

USER MANUAL

WT901C(RS232)

Inclinometer Sensor





Tutorial Link

[Google Drive](#)

Link to instructions DEMO:

[WITMOTION Youtube Channel](#)

[WT901C Playlist](#)

If you have technical problems or cannot find the information that you need in the provided documents, please contact our support team. Our engineering team is committed to providing the required support necessary to ensure that you are successful with the operation of our AHRS sensors.

Contact

[Technical Support Contact Info](#)

Application

- AGV Truck
- Platform Stability
- Auto Safety System
- 3D Virtual Reality
- Industrial Control
- Robot
- Car Navigation
- UAV
- Truck-mounted Satellite Antenna Equipment



Contents

Tutorial Link	- 2 -
Contact	- 2 -
Application.....	- 2 -
Contents.....	- 3 -
1 Introduction	- 5 -
1.1 Warning Statement	- 6 -
2 Instructions of 2023 New Software	- 7 -
3 Use Instructions with PC.....	- 8 -
3.1 Connection Method.....	- 8 -
3.1.1 Serial Connection.....	- 8 -
3.2 Software Introduction	- 12 -
3.2.1 Main Menu	- 12 -
3.2.2 Menu of Configuration	- 14 -
3.3 Calibration	- 18 -
3.3.1 Accelerometer Calibration	- 18 -
3.3.2 Magnetic Field Calibration	- 19 -
3.3.3 Gyroscope Automatic Calibration.....	- 22 -
3.3.4 Reset Z-axis Angle	- 23 -
3.3.5 Reset Height to 0	- 23 -
3.4 Configuration.....	- 24 -
3.4.1 Return Content.....	- 24 -
3.4.2 Output Rate	- 25 -
3.4.3 Baud Rate.....	- 26 -
3.4.4 Data Recording.....	- 27 -
3.4.5 Data Playback	- 29 -
3.4.6 Standby and Wake Up	- 31 -



3.4.7 Placement Direction	- 32 -
3.4.8 Bandwidth	- 33 -
3.4.9 Restore Factory Setting.....	- 35 -
3.4.10 6-axis/ 9-axis Algorithm	- 36 -
4 MCU Connection.....	- 37 -



1 Introduction

The WT901C is a multi-sensor device detecting acceleration, angular velocity, angle as well as magnetic field. The small outline makes it perfectly suitable for industrial retrofit applications such as condition monitoring and predictive maintenance. Configuring the device enables the customer to address a broad variety of use cases by interpreting the sensor data by smart algorithms.

WT901C's scientific name is AHRS IMU sensor. A sensor measures 3-axis angle, angular velocity, acceleration, magnetic field. Its strength lies in the algorithm which can calculate three-axis angle accurately.

WT901C is employed where the highest measurement accuracy is required. It offers several advantages over competing sensor:

- Heated for best data availability: new WITMOTION patented zero-bias automatic detection calibration algorithm outperforms traditional accelerometer sensor
- High precision Roll Pitch Yaw (X Y Z axis) Acceleration + Angular Velocity + Angle + Magnetic Field output
- Low cost of ownership: remote diagnostics and lifetime technical support by WITMOTION service team
- Developed tutorial: providing manual, datasheet, Demo video, free software for Windows computer , and sample code for MCU integration including Python, STM32, Arduino, Matlab, Raspberry Pi, C++, communication protocol for project development
- WITMOTION sensors have been praised by thousands of engineers as a recommended attitude measurement solution



1.1 Warning Statement

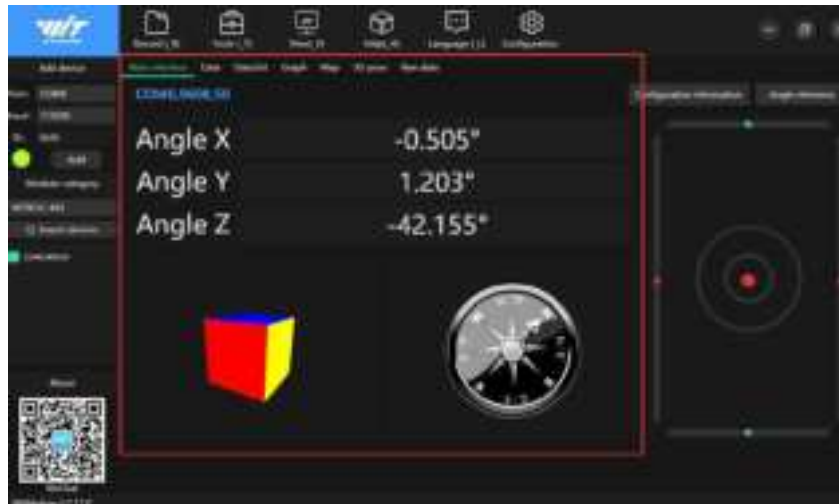
- Putting more than 5 Volt across the sensor wiring of the main power supply can lead to permanent damage to the sensor.
- VCC cannot connect with GND directly, otherwise it will lead to the burning of the circuit board.
- For proper instrument grounding: use WITMOTION with its original factory-made cable or accessories.
- For secondary developing project or integration: use WITMOTION with its compiled sample code.

2 Instructions of 2023 New Software

In order to improve the user experience and our customer service, we develop a new version PC software.

Below is the new software and universal instruction download link.

https://drive.google.com/drive/folders/1dnwmnH7mi4zBpNqDyWLzrzsV7BfeKaD9?usp=share_link



Note:

The 2022 old version software will be reserved for use. You can check "Chapter 3 Use Instructions with PC" for more details. ↓ ↓ ↓

3 Use Instructions with PC

3.1 Connection Method

PC software is only compatible with Windows system.

[WT901C Playlist](#)

3.1.1 Serial Connection

Step 1. Connect the sensor with a serial converter

PIN Connection:

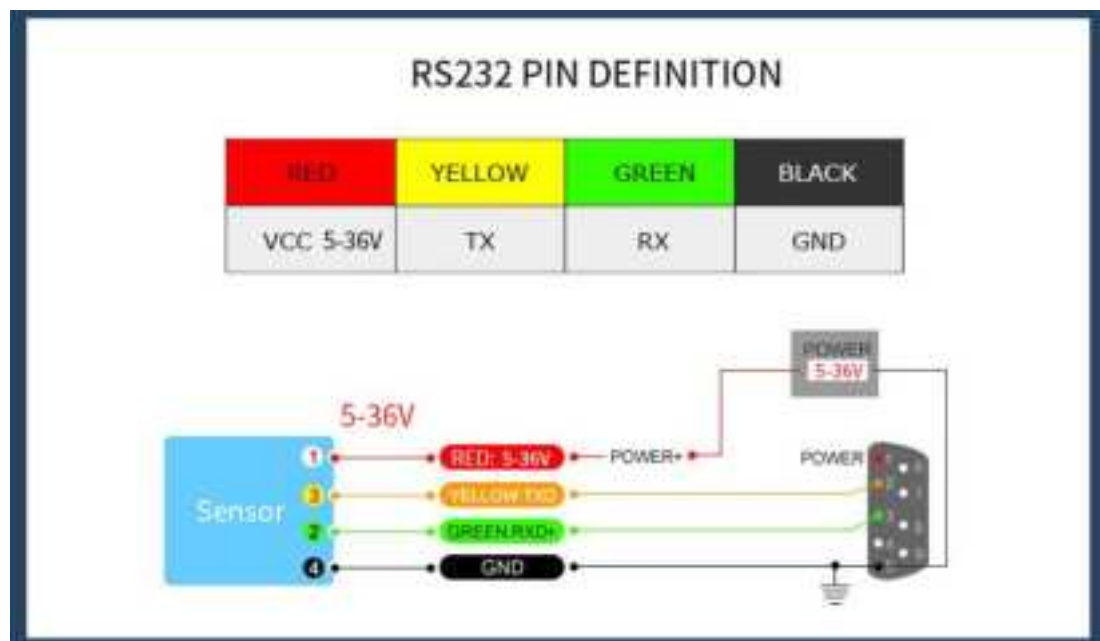
VCC - 5~36V

TX - Yellow

RX - Green

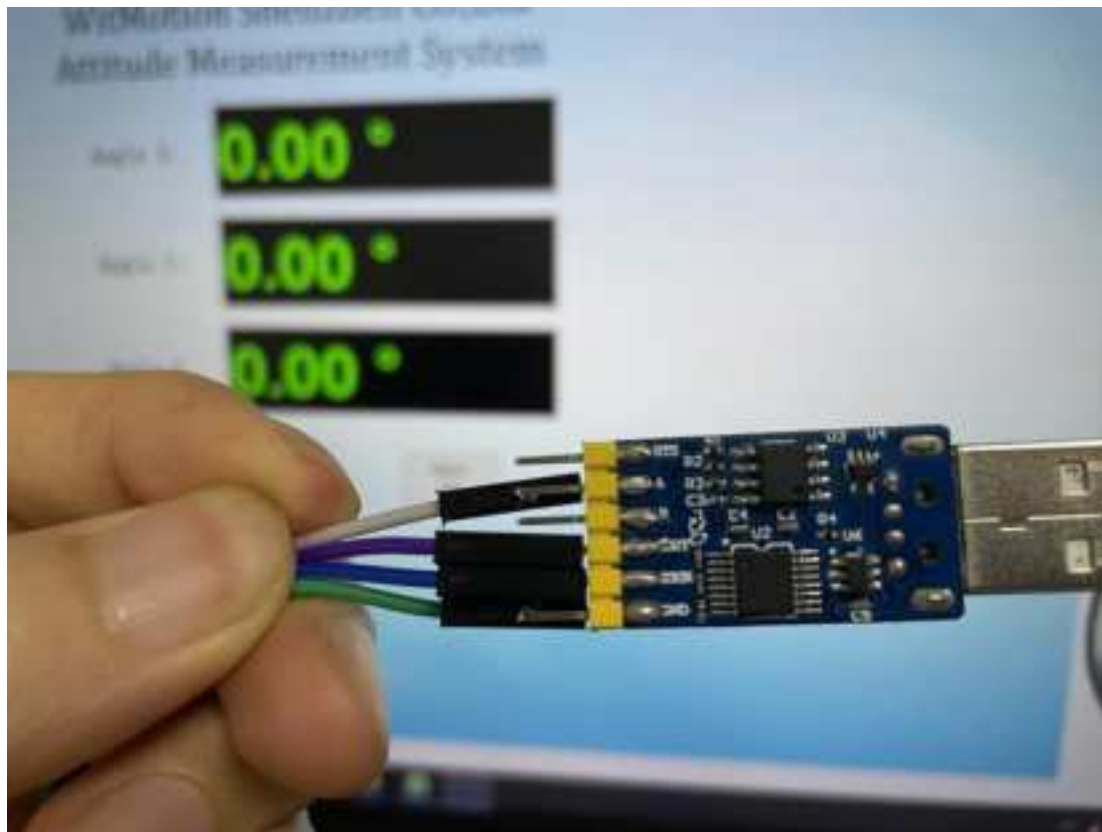
GND - GND

(When connecting with computer, VCC-5-36V is recommended.)



Please check the wiring picture to help you connect.





Recommended tools:



3-in-1 converter



6-in-1 converter



RS232 serial cable

Step 2. Unzip the software and install the driver CH340 or CP2102
(Depending on which accessory for usage.)

[Link to tutorial of 3-in-1 serial converter/ RS232 serial cable \(CH340 driver\)](#)

[Link to tutorial of 6-in-1 serial converter \(CP2102 driver\)](#)

Step 3. Plugin the converter to computer and confirm the “com port” in device manager



Step 4. Open the software(Minimu.exe)
Data will appear after auto-search finishes

Notice: If not successful, please operate manually
Choose the com port and baud rate 9600, data will be shown on the software.

(Old version software instruction)

3.2 Software Introduction

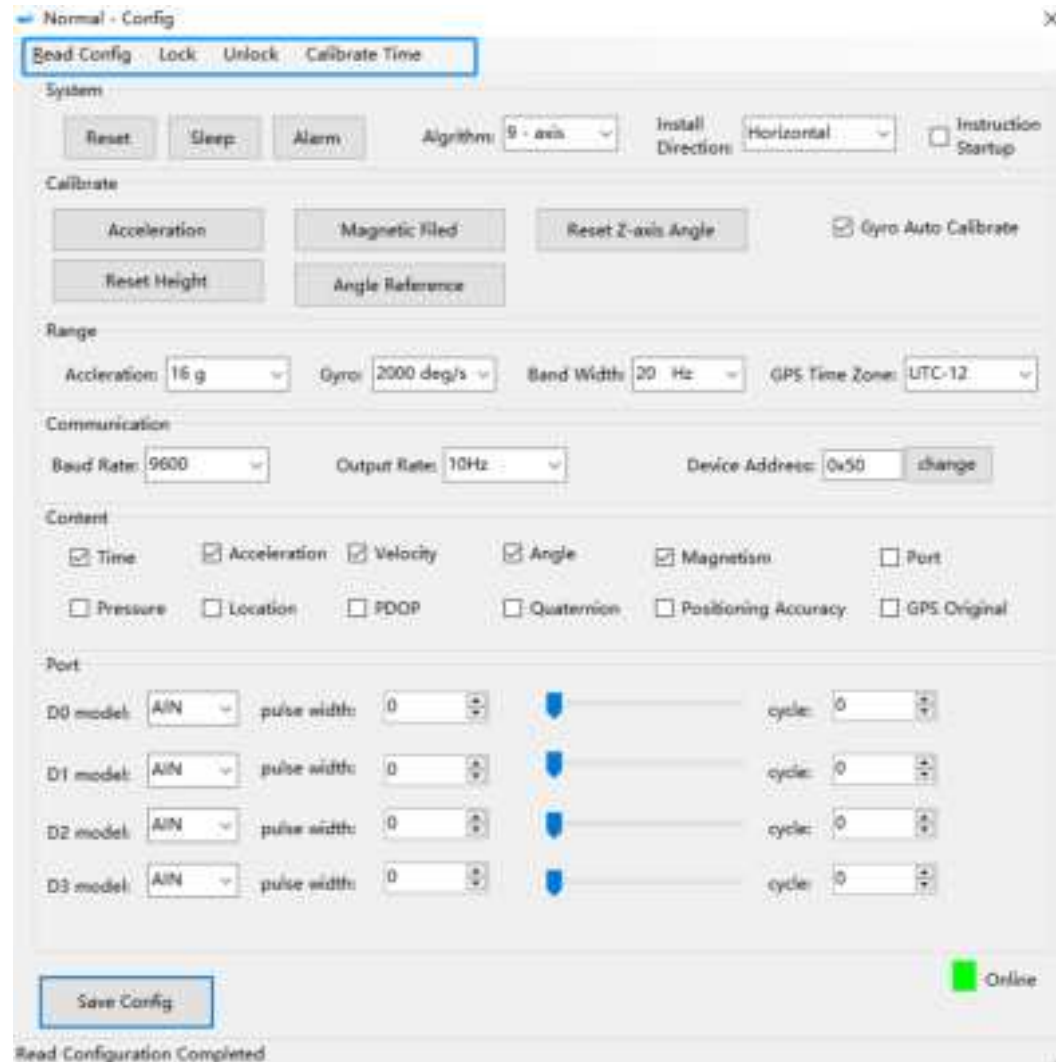
[Link to download software](#)

3.2.1 Main Menu



Main Menu of software		
Button		Function
File		Launch recorded HEX file (Bin format)
Tools		Hide or display tools box on left side
Record		Record function
3D		3D DEMO
Config		Configuration setting
Help	Language	English or Chinese
	Bluetooth Set	Binding device or unbind
	Firmware update	Option for firmware update
	About Minimu	Info about Minimu.exe
	Factory test	For manufacturer internal test only
Auto-search		Auto searching the sensor
Port		Com port selection
Baud		Baud rate selection
Type		Fixed setting as Normal for WT901C
Open		Open com port
Close		Close com port

3.2.2 Menu of Configuration



The screenshot shows the 'Normal - Config' window with the following sections:

- System:** Buttons for 'Reset', 'Sleep', and 'Alarm'. 'Algorithm' is set to '9-axis'. 'Install Direction' is 'Horizontal'. 'Instruction Startup' is unchecked.
- Calibrate:** Buttons for 'Acceleration', 'Magnetic Filed', 'Reset Z-axis Angle', 'Reset Height', and 'Angle Reference'. 'Gyro Auto Calibrate' is checked.
- Range:** 'Acceleration' is '16 g', 'Gyro' is '2000 deg/s', 'Band Width' is '20 Hz', and 'GPS Time Zone' is 'UTC-12'.
- Communication:** 'Baud Rate' is '9600', 'Output Rate' is '10Hz', and 'Device Address' is '0x50' with a 'change' button.
- Content:** Checkboxes for 'Time', 'Acceleration', 'Velocity', 'Angle', 'Magnetism', 'Port', 'Pressure', 'Location', 'PDOP', 'Quaternion', 'Positioning Accuracy', and 'GPS Original'. 'Time', 'Acceleration', 'Velocity', 'Angle', and 'Magnetism' are checked.
- Port:** Four rows for D0, D1, D2, and D3 models, each with a dropdown (all set to 'AIN'), 'pulse width' (all set to '0'), a status indicator (all blue), and 'cycle' (all set to '0').
- Buttons:** 'Save Config' and 'Online' (green indicator).

