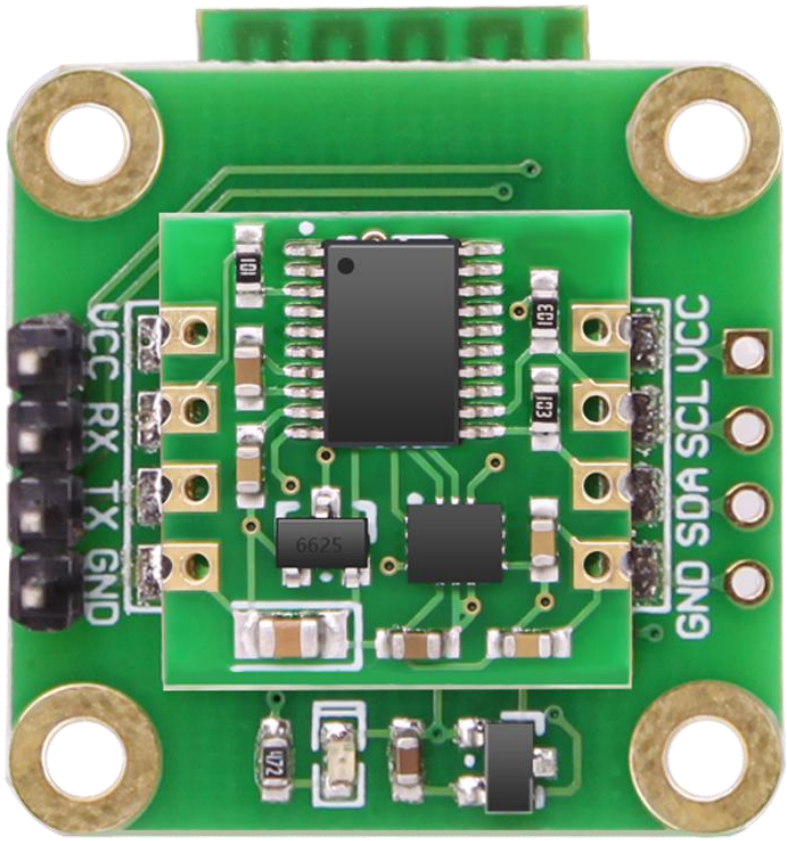
USER MANUAL BWT61

Bluetooth 2.0 Inclinometer Sensor



Tutorial Link

Google Drive

Link to instructions DEMO:
WITMOTION Youtube Channel
BWT61 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 BWT61 is a multi-sensor device detecting acceleration, angular velocity and angle . 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.

BWT61's scientific name is AHRS IMU sensor. A sensor measures 3-axis angle, angular velocity, acceleration. Its strength lies in the algorithm which can calculate three-axis angle accurately.

BWT61 is an CE standard accelerometer. It is employed where the highest measurement accuracy is required. BWT61 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

• 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 , and sample code for MCU integration including 51 serial, STM32, Arduino, Matlab, Raspberry Pi, 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
Red	Flashing	working
Blue	Flashing	pairing process
	Keeping still	successful pairing

2 Use Instructions with PC

2.1 PC Connection

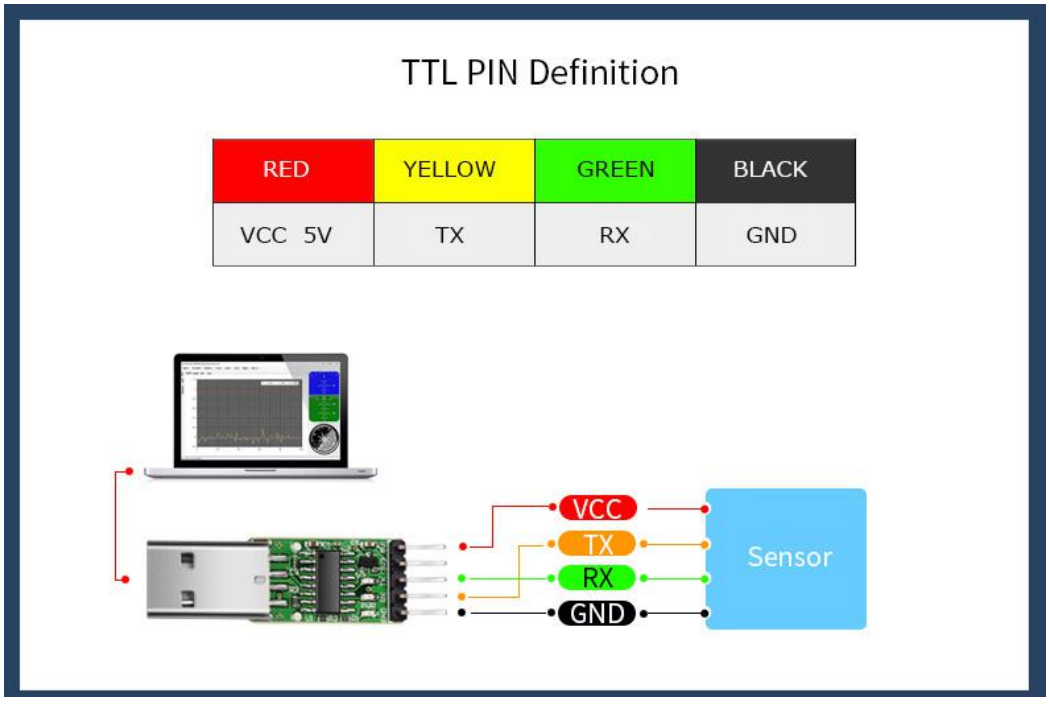
PC software is only compatible with Windows system.

BWT61 Playlist

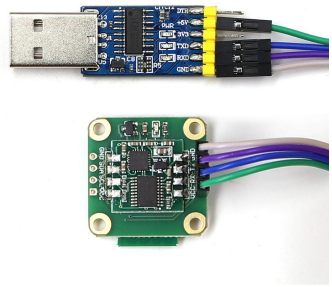
2.1.1 Serial Connection

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

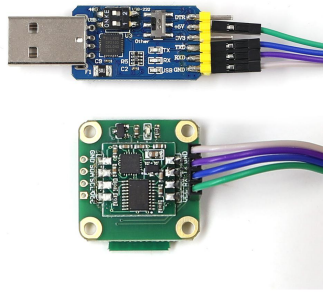
(When connecting with computer, VCC-5V is recommended.)



Recommended tools:



3-in-1 converter



6-in-1 converter

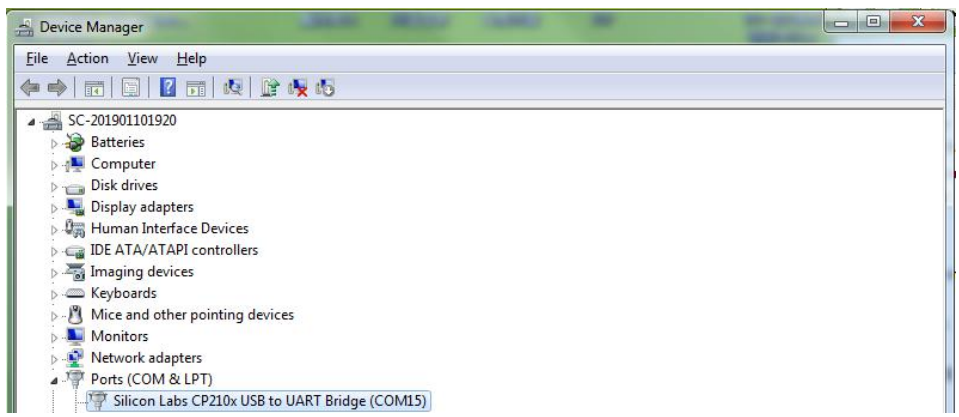
TTL serial cable

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)

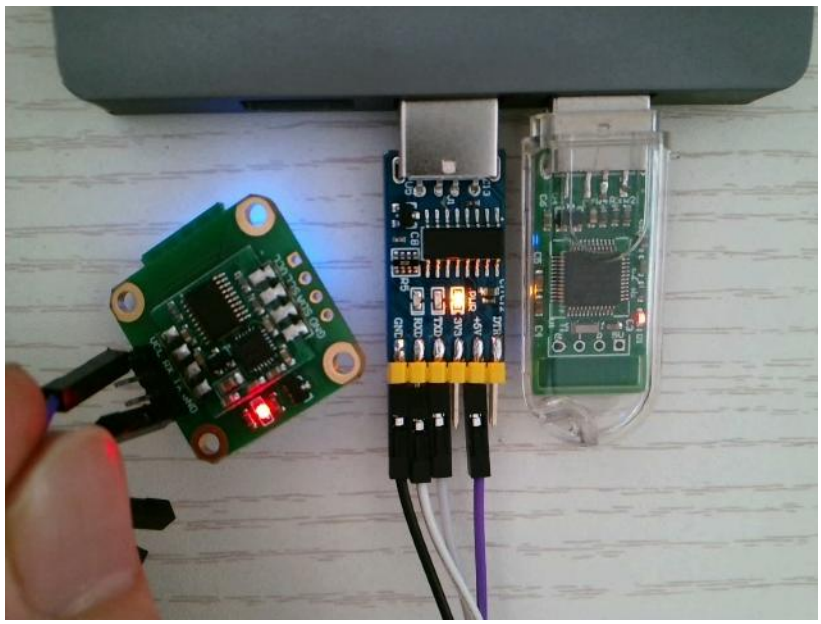
Step 3. Plugin the converter to computer and confirm the "com port" in device manager



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 115200, data will be shown on the software.

