



## 6DoF Inertial Sensor for Automotive

6in1 Sensor

**EWTS5G** series HP (High performance) type

The 6in1 sensor is a 6DoF inertial sensor with functional safety standard ISO26262 compliance for automotive applications. The sensing elements consists 3 Accelerometers and 3 Gyroscopes in single MEMS chip.

The MEMS, ASIC and Cap are directly bonded at wafer level and packaged.

This enables the 6in1 sensor to be compact, highly accurate, easy to install, and highly reliable.

### Feature

- Function Safety compliance (ISO26262) for automotive safety system
  - Compatible with ASIL-D functional safety development
- 6DoF sensors on one single MEMS die with high accurate and for more system design flexibility
  - Orthogonality :  $\leq 0.01^\circ$  between Gyro and Acceleration axis
- Contribute for compact and simple ECU system design
  - 6DoF one package : 4.5 x 4.5 x 1.1 mm
- RoHS compliance

### Rating

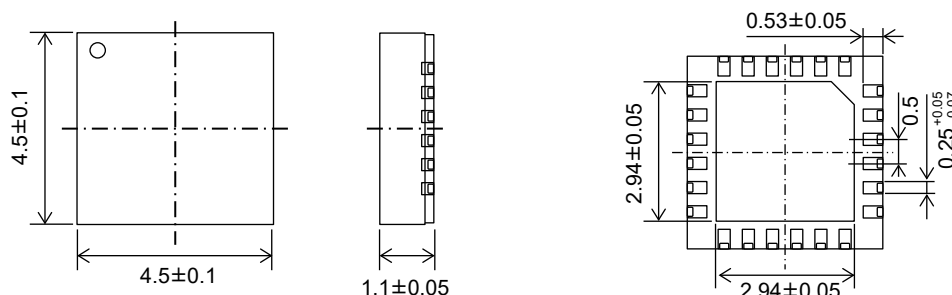
- Characteristics

Size (mm)		4.5 x 4.5 x 1.1
Operation temperature		-40 °C to +125 °C
Storage temperature		-40 °C to +125 °C
Operation voltage [DC]		3.3 ± 0.3 V
Current consumption		$\leq 10$ mA
Data interface		SPI
Gyro	Axis	X, Y, Z
	Zero point error	$\leq \pm 2.0$ dps
	Scale factor error	$\leq \pm 2.0$ %
	Full scale range	$\pm 300$ dps, $\pm 150$ dps, $\pm 120$ dps, $\pm 60$ dps, $\pm 30$ dps (Selectable)
	Frequency response	10 Hz, 12.5 Hz, 27 Hz, 30 Hz, 46 Hz, 60 Hz (Selectable)
	Cross axis sensitivity	$\leq \pm 1.7$ %
	Output noise	$\leq 0.1$ dps rms (LPF : 60 Hz)
Acceleration	Axis	X, Y, Z
	Zero point error	$\leq \pm 0.05$ G
	Scale factor error	$\leq \pm 2.0$ %
	Full scale range	$\pm 16$ G, $\pm 8$ G, $\pm 2$ G, $\pm 1$ G (Selectable)
	Frequency response	10 Hz, 46 Hz, 60 Hz, 250 Hz, 300 Hz, 400 Hz (Selectable)
	Cross axis sensitivity	$\leq \pm 1.7$ %
	Output noise	$\leq 0.004$ G rms (LPF : 60 Hz)
Orthogonality		$\leq 0.01^\circ$

- Reliability test condition (AEC-Q100 compliance)

