Tactical MEMS
6 degrees of freedom inertial sensor
FSS-IMU6132B Product manual

Features

Tactical grade MEMS IMU

- 0.8 °/hr zero bias instability
- 0.1°/ hr Angle random walk机
- 0.02°/s temperature drift (-40 85℃, <=1℃/ min@1σ)

Tactical MEMS Accelerometer

- 10ug zero bias instability
- 0.015m/s/ hr velocity random walk
- 0.2 mg temperature drift (-40~85℃, <=1℃/ min@1σ)

Large range of fine temperature compensation

- l-40 ℃ to 85℃ temperature compensation
- Fine temperature calibration

Independent turntable calibration

- Independent calibration of each module: sensitivity, zero bias, non-orthogonal error

Resistance to high strength conditions

- Super impact tolerance: 2000g (0.5ms, half positive chord, 3 axis)
- Ultra-strong vibration tolerance: 10g (10~2KHz, 3 axis)
- Full temperature environment stable operation: -40℃ ~ 85℃
- 100% magnetic shielding

Real-time and flexible digital interface, small size

- l Configurable output sampling rate up to 200Hz
- Support COM, SPI multiple interfaces
- 51*25.8*9.9mm, weight only 20g

Product Overview

The FSS-IMU6132B is a 6-DOF MEMS inertial sensor module built by Forsense Technology. The standard output three-axis Gyroscope with acceleration information and high precision attitude Angle.

High precision, high resolution, can capture subtle vibration and tilt. **Large range** output makes motion perception possible under **large dynamics**. All modules are equipped **with ultra-wide temperature range of fine warming and independent calibration** before leaving the factory, so that each module can play stably in various extreme conditions, at the same time to ensure the performance of all products is highly consistent.

Application field

• Autonomous driving: vehicle, robot, engineering vehicle, underwater

• Precision measurement: downhole, tunnel, vibration, tilt

• Stable platform: PTZ, mobile communication,

• Navigation control: automatic control system, fixed wing UAV

On the basis of standard performance and output Parameter, on the basis of standard performance and output Parameter, Yuanji also provides **customized software and LOGO customization** services for your special needs, to help you in the product!

Contents

1. Performance Parameter

1.1 Key indicators of Gyroscope

Table 1 Key indicators of Gyroscope

Parameter	Test conditions/Remarks	Minimum value	Typical value	Maximum value	Units
Measuring range			+ 500		°/s
Zero bias instability X axis [1]	@25 ° C, ALLAN variance, 1 σ		1.0		°/hr
Bias instability instability Y axis [1]			0.8		°/hr
Bias instability instability Z axis [1]			0.8		°/hr
Bias instability stability			3		°/hr
Bias instability repeatability			10		°/hr
Resolution			0.0027		°/s
Non-orthogonal between axes			0.02		deg
Internal low-pass cutoff frequency	Software adjustable		47		Hz
ODR			200		Hz
Measuring delay			7		ms
The whole temperature range Bias instability change [2]	-40 ~ 85 ° C, <=1 ° C/min@1σ		0.08 >0.02		°/s
Random Walk X axis [2]	@25 ° C, ALLAN variance, 1 σ		0.15		°/ √hr
Random walk Y axis			0.1		°/ √hr
Random walk Z axis			0.1		°/ √hr
scale factor error			1.5		‰
scale factor nonlinear			200 > 100		ppm

Note 1: IEEE standard, Allan variance curve given at static 25 ° C environment

Note For a temperature change of 2:1 ℃/ min, the total temperature Bias instability changes by 1

1.2 Key indicators of Accelerometer

Table 2 Key indicators of Accelerometer

Parameter	Test conditions/Remarks	Minimum value	Typical value	Maximum value	Units
Measurement Range			Plus or minus 6		g
Bias[1] instability instability	@25 ° C, ALLAN variance, 1 σ		10		Mug
Bias instability stability			25		Mug
Bias instability repeatability			0.1		mg
Resolution			0.0324		mg
Non-orthogonal between axes			0.02		deg
Internal low-pass cutoff frequency	Software adjustable		47		Hz
ODR			200		Hz
Measuring delay			7		ms
Full temperature range zero deviation variation[2]	-40 ~ 85 ° C, <=1 ° C/min@1σ		XY:1.5 Z:2		mg
Random Walk X axis	@25 ° C, ALLAN variance, 1 σ		0.015		m/s/ √hr
Random walk Y axis			0.015		m/s/ √hr
Random walk Z axis			0.02		m/s/ √hr

Note 1: IEEE standard, Allan variance curve given at static 25 ° C environment

Note 1 σ for total temperature zero deviation at temperature change of 2:1 ° C/min

Figure 1 ALLAN variance curve for gyroscope

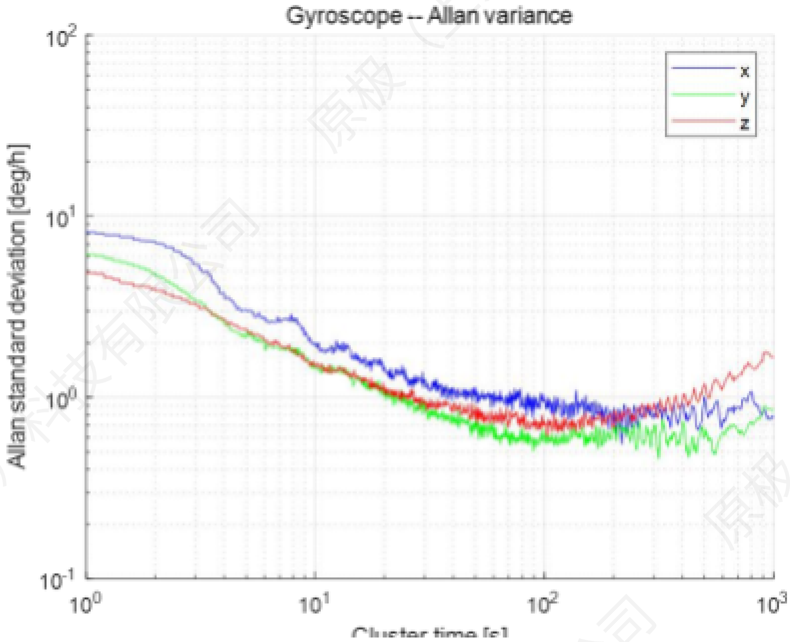
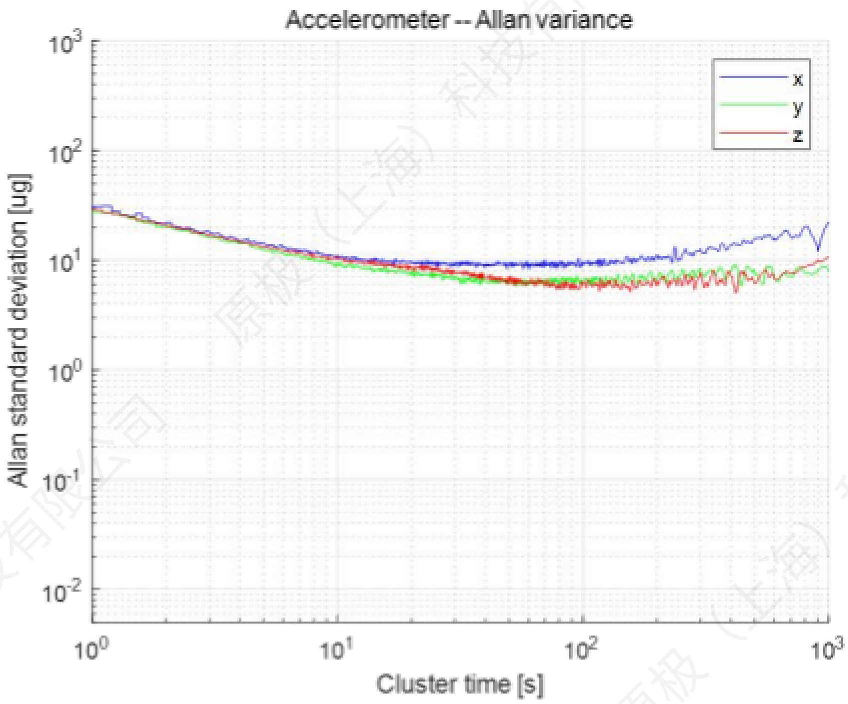


Figure 2 ALLAN variance curve of accelerometer



2 Form structure

Figure 3 Outline structure and size (unit: mm)

