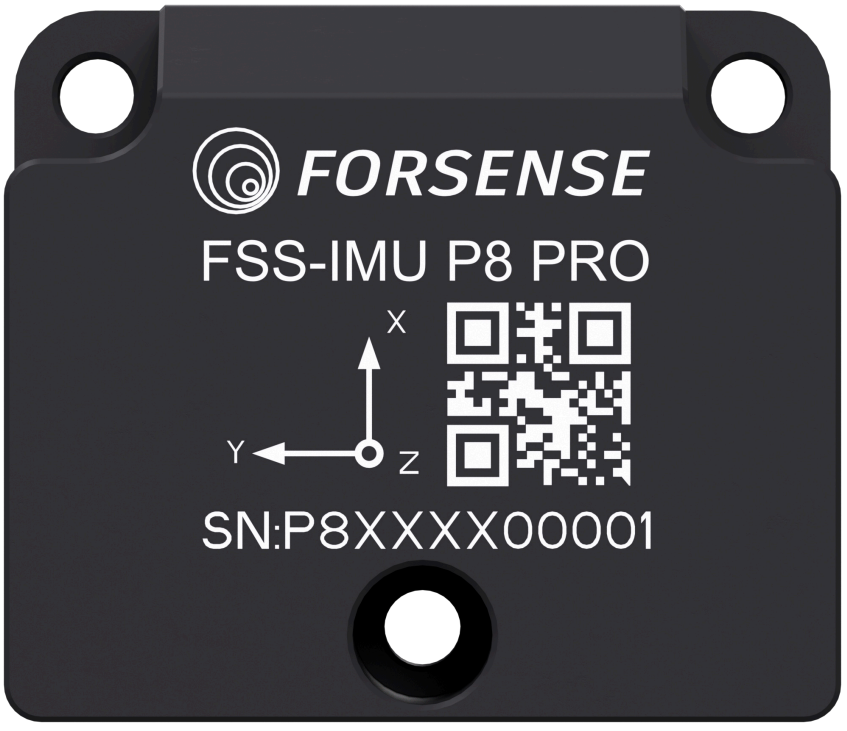
FORSENSE
原极科技

Tactical-grade MEMS 6-DOF inertial sensor

IMUP8-Pro

Product manual



Forsense (Shanghai) Technology Co., Ltd

Please read this user manual carefully before using this product.

FORSENSE
原极科技

Tactical-grade MEMS 6-DOF inertial sensor

FSS-IMUP8-Product Manual（en）

Features

Tactical-grade MEMS Gyroscope

- 0.35°/hr Bias instability
- 0.08°/√hr Angle Random Walk
- 30°/ hr temperature drift (-40℃ ~ 85℃,≤1℃/min @1σ)

Tactical-grade MEMS Accelerometer

- 15μg Bias instability
- 0.03m/s/√hrVelocity Random Walk
- 1mg temperature drift (-40℃ ~ 85℃,≤1℃/min @1σ)

Wide-Range refined temperature compensation

- -40°C to 85°C Temperature Compensation
- Fine-Tuned Temperature Calibration

independent rotary table calibration

- Independent Calibration of Each Module: Sensitivity, Bias, Misalignment
- User Interface for Installation Error Calibration

High-Stress Operating Condition Tolerance

- Extreme Shock Resistance: 2000g (0.5ms, Half-Sine, 3-Axis)
- Superior Vibration Resistance: 10g (10~2KHz, 3-axis)
- Stable Operation Across Full Temperature Range: -40°C ~ 85°C
- 100% Magnetic Shielding

Real-time and Flexible Digital Interface, Compact Size

- Up to500Hz configurable output sampling rate
- Supports Serial Port 422
- 38.6*44.8*21.5mm, weight approx. 72.5g

Product Overview

IMUP8_Pro is a 6 degrees of freedom (DOF) MEMS inertial sensor module developed by Forsense Technology. It standardly outputs three-axis Gyroscope and acceleration information.

High precision and high resolution enable the capture of subtle vibrations and tilts. The wide-range output makes motion perception under large dynamics possible. All modules undergo fine-grained temperature compensation and independent calibration across an ultra-wide temperature range before shipment, ensuring stable performance under various extreme conditions while maintaining high consistency in product performance.

Application Areas

- Aerial Surveying and Mapping

Based on standard performance and Parameter output, Forsense also provides customized software and LOGO services for your special needs, supporting you with tailored products!

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1. Performance Parameter

1.1 Gyroscope Key Metrics

Table 1 Gyroscope Key Metrics

Parameter	Test Conditions/Notes	Min	Typ	Max	Unit
Measurement Range			±300		°/s
Bias instability[2]	@25℃, Allan Variance, 1σ		0.35		°/hr
Resolution			0.005		°/s
Misalignment between axes			0.02		deg
Internal low-pass cutoff frequency	Software Adjustable		80		Hz
Sampling Rate			500	500	Hz
measure delay			7.2		ms
Bias over temperature[1]	-40℃ ~ 85℃, ≤1℃/min @1σ		30		°/hr
Random Walk X-Axis[2]	@25℃, Allan Variance, 1σ		0.08		°/√hr
Random Walk Y-Axis			0.08		°/√hr
Random Walk Z-Axis			0.08		°/√hr
scale coefficient error			1.0		‰
scale factor nonlinear			200		ppm

Note 1: 1σ value of full-temperature Bias variation at a heating rate of 1°C/min

Note 2: Based on IEEE standards, the ALLAN variance curve is provided under static conditions at 25°C

1.2 AccelerometerKey Metrics

Table 2 Accelerometer Key Specifications

Parameter	Test Conditions / Remarks	Min	Typ	Max	Unit
Measurement Range			±6	Optional ±20	g
Bias instability[2]	@25℃, Allan Variance, 1σ		xy:15 z:6(±6g)		μg
			xy:15 z:6(±20g)		μg
Resolution			0.1 (±6g)		mg
			1.0 (±20g)		mg
Internal low-pass cutoff frequency	Software Adjustable		80		Hz
Sample Rate			500	500	Hz
measure delay			7.2		ms
Bias over temperature[1]	-40℃ ~ 85℃, ≤1℃/min @1σ		1.0		mg
Random Walk X-Axis[2]	@25℃, Allan Variance, 1σ		0.03		m/s/√hr
Random Walk Y-Axis			0.03		m/s/√hr
Random Walk Z-Axis			0.03		m/s/√hr

Note 1: 1σ value of full-temperature Bias variation at a heating rate of 1°C/min

Note 2: Based on IEEE standards, the ALLAN variance curve is provided under static conditions at 25°C