2.1.2 USB-HID Connection



Step 1. Insert the USB-HID adapter to USB slot in the beginning

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

Step 3. Wait till the sensor's blue LED light keeps on--pairing succeeds

Step 4. Open the software, Minimu.exe

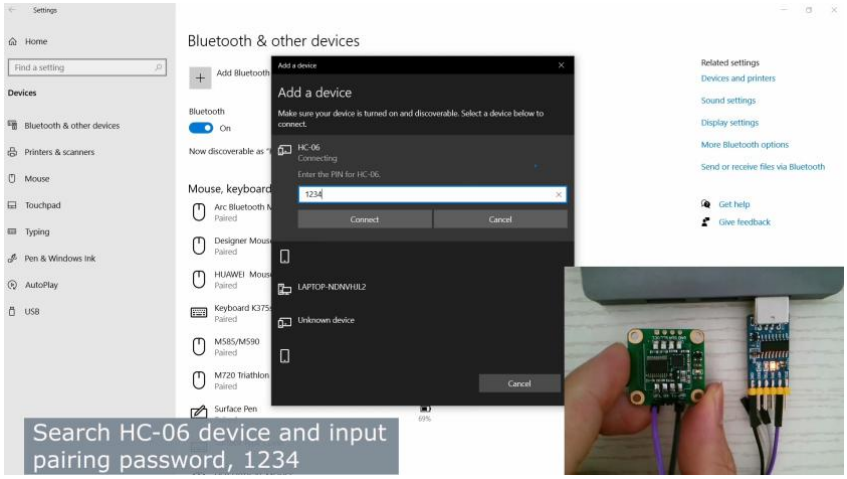
Step 5. Data will appear once the auto-search finishes.

2.1.3 PC's Bluetooth Connection

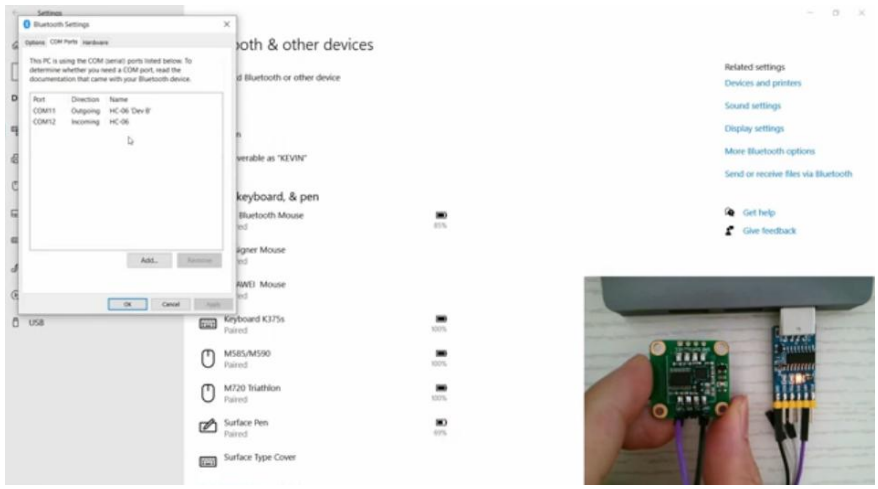
Step 1. Turn on computer's Bluetooth

Step 2. Power on the sensor

Step 3. Search HC-06 device and input pairing password, 1234



Step 4. Confirm the outgoing com port on "More Bluetooth Options" page



Step 5. Open software (Minimu.exe) and choose the correct com port

Step 6. Data will appear once the automatic search finishes

2.2 Software Introduction

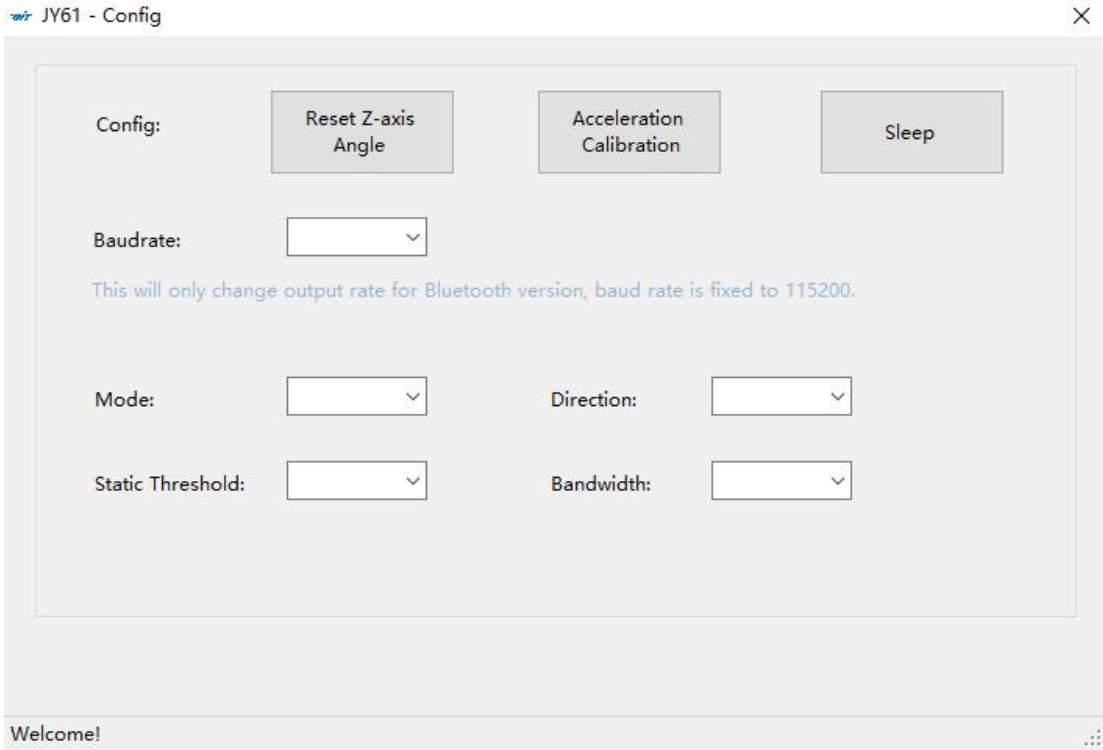
Link to download software

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 Unity DEMO
Config		Configuration setting
Help	Language	Switch to English or Chinese
	Bluetooth Set	Option for 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

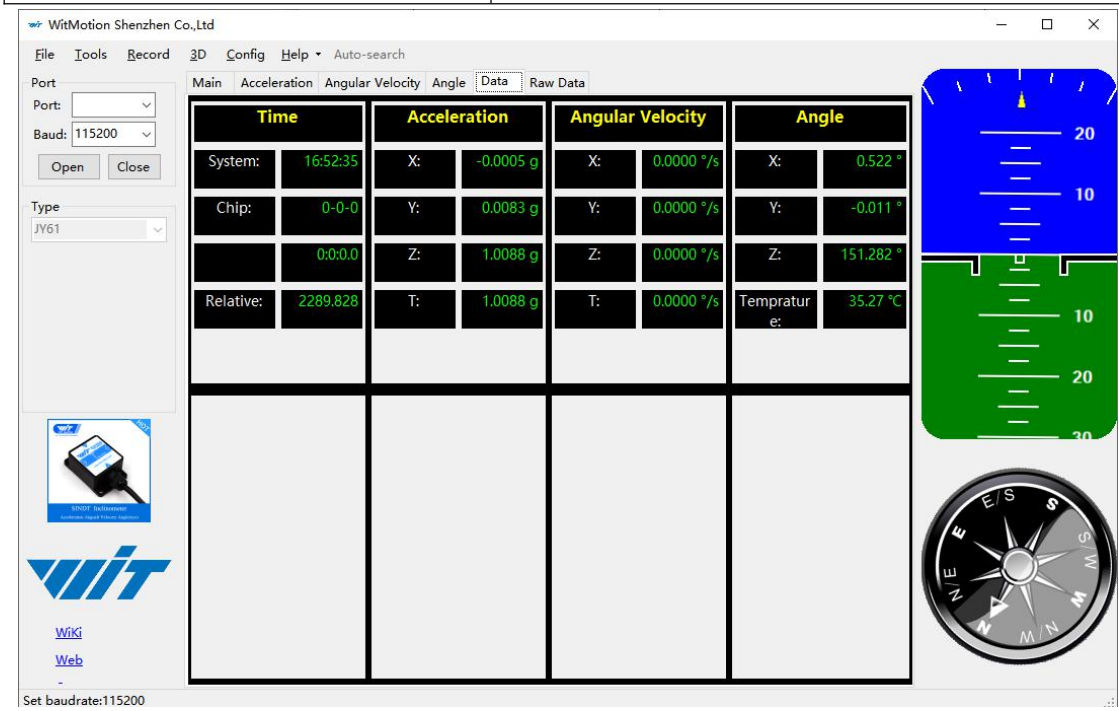
Type	Fixed setting as JY61 for BWT61
Open	Open com port
Close	Close com port
Acc Calibrate	Acceleration calibration

2.2.2 Menu of Configuration



Menu of Configuration	
Button	Function
Zero Z Angle	Reset Z-axis angle to 0 degree
Acceleration Calibration	Ability to proceed accelerometer calibration
Sleep	Sleep function, not available for Bluetooth sensor series
Baudrate	115200(100Hz) (Fixed)/ 9600(20Hz)
Mode	Serial / IIC(only for modules)
Direction	Vertical or horizontal installation
Static threshold	Static threshold for angular velocity
Bandwidth	Option for bandwidth range

Menu of Data	
Button	Function
Time	Real time
Acceleration	Data for Acceleration
Angular Velocity	Data for Angular Velocity
Angle	Data for Angle



2.3 Calibration

Preparation:
Make sure the sensor is “Online”.

