FORSENSE
原极科技

Tactical-level MEMS 6-DOF inertial sensor

FSS-IMUP8

Product Sheet



Forsense (Shanghai) Technology Co., Ltd

Please read this user manual carefully before using this product.

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FSS-IMUP8-Product Sheet（EN）

Features

Tactical-grade MEMS Gyroscope

- 0.5°/hr Bias instability
- 0.1°/√hrAngle Random Walk
- 30°/hrTemperatureDrift (-40℃ ~ 85℃,<=1℃/min @1σ)

Tactical-grade MEMS Accelerometer

- 20μg Bias instability
- 0.035m/s/√hr Velocity Random Walk
- 1mg temperature drift (-40℃ ~ 85℃,<=1℃/min @1σ)

Wide-range refined temperature compensation

- -40°C to 85°C Temperature Compensation
- Refined Temperature Calibration

independent rotary table calibration

- Independent calibration of each module: sensitivity, Bias, Misalignment
- Provides an interface for user calibration of installation errors

High-intensity operating condition tolerance

- Ultra-high shock tolerance: 2000g (0.5ms, half-sine, 3-axis)
- Superior Vibration Resistance: 10g (10~2kHz, 3-axis)
- Full-Temperature Stable Operation: -40°C ~ 85°C
- 100% Magnetic Shielding

Real-Time and Flexible Digital Interface; Compact Size

- Configurable output sample rate up to 1KHz
- Supports Serial Port 422
- 38.6*44.8*21.5mm, weight approximately 58g

Product Overview

IMUP8 is a 6 degrees of freedom (DOF) MEMS inertial sensor module built by Forsense Technology. It comes standard with three-axis Gyroscope and acceleration output.

High precision and high resolution capture subtle vibration and tilt. The wide-range output makes motion sensing under large dynamics possible. Every module is configured with refined temperature compensation over an ultra-wide temperature range and independently calibrated before shipment, so each module performs reliably under extreme operating conditions while ensuring highly consistent performance across all products.

Applications

- Aerial Surveying

In addition to standard performance and output Parameter, Forsense also offers customized software and LOGO customization services for your special needs, giving your product a boost!

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1. Performance Parameter

1.1 Gyroscope Key Specifications

Table 1 Gyroscope Key Specifications

Parameter	Test Conditions/Remarks	Minimum Value	Typical Value	Maximum Value	Unit
Measurement Range			±300		°/s
Bias instability[2]	@25℃, Allan Variance, 1σ		0.5		°/hr
Bias stability	GJB, 10 s Smoothing		2		°/hr
Bias Repeatability	GJB		3		°/hr
Resolution			0.0071		°/s
Misalignment between axes			0.02		deg
Internal low-pass cutoff frequency	Software adjustable	10	80		Hz
Sampling Rate			1000	1000	Hz
measure delay			7.2		ms
Bias over temperature[1]	-40℃ ~ 85℃, <=1℃/min @1σ		30		°/hr
Random Walk[2]	@25℃, Allan Variance, 1σ		0.1		°/√hr
scale coefficient error			1.0		‰
scale factor nonlinear			50		ppm

Note 1: 1σ value of Bias variation over full temperature range under 1°C/min heating

Note 2: IEEE standard, given by ALLAN variance curve in static 25°C environment

1.2 Key Parameters of Accelerometer

Table 2 Key Specifications of Accelerometer

Parameter	Test Conditions/Remarks	Minimum Value	Typical Value	Maximum Value	Unit
Measurement Range			±6	Optional ±20	g
Bias instability[2]	@25℃, Allan Variance, 1σ		20 (±6g)		μg
			25(±20g)		μg
Bias stability	GJB, 10s smoothing		45(±6g)		μg
			60(±20g)		μg
Bias Repeatability	GJB		20(±6g)		μg
			40(±20g)		μg
Resolution			0.1414 (±6g)		mg
			1.4142 (±20g)		mg
Misalignment between axes			0.02		deg
Internal low-pass cutoff frequency	Software Adjustable		80		Hz
Sampling Rate			1000	1000	Hz
measure delay			7.2		ms
Bias over temperature[1]	-40℃ ~ 85℃, <=1℃/min @1σ		1.0		mg
Random Walk[2]	@25℃, Allan Variance, 1σ		0.035(±6)		m/s/√hr
			0.04(±20)		m/s/√hr

Note 1: 1σ variation of Bias over the full temperature range at a heating rate of 1°C/min

Note 2: IEEE standard, given by the Allan variance curve under static conditions at 25 °C

