FORSENSE
原极科技

Automotive MEMS 6-DOF Inertial Sensors

FSS-IMU270-M Product Sheet

Features

Automotive-grade MEMS Gyroscope

- Bias Instability: 4°/hr
- Angle Random Walk: 0.4°/√hr

Automotive-grade MEMS Accelerometer

- Bias Instability: 30μg
- Velocity Random Walk: 0.035m/s /√hr

Independent Rotary Table Calibration

- Independent calibration for every module includes: sensitivity, bias instability, and misalignment
- Temperature compensation: -40°C to 105°C

High-intensity Operating Condition Tolerance

- Ultra Shock Resistance: 2000g（0.5ms, Half-sine shock pulse，3 axis）
- Superb Vibration Resistance: 10g（10~2KHz，3-axis）
- Full-temperature operating Range: -40°C to 105°C
- 100% Magnetic Shielding

Real-time and Flexible Digital Interface with a Small Size

- Configurable output sampling rate up to 1kHz
- uart serial port supported
- 17*17.5*3.7mm, about 1.6g

Description

FSS-IMU270-M is a MEMS inertial measurement unit (IMU) module with 6 degrees of freedom (DOF) developed by Forsense (Shanghai) Technology Co., Ltd. It features three-axis gyroscopes and three-axis accelerometers. It is simple top apply without complex command and configuration.

High precision and resolution combined to help capture subtle vibration and tilt. All modules are calibrated independently on a rotary table and adjusted precisely include bias, scale factor and orthogonality before leaving the factory. In doing so, every module can deliver stable and consistent performance in most extreme conditions.

Applications

- Advanced Driver Assistance System (ADAS)
- Autonomous Driving (AD)
- High-precision Integrated Navigation System
- Platform Stabilization and Control
- Lawn Mower
- Pool Robot

Apart from standard performance and output parameters, Forsense also provides **customized** services, including software development and LOGO design, to better your products!

CONTENT

1. Performance Parameters

1.1 Gyroscope Key Metrics

Table 1 Gyroscope Key Metrics

Parameter	Test Conditions/Remarks	Min.	Typ.	Max.	Unit
Measurement Range			±300		°/s
Bias Instability	@25°C, ALLAN Variance, 1σ		4		°/hr
Bias Stability	GJB, 10s smoothing		20		°/hr
Bias Repeatability	GJB		xz:40 y:65		°/hr
Resolution			0.01		°/s
Non-orthogonal between axes			0.02		deg
Internal Low-pass Cutoff Frequency	Adjustable Software		50		Hz
ODR			100	1000	Hz
Measure Delay			10		ms
Offset Error over Temperature	-40°C~105°C, ≤1°C/min @1σ		xz:0.1 y:0.15		°/s
Random Walk[1]	@25°C, ALLAN Variance, 1σ		0.4		°/√hr
Scale Coefficient Error			xy:2.5 z:0.5		‰
Scale Factor Nonlinear			50		ppm

Note 1: IEEE standard values acquired from Allan Variance analysis in a static environment (25°C).

Note 2: 1σ variation of full-temperature bias at a heating rate of 1°C/min.

1.2 Accelerometer Key Metrics

Table 2 Accelerometer Key Metrics

Parameter	Test Conditions/Remarks	Min.	Typ.	Max.	Unit
Measurement Range			±16		g
Bias Instability	@25,ALLAN Variance, 1σ		30		μg
Bias Stability	GJB, 10s smoothing		xy:45 z:80		μg
Bias Repeatability	GJB		0.5		mg
Resolution			0.5		mg
Non-orthogonal between axes			0.02		deg
Internal Low-pass Cutoff Frequency	Adjustable Software		50		Hz
ODR			100	1000	Hz
Measure Delay			10		ms
Offset Error over Temperature	-40℃~105℃, ≤1℃/min @1σ		1.5		mg
Random Walk[1]	@25℃, ALLAN Variance, 1σ		xy: 0.035 z: 0.045		m/s/√hr
Scale Coefficient Error			xy:0.2 z:0.8		‰
Scale Factor Nonlinear	@25℃		40		ppm

Note 1: IEEE standard values acquired from Allan Variance analysis in a static environment (25°C).

