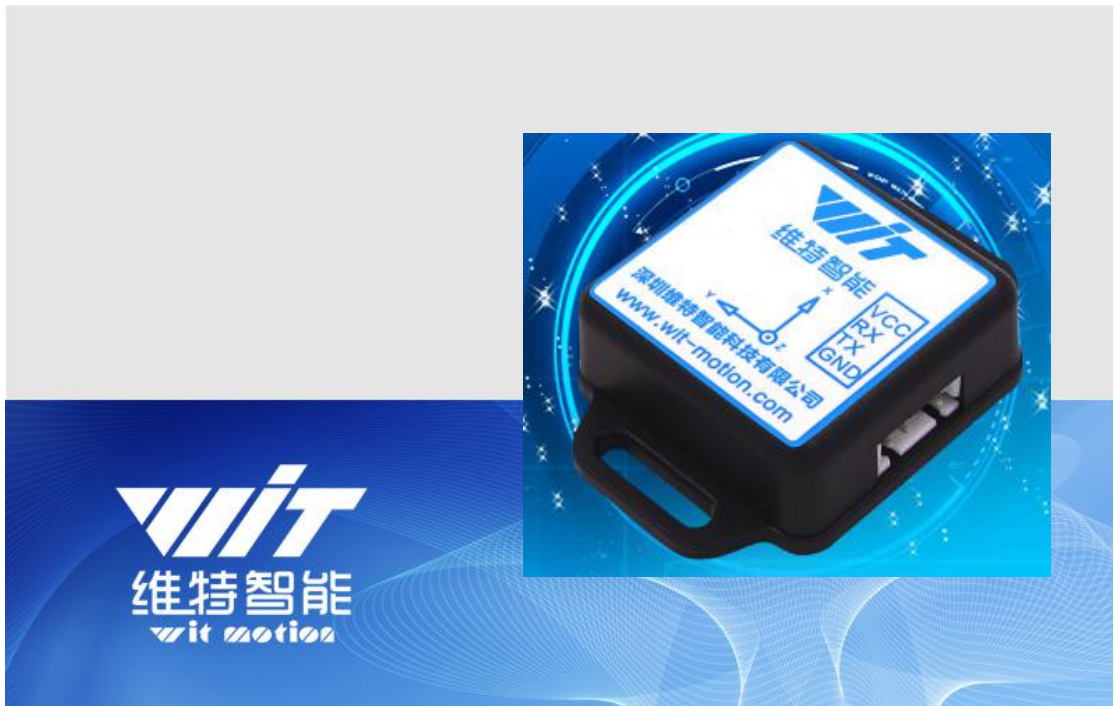




Focus on Attitude Sensor

<https://wiki.wit-motion.com/english>

# WT901C Digital Attitude Sensor Specification



Model : WT901C(TTL/RS232/RS485)

Description : Nine Axis Digital Attitude Sensor

Quality system standard: ISO9001:2016

Tilt switch production standard: GB/T191SJ20873-2016

Criterion of detection: GB/T191SJ20873-2016

Revision date: 2019.09.09

Download Link(software, manual, etc.):

<https://drive.google.com/file/d/1Y7qmvFht8ctU1Nc8oDIQWWpUx8MusimT>

Catalog

- 1 -



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## 1 Description



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- The module integrates high-precision gyroscopes, accelerometer, geomagnetic sensor, high-performance microprocessors and advanced dynamics solves dynamic Kalman filter algorithm to quickly solve the current real-time movement of the module attitude .
- The use of advanced digital filtering technology, can effectively reduce the measurement noise and improve measurement accuracy.
- Integrates gesture solver, with dynamic Kalman filter algorithm, can get the accurate attitude in dynamic environment, attitude measurement precision is up to 0.05 degrees with high stability, performance is even better than some professional Inclinator.
- The module has its own voltage stabilization circuit, working voltage is 3.3v ~ 5v, pin level compatible 3.3V and 5V embedded system and connection convenience .
- Support serial port UART(TTL) or UART(232) or UART(485), interface to facilitate the user to choose the best way to connect. . Serial port rate is adjustable from 2400kbps ~ 921600 kbps(default 9600) .
- The maximum data output rate is 200Hz. Input content can be arbitrarily selected, output rate of 0.1 ~ 200HZ can be djusted (default 10Hz).



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## Built-in core module-WT901C



●

## 2 Features

1) Model: WT901C (TTL/RS232/RS485)

2) Input voltage: 3.3V-5V

3) Consumption current: <40mA

4) Volume: 51.3 \* 36 \* 15 mm

5) Measuring:

Acceleration: X Y Z, Angular Velocity: X Y Z

Magnetic field: X Y Z Attitude angle: X Y Z

6) Range:

Acceleration:  $\pm 2/4/8/16g$ (optional),

angular velocity:  $\pm 250/500/1000/2000^\circ/s$ (optional)

Attitude angle: X Z ( $-180^\circ, 180^\circ$ ), Y ( $-90, 90$ )

7) Precision: Angle:  $0.05^\circ$  .

8) Data output:

time, acceleration, angular velocity, angle, magnetic field, port status,  
quaternion

9) The data output frequency 0.1Hz to 200Hz (default: 10Hz) .

10) Data Interface:

UART(TTL) or UART(232) or UART(485)

baud rate

2400, 4800, 9600(default), 19200, 38400, 57600, 115200, 230400, 460800, 921600)

### 3 Pin Description



Figure 1

Volume	51.3mm X 36mm X 15mm
Weight	13g

Pin	Function
VCC	Power supply, 3.3V-5V input
RX	Serial data input, TTL/232 level
TX	Serial data output, TTL/232 level
GND	GND

### 4 Axial direction

As shown in figure above, The axis of the module is in the upper picture, upward for x-axis, to the left for y-axis, Perpendicular to the paper, outward is z-axis, The direction of rotation is defined by the Law of the right hand. That is to say The direction of four-fingers bending is the direction of rotation around the axis .The thumb of the right hand points to axis.

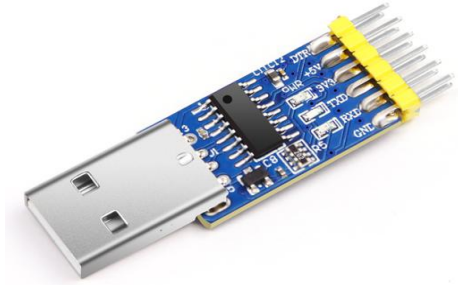


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## 5 Connection

Module 3 in 1 Convert:



Driver installation:

First, install the driver CH340 when we used the USB serial module ,after installed the driver. then get the corresponding Com number in the device manager. Driver as followed:

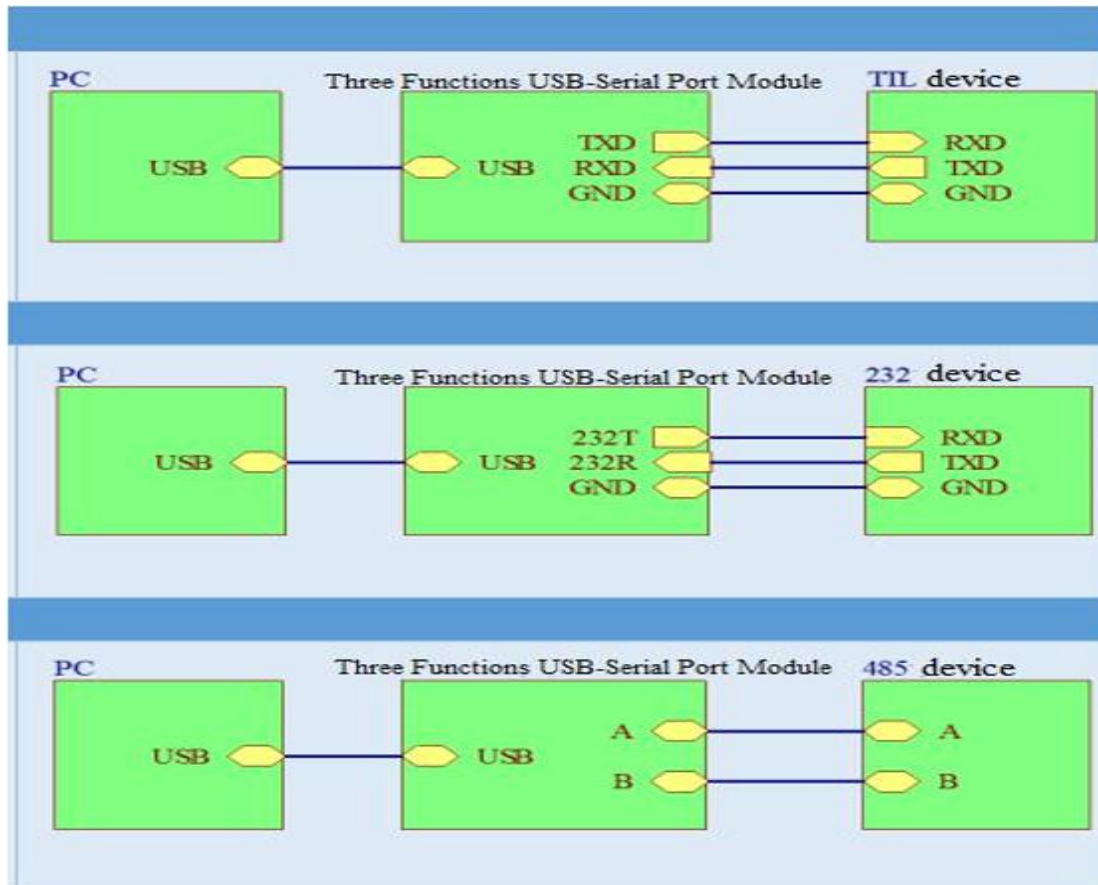
[https://wiki.wit-motion.com/english/doku.php?id=communication\\_module](https://wiki.wit-motion.com/english/doku.php?id=communication_module)

### Resource Summary

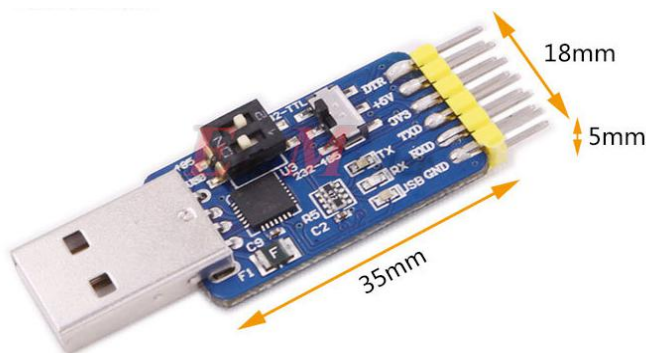
User Manual and Development Documents : [communication\\_module document center](#)

Device driver: [serial\\_port\\_debugging\\_assistant](#) [CH340](#) [CP2102](#)

**Contact us**



Module 6 in 1 Convert:



Driver installation:

First, install the driver CP210X when we used the USB serial module ,after installed the driver. then get the corresponding Com number in the device manager. Driver as followed:

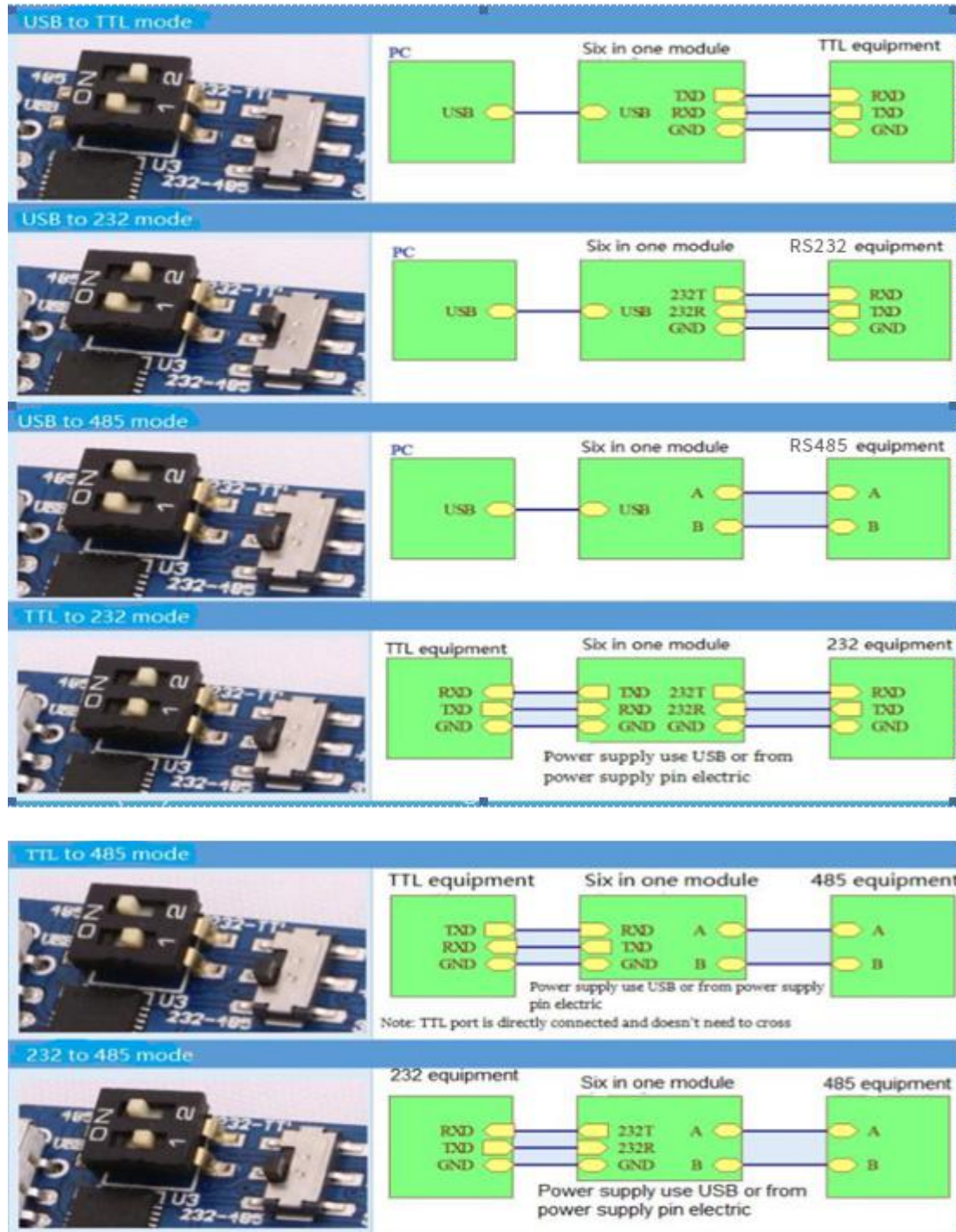


[https://wiki.wit-motion.com/english/doku.php?id=communication\\_module](https://wiki.wit-motion.com/english/doku.php?id=communication_module)

## Resource Summary

User Manual and Development Documents : [communication\\_module](#) document center

Device driver: [serial\\_port\\_debugging\\_assistant](#) [CH340](#) [CP2102](#)