Read Configuration Completed

Menu of Configuration	
Button	Function
Read Config	Reading the current configuration
Lock	Lock the sensor
Unlock	Unlock the sensor
Calibrate Time	Calibration time of chip
Save Config	Save configuration



Menu of System	
Button	Function
Reset	Reset to factory setting
Sleep	Sleep function
Alarm	Alarm function
Algorithm	6-axis algorithm or 9-axis
Installation Direction	Vertical or horizontal installation
Instruction Start-up	Instructions sending to start-up the sensor

Instruction Start-up:

This function is used to prevent the data sent by the module after connecting to the computer to conflict with the mouse, causing the mouse to jump. After checking this function, the function will take effect the next time the module is used, or it can take effect when the module is powered on again.



Menu of Calibrate	
Button	Function
Acceleration	Accelerometer calibration
Magnetic Field	Magnetometer calibration
Reset Height	Reset height data to 0 (only for sensor built-in barometer, including WT901B, WTGAHRS2, WTGAHRS1, HWT901B)
Reset Z-axis Angle	Reset Z-axis angle to 0 degree, not available for WT901C in 9-axis algorithm
Angle Reference	Setting current angle as 0 degree
Gyro Auto Calibrate	Auto-calibration of gyroscope



Menu of Range	
Button	Function
Acceleration	Acceleration measurement range
Gyro	Gyroscope measurement range
Band Width	Bandwidth range
GPS Time Zone	GPS positioning of time zone

Communication

Baud Rate: 9600 Output Rate: 10Hz Device Address: 0x50 [change](#)

Menu of Communication	
Button	Function
Baud Rate	Baud rate selection
Output Rate	Return rate selection
Device Address	Interface for R&D

Content

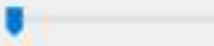
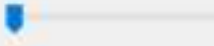
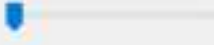
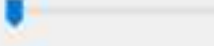
☒ Time
 ☒ Acceleration
 ☒ Velocity
 ☒ Angle
 ☒ Magnetism
 ☐ Port

☐ Pressure
 ☐ Location
 ☐ PDOP
 ☐ Quaternion
 ☐ Positioning Accuracy
 ☐ GPS Original

Menu of Content	
Button	Function
Time	Time data output
Acceleration	Acceleration data output
Velocity	Angular velocity data output
Angle	Angle data output
Magnetism	Magnetic field data output
Port	Port data output
Pressure	Pressure output, only available with the sensor built-in barometer like HWT901B, WTGAHRS2, WT901B, etc
Location	Latitude&Longitude data output, only for GPS IMU series, such as WTGAHRS1, WTGAHRS2
PDOP	Ground velocity data output, only for GPS IMU series, such as WTGAHRS1, WTGAHRS2
Quaternion	Quaternion data output
Positioning Accuracy	Option for GPS positioning accuracy output, including Satellite quantity, PDOP, HDOP, VDOP data, only for GPS IMU series, such as WTGAHRS1, WTGAHRS2
GPS Original	Only output GPS raw data, only for GPS IMU series, such as WTGAHRS1, WTGAHRS2

Menu of Port	
D0 Model	Extended port D0
D1 Model	Extended port D1
D2 Model	Extended port D2
D3 Model	Extended port D3
Pulse width	Pulse width of PWM
Cycle	Cycle of PWM

Port

D0 model:	AIN	pulse width:	0		cycle:	0
D1 model:	AIN	pulse width:	0		cycle:	0
D2 model:	AIN	pulse width:	0		cycle:	0
D3 model:	AIN	pulse width:	0		cycle:	0

3.3 Calibration

Preparation:

Make sure the sensor is "Online".

Calibration on PC software:

It is required to calibrate for the first time usage.

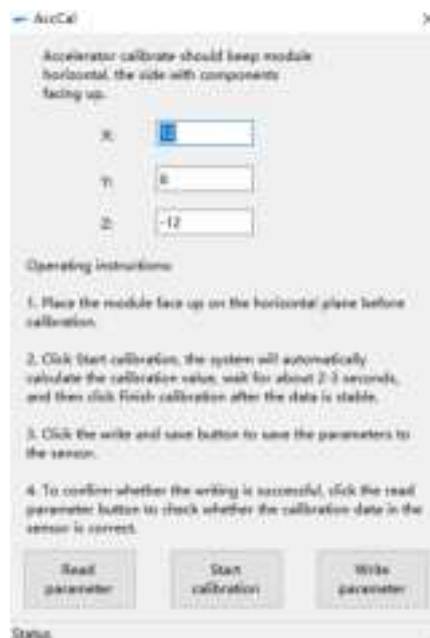
3.3.1 Accelerometer Calibration

Purpose:

The accelerometer calibration is used to remove the zero bias of the accelerometer. Before calibration, there will be different degrees of bias error. After calibration, the measurement will be accurate.

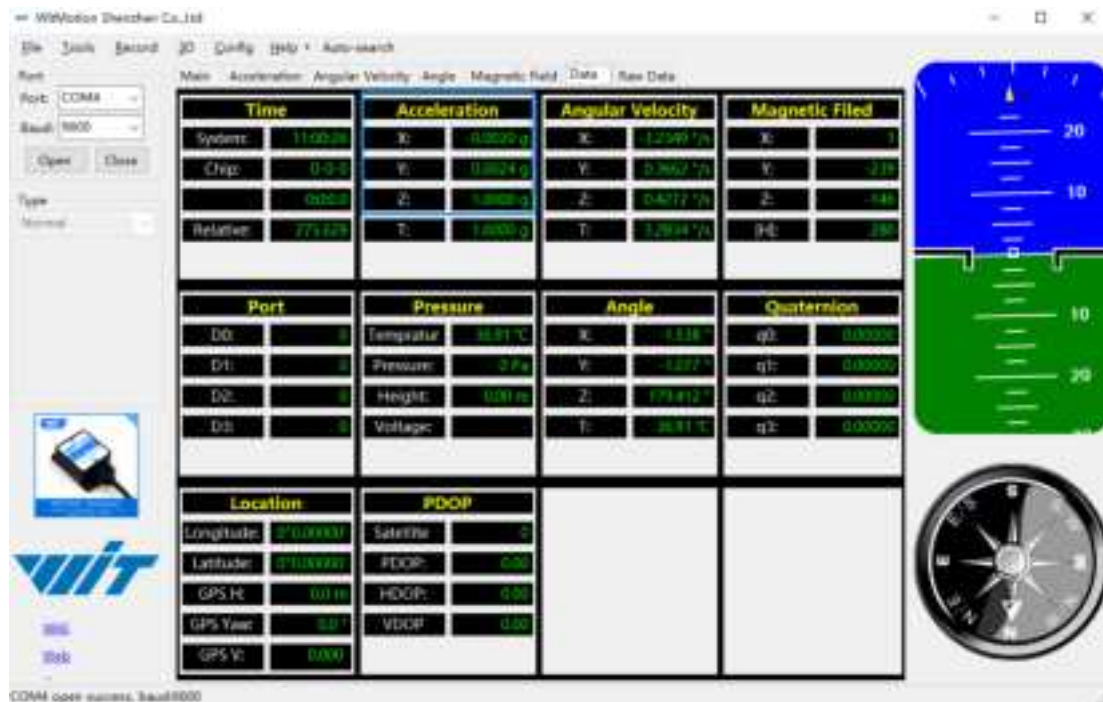
Methods:

- Step 1. Keep the module horizontally stationary
- Step 2. Click the accelerometer calibration
- Step 3. Click the "Start calibration" and wait for 3 seconds



- Step 4. Click "Complete Calibration"

Step 5. Judge the result--confirm if there is 1g on Z-axis acceleration



1. After 1 ~ 2 seconds, the three axial acceleration value of the module is about 0, 0, 1, the X and Y axis Angle is around 0°. After calibration, the x-y axis Angle is accurate.

Note: When putting the module horizontal, there is 1g of gravitational acceleration on the Z-axis.

3.3.2 Magnetic Field Calibration

Purpose:

Magnetic calibration is used to remove the zero bias of the magnetic field sensor. Usually, the magnetic field sensor will have a large zero error when it is manufactured. If it is not calibrated, it will bring a large measurement error, which will affect the accuracy of the measurement of the z-axis Angle of the heading Angle.

