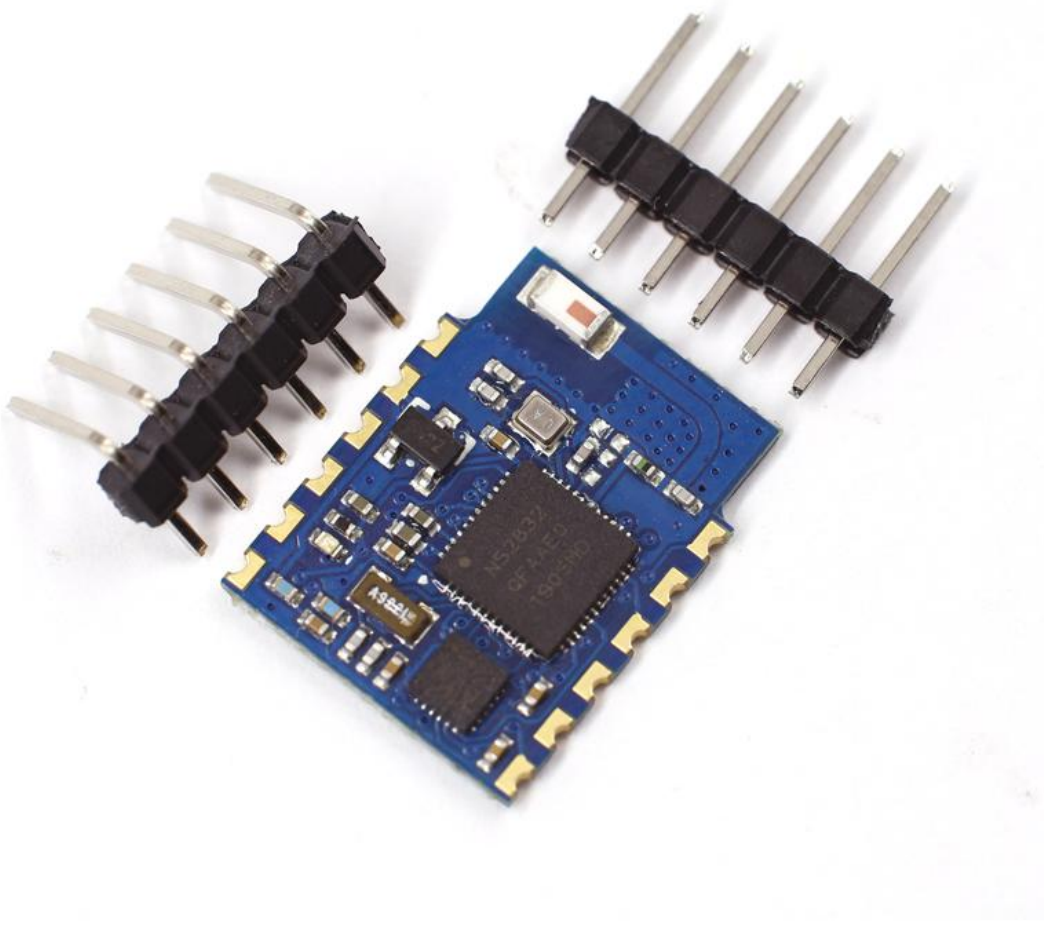
USER MANUAL

WT901BLE BLE5.0

Bluetooth 5.0 Inclinometer Sensor



Tutorial Link

Google Drive

Link to instructions DEMO:
WITMOTION Youtube Channel
WT901BLE 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

1 Introduction

The WT901BLE BLE5.0 is a multi-sensor device detecting acceleration, angular velocity, angle as well as magnetic filed. 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.

WT901BLE BLE5.0'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 the three-axis angle accurately.

It is employed where the highest measurement accuracy is required. WT901BLE BLE5.0 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, APP for Android smartphones, iOS APP for iPhone, 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.
- Do not change the baud rate because WITMOTION BLUETOOTH sensor's baud rate is fixed.
- For secondary developing project or integration: use WITMOTION with its compiled sample code.

1.2 LED Status

LED	Status	Remark
Blue	Flashing (connect with adapter)	Pairing succeeds
	Flashing (connect with Android APP)	Pairing succeeds

2 Use Instructions with PC

2.1 PC Connection

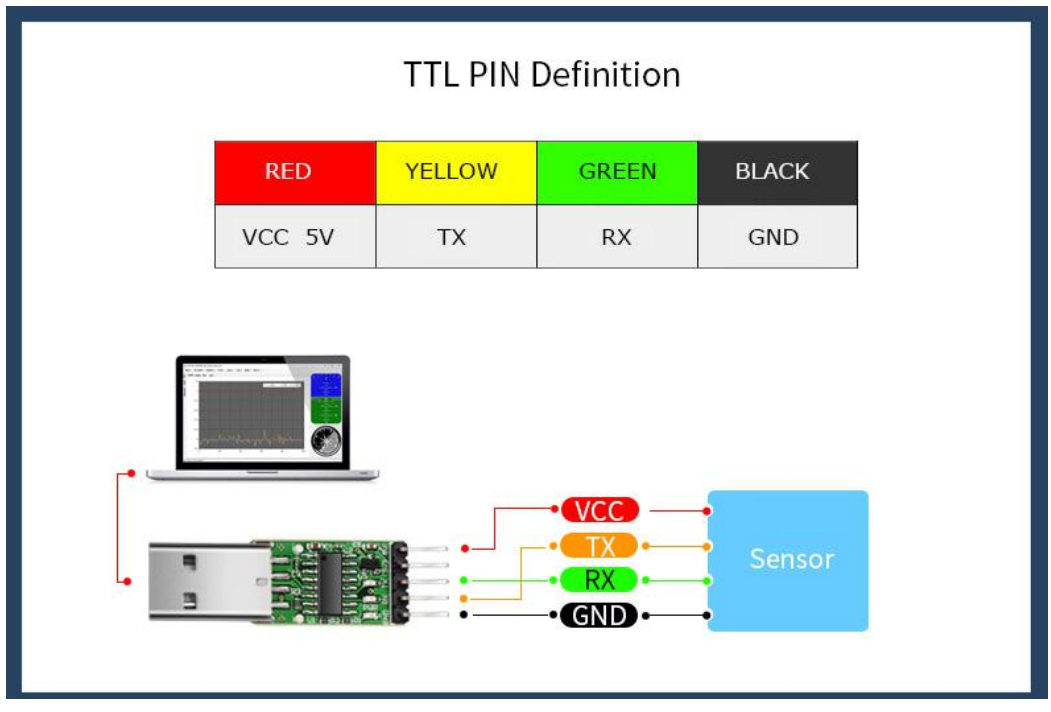
PC software is only compatible with Windows system.

Link to download software

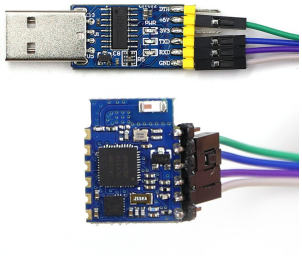
2.1.1 Serial Connection

Step 1. Connect the sensor with a serial converter
PIN Connection:
VCC - 5V
TX - RX
RX - TX
GND - GND

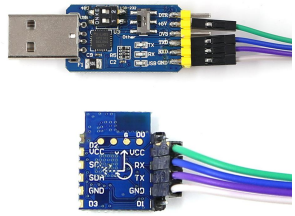
(When connecting with computer, VCC-5V is recommended.)



Recommended tools:



3-in-1 converter



6-in-1 converter

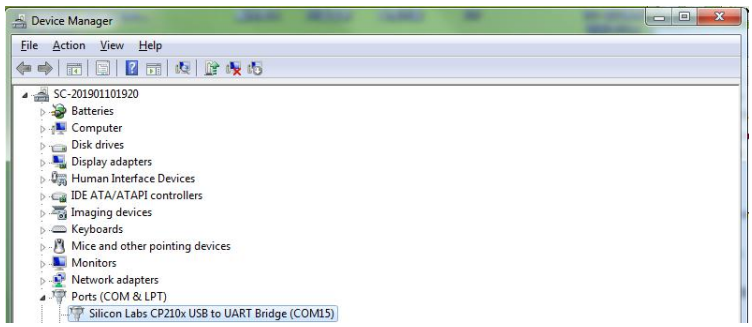
TTL serial cable

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/ TTL serial cable (CH340 driver)

Link to tutorial of 6-in-1 serial converter (CP2102 driver)

Step 3. 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 115200, data will be shown on the software.