Figure 1 Gyroscope Allan Variance Typical Curve

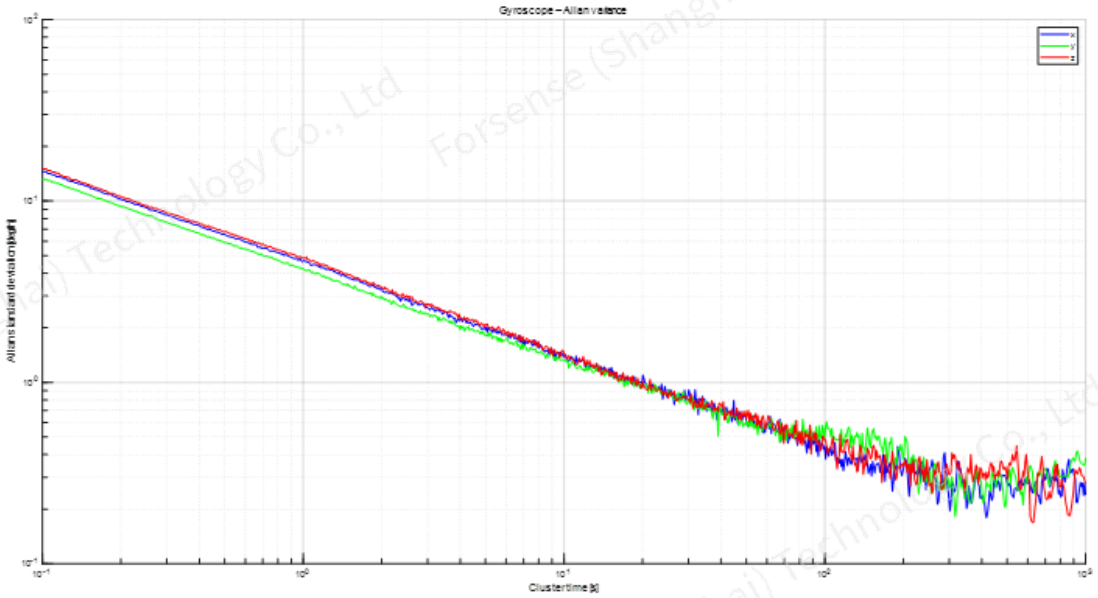
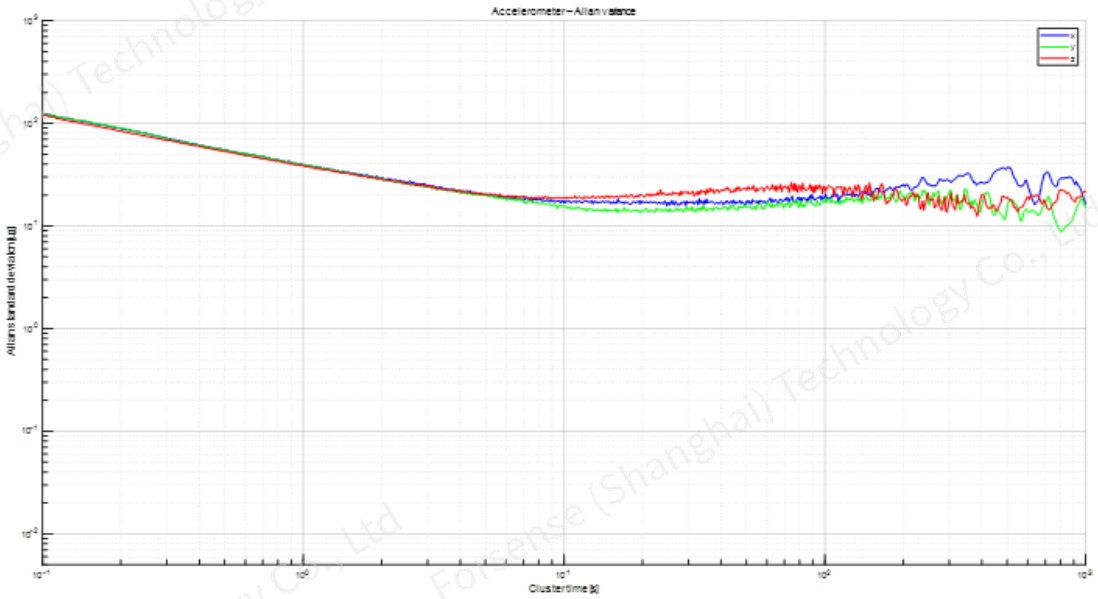


Figure 2 Accelerometer Allan Variance Typical Curve



2. Physical Dimensions

Figure 3 Outline Structure and Dimensions (Unit: mm)