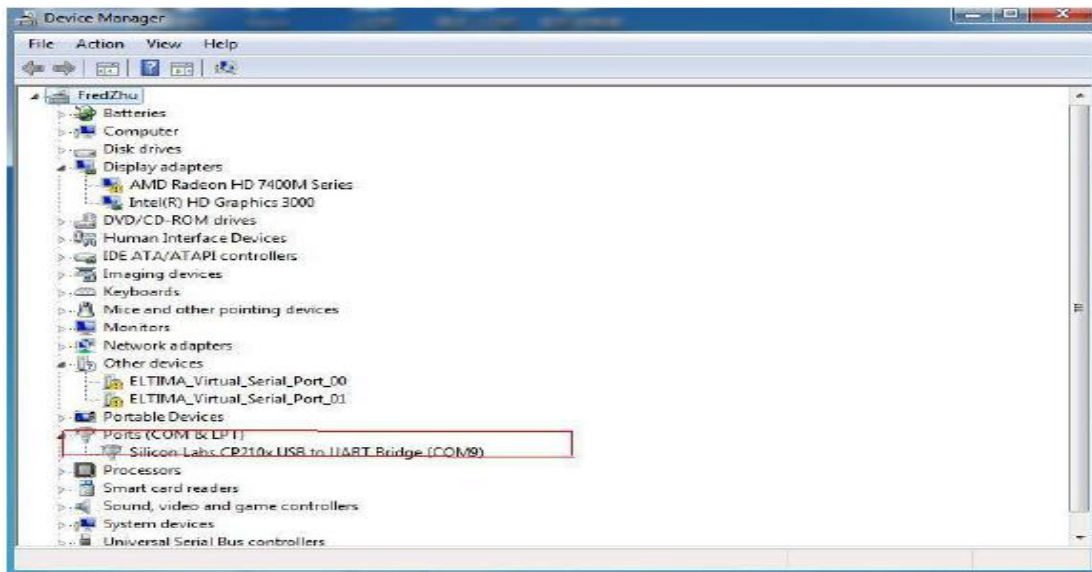




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After installing the module driver, and then Device Manager can query corresponding serial number, as below figure shows:



## 5.1 Connect with PC software

Open the software "MiniIMU.exe" and select the Com number which you have got in the device manager before.

**Ps:** You should see the name of product to choose which type to use



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### 5.1.1 RS485

## One device connection for work



Click the menu "Baud " in the software and then select 9600,Click the menu



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"Type" , Select the model as "Modbus" in the software.



then click the Search choose one of it, then software will show the data.



Clicking the button "Record" can save the data as a file.



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The files are saved in the directory Data.tsv: of the software.

StartTime: 2019-07-23 16:07:30.850																
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(°C)	hx	hy	hz	
0x50	16:15:32.373	00:22:31.160			-0.0166	0.0024	-0.9922	0.0610	0.0610	0.0000	-179.9506	0.8459	4.7021	25.7600	43	-492 86 0
0x50	16:15:32.503															
0x50	16:15:32.503	00:22:31.290			-0.0122	0.0010	-0.9937	0.0610	0.0000	0.0000	-179.9396	0.8514	4.7186	25.7600	42	-493 84 0
0x50	16:15:32.631															
0x50	16:15:32.631	00:22:31.420			-0.0146	0.0029	-0.9932	0.0000	0.1221	0.0000	-179.9396	0.8459	4.7076	25.7700	41	-493 85 0
0x50	16:15:32.764															
0x50	16:15:32.764	00:22:31.550			-0.0186	0.0000	-0.9917	0.0000	0.0000	0.0000	-179.9396	0.8459	4.6967	25.7600	36	-493 88 0
0x50	16:15:32.900															
0x50	16:15:32.900	00:22:31.680			-0.0181	-0.0034	-0.9917	0.0000	0.0000	0.0000	-179.9396	0.8514	4.6747	25.7700	42	-494 83 0
0x50	16:15:33.026															
0x50	16:15:33.026	00:22:31.810			-0.0156	0.0015	-0.9922	0.0000	0.0000	0.0000	-179.9451	0.8514	4.6912	25.7600	49	-496 79 0
0x50	16:15:33.157															
0x50	16:15:33.157	00:22:31.940			-0.0195	-0.0015	-0.9917	0.0000	0.0000	0.0000	-179.9451	0.8514	4.7461	25.7500	42	-494 82 0
0x50	16:15:33.288															
0x50	16:15:33.288	00:22:32.075			-0.0151	-0.0029	-0.9912	0.0000	0.0000	0.0000	-179.9451	0.8569	4.7791	25.7500	48	-497 72 0
0x50	16:15:33.418															
0x50	16:15:33.418	00:22:32.205			-0.0181	0.0005	-0.9932	0.0000	0.0000	0.0000	-179.9506	0.8569	4.8065	25.7600	42	-491 82 0
0x50	16:15:33.547															
0x50	16:15:33.547	00:22:32.335			-0.0195	-0.0010	-0.9932	0.0000	0.0000	0.0000	-179.9506	0.8679	4.8120	25.7700	41	-493 86 0

## Multiple- device connection for work(Just for RS485)

1. you should connect product to PC software, and The location of the connection should correspond, VCC to 5V, GND to GND, A TO B.

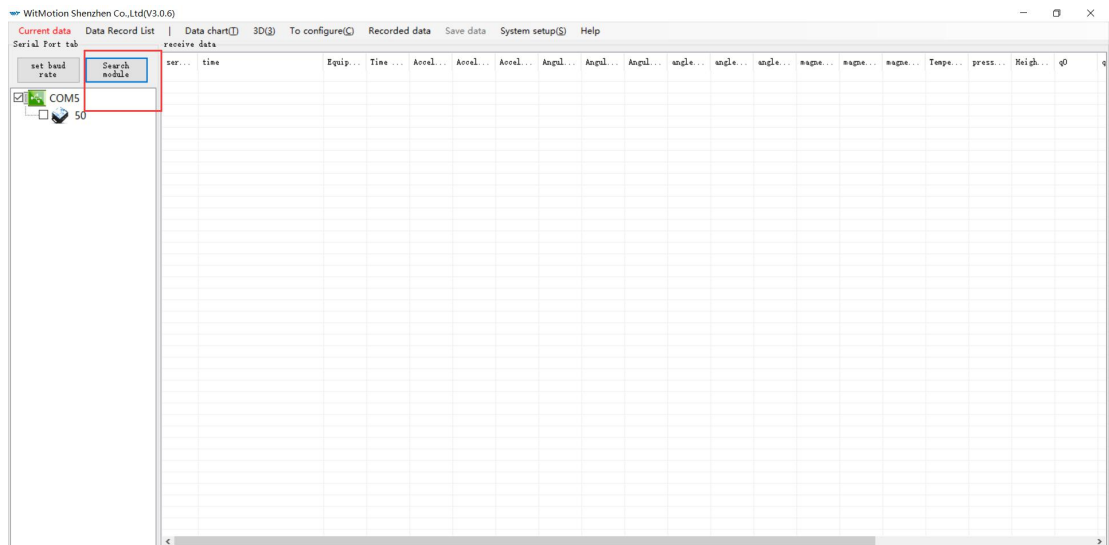


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2. Firstly, connect one product to PC software, then open “Wtzn-Modbus”, elect the Com number which you have got in the device manager before.



3. Then select the com number and click “Search module”, will show product.
4. Select the product and right click, and click configuration, then click “change” to modify device address





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Parameter configuration -> COM5 -> 50

System  
Default Sleep Alarm Algorithm: Axis 9 direction: Horizon ☐ Instruction startup

Calibrate  
Acceleration Magnitude Height Zero Z Angle Set Angle Ref ☒ Gyro Auto Calibrate

Range  
Acceleration: 16 g/s2 Gyro: 2000 deg/ Bandwidth: 20 Hz gps time zone:

Communicate  
Communication rate: 9600 device address: 0x51

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

■ Online

Configuration information reading completed!