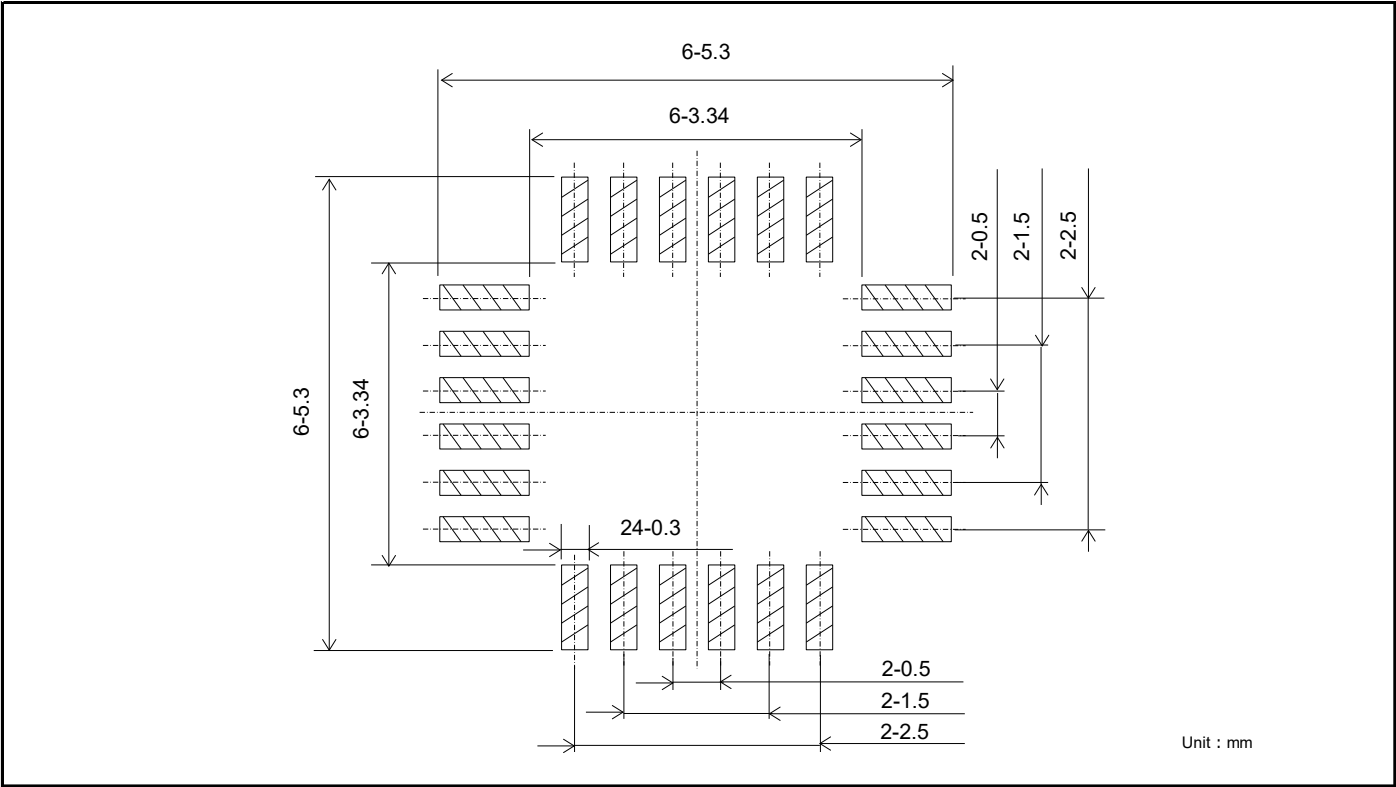
Temperature humidity bias (THB)	85 °C / 85 %RH / 3.6 V / 1000 h
High temperature storage life (HTSL)	150 °C / 1000 h
High temperature operating life (HTOL)	125 °C / 3.6 V / 1000 h
Temp cycling (TC)	-55 °C to 150 °C / 1000 cycles
Mechanical shock (MS)	1500 G / 0.5 ms / 5 times for each axis
Variable frequency vibration (VFV)	50 G / 20 Hz to 2 kHz / 4 times for each axis