Calibration on PC software:

It is required to calibrate for the first time usage.

2.3.1 Accelerometer Calibration

Purpose:

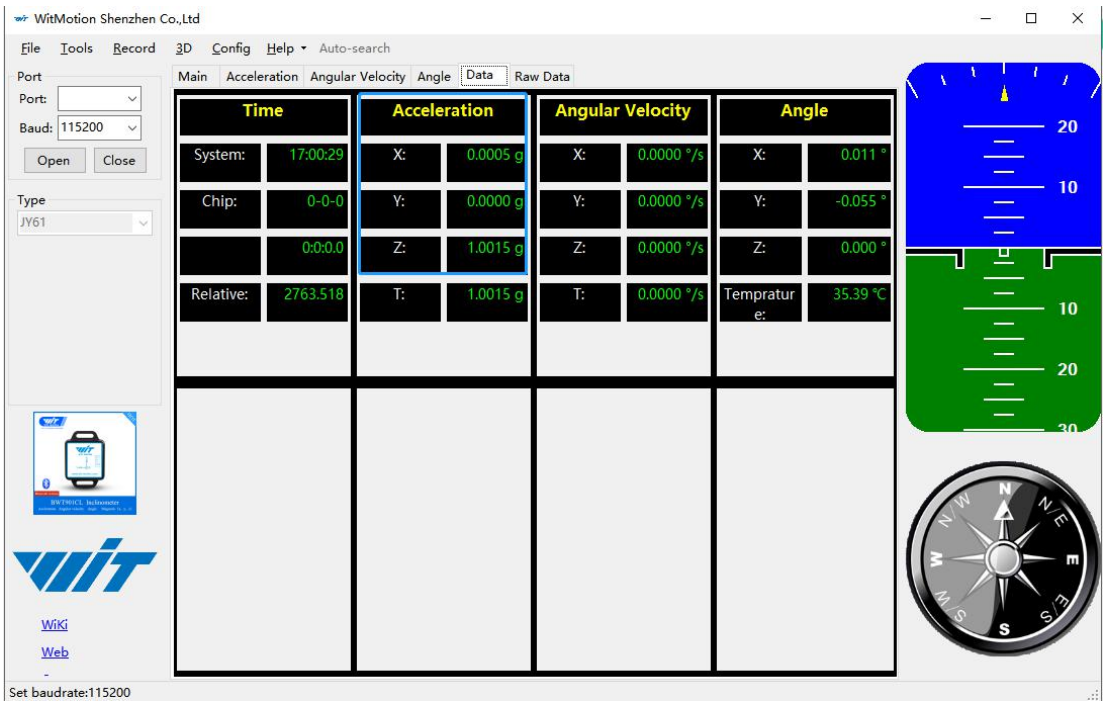
The accelerometer calibration is used to remove the zero bias of the accelerometer. Before calibration, there will be different degrees of bias error. After calibration, the measurement will be accurate.

Methods:

1. Firstly keep the module horizontally stationary, then click "Acceleration Calibration" in the "Config" of the software.

2. 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 one G of gravitational acceleration on the Z-axis.



2.3.2 Reset Z-axis Angle

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.

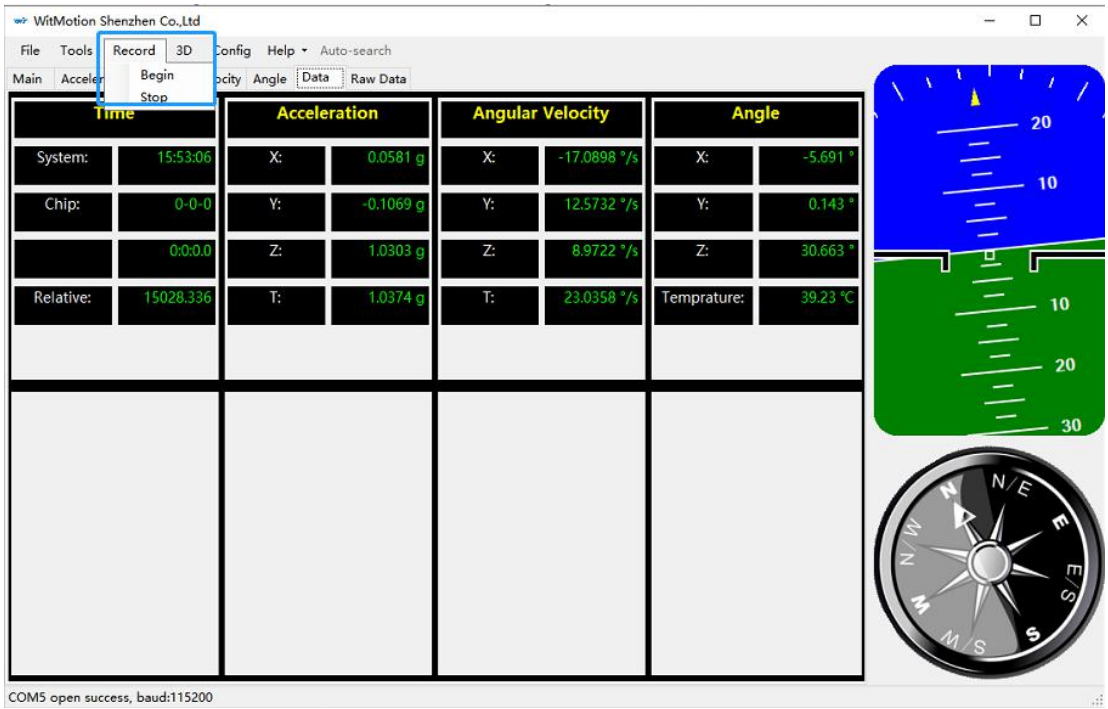
2.4 Configuration

2.4.1 Set Baud Rate

Not available for Bluetooth sensor series.

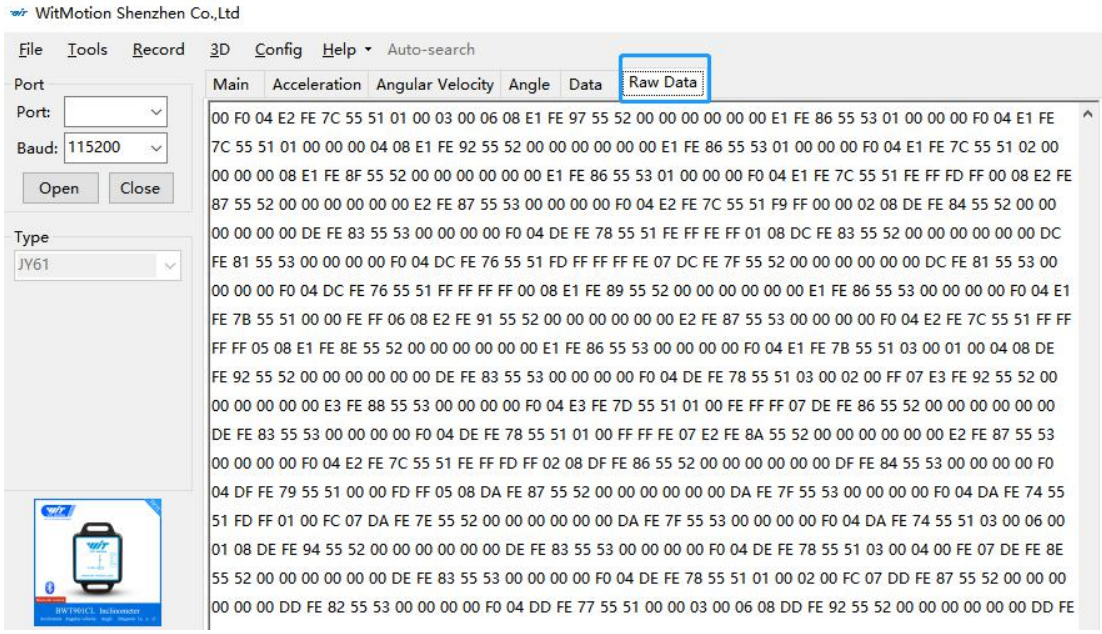
2.4.2 Data Recording

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



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

For raw data analysis, please kindly refer to the register list shown on the datasheet of the corresponding model.