- you should use lines which name are “Multi-level connection” to connect you products, one line can connect two products.



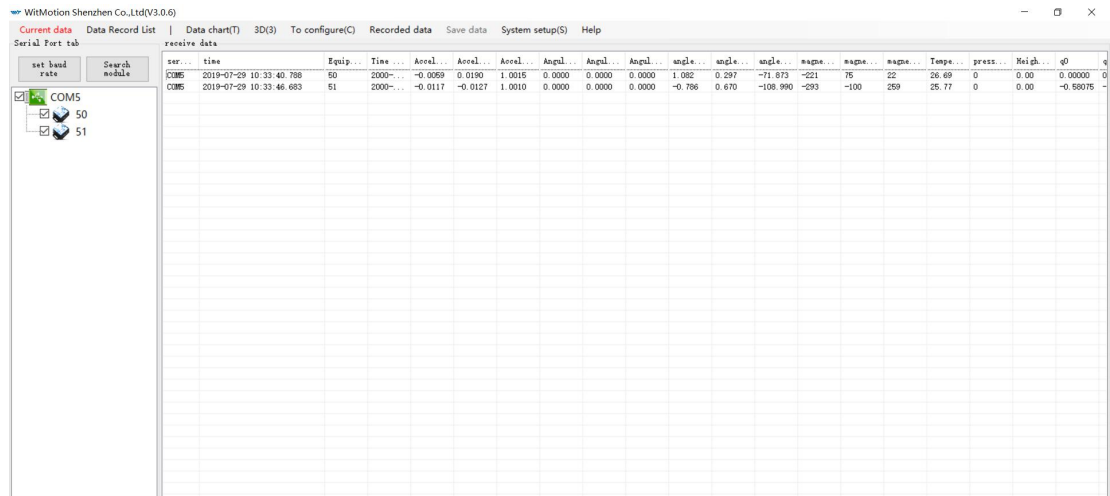
- then click “Search module” again, it will show two products, click product , will show data





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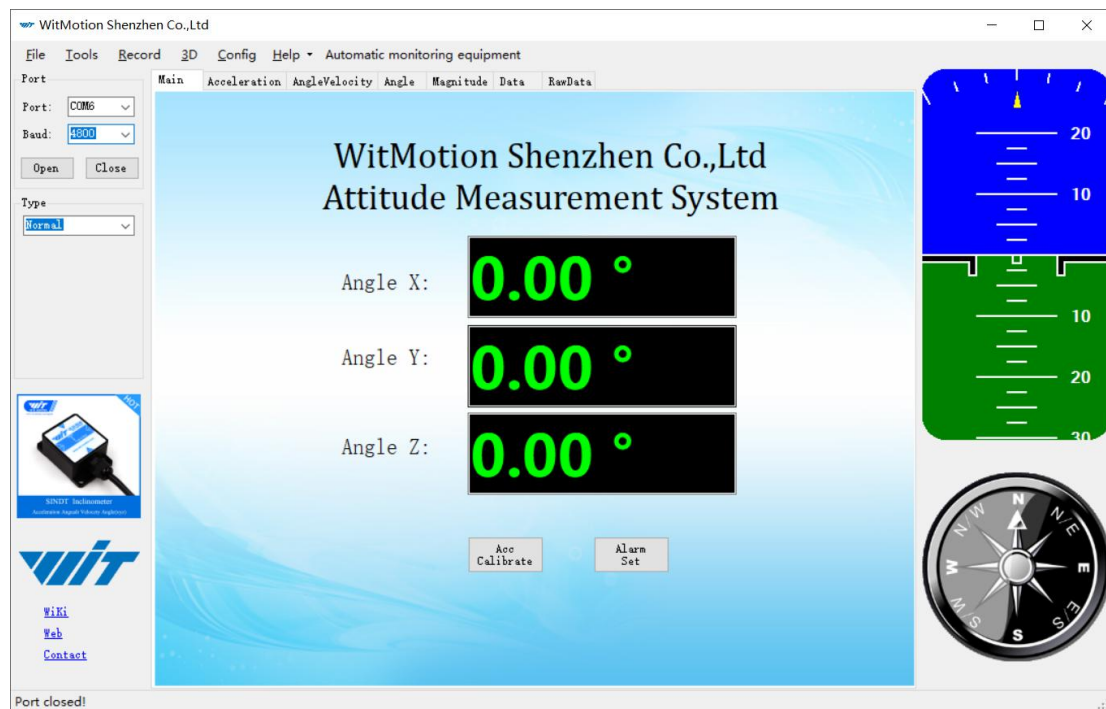


7. The more products you connect, the more baud rate you need to set.

### 5.1.2 RS232 or TTL

Click the menu "Baud " in the software and then select 9600, Click the menu

"Type" , Select the model as "Normal" in the software.

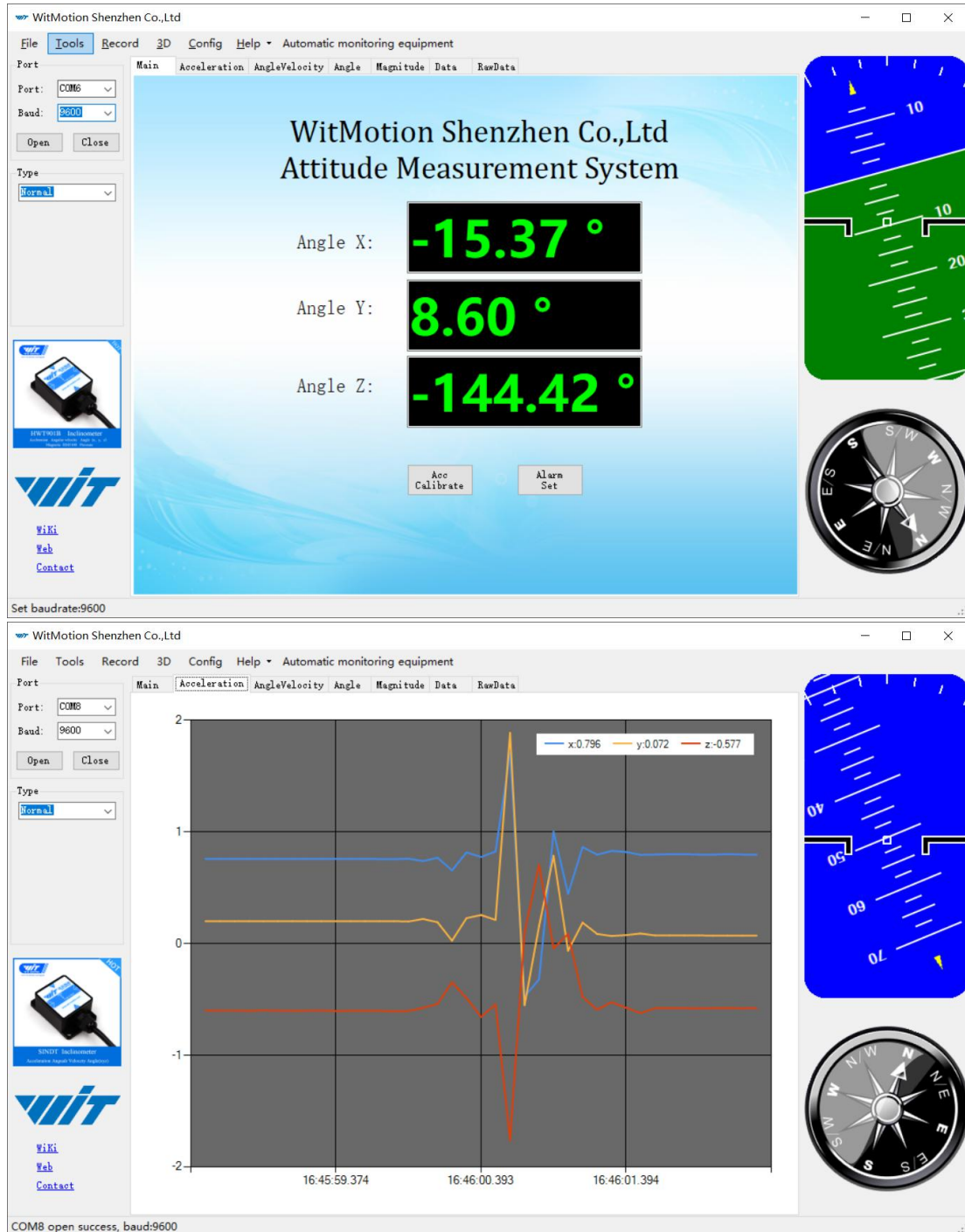


Then click "open", the data will show



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When the time interval between the data acquisition and the last data acquisition is long, the update of the chart will be slow. At this time, click the image right click, pop out the map bar, and click the clear map option to speed up the data refresh rate. Click the “3D” and 3D will display, which displays the posture of the module.