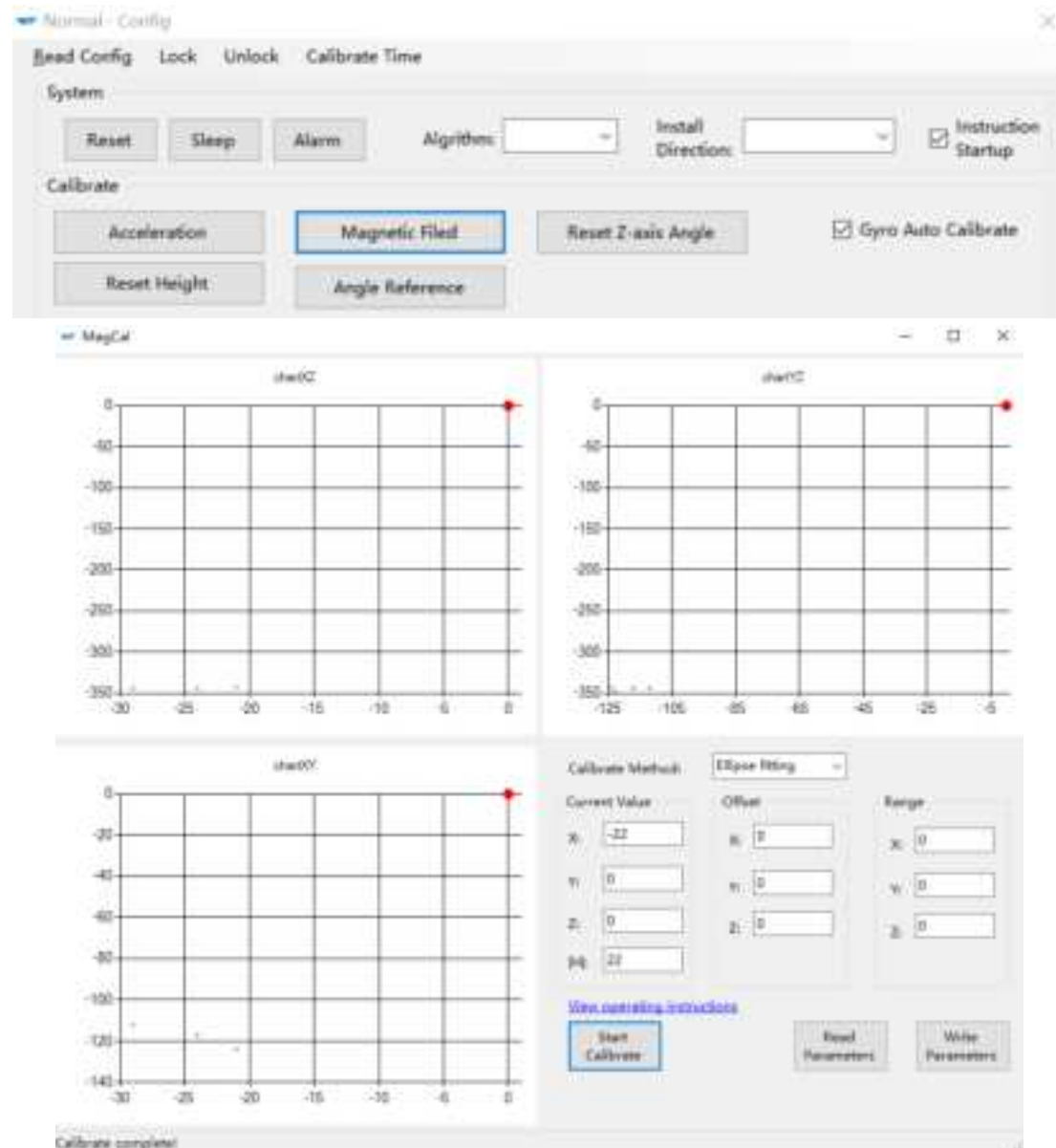
Preparation:

Sensors should be 20CM away from magnetic and iron and other materials

Methods:

Step 1. Open the Config menu

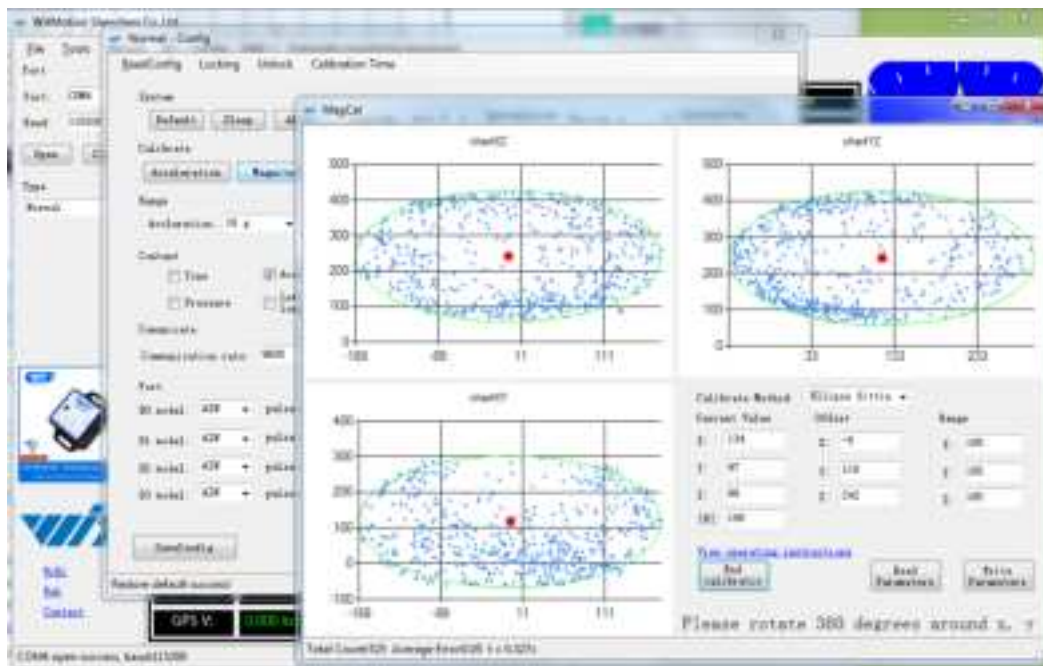
Step 2. Click the magnetic field calibration button. click the “Start calibration”



Step 3. Slowly rotate the module 360° around X, Y, Z, 3-axis accordingly



Step 4. After rotation, click "End calibration"



Successful result:

Most of data dots will be within the ellipse.

If not successful, please stay away from the objective that can create magnetic field interference.

3.3.3 Gyroscope Automatic Calibration

The gyroscope calibration is to calibrate the angular velocity, and the sensor will calibrate automatically.

It is recommended that the automatic calibration of gyroscopes can be inactivated only if the module rotates at a constant speed.



3.3.4 Reset Z-axis Angle

Note: If you want to avoid magnetic interference, you can change the algorithm to Axis 6, then you can use reset function of "Reset Z-axis angle".

The z-axis angle is an absolute angle, and it takes the northeast sky as the coordinate system can not be relative to 0 degree.

Z axis to 0 is to make the initial angle of the z axis angle is relative 0 degree. When the module is used before and z - axis drift is large, the z - axis can be calibrated, When the module is powered on, the Z axis will automatically return to 0.

Calibration methods as follow: firstly keep the module static, click the "Config" open the configuration bar and then click "Reset Z-axis Angle" option, you will see the the angle of the Z axis backs to 0 degree in the module data bar.

3.3.5 Reset Height to 0

Only available for the module built-in barometer like WT901B, HWT901B, WTGAHRS1, WTGAHRS2.

