FORSENSE
原极科技

Tactical MEMS 6-DOF Inertial Sensor

FSS-IMU614E Product Manual

Characteristic

Tactical MEMS gyroscope

- **3.0°/h bias stability**
- **0.04°/s bias repeatability**
- **0.05°/s output noise**

Tactical MEMS accelerometer

- **Zero bias stability of 35ug**
- **1 mg bias repeatability**
- **0.7mg output noise**

Wide range temperature compensation

- **Temperature compensation from -40 ℃ to 85 ℃**
- **Fine temperature calibration**

Turntable Calibration

- **Independent calibration for each module: sensitivity, bias, non-orthogonal error**
- **Provide user installation error calibration interface**

High reliability

- **Super shock resistance: 2000g (0.5ms, half sine, 3-axis)**
- **Super vibration tolerance:10g (10~2KHz, 3-axis)**
- **Stable operation at full temperature: -40 ℃~85℃**
- **100% magnetic shielding**

Flexible digital interface, small size

- **Configurable output sampling rate up to 400Hz**
- **Support serial port, I2C, SPI multiple interfaces**
- **Size of 14.5 * 17 * 3.7mm and weighs only 2g**

Product Description

FSS-IMU614E is a 6-DOF MEMS inertial sensor module made by Forsense technology. Standard outputs are three-axis gyroscope and acceleration information and high-precision attitude angles.

It is **high precision**, **high resolution**, it can capture subtle vibration and tilt. **The output of a large number of processes** makes it possible to sense the movement in large dynamic situations. All modules are equipped with wide temperature range of **temperature compensation** and **independent calibration** in the factory, so that the module can work in various extreme conditions, and ensure the high consistency.

The reserved **integrated navigation interface** can be compatible with the current mainstream satellite navigation.

Application Area

- Automatic driving: vehicle, agricultural machinery, engineering vehicle, underwater
- Precision measurement: underground, tunnel, vibration, tilt
- Stable platform: PTZ, UAV
- Automatic control: industrial equipment, automatic control system

On the basis of standard performance and output parameters, Forsense also provides **customized services for your special needs**, and helps you in the product!

Catalogue

Figure Example

Table Example

1. Performance Parameter

1.1 Key specification of Gyroscope

Table 1 Key specification of Gyroscope

Parameter	Test conditions /remarks	Min	Type	Max	Unit
Measuring range			±500		°/s
Bias stability X-axis	@25℃, 1σ		3.5		°/hr
Bias stability Y-axis	@25℃, 1σ		3.0		°/hr
Bias stability Z-axis	@25℃, 1σ		3.0		°/hr
Bias repeatability	@25℃, 1σ		0.04		°/hr
Non orthogonal between axes			0.01		‰
G value sensitive error			0.01		°/s/g
Internal low pass cutoff frequency	Software adjustable	0.2	47	47	Hz
ODR[1]		1	100	400	Hz
Measurement delay				5.0	ms
Zero bias variation in full temperature range[2]	-40 ~ 85℃，rms		0.15		°/s
Random walk X-axis[3]	Allan variance@25℃，1σ		0.4		°/√hr
Random walk Y-axis	Allan variance@25℃，1σ		0.4		°/√hr
Random walk Z-axis	Allan variance@25℃，1σ		0.3		°/√hr
Output noise[4]	rms@47Hz cf		0.05		°/s
Scale factor error			2.5		‰
Scale factor nonlinearity			100		ppm

[1]The maximum output update rate is not greater than 200Hz@115200bps

[2]1℃/min Temperature range means the test environment, but also the RMS value

[3]According to IEEE standard, Allan variance curve is given under static 25 ℃

[4]RMS index under static 25 ℃ environment and cut-off frequency of 47Hz

1.2 Key specifications of Accelerometer

Table 2 Key specifications of Accelerometer

Parameter	Test conditions /remarks	Min	Type	Max	Unit
Measuring range			±6		g
Bias stability	@25℃, 1σ		35		μg
Bias repeatability	@25℃, 1σ		1.0		mg
Non orthogonal between axes			0.01		deg
Internal low pass cutoff frequency	Software adjustable	0.2	47	47	Hz
ODR[1]		1	100	400	Hz
Measurement delay				5.0	ms
Zero bias variation in full temperature range[2]	-40 ~ 85℃， rms		XY:2.5 Z:4		mg
Random walk X-axis[3]	Allan variance@25℃， 1σ		0.05		$m/s/\sqrt{hr}$
Random walk Y-axis	Allan variance@25℃， 1σ		0.04		$m/s/\sqrt{hr}$
Random walk Z-axis	Allan variance@25℃， 1σ		0.04		$m/s/\sqrt{hr}$
Output noise[4]	rms@47Hz cf		0.7		mg