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## 5.2 Calibration (calibration on PC software)

Reminder: The module calibration and configuration should be carried out under the online state which displayed in the low right corner of the software configuration bar. As shown below, offline shows that the PC software did not control to the module. The module need to be calibrated before using.

Accelerometer calibration and magnetic calibration.

The module should be calibrated before you use it. The module calibrate includes Magnetic field calibration , Accelerometer calibration.

### 5.2.1 Accelerometer calibration

The accelerometer calibration is used to remove the zero bias of the accelerometer. When the sensor is out of the factory, there will be different degrees of bias error. After manual calibration, the measurement will be accurate.

Methods:

1. Firstly keep the module horizontally stationary, in the "Config" of the software click "Acceleration" and a calibration interface will pop up.
2. Check the "Auto Calculate" option, the software will automatically calculates the zero bias value and then click "Write parameter" Click "data" on the left side of the PC software to see the Angle data as shown below:
3. 1 ~ 2 seconds after the module three axial acceleration value is about 0 , 0, 1,



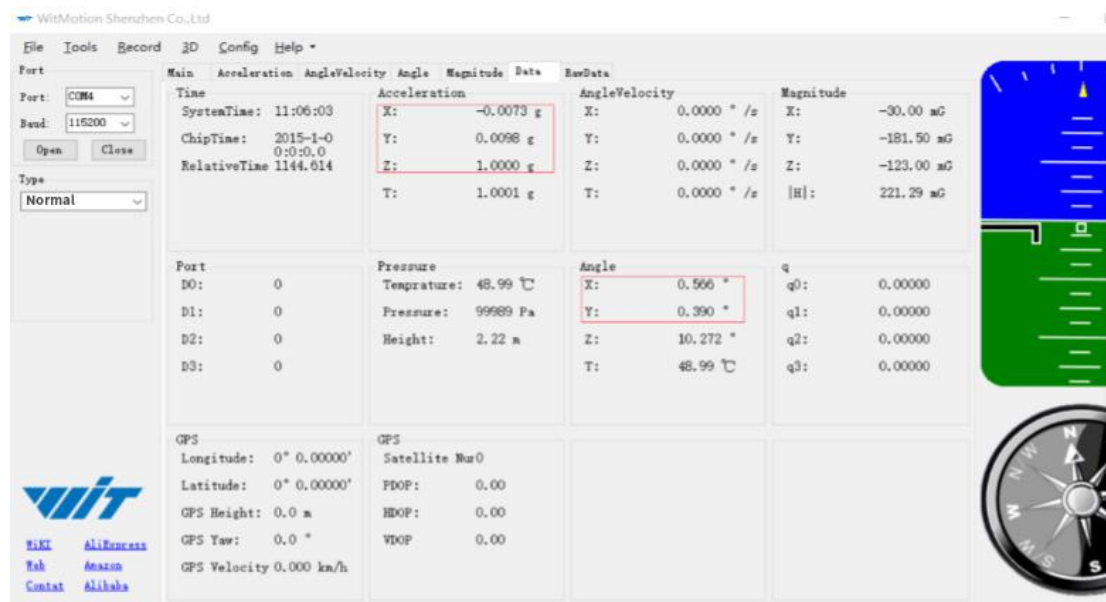
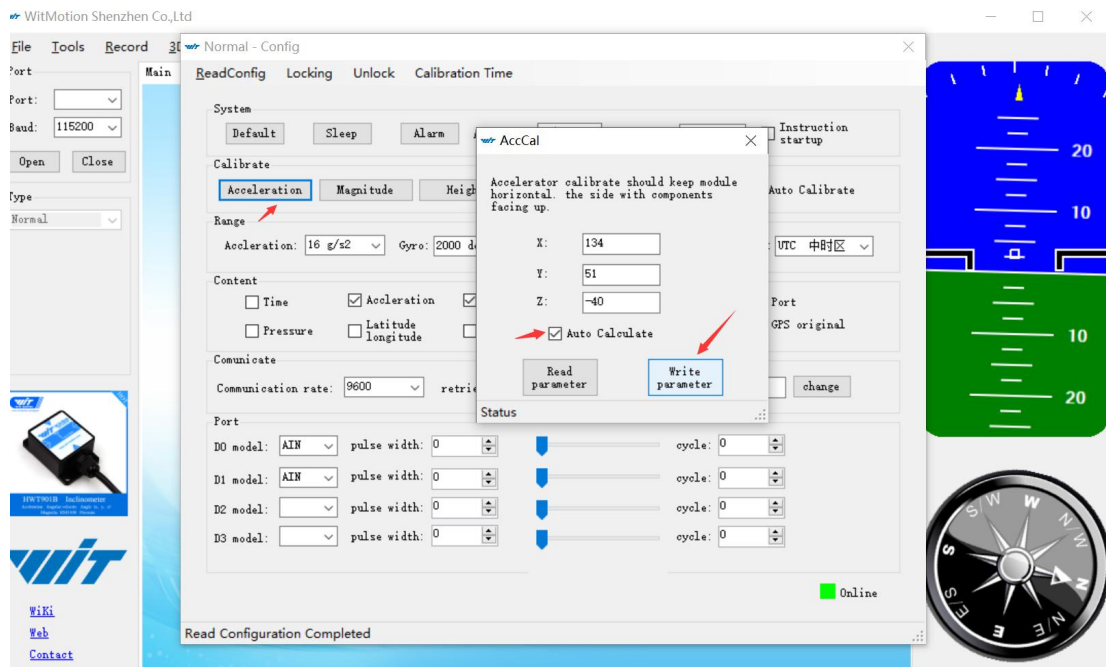
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the X and Y axis Angle around 0 °. After calibration, the x-y axis Angle is accurate. Note: when put the module horizontal , there is one G of gravitational acceleration.