### Dimension

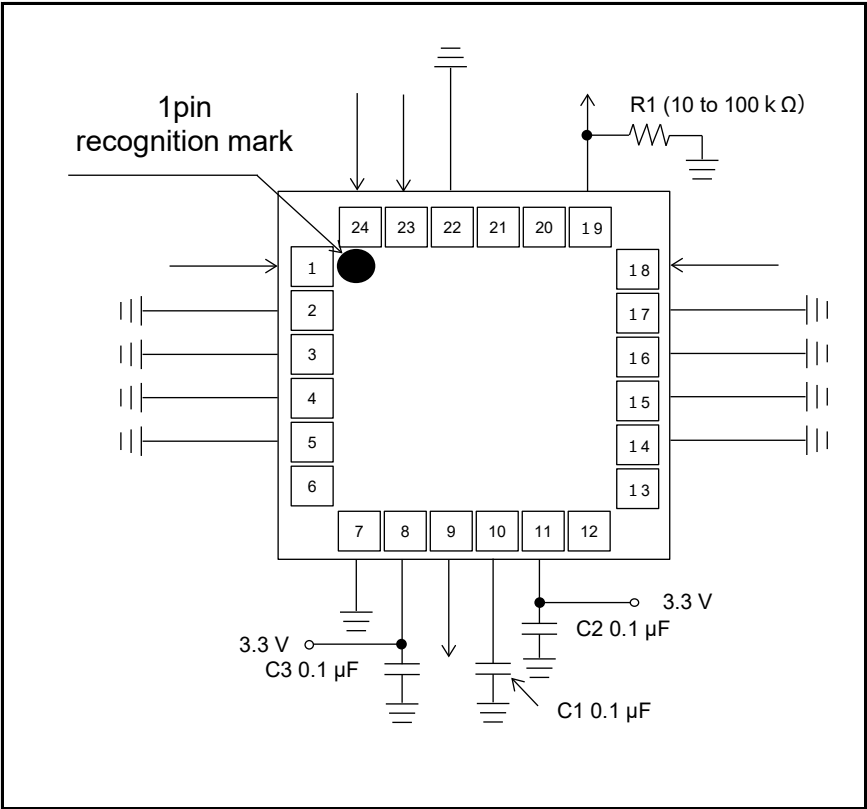


Land pattern

•Recommended land pattern



Electrical connection



No.	Abbreviations
1	MOSI
2	GND3 (MEMS cap)
3, 4, 5	NC
6	TP3
7	GND
8	VDDIO
9	MISO
10	REGOUT
11	VDD
12	TP1
13	TP2
14, 15, 16	NC
17	GND4
18	RESETN
19	TP0 / ALARMB
20	VPP
21	DVDD
22	GND2 (duplicate)
23	NCS
24	SCLK

## Safety and Legal Matters to Be Observed

### Product specifications and applications

- Please be advised that this product and product specifications are subject to change without notice for improvement purposes. Therefore, please request and confirm the latest delivery specifications that explain the specifications in detail before the final design, or purchase or use of the product, regardless of the application. In addition, do not use this product in any way that deviates from the contents of the company's delivery specifications.
- Unless otherwise specified in this catalog or the product specifications, this product is intended for use in general electronic equipment (AV products, home appliances, commercial equipment, office equipment, information and communication equipment, etc.).  
When this product is used for the following special cases, the specification document suited to each application shall be signed/sealed (with Panasonic Industry and the user) in advance..These include applications requiring special quality and reliability, wherein their failures or malfunctions may directly threaten human life or cause harm to the human body (e.g.: space/aircraft equipment, transportation/traffic equipment, combustion equipment, medical equipment, disaster prevention/crime prevention equipment, safety equipment, etc.).

### Safety design and product evaluation

- Please ensure safety through protection circuits, redundant circuits, etc., in the customer's system design so that a defect in our company's product will not endanger human life or cause other serious damage.
- This catalog shows the quality and performance of individual parts. The durability of parts varies depending on the usage environment and conditions. Therefore, please ensure to evaluate and confirm the state of each part after it has been mounted in your product in the actual operating environment before use.  
If you have any doubts about the safety of this product, then please notify us immediately, and be sure to conduct a technical review including the above protection circuits and redundant circuits at your company.

### Laws / Regulations / Intellectual property

- The transportation of dangerous goods as designated by UN numbers, UN classifications, etc., does not apply to this product. In addition, when exporting products, product specifications, and technical information described in this catalog, please comply with the laws and regulations of the countries to which the products are exported, especially those concerning security export control.
- Each model of this product complies with the RoHS Directive (Restriction of the use of hazardous substances in electrical and electronic equipment) (2011/65/EU and (EU) 2015/863). The date of compliance with the RoHS Directive and REACH Regulation varies depending on the product model.  
Further, if you are using product models in stock and are not sure whether or not they comply with the RoHS Directive or REACH Regulation, please contact us by selecting "Sales Inquiry" from the inquiry form.
- During the manufacturing process of this product and any of its components and materials to be used, Panasonic Industry does not intentionally use ozone-depleting substances stipulated in the Montreal Protocol and specific bromine-based flame retardants such as PBBs (Poly-Brominated Biphenyls) / PBDEs (Poly-Brominated Diphenyl Ethers). In addition, the materials used in this product are all listed as existing chemical substances based on the Act on the Regulation of Manufacture and Evaluation of Chemical Substances.
- With regard to the disposal of this product, please confirm the disposal method in each country and region where it is incorporated into your company's product and used.
- The technical information contained in this catalog is intended to show only typical operation and application circuit examples of this product. This catalog does not guarantee that such information does not infringe upon the intellectual property rights of Panasonic Industry or any third party, nor imply that the license of such rights has been granted.
- Design, materials, or process related to technical owned by Panasonic Industry are subject to change without notice.

