1 Features

1.1 Hardware

- High-performance, low-noise MEMS IMU
- Integrated low-noise, high-reliability LDO
- Factory calibrated and temperature compensated over -40 °C to 85 °C, including bias, scale factor, and cross-axis calibration
- Supports PPS + NMEA GPRMC time synchronization
- Supports UART / CAN communication
- Multi-function IOs (synchronization, LED, alarm, etc.)
- Vibration-resistant design for applications in vibration environments
- Integrated temperature sensor
- Compact SMT package, 12.2 × 12.2 × 2.6 mm, easy to integrate
- Product design complies with relevant RoHS requirements, and materials meet halogen-free requirements; certification status shall be subject to the latest official information
- Customization supported

1.2 Software

- Adaptive EKF fusion algorithm
- UART output rate up to 1000 Hz depending on output data type and configuration, with low output latency
- Optimized attitude tracking and vibration suppression for dynamic motion scenarios
- Reduced impact of linear acceleration on attitude estimation under typical operating conditions
- Supports multiple protocols including binary, CAN, and Modbus
- Comprehensive user configuration commands
- Multi-function GUI for convenient operation
- Supports ROS1, ROS2, C, MATLAB, Python, Arduino, and other example projects

2 Applications

The HI04 series is designed for high-performance attitude sensing and complex operating conditions. It is suitable for attitude measurement and control applications under temperature variation, vibration, and dynamic motion conditions. Typical applications include:

- Platform stabilization control
- Construction machinery
- Humanoid robots
- Unmanned aerial vehicles (UAVs)
- Low-speed autonomous mobile robots
- Smart agricultural machinery

3 General Description

3.1 System Block Diagram

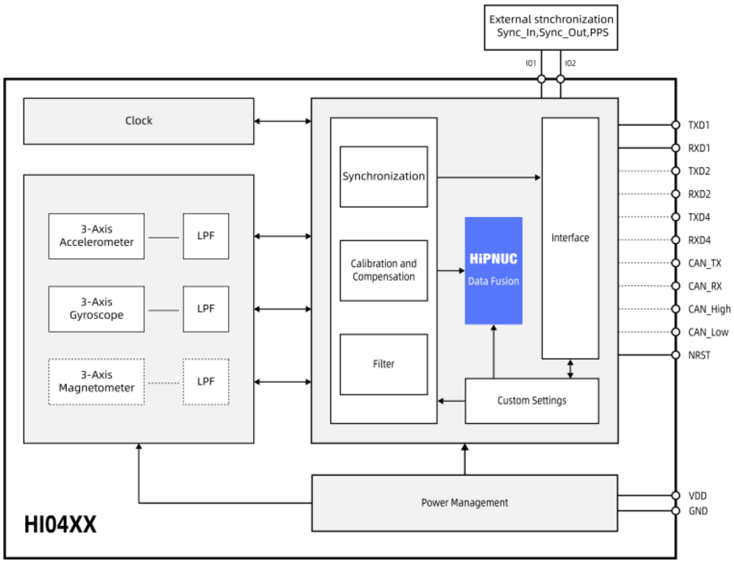

Figure 1: HI04 System Block Diagram

Note 1: Dashed lines indicate functions not supported by some models. See Table 1 for details.

3.2 Description

The HI04 series is a MEMS IMU-based IMU/VRU/AHRS sensor module featuring proprietary adaptive extended Kalman filtering, IMU noise dynamic analysis, and platform motion-state analysis algorithms. It provides raw inertial data (acceleration, angular rate, magnetic field) as well as computed attitude data (Euler angles, quaternions, etc.).

Depending on the model, the HI04 series supports IMU, VRU, or AHRS functions. Not all models integrate a magnetometer or support AHRS output. See Table 1 and Table 2 for detailed configurations.

Each module is factory calibrated for temperature, bias, scale factor, and cross-axis compensation before shipment.

The module currently supports UART and CAN interfaces, as well as PPS + GPRMC time synchronization and synchronization trigger functions. A dedicated GUI is also provided for configuration, real-time display, firmware upgrade, and data logging.

Figure 2: GUI Software

Contents

4 Product Selection

Table 1: Selection Information

HI04a-b-c							
Identifier	Series	a-Sensor Configuration		b-Data Interface		c-Additional Information	
HI	04	M0	IMU/VRU	MI0	UART + CAN (without CAN transceiver)	000	Default
		M3	IMU/VRU/AHRS				
		S2	IMU/VRU	MI1	UART + CAN (with integrated CAN transceiver)	Other	Custom
		S3	IMU/VRU/AHRS				

Note 1: The current standard models are covered in the Product Ordering section; other models are available for customization.

Table 2: HI04 Series Module Configuration

Model	3-axis Accelerometer	3-axis Gyroscope	3-axis Magnetometer
HI04M0-MI0	√	√	×
HI04M3-MI0	√	√	√
HI04S2-MI1	√	√	×
HI04S3-MI1	√	√	√

Table 3: HI04 Interface Configuration

Model	UART	CAN	2 Synchronization Pins (Multi-function IO)
HI04M0-MI0	1	×	√
HI04M3-MI0	1	×	√
HI04S2-MI1	3	√	√
HI04S3-MI1	3	√	√

Note 1: The CAN interface of HI04M0 / HI04M3 requires an external CAN transceiver.

Note 2: Multi-function IOs are not limited to synchronization functions, and also support LED, alarm, and other functions. Refer to the Command and Programming Manual for details.

5 Ordering Information

5.1 Ordering Code

Table 4: Ordering Code

Part Number	Name	Description
HI04M0-MI0-000	IMU/VRU Module	IMU/VRU module
HI04M3-MI0-000	IMU/VRU/AHRS Module	IMU/VRU/AHRS module
HI04S2-MI1-000	IMU/VRU Module	IMU/VRU module with integrated CAN transceiver
HI04S3-MI1-000	IMU/VRU/AHRS Module	IMU/VRU/AHRS module with integrated CAN transceiver

5.2 Contact Information

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

6 Document Information

6.1 Revision History

Table 5: Revision History

Revision	Date	Author	Description
1.0	Oct. 23, 2024	Hipnuc	Initial release
1.1	Nov. 21, 2024	Hipnuc	Updated package dimensions
1.2	Nov. 27, 2024	Hipnuc	Updated package dimensions and synchronization description
1.3	Dec. 28, 2024	Hipnuc	Added HI04M3 and HI04R3 models
1.4	Mar. 3, 2025	Hipnuc	Updated parameters
1.5	Mar. 14, 2026	Hipnuc	Added HI04SX models, updated parameters, reformatted document, removed HI04RX products

6.2 Related Documents and Development Kits

1. Command and Programming Manual
2. STEP model / package files
3. EVAL HI04 evaluation board datasheet and design files
4. RoHS and other certification documents
5. GUI and reference examples

7 System Architecture

The HI04 Series is a family of sensor modules supporting IMU, VRU, and AHRS functional configurations. Depending on the specific model, the product can provide acceleration, angular rate, magnetic field, Euler angles, quaternions, and other outputs.