Figure 1 Gyroscope Allan Variance Typical Curve

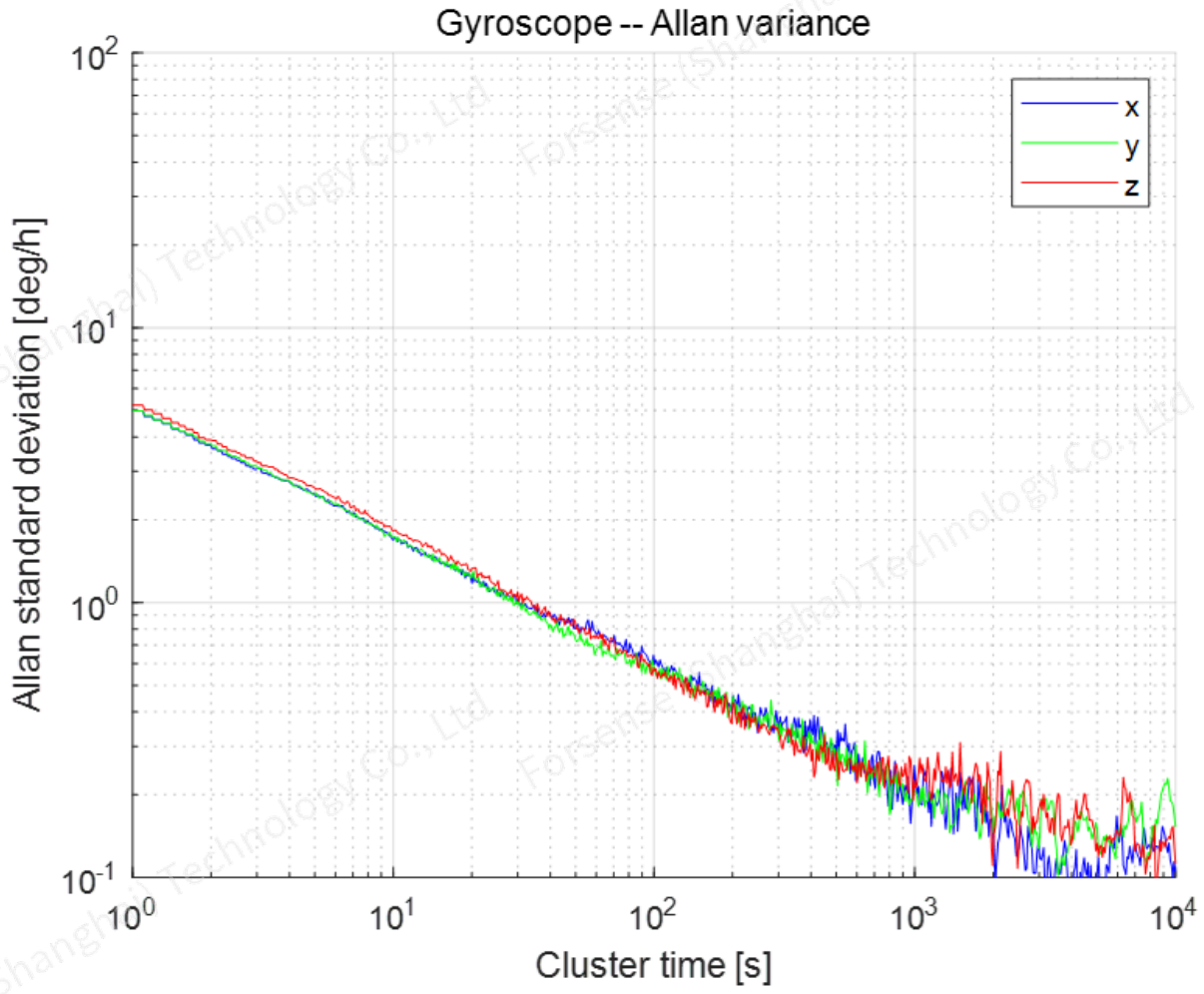
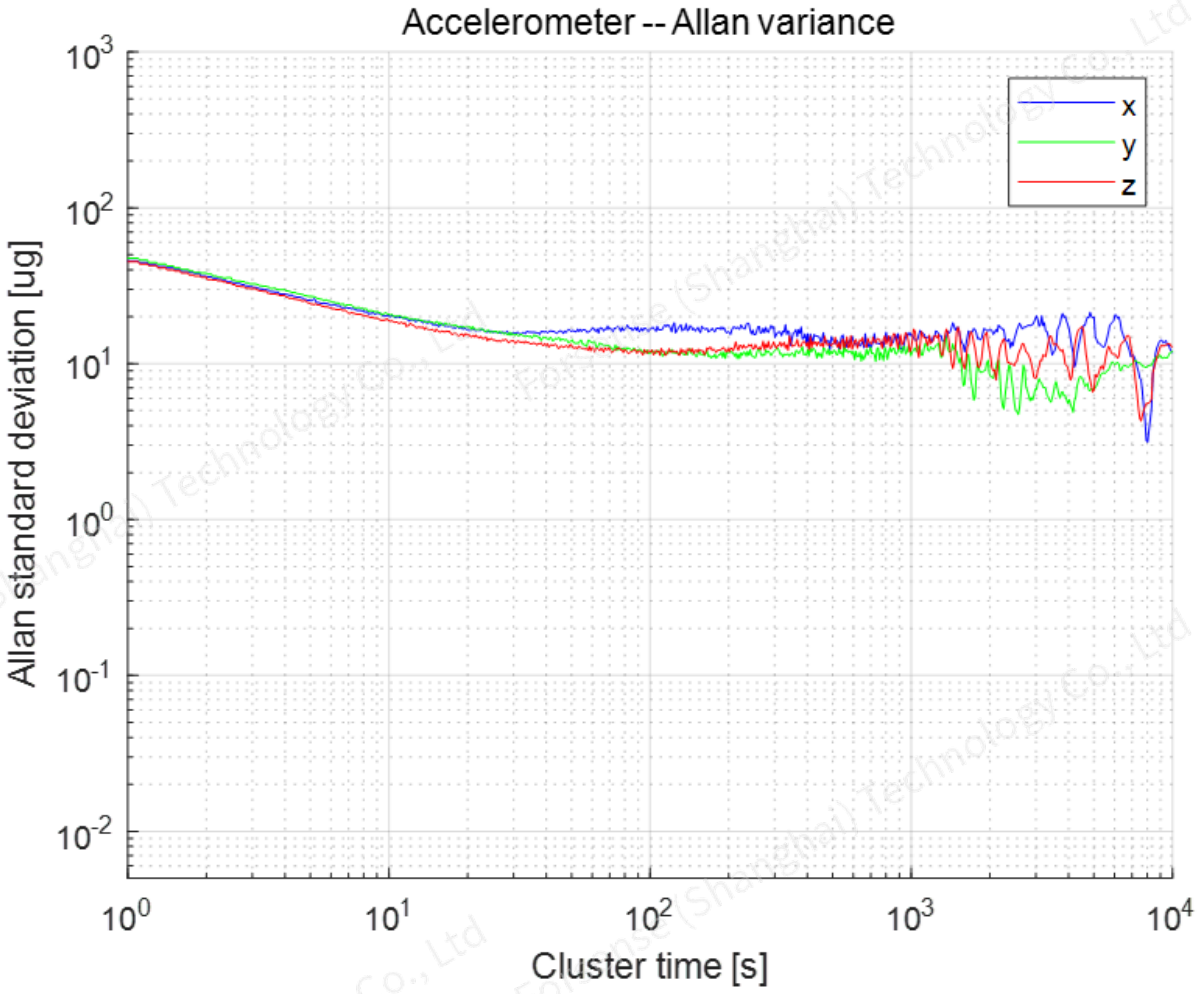


Figure 2 Accelerometer Allan Variance Typical Curve(±6g)


Accelerometer -- Allan variance
Allan standard deviation [ug]
Cluster time [s]
x
y
z
10^3
10^2
10^1
10^0
10^-1
10^-2
10^0
10^1
10^2
10^3
10^4

2. Outline Structure

Figure 3 Outline Structure and Dimensions (Unit: mm)