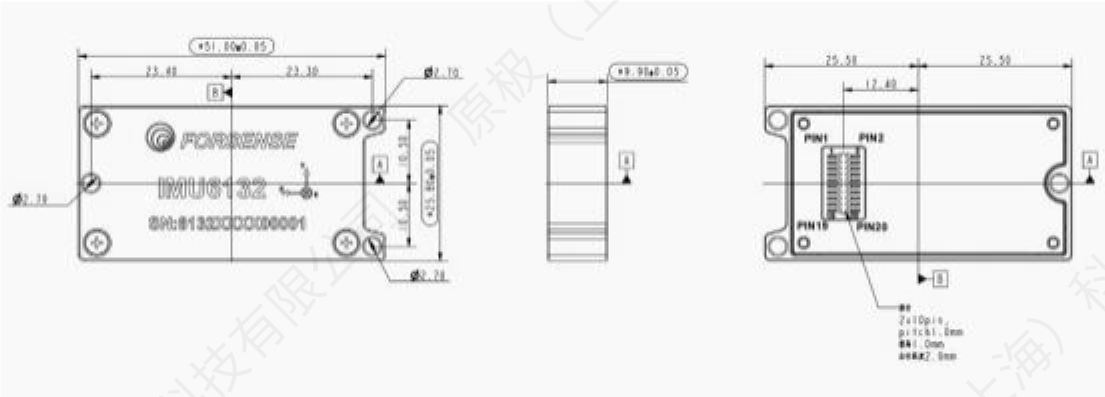
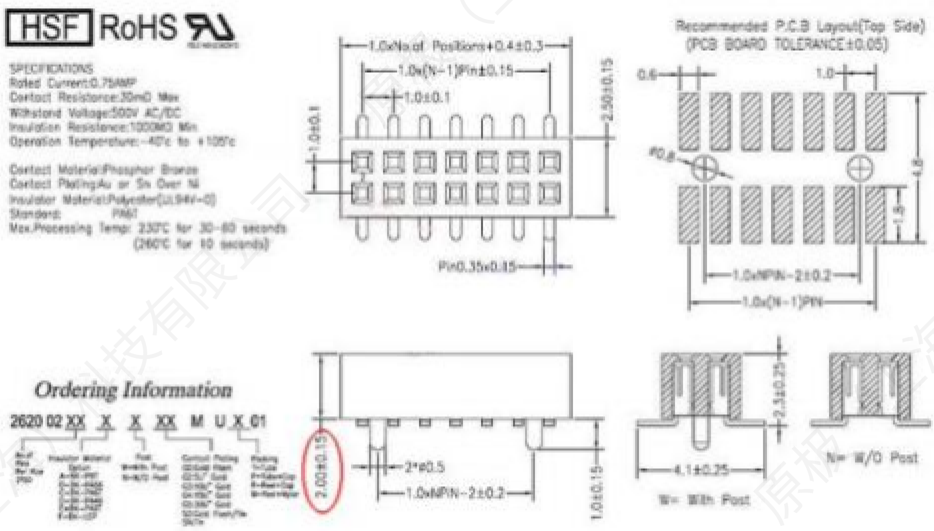


Figure 4 Location diagram of IMU measuring center (unit: mm)

Figure 5 Reference pair busbar Specifications Dimensions (unit: mm)



3 Electrical characteristics

3.1 Maximum tolerance value

Table 3 Maximum absolute rating

Parameters	Symbols	Range	unit
Supply voltage	VCC	-0.3 to 4.0	V
Power source	GND	–	–
Input pin voltage	V in	-0.3 to VCC+0.2	V
Use temperature	Tot	-40 to 85	℃
Storage temperature	Tstg	-40 to 85	℃

3.2 Working Conditions

Table 4 Working conditions

Parameters	Symbols	Minimum value	Typical value	Maximum value	Units
Supply voltage	VCC	3.2	3.3	3.4	V
VCC maximum ripple	Vrpp		+ 40		mV
Power dissipation	P	1.09		1.25	W
Use temperature	Tot	-40		85	℃
Storage temperature	Tstg	-40		85	℃

3.3 IO Threshold Characteristics

Table 5 I/O Threshold Characteristics

Parameters	Symbols	Minimum value	Typical value	Maximum value	Units
Input pin low	V in_low	0		VCC * 0.2	V
Input pin high	V in_high	VCC * 0.7		VCC + 0.2	V
Output pin low	Vout_low	0		0.45	V
Output pin high	Vout_high	VCC – 0.45 –		VCC	V

4 Pin description

Figure 6 Pin diagram

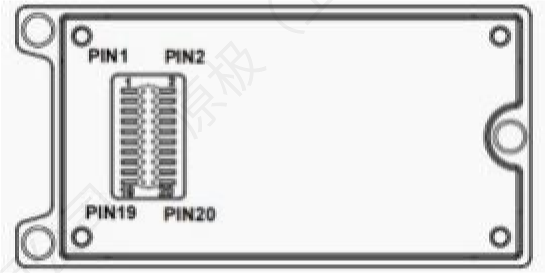


Table 6 Pin description

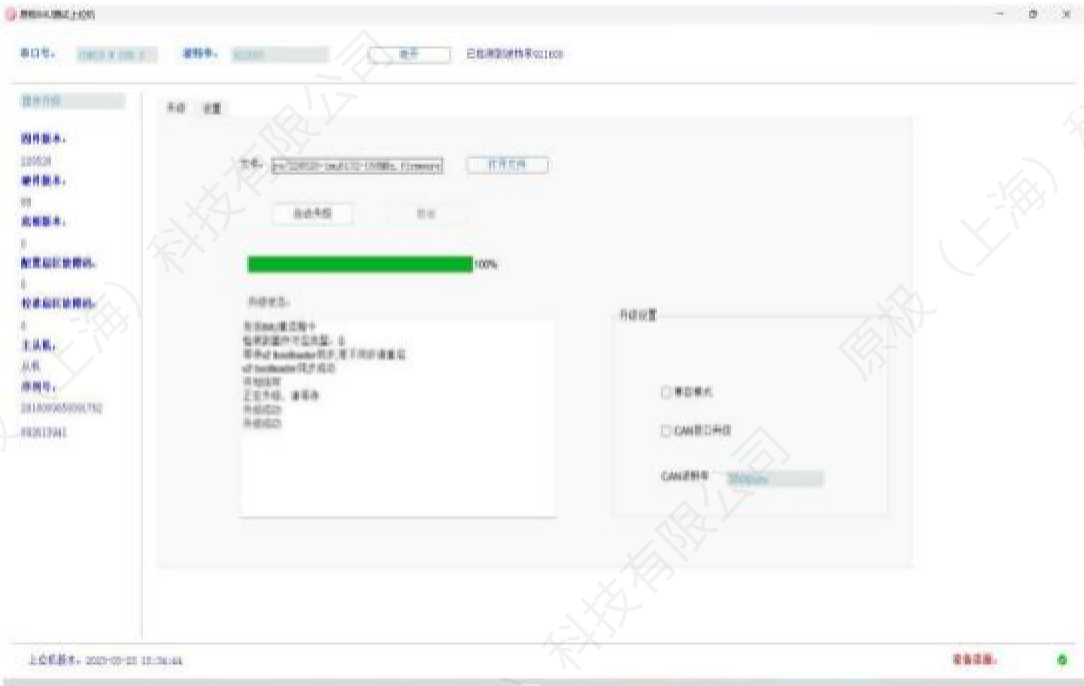
Pin Numbers	Name	Type	Features
1	SCLK	I	SPI clock
2	SDO	O	SPI data MISO
5	SDI	I	SPI data MOS I
6	/CS	I/O	SPI chip select
7	TX	O	COM output
8	CAN_Tx	O	CAN port to send, suspended when not connected
9	RX	I	COM input
13	DRDY/SCL	I/O	Data Ready /I2C clock
14	EXT/ SDA	I/O	External trigger sampling /I2C data
15	CAN_Rx	I	CAN port receive, suspended when not connected
16	/RST	I	External hardware reset input
11, 12	VCC	S	3.3V power supply
3, 4	GND	S	to
19	SEL	I	SPI/I2C mode control Hanging or low: SPI High: I2C
10, 17, 18, 20	NC	N/A	Not connect

Note 1: Pin type: I for input, O for output, S for power supply, N/A for unused

Note 2: The IMU hardware needs to be reset once using /RST during Master initialization

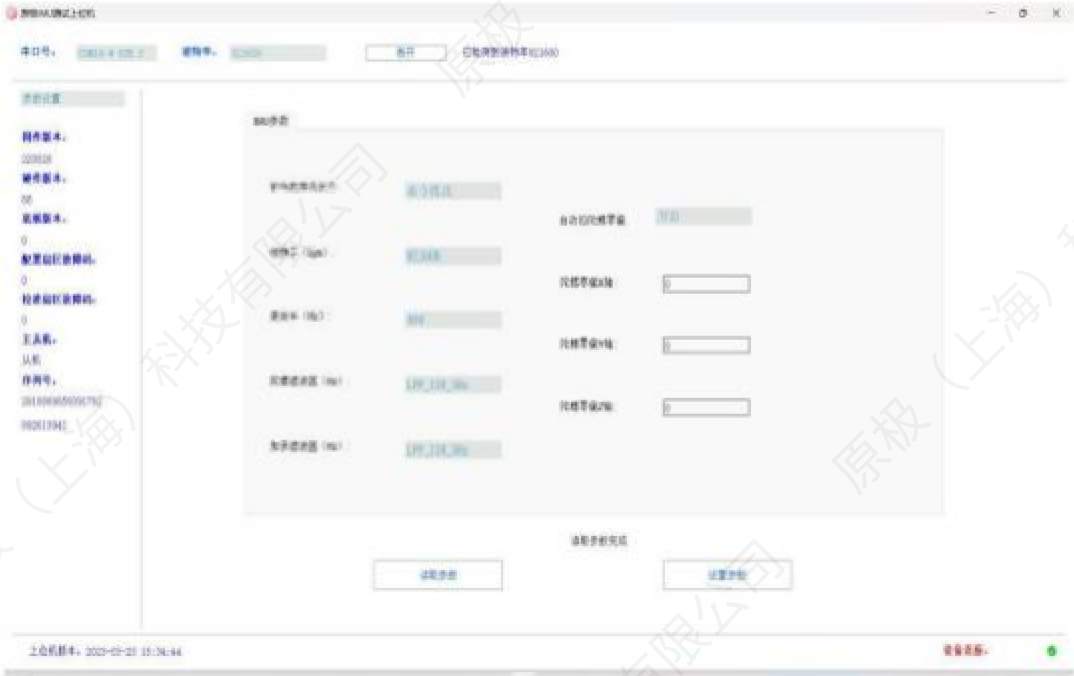
5 Upgrade the serial port firmware

Test the Upper computer software using the Forsense IMU -- select Firmware upgrade -- Open firmware -- click Automatic Upgrade. Figure 7 Upper computer software upgrade interface



6. User parameters function

Use the primitive IMU to test the upper computer, the user can configure the update rate and filter equivalent; Figure 8 User parameter setting interface.