Note 2: 1σ variation of full-temperature bias at a heating rate of 1°C/min.

Fig. 1 Gyroscope - Typical Allan Variance Curve

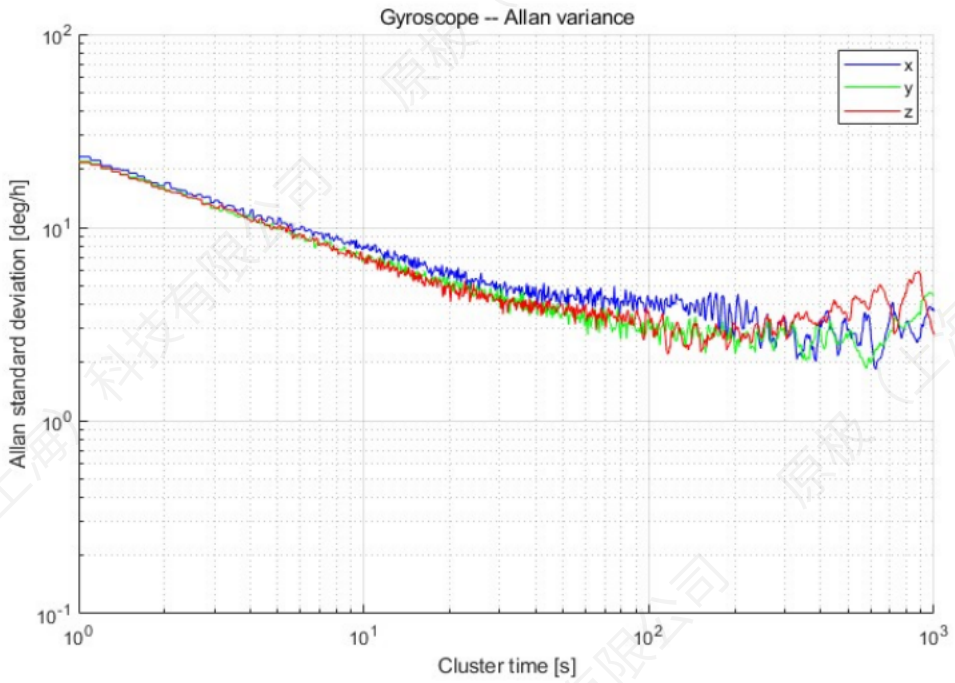
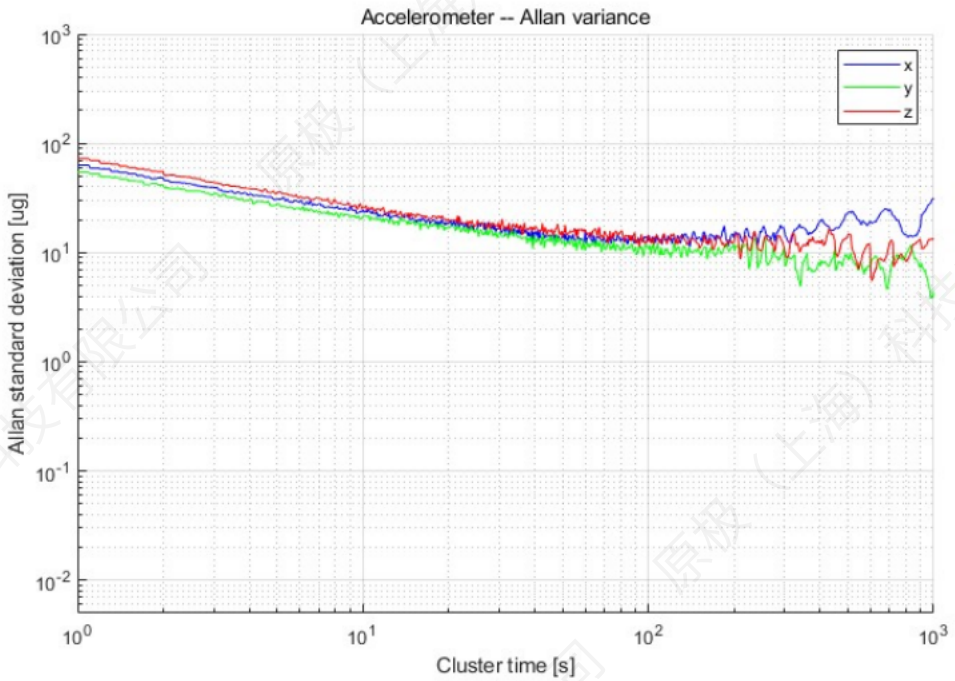