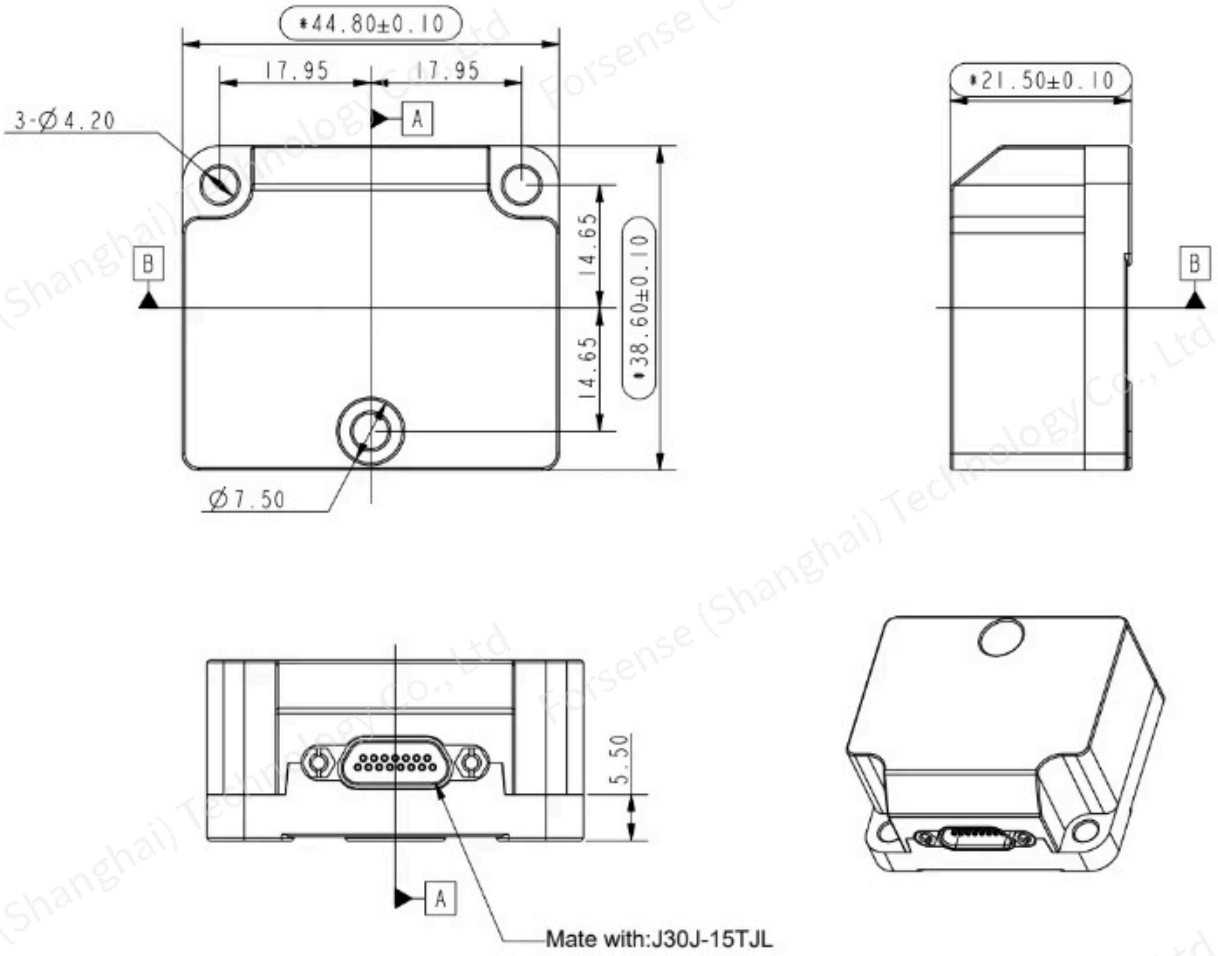
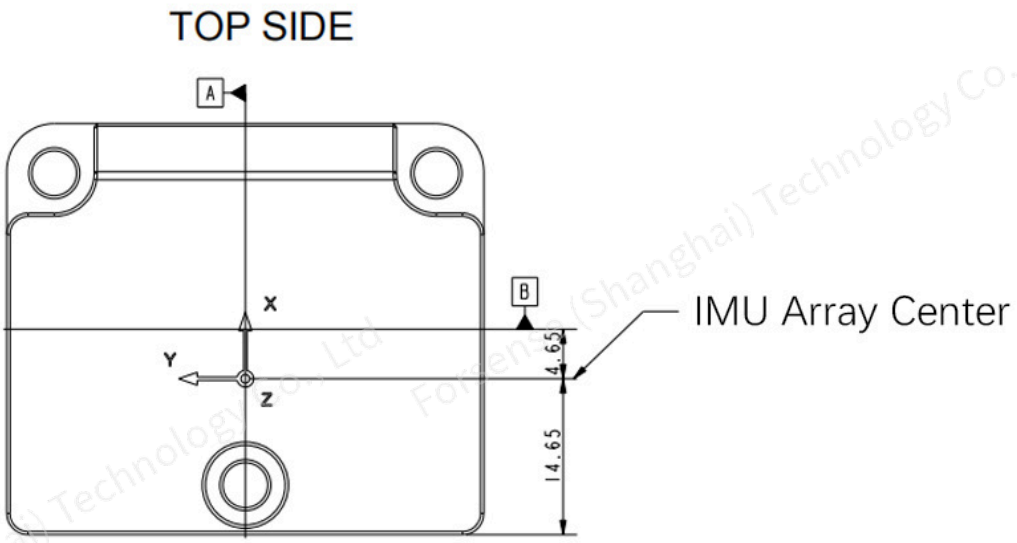
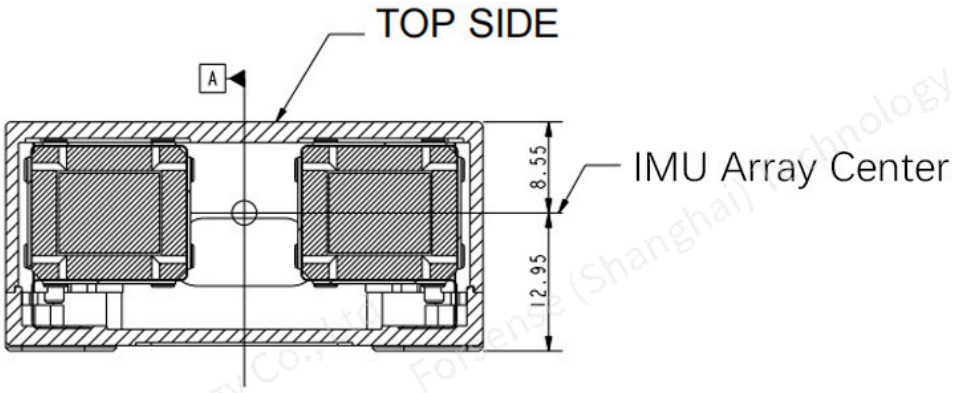


Figure 4 IMU Measurement Center Position (Unit: mm)


TOP SIDE
A
B
X
Y
Z
IMU Array Center
4.65
14.65


TOP SIDE
A
IMU Array Center
8.55
12.95

3. Specifications

3.1 Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings

Parameter	Level	Notes
Storage Temperature	-55℃-90℃	
VSUP to GND	-0.5-6.5V	
Operating Temperature (Tot)	-40-+85℃	
RXD+/RXD- to GND	-7.5V~12.5V	Termination Resistor 120Ω
RXD+ to RXD-	±6V	
TXD+/TXD- to GND	-7.5V~12.5V	
ExtTrig to GND	-0.3V-7V	
NRST to GND	-0.3V-7V	
DATA READY to GND	-0.3V-7V	

3.2 EMC

Table 4 EMC

Test Item	Test Standard
CE	Compliant with EN55032 CISPR 16-2-1
CS	Compliant with EN55035 EN(IEC) 61000-4-6
EFT	Compliant with EN55035 EN(IEC) 61000-4-4
RE	Compliant with EN55032 CISPR 16-2-3
RS	Compliant with EN55035 EN(IEC) 61000-4-3
ESD	Compliant with EN55035 EN(IEC) 61000-4-2

3.3 ESD Level

Table 5 ESD Level

	Test Mode	Test Standard	Test Level
V(ESD) Electrostatic discharge (ESD)	Contact Discharge	Compliant with EN(IEC) 61000-4-2	±8 KV
	Air Discharge		±15 KV

4. Electrical Characteristics

Table 6 Electrical Characteristics

Parameter	Condition	Min.	Typ.	Max.	Unit
Power Input		4.5	5	5.5	V
Power			1		W
Storage Temperature		-55		90	℃
Operating Temperature (Tot)		-40		85	℃
RS422 Input Resistance			120		Ω
RESET(NRST PIN)	High	2.3			V
	Low			0.6	V
NRST Internal Pull-up Resistor			4.7		KΩ
Data Ready			3.3		V
ExtTrig	High	2.3			V
	Low			0.6	V

Note: When the supply voltage exceeds 6V, the internal voltage protection circuit cuts off power and places the device in reset state until the voltage returns to operating conditions, restoring normal operation.

