - Triple Gyroscopes   : ±450 deg/s
  - Tri-Axis Accelerometer   : ±5 G
- 16/32bit Data Resolution
- Digital Serial Interface   : SPI / UART
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)
- Data Output Rate   : to 2,000 Sps
- External Trigger Input / External Counter Reset Input
- Delta Angle/Delta Velocity Output
- Calibration & Operating Temperature Range   : −40°C to +85°C
- Single Voltage Supply   : 3.3 V
- Low Power Consumption   : 18mA (Typ.)

■ APPLICATIONS

- Antenna and Platform Stabilization
- Camera Gimbals
- Motion Analysis and Control
- Navigation Systems
- Vibration Control and Stabilization
- Pointing and Tracking Systems

■ FUNCTIONAL BLOCK DIAGRAM
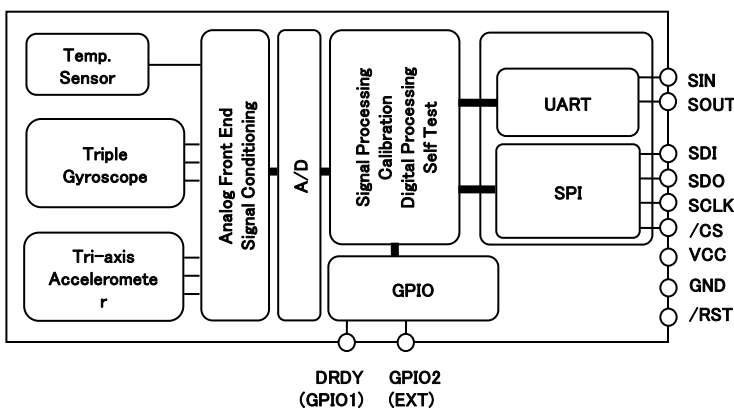
Wide Dynamic Range IMU

■ SENSOR SECTION SPECIFICATION

T_A=25° C, VCC=3.3V, angular rate=0 deg/s, ≤±1G, unless otherwise noted.

Parameter	Test Conditions / Comments	Min.	Typ.	Max.	Unit
GYRO SENSOR					
Sensitivity					
Dynamic Range	-	-	±450	-	deg/s
Scale Factor	16bit	Typ-0.2%	0.016	Typ+0.2%	(deg/s)/LSB
Temperature Coefficient	1 σ, −40°C ≤ T_A ≤ +85°C	-	15	-	ppm/°C
Nonlinearity	≤±300dps	-	0.05	-	% of FS
	≥±300dps	-	0.2	-	
Misalignment	1 σ, Axis-to-axis, Δ = 90° ideal	-	0.02	-	deg
Bias					
Initial Error	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.1	-	deg/s
Temperature Coefficient (Linear approximation)	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.0005	-	(deg/s)/°C
In-Run Bias Stability	Average		3		deg/hr
Angular Random Walk	Average	-	0.2	-	deg/√hr
Linear Acceleration Effect	Average		0.005		(deg/s)/G
Noise					
Noise Density	Average , f = 10 to 20 Hz	-	0.002	-	(deg/s)/√Hz , rms
Frequency Property					
3 dB Bandwidth	-	-	200	-	Hz
ACCELEROMETERS					
Sensitivity					
Dynamic Range	-	±5	-	-	G
Scale Factor	16bit	Typ-0.2%	0.2	Typ+0.2%	mG/LSB
Temperature Coefficient	1σ, −40°C ≤ T_A ≤ +85°C	-	15	-	ppm/°C
Nonlinearity	1 σ,≤ 1G, Best fit straight line	-	0.1	-	% of FS
Misalignment	1 σ, Axis-to-axis, Δ = 90° ideal	-	0.01	-	deg
Bias					
Initial Error	1 σ, −40°C ≤ T_A ≤ +85°C	-	5	-	mG
Temperature Coefficient (Linear approximation)	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.02	-	mG/°C
In-Run Bias Stability	Average	-	0.07	-	mG
Velocity Random Walk	Average	-	0.03	-	(m/sec)/ √hr
Noise					
Noise Density	Average, f = 10 to 20 Hz	-	0.06	-	mG/√Hz , rms
Frequency Property					
3 dB Bandwidth	-	-	200	-	Hz
TEMPERATURE SENSOR					
Scale Factor [1,2]	Output = 2634(0x0A4A) @ +25°C	-	-0.0037918	-	°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.
*2) This is the temperature scale factor for the upper 16bit (TEMP_HIGH).
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.

Small Size and Light Weight IMU

■ GENERAL DESCRIPTION

The M-V340 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 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-V340 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   : 10x12x4mm, 1gram
- Low-Noise, High-Stability
    - Gyro Bias Instability   : 3.5 deg/hr
    - Angular Random Walk   : 0.17 deg/ $\sqrt{}$ hr
- Initial Bias Error   : 0.5 deg/s (1 σ)
- 6 Degrees Of Freedom
    - Triple Gyroscopes   : $\pm$ 450 deg/s
    - Tri-Axis Accelerometer   : $\pm$ 5.8 G
- 16bit Data Resolution
- Digital Serial Interface   : SPI / UART
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)
- Data Output Rate   : to 1,000 Sps
- External Trigger Input / External Counter Reset Input
- Calibration & Operating Temperature Range   : −40°C to +85°C
- Single Voltage Supply   : 3.3 V
- Low Power Consumption   : 16.5mA (Typ.)

