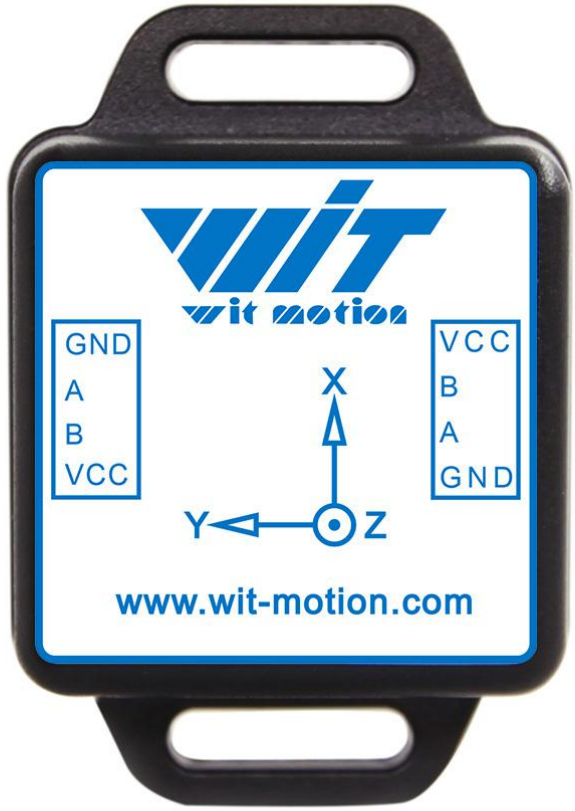
USER MANUAL

WT901C(RS485)

Inclinometer Sensor



Tutorial Link

Google Drive

Link to instructions DEMO:
WITMOTION Youtube Channel
WT901C RS485 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 WT901C 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.

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, 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 Use Instructions with PC

2.1 Connection Method

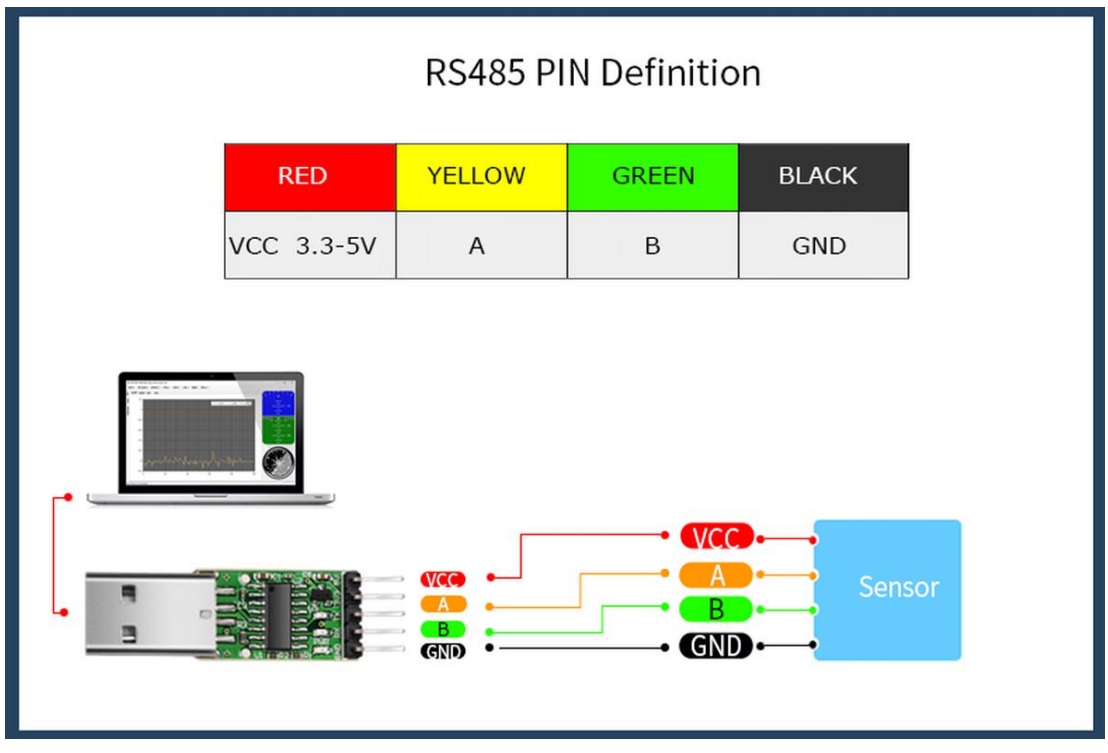
PC software is only compatible with Windows system.

