1 FEATURES

1.1 Hardware

- High-performance tactical-grade MEMS-IMU
- Factory-calibrated for full temperature range (-40℃ to 85℃), including scale factor, cross-axis, and bias.
- Gyroscope bias instability as low as 0.3°/h.
- Accelerometer bias instability as low as 10 μg
- Multiple communication interfaces: RS232 / RS422 / CAN.
- PPS+UTC/GPRMC syncchronous
- Wide input voltage range: 5-36V.
- Excellent vibration resistance.
- RoHS and CE certified.

1.2 Software

- Adaptive extended Kalman fusion algorithm with output rates up to 1000Hz and low latency.
- Outstanding dynamic tracking performance with vibration suppression.
- Excellent suppression of linear acceleration effects.
- Startup time < 2s.
- Supports multiple protocols, including Binary, CANopen and J1939
- Direct data output without external command configuration.
- Multi-functional GUI for convenient operation.
- Support for various development environments and examples, including ROS, C, and QT.

2 APPLICATIONS

- Precision instruments and measurement.
- Platform stabilization and control.
- Construction machinery.
- Construction machinery.
- Autonomous driving.

3 DESCRIPTION

3.1 Product Appearance

Figure 1: HI70

3.2 System Block Diagram

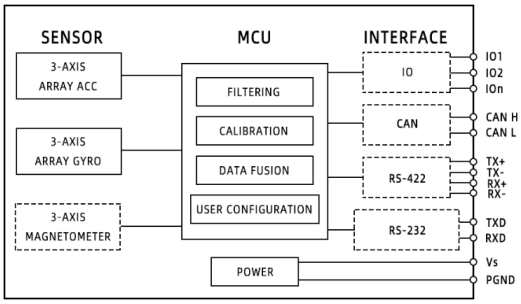

Figure 2: Functional Block Diagram

Note1: The dashed lines indicate features that are not supported by certain models. Please refer to the product selection table (Table 1) for details

3.3 General Description

The HI70 series is an IMU/VRU/AHRS sensor composed of tactical-grade MEMS-IMU and magnetometer. It is equipped with proprietary adaptive extended Kalman filtering, IMU noise dynamic analysis algorithms, and carrier motion state analysis algorithms. This enables high-accuracy attitude angles in dynamic environments and significantly reduces heading drift.

Each sensor undergoes meticulous factory calibration before shipment, including compensation for temperature, bias, scale factor, and cross-axis errors.

The multi-functional GUI (Graphical User Interface) helps users quickly evaluate product performance. Its features include, but are not limited to, module configuration, data display, firmware updates, and data recording.

For product selection and ordering information, please refer to Table 1 and Table 2.

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4 PRODUCT SELECTION

Table 1: Selection Information

HI70a-b-c[1]						
Company	Series	a-Sensor		b-Interface	c-OEM	
HI	70	T2	6DoF 0.3°/h 10ug	MI0 CAN+RS232	000	Default
		T3	6DoF+Magnetic 0.3°/h 10ug	MI1 CAN +RS422	otehrs	OEM

Note1: Example model: HI70T3-MI0-000. All models are factory-calibrated for the full temperature range by default.

5 ORDERING

5.1 Ordering Information

Table 2: Ordering Information

Interf	Part Number	Name	Description
MI0(CAN+RS232)	HI70T2-MI0-000	IMU/VRU Module	Tactical-grade 6DoF 0.3°/h 10ug CAN+RS232
	HI70T3-MI0-000	IMU/VRU/AHRS Module	Tactical-grade 6DoF+Magnetic 0.3°/h 10ug CAN+RS232
MI1(CAN+RS422)	HI70T2-MI1-000	IMU/VRU Module	Tactical-grade 6DoF 0.3°/h 10ug CAN+RS422
	HI70T3-MI1-000	IMU/VRU/AHRS Module	Tactical-grade 6DoF+Magnetic 0.3°/h 10ug CAN+RS422

5.2 Contact us

1. Email: overseas1@hipnuc.com
2. Website:www.hipnuc.com

6 DOCUMENT INFORMATION

6.1 Version Information

Table 3: Document Versions

Version	Date	Author	Changes
1.0	2025 年 3 月 18 日	Hipnuc	Initial

6.2 Related Documents

1. *Commands and Programming Manual*
2. *CAE/Step*
3. *GUI Software and Reference Examples*

7 SPECIFICATIONS

Unless otherwise specified, the test conditions are at 25℃, with a supply voltage of 24V, a gyroscope range of 300°/s, an accelerometer range of 8g, and a magnetometer range of 20 Gauss.