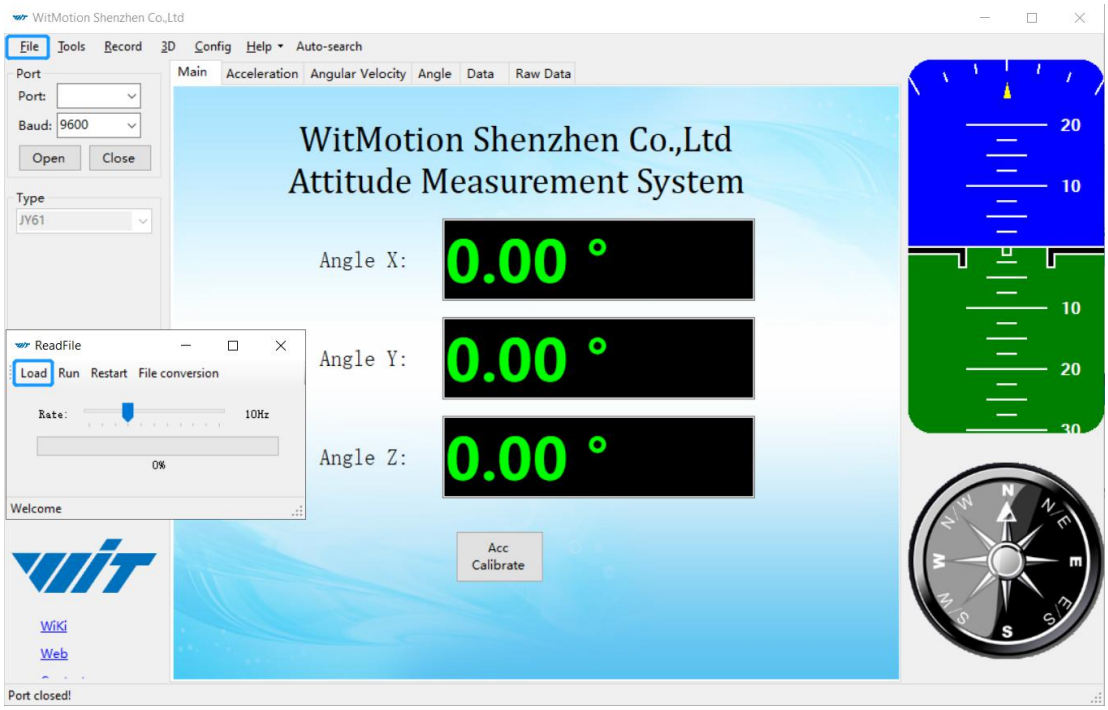


It is highly recommended that data can be pasted to a Excel file. In this way, all data will be shown in order.

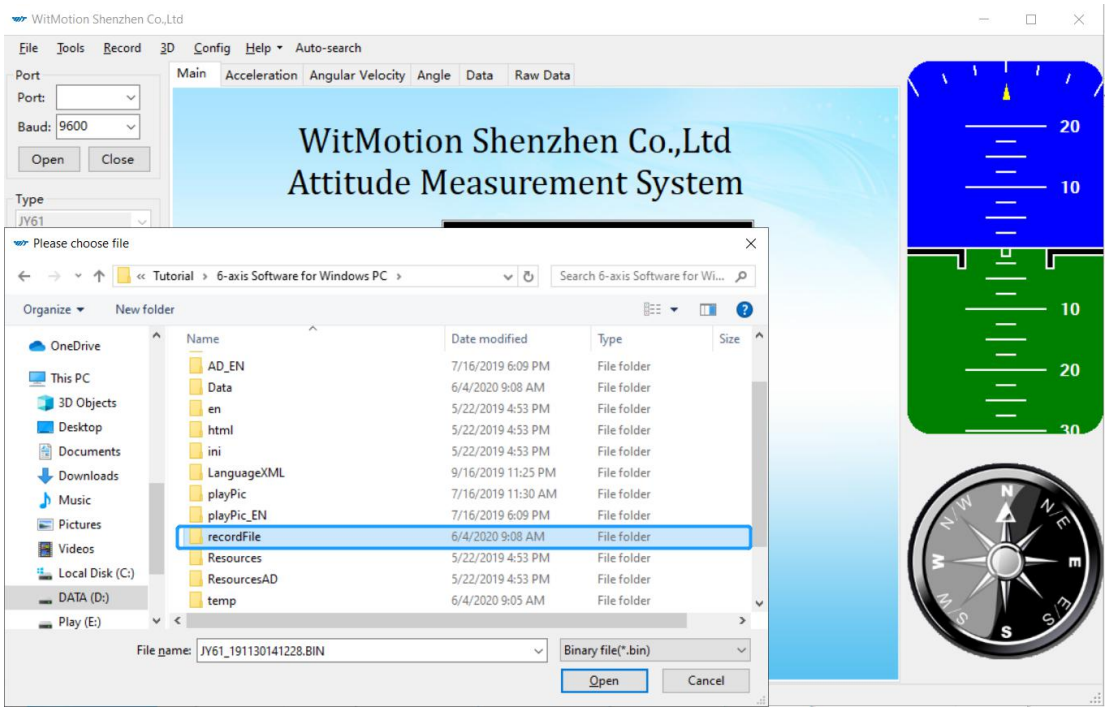
1	StartTime: 2020-04-18 11:31:04.133											
2	address	Time(s)	ax(g)	ay(g)	az(g)	wx(deg/s	wy(deg/s	wz(deg/s	AngleX(d	AngleY(d	AngleZ(d	T(°)
3	0x50	00:53.7	-0.0073	0.0054	1.0186	0	0	0	0.3241	0.3516	13.8702	30.19
4	0x50	00:53.7	-0.0059	0.0054	1.0166	0	0	0	0.3241	0.3516	13.8702	30.2
5	0x50	00:53.7	-0.0054	0.0054	1.0161	0	0	0	0.3241	0.3516	13.8702	30.21
6	0x50	00:53.7	-0.0054	0.0054	1.0161	0	0	0	0.3241	0.3516	13.8702	30.21
7	0x50	00:53.7	-0.0059	0.0059	1.0161	0	0	0	0.3241	0.3461	13.8702	30.21
8	0x50	00:53.7	-0.0059	0.0059	1.0161	0	0	0	0.3241	0.3461	13.8702	30.21
9	0x50	00:53.7	-0.0044	0.0054	1.0161	0	0	0	0.3241	0.3461	13.8702	30.21
10	0x50	00:53.7	-0.0044	0.0054	1.0161	0	0	0	0.3241	0.3461	13.8702	30.21
11	0x50	00:53.7	-0.0034	0.0059	1.0166	0	0	0	0.3241	0.3461	13.8702	30.21
12	0x50	00:53.7	-0.0034	0.0059	1.0166	0	0	0	0.3241	0.3461	13.8702	30.21
13	0x50	00:53.8	-0.0054	0.0054	1.0166	0	0	0	0.3241	0.3461	13.8702	30.21
14	0x50	00:53.8	-0.0054	0.0054	1.0166	0	0	0	0.3241	0.3406	13.8702	30.21
15	0x50	00:53.8	-0.0063	0.0054	1.0181	0	0	0	0.3241	0.3406	13.8702	30.21
16	0x50	00:53.8	-0.0063	0.0054	1.0181	0	0	0	0.3241	0.3406	13.8702	30.21
17	0x50	00:53.8	-0.0063	0.0054	1.0171	0	0	0	0.3241	0.3406	13.8702	30.21
18	0x50	00:53.8	-0.0063	0.0054	1.0171	0	0	0	0.3186	0.3406	13.8702	30.21

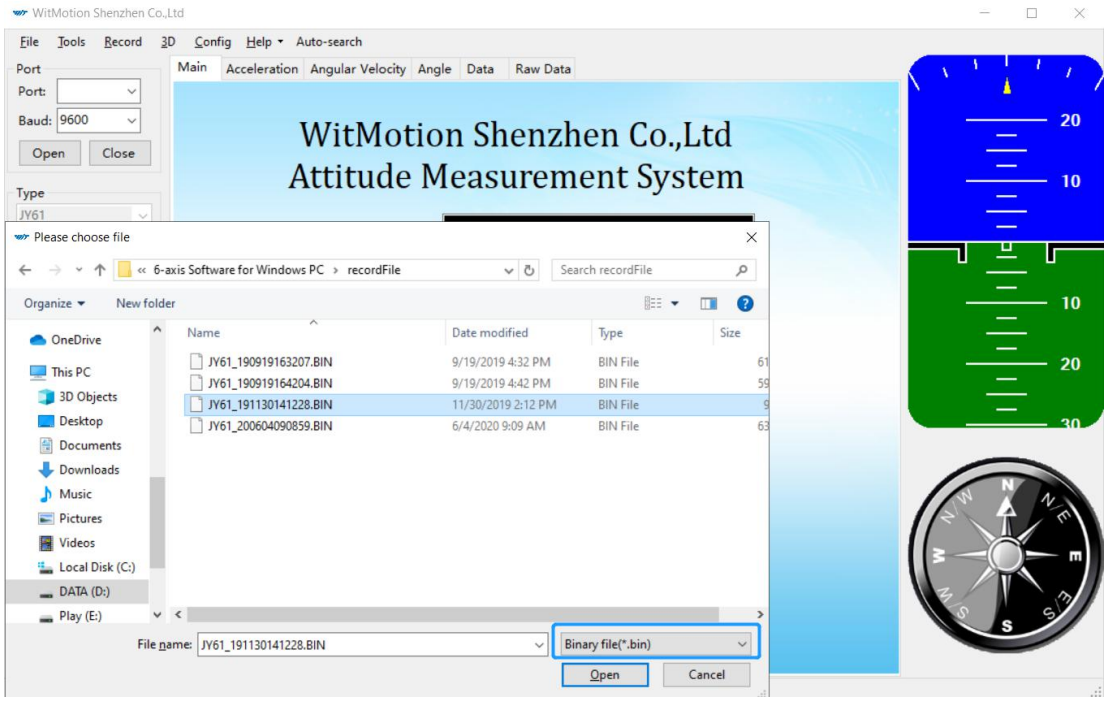
2.4.3 Data Playback

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”