■ APPLICATIONS

- Unmanned Systems
- Motion Analysis and Control
- Navigation Systems
- Vibration Control and Stabilization
- Pointing and Tracking Systems

■ FUNCTIONAL BLOCK DIAGRAM

IMU M-V340
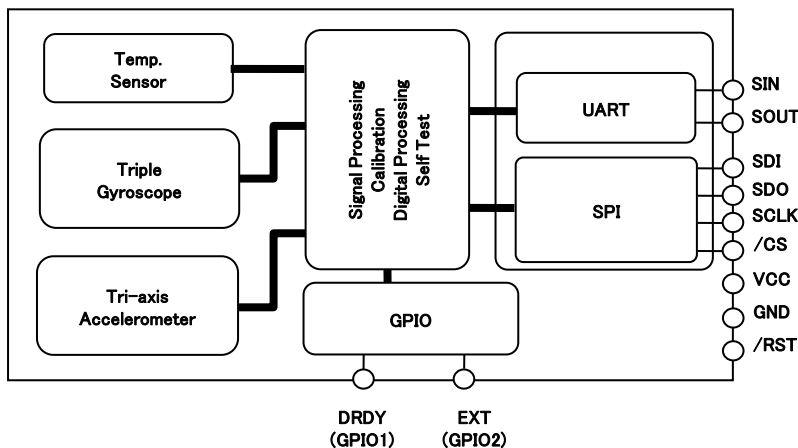
Small Size and Light Weight IMU

■ SENSOR SECTION SPECIFICATION

T_A=25°C, VCC=3.3V, angular rate=0 deg/s, ≤±1G, unless otherwise noted.

Parameter	Test Conditions / Comments	Min.	Typ.	Max.	Unit
GYRO SENSOR					
Sensitivity					
Dynamic Range	-	-	±450	-	deg/s
Sensitivity	-		0.015		(deg/s)/LSB
Temperature Coefficient	1 σ, −40°C ≤ T_A ≤ +85°C	-	10	-	ppm/°C
Nonlinearity	≤±300dps	-	0.1	-	% of FS
	≥±300dps	-	0.5	-	
Misalignment	1 σ, Axis-to-axis, Δ = 90° ideal	-	0.1	-	deg
Bias					
Initial Error	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.5	-	deg/s
Temperature Coefficient (Linear approximation)	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.001	-	(deg/s)/°C
In-Run Bias Stability	Average		3.5		deg/hr
Angular Random Walk	Average	-	0.17	-	deg/√hr
Linear Acceleration Effect	Average		0.01		(deg/s)/G
Noise					
Noise Density	Average , f = 10 to 20 Hz	-	0.0025	-	(deg/s)/√Hz , rms
Frequency Property					
3 dB Bandwidth	-	-	200	-	Hz
ACCELEROMETERS					
Sensitivity					
Dynamic Range	-	±5.8	-	-	G
Scale Factor	16bit		0.18		mG/LSB
Temperature Coefficient	1σ, −40°C ≤ T_A ≤ +85°C	-	35	-	ppm/°C
Nonlinearity	1 σ,≤ 1G, Best fit straight line	-	1	-	% of FS
Misalignment	1 σ, Axis-to-axis, Δ = 90° ideal	-	0.2	-	deg
Bias					
Initial Error	1 σ, −40°C ≤ T_A ≤ +85°C	-	8	-	mG
Temperature Coefficient (Linear approximation)	1 σ, −40°C ≤ T_A ≤ +85°C	-	0.1	-	mG/°C
In-Run Bias Stability	Average	-	0.05	-	mG
Velocity Random Walk	Average	-	0.15	-	(m/sec)/ √hr
Noise					
Noise Density	Average, f = 10 to 20 Hz	-	0.25	-	mG/√Hz , rms
Frequency Property					
3 dB Bandwidth	-	-	200	-	Hz
TEMPERATURE SENSOR					
Scale Factor [1,2]	Output = 1469 @ +25°C	-	-0.0053964	-	°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.
*2) This is the temperature scale factor for the upper 16bit (TEMP_HIGH).
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.

IMU M-G550PC2

CAN Interface & Waterproof IMU

■ GENERAL DESCRIPTION

The M-G550PC2 is a small form factor inertial measurement unit (IMU) with 6 degrees of freedom: tri-axial 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 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 Controller Area Network (CAN) interface support for host communication, the M-G550PC2 reduces technical barriers for users to introduce inertial measurement and minimizes design resources to implement inertial movement analysis and control applications.

This unit is packaged in a water-proof and dust-proof metallic case. It is suitable for use in industrial and heavy duty 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

- Size, Weight : 52x52x26mm, 81grams
- Water Proof and Dust Proof : IP67
- Low-Noise, High-Stability
  - Gyro Bias Instability : 3.5 deg/hr
  - Angular Random Walk : 0.1 deg/$\sqrt{}$ hr
- Initial Bias Error : 0.5 deg/s (1σ)
- 6 Degrees Of Freedom
  - Triple Gyroscopes : $\pm$ 150 deg/s
  - Tri-Axis Accelerometer : $\pm$ 5 G
- 16bit Data Resolution
- Interface : CANopen (ISO11898-2, High speed CAN)
- Bit Rate : 10k to 1M bps (Selectable)
- Node-ID : 1 to 127
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)
- Sampling Rate : to 1,000 Sps
- Data Logging : 1,048,560 data samples
- Operating Temperature Range : −40°C to +70°C
  (without mechanical actuation)
- Single Voltage Supply : 9 to 30V
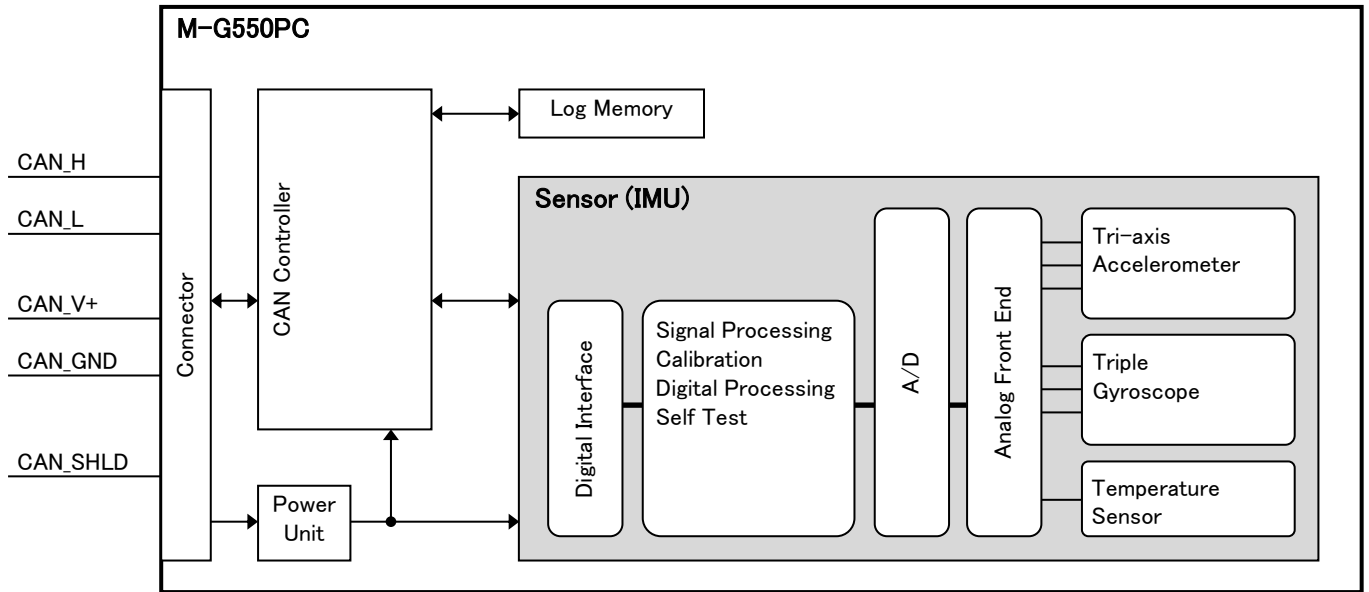- Low Power Consumption : 26.5mA (Typ.) @Vin = 12V