[1]The maximum output update rate is not greater than 200Hz@115200bps

[2]1℃/min Temperature range means the test environment, but also the RMS value

[3]According to IEEE standard, Allan variance curve is given under static 25 ℃

[4]RMS index under static 25 ℃ environment and cut-off frequency of 47Hz

1.3 Key parameters of Attitude Angle

Table 3 Key parameters of Attitude Angle

Parameter	Test conditions /remarks	Min	Type	Max	Unit
Roll angle	Static / Dynamic		±0.3/±0.5		°
Pitch angle	Static / Dynamic		±0.3/±0.5		°
Heading angle	One rotation at sign 1 sigma		0.5		°
ODR[1]		1	100	400	Hz

[1]The maximum output update rate is not greater than 200Hz@115200bps

Figure 1 Allan variance curve of Gyroscope

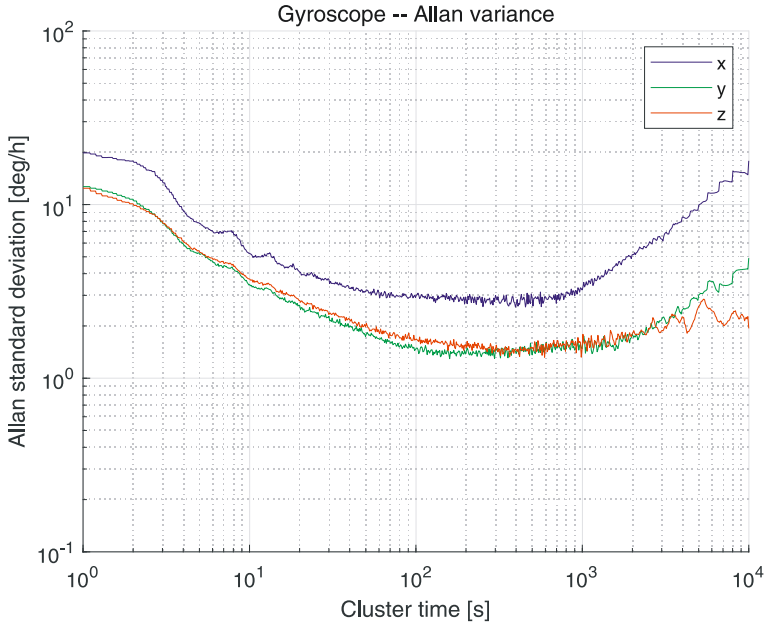
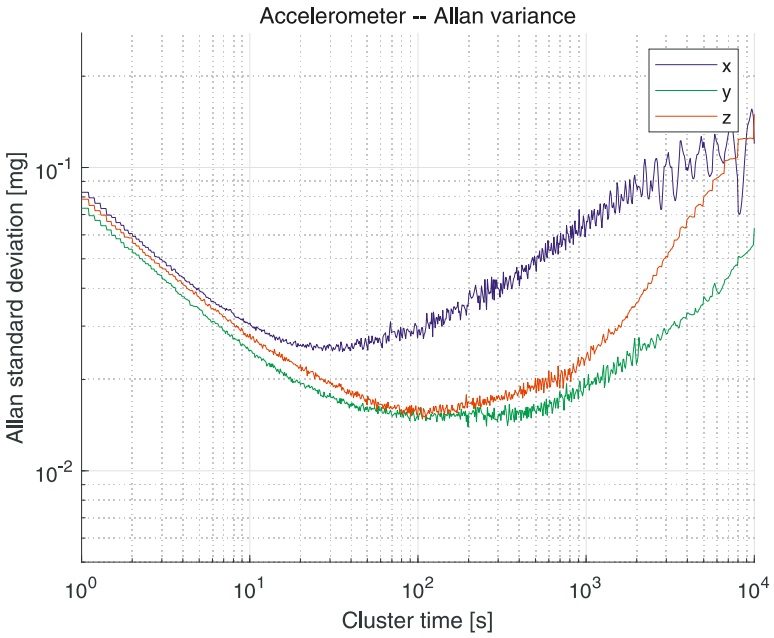
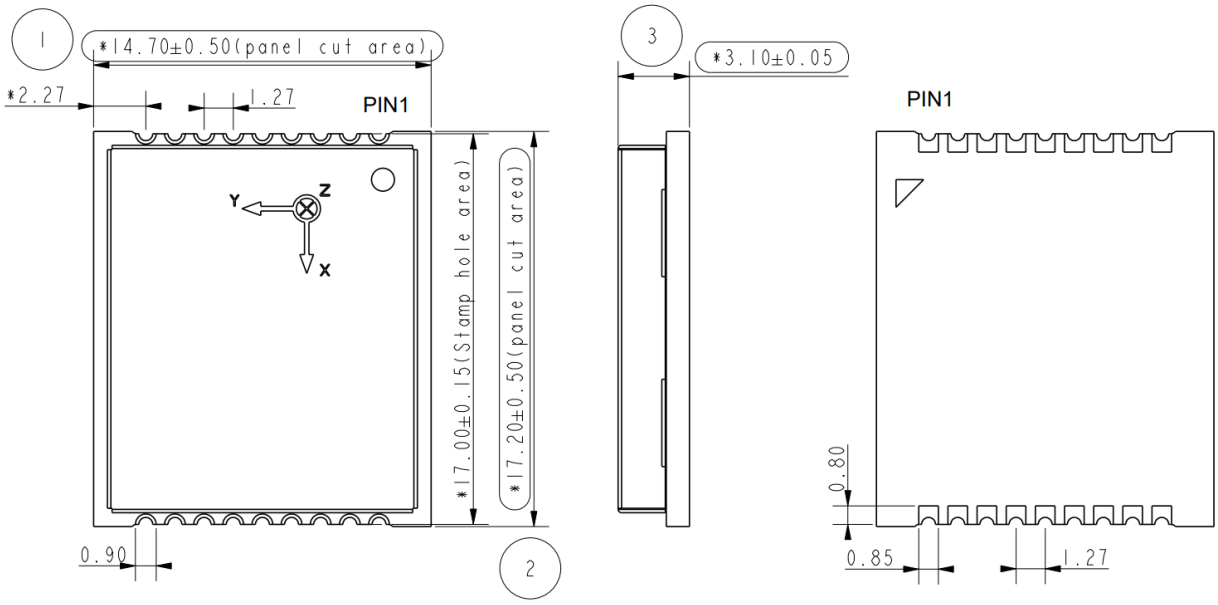