5. Pin Definition

Figure 5 Pin Schematic Diagram

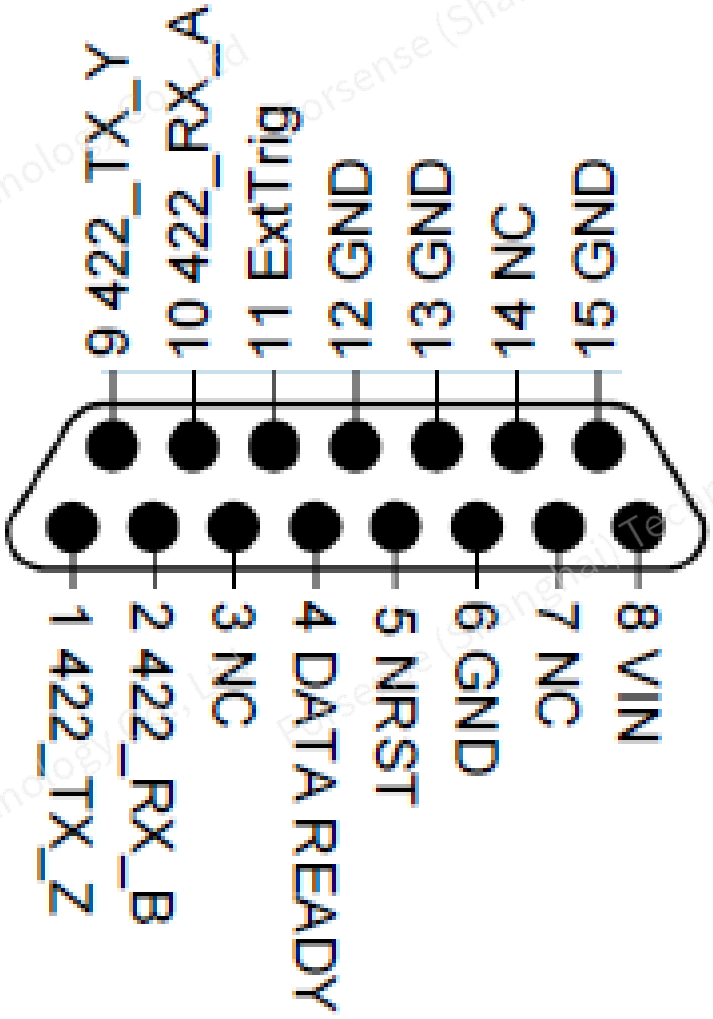


Table 7 Pin Definitions

Pin No.	Pin Name	Pin Description
1	422_TX_Z	RS-422,TXD-
2	422_RX_B	RS-422,RXD-
3	NC	Not Connected
4	DATA READY	Data Ready
5	NRST	External Hardware Reset Input, Internal Pull-up
6	GND	Signal Ground
7	NC	Not Connected
8	VIN	Power Input, +5V Input
9	422_TX_Y	RS-422,TXD+
10	422_RX_A	RS-422,RXD+
11	ExtTrig	External Trigger
12	GND	Ground (GND)
13	GND	Ground (GND)
14	NC	Not Connected
15	GND	Ground (GND)

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6. Recommended Connection Method

Figure 6 Block Diagram of Normal Acquisition Mode

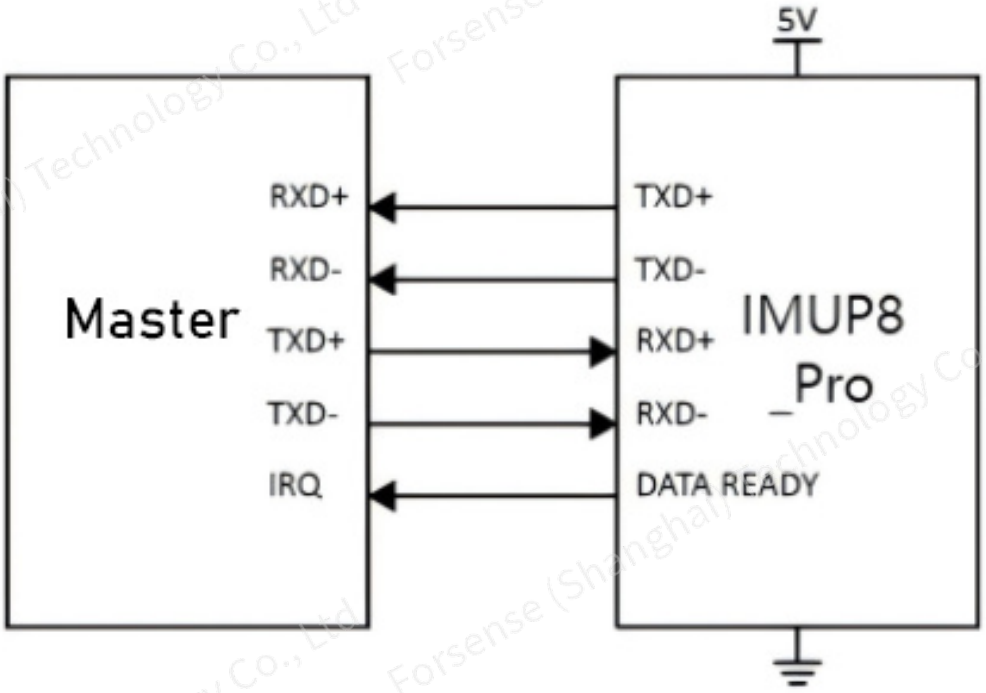
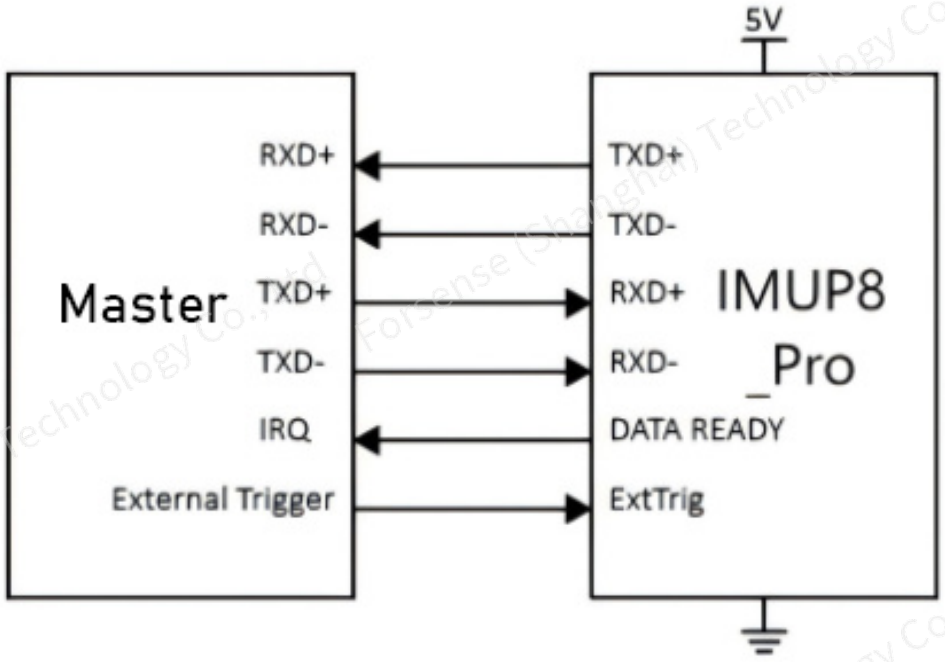