WitMotion Shenzhen Co.,Ltd
File
Tools
Record
3D
Config
Help
Auto-search
Port
Port:
COM3
Baud:
115200
Open
Close
Type
Bluetooth 5.0
Transmit mode
Main
Acceleration
Angular Velocity
Angle
Magnetic Field
Data
Raw Data
WitMotion Shenzhen Co.,Ltd
Attitude Measurement System
Angle X:
0.13 °
Angle Y:
-1.40 °
Angle Z:
127.92 °
Acc Calibrate
WiKi
Web
Contact
20
10
10
20
E/S
N/E
S/W
N/W
M/N
COM3 open success, baud:115200

2.1.2 BLE 5.0 Adapter Connection

Adapter's CP2102 driver link

Step 1. Insert adapter into the USB port in the beginning

Step 2. Power on the sensor after blue light of adapter flashes

Step 3. Wait till the adapter's blue LED light keeps on--
means pairing succeeded

Step 4. Open the software, Minimu.exe

Step 5. Data will appear once the auto-search finished

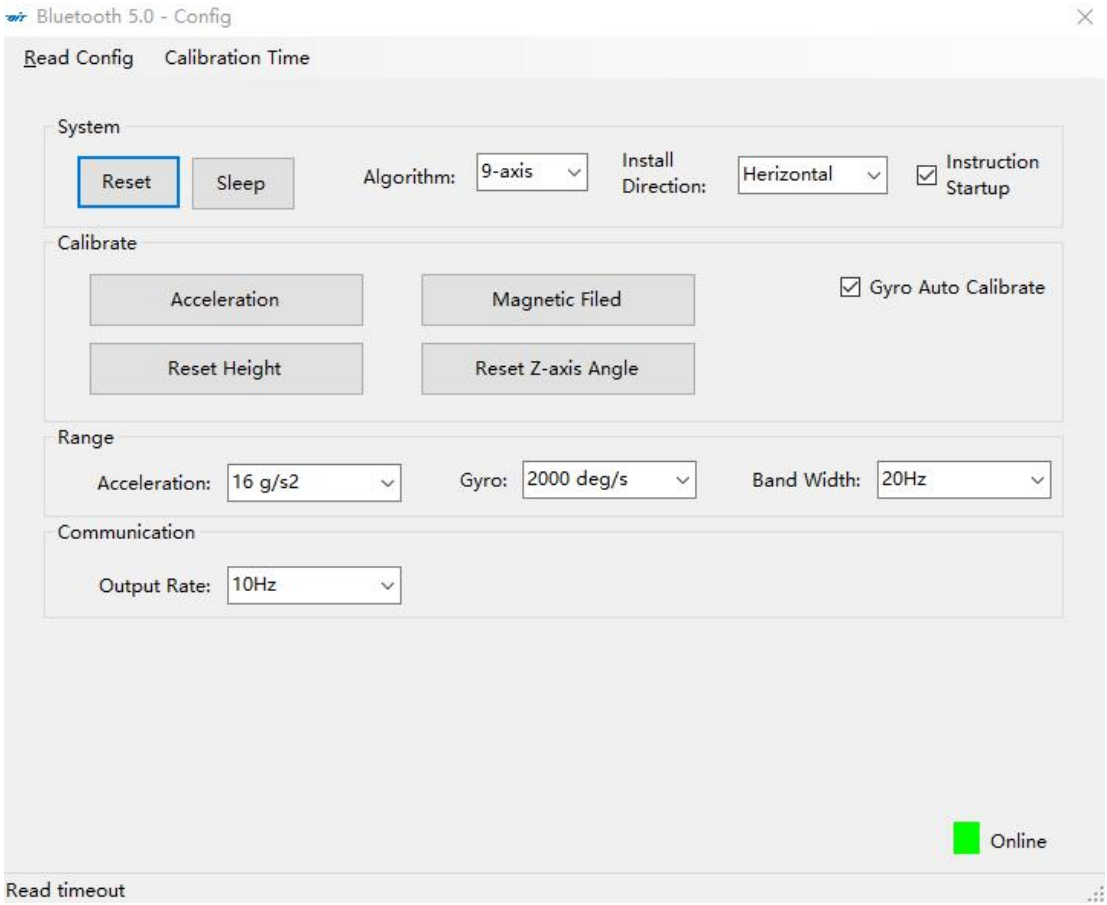
2.2 Software Introduction

2.2.1 Main Menu

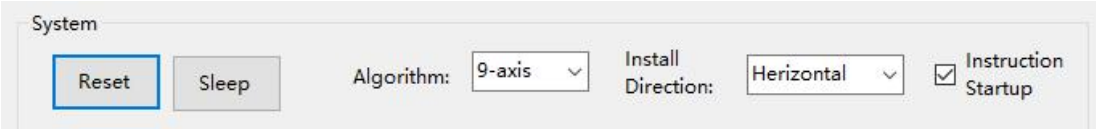
Main Menu of software		
Button		Function
File		Launch recorded HEX file (Bin format)
Tools		Hide or display tools box on left side
Record		Record function
3D		3D DEMO
Config		Configuration setting
Help	Language	English or Chinese
	Bluetooth Set	Binding device or unbind
	Firmware update	Option for firmware 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 Bluetooth 5.0 for WT901BLE BLE5.0
Open		Open com port

Close	Close com port

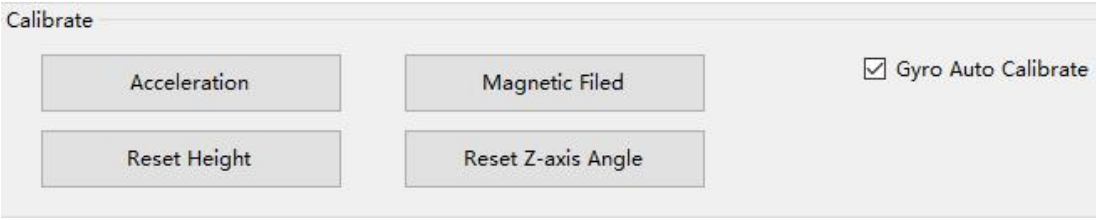
2.2.2 Menu of Configuration



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

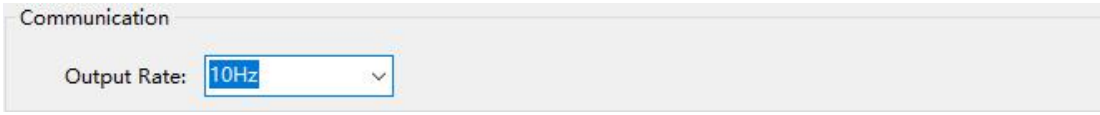


Menu of System	
Button	Function
Reset	Reset to factory setting
Sleep	Sleep function, not available for Bluetooth sensor series
Algorithm	6-axis algorithm or 9-axis
Installation Direction	Vertical or horizontal installation
Instruction Start-up	Instructions sending to start-up the sensor



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, WTAHRS2, WTHARS1, HWT901B)
Reset Z-axis Angle	Reset Z-axis angle to 0 degree, not available for WT901BLE BLE5.0 in 9-axis algorithm
Gyro Auto Calibrate	Auto-calibration of gyroscope

Menu of Range	
Button	Function
Acceleration	acceleration measurement range (2/4/8/16g/s2)
Gyro	gyroscope measurement range (250/500/1000/2000 deg/s)
Band Width	Bandwidth range (5/10/20/42/98/188/256Hz)



Menu of Communication	
Button	Function
Output Rate	Return rate selection

2.3 Calibration

Preparation: Ensuring the sensor is “Online”.

Calibration on PC software:

It is required to calibrate for the first time usage.

2.3.1 Accelerometer Calibration

Purpose:

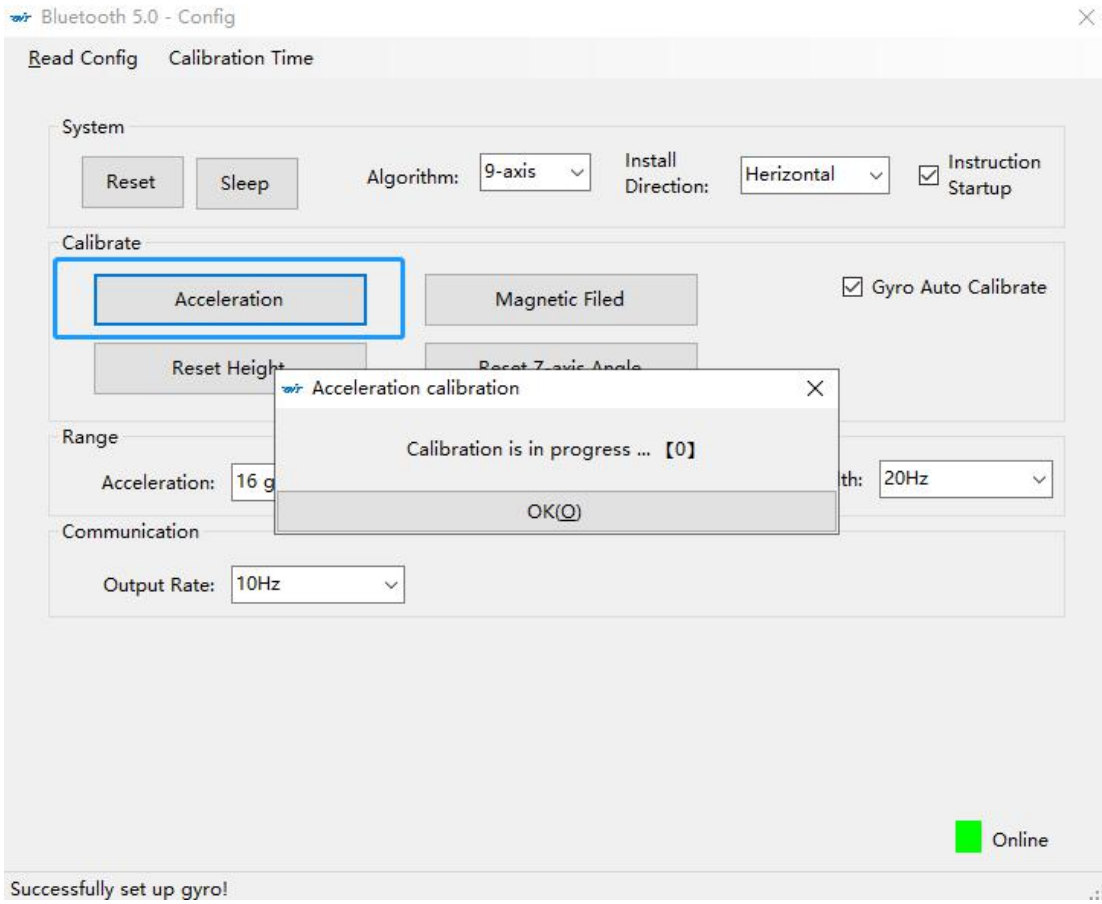
The accelerometer calibration is used to remove the zero bias of the accelerometer. Before calibration, there will be different degrees of bias error. After calibration, the measurement will be accurate.