Figure 2 Allan variance curve of Accelerometer



2. Configuration

Figure 3 Outline structure and dimensions（Company：mm）



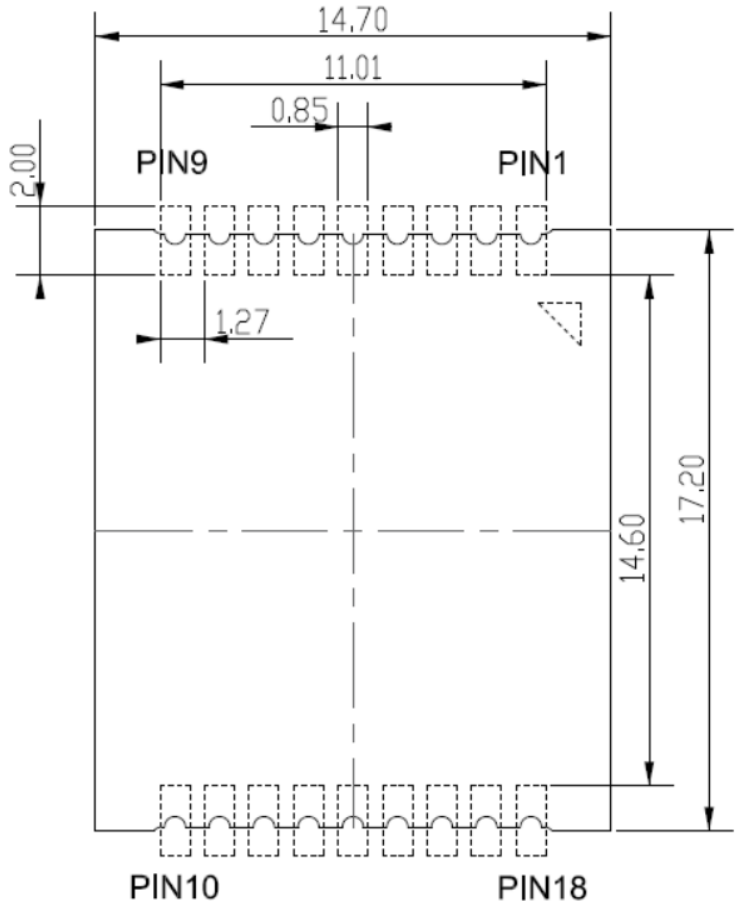
3. Electrical Characteristics

Table 4 Electrical characteristics

Parameter	Symbol	Interface type	Min	Max	Unit
Power input	VCC		3.2	3.3	V
Power ground	GND				
Serial output	TX1	UART	3.2	3.3	V
Serial input	RX1	UART	0.3	3.3	V
Reserved pin	NC	IO	0.3	3.3	V
Electric current	I		50	150	mA
Temperature	T		-40	85	℃

4. Pin Description

Figure 4 Pin diagram



RECOMMENDED PCB LAYOUT TOP VIEW

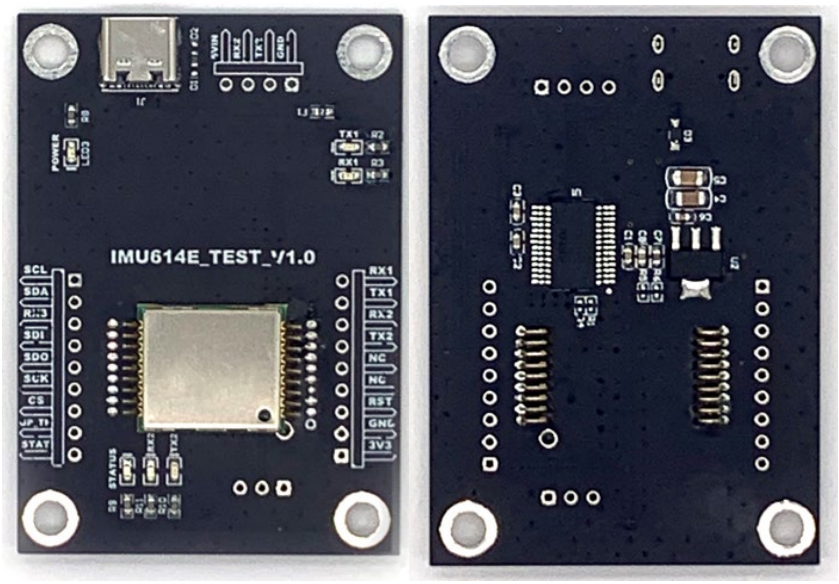
Table 5 Pin description

Pin No.	Pin Name	Pin Description
1	VCC	Power input, 2.8 ~ 3.3V input, 60mA, ripple wave no more than 40mv
2	GND	Power ground
3	RST	External reset pin, recommended to be empty or external pull-up
4	NC	Not connect
5	NC	Not connect
6	TX2	Serial port 2 is used to upgrade IMU firmware. It is recommended to lead out test points
7	RX2	Serial port 2 is used to upgrade IMU firmware. It is recommended to lead out test points
8	TX1	IMU data communication port(LVTTL)
9	RX1	IMU data communication port(LVTTL)
10	I2C_SCL	Standby I2C interface
11	I2C_SDA	Standby I2C interface
12	RX3	Standby interface
13	MOSI	SPI data input
14	MISO	SPI data output
15	SCK	SPI serial clock
16	NSS	Selected SPI films
17	PPS	External synchronous sampling trigger signal
18	DR	Data ready indication

[1] When the host is initialized, reset the IMU hardware once by using / RST.

5. Introduction to Test Base Plate

Figure 5 Introduction to Test Base Plate



1, IMU614E test base module composition

The IMU614E test mainboard consists of the IMU module, USB module, and power module.

2, IMU614E test baseboard function brief introduction

1), The power module is converted from 5V to 3.3V by linear voltage regulator to supply power to each module;

2), IMU module has serial port, I2C, SPI various interfaces, through the plug-in to lead out each pin independently, can complete the IMU614E follow-up function expansion test. Usually the standby serial ports TX2 (pin 6) and RX2 (pin 7) are used to upgrade the IMU firmware and lead to the test point.

3), USB module through the IMU614E serial port TX1 (pin 8), RX1 (pin 9) connection, through the Type-C connector can be connected to the external, to achieve the connection of computer system and external equipment.