Depending on the model configuration, the HI04 module can integrate a 3-axis accelerometer, 3-axis gyroscope, 3-axis magnetometer, and a high-performance processor. The processor is mainly used for sensor synchronization, calibration, algorithm fusion, and user configuration. In addition, based on application scenarios and sensor characteristics, the module supports multiple modes such as 6-DoF, AHRS, and humanoid robot mode. Refer to the Command and Programming Manual for details.

7.1 IMU

The HI04 can be used as an inertial measurement unit (IMU), providing precise 3-axis acceleration and 3-axis angular rate data. These data are acquired by the internally integrated high-precision accelerometer and gyroscope and can reflect the motion state and dynamic changes of the object in three-dimensional space in real time.

Compared with uncompensated and uncalibrated raw inertial devices, the HI04 provides better output consistency and stability due to system-level factory calibration and compensation, including cross-axis, scale factor, bias, and temperature calibration.

7.2 VRU

The HI04 can output attitude information referenced to gravity through the fusion algorithm, mainly including pitch and roll. In 6-DoF mode, it can also output an estimated yaw angle, but this value accumulates drift over time.

7.3 AHRS

Based on IMU and VRU functions, the HI04 can further implement AHRS by introducing a high-precision, wide-range TMR (Tunnel Magnetoresistance) geomagnetic sensor. This enhances attitude sensing capability and enables long-term stable pitch, roll, and yaw outputs referenced to magnetic north.

8 Pin Definitions

8.1 HI04M0 / HI04M3 Pin Definition

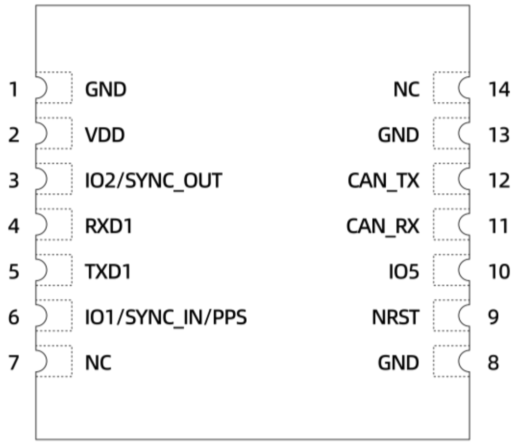

Figure 3: HI04M0 / HI04M3 Pin Definition

Table 6: HI04M0 / HI04M3 Pin Definition

No.	Pin Name	Type	Function	Remark
1	GND	Power	Ground	
2	VDD	Power	Power input	
3	IO2 (SYNC_OUT)	I/O	Synchronization output, can be used as data ready signal	
4	UART1_RX	I/O	UART1 receive	
5	UART1_TX	I/O	UART1 transmit	
6	IO1 (SYNC_IN/PPS)	I/O	Synchronization input, can accept external trigger signals such as GNSS PPS	
7	NC	N/A	Reserved, leave floating	
8	GND	Power	Ground	
9	NRST	I	Reset pin, active low. Connection to host GPIO is recommended. Leave floating if unused	
10	IO5	I/O	LED indicator control signal	
11	CAN_RX	I/O	CAN receive signal	
12	CAN_TX	I/O	CAN transmit signal	
13	GND	Power	Ground	
14	NC	N/A	Reserved, leave floating	

8.2 HI04S2 / HI04S3 Pin Definition

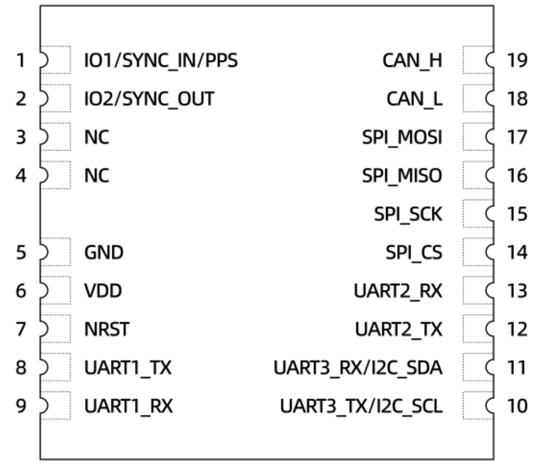

Figure 4: HI04S2 / HI04S3 Pin Definition

Table 7: HI04S2 / HI04S3 Pin Definition

No.	Pin Name	Type	Function	Remark
1	UART4_TX	I/O	UART4 transmit	
2	VDD	Power	Power input	
3	IO2 (SYNC_OUT)	I/O	Synchronization output, can be used as data ready signal	
4	UART1_RX	I/O	UART1 receive	
5	UART1_TX	I/O	UART1 transmit	
6	IO1 (SYNC_IN/PPS)	I/O	Synchronization input, can accept external trigger signals such as GNSS PPS	
7	UART4_RX	I/O	UART4 receive	
8	GND	Power	Ground	
9	NRST	I	Reset pin, active low. Connection to host GPIO is recommended. Leave floating if unused	
10	UART2_TX	I/O	UART2 transmit	
11	CAN_L	AIO	CAN Low	
12	CAN_H	AIO	CAN High	
13	GND	Power	Ground	
14	UART2_RX	I/O	UART2 receive	

Table 8: UART Function Description

Port	Data Transmission	Command Configuration	GPRMC Input	Firmware Upgrade
UART1	√	√	√	√
UART2	√	√	√	×
UART4	×	×	×	×

9 Interface and Reference Design

9.1 Power Supply

The module integrates an LDO to suppress the impact of input power noise on internal analog and digital circuits. The recommended input voltage range is 3.2 V to 5.0 V. See Table 15 for the operating voltage range. External power can be supplied by LDO or DC/DC.

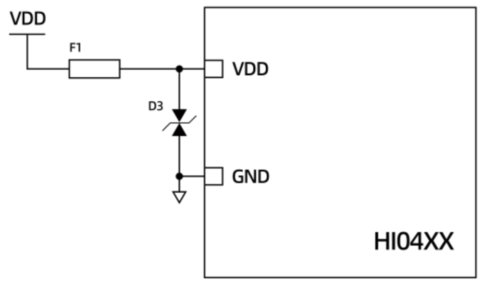

Figure 5: HI04 Power Supply Reference Circuit

9.2 UART

The HI04 series supports flexible communication through UART1/UART2 in full-duplex mode. The default serial configuration is standard 8N1, as follows:

- Baud rate: 115200 bps (configurable)
- Data bits: 8
- Parity: None
- Stop bits: 1

This configuration is widely used in industrial applications and is compatible with most embedded systems, industrial controllers, robot controllers, and similar devices. In addition, the HI04 can be extended to RS-485 or RS-422 communication by adding an external RS-485 or RS-422 transceiver, improving system flexibility and expandability.