WT901C RS485 Playlist

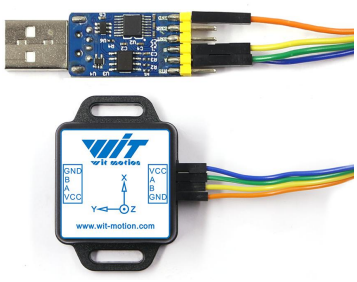
2.1.1 Serial Connection

Step 1. Connect the sensor with a serial converter
PIN Connection:
VCC - 3.3-5V
B - B
A - A
GND - GND

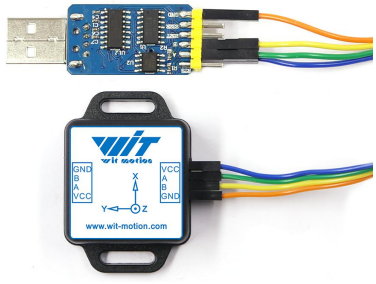
(VCC 3.3-5V is recommended for connection)



Recommended tools:



3-in-1 converter



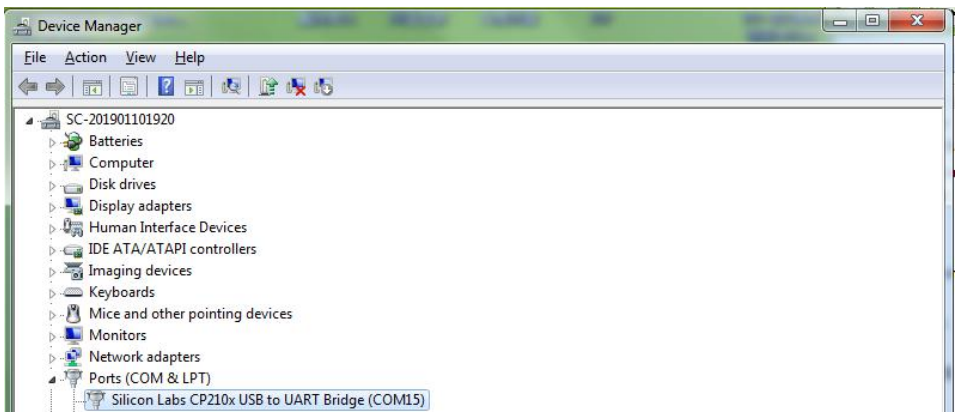
6-in-1 converter

RS485 serial cable

[Link to tutorial of 3-in-1 serial converter/ RS485 serial cable (CH340 driver)]

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

Step 1. Unzip the software and install the driver CH340 or CP2102 (Depending on which accessory for usage.)



Step 2. Insert the converter to computer and confirm the "com port" in device manager