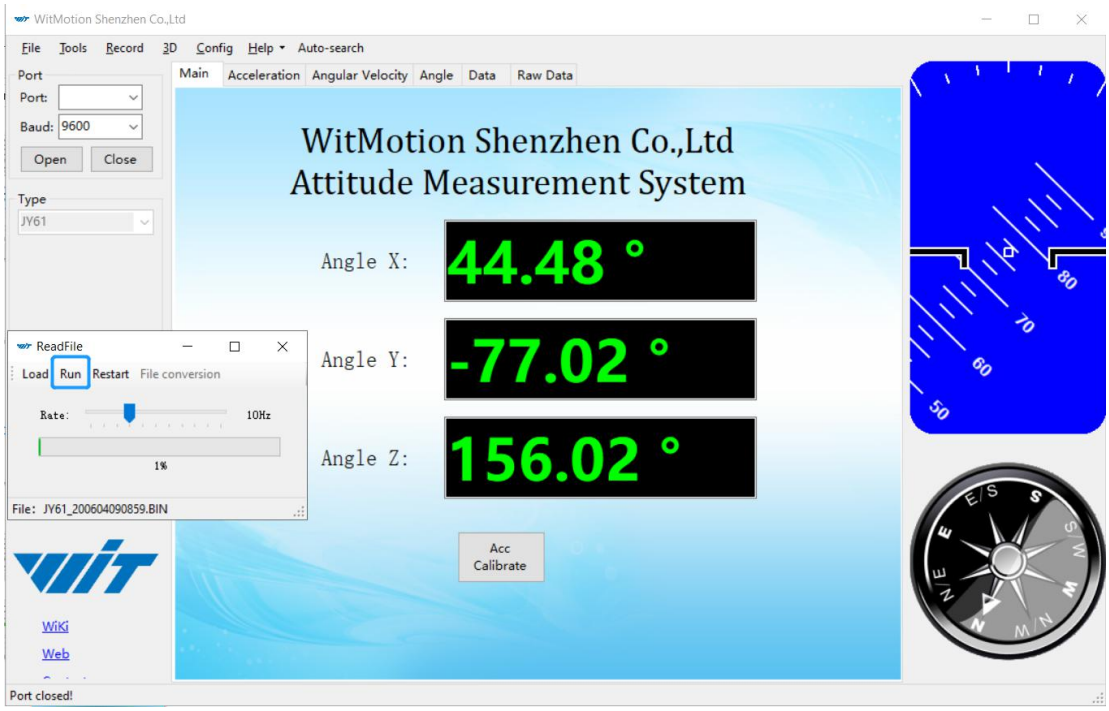


Step 3: Choose the original path of software installation and load the Bin file





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



2.4.4 Standby and Wake Up

Not available for Bluetooth sensor series.

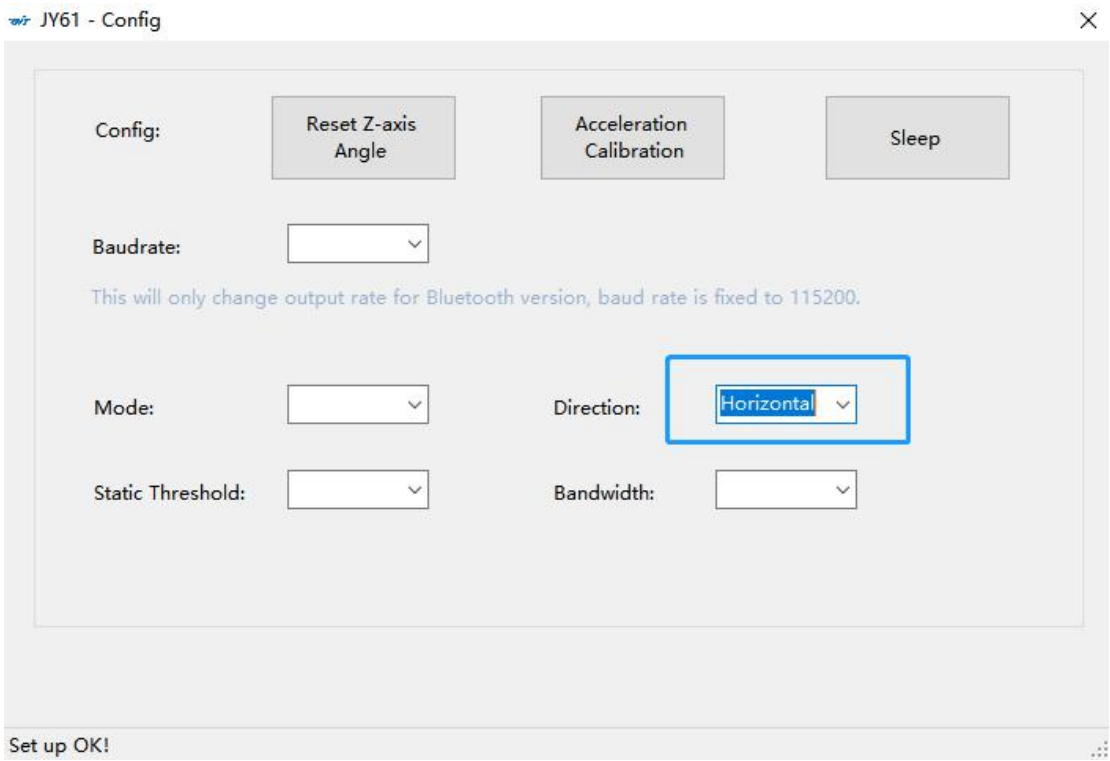
2.4.5 Placement Direction

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

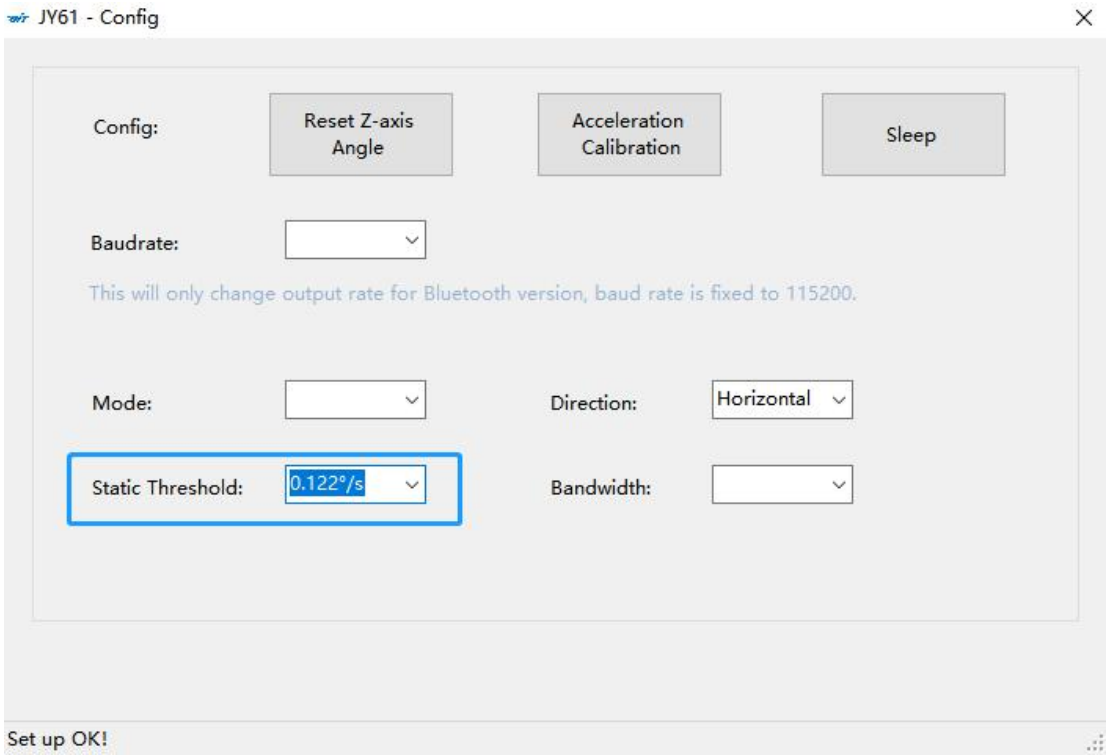
Step 3: Click "Vertical" as install directions on "Config" menu