■ APPLICATIONS

- Motion and Vibration Measurement
- Platform Stabilization
- Attitude Detection for Unmanned Systems
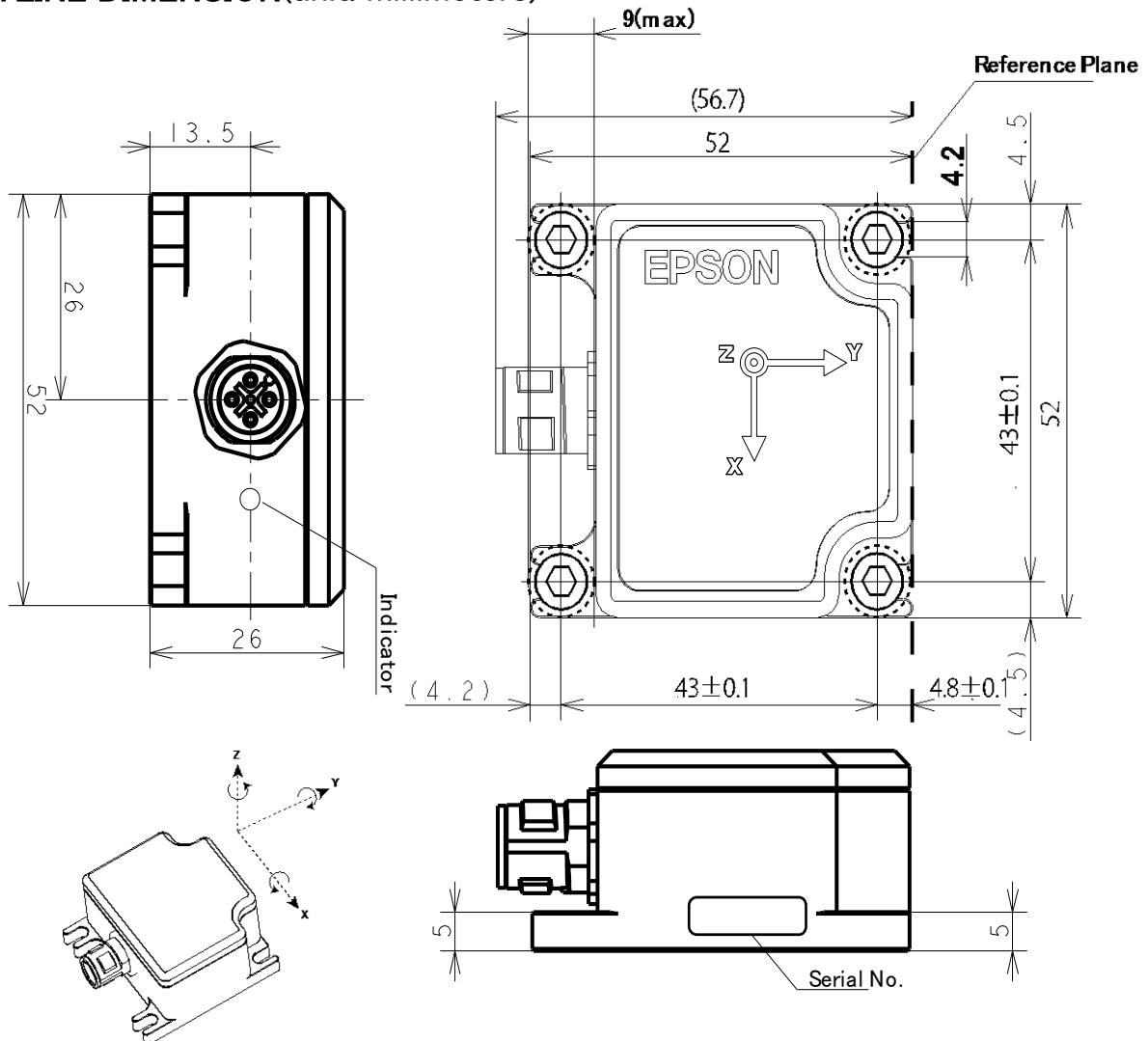- Vibration Control and Stabilization

CAN Interface & Waterproof IMU

■ FUNCTIONAL BLOCK DIAGRAM

M-G550PC

Log Memory

CAN_H

CAN_L

CAN_V+

CAN_GND

CAN_SHLD

Connector

CAN Controller

Power Unit

Sensor (IMU)

Digital Interface

Signal Processing
Calibration
Digital Processing
Self Test

A/D

Analog Front End

Tri-axis Accelerometer

Triple Gyroscope

Temperature Sensor

■ OUTLINE DIMENSION(unit: millimeters)

9(max)

Reference Plane

(56.7)

52

4.2

4.5

13.5

26

52

26

EPSON

Z Y

X

43±0.1

52

Indicator

(4.2)

43±0.1

4.8±0.1

(4.5)

Z Y

X

5

5

Serial No.