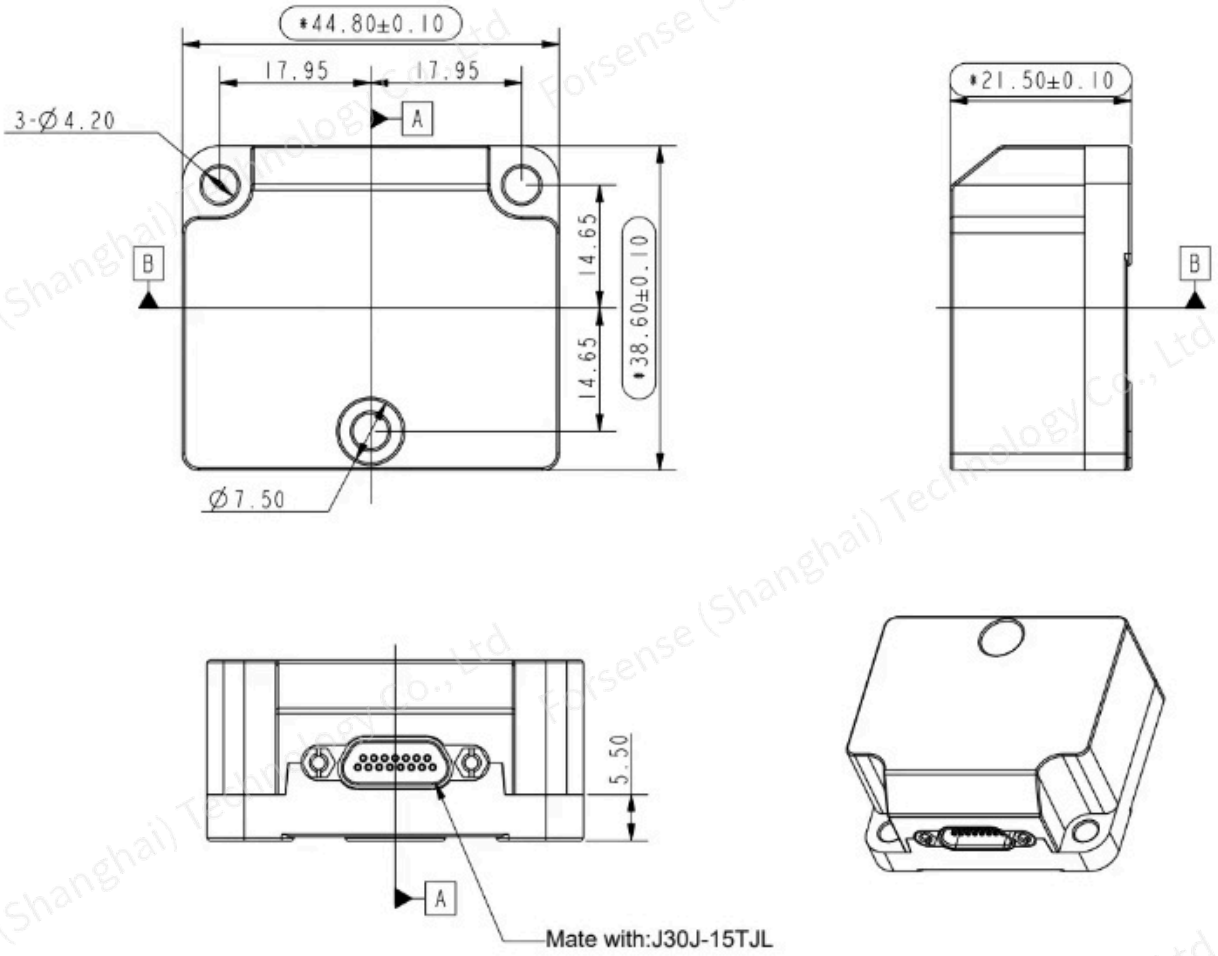
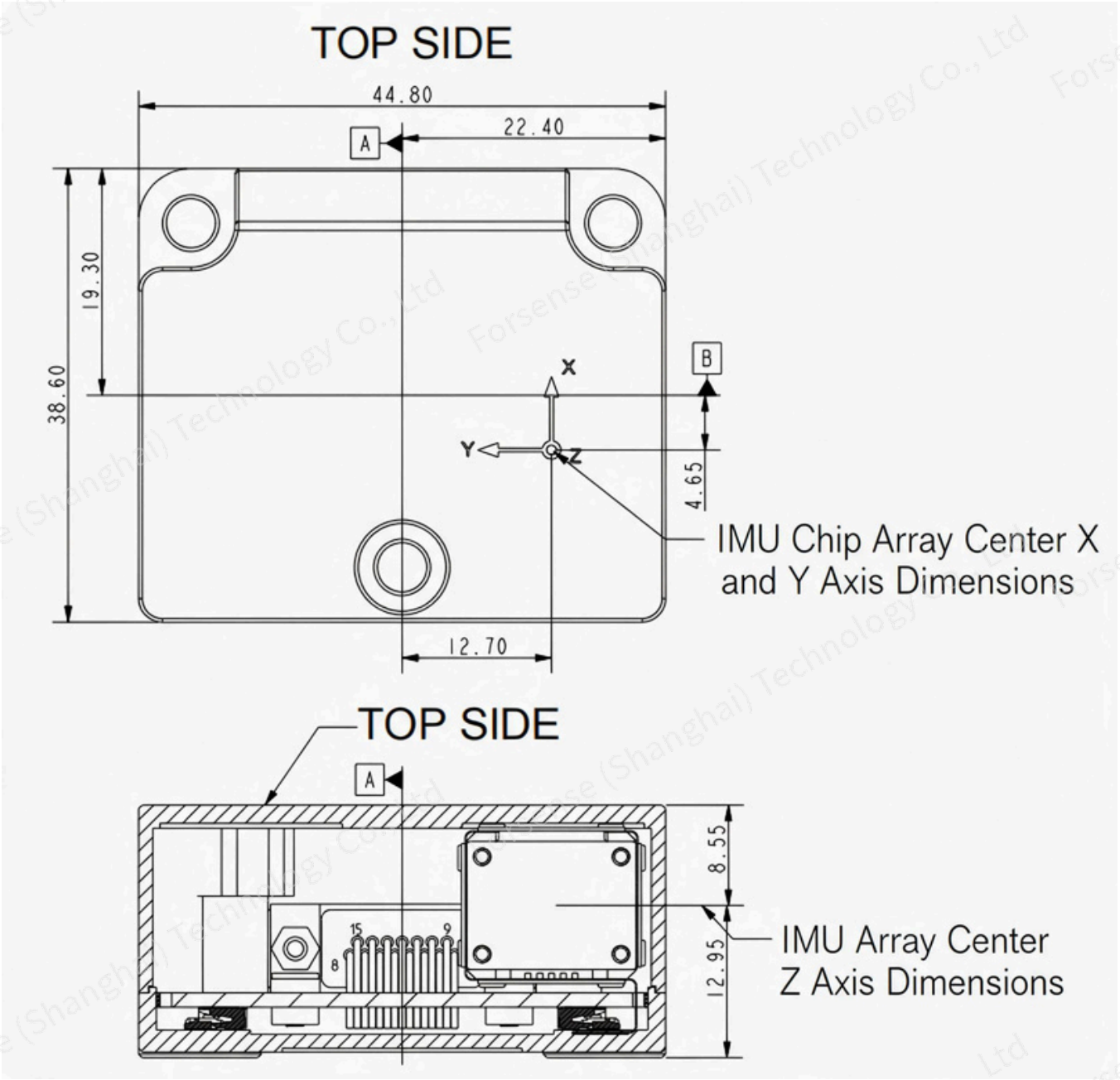