2.4.6 Static Threshold

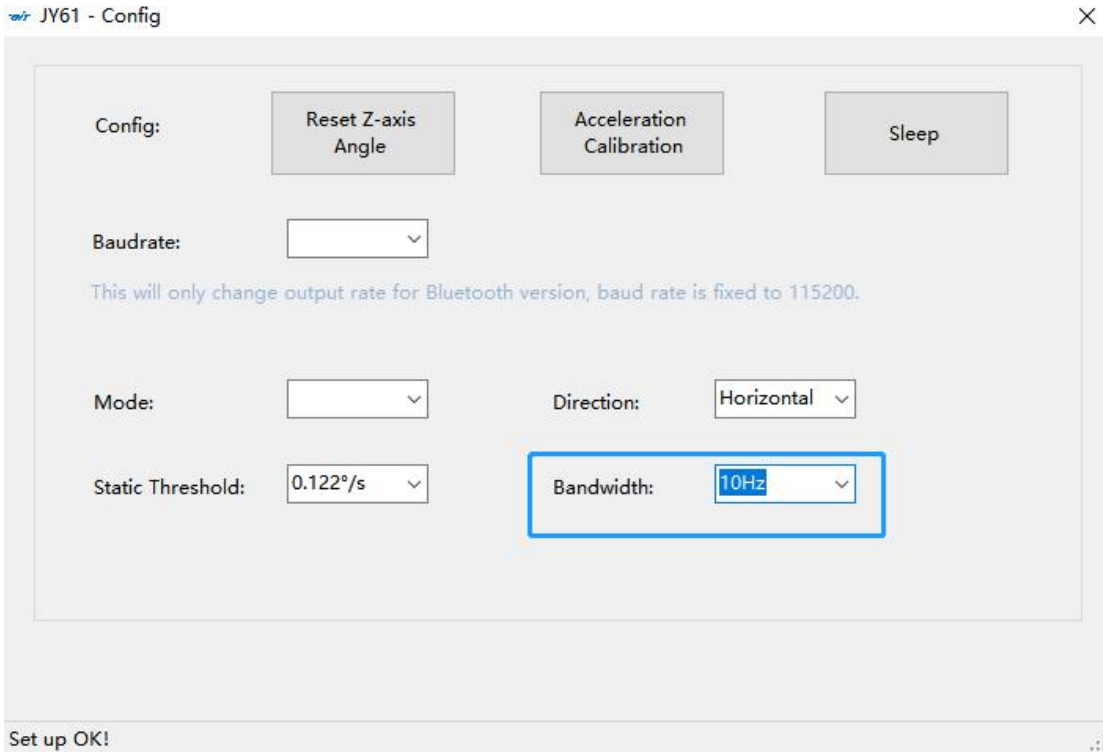
Static threshold: When the module is stationary, the angular velocity measured by the gyro chip changes slightly. The function of the static threshold is that when the angular velocity is less than the threshold, the module output angular velocity is 0.

Setting method:
Click the "Still Threshold" option in the configuration bar of the PC software to set the threshold. The module default is 0.122°/ s.



2.4.7 Bandwidth

Default bandwidth is 10Hz.

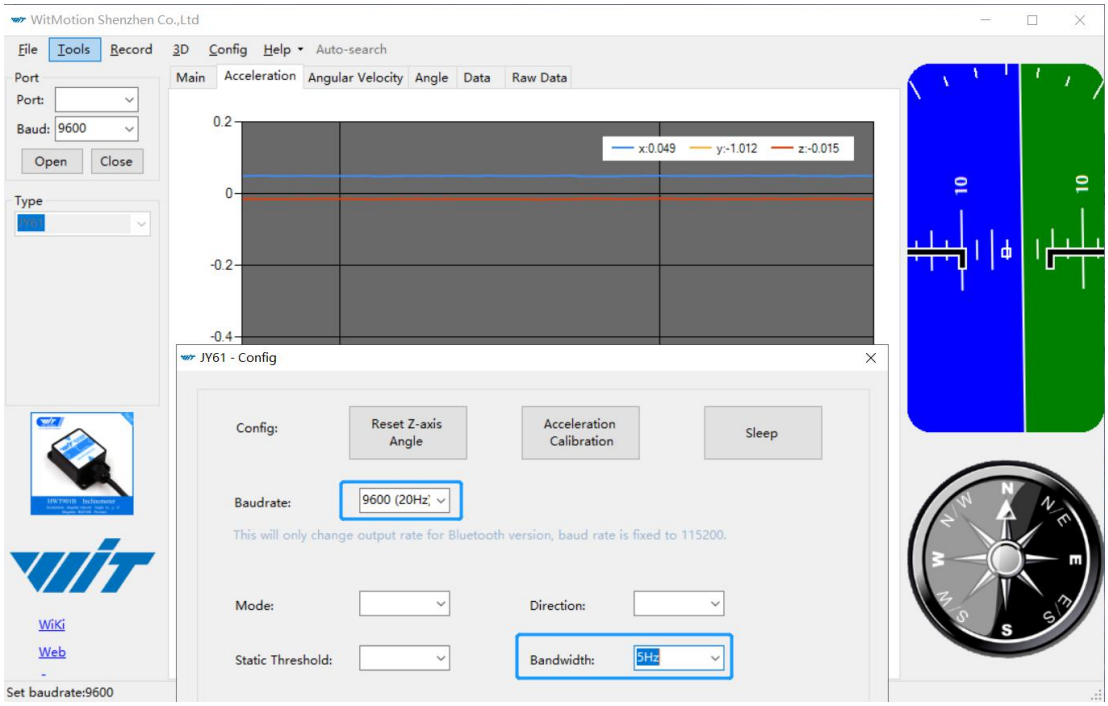


Function:

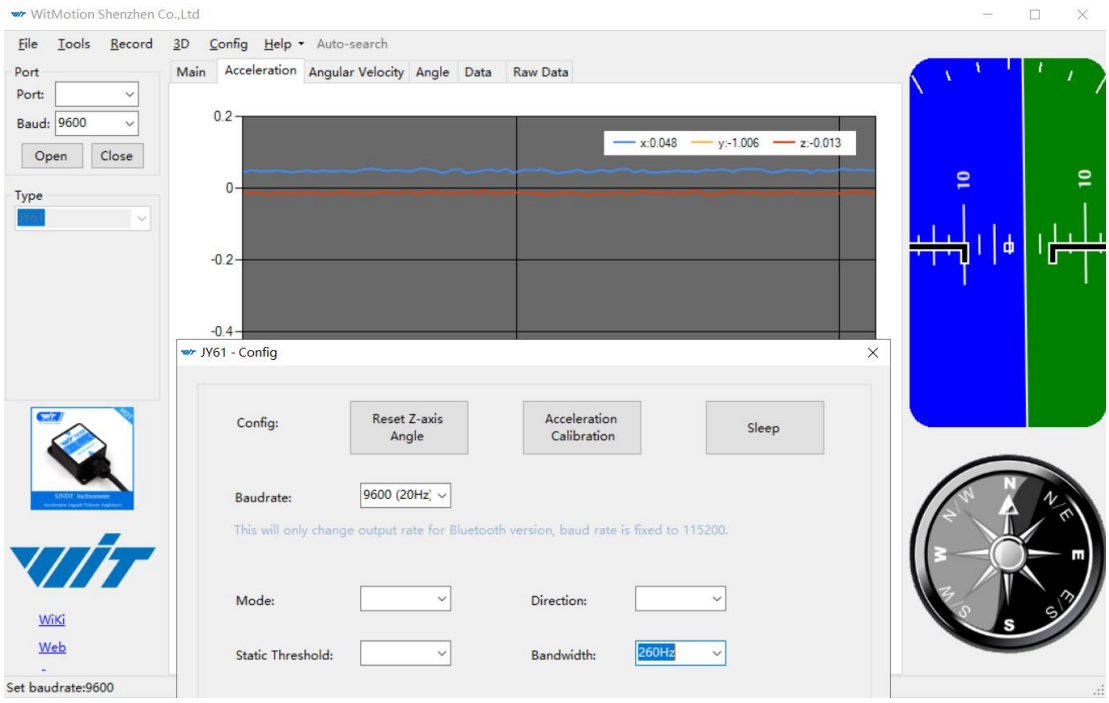
1. The higher rate of bandwidth setting will lead to the higher fluctuation in data waveform. Conversely, the lower rate of bandwidth, data will become more fluent.

For example:

Bandwidth as 20Hz, Output rate as 5Hz. The waveform is very steady.



Bandwidth as 256Hz, Output rate as 20Hz. The waveform will show more fluctuation.