7 Communication protocols

7.1 SPI communication protocol

Example of SPI host read driver based on STM32:
https://data.forsense-imu.com/page/download.html

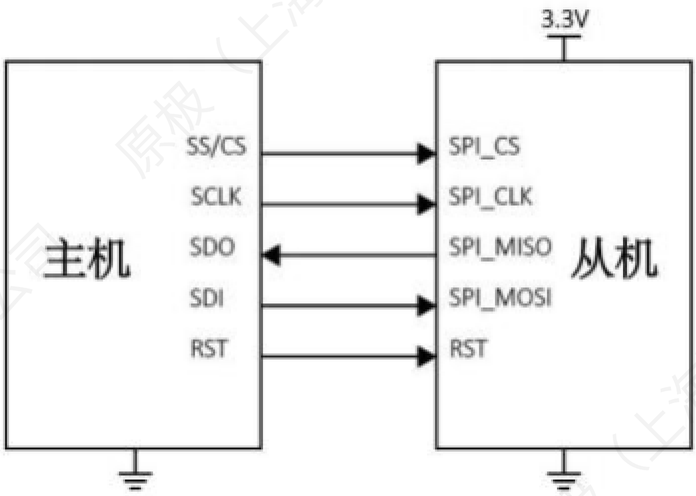
7.1.1 SPI Interface Parameters

Table 7 SPI interface parameters

SPI host	This product acts as slave
SPI rate	0.2 to 2 MHZ
SPI word length	16bit
Phase	Rising edge trigger (mode 3, CPHA=1)
Polarity	Idle for high (mode 3, CPOL=1)
Bit order	MSB priority

7.1.2 SPI connection diagram

FIG. 9 SPI connection diagram

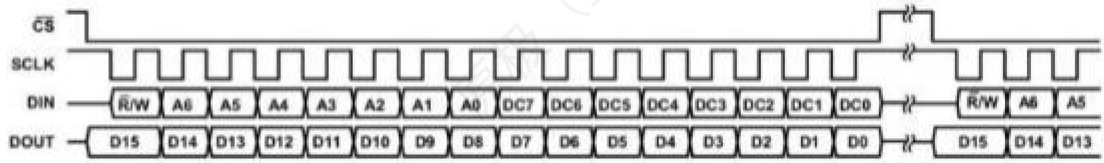


Note 1: Before the initial reading, it is necessary to reset the IMU and wait for 3s to make the IMU enter the normal working state.

Note 2: Refer to the corresponding manual for SPI pins of different IMU models

7.1.3 SPI communication bit order

The SPI interface supports full-duplex serial communication (performing both send and receive at the same time) using the bit order shown in the image below. Figure 10 Schematic diagram of SPI communication bit order



Where, the highest bit of D IN represents the read/write operation, [A6:A0] represents the register address, and [DC7:DC0] represents the data written (write operation) or DUMMY data (read operation).

When R-/W =1, the DOUT data of this SPI cycle is meaningless. When /W =0, the DOUT data of this SPI cycle represents the output data of the register of the last two cycles, see the example of BURST reading for details.R

7.1.4 SPI register

Table 8 List of SPI registers

name	Address	Read/Write	Default	Window ID	Description
BURST	0x00	RW		0	Continuous reads
FILTER_CTRL	0x07, 0x06	RW	0x00BB	1	Filter selection
PROD_ID1	0x6C	R	0x494d	1	ID Number 1
PROD_ID2	0x6E	R	0x5536	1	ID Number 2
PROD_ID3	0x70	R	0x3132	1	ID number 3 (IMU612)
			0x3134	1	ID number 3 (IMU614)
			0x3138	1	ID number 3 (IMU618)
			0x3141	1	ID number 3 (IMU6132A)
			0x3142	1	ID number 3 (IMU6132B)
WIN_CTRL	0x7F, 0x7E	RW	0x0000	0, 1	Window ID selection
TEMP_HIGH	0x0E	R	\	0	Temperature high byte
TEMP_LOW	0x10	R	\	0	Temperature low byte
XGYRO_HIGH	0x12	R	\	0	Gyro X axis height bytes
XGYRO_LOW	0x14	R	\	0	Gyro X axis low byte
YGYRO_HIGH	0x16	R	\	0	Gyro Y-axis height bytes
YGYRO_LOW	0x18	R	\	0	Gyro Y axis low byte
ZGYRO_HIGH	0x1A	R	\	0	Gyro z-axis height bytes
ZGYRO_LOW	0x1C	R	\	0	Gyro Z axis low byte
XACCEL_HIGH	0x1E	R	\	0	Add table X axis height bytes
XACCEL_LOW	0x20	R	\	0	Accelerometer X axis low byte
YACCEL_HIGH	0x22	R	\	0	Accelerometer Y axis height bytes

YACCEL_LOW	0x24	R	\	0	Accelerometer Y axis low byte
ZACCEL_HIGH	0x26	R	\	0	Accelerometer z-axis height bytes
ZACCEL_LOW	0x28	R	\	0	Accelerometer z-axis low byte

7.1.4.1 SPI BURST Register

BURST reads Register continuously, reading all data in a single data stream without stopping between 16-bit segments. Table 9 Format of SPI BURST Register

Address	bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	Read/write
0x01									RW
Address	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Read/Write
0x00	BURST_CMD								RW

The BURST reading method is as follows: sending 0x8000 before reading indicates setting BURST and starting reading, and then sending 0x0000 all the time and receiving data. The contents of the output register are offset by 2 SPI cycles compared with the sending of the read instruction, and the continuous chip selection low level is kept during reading.

FIG. 4 Schematic diagram of continuous reading of SPI BURST

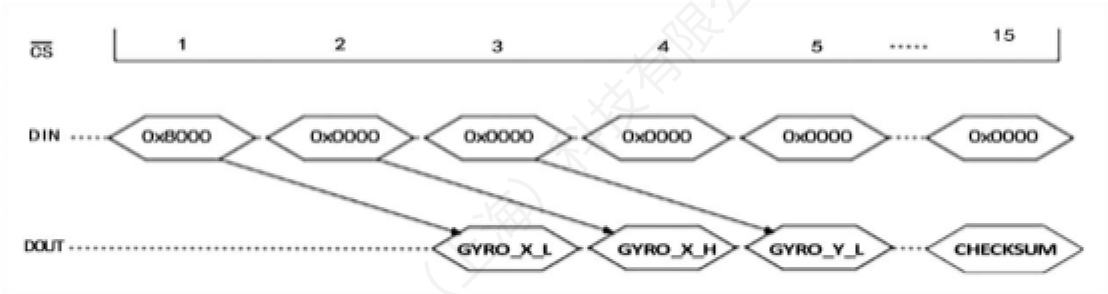


Table 10 Basic format of continuous reading by SPI BURST

Sending sequence	1	2	3	4	5	6
What to send	GYRO_X_L	GYRO_X_H	GYRO_Y_L	GYRO_Y_H	GYRO_Z_L	GYRO_Z_H
Send order	7	8	9	10	11	12
What to send	ACCL_X_L	ACCL_X_H	ACCL_Y_L	ACCL_Y_H	ACCL_Z_L	ACCL_Z_H
Send order	13					
What to send	CHKSM					

Note 1: All data are 16-bit widths

Note 2: The format of gyro and accelerometer data after concatenation is expressed as int32

Note 3: CHKSM stands for CHECKSUM, which is used to confirm data integrity. It is calculated by summing all the data before the CHECKSUM

In the BURST continuous reading process, 32-bit complete data is divided into high 16 bits and low 16 bits respectively output, output using the small-endian mode, that is, low bytes output first. Users need to splice the two parts of 16-bit data to restore the complete 32-bit data.

Figure 5 Schematic diagram of SPI32 bit data restoration

After obtaining the complete 32-bit data, the standard frame user can convert it into angular velocity, acceleration, temperature and attitude Angle information according to the following formula.

Table 11 Standard frame SPI 32-bit data conversion formula

Name	Units	formula	Conditions/Notes
Angular Speed	°/s	G=SF/65536*GYRO	GYRO is the GYRO data for the X/Y/Z axis in the table above ● Gyro scale factor SF = 0.016
Acceleration	mg	A=SF/65536*ACCL	ACCL is the ACCL data for the X/Y/Z axis in the table above SF = 0.2 for ● Burst pattern ● For single register mode, SF=0.2/1000
Temperature	℃	T=SF/65536*(TEMP-172621824) +25	TEMP indicates the TEMP data in the preceding table ● Temperature scale factor SF =-1/263.4
Attitude Angle	°	D=SF/65536*ATT	ATT is the ATT data in the table above ● Attitude scale factor SF = 0.00699411

7.1.4.2 SPI FILTER_CTRL Register

The FILTER_CTRL Register provides the user with control over the digital low-pass filter. The Register is a read/write Register, the write command is send 0x86XX, and the current SPI cycle setting is valid. The read command is sent 0x0600, and the output Register content is offset by 2 SPI cycles than the read command is sent.

Table 12 SPI FILTER_CTRL Register format

Address	bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	Read/Write

0x07									RW
Address	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Read/Write
0x06	Accelerometer filter configuration				Gyro filter configuration				RW

Table 13 Filter configuration

	Encoding	Description
Accelerometer /Tuo Screw filter fitting buy	4'b 0000	IIR filter fc=1 Hz
	4'b 0001	IIR filter fc=1 Hz
	4'b 0010	IIR filter fc=2 Hz
	4'b 0011	IIR filter fc=5 Hz
	4'b 0100	IIR filter fc=10 Hz
	4'b 0101	IIR filter fc=15 Hz
	4'b 0110	IIR filter fc=20 Hz
	4'b 0111	IIR filter fc=25 Hz
	4'b 1000	IIR filter fc=30 Hz
	4'b 1001	IIR filter fc=35 Hz
	4'b 1010	IIR filter fc=40 Hz
	4'b 1011	no filter

Note: For example, if the gyro is configured and the accelerometer filter is 10Hz, the value 0x8644 is written.