Figure 4 IMU Measurement Center Position (Unit: mm)


TOP SIDE
44.80
22.40
A
19.30
38.60
B
X
Y
Z
4.65
IMU Chip Array Center X and Y Axis Dimensions
12.70
TOP SIDE
A
8.55
12.95
IMU Array Center Z Axis Dimensions

3. Specifications

3.1 Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings

Parameter	Grade	Remarks
Storage Temperature	-55℃-90℃	
VSUP to GND	-0.5-6.5V	
Operating Temperature (Tot)	-40-+85℃	
RXD+/RXD- to GND	-7.5V~12.5V	Matching 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	Complies with EN55032 CISPR 16-2-3
RS	Complies with EN55035 EN(IEC) 61000-4-3
ESD	Complies with EN55035 EN(IEC) 61000-4-2

3.3 ESD Level

Table 5 ESD Grade

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

4. Electrical Characteristics

Table 6 Electrical Characteristics

Parameter	Conditions	Min	Typical	Max	Unit
Power Input		4.5	5	5.5	V
Power			0.7		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 is higher than 6V, the internal voltage protection circuit cuts off the power and puts the device into reset state until the voltage returns to operating conditions and operation resumes.

5. PinDefinition

Figure 5 Pin Schematic Diagram

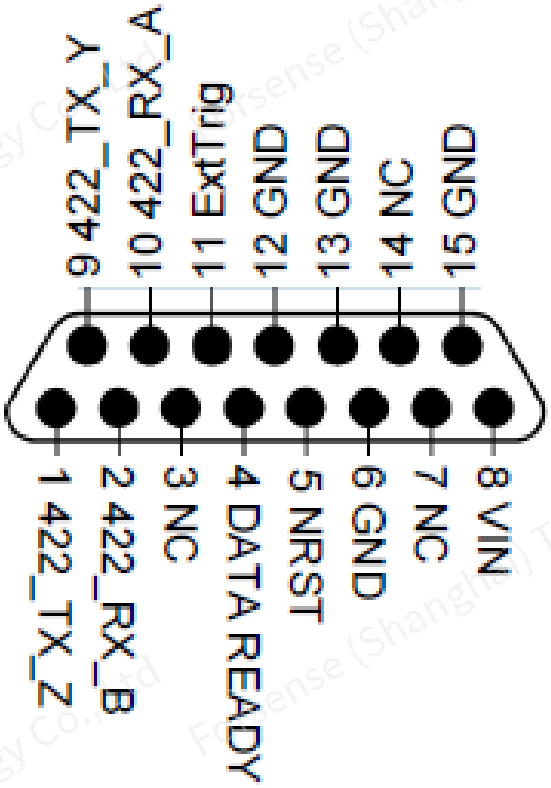


Table 7 Pin Definition

Pin Serial 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 pps
12	GND	Ground (GND)
13	GND	Ground (GND)
14	NC	Not connected
15	GND	Ground (GND)

6. Recommended connection

Figure 6 Normal Acquisition Mode Block Diagram

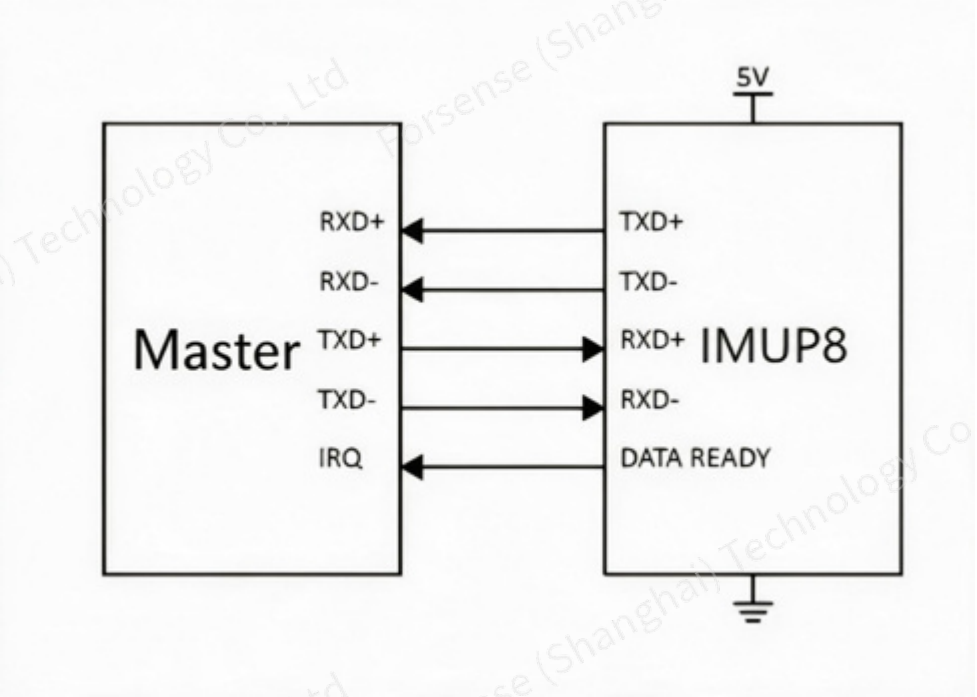
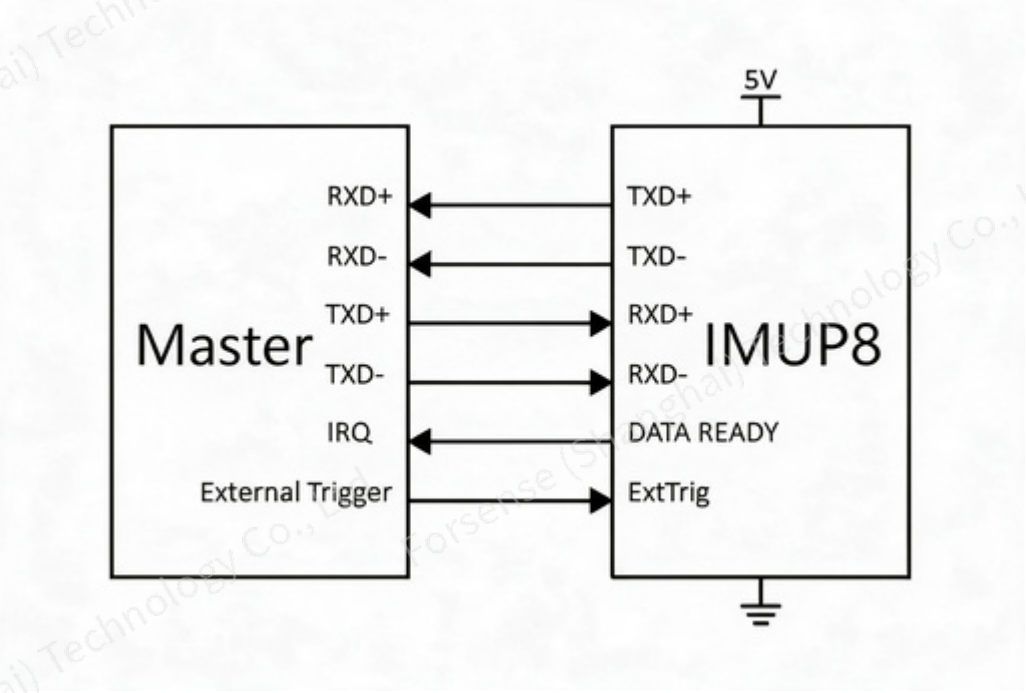