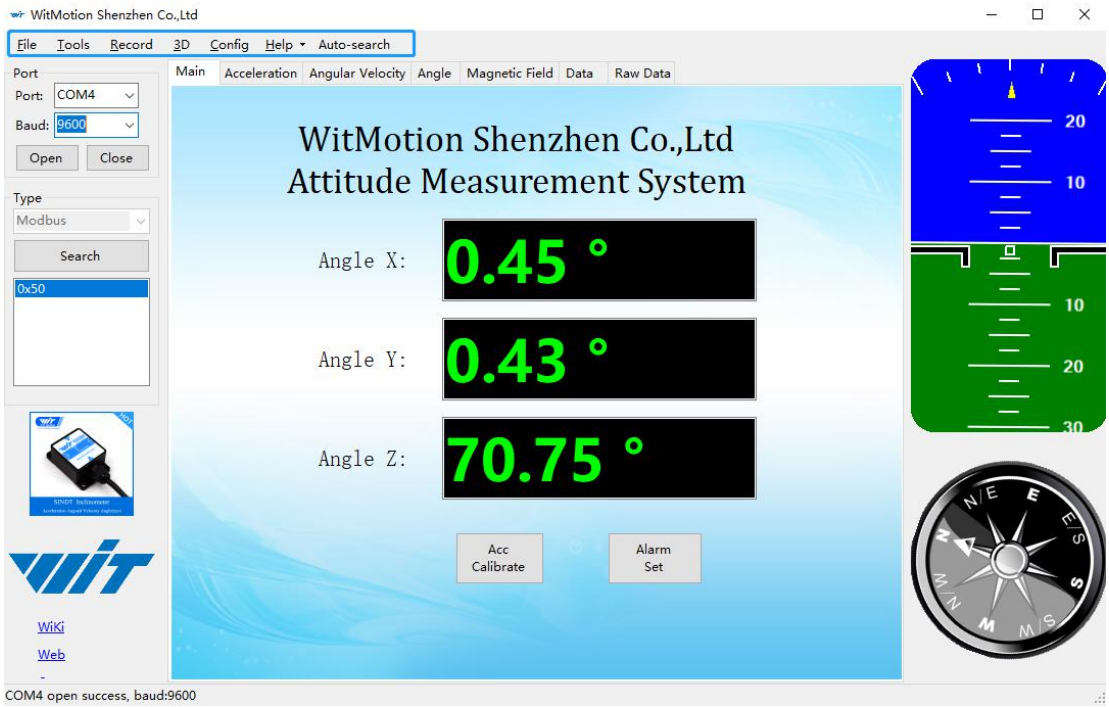
Step 3. Open the software(Minimu.exe)
Data will appear after auto-search finishes