7.1.4.3 SPI ID register

The ID register is a read-only register, and the data content is the character "IMU" in ASCII encoding form. The reading method is similar to that of BURST data reading: 0x6A00~0x7000 is sent when reading, and the data is received. The output register content is offset by 2 cycles than the read instruction sending.

The complete ID of the product can be obtained by splicing 4 16-bit ID data into ASIC II code. The concatenation method is used to concatenate data from the BURST continuously, PROD_ ID1 at the high level and PROD_ ID4 at the low level.

Table 14 SPI ID register format

Address	bit15 ~ bit0	Encoding	Read/Write
0x6C	PROD_ ID1	0x494D	R
0X6E	PROD_ ID2	0x5536	R
0x70	PROD_ ID3 The coded content represents the product ID	0x3132(IMU612)	R
		0x3134(IMU614)	R
		0x3138(IMU618)	R
		0x3141 (IMU6132A)	R
		0x3142(IMU6132B)	R

7.2.2 Packet Format

The packet structure of IMU output and user input is composed as follows:

Table 18 IMU output and user input data structures

Offsets	Data type	name	Description
0	uint8	Frame header 1	The IMU output Frame header: 0xAA, 0x55 The user enters Frame header: 0x55, 0xAA
1	uint8	Frame header 2	
2	uint16	ID low	The lower byte of the COM frame ID
3		ID high byte	The upper byte of the COM frame ID
4	uint16	Data length low	The low word of the frame length for COM communication Section, length is the number of bytes occupied by the pay load, that is, n
5		High data length	COM Indicates the upper word of the frame length Section, length is the number of bytes occupied by pay load, that is, n
6	uint8	Pay load (n bytes)	Data load
6+n	Uint32	CRC_CEHCK (32-bit data low byte)	CRC check
7+n		CRC_CEHCK (low byte in 32-bit data)	
8+n		CRC_CEHCK (high byte in 32-bit data)	
9+n		RC_CEHCK (32-bit data high byte)	

Note 1: Data is transmitted in small-endian format, with low bytes first and high bytes last

Note 2: The initial value of crc32 is 1. CRC calculation does not include all the data of this frame itself. See the end of the document for table lookup calculation

7.2.3 Data Flow Frame -- AHRS data

Table 19 Serial AHRS data format

	Frame Headers	Frame Headers	ID	length	pay load	Frame Tail
Data type	uint8	uint8	uint16	uint16	A1	uint32
Coding	0xAA	0x55	0x0002	0x002C		crc32

Note 1: Maximum output update rate is not greater than 200Hz@115200bps

Table 20 Serial port A1 load data format

offset	Name	Data type	Units	Description
0	timer	uint32	Mus	Time scale

4	pitch	float	°	Pitch Angle
8	roll	float	°	Roll Angle
12	yaw	float	°	Heading Angle
16	ax	float	g	X-axis acceleration
20	ay	float	g	Y-axis acceleration
24	az	float	g	Z-axis acceleration

28	gx	float	°/s	X axis Angular velocity
32	gy	float	°/s	Y-axis Angular velocity
36	gz	float	°/s	Z axis Angular velocity
40	temp	float	℃	IMU chip temperature

Example: Get AHRS data stream:

AA 55 02 00 2C 00 6D 89 16 05 8F C2 65 40 14 AE 07 BF 5C 0F B2 43 25 06 81 3D BC 74 13 3C 60 E5 80 BF EC 51 38 BD 0A D7 A3 BB CD CC CC BC D7 A3 EE 41 0C BF 84 80 is resolved as follows:

Table 21 Serial port A1 acquires AHRS data stream

Description	Raw Value	Analytic value	Description	Raw Value	Analytic value
ID	0200	02	Y-axis acceleration	BC74133C	0.009 g
Length	2C00	44	Z-axis acceleration	60E580BF	1.007 g
Time scale	6D891605	85363053	X axis Angular velocity	EC5138BD	-0.045°/s
Pitch Angle	8FC26540	3.59°	Y-axis Angular velocity	0AD7A3BB	-0.005°/s
Roll angle	14AE07BF	-0.53°	Z axis Angular velocity	CDCCCCBC	-0.025°/s
Yaw angle	5C0FB243	356.12°	IMU chip temperature	D7A3EE41	29.83 ℃
X-axis acceleration	2506813D	0.063 g	crc32 Check	0CBF8480	2156183308

7.2.4 Command Mode GET Output — System status

Table 22 COM system status data format

	Frame header	Frame header	ID	length	pay load	Frame Tail
Data type	uint8	uint8	uint16	uint16	S1	uint32
Coding	0xAA	0x55	0x00FF	0x002A		crc32

Note 1 Depending on the IMU model, the length of this frame will vary, and all represent the length of S1, which needs to be confirmed according to the IMU model.

Table 23 Serial port S1 load data format

offset	Name	Data type	Description
0	Software_ver	uint32	Software version number
4	Hardware_ver	uint32	Hardware version number
8	rev	uint16	Reserved bytes
10	sn0	uint32	First SN number
14	sn1	uint32	Second SN
18	sn2	uint32	Third SN
22	Board_version	uint32	Base Plate version number
26	Rev[16]	Uint8	All that follows is reserved bytes

Note 1 The reserved bytes vary based on the IMU model. The IMU614E is 16 bytes.

Example: Obtain System status

Enter data: 55 AA 01 00 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 BD DB 31 34

Response data: AA 55 FF 00 2A 00 1F 39 03 00 65 6F 01 00 50 83 30 33 35 55 34 50 15 FF 8F 5F FF FF 50 83 FF 1F 29 00 00 00 00 E0 00 07 10 17 08 50 D0 37 10 3B 7A C3 00 02

Based on the response data, the resolution yielded software version number 211231 (1F 39 03 00) and hardware version number 94053(65 6F 01 00).

7.2.5 Command Mode GET output — Read the Parameter

Table 24 COM Parameter Input data format

	Frame header	Frame header	ID	length	pay load	Frame Tail
Data type	uint8	uint8	uint16	uint16	P1	uint32
Coding	0x55	0xAA	0x0006	0x0018		crc32

Table 25 Output data format of COM Parameter

	Frame Headers	Frame Headers	ID	length	pay load	Frame Tail
Data type	uint8	uint8	uint16	uint16	P1	uint32
Coding	0xAA	0x55	0x7530	0x0018		crc32

Note 1 When the Parameter is read, the IMU disables the data flow. After the setting is complete, the data flow needs to be enabled again.

Table 26 Load data format of COM P1

offset	name	Data type	Description
0	Param1	float	Obtained Parameter (input data can be ignored)
4	Param2	float	Keep, default to 0
8	Param3	uint32	Set the Parameter index
12	Param4	uint32	Reserved, the default value is 0
16	Param5	Int32	Keep, default is 0
20	Param6	Int32	Keep, default is 0

Table 27 Index of Parameter of the COM P1 load

Param3	Param1	Units
3	The COM outputs the baud rate. The following baud rates are supported 115200, 230400, 460800, 921600, 1500000	bps
4	Coordinate system orientation (see Table 34 Coordinate System Orientation correspondence table)	
8	X-axis GYRO zero offset calibration result, GYRO X OFF	°/s
9	Y-axis GYRO zero bias calibration	°/s

	results, GYRO_Y_OFF	
10	Calibration result of Bias instability of Z-axis GYRO, GYRO_Z_OFF	°/s
21	AHRS output frequency, default 100Hz	Hz
31	Internal filter configuration, define the same SPI FILTER_CTRL table	

Example: Obtain AHRS output frequency

Input data: 55 AA 06 00 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 15 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 66 CB 46 AC

Response data: AA 55 30 75 18 00 00 00 00 48 42 00 00 00 00 00 00 00 00 15 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 31 2F A2 0A

According to the response data, the analysis results in an output frequency of 50hz (00 00 48 42).

7.2.6 Command mode SET instruction

Table 28 Syntax of the COM input command

	Frame header	Frame Headers	ID	length	pay load	Frame Tail
Data type	uint8	uint8	uint16	uint16	R1	uint32
Coding	0x55	0xAA	CMD	0x0018		crc32

Note 1: For details about the relationship between CMD and R1, see the R1 load Parameter index table

Table 29 COM R1 load data format

offset	Name	Data type	Description
0	Param1	float	Set Parameter
4	Param2	float	Keep, default to 0
8	Param3	uint32	Set the Parameter index
12	Param4	uint32	Reserved. The default value is 0
16	Param5	Int32	Keep, default is 0
20	Param6	Int32	Keep, default is 0

Table 30 Serial R1 load parameter index table

CMD	Param1	Param3	Description
1	0	0	Trigger to get system status data once
2	0	0	Trigger to obtain AHRS data once
3	<mode>	0	Set output Mode: Mode=1, data stream output AHRS Mode=100, disable data stream mode, enter COMMAD mode
5	0	0	Save the current Parameter to FLASH

6	0	<value>	Read Parameter, value is the index of the Parameter to be read, that is, P1. index, see the COM response output - Parameter read For example, if you want to read AHRS output frequency (ODR), set value=21 For example, to read the baud rate of the COM, set value=3. For example, to read the internal filter, set value=31. For example, to read the coordinate system direction, set value=4
9	0	0	Perform a software reboot
14	<value>	3	To set the Serial output baud rate, the valid value in bps value is: If the value is other than 115200, 230400, 460800, 921600, 1500000, the baud rate Parameter is set using 115200bps by default. The setting takes effect only after the system restarts.