Figure 7 Triggered Acquisition Mode Block Diagram



7. serial communication protocols

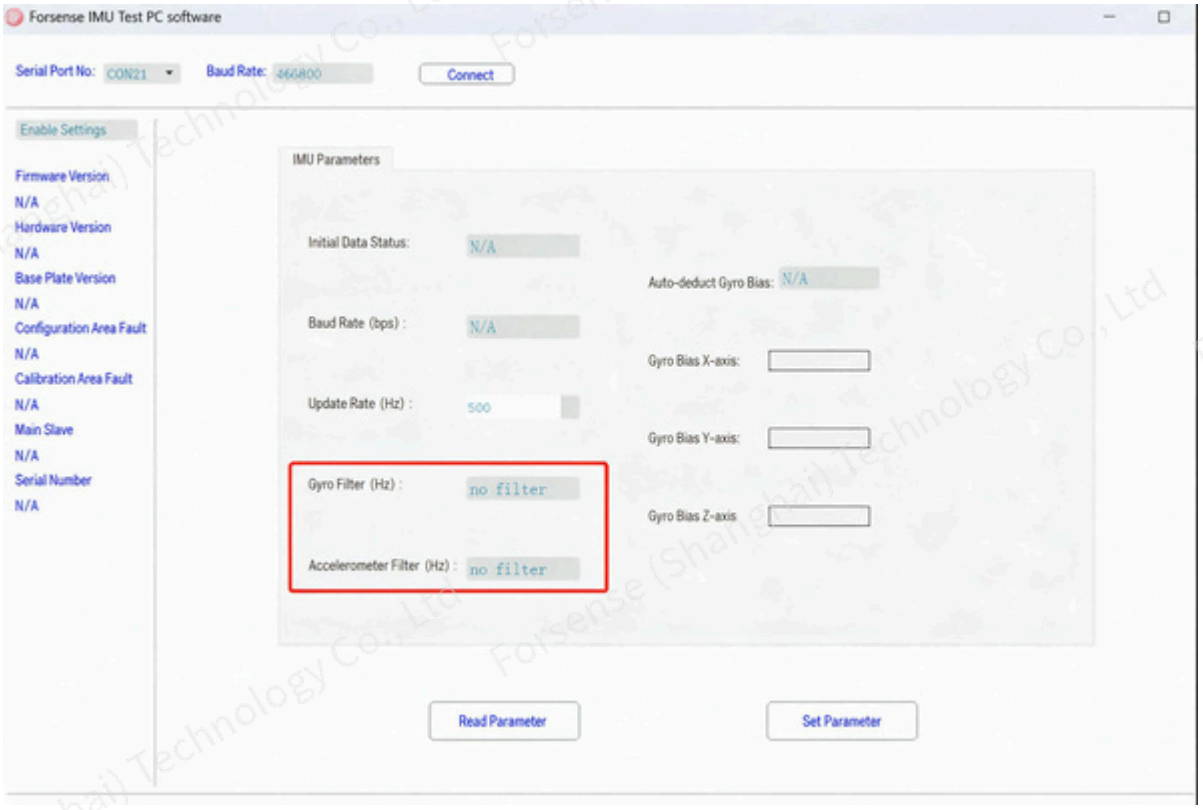
Reference Documents Forsense IMU Communication Protocols（en）

Includes serial communication protocols, coordinate system settings, filter settings, Parameter settings, OTA update method, time synchronization, etc.

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8. Post-processing Usage Notes

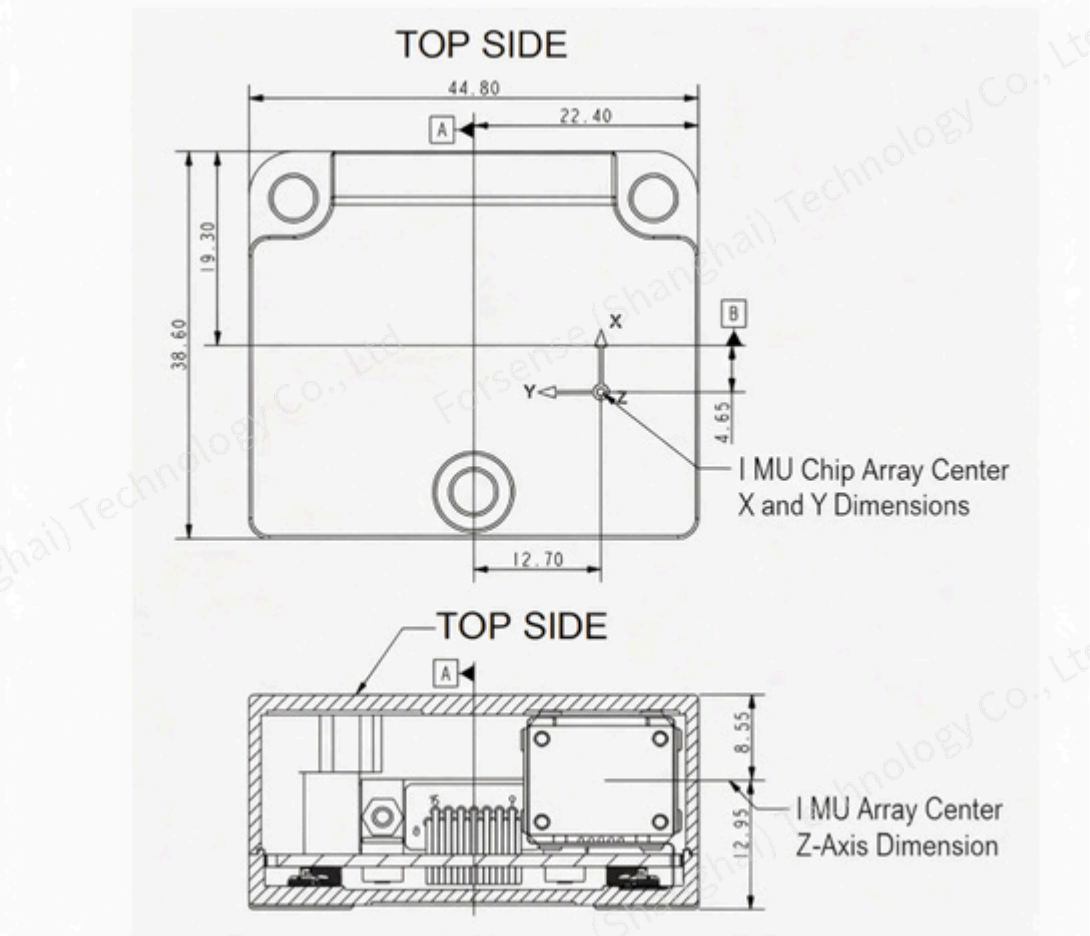
1. Confirm whether all filters are set to no filter (keep screenshots). Update Rate is generally set to 500hz, which can be confirmed via PC software or queried by command; for specific commands, refer to the 7.6 Command Mode SET command or Section 7.10 Common AT Commands