7.1 Absolute Maximum Ratings

Table 4: Absolute Maximum Ratings

Parameters	Limit	Comment
Mechanical Shock	3000g	Duration <0.5ms
Storage Temperature	-40℃-85℃	
ESD HBM	30KV	JEDEC/ESDA JS-001
Power Input Voltage	40V	
IO1	0-3.6V	
RS-232 TX to GND	±13.2V	
RS-232 RX to GND	±24V	
CAN H or CAN L to GND	±36V	
CAN H to CAN L	±27V	
RS-422 TX+ TX- RX+ RX-	±14V	

7.2 Normal Operation

Table 5: Normal Operation

Parameters	Condition	Min	Nom	Max	Unit	Note
Input Voltage		4.8	-	36	V	
Power Consumption			400		mW	
Operating Temperature		-40	-	85	℃	
Gyroscope Range			300	320	°/s	
Accelerometer Range			8	16	g	
Startup Time				2	s	1

Note1: The startup time refers to the duration from power-on to the output of valid data by the system. During this period, the module should remain stationary.

7.3 Interface

Table 6: Interface parameters

Interf	Parameters	Condition	Min	Nom	Max	Unit	Note
RS-232	Baud rate	RS-232	9600	115200	921600	bps	1
	Start Bit			1		bit	
	Data Length			8		bits	
	Stop Bit			1		bit	
	Parity Bit			None		bit	
	Output Frame Rate		0	100	1000	Hz	2
	Input Impedance		3	5	7	kΩ	
	Output Impedance		300	10M		Ω	
CAN	Baud Rate		125	500	1000	kbps	3
	Output Frame Rate		5	100	200	Hz	4
	Input Impedance	With 120Ω Resistor		120		Ω	5
		Without 120Ω Resistor	19	30	52	kΩ	
RS-422	Baud Rate		9600	115200	921600	bps	
	Start Bit			1		bit	
	Data Length			8		bits	
	Stop Bit			1		bit	
	Parity Bit			无		bit	
	Output Frame Rate		0	100	1000	Hz	
	Input Impedance	With 120Ω Resistor		120		Ω	5
		Without 120Ω Resistor	48			kΩ	
Trigger	Logic Voltage	High	2.0			V	6
		Low			0.6	V	
	Delay	From trigger to data transmission			800	us	

Note1: For modifications, refer to the Instruction and Programming Manual.

Note2: The sensor supports data output rates of 1, 5, 10, 50, 100, 200, 250, 500, and 1000 Hz.

Note3: For modifications, refer to the Instruction and Programming Manual.

Note4: The sensor supports data output rates of 5, 10, 50, 100, and 200 Hz.

Note5: By default, no 120Ω resistor is connected.

Note6: Refer to the synchronization function section and the Instruction and Programming Manual for trigger timing and configuration details.

7.4 Gyroscope

Table 7: Gyroscope Parameters

Parameters	Condition		Min	Nom	Max	Unit	Note
Range				300		°/s	
Resolution				16bit			
Linearity Error	300°/s -40℃-110℃ 100°/s -40℃-110℃		-0.3 -0.04	±0.15 ±0.01	0.3 0.04	°/s	1
Cross-axis Error			-0.15		0.15	%	
3dB Bandwidth				235	250	Hz	
Sampling Rate				1000		Hz	
Noise Density		XY Z		0.0004 0.0006		(°/s)/√Hz	
Bias Instability	Allan Variance			0.3		°/h	2
Bias Stability	10s average			0.5		°/h	
Bias Repeatability				0.8		°/h	
Angular Random Walk	Allan Variance	XY Z		0.015 0.025		°/√h	3
Bias Temperature Drift	-40-85℃	XY Z		 0.01	0.25 0.03	°/s	
Accelerometer Sensitivity	For constant gravity input			0.00075		°/s/g	

Note1: Linearity error refers to the maximum deviation between the measured value and the best-fit straight line at the specified range. The best-fit linear model is determined using the least squares method.