Methods:

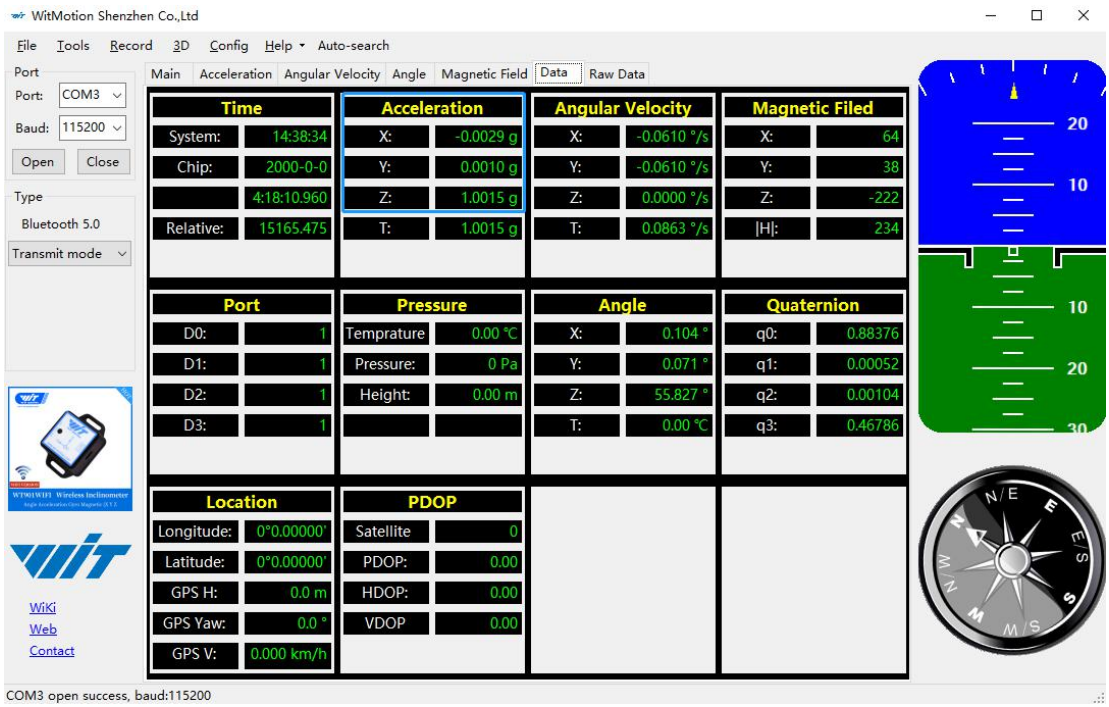
Step 1. Keep the module horizontally stationary

Step 2. Click the acceleration in the “Config” and wait for 5 seconds

Step 3. Calibration done if OK shows



Step 4. Check the result--confirm if there is 1g on Z-axis acceleration



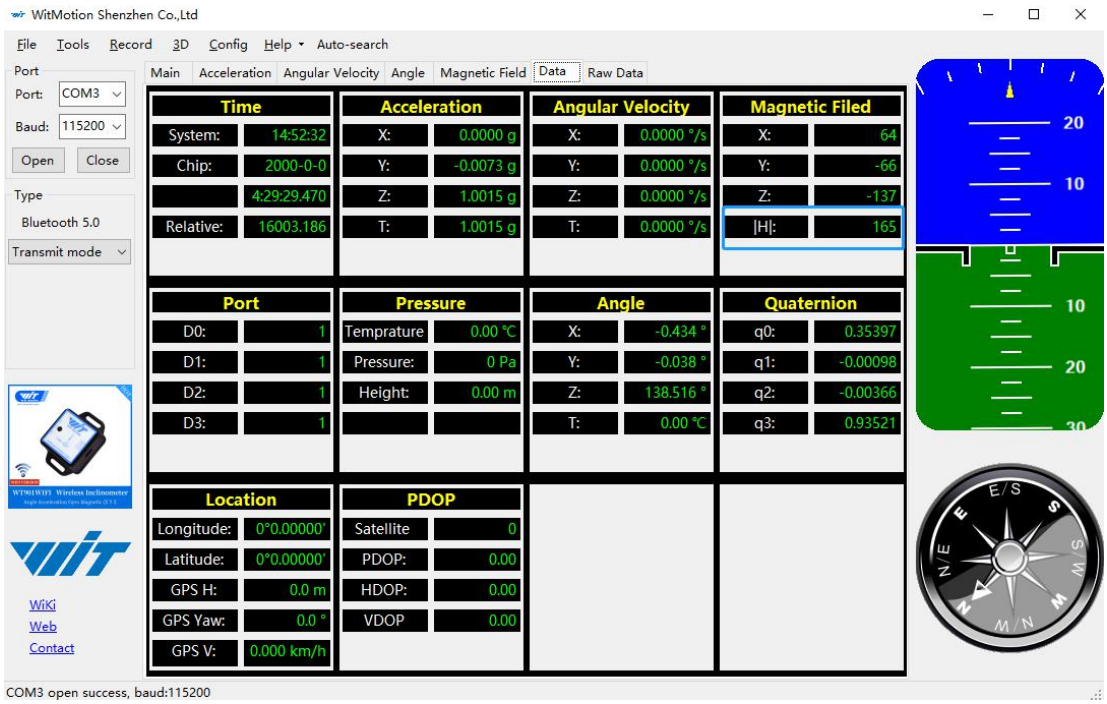
2.3.2 Magnetic Field Calibration

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:

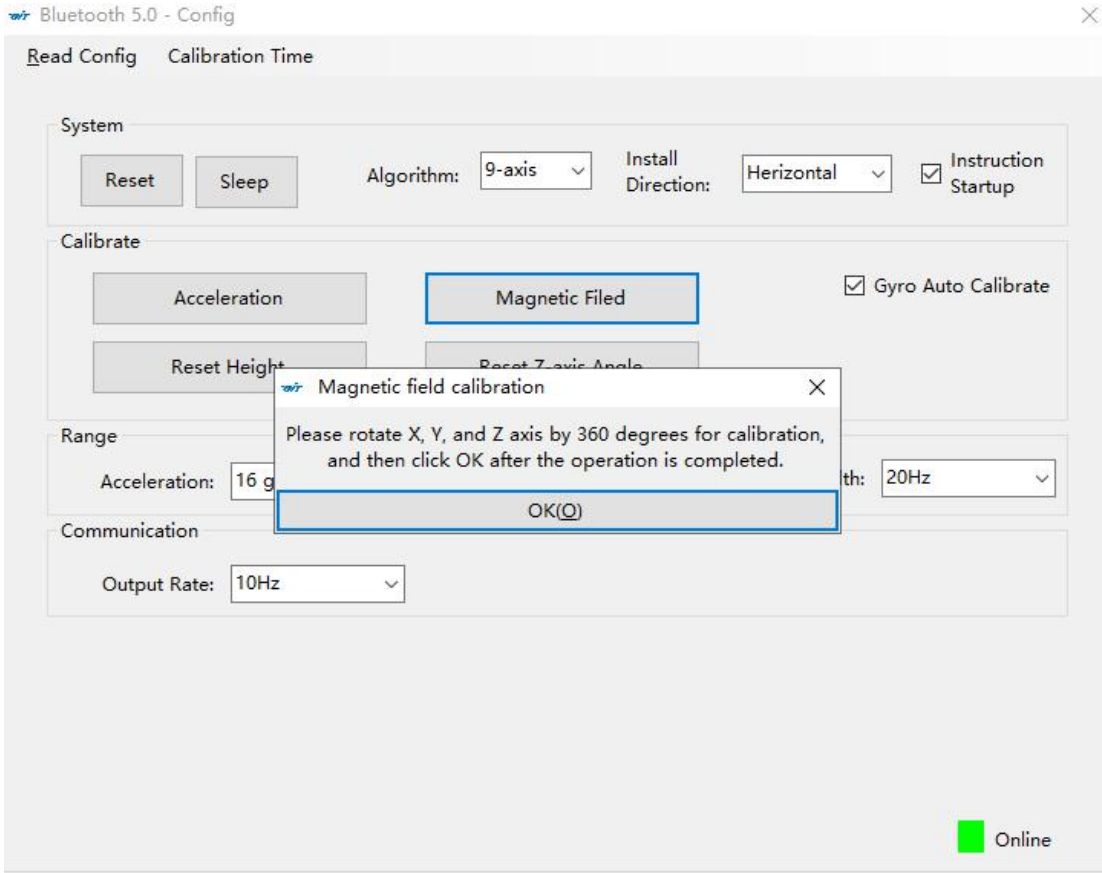
1. Sensors should be 20cm away from magnetic and iron and other materials
2. The value of H in magnetic field must be lower than 350.



Methods:

Step 1. Open the Config menu.