Fig. 2 Accelerometer - Typical Allan Variance Curve



2. External Structure

Fig. 3 Structure and Size (unit: mm)

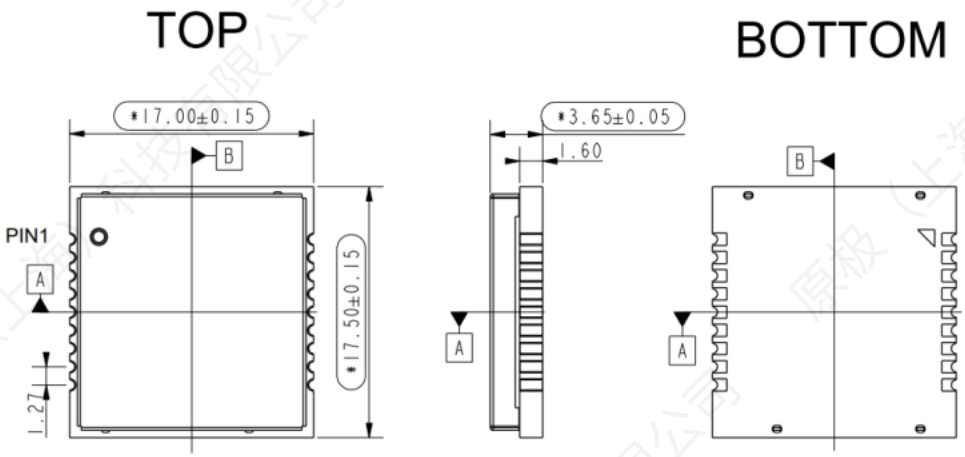
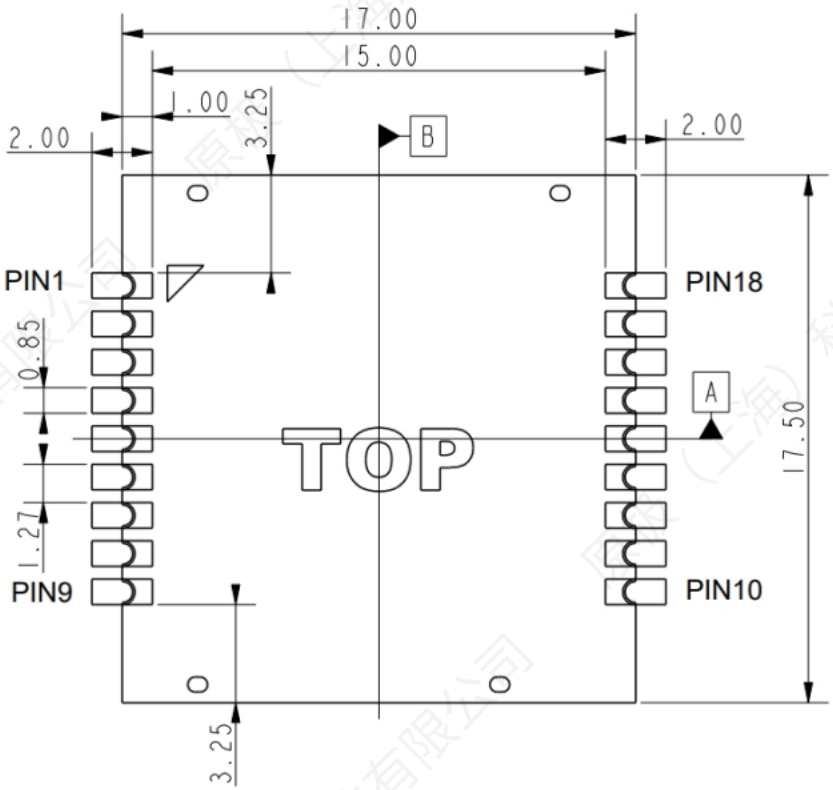