Accelerometer

Accelerometer M-A351AS/AU
High Precision 3axis Accelerometer

■ GENERAL DESCRIPTION

Accelerometer M-A351 (vibration and inclination) series is a wideband model with wider measurement bandwidth capability. The M-A351 series enables measurement bandwidths of up to 100Hz, and an increased data output rate of up to 1,000Sps. Moreover, the measurement resolution is improved to 0.06uG/LSB, and the output mode of each acceleration axis can be selected from acceleration/tilt angle/tilt angle speed. A highly accurate and stable three axis accelerometer equipped with detection elements made from quartz crystal micro-fabrication technology and wide temperature range by incorporating built-in temperature compensation technology.

Using the M-A351 series with the latest generation technology eliminates the need for costly components such as high fidelity AD converters, analog accelerometers, and noise/wiring challenges associated with legacy analog systems. The highly integrated M-A351 series with serial digital output (SPI or UART) simplifies the design of high performance measurement systems by reducing the overall system cost, weight, and power consumption.

The M-A351 series accelerometer facilitates the differentiation and development of new applications in the various fields of industrial systems.

■ FEATURES

● Small Size and Lightweight	: 24x24x19mm, 12grams
● Low Noise	: 0.5 uG/√Hz (Average)
● High Resolution	: 0.06 uG/LSB
● Wide Bandwidth	: 100 Hz (selectable)
● Output Rate	: SPI 500 Sps / UART 1,000 Sps (Max., selectable)
● Three Axis Accelerometer	: ±5 G
● Digital Serial Interface	: SPI (M-A351AS) / UART (M-A351AU)
● Wide Operating Temperature Range	: −20°C to +85°C
● Low Voltage Supply	: 3.3 V
● Low Power Consumption	: 66mW
● Output Mode Selection (each axis)	: Acceleration, Tilt Angle, or Tilt Angle Speed

■ APPLICATIONS

● Building and Structural Health Monitor
● Seismic Observation
● Earthquake Detection

■ FUNCTIONAL BLOCK DIAGRAM
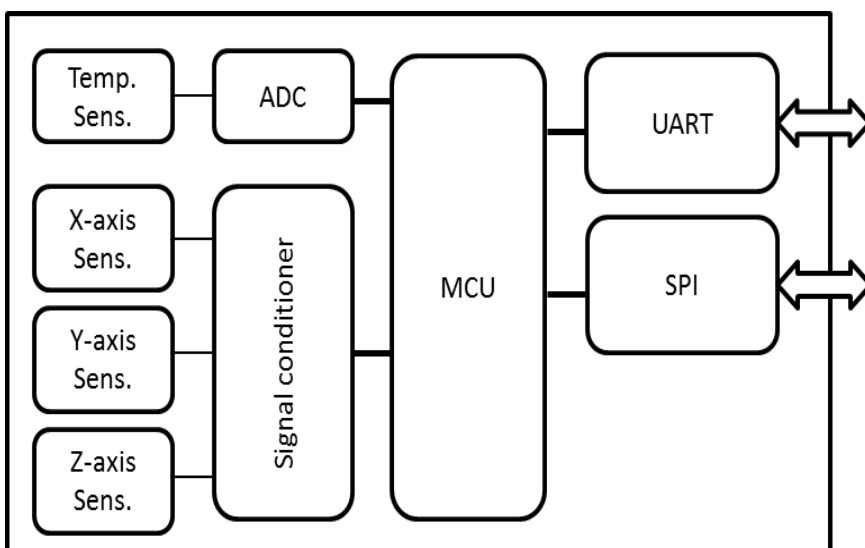
Accelerometer M−A351AS/AU
High Precision 3axis Accelerometer

■ SENSOR SECTION SPECIFICATION

Parameter	Test Conditions / Comments	Spec.	Unit
Acceleration Output Data Type			
Input Range (*1)	Reduced accuracy operating range	+/-5	G
Input Range (*2)	Accuracy guaranteed by specification	+/-1	G
Null Offset	T_A=25°C	+/-4	mG
Null Offset Repeatability	T_A=25°C and VCC=3.3V for one year after shipment	3	mG
Null Offset Temperature Variation	-20°C to +85°C	+/-4	mG
Noise Density	T_A=25°C,average 0.5Hz to 6Hz,horizontal (+/-5deg.)	0.5	µGrms/√Hz
	T_A=25°C,peak 0.5Hz to 100Hz,horizontal (+/-5deg.)	60	µGrms/√Hz
Resolution	UART/SPI (Binary)	0.06	µG/LSB
Tilt Angle Output Data Type (*3)			
Input Range	Accuracy guaranteed by specification	+/-0.785	rad
Null Offset Repeatability	T_A=25°C and VCC=3.3V for one year after shipment	+/-3.491	mrad
Resolution	UART/SPI (Binary)	0.002	µrad/LSB
Tilt Angle Speed Output Data Type (*4)			
Calculating Range	Unit per millisecond of measurement trigger	+/-2.094	rad/ms
Resolution	UART/SPI (Binary)	2	(µrad/s)/LSB
Common			
Filter Bandwidth (*5)	Selectable with command	5,10,20,50,100	Hz
Data Output Rate (*5)	UART, Selectable with command	Up to 1000	Sps
	SPI, Selectable with command	Up to 500	Sps
Power Supply Voltage	T_A=25°C	3.3	V
Consumption Current	Measurement mode, T_A=25°C	20	mA

T_A=−20° C to +85° C, VCC=3.15V to 3.45V,±1G, unless otherwise noted.
∗1 The range from above ±1G to ±5G is outside the guaranteed accuracy specifications.
∗2 The calibrated standard 1G gravitational acceleration value is 9.80665 m/s².
∗3 Tilt angle is internally calculated from the gravitational acceleration.
∗4 Tilt angle speed = delta tilt angle / data rate.
∗5 The output data rate and internal filter bandwidth is selectable by the command.