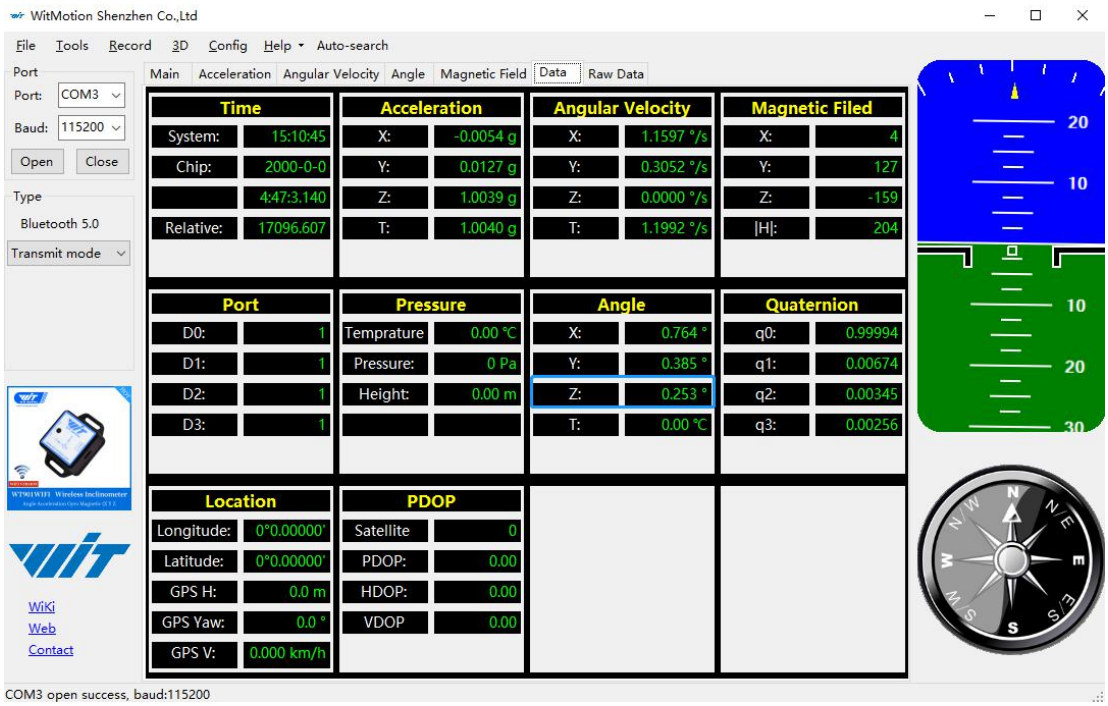
Step 2. Click the “magnetic field” and slowly rotate the sensor 360° around X, Y, Z, 3-axis accordingly.



Step 3. Click OK once the calibration done.

Step 4. Place the sensor horizontally stationary and make the Y axis point to the north.

Step 5. Check the data of Z axis angle, it's ok if the value is about 0°.



2.3.3 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.

2.3.4 Reset Z-axis Angle

Note: If you want to avoid magnetic interference, you can change the algorithm to 6-axis, function of resetting Z-axis angle can be used.

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 "Reset Z-axis Angle" in the "Config", you will see the angle of the Z axis backs to 0 degree in the module data bar.

2.3.5 Reset Height to 0

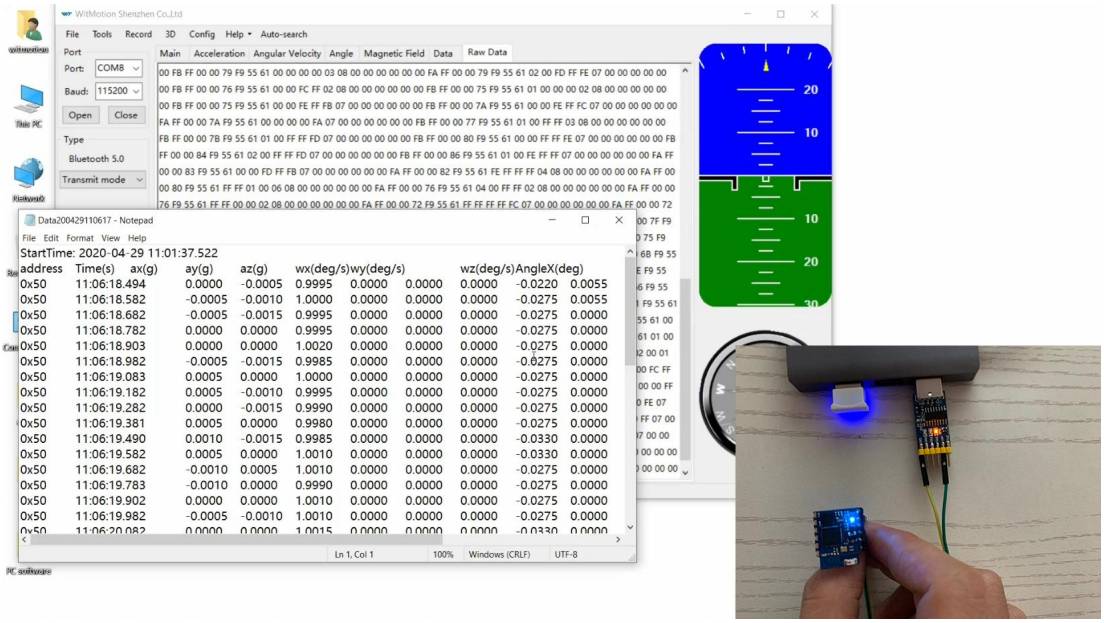
Only available for the module built-in barometer like WT901B, HWT901B, WTGAHRS1, WTGAHRS2.

2.4 Configuration

2.4.1 Data Recording

There is no memory chip in the sensor module, and the data can be recorded and saved on the computer.

Method is as follows: Click "Record" and "Start" will save the data as a TXT file.The saved file is in the directory of the upper computer program Data.tsv: the beginning of the file has the value corresponding to the data.

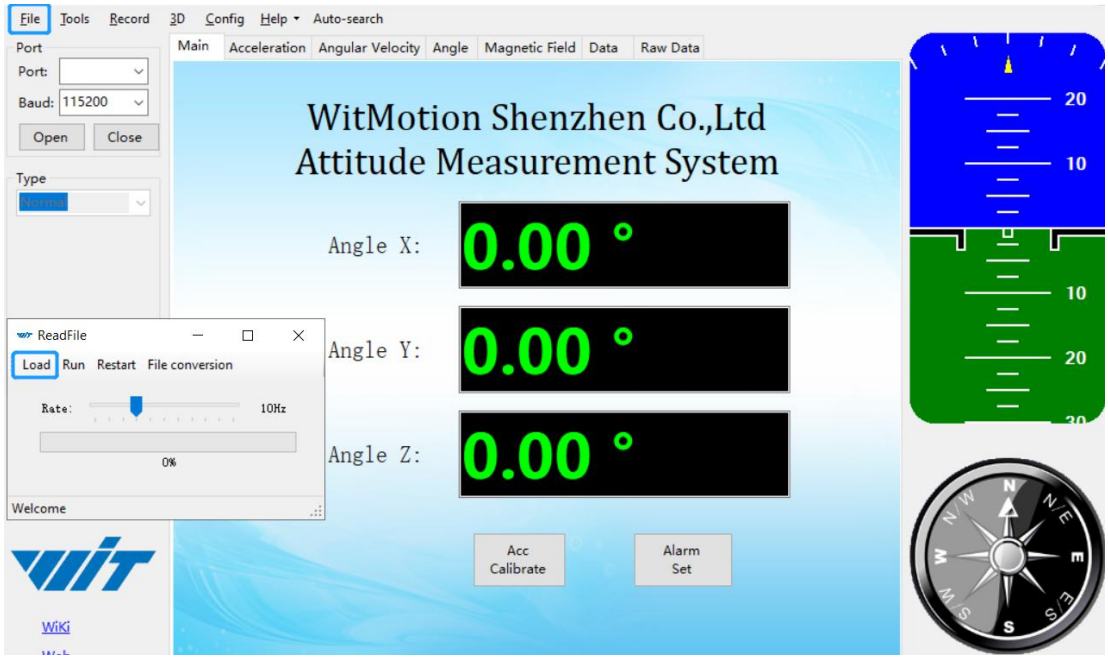


It is highly recommended that data can be pasted to a Excel file. In this way, all data will be shown in order.