Note 1: Baud rate and output frame rate can both be changed by commands. Refer to the Command and Programming Manual for details.

When using UART communication with the HI04 series, a 3.3 V logic level on the host processor is recommended. If communication with 5 V or 1.8 V logic devices is required, an external level shifter shall be added by the user to ensure communication reliability and device safety.

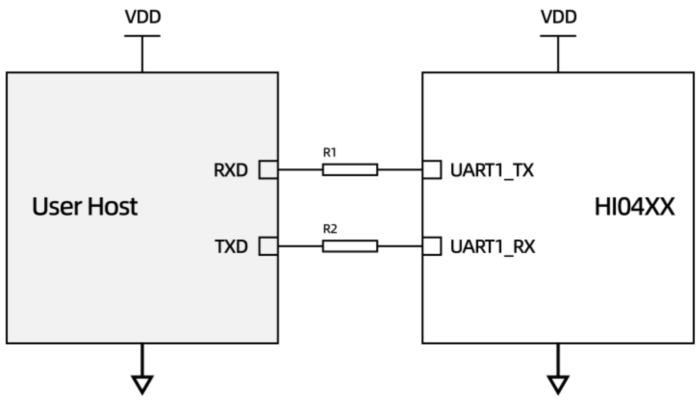

Figure 6: Minimum System for HI04 UART Communication

9.3 CAN

The HI04 module supports standard CAN 2.0B communication. The default baud rate is 500 kbps, which can meet the requirements of most industrial and embedded applications. The baud rate is user-configurable to adapt to different communication scenarios. Refer to the Command and Programming Manual for details.

9.3.1 HI04M0 / HI04M3 CAN Reference Design

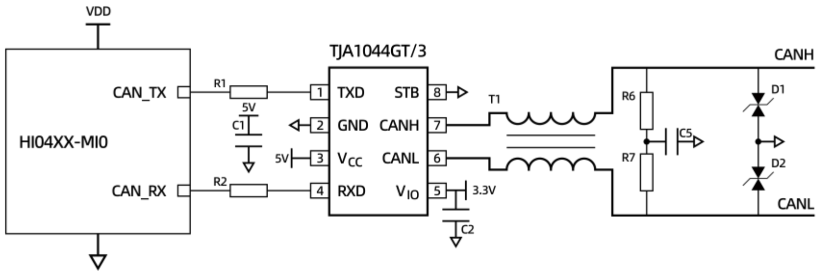

Figure 7: HI04M0 / HI04M3 CAN Reference Circuit

9.3.2 HI04S2 / HI04S3 CAN Reference Design

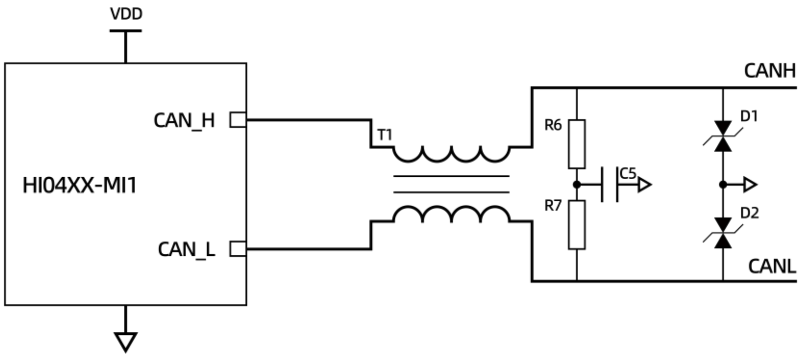

Figure 8: HI04S2 / HI04S3 CAN Reference Circuit

Note 1: Terminal resistor configuration depends on the system bus topology. R6/R7 in the reference circuit are for design reference only.

Note 2: Baud rate, CAN ID, and other parameters can be modified via commands. Refer to the command and programming manual for details.

9.4 Synchronization System

The HI04 supports pulse-trigger synchronization and PPS + GPRMC time synchronization, enabling time alignment with a host or external devices such as GNSS, cameras, radar, etc.

9.4.1 Host Trigger Synchronization (UART)

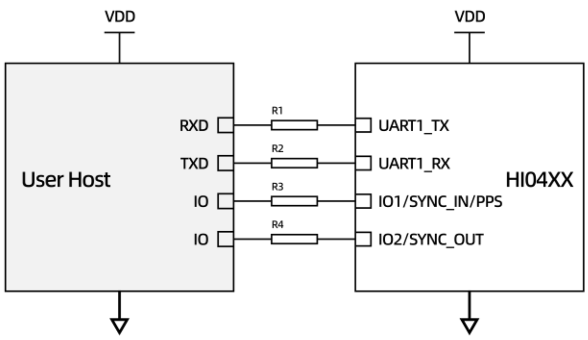

Figure 9: HI04 Host-Triggered Synchronization (UART)

In this connection method, IO1/IO2 are directly connected to the host system for inter-system trigger synchronization. If IO1 is used as synchronization input, IO1 shall be configured as synchronization input mode and the host shall provide pulses with the same frequency as the output data rate to the HI04. If IO2 is used, IO2 shall be configured as synchronization output mode, and the output pulse frequency will match the output data rate and can be used as a Data Ready signal. IO1 and IO2 do not need to be used simultaneously. Users can select the appropriate synchronization method according to their system architecture.

9.4.2 Host PPS + GPRMC Time Synchronization (UART)

In this connection method, IO1/IO2 are directly connected to the host system for inter-system time synchronization. IO1 shall be configured as PPS synchronization input mode, and the host shall provide PPS pulses to the HI04. If IO2 is used, IO2 shall be configured as synchronization output mode, and the output pulse frequency will match the output data rate and can be used as a Data Ready signal. UART1_RX shall receive the GPRMC data generated by the host.

9.4.3 External Device PPS + GPRMC Synchronization (UART)

The HI04 can perform PPS + GPRMC time synchronization with an external device that can provide PPS and GPRMC information. In this case, the HI04, host, and GNSS shall share a common ground. IO1 receives the PPS pulse signal from the external device, and UART2_RX receives the GPRMC information.

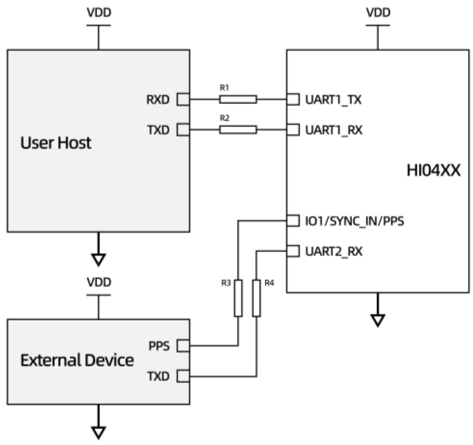

Figure 10: HI04 and External Device PPS + GPRMC Synchronization

9.4.4 CAN (Synchronization)

Synchronization is also supported in CAN communication scenarios. In this case, the HI04 communicates with the host through the CAN interface, while synchronization IOs can still be used for external triggering or time alignment. Refer to the UART synchronization section for detailed timing and configuration methods.