2,IMUP8 data output has a 7.2ms delay, which needs to be subtracted when using the DRDY signal for timestamping,

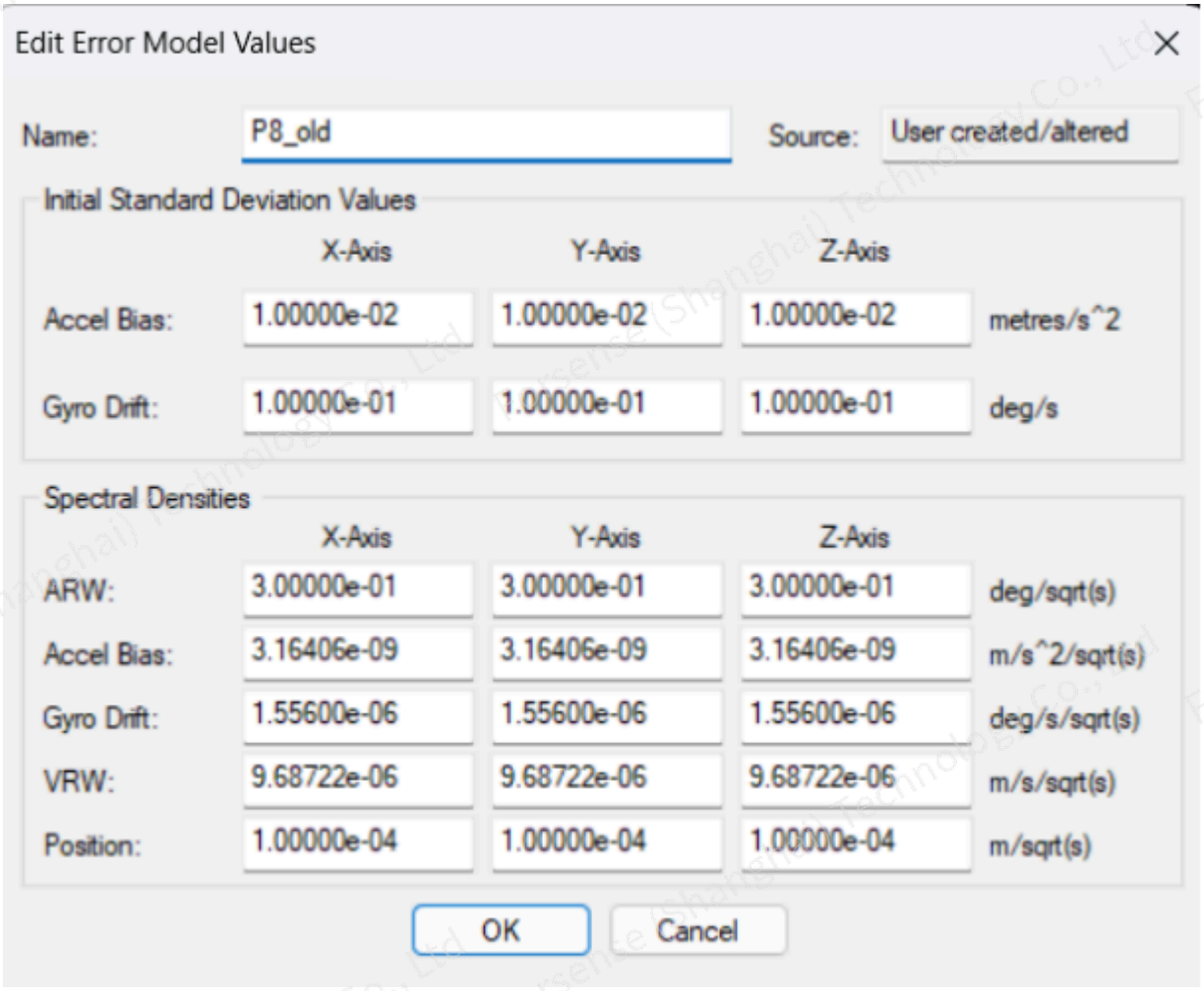
3. Lever Arm Configuration

NoteIMUThe physical center point of P8 is shown in the figure below; pay attention to this when configuring the lever arm.