■ TYPICAL PERFORMANCE CHARACTERISTICS

Noise power spectrum density
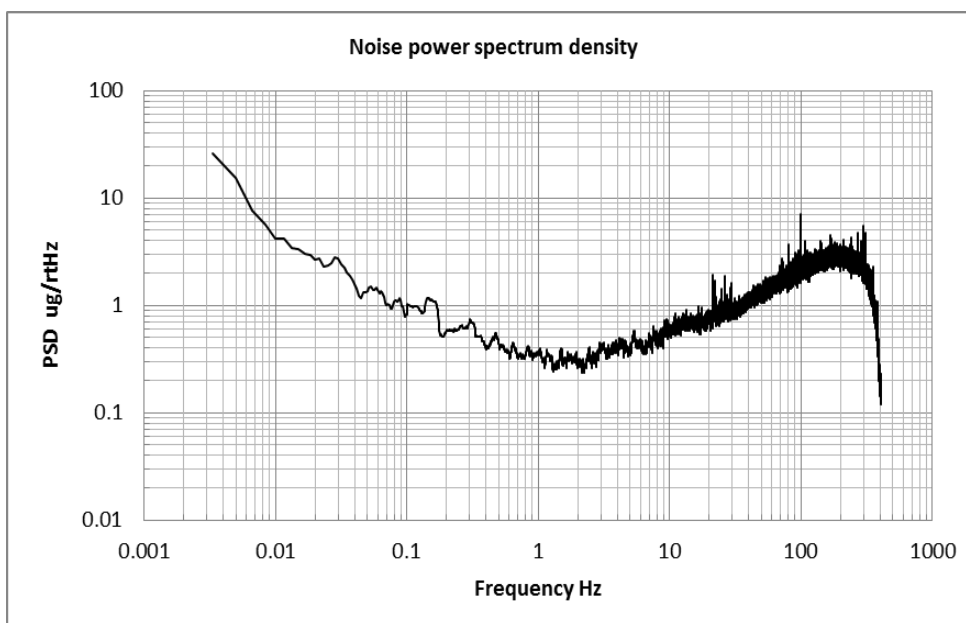
Accelerometer M-A550AC2

CAN Interface & Waterproof

■ GENERAL DESCRIPTION

 The M-A550AC2 is a high accuracy and high stability 3 axis accelerometer. This sensor unit is based on Quartz technology for high accuracy, high stability, small size, and low power consumption. This sensor unit enables wide dynamic range acceleration and vibration sensing. Acceleration and tilt angle is available as user selectable output measurement options. This sensor unit uses the latest technology to improve performance and offer wider sensing bandwidth. With Controller Area Network (CAN) interface supported for host communication, the M-A550AC reduces technical barriers for users to incorporate seismic and vibration sensing, and minimizes design resources to implement control and monitoring applications. This unit is packaged in a water-proof and dust-proof metallic case making it suitable for use in industrial and heavy duty applications.

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

## ■ FEATURES

- Integrated Sensor   : M-A351
- Size and Weight   : 52x52x26mm, 81grams
- High Resolution   : 0.06 uG/LSB
- Wide Bandwidth   : 50 Hz
- Three Axis Accelerometer   : ±5 G (Accuracy range ±1G)
- Digital Serial Interface   : CANopen (ISO11898-2 High speed CAN)
- Water and Dust Proof   : IP67 Equivalent
- Output Rate   : 500 Sps (selectable)
- Node-ID   : 1 to 127
- Operating Temperature Range   : −20°C to +70°C
- Single Voltage Supply   : 9 to 30V
- Low Power Consumption   : 24mA (Typ.) @Vin = 12V
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)
- Data Logging Function

■ APPLICATIONS

- Building and Structural Health Monitor
- Seismic Observation
- Earthquake Detection

■ FUNCTIONAL BLOCK DIAGRAM
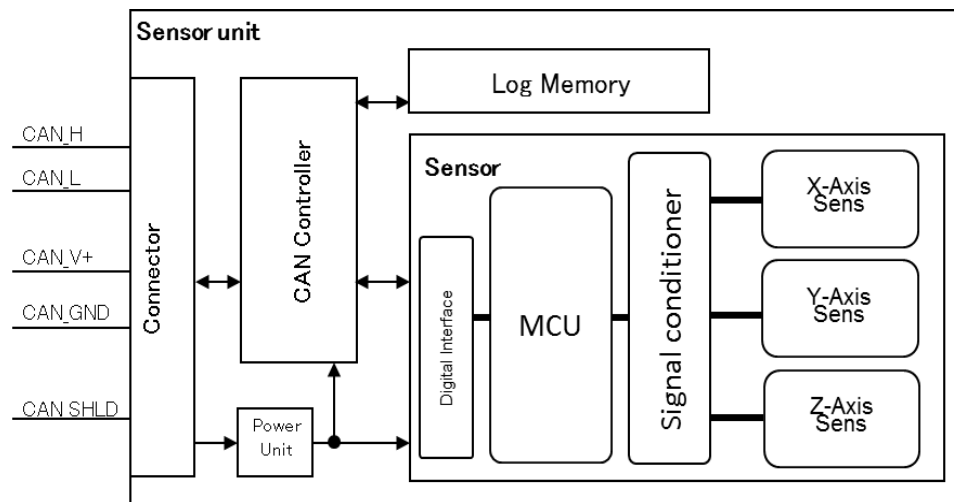
CAN Interface & Waterproof
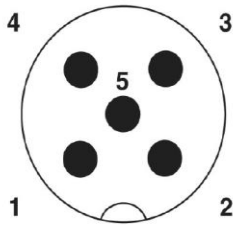
■ CABLE LENGTH

CAN bitrate	Total Cable Length
1000kbps	40m
500kbps	100m
250kbps	250m
125kbps	500m

■ CONNECTOR PIN LAYOUT AND FUNCTIONS

Model Number	SACC-DSI-MS-5CON-M12-SCO SH
Manufacturer	PHOENIX CONTACT

No	Pin Name	I/O	Description
1	CAN_SHLD	-	CAN Shield [*1]
2	CAN_V+	I	external power supply (9-30V)
3	CAN_GND	-	Ground
4	CAN_H	I/O	CAN H bus line
5	CAN_L	I/O	CAN L bus line

Note: This unit should be connected to a connector that satisfies at least the IP67 water and dust proof specification.