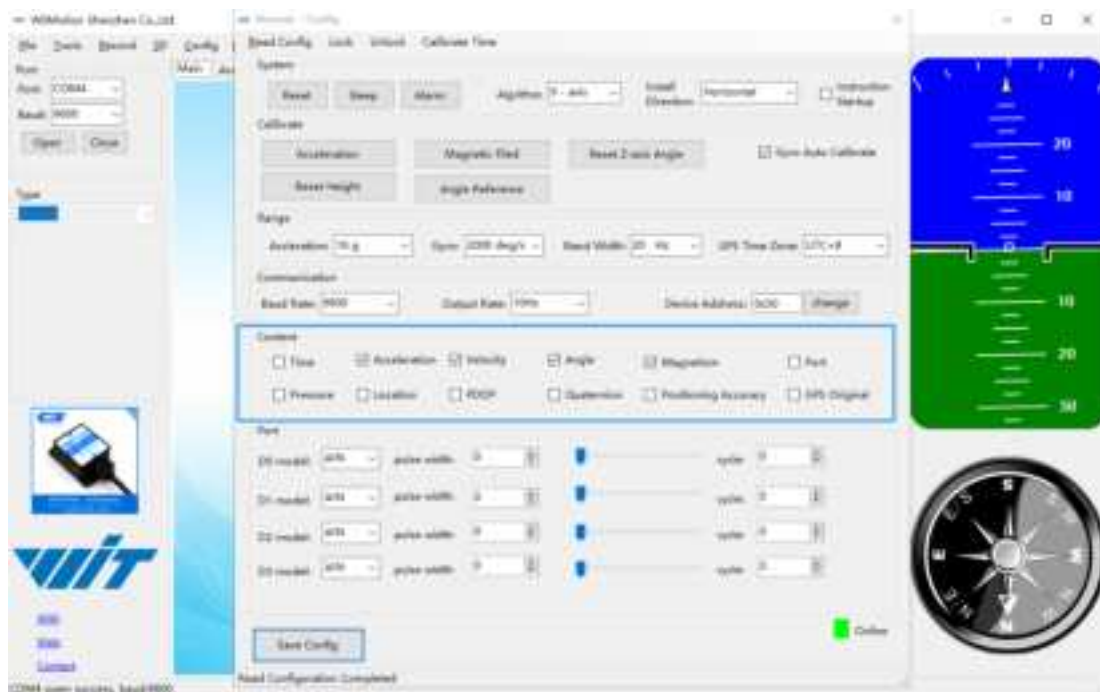
3.4 Configuration

3.4.1 Return Content

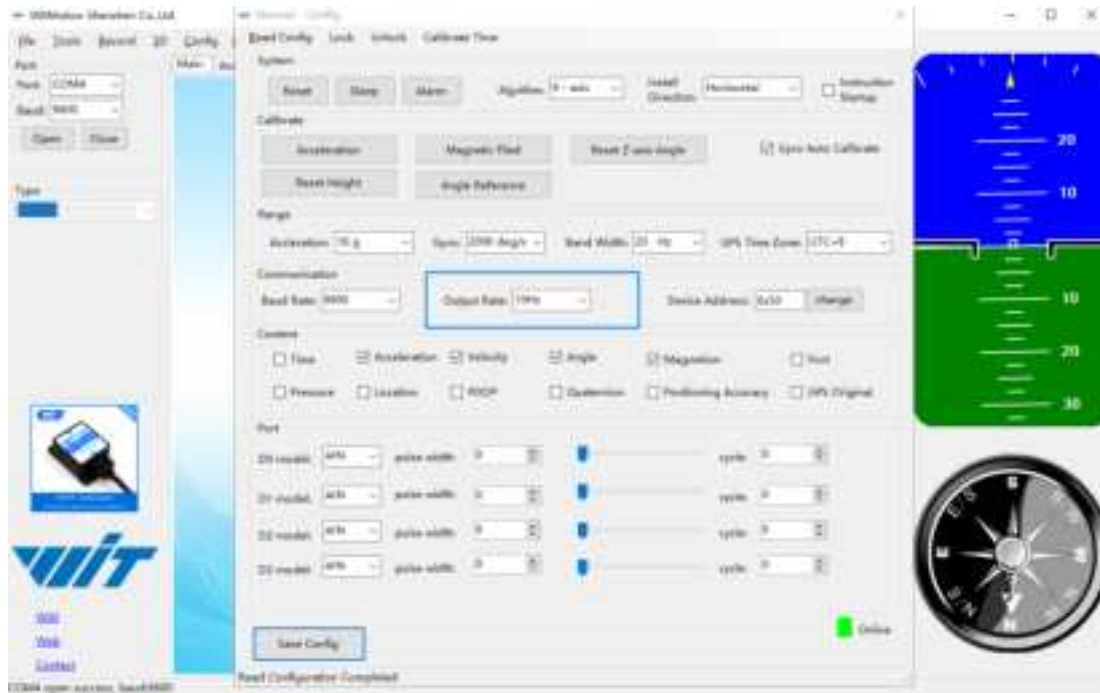
Setting method: The content of the data return can be set according to user needs, click the configuration option bar, and check the data content to be output.

Taking WT901C as an example, the default output of the module is acceleration, angular velocity, angle, and magnetic field.

Notice: If choosing the GPS Original, there will be no other data output.



3.4.2 Output Rate



The default return rate of the module is 10Hz, the highest return rate supports 200Hz.

10Hz refers to the return of 10 data packets in 1S. 1 data packet is 33 bytes by default.

Note: If there are more backhaul contents and the communication baud rate is lower, it may not be possible to transmit so much data. Then the module will automatically reduce the frequency and output at the maximum allowable output rate. To put it simply, if the return rate is high, the baud rate should also be set higher, generally 115200.

3.4.3 Baud Rate

The module supports multiple baud rates, and the default baud rate is 9600. To set the baud rate of the module, you need to select the baud rate to be changed in the communication rate drop-down box in the configuration bar based on the correct connection between the software and the module.

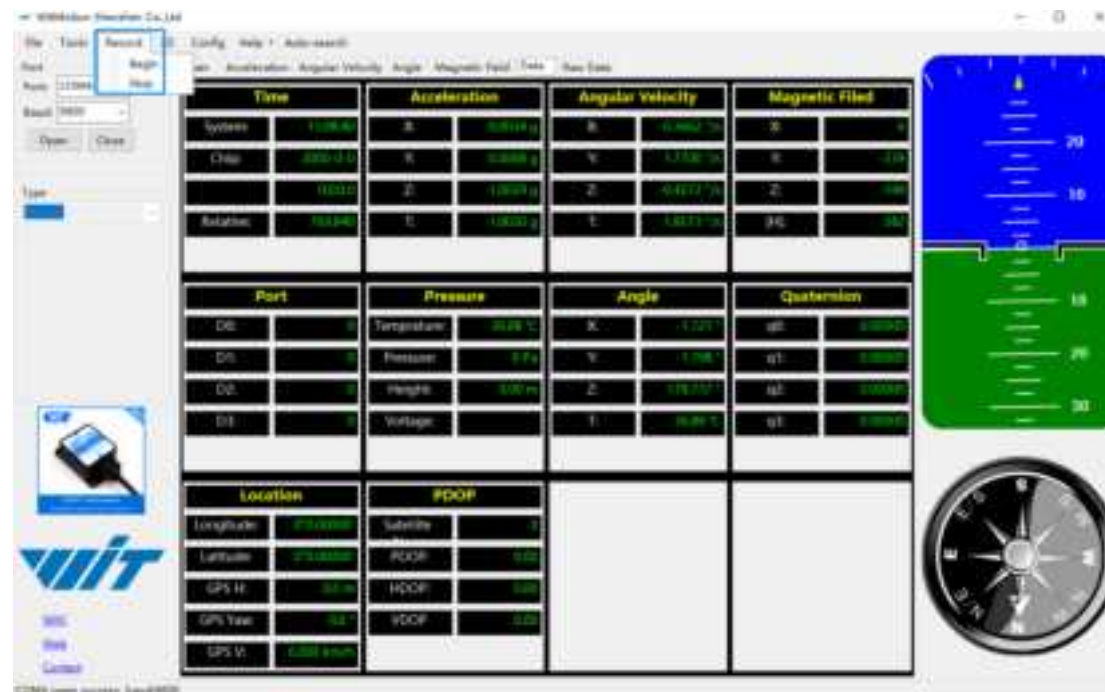
Note: After the change, the module will no longer output data at the original baud rate. The data will be output only when the baud rate that has been changed is selected on the PC software again.

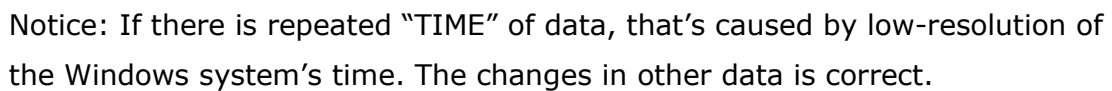
3.4.4 Data Recording

Method are as follows:

Step 1: Click "Record" and "Begin"

Step 2: Click "Stop"