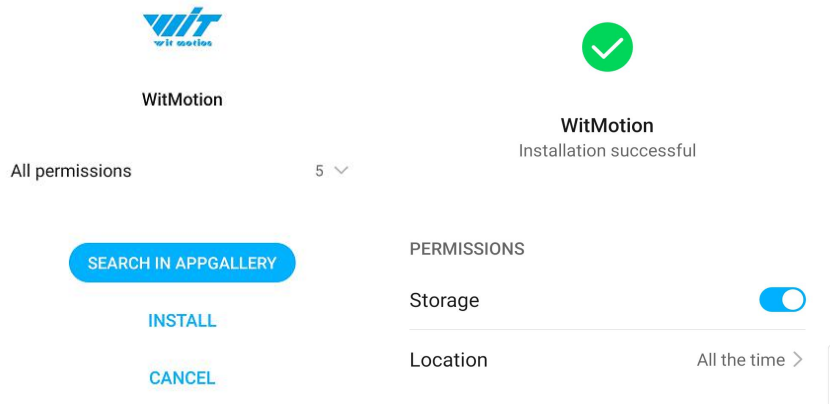
2. The higher rate of bandwidth will solve the data-repeating problem. For example, if the bandwidth setting is 20Hz, retrieval rate as 100Hz, there will be 5 repeating data. If you prefer there is no repeating data, it is required to increase the bandwidth more than 100Hz.

3 Use Instructions with Android Phone

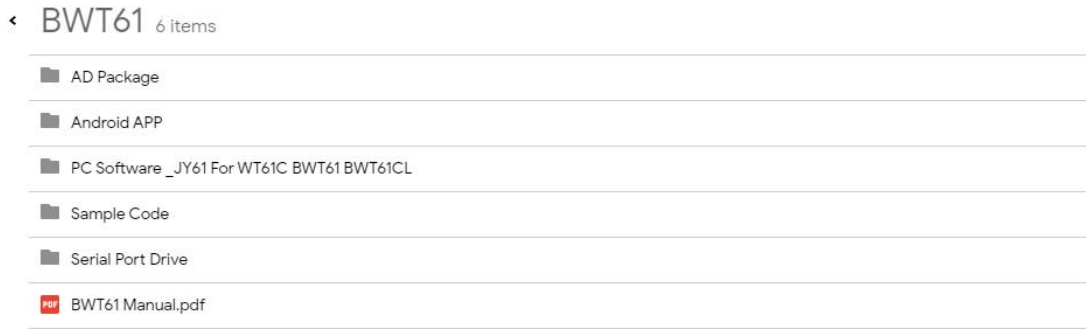
For APP configuration introduction, please referring to the Chapter 2.2

3.1 APP Installation

Install the APK file, give permission of Location and Storage



[Link to download Android APP]



About Android APP:

1. It is required to allow for application positioning (Always allowed), and turn 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.

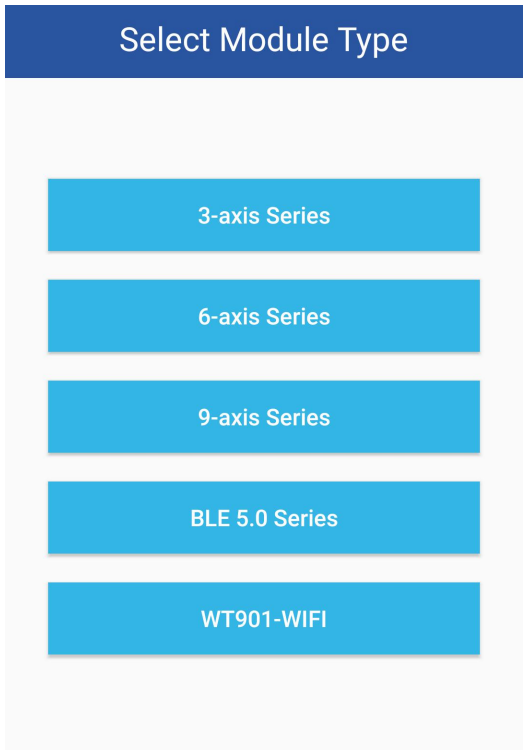
2. After turning on Bluetooth, it takes about one minute to search for authorization to find Bluetooth.

3.2 Connection

3.2.1 APP Pairing

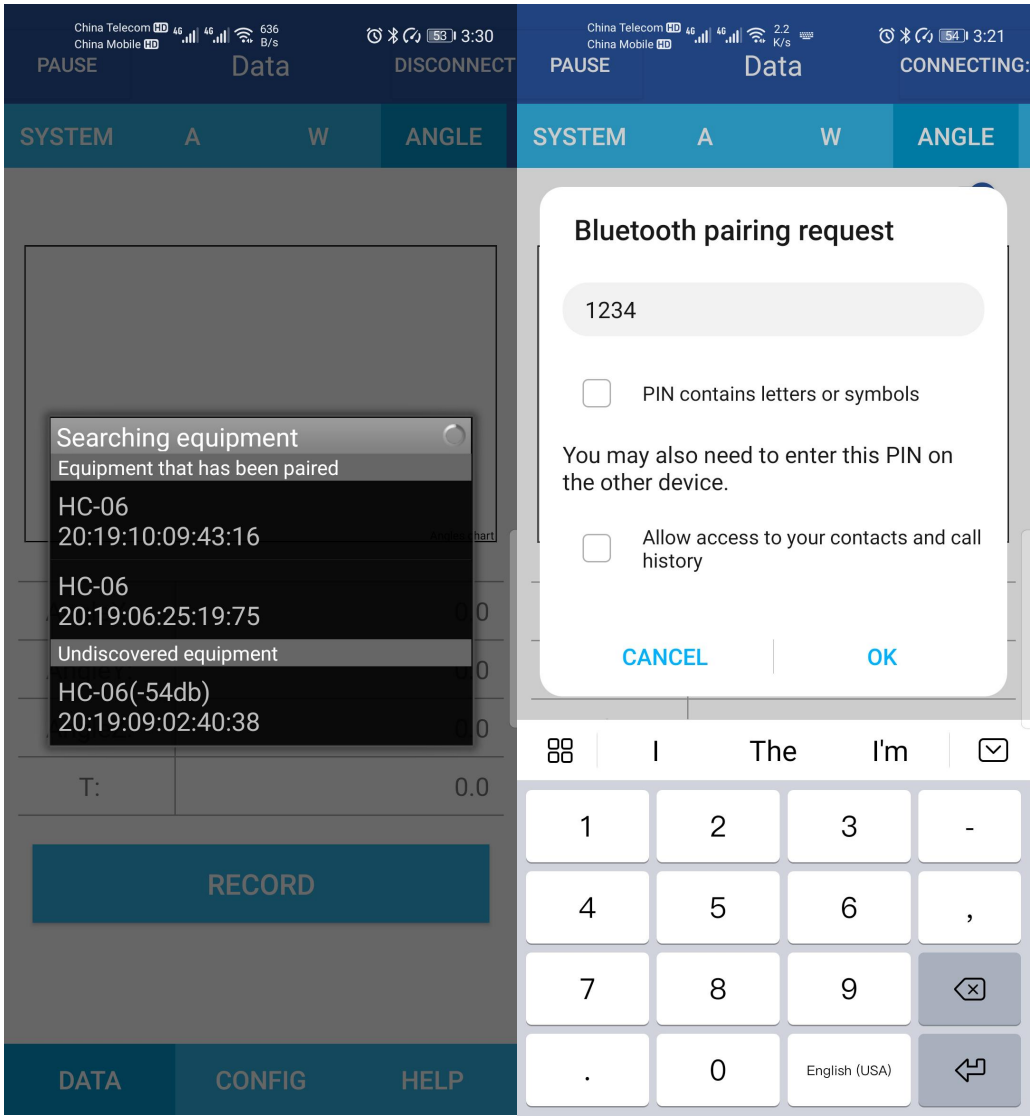
Step 1. Install the APK file, give permission of Location and Storage

Step 2. Open APP and choose “6-axis Series”



Step 3. Power on the Bluetooth sensor BWT61 and the Bluetooth of the device.

Step 4. Search the Bluetooth connection in the phone, the name of which was ”HC -06 ", password is 1234.



Step 5. When pairing is done, the blue LED light of sensor will remain still. After a few seconds, the data will show automatically.