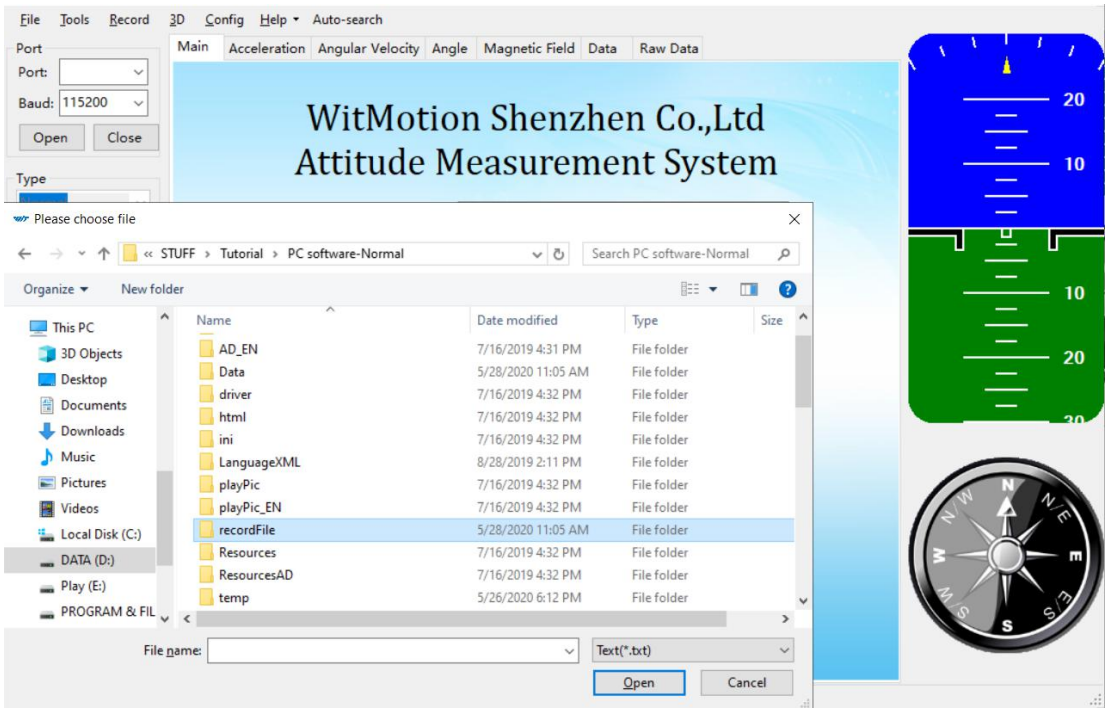
address	Time(s)	ChipTime	ax(g)	ay(g)	az(g)	wx(deg/s)	wy(deg/s)	wz(deg/s)	AngleX(deg	AngleY(deg	AngleZ(deg)	T(°)	hx	hy	hz
0x50	43:06.4	02:40.4	0.4443	0.1777	-0.8696	3.1738	-0.3662	-29.541	166.0364	-29.2072	120.6299	29.97	0	50	313
0x50	43:06.5	02:40.5	0.02	0.5796	-0.7739	-192.0166	283.9355	-700.2563	142.0532	-24.884	154.8907	30	-29	7	312
0x50	43:06.6	02:40.6	-0.2896	0.8599	-0.5571	-8.2397	-3.7842	-264.5264	124.0741	20.0171	-158.2196	30	-7	-85	291
0x50	43:06.7	02:40.7	-0.771	0.5322	-0.4761	36.0718	43.8232	-226.8677	132.984	41.4514	-138.0872	30	38	-93	289
0x50	43:06.8	02:40.8	-0.5601	0.4233	-0.5562	55.7861	101.9897	274.1699	144.5087	35.5792	-132.4292	30	22	-58	301
0x50	43:06.9	02:40.9	-0.0059	0.5503	-1.0103	139.0991	-32.7759	432.251	141.4929	1.8073	-174.1113	30	-22	-9	308
0x50	43:07.0	02:41.0	0.2656	0.3887	-0.8594	124.3896	7.8735	341.1865	154.6985	-15.5896	157.3077	30.01	-14	46	307
0x50	43:07.1	02:41.1	0.3911	0.1104	-0.8467	40.7715	11.9019	257.1411	177.3303	-25.7684	127.7325	30	0	104	294
0x50	43:07.2	02:41.2	0.3896	0.3022	-0.8994	-90.0879	135.3149	-268.9819	163.4601	-31.9867	128.6829	30.03	-2	67	308
0x50	43:07.3	02:41.3	0.2939	0.9531	-0.2837	-251.5259	48.645	-750.4272	119.0149	-0.3625	-174.1608	30.03	-30	-56	295
0x50	43:07.4	02:41.4	-0.4614	0.7075	-0.3384	-27.3438	-19.4702	-226.9287	112.8021	30.6519	-161.4001	30	33	-122	272
0x50	43:07.5	02:41.5	-0.7988	0.6279	-0.5044	28.0762	81.7261	122.1924	122.0087	39.8035	-151.1389	30	63	-110	275
0x50	43:07.6	02:41.6	-0.2495	0.8135	-0.5327	36.377	5.6763	93.0176	121.8494	15.7214	-161.109	30	12	-108	288
0x50	43:07.7	02:41.7	0.3057	0.7432	-0.5996	74.0356	-0.061	379.7607	126.7603	-11.4478	-176.6711	30.03	-51	-68	295
0x50	43:07.8	02:41.8	0.4922	0.4653	-0.7129	134.7656	24.231	268.9819	145.3656	-32.4756	163.3832	30.02	-83	10	295
0x50	43:07.9	02:41.9	0.4507	0.4272	-0.7871	-186.5234	-36.3159	420.6543	166.2616	-49.1583	130.2924	30.02	-86	71	292
0x50	43:08.0	02:42.0	0.6045	-0.062	-0.8027	37.9028	7.6294	-138.0005	173.4357	-45.8514	118.0206	30.03	-66	75	298
0x50	43:08.1	02:42.1	0.4712	0.6011	-0.5688	-172.6685	-7.1411	-537.6587	137.6312	-31.2396	163.8171	30.03	-78	20	300
0x50	43:08.2	02:42.2	-0.0649	0.873	-0.4028	-115.6616	2.3193	-276.2451	113.6481	4.6417	-169.8761	29.98	-37	-101	283
0x50	43:08.3	02:42.3	-0.4092	0.856	-0.1816	-134.8877	-38.208	-155.7007	99.8822	26.933	-165.943	30.03	32	-166	244
0x50	43:08.4	02:42.4	-0.5171	0.8809	-0.1152	84.1064	0.9155	86.2427	94.8285	33.2666	-167.5415	30.06	72	-186	218
0x50	43:08.5	02:42.5	-0.1782	0.9595	-0.2793	243.2861	29.3579	406.8604	110.7367	13.3429	-169.0686	30.03	29	-156	254

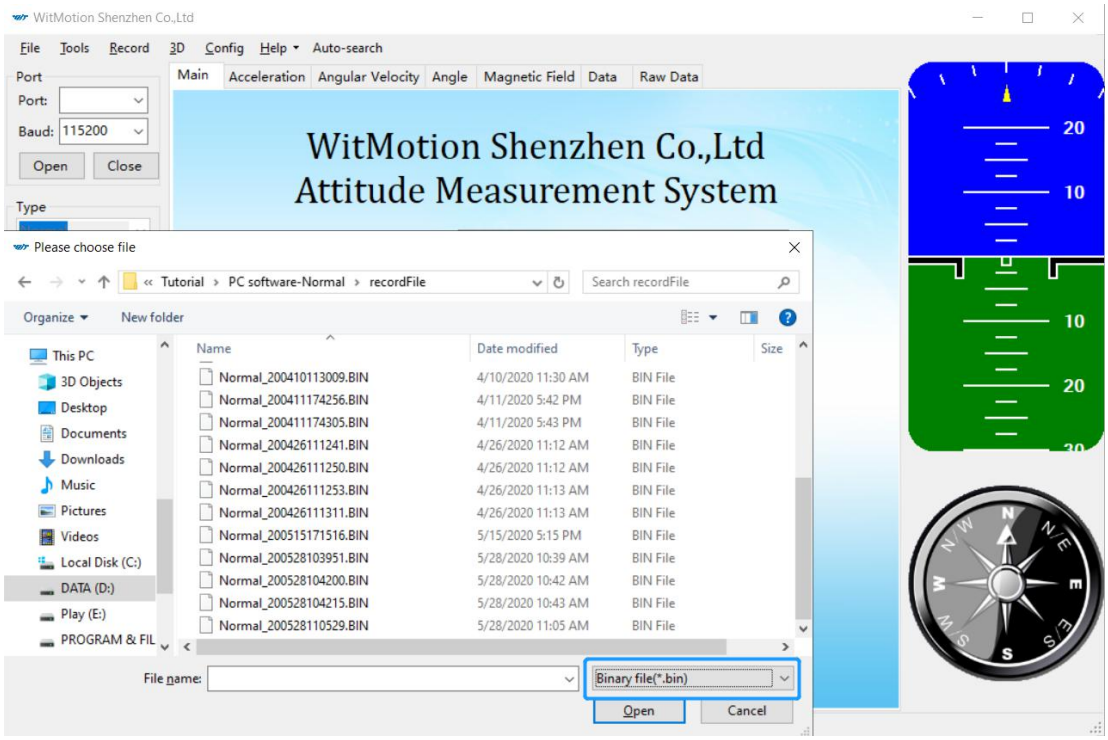
2.4.2 Data Playback

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"