Starttime: 2020-04-11 18:54:24.457																			
Address	Time(s)	ChpTime(s)	az(deg)	az(deg)	wz(deg)	wz(deg)	wz(deg)	Angle0(deg)	Angle1(deg)	Angle2(deg)	T(°)	fr	fg	fz					
0x50	43.06.4	02.40.4	0.4443	0.1777	-0.6696	1.1738	0.5882	-28.541	168.0356	-26.072	120.0299	28.97	0	30	333				
0x50	43.06.5	02.40.5	0.02	0.5794	-0.7739	192.0166	263.8955	-700.2569	142.0532	-24.864	154.8907	30	-29	7	313				
0x50	43.06.6	02.40.6	-0.2999	0.8589	-0.5571	-6.2397	1.7842	-264.5264	124.0241	20.0171	158.2196	30	-7	85	281				
0x50	43.06.7	02.40.7	0.7771	0.5322	-0.4761	50.0718	45.8232	-228.8677	152.984	41.4514	158.0872	30	58	-95	289				
0x50	43.06.8	02.40.8	-0.5601	0.4233	-0.5362	55.7881	101.3697	-274.1688	146.5657	35.3792	132.4292	30	22	-58	301				
0x50	43.06.9	02.40.9	-0.0059	0.5503	-1.0103	126.0991	-32.7759	-632.231	161.4629	1.8073	174.1113	30	22	-6	308				
0x50	43.07.0	02.41.0	0.2656	0.3887	-0.8094	124.3886	7.8785	541.1885	154.8885	15.5686	167.3077	30.01	14	46	307				
0x50	43.07.1	02.41.1	0.8911	0.1104	-0.8487	40.7715	11.8819	-257.5417	177.3383	-29.7664	127.7325	30	0	104	284				
0x50	43.07.2	02.41.2	0.3896	0.3002	-0.8994	90.0879	135.3149	-268.8819	165.4001	31.9887	128.6829	30.03	-2	87	326				
0x50	43.07.3	02.41.3	0.2939	-0.9501	-0.2837	-291.5250	48.4645	-750.4272	118.0149	0.3625	174.1608	30.05	30	-36	295				
0x50	43.07.4	02.41.4	0.4614	0.7071	0.3384	-27.3436	-19.4702	-226.9287	112.9021	30.6019	161.8001	30	10	-122	272				
0x50	43.07.5	02.41.5	0.7988	0.6279	-0.5044	38.0762	81.7261	122.1924	122.0587	38.8035	151.1389	30	61	110	275				
0x50	43.07.6	02.41.6	0.2495	0.8185	-0.5327	36.377	3.6795	93.0176	121.8484	15.7214	-167.109	30	12	-108	288				
0x50	43.07.7	02.41.7	0.3057	0.7432	0.5998	74.0396	-0.061	579.7607	126.7695	-11.4478	176.6711	30.05	51	-68	295				
0x50	43.07.8	02.41.8	0.4922	0.4653	0.7129	154.7656	24.231	268.3819	140.5056	32.4756	163.3932	30.02	63	10	295				
0x50	43.07.9	02.41.9	0.4507	0.4272	-0.7671	186.5234	36.3139	420.6543	160.2619	48.1583	130.2024	30.02	86	71	292				
0x50	43.08.0	02.42.0	0.8045	-0.2602	-0.8027	37.8028	7.6284	-130.0005	175.4357	-48.8116	118.0206	30.03	68	73	296				
0x50	43.08.1	02.42.1	0.4712	0.6811	-0.5690	127.6885	7.1411	-337.8587	167.6312	61.3388	163.8171	30.03	78	10	306				
0x50	43.08.2	02.42.2	0.0948	0.873	0.4028	115.8816	2.3195	-276.2481	118.8481	0.6417	168.8791	29.98	57	301	293				
0x50	43.08.3	02.42.3	0.4092	0.856	0.1816	154.8877	38.208	-155.7007	99.8622	28.935	-165.945	30.03	52	106	244				
0x50	43.08.4	02.42.4	0.1171	0.8809	-0.1132	84.1064	0.9155	86.2427	94.8283	33.2666	167.3415	30.06	72	186	218				
0x50	43.08.5	02.42.5	-0.1782	0.9696	-0.2793	383.2881	28.5759	608.8604	110.7367	12.3929	160.0686	30.03	29	-154	245				

3.4.5 Data Playback

New function: When creating recorded file each time, there will a BIN file created in the folder of record file in path of installed software meanwhile.

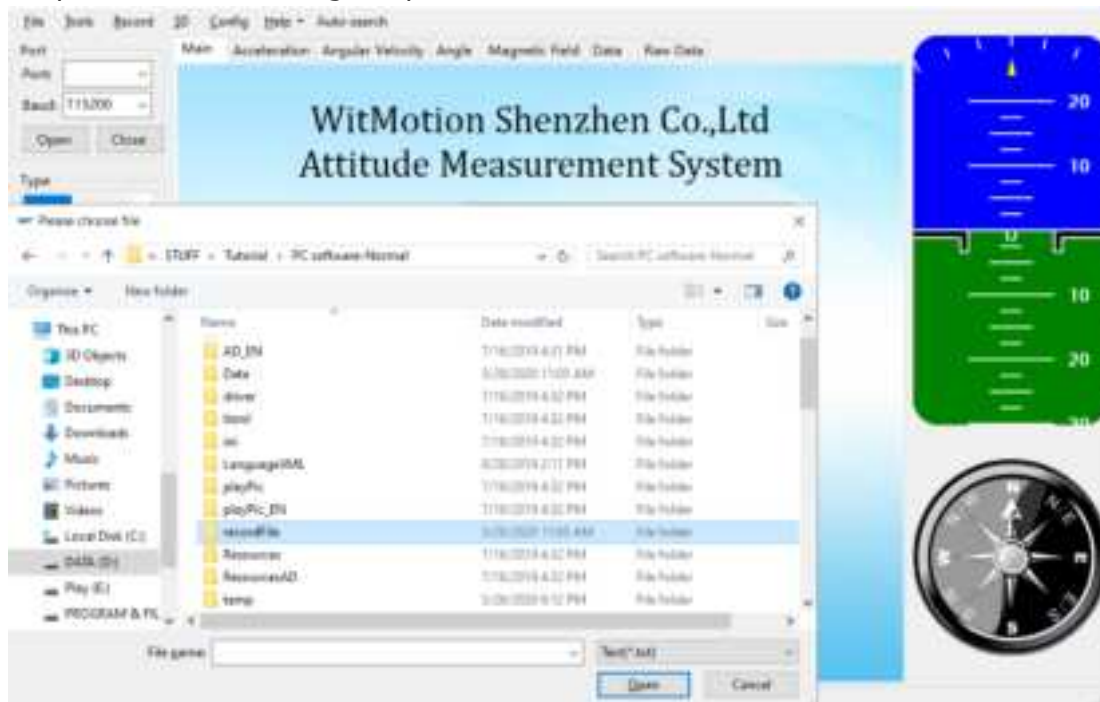
Recorded data playback method:

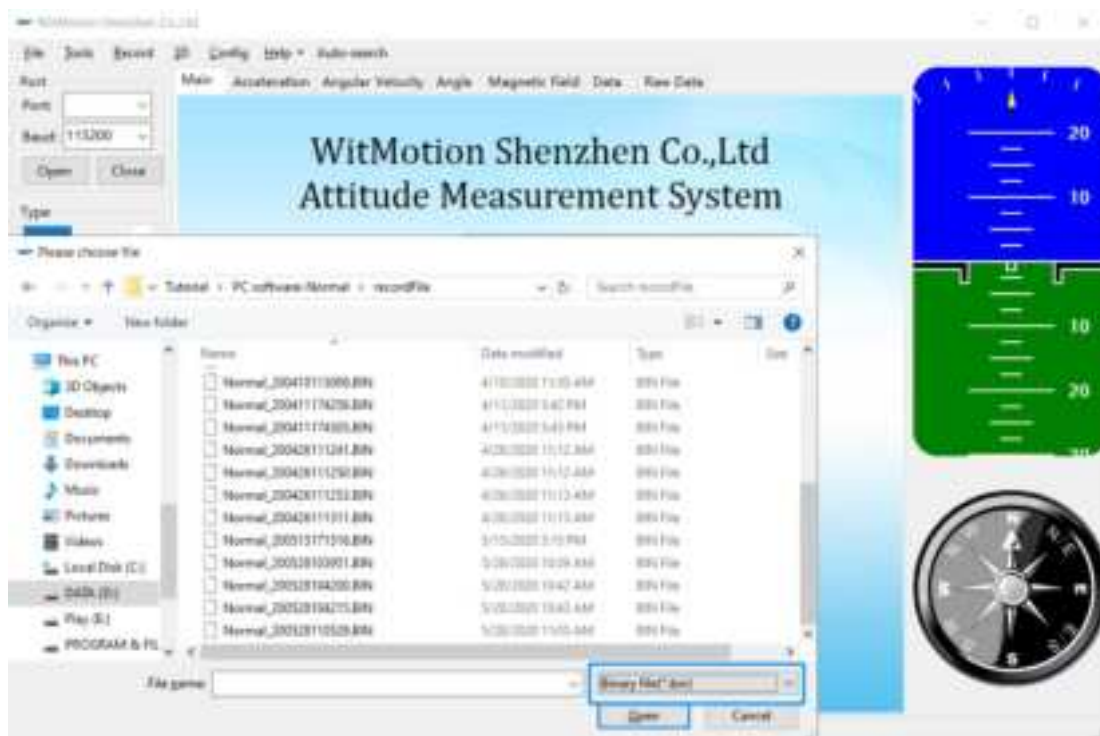
Step 1: Disconnect the sensor

Step 2: Click "File" Button and then click "Load"



Step 3: Choose the original path of software installation and load the Bin file





Step 4: Click "Run" and the Binary file will be playback
When playback, the rate can be editable.