Fig. 4 Recommended Pad Size (unit:mm)



3. Electrical Properties

3.1 Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings

Parameter	Symbol	Range	Unit
Supply Voltage	VCC	-0.3 to 4	V
Ground	GND	-	-
Input Pin Voltage	Vin	-0.3 to VCC+0.3	V
Operating Temperature	Tot	-40 to 105	℃
Storage Temperature	Tstg	-40 to 125	℃

3.2 Operating Conditions

Table 4 Operating Conditions

Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**
Supply Voltage	VCC	3.13	3.3	3.47	V
VCC Maximum Ripple	Vrpp		±40		mV
Power Consumption	P		0.085		W
Operating Temperature	T	-40		105	℃
Storage Temperature	T	-40		125	℃

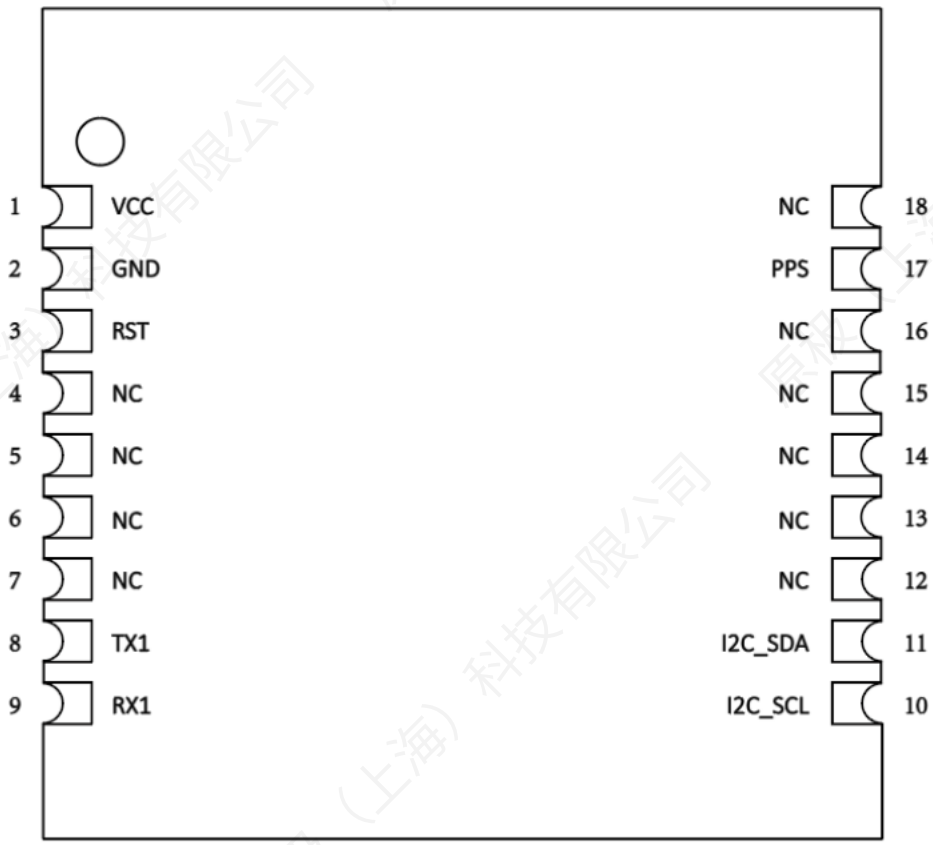
3.3 IO Threshold Characteristics

Table 5 IO Threshold Characteristics

Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**
Input Pin Low Voltage	Vin_low	0		VCC*0.2	V
Input Pin High Voltage	Vin_high	VCC*0.7		VCC+0.2	V
Output Pin Low Voltage	Vout_low	0		0.45	V
Output Pin High Voltage	Vout_high	VCC-0.45		VCC	V

4. Pin Definitions

Fig. 5 Pin Diagram



IMU270-M Pin Layout (Top View)