9.5 Reference Design BOM

Table 9: Reference Design BOM

Item	Reference	Part	P/N	Vendor
Fuse	F1	300 mA	JK-SMD0603-030-6	JK
TVS	D3	SMF5.0CA	SMF5.0CA	Littelfuse
Resistor	R1,R2,R3,R4,R5	1 kΩ	RC0402JR-071KL	YAGEO
Resistor	R6,R7	60.4 Ω	RC1206FR-0760R4L	YAGEO
Capacitor	C1,C2	0.1 μF	CC0402KRX5R7BB104	YAGEO
Capacitor	C5	1 nF	CC0402KRX7R9BB102	YAGEO
Common Choke	T1	5.8 kΩ @ 10 MHz, 100 μH @ 100 kHz, 150 mA	ACT45B-101-2P-TL003	TDK
TVS	D1,D2	SMBJXXCA	SMBJXXCA	Littelfuse

Note 1: Series resistors can be selected according to communication distance, rate, and system EMC requirements. Typical values are 33 Ω, 100 Ω, or 1 kΩ.

Note 2: The voltage rating of TVS devices shall be selected according to the system supply platform. In multi-node cascaded applications, SMAJ series devices may also be used.

10 Specifications

10.1 Gyroscope

Table 10: Gyroscope Specifications

Parameter	Product	Condition		Min	Typ	Max	Unit	Remark
Range	HI04MX				±250 ±500 ±1000 ±2000		°/s	Default: 2000
	HI04SX				±250 ±500 ±1000 ±2000 ±4000		°/s	Default: 2000
Resolution	HI04MX				16		bit	
	HI04SX				16	20		
Scale Factor Error		Before SMT, 100 °/s rotation			600	850	ppm	Typical: RMS
		After SMT, 100 °/s rotation			1200	2000	ppm	
Nonlinearity					±0.05		%FS	1
Noise Density	HI04MX	Bandwidth 47 Hz			0.014		°/s/√Hz	
	HI04SX	Bandwidth 10 Hz			0.0025		°/s/√Hz	
3 dB Bandwidth	HI04MX				80	200	Hz	2
	HI04SX				80	400	Hz	
Zero-Rate Output						±0.45	°/s	3
Sampling Rate					1000		Hz	
Bias Instability Allan Variance	HI04MX		X		2.5	4	°/h	Typical: 1σ Maximum: 3σ
			Y		3.2	5.5		
			Z		3	5.5		
	HI04SX		X		4	6	°/h	
			Y		1.5	2.5		
			Z		1.7	4		
Bias Stability 10 s Average	HI04MX		X		10	14	°/h	Typical: 1σ Maximum: 3σ
			Y		13	17		
			Z		10	13		
	HI04SX		X		10	16	°/h	
			Y		4	7		
			Z		5	13		
Bias Repeatability	HI04MX		X		20	36	°/h	
			Y		36	61		
			Z		16	25		
	HI04SX		X		11	35	°/h	
			Y		10	30		
			Z		9	20		

Angle Random Walk Allan Variance	HI04MX	X	0.55	1.1	°/√h	Typical: 1σ Maximum: 3σ
		Y	0.82	1.2		
		Z	0.47	0.7		
	HI04SX	X	0.12	0.16	°/√h	
		Y	0.1	0.12		
		Z	0.1	0.14		
Bias Temperature Drift	-40 °C to 85 °C		0.07	0.15	°/s	4
Accelerometer Sensitivity	XYZ		0.05		°/s/g	

Note 1: Maximum deviation from the best-fit straight line within the specified range.

Note 2: Different modes have different bandwidths. The default bandwidth in 6-DoF mode is 80 Hz.

Note 3: After initial bias calibration, bias can be estimated in real time by the algorithm engine.

Note 4: Measured in Hipnuc laboratory thermal chamber and rate table, with temperature ramp rate less than 3 °C/min.