			Procedure for setting the power-off: Set the baud rate, save Parameter to the flash, and reset the running software
14	<value>	21	Set the periodic AHRS data output frequency, commonly used in units of Hz value The values are: 1, 10, 50, 100, 200 Recommended mapping between output frequency and COM baud rate 200Hz: 921600bps 200Hz: 460800bps 100Hz: 115200bps
14	<value>	31	Internal filter configuration, defined with SPI accelerometer and gyroscope filter configuration, default 0xBB, that is, 47Hz
14	<value>	4	Set the orientation of the IMU coordinate system. The value ranges from 101 to 124. See Table 34 for the corresponding relation of the orientation of the coordinate system

Note 1: Please note that all values in this table are in decimal

Note 2: The host computer command generator function can be used to generate corresponding commands to send, see the use of the host computer section of this manual

For example, to enable AHRS output:

Enter 3 in CMD ID and 1 in Parameter 1. The generated hexadecimal array can be sent to the COM assistant or program array

IMU.

7.2.7 Command Mode Output – User command response

Table 31 Setting Parameter COM response data format

	Frame Header	Frame Headers	ID	length	ACK	Param3	Frame end
Data type	uint8	uint8	uint16	uint16	uint16	uint16	uint32
Coding	0xAA	0x55	0x753D	0x0004	0x7534	Parameter index	crc32

Table 32 Reserved parameters Serial port response data format

	Frame header	Frame Headers	ID	length	ACK	result	Frame Tail
Data type	uint8	uint8	uint16	uint16	uint16	uint16	uint32
Coding	0xAA	0x55	0x753D	0x0004	0x0005	0x01	crc32

Table 33 Serial user command response data format

	Frame Headers	Frame Headers	ID	length	command	result	Frame Tail
Data type	uint8	uint8	uint16	uint16	uint16	uint16	uint32
Coding	0xAA	0x55	0x0064	0x0004	Command ID	0x01	crc32

Example: Set the serial output baud rate to 115200

Input data:

55, AA, 0 e, 00,18,00,00,00, E1,
47,00,00,00,00,03,00,00,00,00,00,00,00,00,00,00,00,0 0,00,00,00,56,2 B, 4 d,
93

Response data: AA 55 3D 75 04 00 34 75 03 00 A7 98

2A 54 Set the periodic AHRS data output frequency

to 100hz

Input data: 55 AA 0E 00 18 00 00 00 00 C8 42 00 00 00 00 00 00 00 00 15 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 0A 2B 2C 8D

Response data: AA 55 3D 75 04 00 34 75 15 00 70 2D

B2 48 Save the current parameter to FLASH

Input data: 55 AA 05 00 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 C9 2F E6 32

Response data: AA 55 3D 75 04 00 05 00 01 00 5A CF

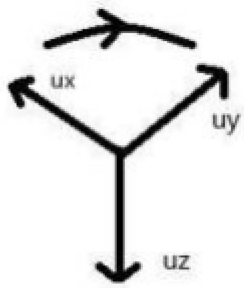
B1 7C Set output mode to AHRS data Stream

Input data: 55 AA 03 00 18 00 00 00 00 80 3F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 52 D8 8E E8

Response data: AA 55 64 00 04 00 03 00 01 00 E7 87 E3 AD

7.2.9 Coordinate system setting function

Set the firmware coordinate system, and display the corresponding firmware design coordinate system in the upper computer FIG. 13 Firmware original coordinate system



According to the rules in the figure above, when the x and y axes are determined, the z axis is determined The Z axis is perpendicular to the plane from the X to the Y axis There are a total of twenty-four orientations for the X/Y/Z triaxial axis, as shown in the table below:

The orientation of the coordinate system in Table 34 corresponds to the table

Orientation (value)	XAxis	YAXis	ZAxis	Instructions
101	+Ux	+Uy	+Uz	Default orientation
102	-Ux	-Uy	+Uz	
103	-Uy	+Ux	+Uz	
104	+Uy	-Ux	+Uz	
105	-Ux	+Uy	-Uz	
106	+Ux	-Uy	-Uz	
107	+Uy	+Ux	-Uz	
108	-Uy	-Ux	-Uz	
109	-Uz	+Uy	+Ux	
110	+Uz	-Uy	+Ux	
111	+Uy	+Uz	+Ux	
112	-Uy	-Uz	+Ux	
113	+Uz	+Uy	-Ux	
114	-Uz	-Uy	-Ux	
115	-Uy	+Uz	-Ux	
116	+Uy	-Uz	-Ux	
117	-Ux	+Uz	+Uy	
118	+Ux	-Uz	+Uy	
119	+Uz	+Ux	+Uy	
120	-Uz	-Ux	+Uy	
121	+Ux	+Uz	-Uy	
122	-Ux	-Uz	-Uy	

123	-Uz	+Ux	-Uy	
124	+Uz	-Ux	-Uy	

How to change the coordinate system to 102 Orientation:

Enter 14 in CMD ID, 102 in Parameter 1, and 4 in Parameter 3. The generated hexadecimal array can be filled into the COM assistant or program array and sent to the IMU.

How to read the coordinate system orientation:

Enter 06 in CMD ID and 4 in Parameter 3. The generated hexadecimal array can be filled into the COM assistant or program array and sent to the IMU.

Example: Set the
coordinate system to 115
towards the input data:
55, aa, 0 e, 00,18,00,00,00, e6,
42,00,00,00,00,04,00,00,00,00,00,00,00,00,00,00,00, 00,00,00,00,46,6 a, 4 e, 86
Response data: AA 55 3D 75 04 00 34 75 04 00 60 0E 6B 1B Refer to Table 31, the Parameter index is 04, and the setting is successful

Read the coordinate system:
Input data: 55 AA 06 00 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 69 64 09 E4
Response data: AA 55 30 75 18 00 00 00 00 E6 42 00 00 00 00 00 00 00 00 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 B2 2F 2D 4E
According to Table 25 and Table 26, the resolution results in Parameter 1 being 115 (float) and Parameter 3 being 04. That is, the coordinate system is 115 orientation

7.2.10 FAQs about COM Connection

1) The RX of the IMU cannot connect to two Master TX
The RX of the COM cannot be connected to two TX at the same time. Therefore, if the Forsense upper machine needs to be connected, it needs to disconnect the communication with the COM of the user's host. Otherwise, the upper computer cell can only receive data and cannot send commands to the IMU.
As shown in the picture below:

Figure 6 Schematic diagram of COM connection

2) The version number cannot be obtained
You are advised to use the COM of the FT232 chip. CH340 and PL2303 data cables may lose packets when the baud rate is high (>115200bps)
It is recommended that COM be connected directly, and it is not recommended to be connected in series. If the interface of RS422 is connected to the computer,

directly use RS422 to USB cable, and do not use RS422 to RS232+RS232Z to USB cable in series.

3) Upper computer software curve display lag

For FT232 data cables, use the system administrator to turn on the Upper computer software and automatically configure the COM delay. Manually configure the COM delay in the device manager.

8 Time sync

With time synchronization, you can ensure that the internal clock of the device is consistent with the external time reference, which can eliminate the time deviation due to clock drift;

In a system where multiple devices work together, the timestamps of all devices are based on the same time benchmark, which helps to ensure the consistency and accuracy of the data.

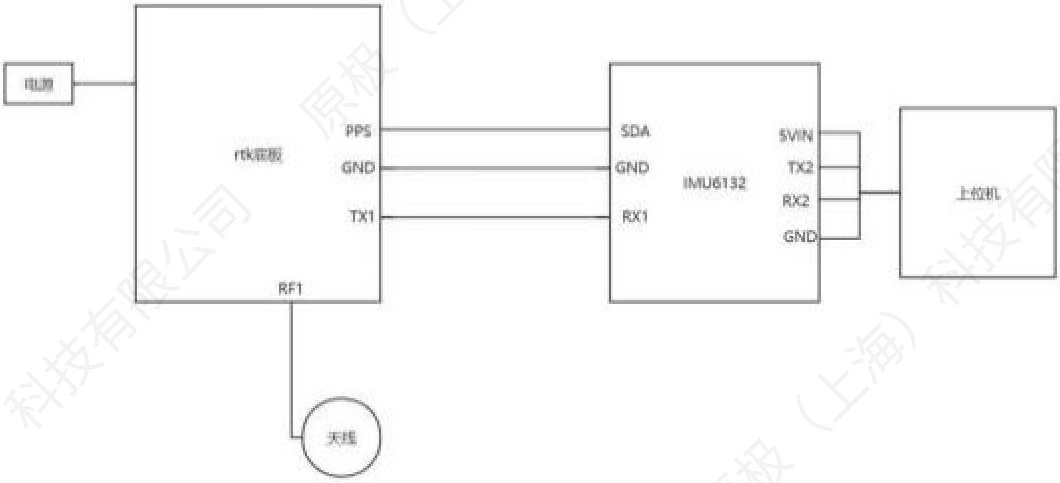
At present, this module provides two time synchronization methods:

1. Access pps signal +rmc message.
2. Synchronize time on the Master using DRDY signals

8.1 Connecting the PPS Signal and GPRMC Packet

8.1.1 Hardware connection

1. Connect the IMU to the RTK baseboard based on the connection diagram



Connection diagram for the IMU6132

8.1.2RTK Configuration Requirements:

RTK packet input requirements: GPRMC 10HZ

Disable inertial navigation assistant-related functions of the RTK board
Disable other statements.