Figure 7 Block Diagram of Triggered Acquisition Mode


5V
Master
RXD+
RXD-
TXD+
TXD-
IRQ
External Trigger
TXD+
TXD-
RXD+
RXD-
DATA READY
ExtTrig
IMUP8
_Pro

7. serial communication protocols

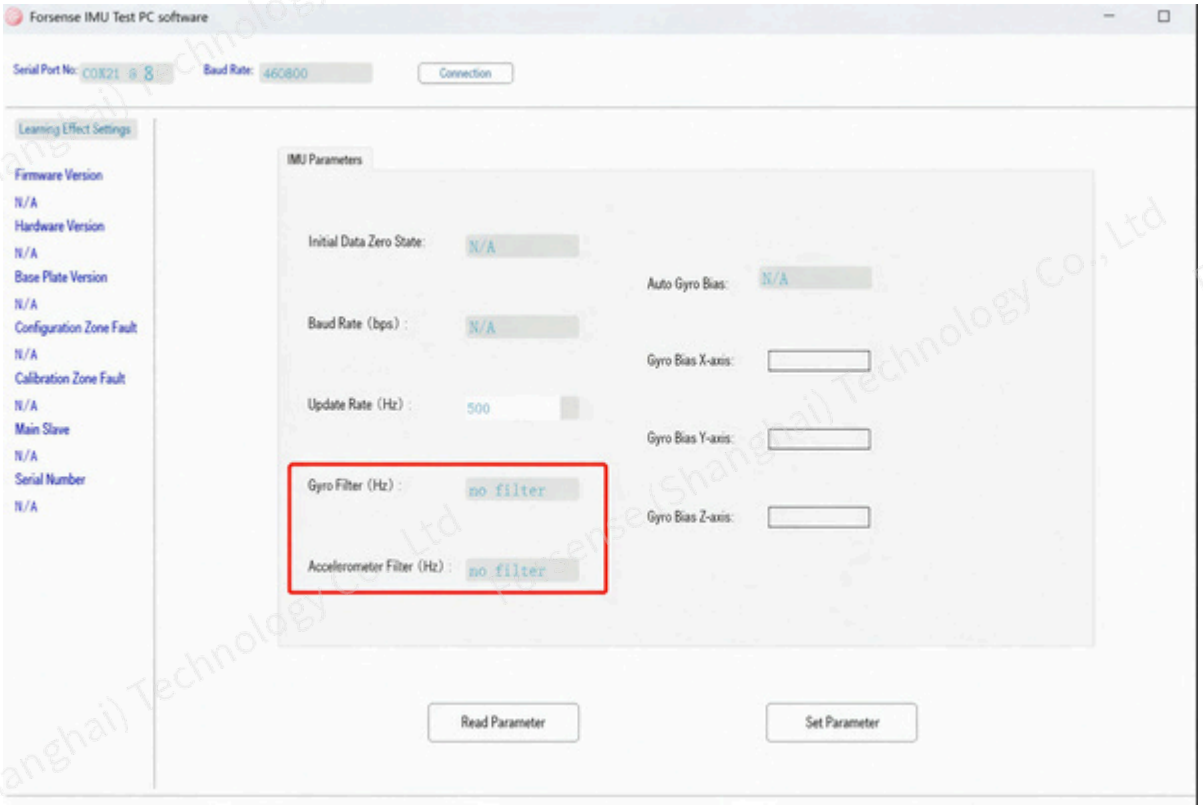
Reference Document Forsense IMU Communication Protocols（en）

Includes serial communication protocols, Coordinate System Settings, Filter Settings, Parameter Settings, OTA Update Method, Time Synchronization, etc.

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8. Precautions for Post-Processing

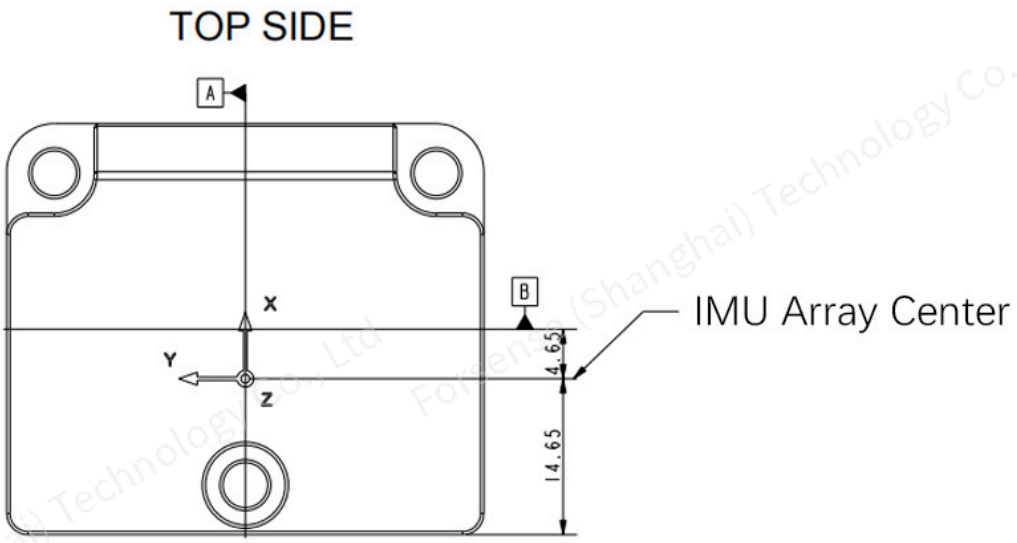
(1) Confirm that all filters are set to no filter (keep a screenshot for records). Update Rate is generally set to 500 Hz, which can be confirmed via PC software or queried by command. For specific commands, refer to the 7.6 Command Mode SET Command or Section 7.10 Common AT Commands.