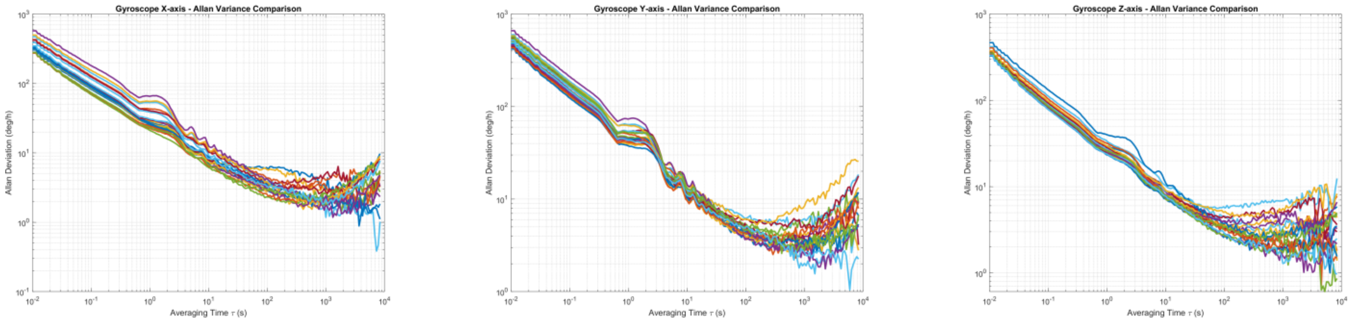

Figure 11: HI04MX Gyroscope Allan Variance

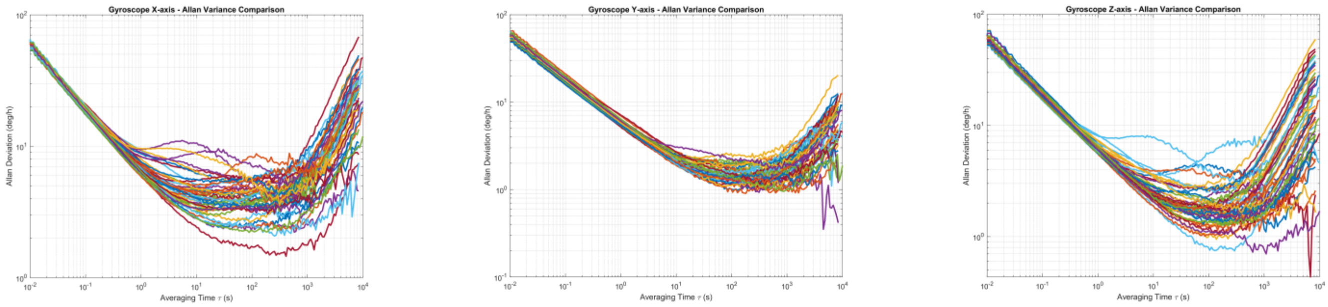

Figure 12: HI04SX Gyroscope Allan Variance

10.2 Accelerometer

Table 11: Accelerometer Specifications

Parameter	Product	Condition	Min	Typ	Max	Unit	Remark
Range	HI04MX			±3 ±6 ±12 ±24		g	Default: 12
	HI04SX			±2 ±8 ±16 ±32		g	Default: 16
Resolution	HI04MX			16		bit	
	HI04SX			16	20		
Initial Bias	Before SMT, Horizontal Static			1	2	mg	Typical: RMS
	After SMT, Horizontal Static			10	20		
Nonlinearity				0.01		%FS	1
3 dB Bandwidth	HI04MX			90	200	Hz	2
	HI04SX			90	400		
Noise Density	HI04MX			0.16	0.2	mg/√Hz	
	HI04SX	Bandwidth 10 Hz		0.05	0.07		
Sampling Rate				1000		Hz	
Bias Instability Allan Variance	HI04MX	X		0.021	0.035	mg	Typical: 1σ Maximum: 3σ
		Y		0.032	0.065		
		Z		0.023	0.03		
	HI04SX	X		0.012	0.02	mg	
		Y		0.009	0.015		
		Z		0.016	0.022		
Bias Stability 10 s Average	HI04MX	X		0.068	0.1	mg	Typical: 1σ Maximum: 3σ
		Y		0.09	0.15		
		Z		0.07	0.06		
	HI04SX	X		0.032	0.055	mg	
		Y		0.022	0.032		
		Z		0.048	0.082		
Bias Repeatability	HI04MX	X		0.22	0.4	mg	Typical: 1σ Maximum: 3σ
		Y		0.15	0.21		
		Z		0.12	0.2		
	HI04SX	X		0.1	0.3	mg	
		Y		0.06	0.2		
		Z		0.1	0.2		
Velocity Random Walk Allan Variance	HI04MX	XYZ		0.09	0.11	m/s/√h	Typical: 1σ
	HI04SX	XYZ		0.019	0.03	m/s/√h	Maximum: 3σ

Bias Temperature Drift -40 °C to 85 °C	HI04MX	XYZ	2	5	mg	3
	HI04SX	XY	2	5	mg	
		Z	6	15		

Note 1: Maximum deviation from the best-fit straight line within the specified range.

Note 2: Different modes have different bandwidths. The default bandwidth in 6-DoF mode is 90 Hz.

Note 3: Measured in Hipnuc laboratory thermal chamber and rate table, with temperature ramp rate less than 3 °C/min.

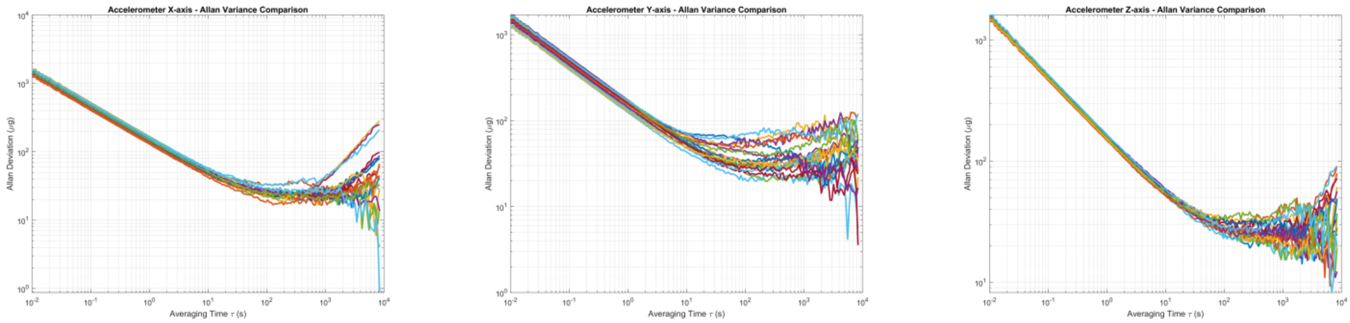

Figure 13: HI04MX Accelerometer Allan Variance

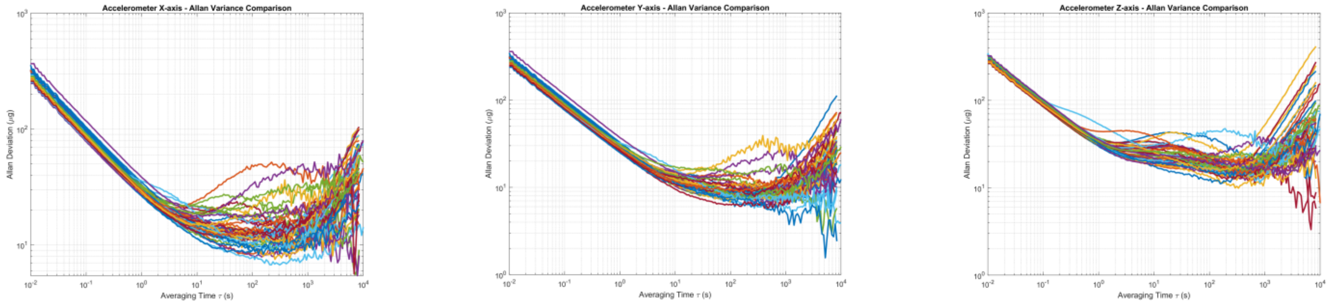

Figure 14: HI04SX Accelerometer Allan Variance

10.3 Magnetometer

Table 12: Magnetometer Specifications

Parameter	Min	Typ	Max	Unit	Remark
Range		±2000		μT	
Noise	0.19	0.45		μT	
Nonlinearity	±10	±20		μT	

10.4 Temperature Sensor

Table 13: Temperature Sensor Specifications

Parameter	Min	Typ	Max	Unit	Remark
Range	-40	-	85	℃	
Offset Error		±5		℃	

10.5 Fusion Accuracy

Unless otherwise specified, the following fusion accuracy data are obtained after factory calibration under typical installation conditions. Attitude accuracy is affected by installation flatness, mechanical stress, vibration environment, linear acceleration, magnetic environment, and user calibration status. Actual application results may vary.