#### 4. Calibration video:

<https://www.youtube.com/channel/UCxBLgvYQNk-sGVDp42ch-Ug>





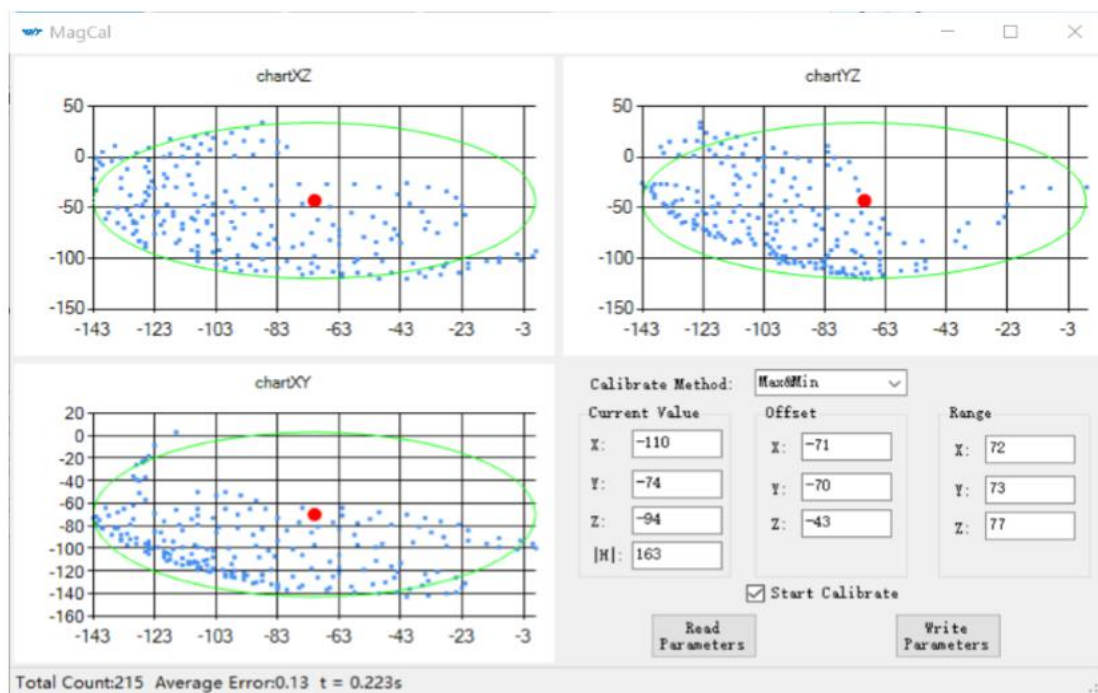
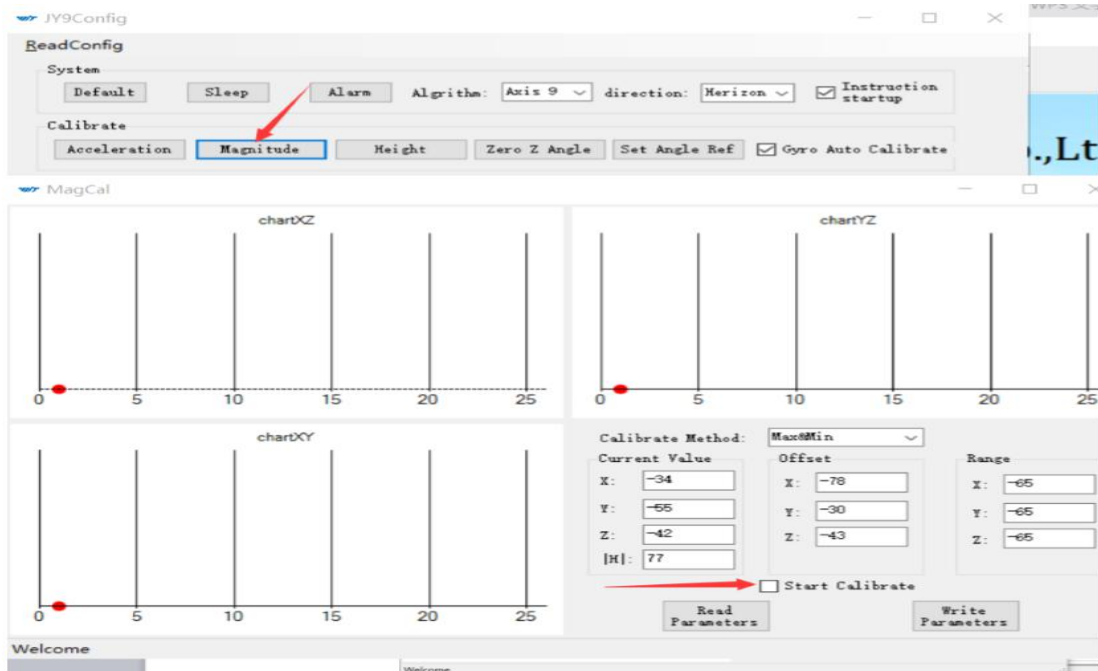
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### 5.2.2 Magnetic field calibration

Magnetic calibration is used to remove the zero deviation 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. The magnetic calibration method is as follows:

1. When calibrating, firstly connect the module and computer, place the module far away from the interference magnetic (20CM away from magnetic and iron and other materials), and then open the PC software.
2. In the setting page, click the magnetic field button under the calibration bar to enter the magnetic field calibration mode. At this time, the MagCal window pops up and click to start the calibration.
3. Then, slowly rotate the module around the three axes so that the data points can be drawn in the three planes. The data points can be rotated several more times, and the calibration can be stopped after the regular ellipses are drawn. After the calibration is complete, click write parameters.



Note: data points within the ellipse, as far as possible can't oval outside, if you can't draw the ellipse, please stay away from the magnetic field interference, reference calibration video again, slowly put the module in the earth's magnetic field on the north-south axis.





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### 5.3 Gyroscope Automatic Calibration

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

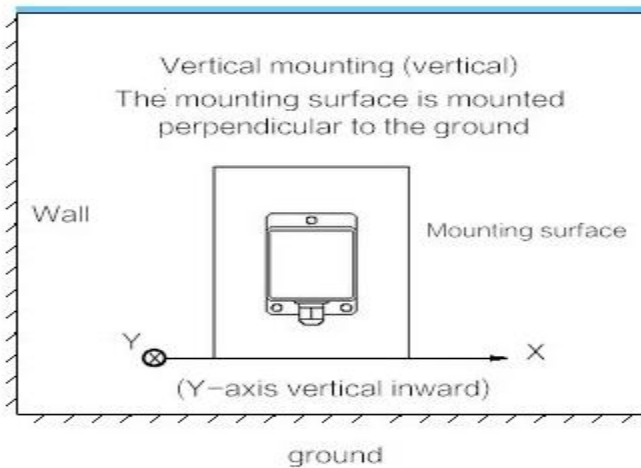
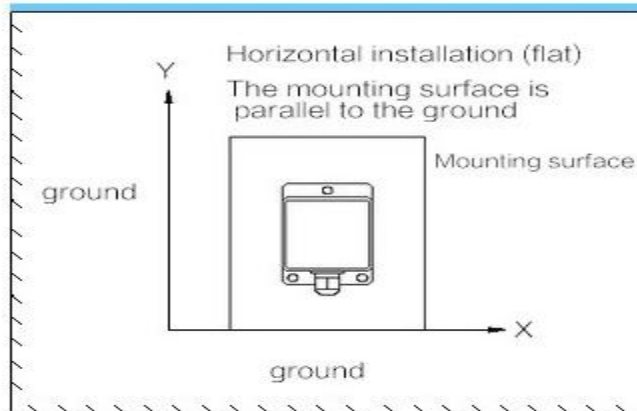
The automatic calibration of gyroscopes can be removed only if the module rotates at a constant speed

### 5.4 Installation direction

The default installation direction of the module is horizontal installation. When the module needs to be placed vertically, you can use the vertical installation setting.

Vertical installation method: Rotate the module around the X-axis and place it 90 degrees vertical when installing vertically , Select the "vertical" in the "Config" of the PC software.

Once the setting are completed, calibrate them to use.