PPS second pulse: 1s once, rising edge triggered, pulse width 5ms, aligned to UTC time. High level must not be higher than 5v. Ensure that the baud rate of the COM of the RTK is the same as that of the IMU.

8.1.3 Command sequence for the IMU to enable time synchronization

After the IMU is connected to the Master, open the COM assistant and send commands successively: AT+SETNO (stop data output to facilitate sending commands)

AT+DRY_ENABLE (starting time synchronization) AT+SAVE (saving Parameter)

AT+SETYES (restore data output)

8.1.4 How to Check whether time synchronization is successful:

The steps to confirm are as follows

Before synchronization, count the value of the IMU itself in ms format

After synchronization, it will become the true value of UTC conversion in ms, taking the true value 43767630ms as an example to convert the given ms value to s:

43,767,630ms= 43,767.63s

To convert s to h, min, and s:

First, divide the number of seconds by 3600 (1h=3600s) to get the number of hours and the number of seconds remaining. 43,767s ÷ 3600 = 12h... 567s (rounded)

Next, divide the number of seconds left by 60 (1min=60s) to get the number of minutes and the number of seconds left. 567s ÷ 60 = 9min... 27s (rounded)

Collate the results:

Combine h, min, s, and the initial decimal part from the steps above to form the final UTC time representation (hhmmss.sss).

The final UTC time representation is: 120927.63

2 Depending on the IMU update rate you set, the timestamp interval will change accordingly. For example:

When the IMU update rate is 10Hz, the corresponding timestamp interval is 100 ms;

In this case, the timestamp will be sent at a frame interval of every 10 ms to ensure the same step as the IMU data. The following is an example

```
#time_us,accx,accy,accz,gyrox,gyroy,gyroz,temperature,roll,pitch,yaw,mx,my,mz
43767630,0.000911493,-0.00593111,-0.999837,-0.112592,0.0775201,-0.239427,37.375,0.37371,0.0374005,359.763
43767640,0.00104886,-0.00639931,-1.00023,-0.11155,0.0945329,-0.198418,37.375,0.372709,0.0378392,359.763
43767650,0.0010143,-0.00654209,-1.00144,-0.143203,0.0859424,-0.187509,37.375,0.372681,0.038661,359.763
43767660,0.000973708,-0.00638983,-1.00176,-0.166009,0.092228,-0.200648,37.375,0.372481,0.0390947,359.763
43767670,0.00147395,-0.00683136,-1.001,-0.192246,-0.00178328,-0.157266,37.375,0.372781,0.0399402,359.763
43767680,0.00223095,-0.00695176,-1.00109,-0.0757273,-0.000226222,-0.138093,37.375,0.372781,0.0399402,359.763
43767690,0.00127585,-0.00571409,-1.00053,-0.173622,0.0492768,-0.163678,37.375,0.373524,0.0425388,359.763
43767700,0.00074174,-0.00655202,-1.00021,-0.115697,0.000131873,-0.160155,37.375,0.372256,0.0430011,359.763
43767710,0.00167231,-0.00625615,-1.00077,-0.196135,-0.000426489,-0.177769,37.375,0.372131,0.0433163,359.763
43767720,0.00185977,-0.0061884,-1.00042,-0.224989,-0.0107625,-0.0937578,37.375,0.371704,0.0457214,359.763
43767730,0.00024303,-0.00667565,-1.00119,-0.252968,0.0338021,-0.143835,37.375,0.371704,0.0457214,359.763
43767740,0.000261399,-0.00675453,-1.00142,-0.221033,0.0709242,-0.198763,37.375,0.37201,0.0447791,359.763
43767750,0.000898074,-0.00627877,-1.00137,-0.146918,0.0208479,-0.177816,37.375,0.372149,0.0439286,359.763
43767760,0.00114561,-0.00632768,-1.00142,-0.116412,0.0106449,-0.195621,37.375,0.371879,0.0448294,359.763
43767770,0.00031602,-0.0065025,-1.00118,-0.151384,0.107034,-0.151737,37.375,0.371925,0.0443909,359.763
43767780,0.000111739,-0.00596614,-1.00127,-0.191872,0.0392804,-0.190575,37.375,0.371925,0.0443909,359.763
43767790,0.000446753,-0.00575444,-1.00054,-0.144282,0.0438216,-0.206097,37.375,0.371021,0.0432654,359.763
43767800,0.000744278,-0.00620892,-1.00097,-0.0806283,0.0402478,-0.2018,37.375,0.370079,0.0418417,359.763
43767810,0.000249961,-0.00627208,-1.00092,-0.205578,0.0244218,-0.173429,37.375,0.369413,0.0418069,359.763
43767820,1.2315e-05,-0.00632706,-1.00116,-0.190721,0.0747152,-0.227714,37.375,0.3691,0.0408873,359.763
43767830,0.00024524,-0.00670832,-1.00086,-0.117692,0.111822,-0.193005,37.375,0.3691,0.0408873,359.763
43767840,0.000537576,-0.00604259,-1.00108,-0.146042,0.043116,-0.178889,37.375,0.369541,0.0392609,359.763
43767850,0.00102963,-0.00625389,-1.00084,-0.165271,0.000858686,-0.146898,37.375,0.369012,0.0390227,359.763
43767860,0.00121603,-0.0058367,-1.00105,-0.207972,0.0699086,-0.172457,37.375,0.368091,0.0399286,359.763
43767870,0.00114882,-0.00628435,-1.00111,-0.192793,0.0395967,-0.177017,37.375,0.36763,0.0405705,359.763
```

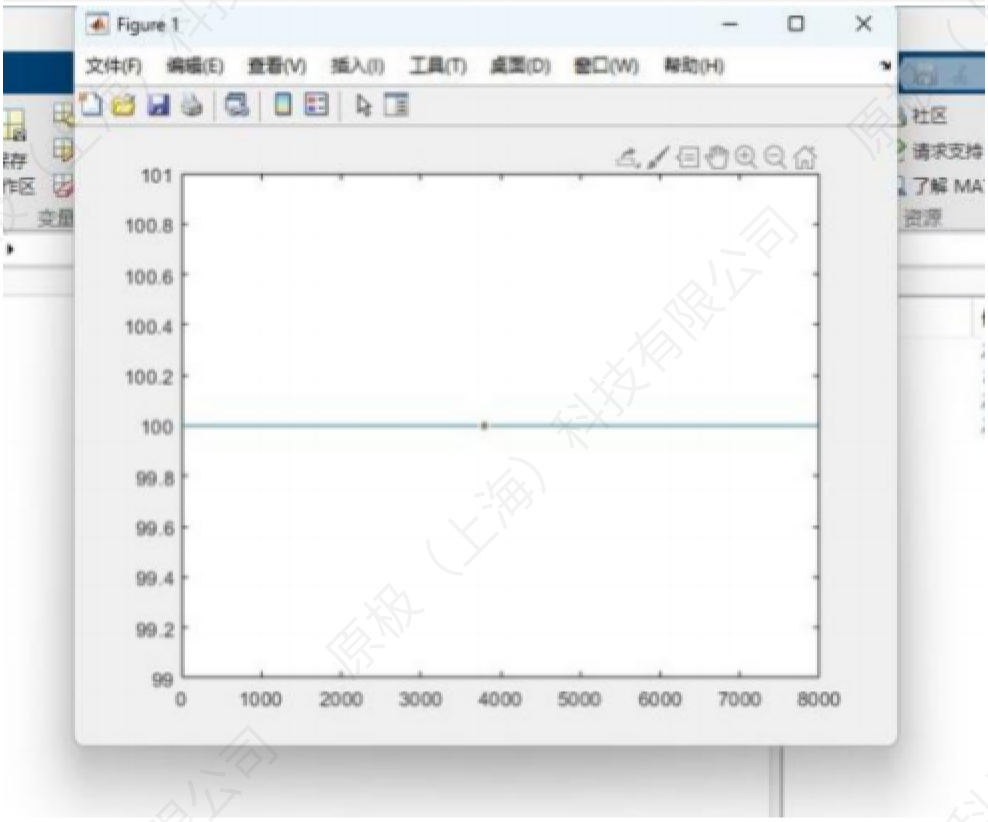
8.1.5 How Do I Verify that the timestamp is correct after the time synchronization is successful

1. Collect and decode RMC data and AHRS data after time synchronization at the same time.

2. Convert the two time stamps into the same format, and use matlab and other tools to count the following indicators of the following two groups of corresponding time stamp data