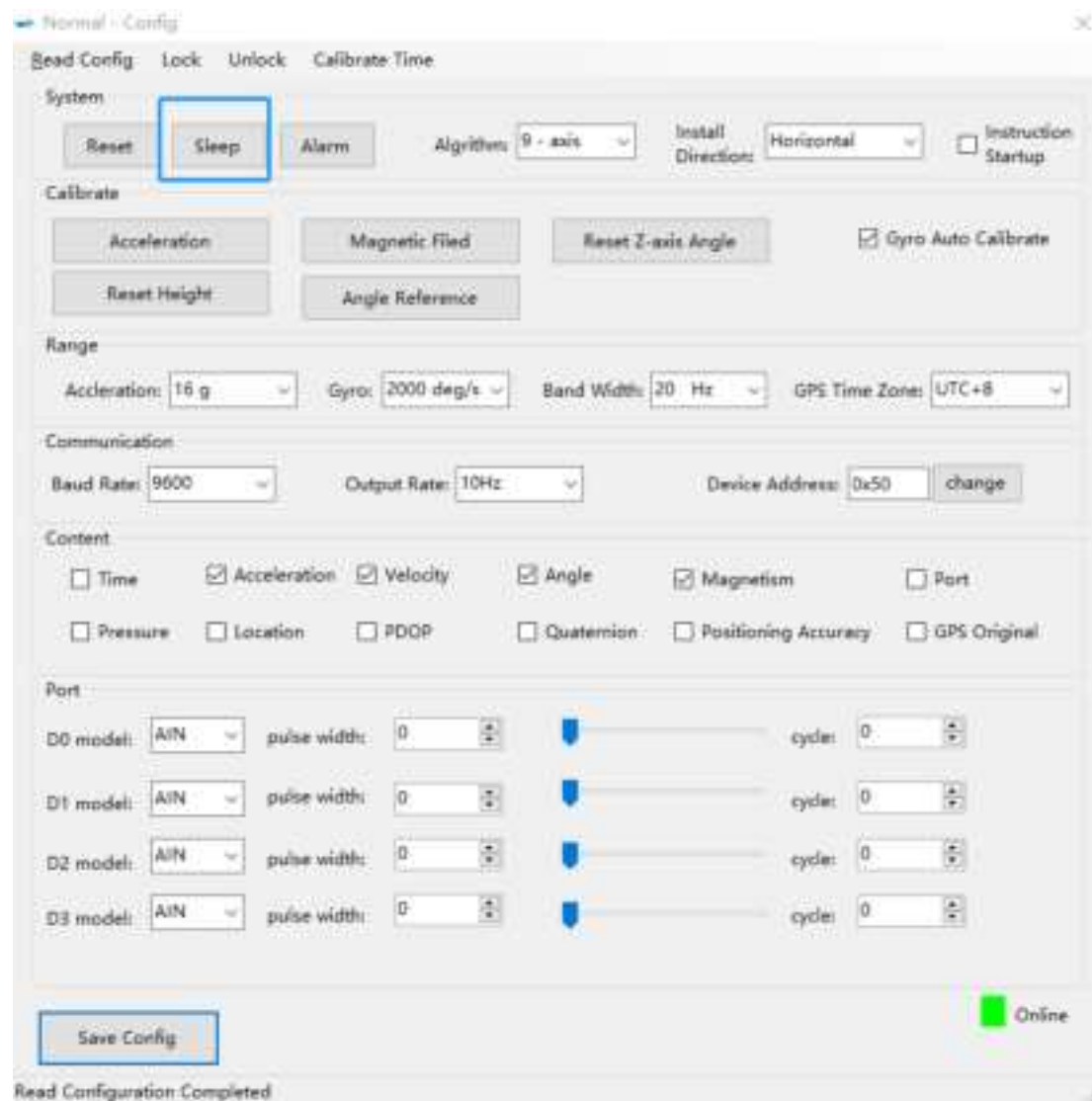


3.4.6 Standby and Wake Up

Sleep: The module paused working and entered the standby mode. Power consumption is reduced after sleeping.

Wake Up: The module enters the working state from the standby state.

The module defaults to a working state, in the “Config” of the software, click “Sleep” option to enter the sleep state, click “Sleep” again to release sleep.



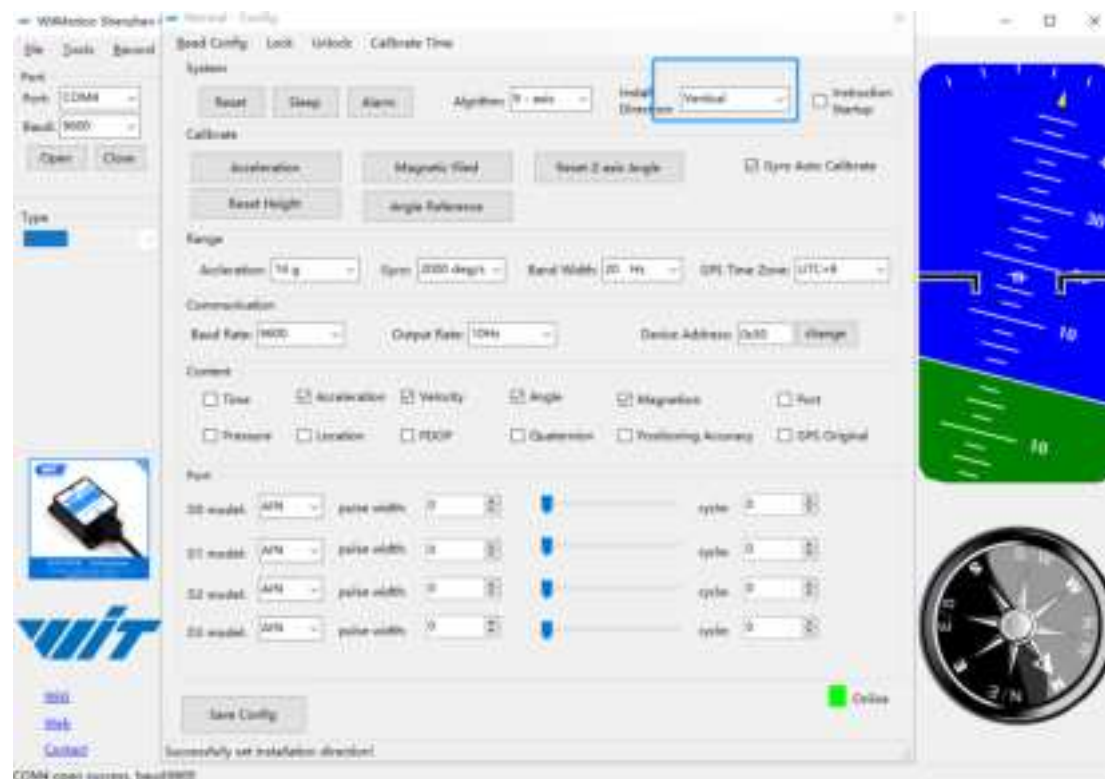
3.4.7 Placement Direction

The default installation direction of the module is horizontal. When the module needs to be installed vertically, the vertical installation can be set.

Step 1: Rotate the module 90 degrees around the X-axis

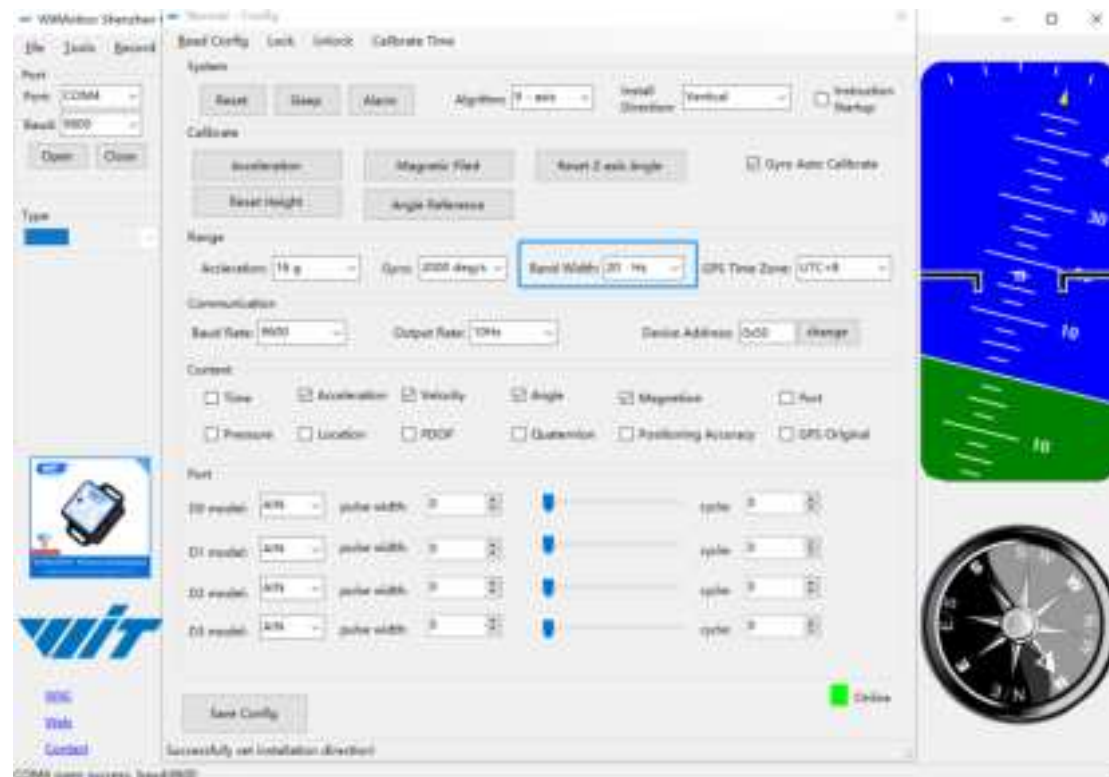
Step 2: Place the sensor 90 degrees vertically

Step 3: Click “Vertical” as install directions on “Config” menu



3.4.8 Bandwidth

Default bandwidth is 20Hz.