**Panasonic Industry will assume no liability whatsoever if the use of our company's products deviates from the contents of this catalog or does not comply with the precautions. Please be advised of these restrictions.**

## Matters to Be Observed When Using This Product

(In-vehicle IMU sensor / 6in1 sensor)

### Use environments and cleaning conditions

- This product is intended for standard general-purpose use in electronic equipment, and is not designed for use in specific environments described below. Using the product in such specific environments or service conditions, therefore, may affect the performance of the product. Please check the performance and reliability of the product first before using the product.
  - (1) Used in liquid, such as water, oil, chemicals, and organic solvents.
  - (2) Used in a place exposed to direct sunlight, an outdoor place with no shielding, or a dusty place.
  - (3) Used in a place where the product is heavily exposed to sea breeze or a corrosive gas, such as  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$ , or  $\text{NO}_x$ .
  - (4) Used in an environment where static electricity and electromagnetic waves are strong.
  - (5) Solder flux of the soldered sensor is cleansed with a solvent, water, or a water-soluble cleaner.
  - (6) Used in a place where dew concentrates on the product.
  - (7) Used in a contaminated state.
- Do not clean the sensor or the board carrying the sensor with ultrasonic waves. It may cause the sensor to resonate with ultrasonic waves, which destroys the MEMS.
- Do not use an underfill material or side fill material and do not carry out a potting process (coating with a resin), either.

### Response to anomalies and handling conditions

Do not apply heavy impact to the sensor. It may affect the performance of the sensor. Do not use a sensor dropped on the floor, etc.

### Reliability

A product conforming to "AEC-Q100" refers to a product having passed some or all of the evaluation test items defined in AEC-Q100.

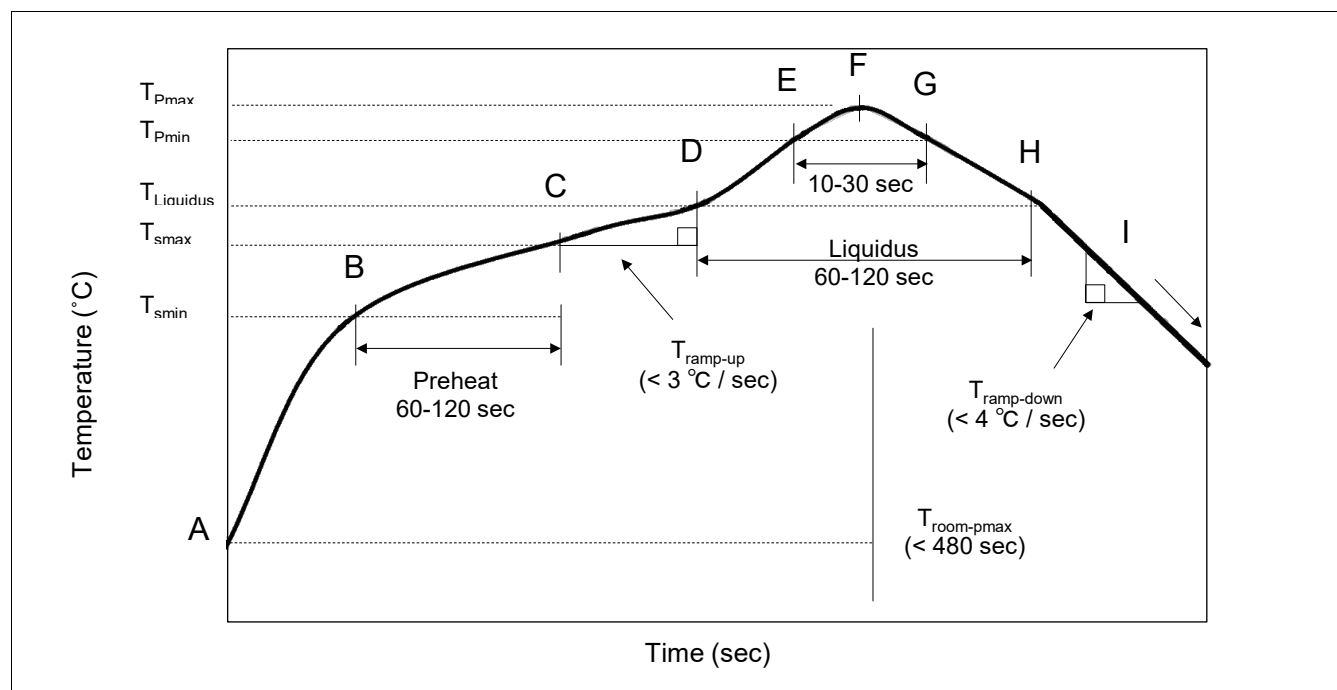
To know the detailed specifications of individual products or specific evaluation test scores, please contact us. We issue a delivery specification sheet for each product ordered. Please confirm with the sheet when you place an order with us.