Normal - Config

ReadConfig Locking Unlock Calibration Time

System

Default Sleep Alarm Algorithm: Axis 9

Calibrate

Acceleration Magnitude Height Zero Z Angle Set Angle Ref Gyro Auto Calibrate

Range

Acceleration: 16 g/s2 Gyro: 2000 deg/ 20 Hz gps time zone: UTC 中时区

Content

☐ Time ☒ Acceleration ☒ Velocity ☒ Euler angle ☒ Magnetism ☐ Port

☐ Pressure ☐ Latitude longitude ☐ Ground velocity ☐ Quaternion ☐ Positioning accuracy ☐ GPS original accuracy

Communicate

Communication rate: 9600 retrieval rate: 10Hz device address: 0x50 change

Port

D0 model: AIN pulse width: 0 cycle: 0

D1 model: AIN pulse width: 0 cycle: 0

D2 model: pulse width: 0 cycle: 0

D3 model: pulse width: 0 cycle: 0

Online

Read Configuration Completed



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## 5.5 Dormancy and break dormancy

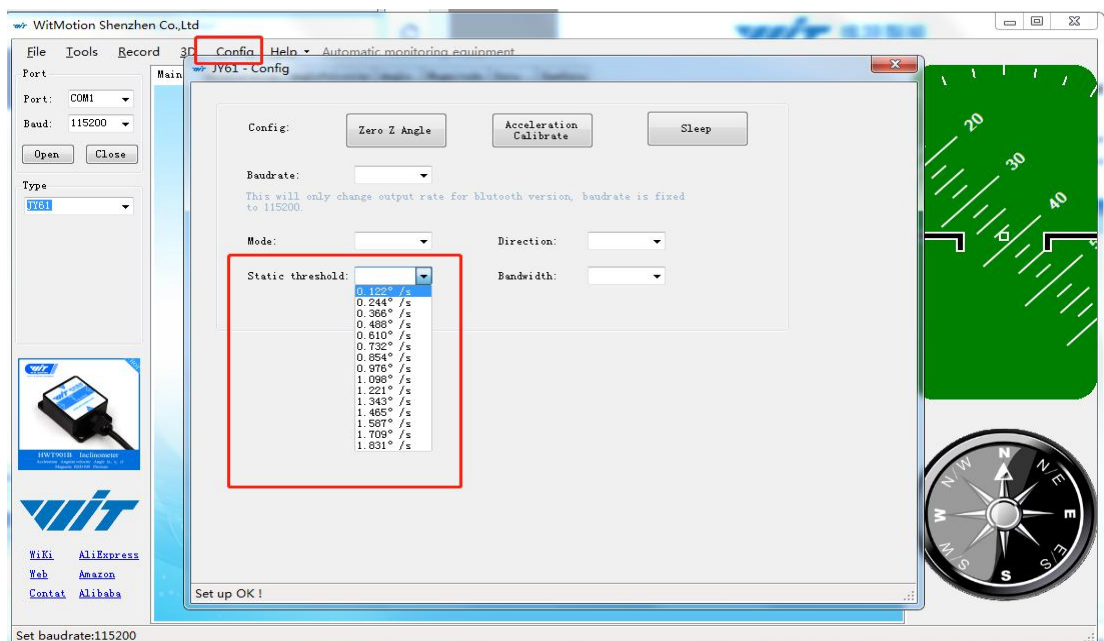
Dormancy: The module pauses working and enters the standby state, dormancy can reduce power consumption.

Break dormancy: The module enters the working state from the standby state.

How to use: The default state of the module is working state, Click "Sleep" in the "config" of the PC software to enter the standby state, click "Sleep" again the module will break the dormancy.

## 5.6 Static threshold and measure width

Static threshold : The angular velocity of the gyroscope chip is slightly change when the module is in static placement. The effect of the "Static threshold" is When the angular velocity is less than the threshold module output angular velocity is 0.





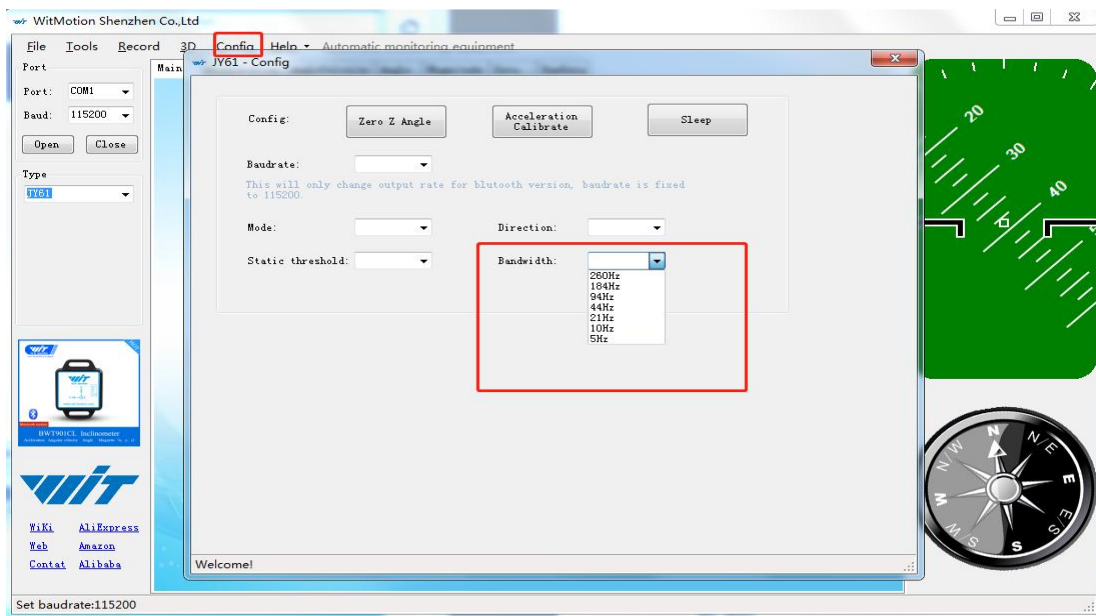
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Bandwidth : The module output the data within the measurement bandwidth.

Data greater than bandwidth is automatically filtered out.

How to use: Click the "Bandwidth " of the "config " in the PC software. default is 10 HZ.



PS: The default setting of Static threshold and bandwidth works in most case. you should not set it any more.

## 5.7Connect to Phone(Just for TTL / RS232)

### 1) Install the app in the Phone.

APP download address:

<https://wiki.wit-motion.com/english/doku.php?id=inclinometer>

WT901C	3.3-5V	TTL/RS232	XYZ ±2、4、8、 16	X Y Z	X Y Z	X Y 0.05	yes	yes
--------	--------	-----------	----------------------	-------	-------	----------	-----	-----

### 2) we need OTG device to connect to phone



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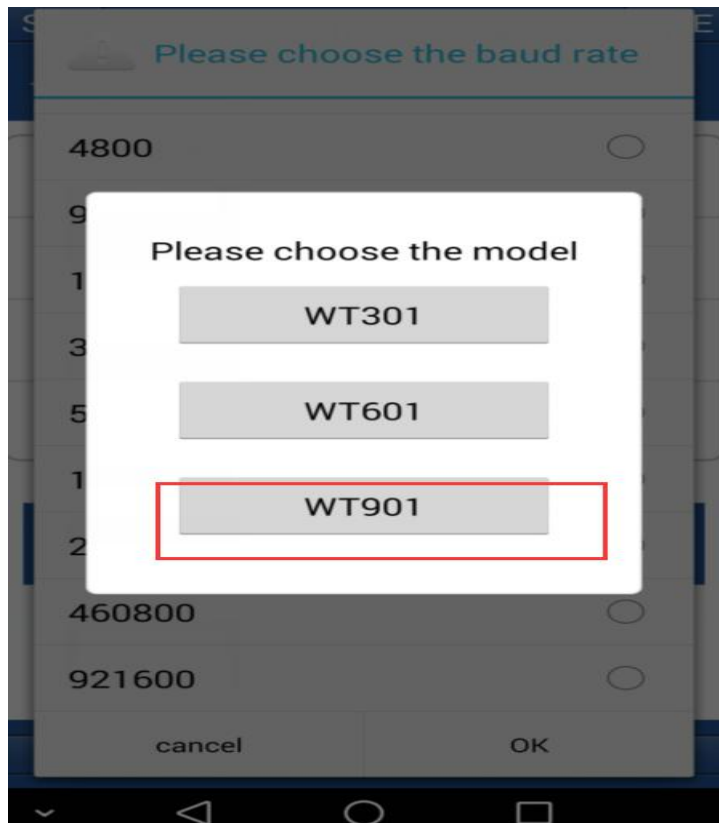