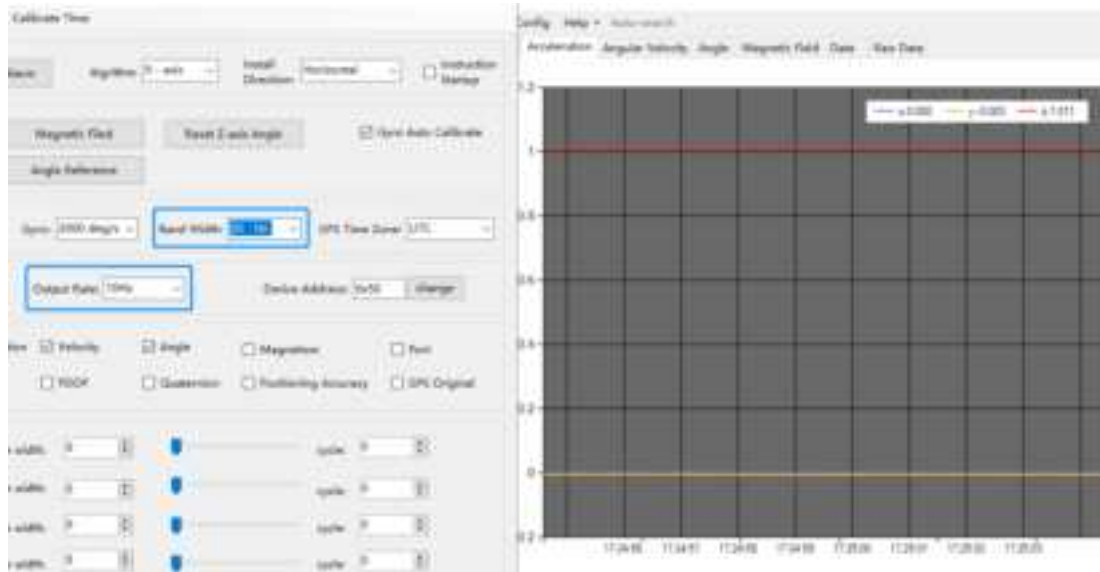


Function:

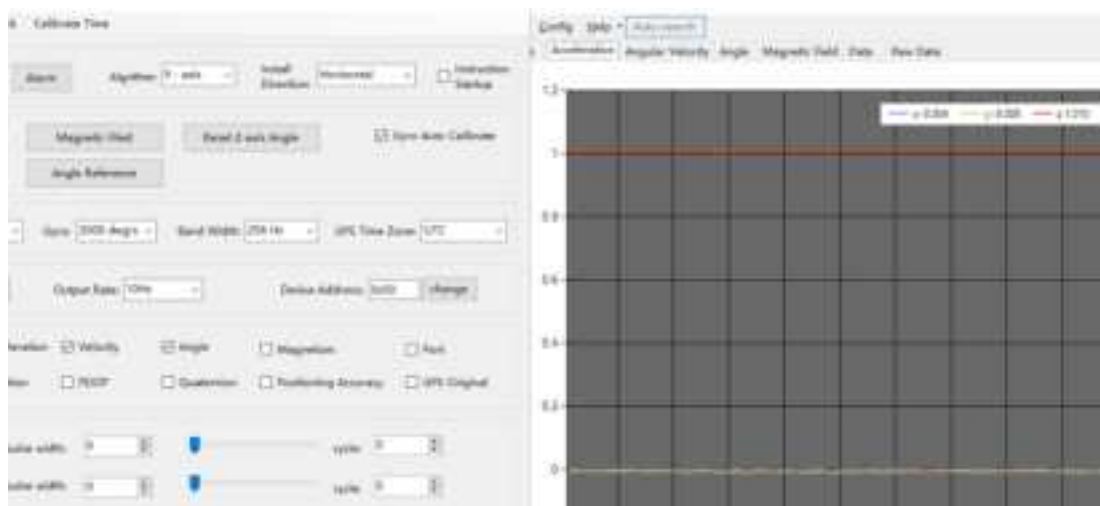
1. The higher rate of bandwidth setting will lead to the higher fluctuation in data waveform. Conversely, the lower rate of bandwidth, data will become more fluent.

For example:

Bandwidth as 20Hz, Output rate as 10Hz. The waveform is very steady.



Bandwidth as 256Hz, Output rate as 10Hz. The waveform will show more fluctuation.



2. The higher rate of bandwidth will solve the data-repeating problem.

For example, if the bandwidth setting is 20Hz, retrieval rate as 100Hz, there will be 5 repeating data.

If you prefer there is no repeating data, it is required to increase the bandwidth more than 100Hz.



3.4.9 Restore Factory Setting

Operation method:

Connect the WT901C module and the computer through the USB-TTL module, click the setting tab, and click to restore the default. After restoring the factory settings, power on the module again. (This method needs to know the baud rate of the module in advance, if the baud rate does not match the instruction will not take effect, please try to use the short circuit method to recover)

3.4.10 6-axis/ 9-axis Algorithm

6-axis algorithm: Z-axis angle is mainly calculated based on angular velocity integral. There will be calculated error on Z-axis angle.

9-axis algorithm: Z-axis angle is mainly calculated and analyzed based on the magnetic field. Z-axis angle will have few drift.

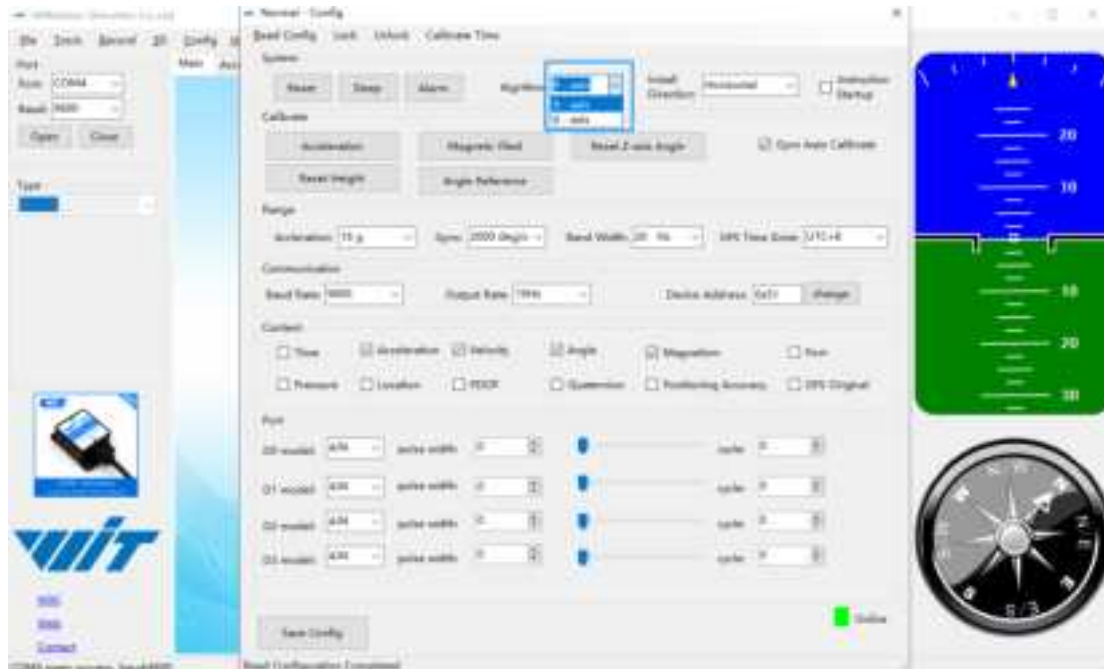
The default algorithm of WT901C is 9-axis. If there is magnetic field interference around installed environment, it is recommended to switch to 6-axis algorithm to detect the angle.

Method:

Step 1: Switch to the "6-axis" algorithm on "Config" menu

Step 2: Proceed the "Accelerometer calibration" and "Reset Z-axis angle" calibration.

After the calibration is completed, it can be used normally.



4 MCU Connection



[Link to download all sample code](#)

[Link to sample code instructions demo](#)