Note2: Linearity error refers to the maximum deviation between the measured value and the best-fit straight line at the specified range. The best-fit linear model is determined using the least squares method.

Note3: Linearity error refers to the maximum deviation between the measured value and the best-fit straight line at the specified range. The best-fit linear model is determined using the least squares method.

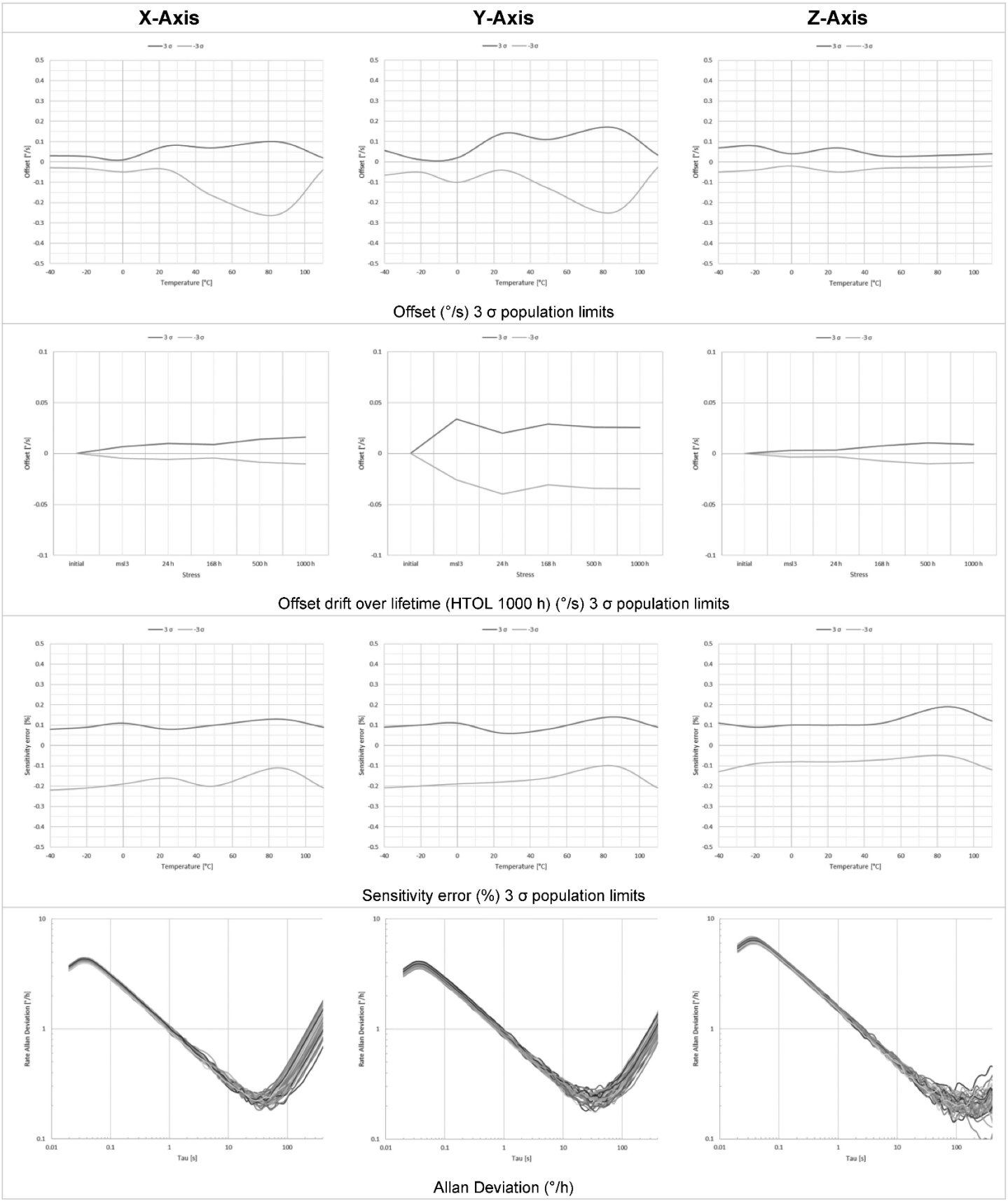

Figure 3: HI70 Gyroscope typical performance characteristics

7.5 Accelerometer

Table 8: Accelerometer Parameters

Parameters	Condition	Min	Nom	Max	Unit	Note
Range			16		g	
Resolution			16bit			
Initial Bias				2	mg	
Linearity Error	8g -40℃-110℃ 1g -40℃-110℃	15 1	3 0.5	15 1	mg	1
Cross-axis Error		-0.15		0.15	%	
3dB Bandwidth			210	235	Hz	
Sampling Rate			1000		Hz	
Noise Density			0.0008		$m/s^2\sqrt{Hz}$	
Bias Instability	Allan Variance		10		ug	2
Bias Stability	10s average		30		ug	
Bias Repeatability			40		ug	
Random Walk	Allan Variance		0.03		$m/s\sqrt{h}$	
Bias Temperature Drift	-40-85℃		0.5	2	mg	

Note1: Linearity error refers to the maximum deviation between the measured value and the best-fit straight line at the specified range. The best-fit linear model is determined using the least squares method.

Note2: The Allan variance minimum value is divided by 0.664 to obtain this value. Measurements are taken with a 13 Hz low-pass filter setting, a sampling rate of 200 Hz, and a stabilization time of 15 minutes before data collection to ensure full thermal stability.

Note3: Velocity random walk is the white noise term estimated from the Allan variance at a time constant τ=1 second.