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

2.2 Software Introduction

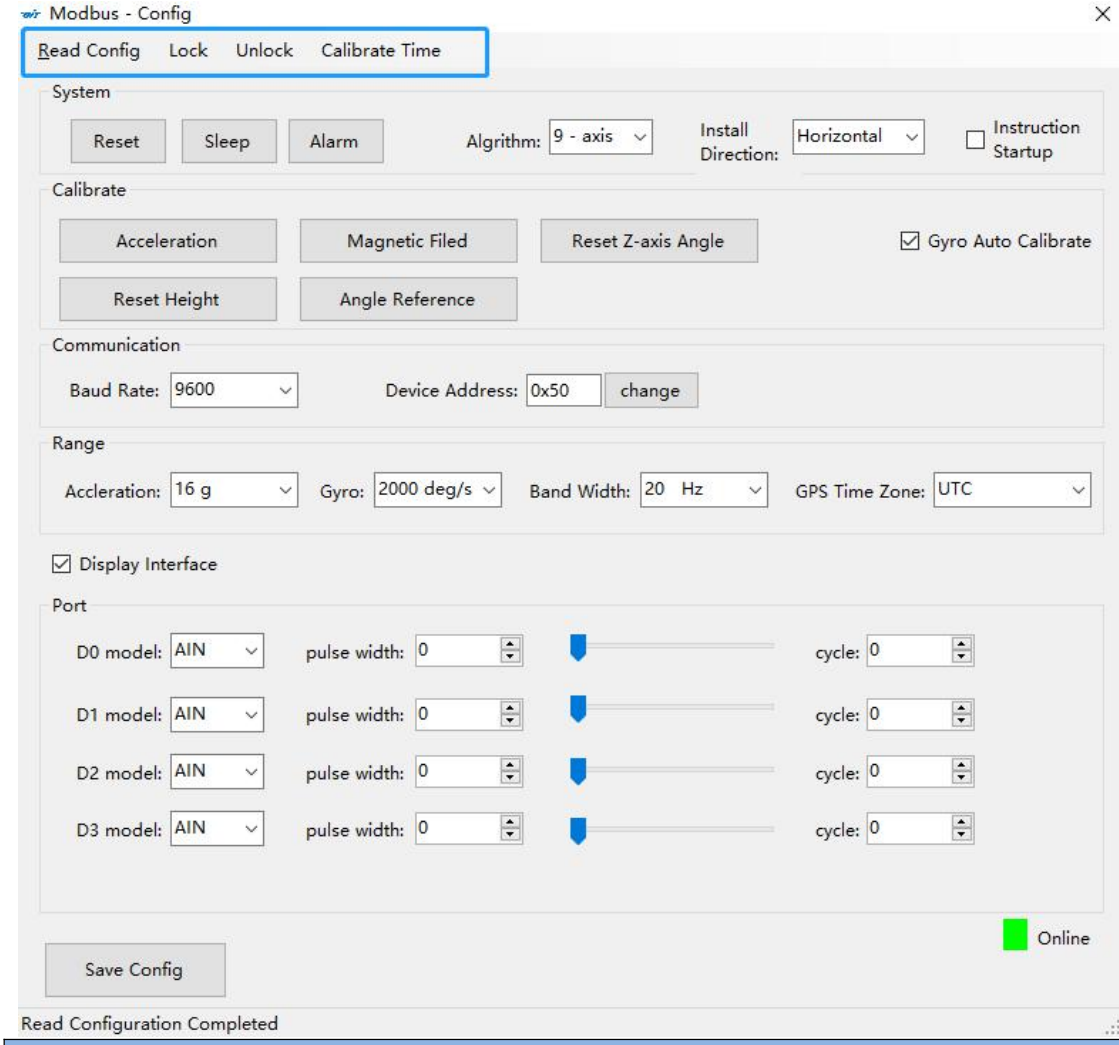
Link to download software

2.2.1 Main Menu

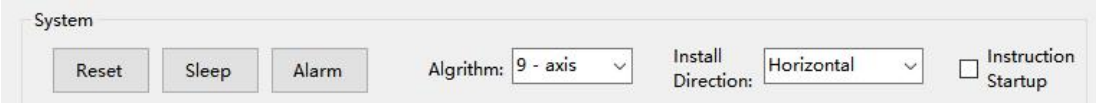


Main Menu of software		
Button		Function
File		Launch recorded HEX file (Bin format)
Tools		Hide or display tools box on left side
Record		Record function
3D		3D DEMO
Config		Configuration setting
Help	Language	English or Chinese
	Bluetooth Set	Binding device or unbind
	Firmware update	Option for firmware 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 Modbus for WT901C RS485
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
Lock	Lock the sensor
Unlock	Unlock the sensor
Calibrate Time	Calibration time of chip
Save Config	Save configuration

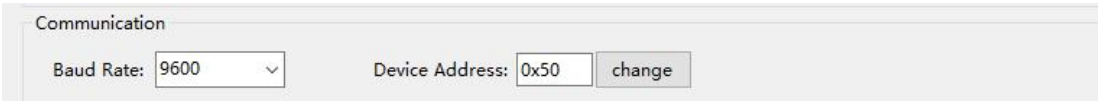


Menu of System	
Button	Function
Reset	Reset to factory setting
Sleep	Sleep function
Alarm	Alarm function
Algorithm	6-axis algorithm or 9-axis
Installation Direction	Vertical or horizontal installation
Instruction Start-up	Instructions sending to start-up the sensor

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



Menu of Communication	
Button	Function
Baud Rate	Baud rate selection
Device Address	0X50

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:

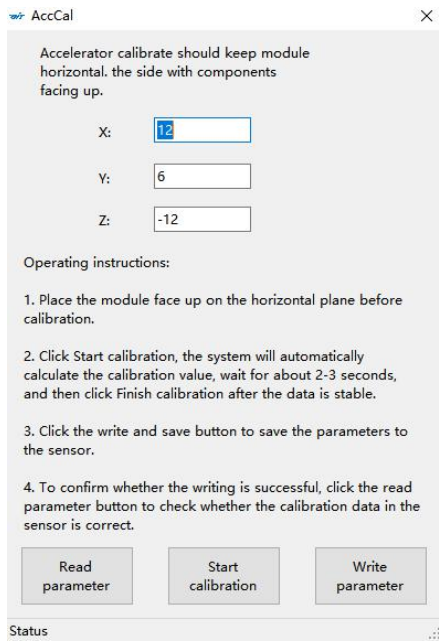
The accelerometer calibration is used to remove the zero bias of the accelerometer. Before calibration, there will be different degrees of bias error. After calibration, the measurement will be accurate.

Methods:

Step 1. Keep the module horizontally stationary

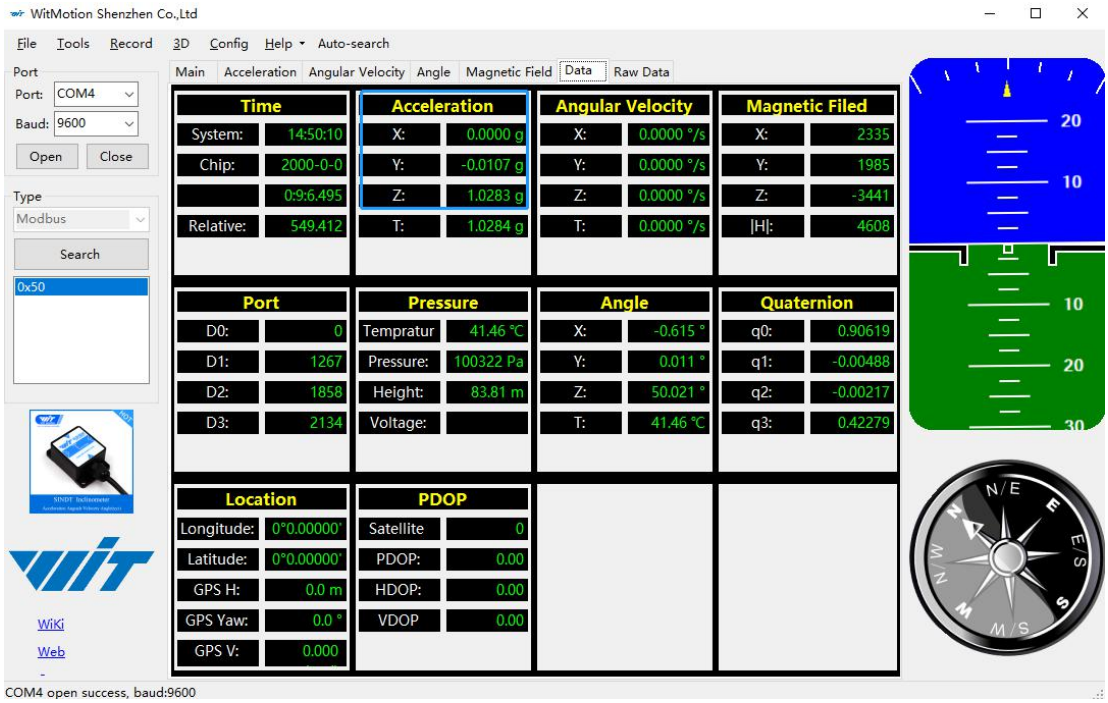
Step 2. Click the accelerometer calibration

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. After1 ~ 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.

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.