Table 14: Attitude Accuracy

Parameter	Condition	Min	Typ	Max	Unit	Remark
Pitch/Roll (Static)	Before SMT		0.1	0.2	°	1
	After SMT		0.3	0.4		
Pitch/Roll (Dynamic)	Before SMT		0.2	0.3	°	
	After SMT		0.4	0.6		
Heading (AHRS)			2	3	°	2
Static Heading Drift (6-DoF)	Static for 2 h		0.15	0.2	°	
Dynamic Heading Drift (6-DoF)	HI04MX		10	18	°	3
	HI04SX		5	10		
Heading Rotation Error (6-DoF)	100 °/s rotation, Before SMT		0.2	0.3	°	4
	100 °/s rotation, After SMT		0.4	0.7		

Note 1: Data are referenced to the calibration plane and obtained from 20 test samples.

Note 2: Measured after magnetic calibration and under conditions without surrounding magnetic interference. The product shall be configured in AHRS mode.

Note 3: Measured on an indoor cleaning robot moving for 1 hour, result shown as 1σ. In 6-DoF mode, the heading angle is an estimate without magnetic reference, and its long-term stability is affected by initial alignment, motion condition, environmental condition, and time.

Note 4: Average per-turn error over 10 rotations on a rate table.

11 System and Electrical Specifications

11.1 Electrical Specifications

Table 15: Electrical Specifications

Parameter	Product	Min	Typ	Max	Unit	Remark
Operating Voltage Range VDD		3.2	-	5.5	V	
Power Consumption	HI04MX			160	mW	
	HI04SX			240		
V_{OL}			-	0.4	V	
V_{OH}		2.6			V	
V_{IL}		-0.3		1	V	
V_{IH}		1.9		3.6	V	

11.2 Interface Specifications

Table 16: Interface Specifications

Port	Parameter	Min	Typ	Max	Unit	Remark
UART1	Baud rate	9600	115200	921600	bps	
UART2	Output Data Rate	0	100	1000	Hz	
CAN	Baud Rate	125	500	1000	kbps	
	Output Data Rate	0	100	200	Hz	
	Differential Voltage		1.5	3	V	
	Internal Terminal Resistor		None		Ω	

11.3 System Specifications

Table 17: System Specifications

Parameter	Value	Remark
Dimensions	12.2 × 12.2 × 2.6 mm	
Weight	<1.5 g	
System Startup Time	2 s	1
Operating Temperature	-40 °C to 85 °C	
Shield Material	Nickel silver	
Vibration Resistance	1.0 mm (10 Hz to 58 Hz), ≤20 g (58 Hz to 600 Hz)	
Environmental Compliance	Complies with relevant RoHS requirements	
Compliance Information	Refer to the latest official information for related certification and conformity documents	
Drop Test	3 free drops from a 75 cm laboratory bench	
Temperature Shock Test	Temperature ramp from -40 °C to 85 °C within 1 hour, total 5 cycles	
Moisture Sensitivity Level (MSL)	MSL2	

Note 1: Time from power-on to valid data output.

11.4 Absolute Maximum Ratings

Table 18: Absolute Maximum Ratings

Parameter	Limit	Remark
Mechanical Shock	2,000 g	Duration < 0.2 ms
Storage Temperature	-40 °C to 125 °C	
ESD (HBM)	2 kV	JEDEC/ESDA JS-001
Input Voltage	9 V	
I/O to GND Voltage	-0.3 V to 5 V	
CAN H or CAN L to GND	±36 V	

Note 1: Stresses above the absolute maximum ratings may cause permanent damage to the device. Functional operation at these conditions is not guaranteed.

12 Mechanical Dimensions

All dimensions are in mm.

12.1 Product Dimensions

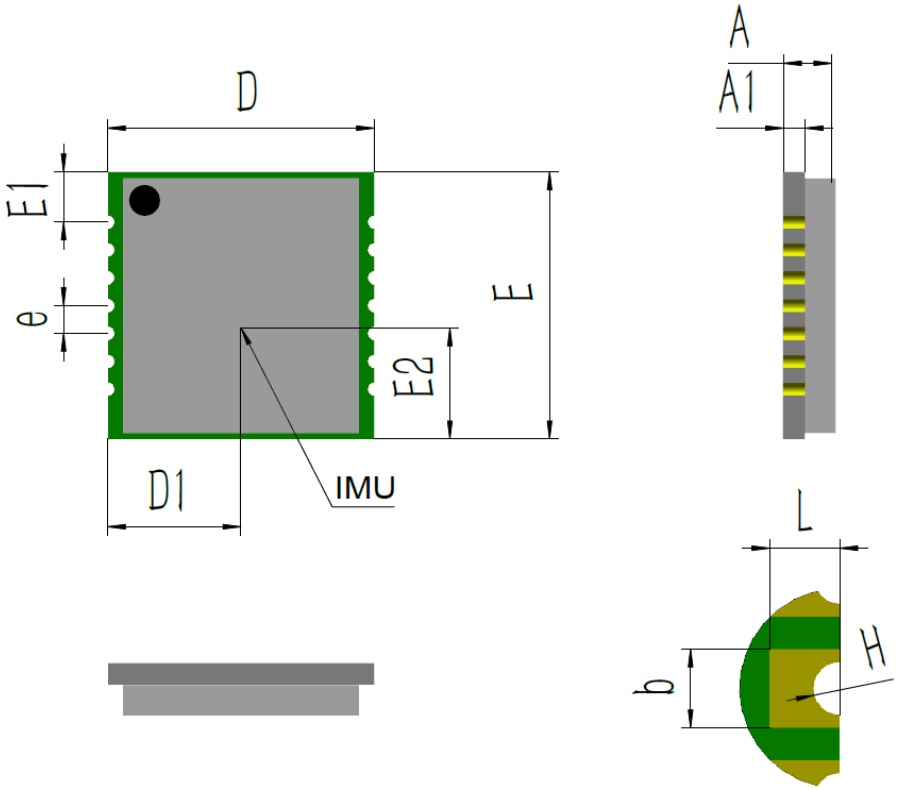

Figure 15: HI04 Mechanical Dimensions and IMU Position

Table 19: HI04 Dimensions

Symbol	Min (mm)	Typ (mm)	Max (mm)
A	2.5	2.6	2.7
A1	0.95	1	1.05
D	12	12.2	12.4
D1	6	6.1	6.2
E	12	12.2	12.4
E1	2.04	2.24	2.44
E2	3.6	3.8	4
e	1.25	1.27	1.28
L	0.95	1	1.05
b	0.87	0.9	0.92
H	R0.26	R0.27	R0.28