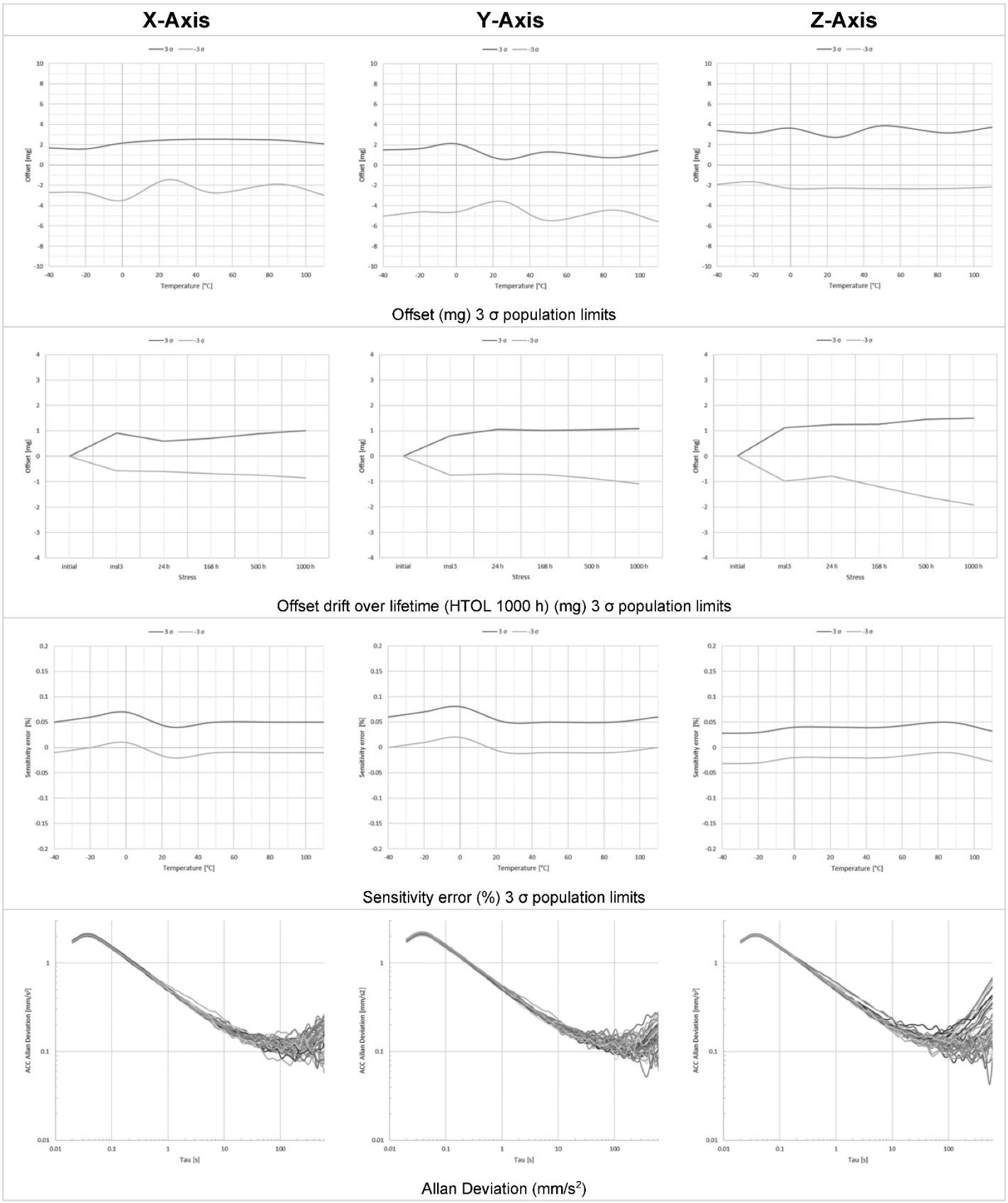

Figure 4: HI70 Accelerometer typical performance characteristics

7.6 Magnetic

Table 9: Magnetic parameters

Parameters	Condition	Min	Nom	Max	Unit	Note
Range		-20	-	20	Gauss	
Sampling Rate			200Hz			
Linearity			0.1		Fs%	

7.7 Temperature Sensor

Table 10: Temperature Sensor

Parameters	Condition	Min	Nom	Max	Unit	Note
Range		-50	-	135	℃	
Offset error			±1		K	

7.8 Fusion Parameters

Table 11: Fusion Parameters

Parameters	Value
Pitch	±90°
Roll	±180°
Yaw	±180°
Resolution	0.01°
Quaternion	Supported

7.9 Fusion Accuracy

Table 12: Fusion Accuracy

Parameters	Condition	Product	Min	Nom	Max	Unit	Note
Pitch/Roll (Static)				0.05	0.07	°	
Pitch/Roll (Dynamic)				0.05	0.07	°	
Yaw Static Drift (6DOF)	Stationary 2h			0.1		°	1
Yaw Magnetic Assistance (AHRS)				2	3	°	2
Yaw Rotation Error (6DOF)	100°/s			<0.5	1	°	3

Note1: The module remains stationary and horizontal for 2 hours.

Note2: Calibrate geomagnetically in a no-interference environment and set to AHRS mode..

Note3: Accumulated yaw angle error after 10 continuous rotations on a turntable.

7.10 Mechanical and Environmental Parameters

Table 13: 7.10 Mechanical and Environmental Parameters

Parameters	Value
Dimensions	44.8X38.6X18.5mm
Weight	55g
Housing Material	Aluminum Alloy
Mounting Screws	M4
Surface Treatment	Anodized
Vibration Resistance	1.0mm(10Hz-58Hz)&≤20g(58Hz-600Hz)
Drop Test	Dropped freely from a height of 75 cm, 3 times
Temperature Shock	Temperature cycles from -40℃ to 85℃ within 1 hour, repeated 5 times

7.11 Dimensions

All Dimensions in mm units.