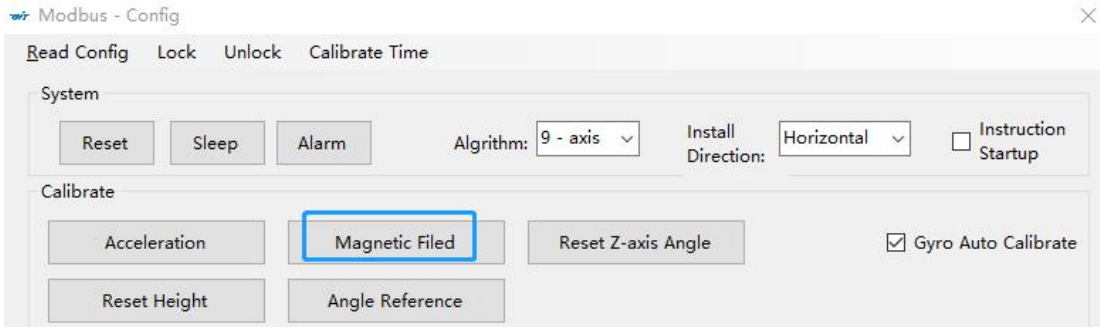
Preparation:

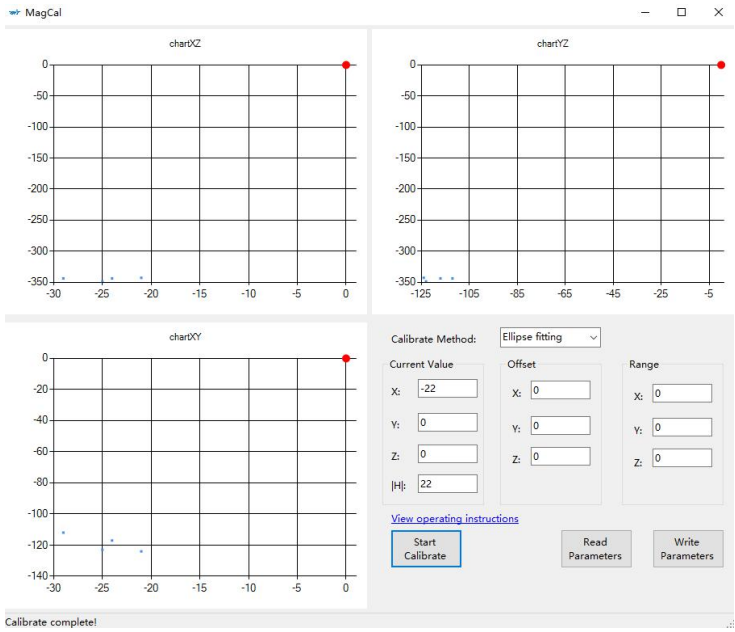
Sensors should be 20CM away from magnetic and iron and other materials

Methods:

Step 1. Open the Config menu

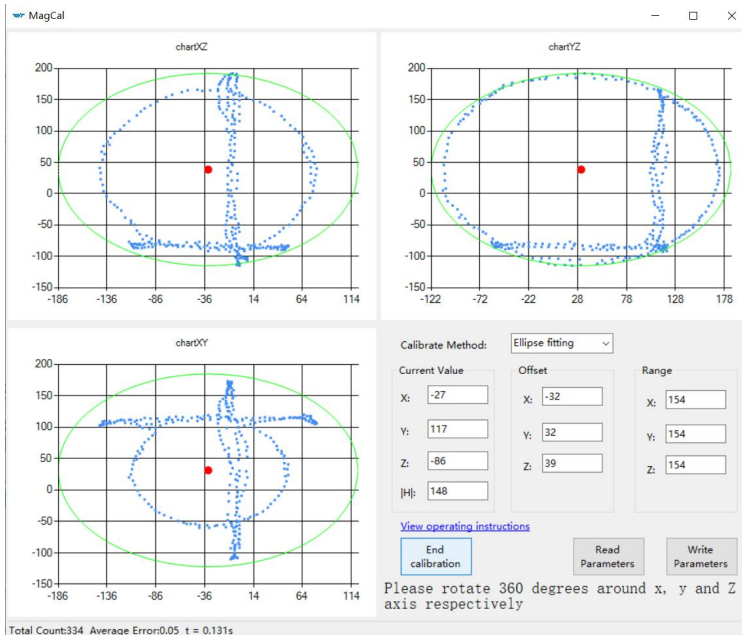
Step 2. Click the magnetic field calibration button. click the "Start calibration"





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.