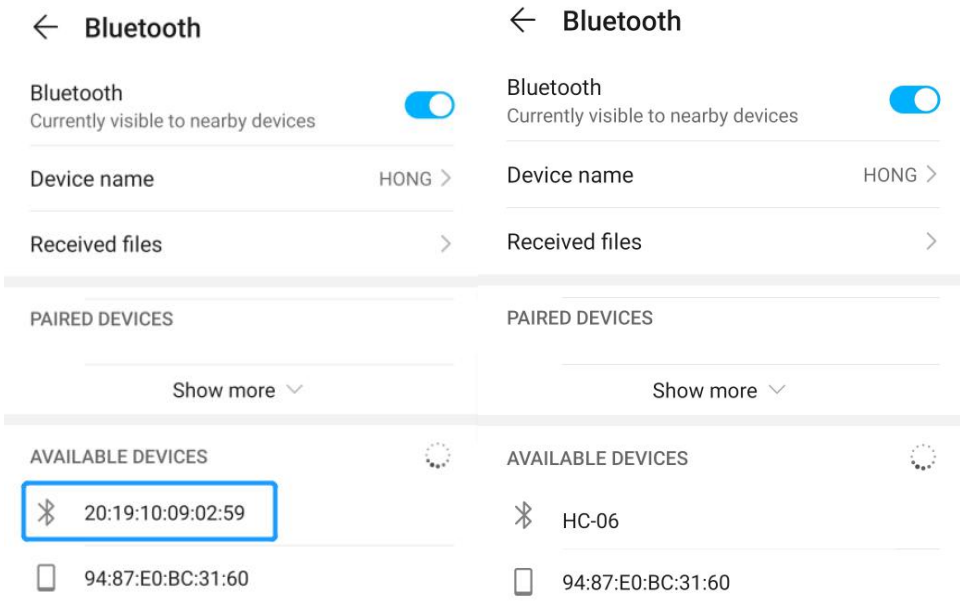
3.2.2 Phone's Bluetooth Pairing

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

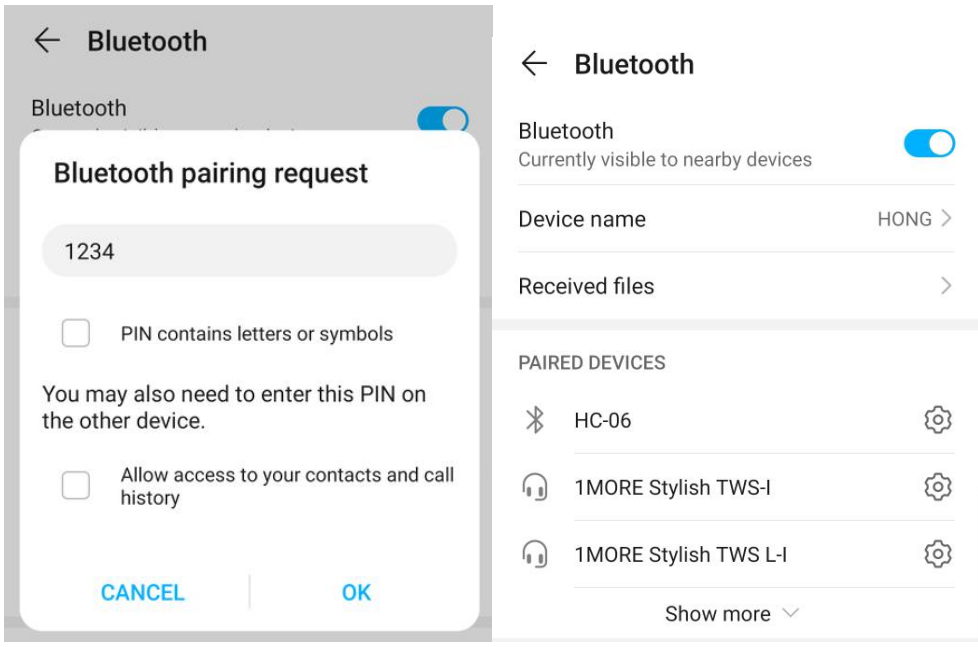
Step 2. Turn on the Bluetooth in the setting menu of smartphone

Step 3. Search the Bluetooth sensor

(First pairing the device will be recognize as mac address and will be shown as HC-06 after successful pairing.)



Step 4. Click the "MAC address" device and input the password "1234"



Step 5. Open the WITMOTION APP, and choose “6-axis Series”

Step 6. Click “Scan” and select the paired Bluetooth device “HC-06”
(No need to input password)

Step 7. The Blue LED light of sensor will remain still. Connection with APP is successful.

3.3 Calibration

Link to calibration demo:

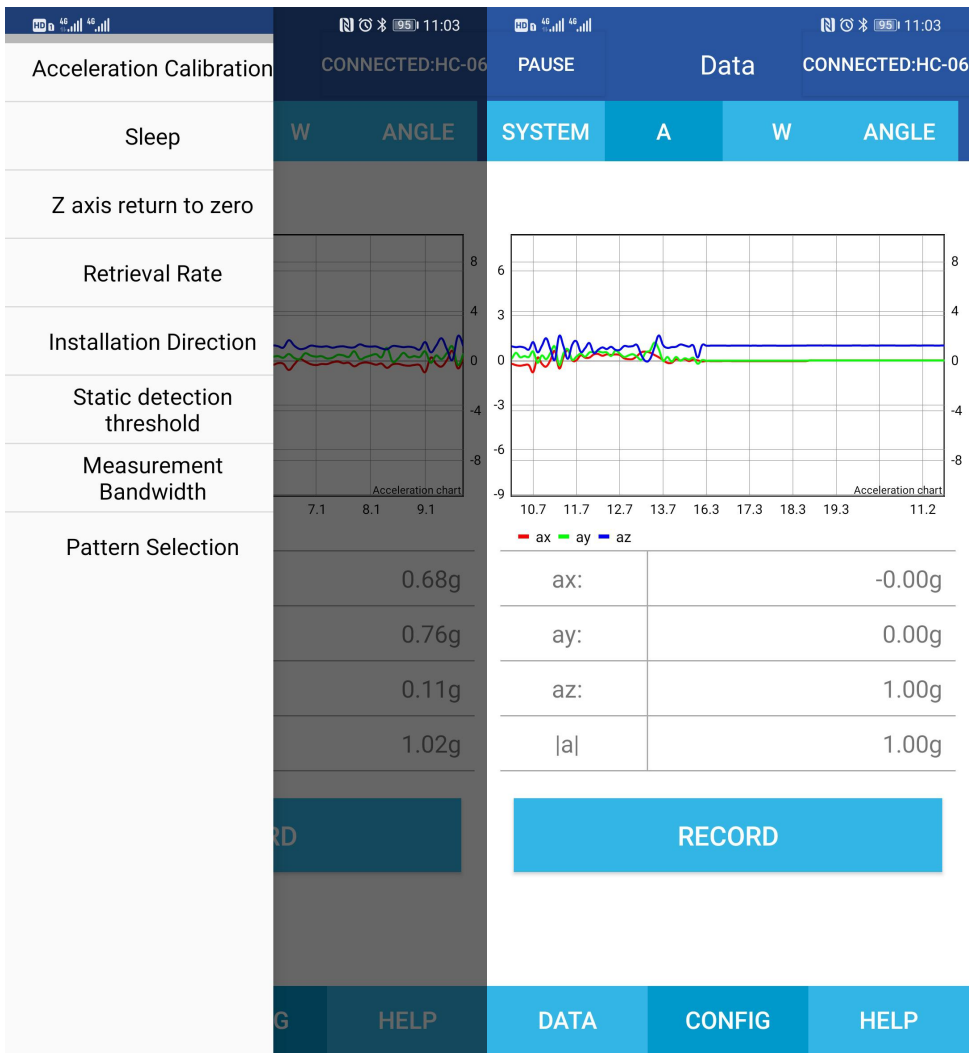
3.3.1 Acceleration Calibration

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



3.3.2 Reset Z-axis Angle

Step 1. Keep the module horizontally stationary

Step 2. Click the “Calibration” menu

Step 3. Click the “Z axis return to zero” and wait for 3 seconds

Step 4. Check the data of “Angle Z” to see if it is 0°.

4 Multiple Connection

For software introduction, please referring to the Chapter 2.2.

4.1 Download Link

For multi-connection, please download the multi-connection HID software.
Download link

4.2 Connection Instructions

Step 1. Open the multiple-connection PC software

Step 2. Plugin the USB-HID adapter in the beginning

Step 3. Power on the sensor after the red light of USB-HID adapter begins flashing

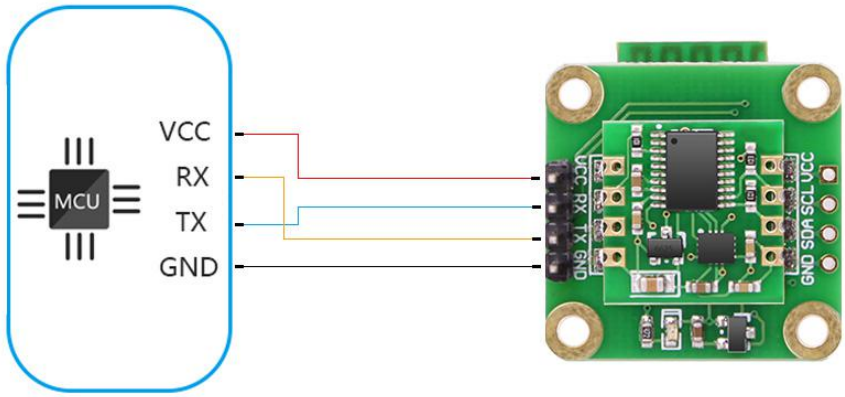
Step 4. Wait till sensor's blue LED light stops flashing--means pairing succeeds

Step 5. For multiple-connection, repeat Step 2-4

Step 6. Click the HID device accordingly and the data will show

Notice:
1. The multiple-connection will require the USB-HID 2.0 adapter.
The USB-HID adapter is driver-free design.
2. Each BWT61 Bluetooth 2.0 sensor can only pair with 1 USB-HID adapter.
3. The multiple-connection can reach up to 8pcs.

5 MCU Connection



Link to download all sample code

Link to sample code instructions demo

Notice: There is no sample code provided for Linux or Python system at present.

5.1 Arduino

Download link

Arduino UNO3 Demo Link

5.2 STM32

Download link

5.3 Raspberry pi

Tutorial link

5.4 C#

DEMO link

5.5 C++

DEMO link

5.6 Matlab

Receive Sample Code

Dataplot DEMO