*1 CAN_SHLD is connected to the case. CAN_SHLD is internally connected to CAN_GND via a capacitor 0.01uF/100V.

■ OUTLINE DIMENSION(unit: millimeters)
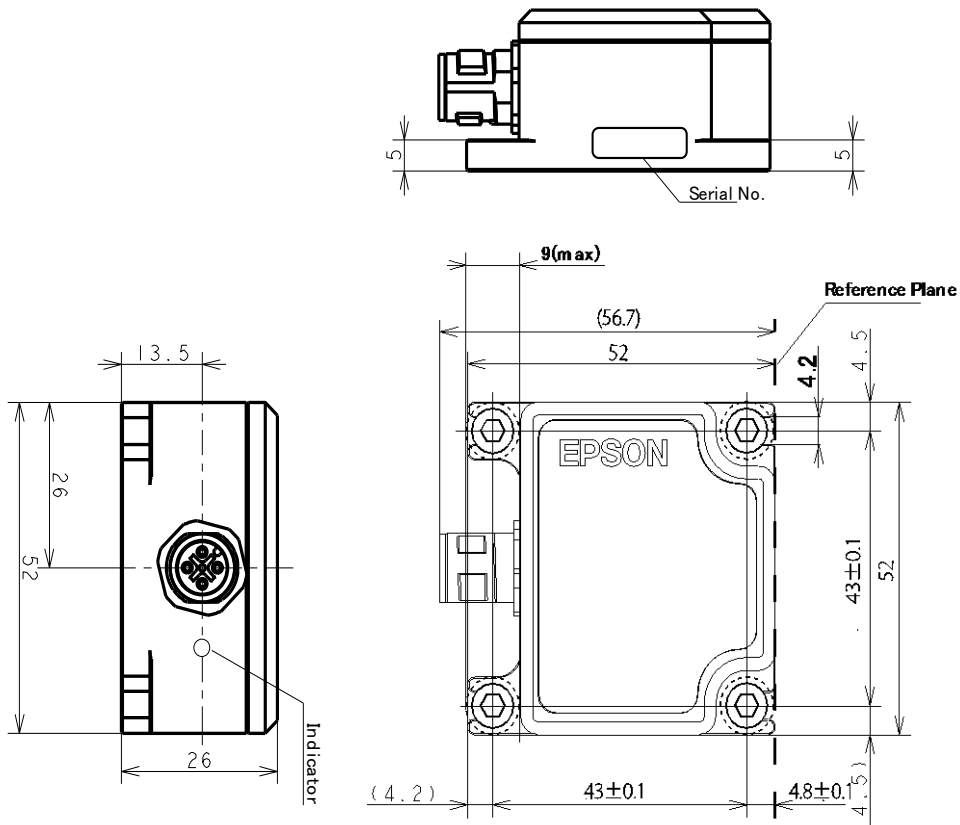
Accelerometer M-A550AR2
RS422 Interface & Waterproof

■ GENERAL DESCRIPTION

The M-A550AR2 is a high accuracy and high stability 3 axis accelerometer. This sensor unit is based on Quartz technology for high accuracy, high stability, small size, and low power consumption. This sensor unit enables wide dynamic range acceleration and vibration sensing. Acceleration, tilt angle and tilt angular velocity is available as user selectable output measurement options. This sensor unit uses the latest technology to improve performance and offer wider sensing bandwidth. With RS422 interface supported for host communication, the M-A550AR2x reduces technical barriers for users to incorporate seismic and vibration sensing, and minimizes design resources to implement control and monitoring applications. This unit is packaged in a water-proof and dust-proof metallic case making it suitable for use in industrial and heavy duty applications.

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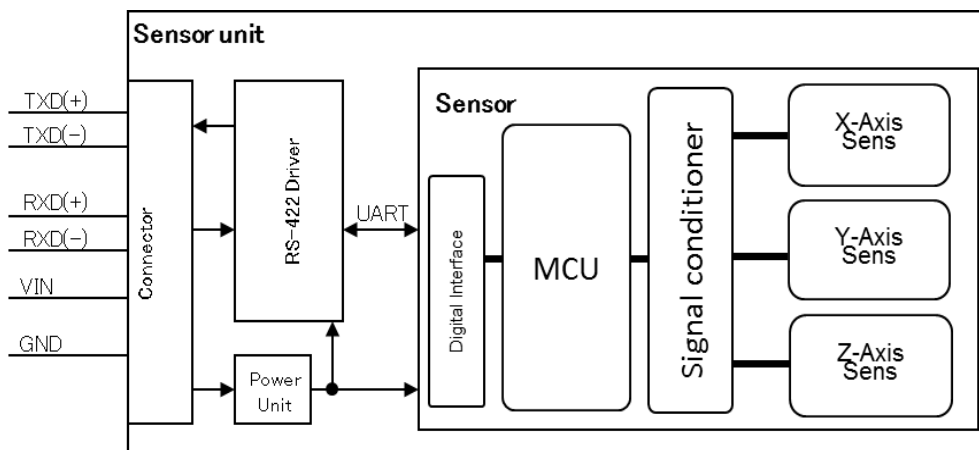
■ FEATURES

- Integrated Sensor : M-A351
- Size and Weight : 52x52x26mm, 81grams
- High Resolution : 0.06 uG/LSB
- Wide Bandwidth : 50 Hz
- Three Axis Accelerometer : ±5 G (Accuracy range ±1G)
- Digital Serial Interface : RS422
- Water and Dust Proof : IP67 Equivalent
- Output Rate : 500 Sps (selectable)
- Cable Length : 250 m(max)
- Operating Temperature Range : −20° C to +70° C
- Single Voltage Supply : 9 to 30V
- Low Power Consumption : 16mA (Typ.) @Vin = 12V
- Calibrated Stability (Bias, Scale Factor, Axial Alignment)