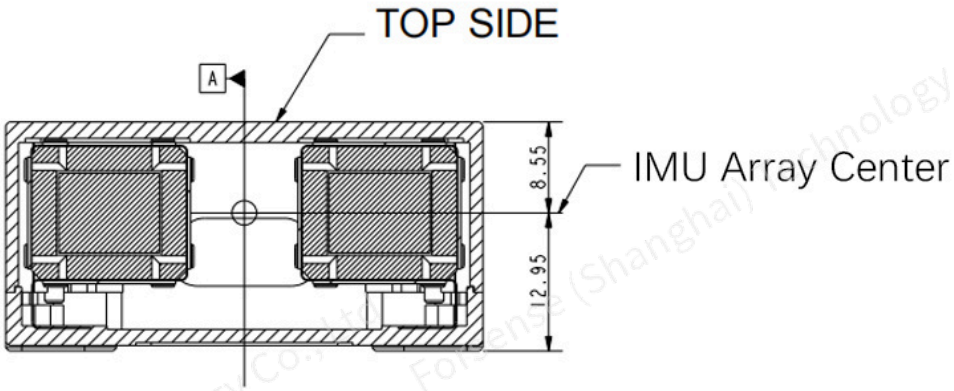


2,IMUP8_PThe ro data output has a 7.2 ms delay; this must be subtracted when timestamping!!!

(3) Lever Arm Configuration

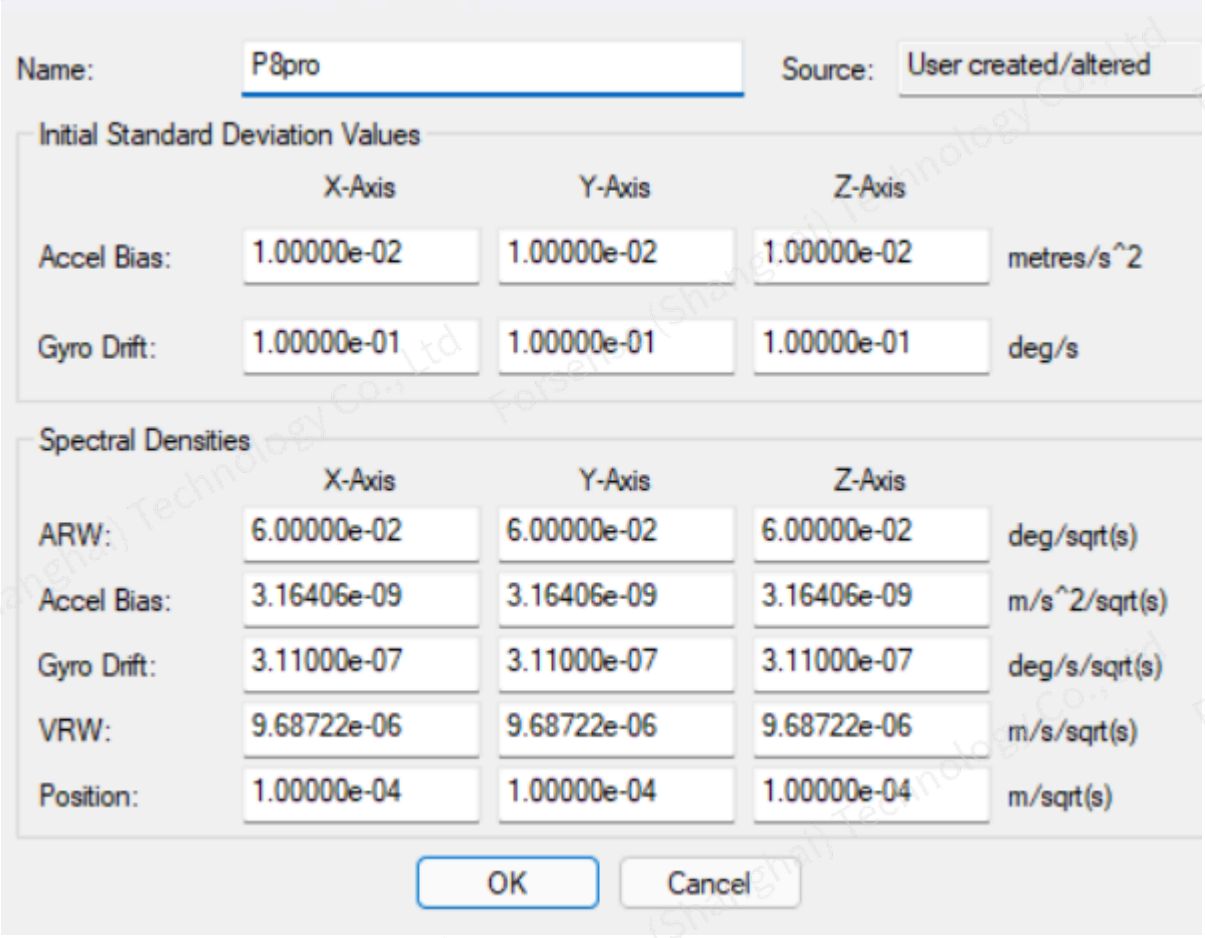
NoteIMUP8_PThe physical center of ro is shown in the figure below. Pay attention when configuring the lever arm.