3)Then open the app and choose WT901

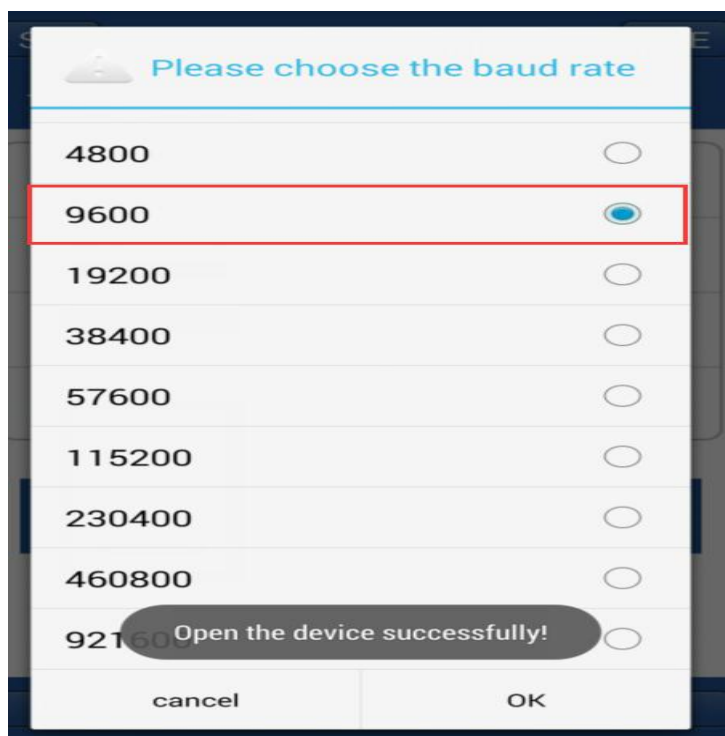


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4) choose 9600



Then the data will show





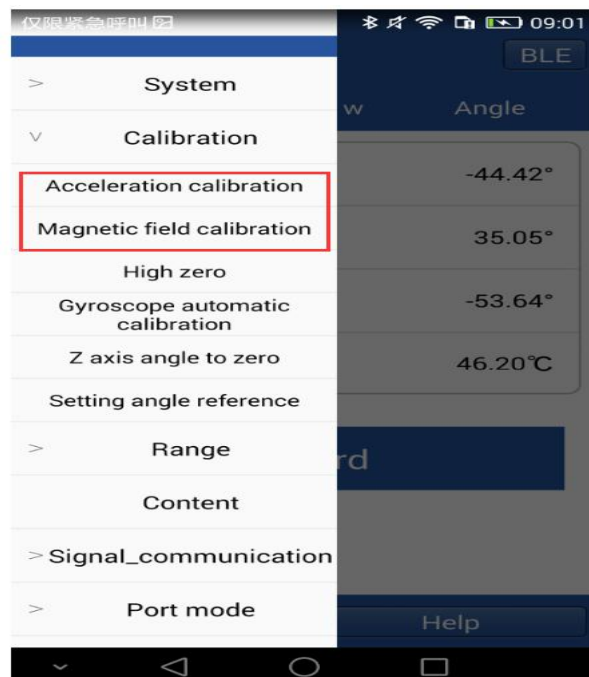
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#### 4) Calibration(calibration on APP)

Please keep the BWT901CL on the horizontal level and make the “acceleration calibration” and “Magnetic field calibration” as below:





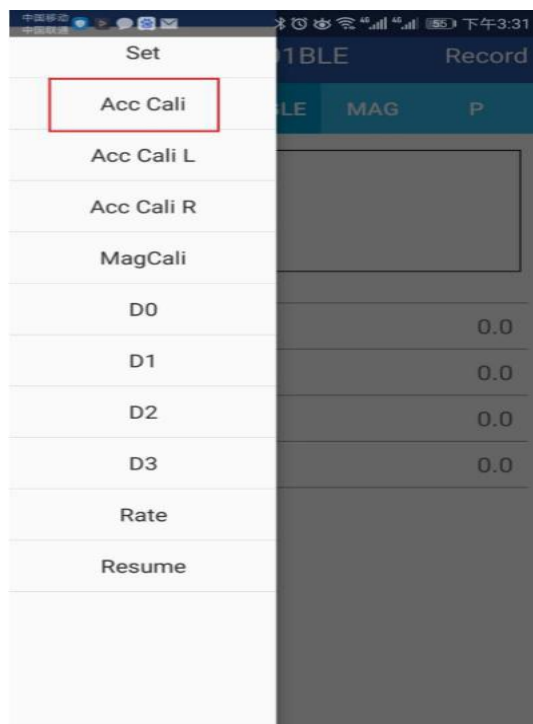
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## 1) Accelerometer Calibration

The accelerometer calibration is used to remove the zero bias of the accelerometer. When the sensor is out of the factory, there will be different degrees of bias error. After manual calibration, the measurement will be accurate.

1、Methods as below: Firstly keep the module horizontally stationary, click "Acceleration", after 1~2s the acceleration X Y Z value will at 0 0 1. X Y angle: 0°.After calibration the value will be accurate.



## 2) Magnetic Calibration

Magnetic field calibration is used to remove the magnetic field sensor's zero offset. Usually, the magnetic field sensor will have a large zero error when it is manufactured. If it is not



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calibrated, it will bring about a large measurement error and affect the accuracy of the Z-axis angle measurement of the heading angle.

Calibration methods as follow:

1. When calibrating, first connect the module and the computer, and place the module in a place far away from the disturbing magnetic field (ie, more than 20 CM away from magnets and iron, etc.), and then open the upper computer software. 2. Click the "Magnetic Field Calibration" and rotate 360° around the X axis of the module ( you can rotate around the Y axis or the Z axis first). Rotate a few turns, then turn 360° around the Y axis. Then turn 360° around the Z axis, then turn a few turns at random, then click the "Finish" to complete the calibration.

## 6 Application area

Agricultural machinery



Internet of things



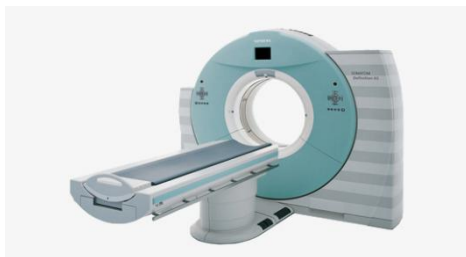
Solar energy



Power monitoring



Medical instruments



Construction machinery



Geological monitoring





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## WT901C 9-axis Digital Inclinometer

Contact: Mr. Kyle Tsang

E-mail : [support@wit-motion.com](mailto:support@wit-motion.com)

Skype: live:kyle\_8394

WhatsApp: +86 136 523 39539

Amazon in USA: [www.amazon.com/witmotion](http://www.amazon.com/witmotion)

Amazon in Canada: [www.amazon.ca/witmotion](http://www.amazon.ca/witmotion)

Amazon in Japan: [www.amazon.co.jp/witmotion](http://www.amazon.co.jp/witmotion)

Official Direct Store: [www.aliexpress.com/store/4709011](http://www.aliexpress.com/store/4709011)

Address : Honghai building 1405 Songgang town Baoan District

Shenzhen Guangdong Province China