■ APPLICATIONS

- Building and Structural Health Monitor
- Seismic Observation
- Earthquake Detection

■ FUNCTIONAL BLOCK DIAGRAM

RS422 Interface & Waterproof

■ CONNECTOR PIN LAYOUT AND FUNCTIONS

Model Number	SACC-DSI-MS-8CON-M12-SCO SH		
Manufacturer	PHOENIX CONTACT		
Pin No.	Mnemonic	Type*1	Description
1	NC	N/A	Do Not Connect
2	VIN	S	Power Supply (9-30V)
3	GND	S	0V
4	TD-	O	Transmit Data (-)
5	RD+	I	Received Data (+)
6	TD+	O	Transmit Data (+)
7	NC	N/A	Do Not Connect
8	RD-	I	Received Data (-)

＊1) Pin Type I :Input, O :Output, I/O :Input/Output, S :Supply, N/A :Not Applicable

■ OUTLINE DIMENSION(unit: millimeters)

IMU Application Examples

Precision Agriculture

M-G364

M-G354

Implement Articulation

Auto-Steering Guidance

Stabilization

M-G364

M-V340

Antenna Pointing

Optical Stabilization
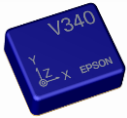
Construction and Mining Machine Control

M-G550

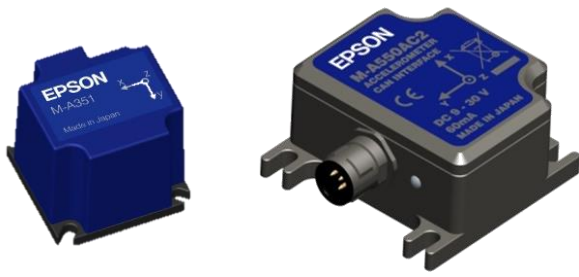Grading and Bulldozing

Excavator Bucket Positioning
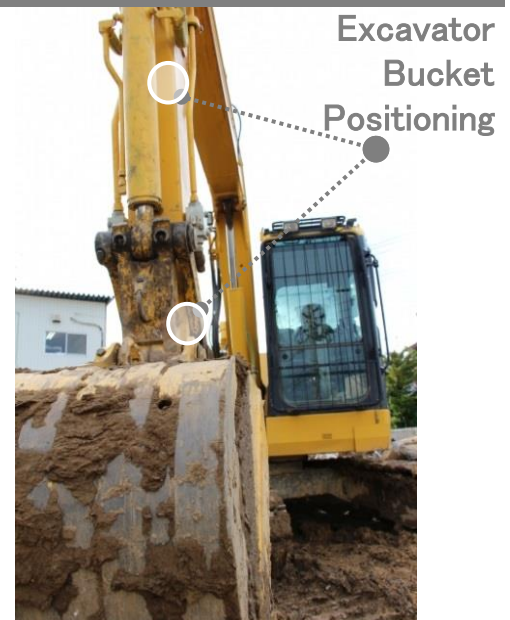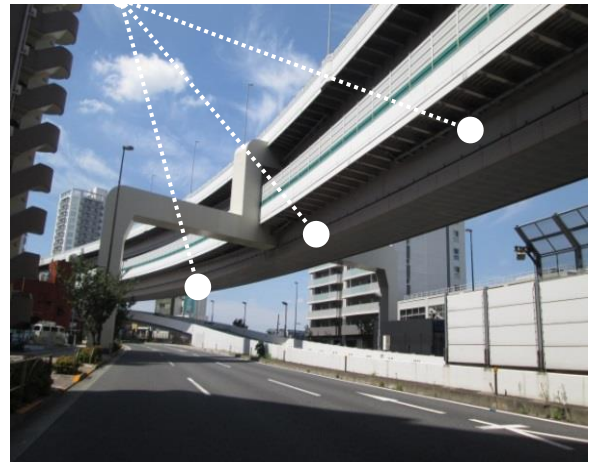
Accelerometer Application Examples

Structure Health Monitoring (SHM)

M-A351   M-A550

Bridge Monitoring
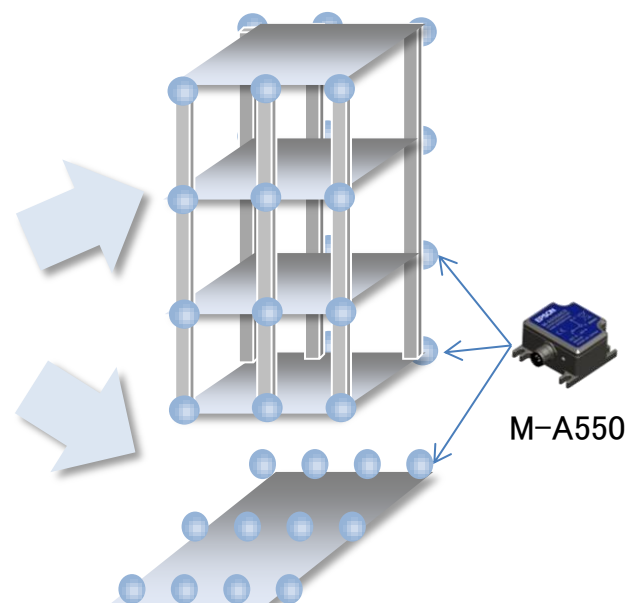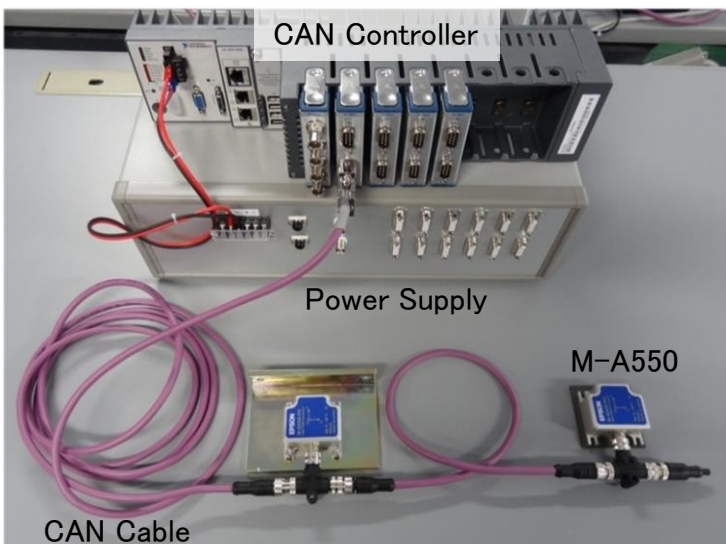
## Building and Earthquake Monitoring, Maintenance