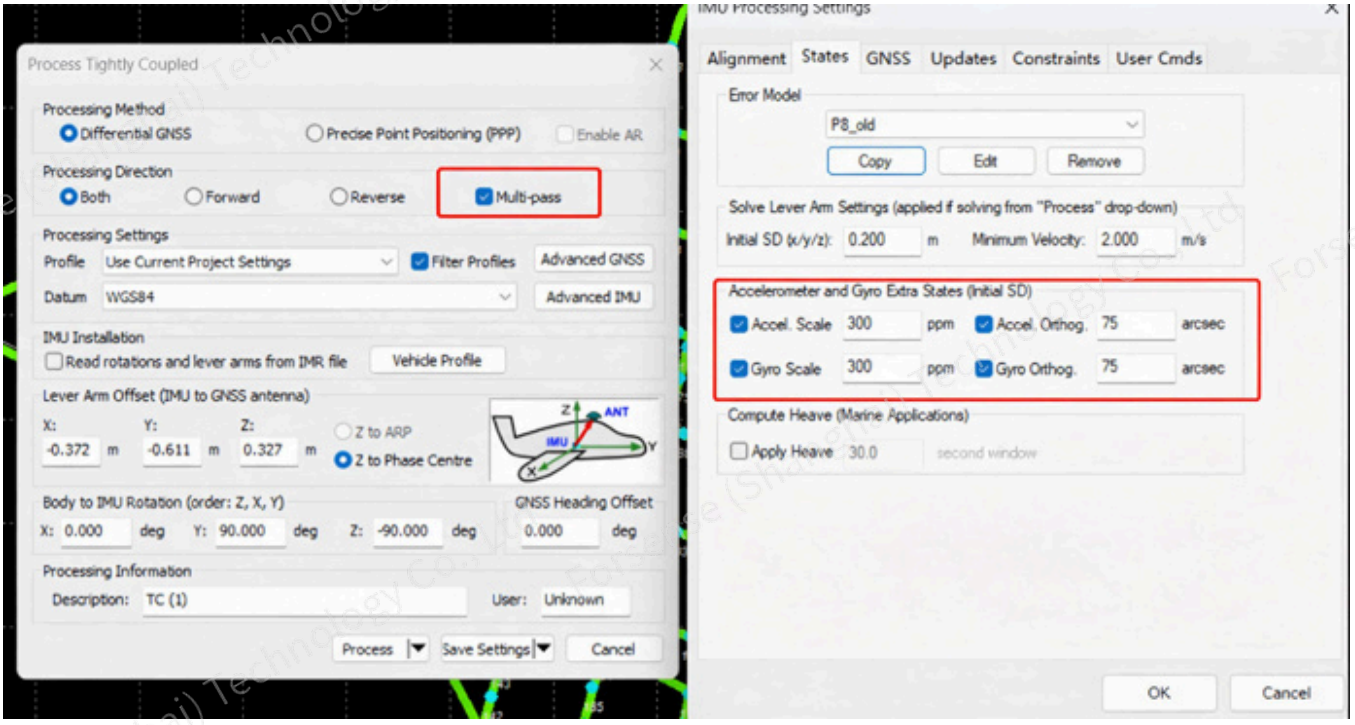


4. Data Processing

① Use the followingIMUP8_Pro Parameter



② When processing IE, check the configuration shown in the figure below

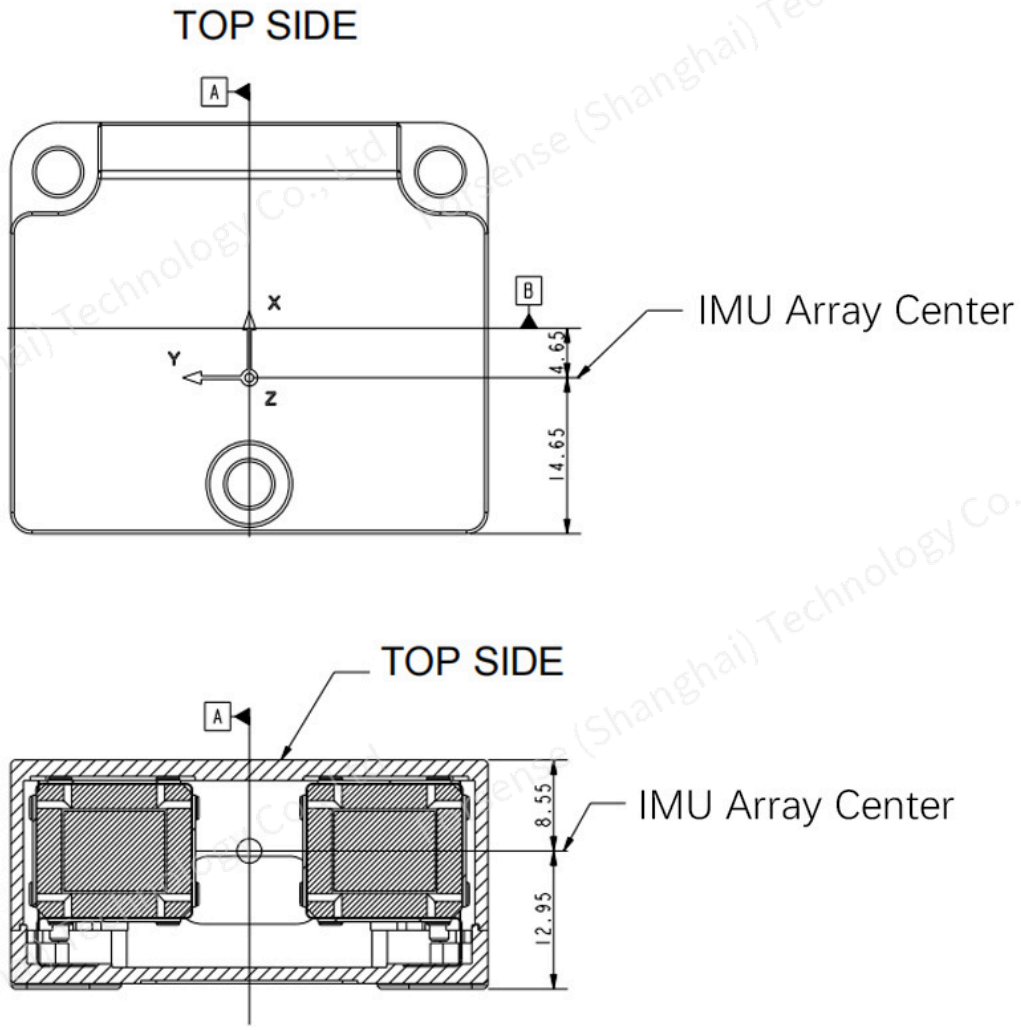


5. Recommended Flight Modes

Stationary before takeoff, fly a figure-8 pattern forward and backward, and remain stationary after landing

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9. Coordinate System Definition



Coordinate System Usage of This ProductRight-Forward-UpCoordinate System:

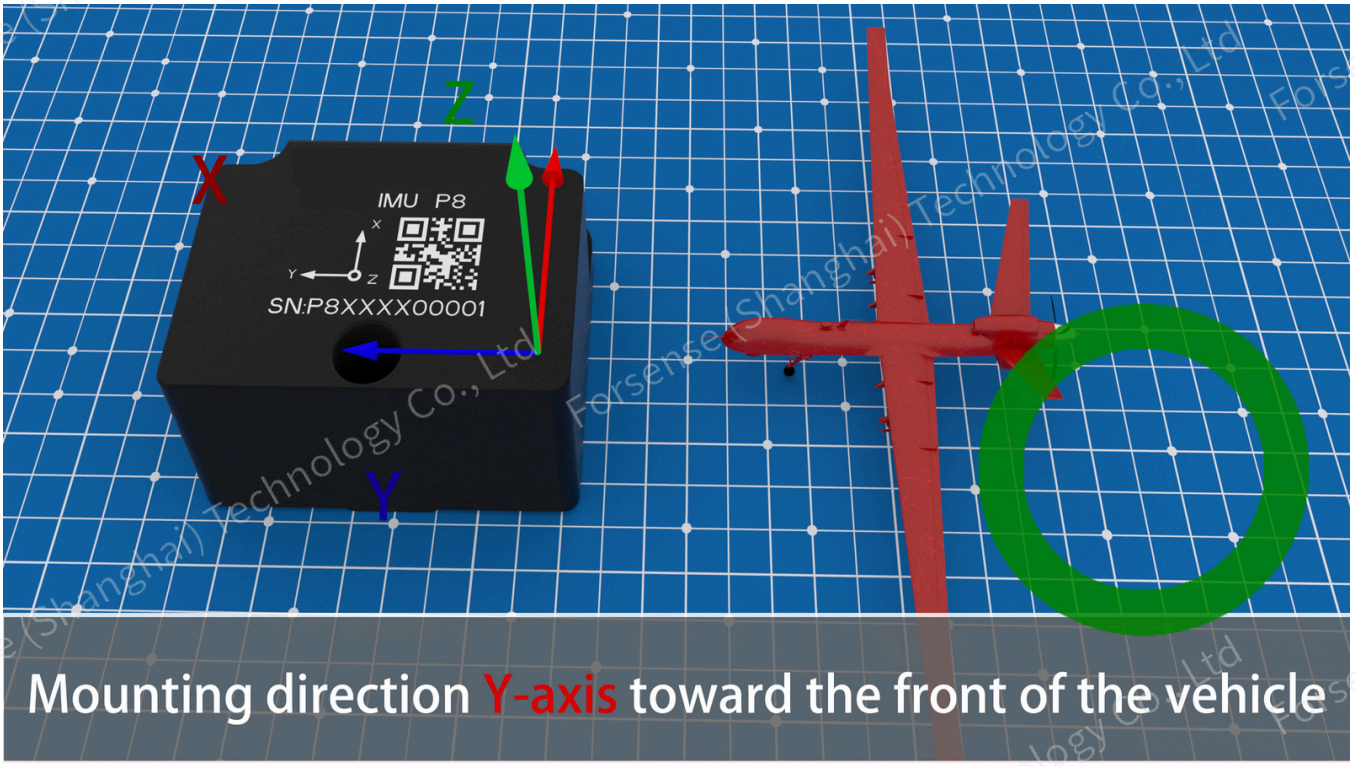
9.1 Device Installation

1. The module should be securely fixed to a rigid plane, avoiding installation in locations with significant vibration.

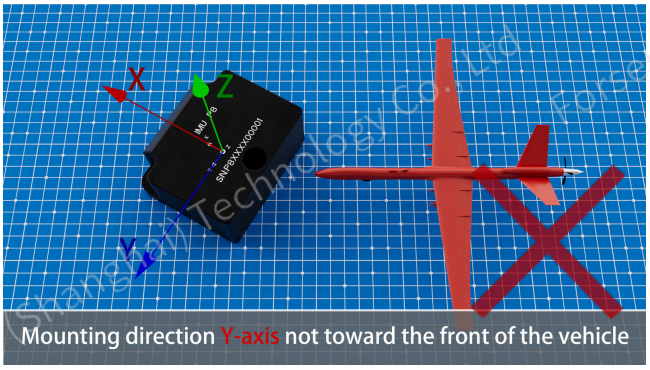
2. The module's orientation should align with the vehicle's forward direction.

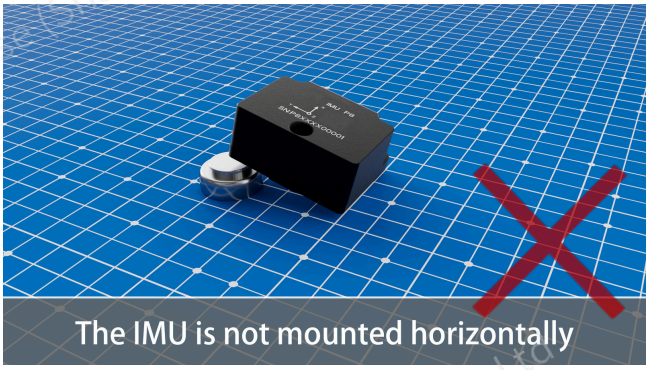
The correct installation diagram is shown below

Y-axisFacing the front of the vehicle

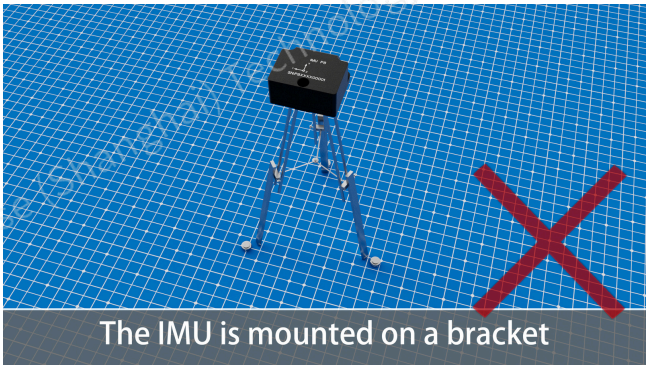


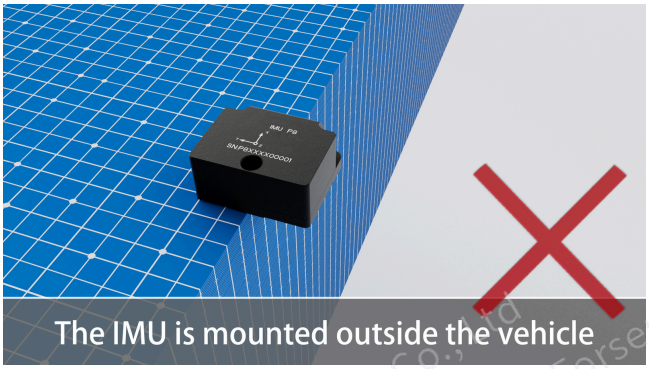
All of the following mounting methods are incorrect.










The IMU is mounted outside the vehicle


The IMU is fixed by hand

10. OptionalAccessories





422 Serial Port Cable (Shipped Harness Includes5V Power Supply) 422 andIMUP8 Signal Adapter Cable

11. Revision History

Latest Manual Version: IMUP8_Pro_Datasheet_Product Manual（en）

Version	Date	Status/Notes
Version 1.0	2023.10.07	Initial Release
Version 1.1	2023.12.14	Added Attachments
Version 1.2	2024.03.26	Added Common AT Commands
Version 1.3	2024.05.08	Added PC software Connection Diagram
Version 1.4	2024.05.10	Added Post-Processing Usage Notes
Version 1.5	2024.08.01	Adjust content relationships
Version 1.6	2024.09.30	Add description of time synchronization feature
Version 1.7	2024.12.02	Add AHRS-Q data stream
Version 1.8	2025.08.04	Simplify communication protocol