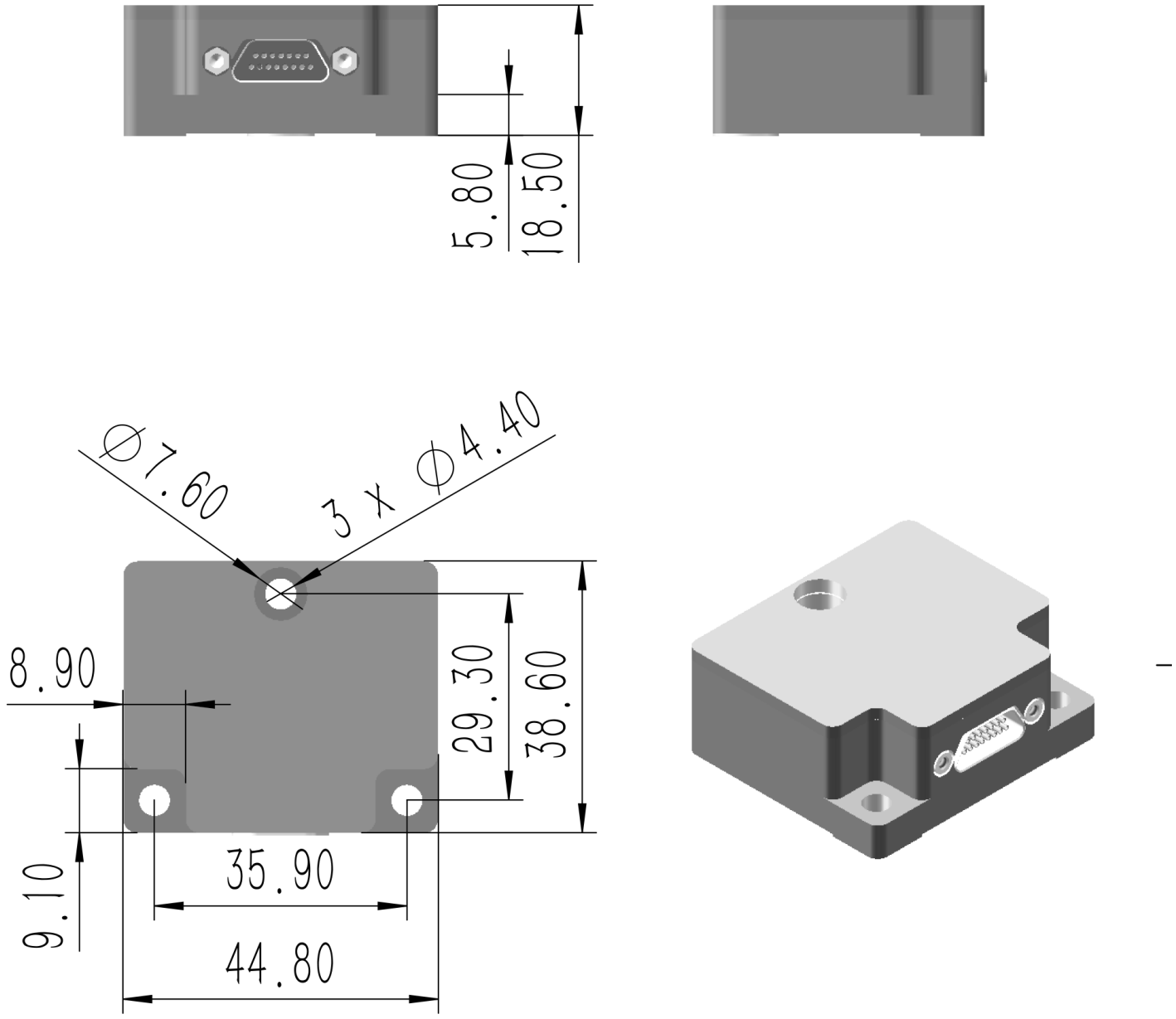

Figure 5: HI70 Mechanical Dimension

7.12 Pin Definition

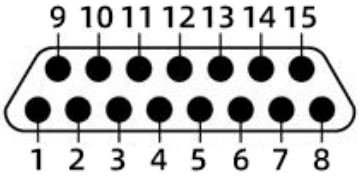

Figure 6: HI70 Pin definition(sensor side)

Table 14: MI0(CAN+RS232)

J30	Pin Name	Type	Description	Note
1	TXD1	O	COM 1 output (232 level)	
2	RXD2	I	COM 2 input (232 level)	
3	IO2	O	Synchronization output	
4	CAN L	AIO	CAN Low	
5	RST	I	Module reset pin (Active Low)	
6	SGND	Power	Signal Ground	
7	RSV		Reserved	
8	Vs	Power	Power input +	
9	TXD2	O	COM 2 output (232 level)	
10	RXD1	I	COM 1 input (232 level)	
11	IO1	I	Synchronization input,PPS input	
12	SGND	Power	Signal Ground	
13	SGND	Power	Signal Ground	
14	CAN H	AIO	CAN High	
15	PGND	Power	Power Ground	