Table 6 Pin Definitions

Pin No.	Pin Name	Pin Description
1	VCC	Power Input: +3.3V, 40mA, with ripple not exceeding ±40mV
2	GND	Ground
3	RST	External hardware reset input, internal pull-up (for SPI mode)
4	NC	No connection
5	NC	No connection
6	NC	No connection
7	NC	No connection
8	TX1	Receive asynchronous data output (Data communication interface (LVTTL))
9	RX1	Receive asynchronous data input (Data communication interface (LVTTL))
10	I2C_SCL	I2C Serial Clock

11	I2C_SDA	I2C Serial Data
12	NC	No connection
13	NC	No connection
14	NC	No connection
15	NC	No connection
16	NC	No connection
17	PPS	Signal to trigger external synchronized sampling
18	NC	No connection

5. Recommended Welding Furnace Temperature Profile

Fig. 6 Welding Furnace Temperature Profile

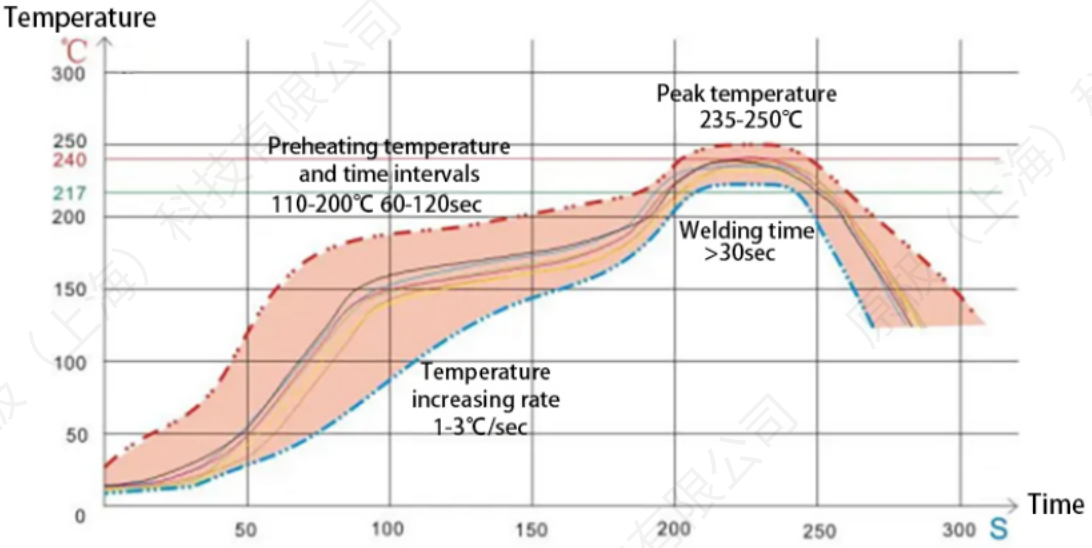


Table 7 Temperature Setting Modes

Parameter	Min.	Max.	Unit
Maximum Temperature ramp-up rate (target = 0.8) (Calculated time distance of the slope=60s))	1	3	°/s
Maximum ramp-down rate (Calculated time distance of the slope=60s))	-3	-1	°/s
Preheating temperature and time intervals	60	120	s
Reflux time (period over 217°C)	40	70	s
Maximum temperature	235	250	°C
Maximum number of reflux		1	Times

For more information about SMT modules, please refer to the document Forsense - LCC Module_SMT Application Guide.

Notes:

1. For modules, it is recommended to use reflux welding equipment with eight or higher temperature zones;

2. The module is a high-precision sensor sensitive to any deformation;

- If the thickness of the PCB board is less than 1.0 mm, it is recommended to use reflow fixtures to prevent the board from getting deformed under high temperature, thereby ensuring the coplanarity of pins.

- It is recommend that customers use high TG value boards as PCB main boards to avoid deformation during high temperature reflow, thus reducing the possibility of warping, extrusion, empty soldering, and solder bridging.

3. Due to the sensitive devices inside the module, the maximum temperature of the reflux soldering machine must not exceed 260°C (referring to the the top surface temperature of the package);

4. It is recommended to use lead-free solder paste, including the recommended product Alpha OM-338 SAC305 Sn96.5Ag3.0Cu0.5;

5. Given sensitive devices in the module, the second reflux should be avoided to ensure proper performance of the module;

6. Cooling;

- Controlled cooling ramp rate can help reduce negative soldering effects (e.g. more brittle solder joints) and mechanical stresses within the product. Controlled cooling contributes to bright soldered surfaces with fine crystalline particles and low contact angles, avoiding the warping of the shielding cap caused by rapid cooling changes.