First, the statistical time stamp interval
is stable, confirm whether there is a
packet loss judgment condition:
Example: 10HZ output: the interval is stable to 100ms

```
%time_us,accx,accy,accz,gyrox,gyroy,gyroz,temperature,roll,pitch,yaw,mx,my,mz
10138100,-0.00785668,0.000511979,-1.00068,0.00577856,0.0224228,-0.170839,43.6992,-0.185733,-0.373024,2.66486
10138200,-0.00548826,-8.32841e-06,-1.00069,0.120156,-0.0394001,0.0182559,43.6992,-0.177175,-0.373694,2.66124
10138300,-0.0177959,-0.0481571,-1.00444,-0.452245,-0.0625247,-6.75837,43.6992,-0.166894,-0.370253,2.60756
10138400,-0.00540888,-0.000368123,-0.999689,0.0587807,0.157406,-0.743163,43.7031,-0.179521,-0.368657,2.35367
10138500,-0.00681769,0.00110348,-1.00052,-0.0118609,-0.0201513,-0.0745728,43.6992,-0.174604,-0.366914,2.32512
10138600,-0.00541474,-2.34533e-05,-1.00088,0.0289074,-0.0428571,0.0164407,43.6992,-0.168918,-0.367043,2.32495
10138700,-0.00661371,0.000592246,-1.00062,0.00993176,-0.000438364,-0.0288885,43.6953,-0.163664,-0.364568,2.3255
10138800,-0.0048226,6.92813e-05,-1.00043,-0.00735649,0.0273419,-0.0158955,43.6992,-0.155855,-0.371403,2.33634
10138900,-0.00664255,0.000866315,-1.00145,0.0919172,-0.0107388,-0.0110982,43.7031,-0.151304,-0.366063,2.33678
10139000,-0.00515508,-0.000483297,-0.999668,-0.00652478,0.114841,-0.00554243,43.6992,-0.147101,-0.370124,2.3664
10139100,-0.00679933,8.07165e-05,-1.00015,0.0193778,-0.00205665,0.000614035,43.6953,-0.141752,-0.363385,2.36672
10139200,-0.00633591,0.000995697,-1.00043,0.0350645,-0.0332949,0.0570056,43.6875,-0.136313,-0.36819,2.37055
10139300,-0.00676747,0.000319971,-1.00062,0.0243442,0.0444976,0.00981862,43.6875,-0.133467,-0.362919,2.37656
10139400,-0.00663674,0.000352815,-1.00029,0.00787024,0.0201864,-0.00876646,43.6953,-0.129017,-0.368695,2.37739
10139500,-0.00679523,0.00118807,-1.00101,-0.00626396,-0.0206355,-0.00567084,43.6953,-0.12762,-0.359295,2.37722
10139600,-0.00583052,8.28852e-05,-0.99977,0.0120336,0.0297521,-0.00074564,43.6992,-0.122915,-0.366905,2.37741
10139700,-0.00690794,0.000215317,-1.00052,0.000730211,-0.0126271,-0.0145498,43.6992,-0.116187,-0.361241,2.37884
10139800,-0.00553715,0.000524005,-1.00127,0.0570455,-0.014946,0.0273024,43.6992,-0.109288,-0.369261,2.37931
10139900,-0.0059149,5.67176e-05,-1.00066,0.00898911,0.0247195,0.0501371,43.7031,-0.100622,-0.362934,2.39978
10140000,-0.00614014,-5.688e-06,-1.0002,-0.121098,0.0651305,-0.00916049,43.707,-0.100607,-0.366901,2.41725
10140100,-0.00616532,-0.000320024,-1.00114,0.0116914,0.00976389,-0.00659498,43.707,-0.0948647,-0.361206,2.41734
10140200,-0.00566859,-0.0003737,-1.00026,-0.00623558,0.013495,0.00671942,43.707,-0.0888662,-0.36321,2.41761
10140300,-0.00680167,-8.83485e-05,-1.00077,-0.100855,0.0120432,-0.00189858,43.707,-0.0788807,-0.362496,2.41875
```



IMU10HZ

two Statistics two sets of corresponding timestamp data the same output frequency, the same starting point under the time difference is 0 (in the case of satellite condition is good)

The following is a statistical example:

	A	B	C
4	10147500	10147500	0
5	10147600	10147600	0
6	10147700	10147700	0
7	10147800	10147800	0
8	10147900	10147900	0
9	10148000	10148000	0
10	10148100	10148100	0
11	10148200	10148200	0
12	10148300	10148300	0
13	10148400	10148400	0
14	10148500	10148500	0
15	10148600	10148600	0
16	10148700	10148700	0
17	10148800	10148800	0
18	10148900	10148900	0
19	10149000	10149000	0
20	10149100	10149100	0
21	10149200	10149200	0
22	10149300	10149300	0
23	10149400	10149400	0
24	10149500	10149500	0
25	10149600	10149600	0
26	10149700	10149700	0
27	10149800	10149800	0
28	10149900	10149900	0
29	10150000	10150000	0
30	10150100	10150100	0
31	10150200	10150200	0
32	10150300	10150300	0
33	10150400	10150400	0
34	10150500	10150500	0
35	10150600	10150600	0
36	10150700	10150700	0
37	10150800	10150800	0
38	10150900	10150900	0

Sheet1 Sheet2 Sheet3

IMU10HZ

8.2 Synchronize Time on the Master Using DRDY Signals

8.2.1DRDY Signal Function

In an IMU, the DRDY (Data Ready) signal is an important status marker or interrupt signal used to indicate that the IMU's data is ready and can be read. When the IMU completes a round of data acquisition and processing, the DRDY signal will change to an active state (usually low), which means that the new acceleration, Angular velocity and other data are ready to be read.

After the Master is connected to the IMU, it can determine the exact moment when the data is ready by detecting the clock synchronization signal from inside the IMU provided by the DRDY, and add a time stamp and parse the data at that moment. This means that whenever the DRDY signal changes, the Master knows that the data is ready and can record the time at this time as a timestamp for that data.

8.2.2 How do I turn on the DRDY signal

After upgrading most products through the Upper computer software COM, DRDY is enabled by default (currently P8MINI, IMU470, IMU470, IMU470).

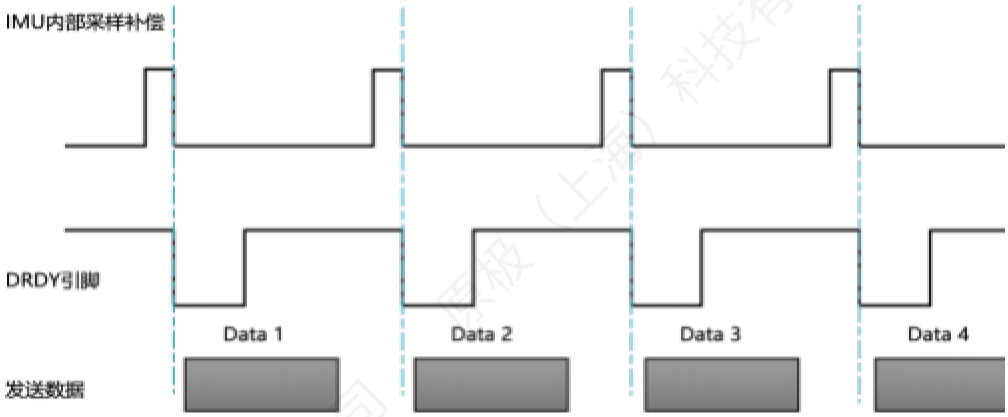
The DRDY of IMU16460 is off by default, and the subsequent firmware will be set to on by default.) If DRDY is off after the product is upgraded through the COM, the Upper computer software can read the COM table and change the 39th COM table to the value 100. If the customer needs to enable the DRDY function when using the old firmware, he can use the command generator on the Upper computer software to input the following Parameter and send the command to enable the DRDY function. If you burn through the burner, the DRDY function is turned on by default

8.2.3DRDY Signal

DRDY Pin output serves two purposes:

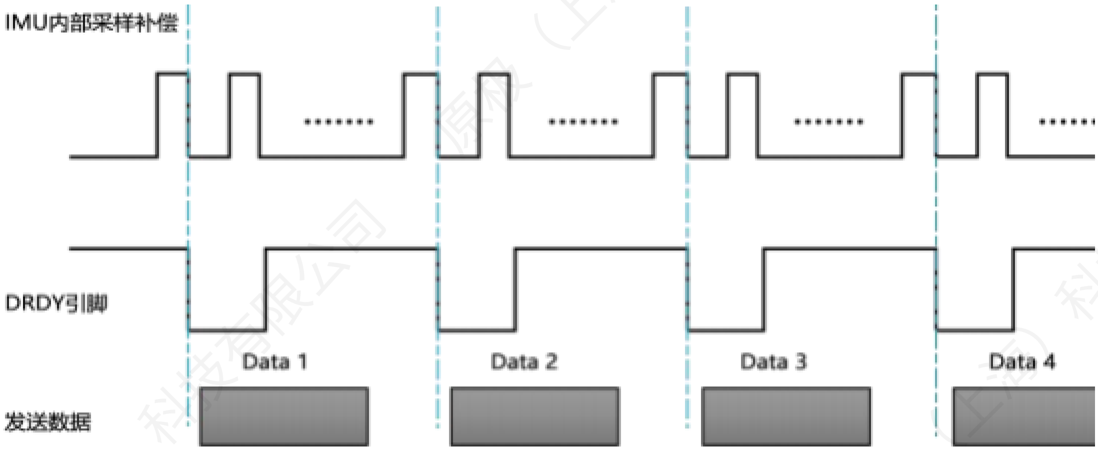
1. to provide a clock synchronization signal from inside the IMU; How to 2 Provide a signal to signal the start of transmitting data frames.

The internal sampling frequency is consistent with the serial output frequency



When the internal sampling frequency of the IMU (maximum ODR) is consistent with the serial output frequency (current ODR), the DRDY pin will be pulled down immediately after the completion of imu data sampling compensation, at which time the data frame will be sent from the serial port, and the DRDY internal sampling frequency will be pulled up again in the next cycle.

The serial output frequency is less than the IMU internal sampling frequency



When the serial output frequency is less than the IMU internal sampling frequency, when the IMU data sampling compensation is completed, the frequency divider value (maximum ODR/ current ODR) determines whether the DRDY pin youdaoplaceholder3 is immediately pulled down. After the DRDY is pulled down, the data frame will be sent from the string port, and the DRDY Pin will be pulled up again in the next IMU sampling cycle.

9. Coordinate system definition

This product coordinate system uses the front - right - down (FRD) coordinate system, Euler Angle range is as follows: rotation around the Z axis: Yaw course Angle range: 0° ~360°;

Rotation around the X axis: Roll Angle roll range: -180° ~180°; Rotation around the Y-axis direction: Pitch Angle range: -90° ~90°.