### Circuit design and circuit board design

- We take all possible measures to ensure the sound quality of the sensor. However, the time-dependent deterioration of a sensor may result in various failure modes in which the sensor's 0-point voltage and sensitivity shift from the specified 0-point voltage and sensitivity or the sensor shows unstable behavior. Therefore, when designing the circuit set, examine the effects of a malfunctioning sensor on the circuit set in advance.
- Do not mount a sensor close to the board edge or screw hole (separate the sensor from the sectional surface of the board by 15 mm or more). Keep the twist applied to the sensor equal to or less than 500  $\mu\text{s}$ .
- If a heat-generating component is in the circuit set, heat from the component can affect the output of the sensor. Consider the location of the heat-generating component so that the temperature of the sensor does not exceed its guaranteed operating temperature.
- Do not place a sensor close to a power control circuit, a high-voltage source, etc. Do not mount a switch, connector, etc., on the back surface of the board that corresponds to the front surface where the sensor is mounted.
- Do not lay a signal line under the sensor. Arrange other components in such a way as to prevent a different component being brought into direct contact with the sensor when vibrations are applied to the board.
- Resonance of the board carrying the sensor, due to vibrations applied thereto, may lead to destruction of the MEMS. Conduct a vibration test of the circuit unit in which the sensor is incorporated.

## Mounting conditions

- During the reflow soldering process, do not apply heat of 265 °C or higher to the upper surface of the sensor. Carry out reflow soldering cycles two times or less and do not exceed this. The recommended reflow profile is shown in the following graph.



Step	Setting	Constraints		
		Temperature (°C)	Time (sec)	Maximum rate (°C/sec)
A	Troom	25	-	-
B	TSmin	150	-	-
C	TSmax	200	60 < t <sub>BC</sub> < 120	-
D	TLiquidus	217	-	r(TLiquidus-TPmax) < 3
E	TPmin [255°C, 260°C]	255	-	r(TLiquidus-TPmax) < 3
F	TPmax [260°C, 265°C]	260	t <sub>AF</sub> < 480	r(TLiquidus-TPmax) < 3
G	TPmin [255°C, 260°C]	255	10 < t <sub>EG</sub> < 30	r(TPmax-TLiquidus) < 4
H	TLiquidus	217	60 < t <sub>PH</sub> < 120	-
I	Troom	25	-	-

- Adopt normal resist as the board resist of the land.
- Avoid a solder connection of the central pad. Keep the central pad from contacting the board over the entire temperature range.
- Connect an NC terminal to the sensor for improved mounting efficiency.

## Storage conditions

Keep the sensor in a sealed packaging bag at a temperature of 40°C or lower and a relative humidity of 90% R.h. for up to 12 months from the day the sensor was put in the bag.

After unsealing the bag, keep the sensor in an environment with a temperature of 30°C or lower and a relative humidity of 60% R.h. and mount it on the board within 168 hours (MSL3).