Note1： 信号地与电源地内部相连

Table 15: MI1(CAN+RS422)引脚功能描述

J30	Pin Name	Type	Description	Note
1	TXD-	AIO	RS422 negative output	
2	RXD-	AIO	RS4222 negative input	
3	IO2	O	Synchronization output	
4	CAN L	AIO	CAN Low	
5	RST	I	Module reset pin (Active Low)	
6	SGND	Power	Signal Ground	
7	RSV		Reserved	
8	Vs	Power	Power input +	
9	TXD+	O	RS422 positive output	
10	RXD+	I	RS422 positive input	
11	IO1	I	Synchronization input,PPS input	
12	SGND	Power	Signal Ground	
13	SGND	Power	Signal Ground	
14	CAN H	AIO	CAN High	
15	PGND	Power	Power Ground	

8 COORDINATE

8.1 Coordinate System

The vehicle system uses the Right-Front-Up (RFU) coordinate system, while the geographic coordinate system adopts the East-North-Up (ENU) coordinate system. The accelerometer and gyroscope axes are shown in the figure below:

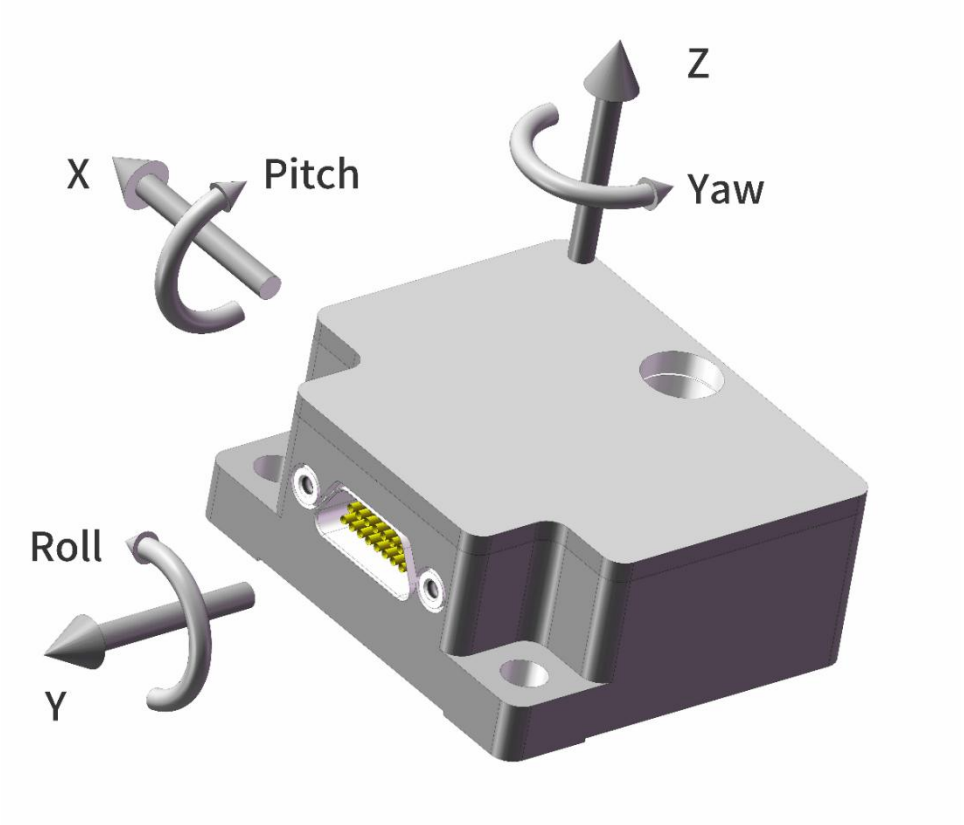

Figure 7: HI70 Coordinate System

The Euler angle rotation sequence follows the East-North-Up (ENU) 312 convention, which rotates in the following order: Z-axis, X-axis, and then Y-axis. The specific definitions are as follows:

- Rotation around the Z-axis:Yaw\psi(ψ) -180° - 180°
- Rotation around the X-axis:Pitch\theta(θ) -90°-90°
- Rotation around the Y-axis:Roll\phi(ϕ) -180°-180°

If the module is considered as an aircraft, the positive direction of the Y-axis should be regarded as the nose direction. When the sensor frame coincides with the inertial frame, the ideal Euler angle output is: Pitch = 0°, Roll = 0°, Yaw = 0°.