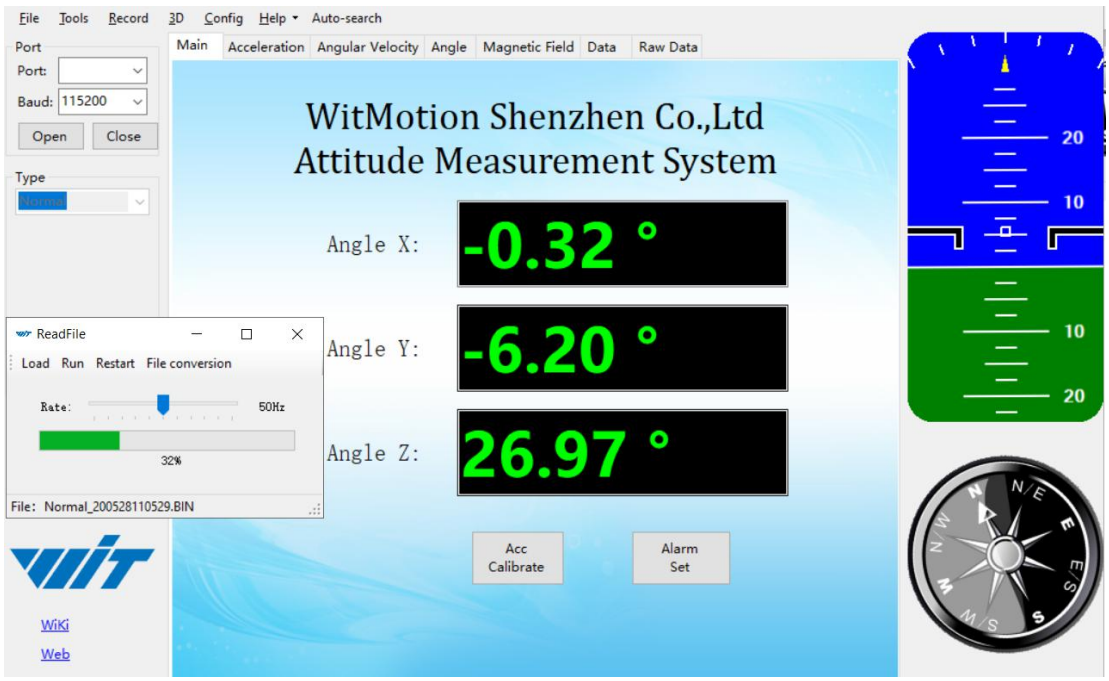


Step 3: Choose the original path of software installation and load the Bin file





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



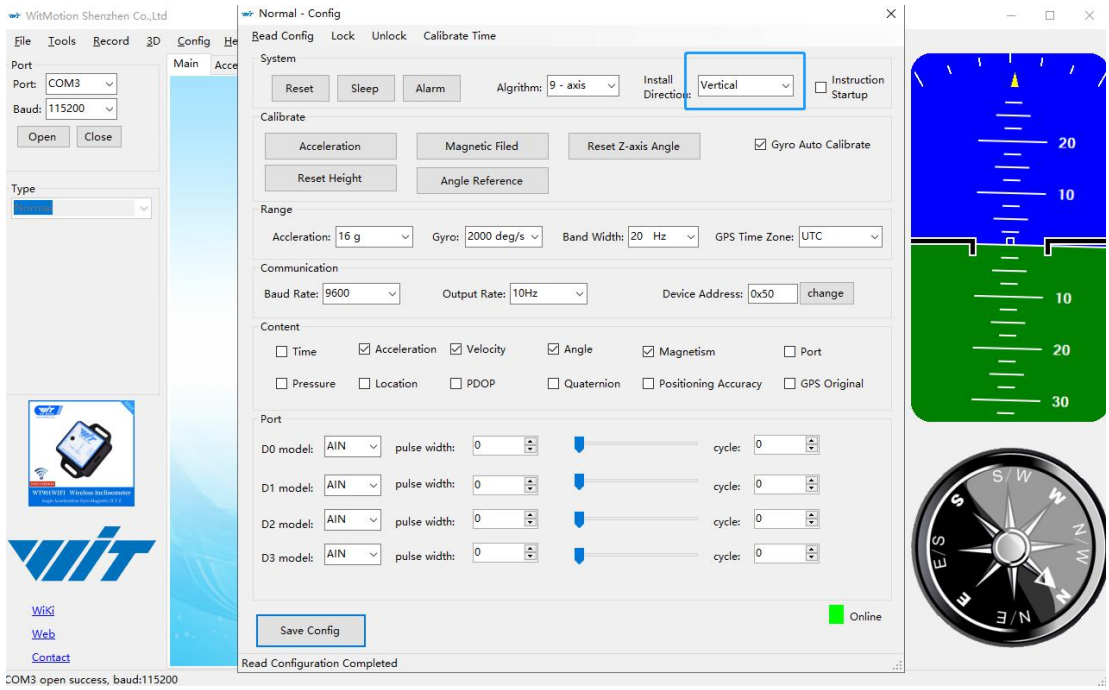
2.4.3 Placement Direction

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

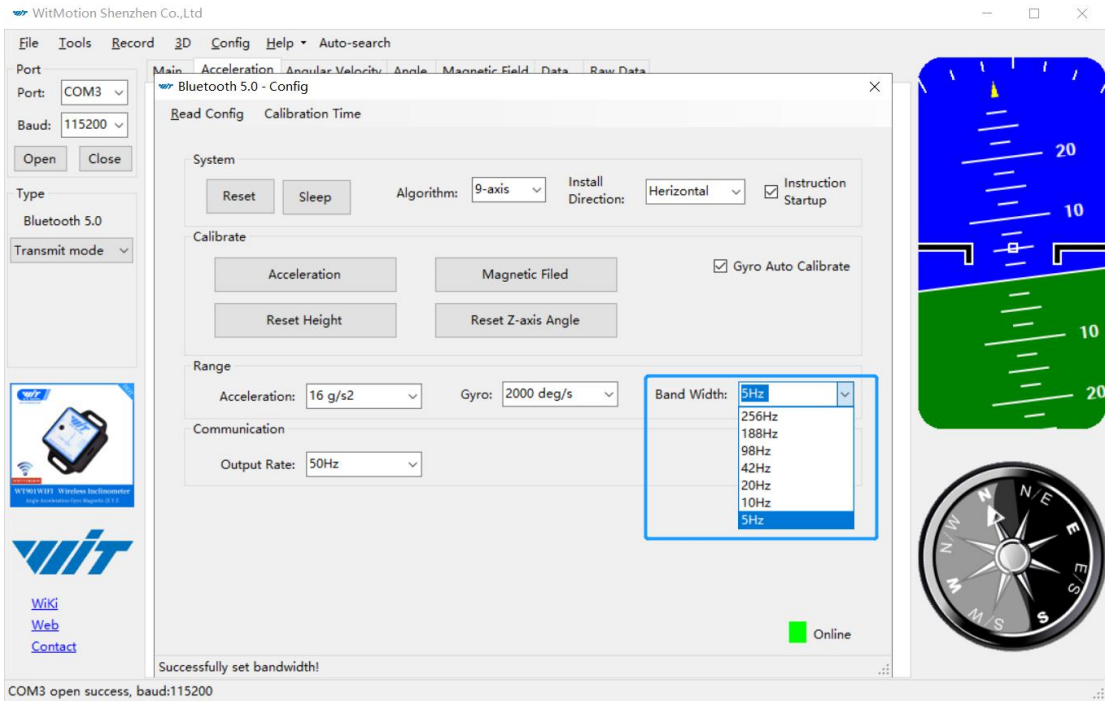
Step 2: Place the sensor 90 degrees vertically

Step 3: Click "Vertical" as install directions on the "Config" menu



2.4.4 Bandwidth

Default bandwidth is 20HZ.

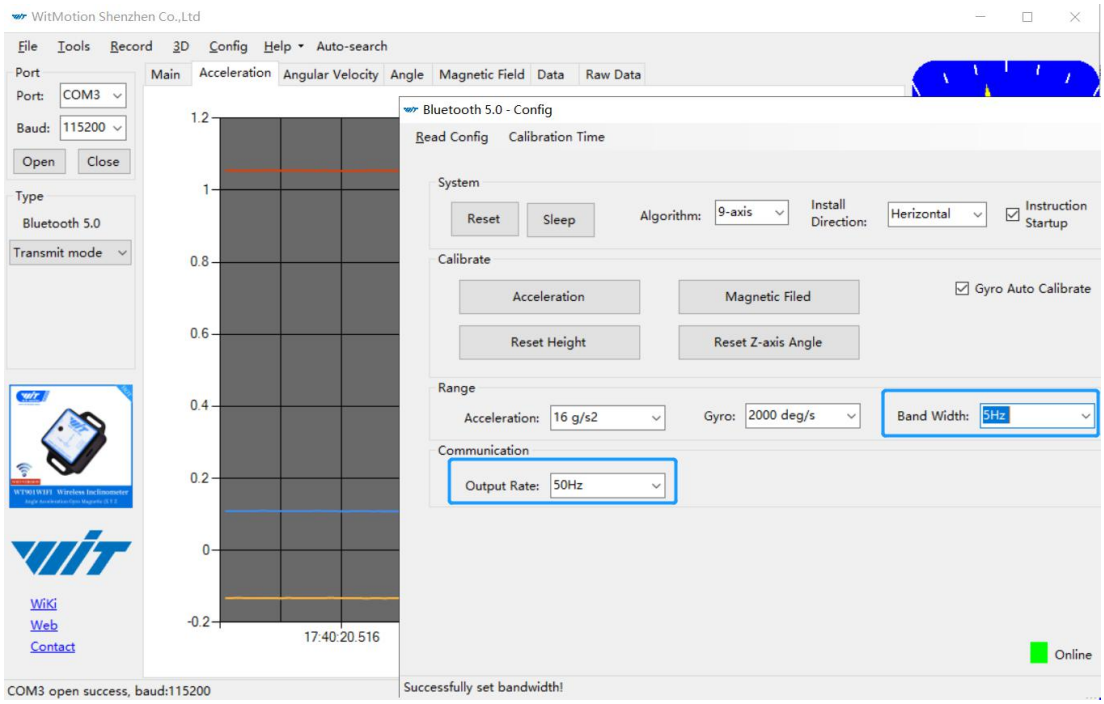


Explanation:

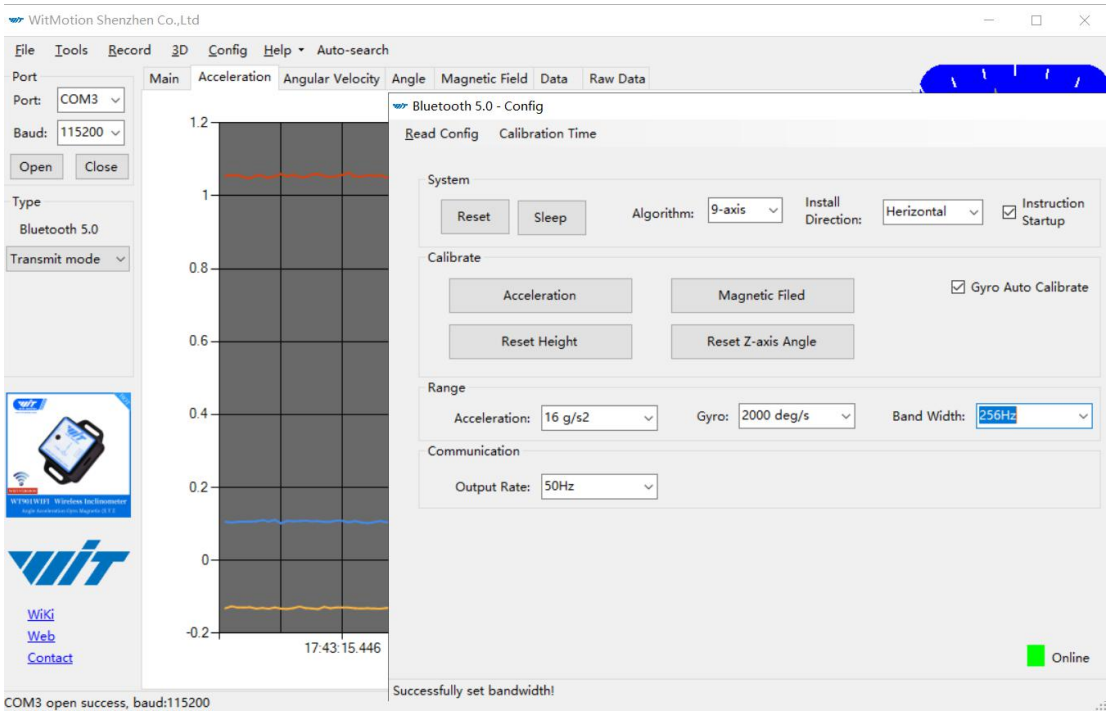
1. The higher rate of bandwidth setting will lead to higher fluctuation in data waveform. Conversely, the lower rate of bandwidth, data will become more fluent.

For example:

Bandwidth as 50Hz, Output rate as 5Hz. The waveform is very steady.



Bandwidth as 256Hz, Output rate as 50Hz. 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 50Hz, there will be 5 repeating data.

If you prefer there is no repeating data, it is required to increase the bandwidth more than 50Hz.

2.4.5 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.

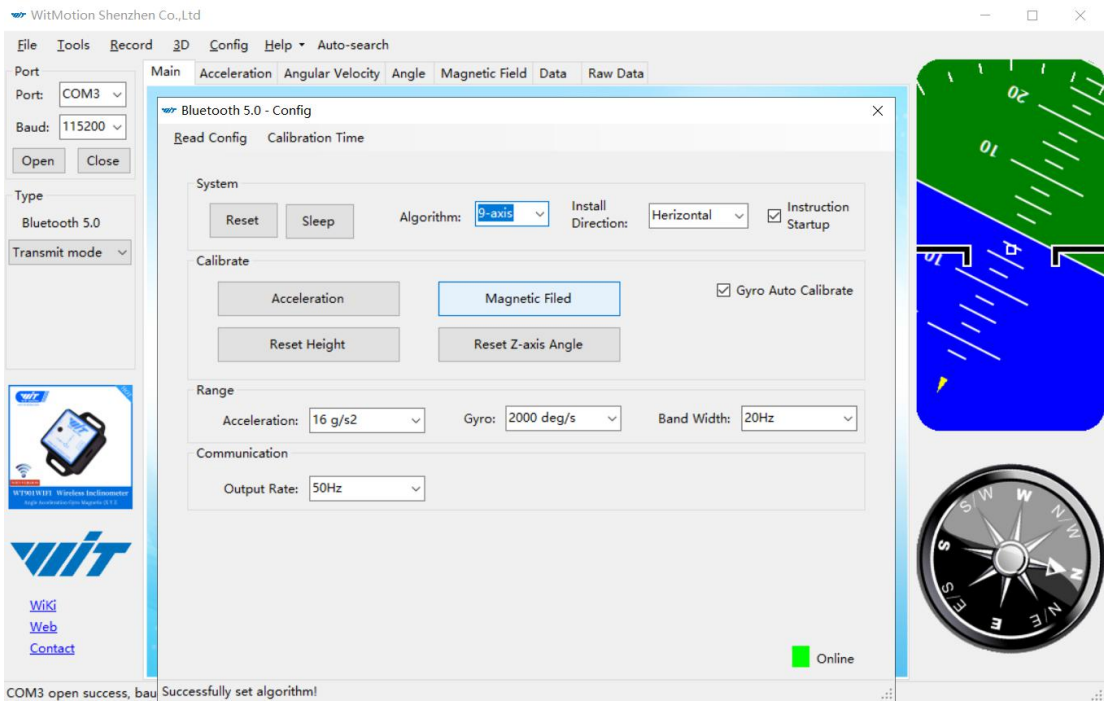
The default algorithm of WT901BLECL is 9-axis. If there is magnetic field interference around installed environment, it is recommended to switch to 6-axis algorithm to detect the angle.

Method:

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

Step 2: Proceed with the “Accelerometer calibration” and “Reset Z-axis angle” calibration.

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

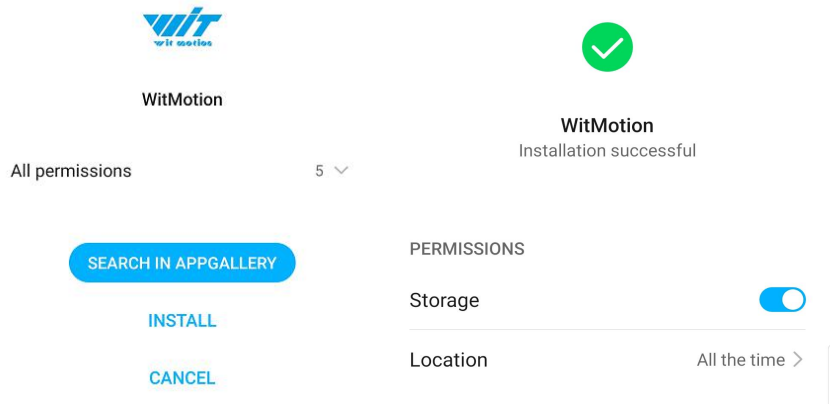


3 Use Instructions with Android phone

For APP configuration introduction, please referring to the Chapter 2.2

3.1 APP Installation

Install the APK file, give permission of Location and Storage



APP download link

About Android APP:

1. It is required to allow for application positioning (Always allowed), and power on the positioning function and Bluetooth

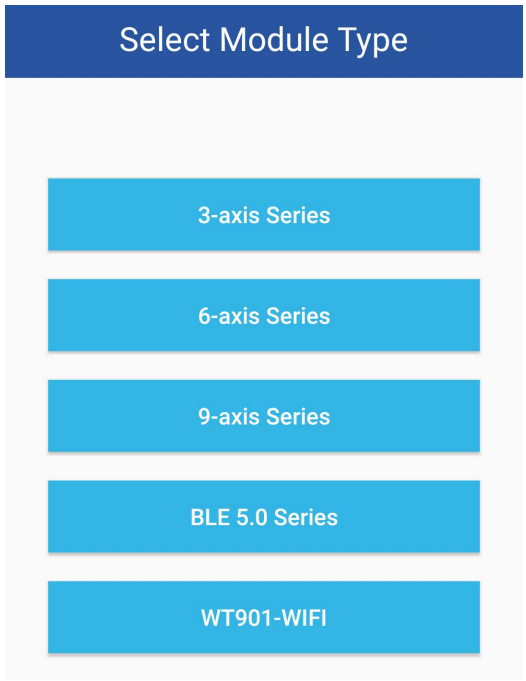
Note: Paired devices can be searched without turning on positioning, but according to Google's requirements, if APP installed on a higher version of Android (6.0) mobile phone is paired with a Bluetooth device, positioning must be allowed when using Bluetooth at the same time.