Roll, pitch, and course Angle diagram is as follows:

FIG. 21 Schematic diagram of roll, pitch and heading Angle

10. CRC table lookup method calculation

```
static  const  uint32_t  crc32_tab [ ]  =  {
0x00000000, 0x77073096, 0xee0e612c, 0x990951ba, 0x076dc419, 0x706af48f,
0xe963a535, 0x9e6495a3, 0x0edb8832, 0x79dcb8a4, 0xe0d5e91e, 0x97d2d988,
0x09b64c2b, 0x7eb17cbd, 0xe7b82d07, 0x90bf1d91, 0x1db71064, 0x6ab020f2,
0xf3b97148, 0x84be41de, 0x1adad47d, 0x6ddde4eb, 0xf4d4b551, 0x83d385c7,
0x136c9856, 0x646ba8c0, 0xfd62f97a, 0x8a65c9ec, 0x14015c4f, 0x63066cd9,
0xfa0f3d63, 0x8d080df5, 0x3b6e20c8, 0x4c69105e, 0xd56041e4, 0xa2677172,
0x3c03e4d1, 0x4b04d447, 0xd20d85fd, 0xa50ab56b, 0x35b5a8fa, 0x42b2986c,
0xdbbbc9d6, 0xacbcf940, 0x32d86ce3, 0x45df5c75, 0xdcd60dcf, 0xabd13d59,
0x26d930ac, 0x51de003a, 0xc8d75180, 0xbfd06116, 0x21b4f4b5, 0x56b3c423,
0xcfba9599, 0xb8bda50f, 0x2802b89e, 0x5f058808, 0xc60cd9b2, 0xb10be924,
0x2f6f7c87, 0x58684c11, 0xc1611dab, 0xb6662d3d, 0x76dc4190, 0x01db7106,
0x98d220bc, 0xefd5102a, 0x71b18589, 0x06b6b51f, 0x9fbfe4a5, 0xe8b8d433,
0x7807c9a2, 0x0f00f934, 0x9609a88e, 0xe10e9818, 0x7f6a0dbb, 0x086d3d2d,
0x91646c97, 0xe6635c01, 0x6b6b51f4, 0x1c6c6162, 0x856530d8, 0xf262004e,
0x6c0695ed, 0x1b01a57b, 0x8208f4c1, 0xf50fc457, 0x65b0d9c6, 0x12b7e950,
0x8bbeb8ea, 0xfcb9887c, 0x62dd1ddf, 0x15da2d49, 0x8cd37cf3, 0xfbd44c65,
0x4db26158, 0x3ab551ce, 0xa3bc0074, 0xd4bb30e2, 0x4adfa541, 0x3dd895d7,
0xa4d1c46d, 0xd3d6f4fb, 0x4369e96a, 0x346ed9fc, 0xad678846, 0xda60b8d0,
0x44042d73, 0x33031de5, 0xaa0a4c5f, 0xdd0d7cc9, 0x5005713c, 0x270241aa,
0xbe0b1010, 0xc90c2086, 0x5768b525, 0x206f85b3, 0xb966d409, 0xce61e49f,
0x5edef90e, 0x29d9c998, 0xb0d09822, 0xc7d7a8b4, 0x59b33d17, 0x2eb40d81,
0xb7bd5c3b, 0xc0ba6cad, 0xedb88320, 0x9abfb3b6, 0x03b6e20c, 0x74b1d29a,
0xead54739, 0x9dd277af, 0x04db2615, 0x73dc1683, 0xe3630b12, 0x94643b84,
0x0d6d6a3e, 0x7a6a5aa8, 0xe40ecf0b, 0x9309ff9d, 0x0a00ae27, 0x7d079eb1,
0xf00f9344, 0x8708a3d2, 0x1e01f268, 0x6906c2fe, 0xf762575d, 0x806567cb,
0x196c3671, 0x6e6b06e7, 0xfed41b76, 0x89d32be0, 0x10da7a5a, 0x67dd4acc,
0xf9b9df6f, 0x8ebeeff9, 0x17b7be43, 0x60b08ed5, 0xd6d6a3e8, 0xa1d1937e,
0x38d8c2c4, 0x4fdff252, 0xd1bb67f1, 0xa6bc5767, 0x3fb506dd, 0x48b2364b,
0xd80d2bda, 0xaf0a1b4c, 0x36034af6, 0x41047a60, 0xdf60efc3, 0xa867df55,
0x316e8eef, 0x4669be79, 0xcb61b38c, 0xbc66831a, 0x256fd2a0, 0x5268e236,
0xcc0c7795, 0xbb0b4703, 0x220216b9, 0x5505262f, 0xc5ba3bbe, 0xb2bd0b28,
0x2bb45a92, 0x5cb36a04, 0xc2d7ffa7, 0xb5d0cf31, 0x2cd99e8b, 0x5bdeae1d,
0x9b64c2b0, 0xec63f226, 0x756aa39c, 0x026d930a, 0x9c0906a9, 0xeb0e363f,
0x72076785, 0x05005713, 0x95bf4a82, 0xe2b87a14, 0x7bb12bae, 0x0cb61b38,
0x92d28e9b, 0xe5d5be0d, 0x7cdcefb7, 0x0bdbdf21, 0x86d3d2d4, 0xf1d4e242,
0x68ddb3f8, 0x1fda836e, 0x81be16cd, 0xf6b9265b, 0x6fb077e1, 0x18b74777,
0x88085ae6, 0xff0f6a70, 0x66063bca, 0x11010b5c, 0x8f659eff, 0xf862ae69,
0x616bffd3, 0x166ccf45, 0xa00ae278, 0xd70dd2ee, 0x4e048354, 0x3903b3c2,
0xa7672661, 0xd06016f7, 0x4969474d, 0x3e6e77db, 0xaed16a4a, 0xd9d65adc,
```

```
0x40df0b66, 0x37d83bf0, 0xa9bcae53, 0xdebb9ec5, 0x47b2cf7f, 0x30b5ffe9,
0xbdbdf21c, 0xcabac28a, 0x53b39330, 0x24b4a3a6, 0xbad03605, 0xcdd70693,
0x54de5729, 0x23d967bf, 0xb3667a2e, 0xc4614ab8, 0x5d681b02, 0x2a6f2b94,
0xb40bbe37, 0xc30c8ea1, 0x5a05df1b, 0x2d02ef8d,
}
uint32_t crc_crc32 (uint32_t crc, const uint8_t *buf, uint32_t size ) {
for (uint32_t i=0; i<size ; i++) {
crc = crc32_tab [ (crc ^ buf [ i ] ) & 0xff] ^ (crc >> 8 ) ;
}
return crc;
}
```

11 Use examples

11.1 Device Installation

1. The module should be firmly fixed on a rigid plane and avoid being installed in a position with large vibration.
2. The module should be installed in the same direction as the front.

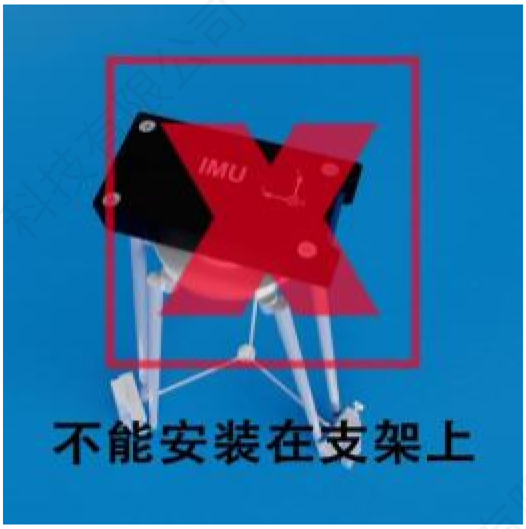
Figure 15 Schematic diagram of installing the module

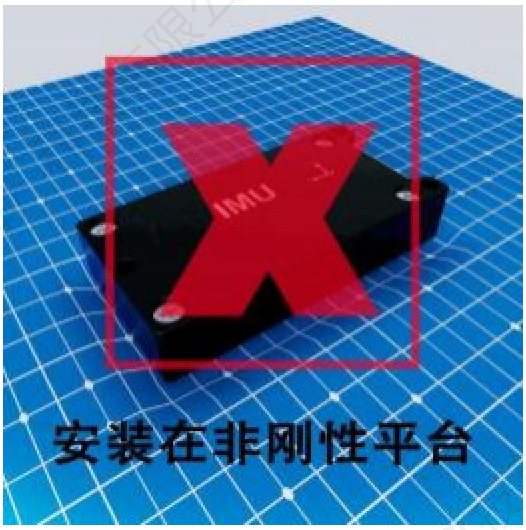
The correct installation diagram is as follows

The X axis faces the front of the car

Figure 16 Diagram of proper installation

The following installation methods are all incorrect installation



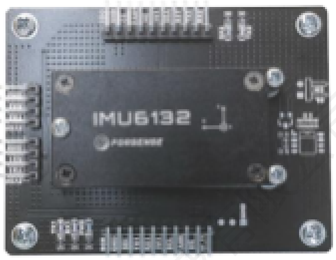


11.2 Example for Connecting a Upper computer software

FIG.17 Schematic diagram of module connecting to Upper computer software

	名称	数量
1	IMU6132	1个
	附件名称	数量
2	IMU6132测试底板	1个
3	TTL串口线	1个
4	USB转CAN模块	1个

12 Select accessories



IMU6132B tests the Base Plate TTL COM USB to CAN module

13 Update the record

Versions	Dates	Status/Comments
Version 1.0	2023.09.15	First issue
Version 1.1	2023.10.07	Update coordinate system definition
Version 1.2	2023.12.14	Add attachments
Version 1.3	2024.04.10	Update appliance features
Version 1.4	2024.05.10	Add Upper computer software connection diagram
Version 1.5	2024.09.19	Added time synchronization steps