If users need to change the default sensor coordinate system, they can refer to the instruction and programming manual.

8.2 Center of Sensor

Table 16: 8.2 Center of Sensor

HI 70 Axis	X-offset	Y-offset	Z-offset	Unit
X	0	-3.3	-2.45	mm
Y	0	-3.3	-2.45	mm
Z	0	-3.3	-2.45	mm

8.3 Mounted

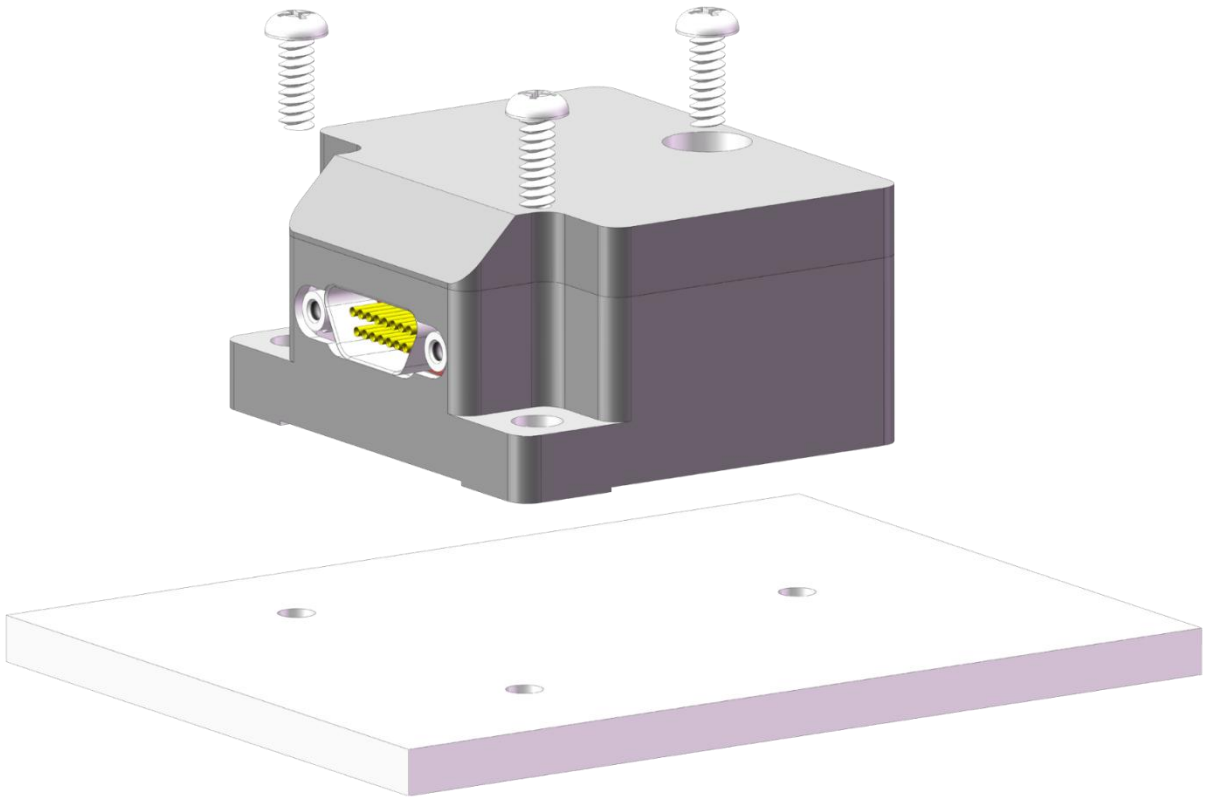

Figure 8: Mounting Example

Note1: For other mounting methods, please refer to the instruction and programming manual to rotate the coordinate system.

Note2: It is recommended to mount the module in a location on the object under test that experiences minimal vibration and temperature variation, and ensure a rigid connection with the tested carrier.

9 PROTOCOL

9.1 Serial Binary Protocol

To facilitate user operation, we provide a variety of serial protocols for selection. For more detailed information, please refer to the instruction and programming manual.

9.2 CAN

The module supports both CANopen and J1939 protocols.