M-A351   M-A550

TOP Floor

Ground Floor
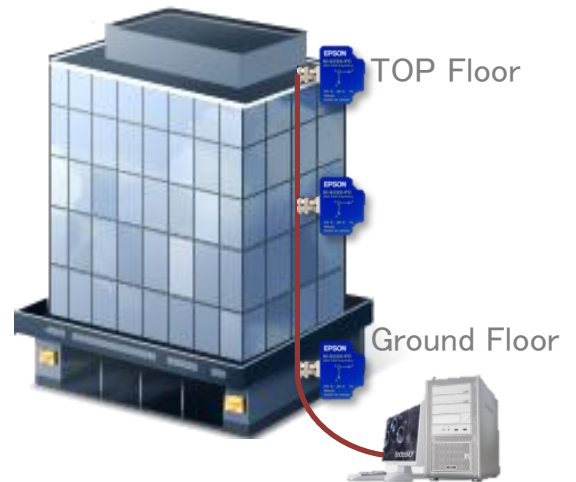
Multi-sensor Measurement System with CAN Interface

CAN Controller

Power Supply

M-A550

CAN Cable

M-A550

Evaluation Kit

This USB Evaluation Cable Interface Board enables a PC to control the Epson IMU and Accelerometer via USB interface when used with the USB Evaluation Cable and boards. The USB evaluation tools simplify the initial evaluation and rapid testing of the Epson IMU and Accelerometer products. The power is supplied from USB power.
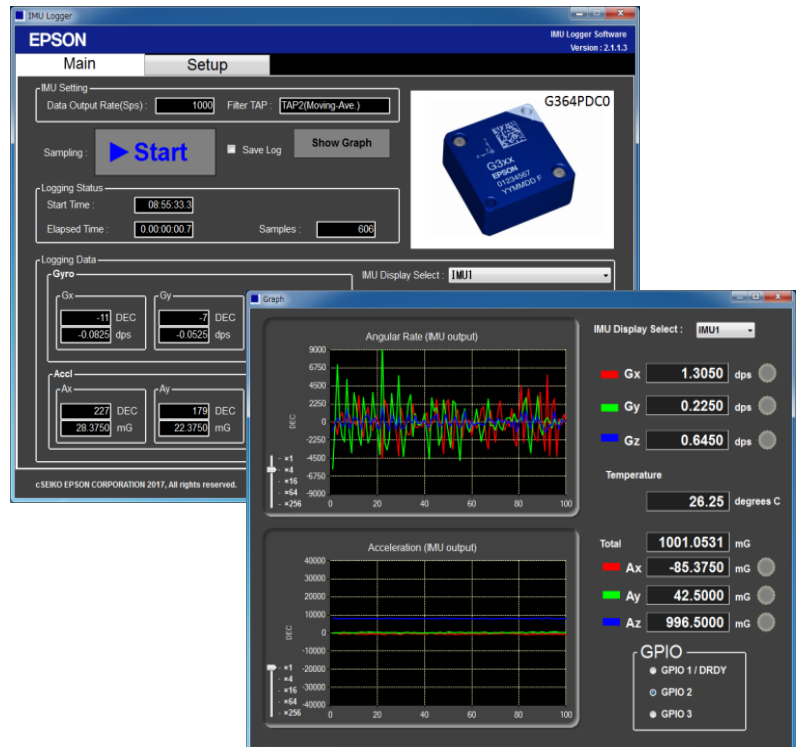
■ Block Diagram

■ USB Evaluation Kit

M-V34EV021   M-G32EV031
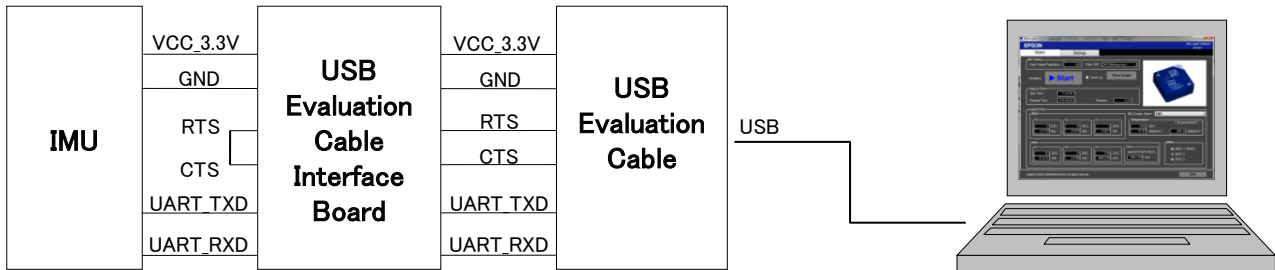
USB Evaluation Cable

Logger software for Windows
Downloadable on EPSON Website.

■ Combination Table

Usage	USB Evaluation Cable	Evaluation board	Products
Data logger on PC	M-C30EV041	M-G32EV031	M-G354PD M-G364PDC0 M-G364PDCA
		M-V34EV021	M-V340PD
	M-C30EV141	---	M-A351AU
Built in customer board	---	M-G32EV031	M-G354PD M-G364PDC0 M-G364PDCA
		M-V34EV011	M-V340PD

Global Network

In order to understand the customer needs around the world and respond quickly, we are expanding our bases globally and providing services closely to customers.

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