7. Exterior inspection:

- After the module is soldered, the X-ray and optical magnifying glass are used to test the welding quality. For details, please refer to the IPC-A-610F standards.

8. Using electric soldering iron requires the temperature to be controlled at 260 °C to 290 °C, the single welding time shall not exceed 3s, and the anti-static treatment shall be done.

6. ESD Protection

Static electricity may cause intermittent or permanent circuit damage, which is very harmful to electronic products. Most of them are identified as ESD damage.

Therefore, the electrostatic protection of modules is particularly important. The production and transportation process needs to be strictly subject to the following conditions:

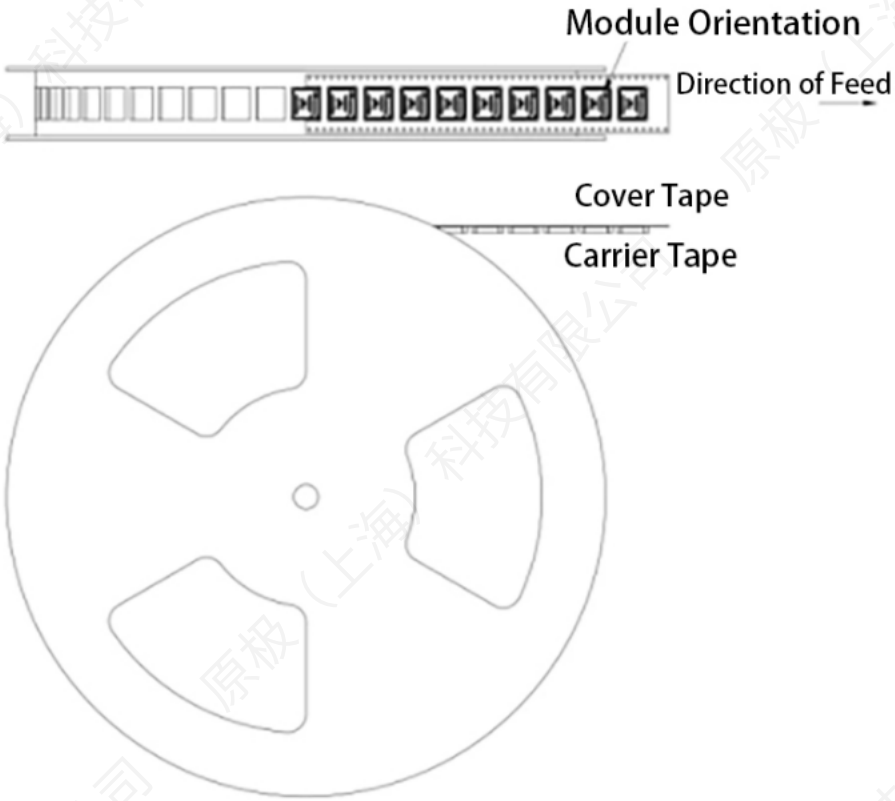
- It is prohibited to touch the module, especially the pin position, with bare hands;
- SMT patch machines, workstations, soldering irons and other equipment need to be grounded;
- Operators wear human anti-static bracelets with grounding wires (cordless static bracelets are not allowed and anti-static gloves are recommended);
- Packaging and PCBs must be made of qualified anti-static materials.

7. Packaging

The IMU270-M module is packaged in sealed tape and reel, which contributes to efficient production.

7.1 Tape and Reel Packaging

Fig. 7 Tape and Reel Packaging Diagram



Reel Size: 13inch (OD 330 x ID 100 x Thickness 37mm)

7.2 Carrier Tape

The IMU270-M module is placed on the carrier tape in the position and orientation shown below before leaving the factory:

Fig. 8 Module Position and Orientation on Carrier Tape

8. History

Version	Date	Status/Notes
Version 1.0	09/29/2024	First Edition