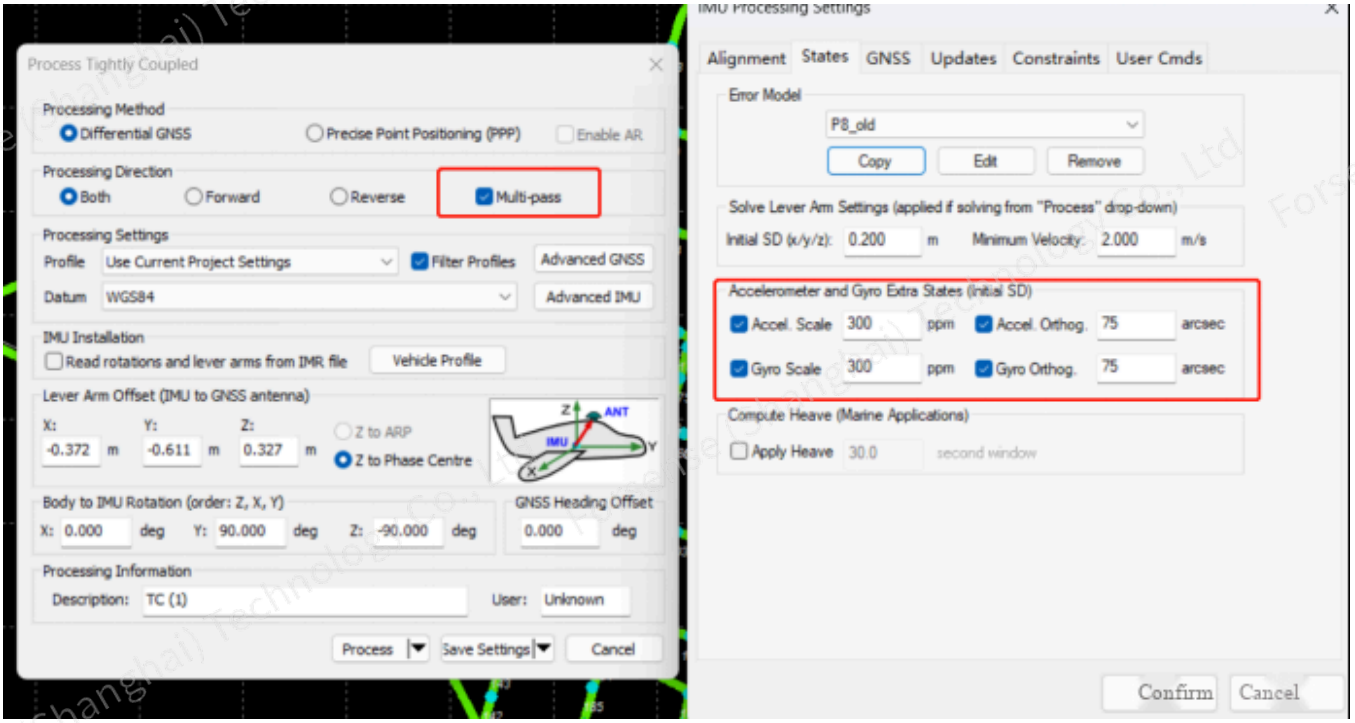


4. Data Processing

Use the followingIMUP8 Parameter



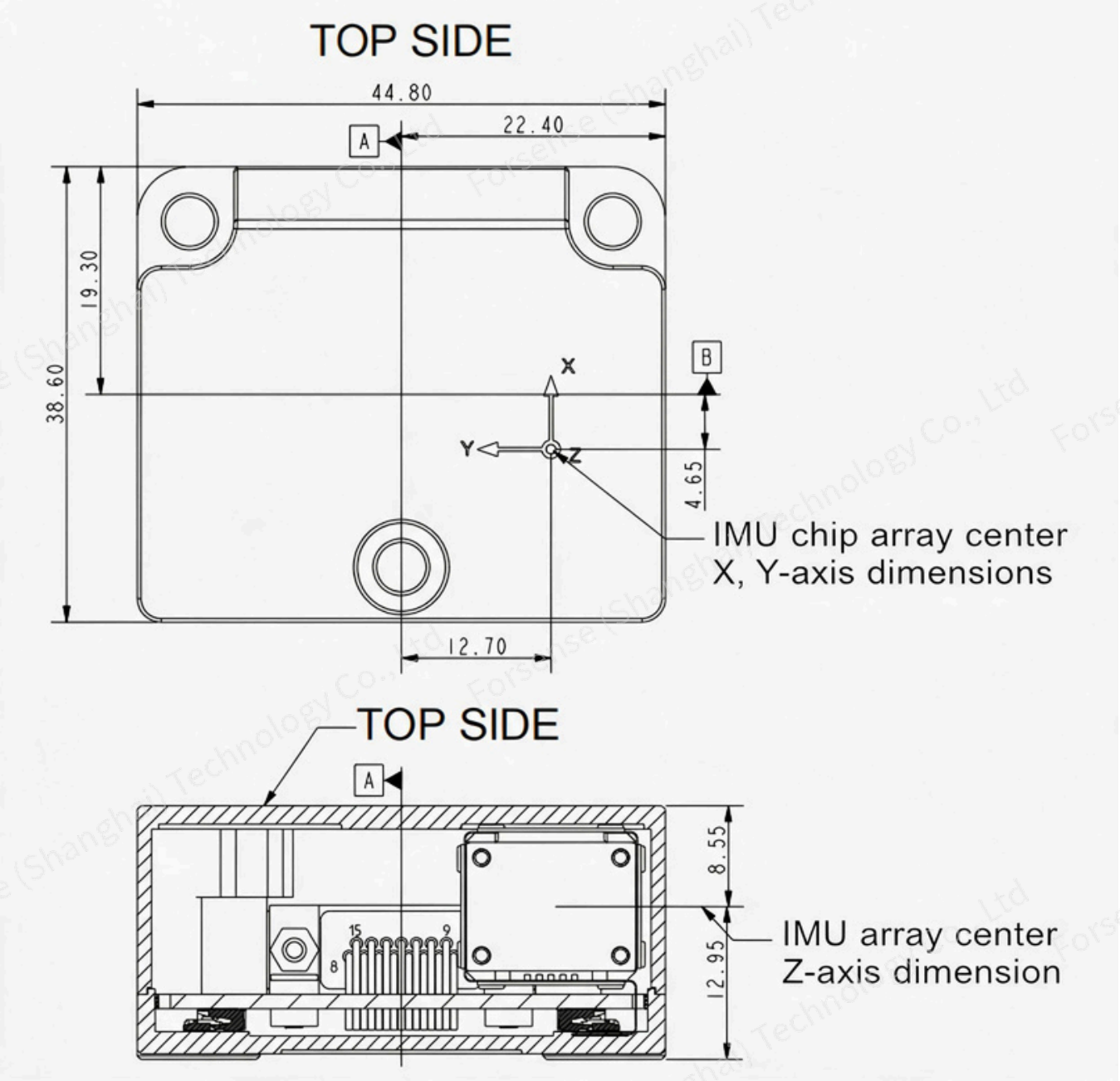
For IE processing, check the configuration shown in the figure below.



5. Recommended Flight Mode

Stationary before takeoff, forward/backward figure-eight, and stationary after landing.

9. Coordinate System Definition



This product's coordinate system uses Right-Forward-UpCoordinate System.