12.2 HI04 Recommended Land Pattern

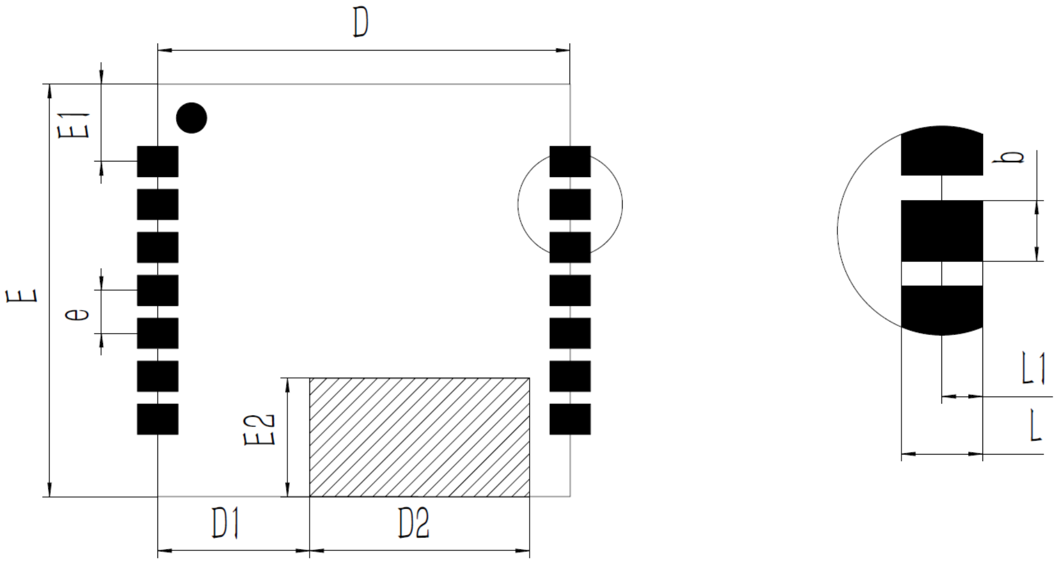

Figure 16: HI04 Recommended Land Pattern

Note 1: Exposed copper is not allowed on the backside of the device. For HI04 variants with magnetometer function, copper pouring and routing are prohibited in the shaded area.

Table 20: HI04 Recommended Land Pattern Dimensions

Symbol	Min (mm)	Typ (mm)	Max (mm)
D		12.2	
D1		5	
D2		5.5	
E		12.2	
E1		2.24	
E2		5	
e		1.27	
b		0.9	
L		2	
L1		1	

13 Coordinate System

13.1 ENU (Default)

The body frame uses a right-forward-up (RFU) coordinate system, and the geographic frame uses an east-north-up (ENU) coordinate system. The accelerometer and gyroscope axes are shown in the figure below:

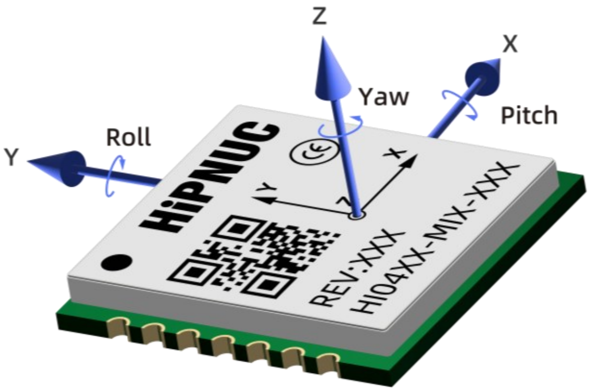

Figure 17: HI04 Coordinate System

The positive direction of angular velocity follows the right-hand rule. Quaternion output order is defined in the Command and Programming Manual. Euler angles are output using the Z-X-Y (312) rotation sequence. For conventions involving intrinsic/extrinsic rotations and coordinate transformation definitions, refer to the definitions in the Command and Programming Manual. The detailed definitions are as follows:

- Rotation about Z-axis: Yaw (ψ), range: -180° to 180°
- Rotation about X-axis: Pitch (θ), range: -90° to 90°
- Rotation about Y-axis: Roll (ϕ), range: -180° to 180°

When the module coordinate frame coincides with the reference coordinate frame, the ideal Euler angle output is Pitch = 0°, Roll = 0°, Yaw = 0°.

For coordinate frame rotation, refer to the Command and Programming Manual.

13.2 NWU and NED

The body frame can also be configured as NWU or NED. User configuration is required. Refer to the Command and Programming Manual for details.

14 Evaluation Board

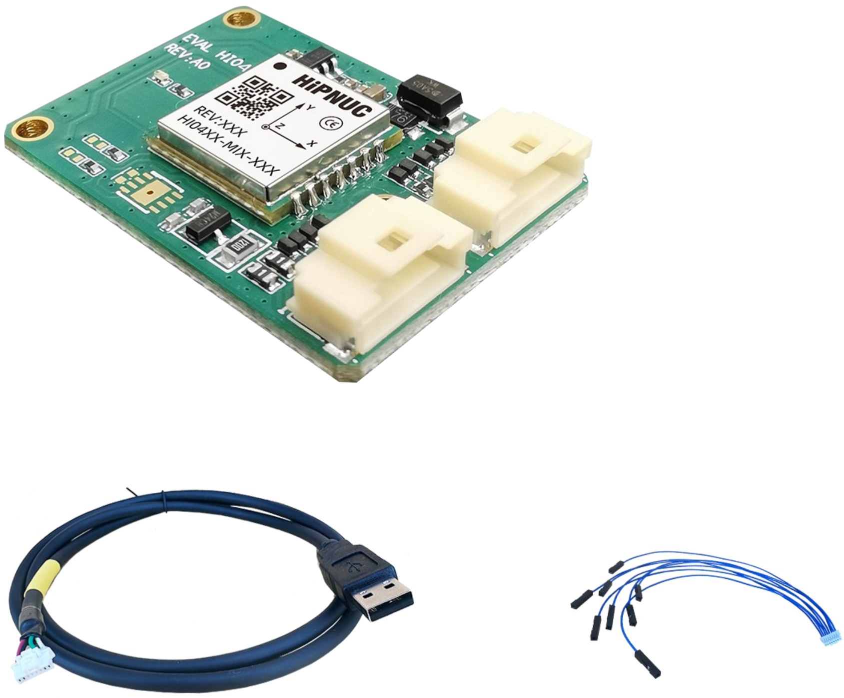

Figure 18: HI04 Series Evaluation Board and Cable Harness

Note 1: For details, please refer to the specification of the EVAL HI04 evaluation board.

15 Communication Protocols

15.1 Serial Binary Protocol

The product supports a serial binary communication protocol. For detailed packet format, output configuration, and command definitions, refer to the Command and Programming Manual.

15.2 Modbus

By adding an external RS-485 transceiver, communication based on Modbus RTU is supported. Refer to the Command and Programming Manual for detailed protocol definitions.

15.3 CAN

CAN communication supports CANopen and SAE J1939. Refer to the Command and Programming Manual for detailed protocol definitions.