2. After turning on Bluetooth, it takes about one minute to search for authorization to find Bluetooth.

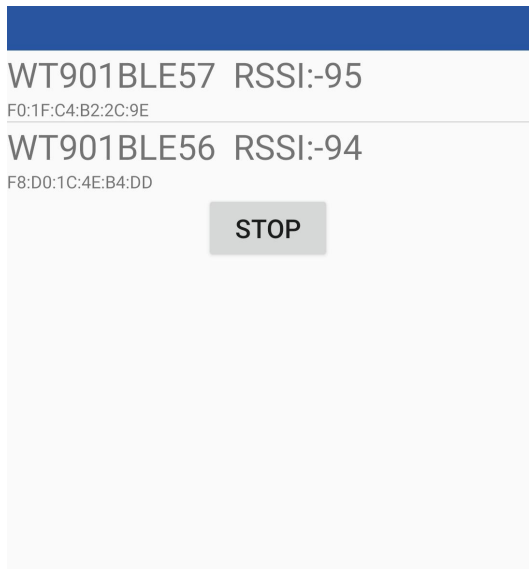
3.2 Connection

Step 1. Install the APK file, give permission of Location and Storage

Step 2. Open APP and choose “BLE 5.0 Series” as sensor series

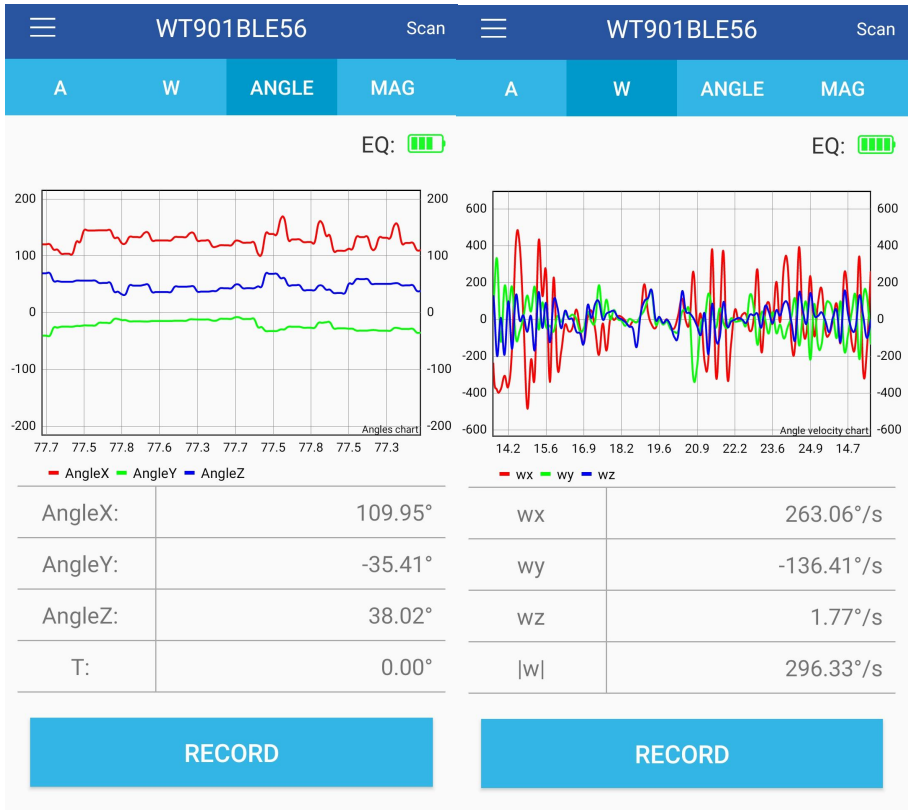


Step 3: power on the sensor and scan the device



Step 4. When pairing is done, the blue LED light of the sensor will flash and keep about one second

After a few seconds, the data will show automatically



3.3 Calibration

Link to calibration demo

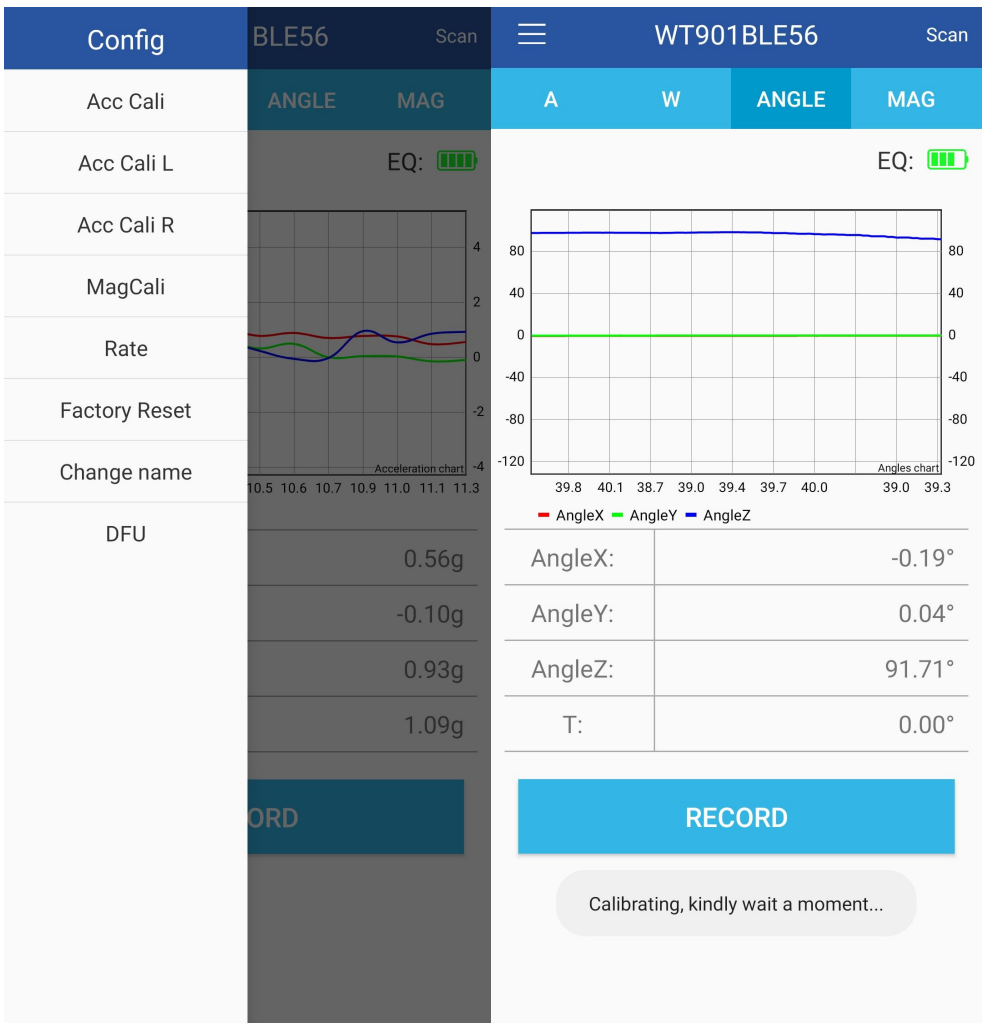
3.3.1 Acceleration Calibration

Step 1. Keep the module horizontally stationary

Step 2. Click the "Calibration" menu

Step 3. Click the "Acceleration Calibration" and wait for 3 seconds

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



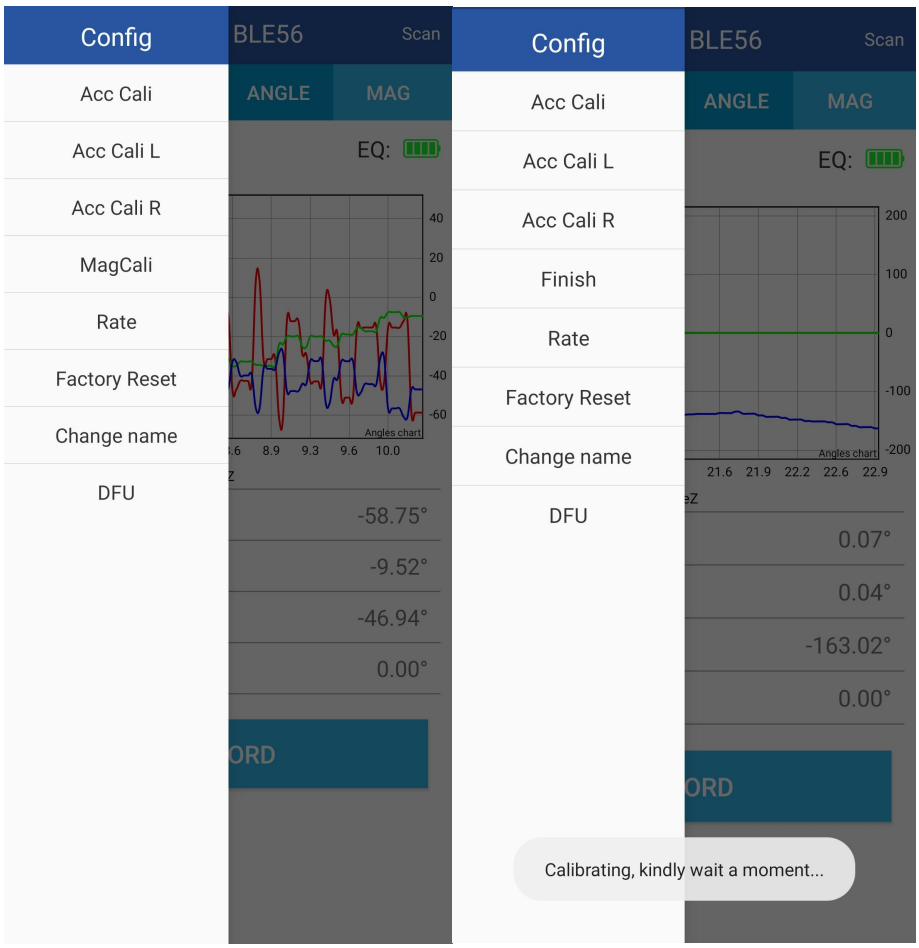
3.3.2 Magnetic Field Calibration

Step 1. Click the "Calibration" menu

Step 2. Click the "Magnetic calibration" button

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

Step 4. After rotation, click “Finish”



Check the result: The Z-axis angle will have less drift than before.
Notice: If not successful, please stay away from the objective that can create magnetic field interference.