10. Usage Example

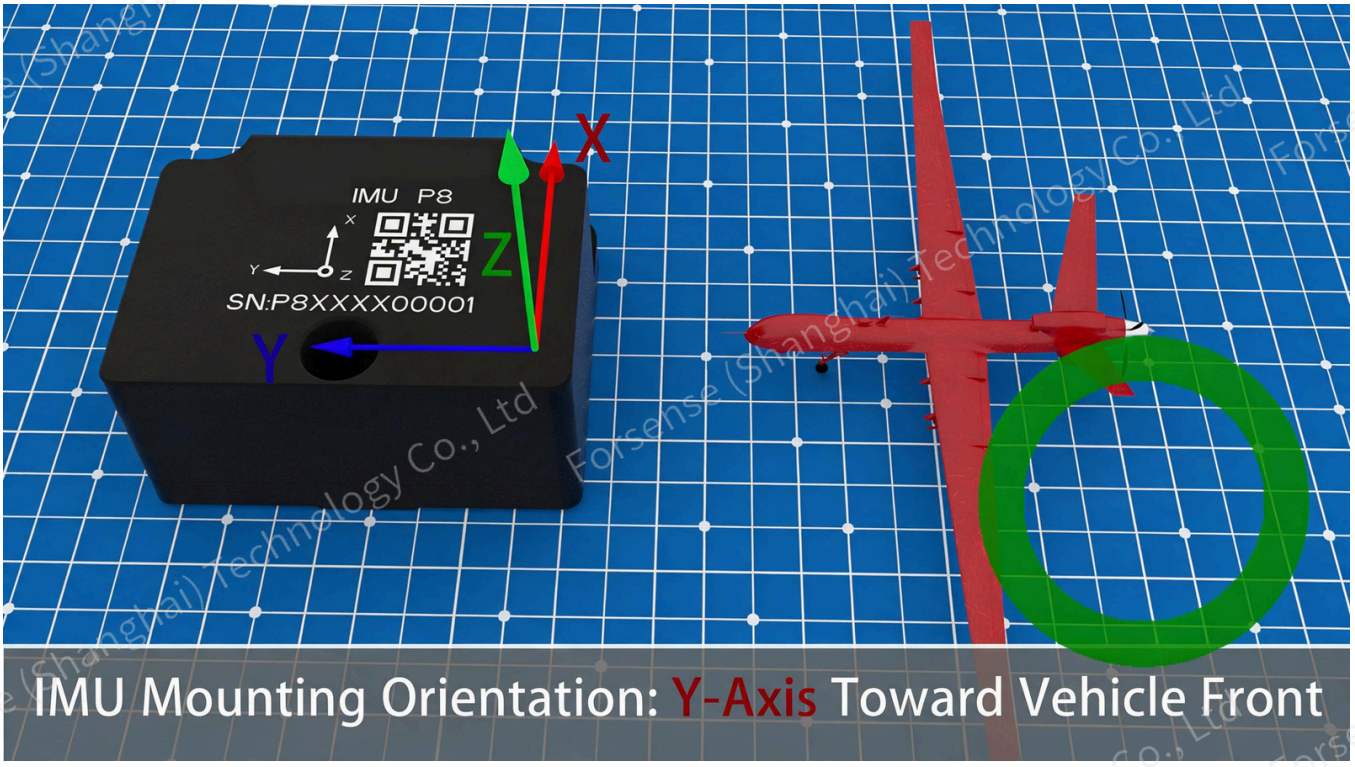
1. The module should be securely mounted on a rigid surface, avoiding installation in high-vibration locations.

2. The module installation orientation should be aligned with the forward direction of the vehicle.

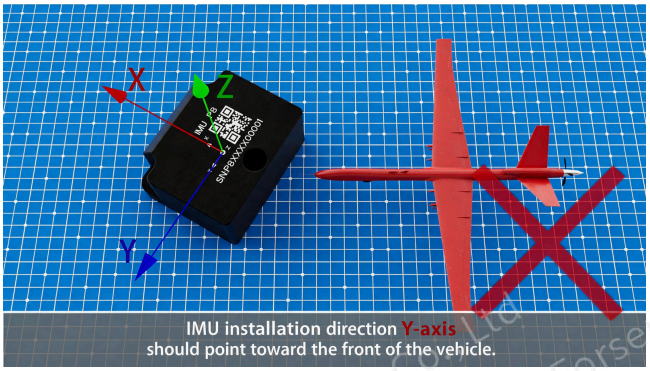
The correct installation diagram is shown below.

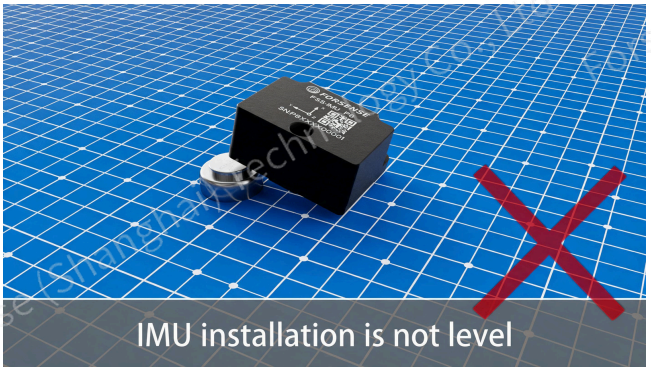
YFacing the Vehicle Front

Figure8 Correct Installation Diagram

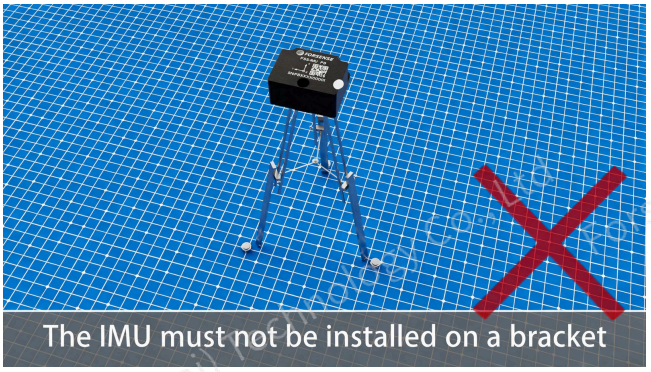


The following installation methods are all incorrect.


X
Z
Y
IMU installation direction Y-axis
should point toward the front of the vehicle.


IMU installation is not level


The IMU must not be installed on a non-rigid surface.


The IMU must not be installed on a bracket


The IMU must not be mounted suspended outside the vehicle


Do Not Install the IMU by Hand

11. OptionalAccessories



422Serial PortCable (Shipping and Delivery Harnesswith 5V power supply)



422 andIMUP8 Signal Adapter Cable

12. Revision History

Latest Manual Version: IMUP8_Product Sheet（EN）

Version	Date	Status/Notes
Version 1.0	2023.08.30	Initial release
Version 1.1	2023.10.07	Update Coordinate System Definition
Version 1.2	2023.12.14	Add Accessories
Version 1.3	2024.03.26	Added common AT commands
Version 1.4	2025.05.14	Added post-processing usage precautions
Version 1.5	2025.05.15	Added specifications related to Accelerometer±20g
Version 1.6	2024.06.26	Added Time Synchronization Function section
Version 1.7	2025.08.01	Adjusted content structure
Version 1.8	2025.08.04	Simplified communication protocol
Version 1.9	2025.08.05	Add Time Synchronization Steps