16 Soldering and Installation

16.1 Reflow Profile

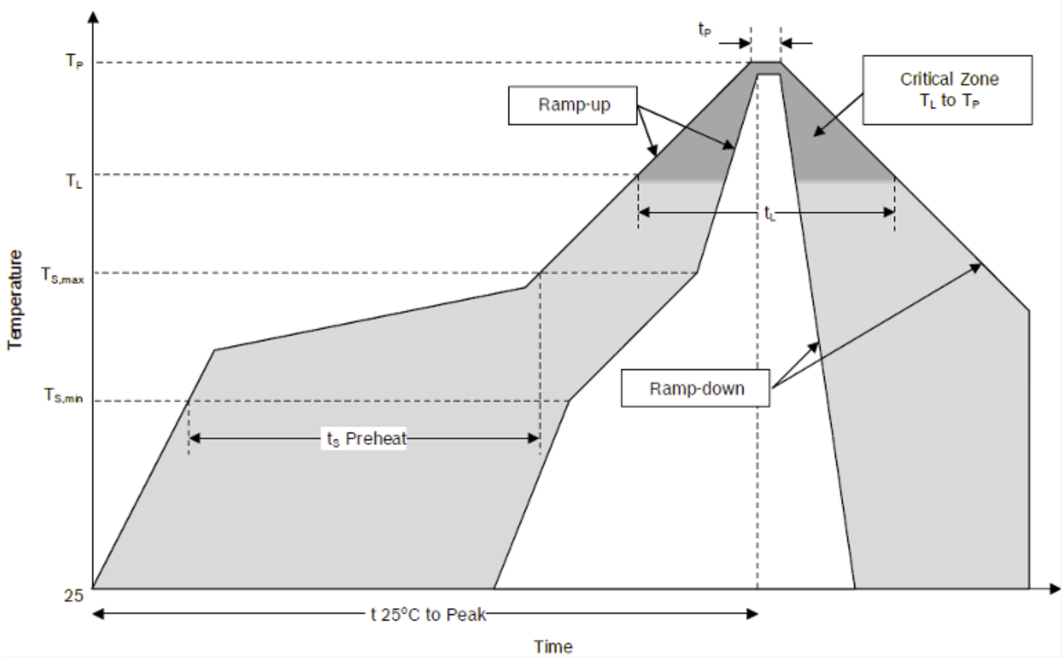

Figure 19: SMT Reflow Profile

Table 21: SMT Reflow Profile

Parameter	Description
Average ramp-up rate (TSmax to Tp)	3 °C/s max
Temperature min (TSmin)	150 °C
Temperature max (TSmax)	200 °C
Time (TSmin to TSmax)	60 to 180 s
Temperature (T_L)	170 °C
Time (tL)	60 to 150 s
Peak classification temperature (T_P)	250 °C
Time within 5 °C of actual peak temperature (tp)	20 to 40 s
Ramp-down rate	6 °C/min max
Time 25 °C to peak temperature	8 min max

16.2 Installation Recommendations

MEMS sensors are high-precision measurement devices that combine electronic structures and mechanically sensitive structures. To obtain better measurement accuracy, assembly consistency, and mechanical reliability, users are advised to pay attention to the following points during PCB design and system integration:

● For models with a magnetometer, keep the module away from motors, inductors, high-current loops, ferromagnetic materials, and magnetic fasteners to reduce magnetic interference on heading accuracy

● It is recommended to mount the module horizontally on the target carrier

● It is not recommended to place the sensor near buttons, connectors, or other locations that may introduce local mechanical stress

● It is not recommended to place the sensor near high-heat sources such as main controllers, power devices, or graphics processors, to avoid local rapid heating that may affect measurement results

● It is not recommended to place the sensor in areas of concentrated PCB mechanical stress, such as the center of diagonal crossing lines or near screw holes

- Avoid placing the sensor in areas where PCB resonance or strong vibration response may occur

If the above recommendations cannot be fully satisfied due to system structural constraints, application-specific online offset or installation error compensation calibration after final assembly is recommended to reduce potential impact.

17 Packaging

17.1 Tape

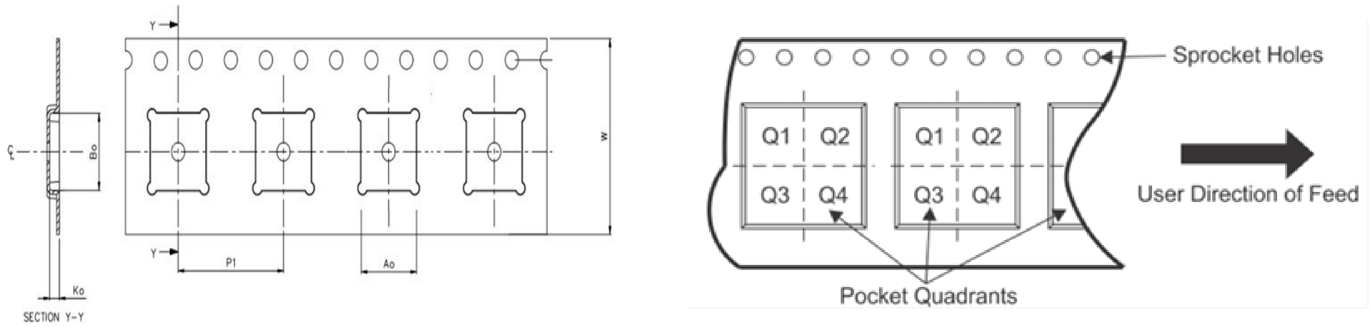

Figure 20: Tape Dimensions and Pin 1 Orientation

Table 22: Tape Dimensions

Device	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)
HI04	12.5	12.5	3.0	16	24

17.2 Reel

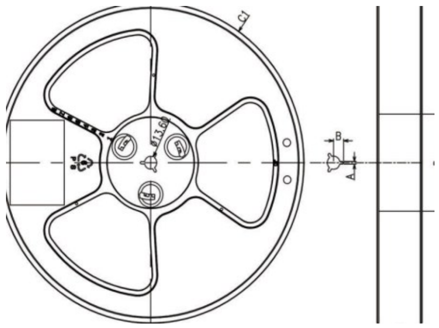

Figure 21: Reel Dimensions

Table 23: Reel Dimensions

Product	SPQ (pcs)	Reel Diameter C1 (mm)	Reel Width H (mm)	A (mm)	B (mm)	T (mm)	D (mm)
HI04	1000	330	12.8	2.5	11	2.0	100

17.3 Packaging Method

The HI04 series is packaged using reel, vacuum sealing, and carton packaging. Standard package quantity and carton dimensions are shown below:

Table 24: Packing Method

HI04

Reel

Vacuum Sealed

Boxed

Table 25: Carton Dimensions

Product	SPQ (pcs)	L (mm)	W (mm)	H (mm)
HI04	1000	360	360	40

18 Disclaimer

The parameters listed in this document are typical values, maximum values, or measured values obtained under specified test conditions and do not constitute final delivery commitments. Hipnuc reserves the right to modify the product, document, and related information without prior notice.