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 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.

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 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.

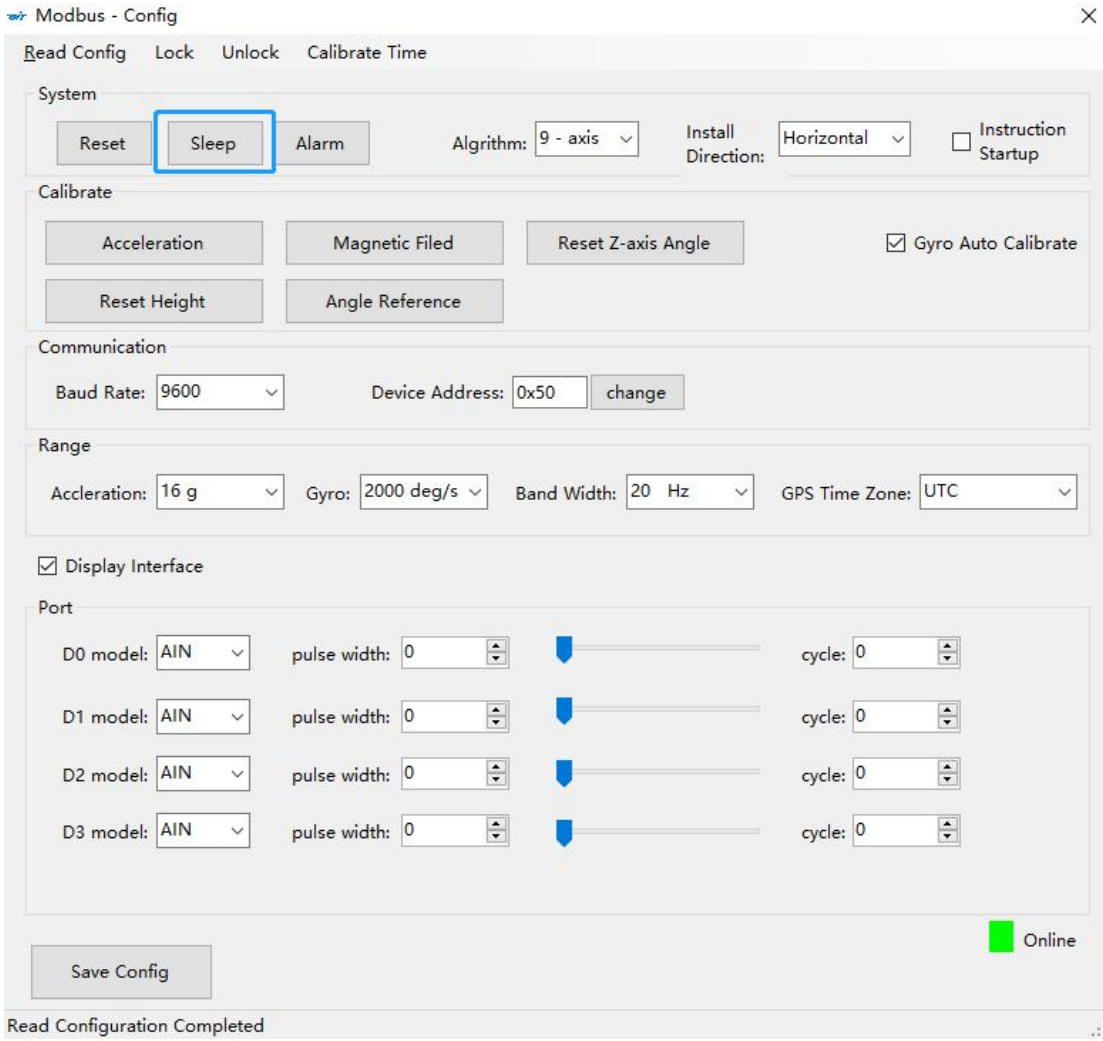
Note: After the change, the module will no longer output data at the original baud rate. The data will be output only when the baud rate that has been changed is selected on the PC software again.

2.4.2 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.



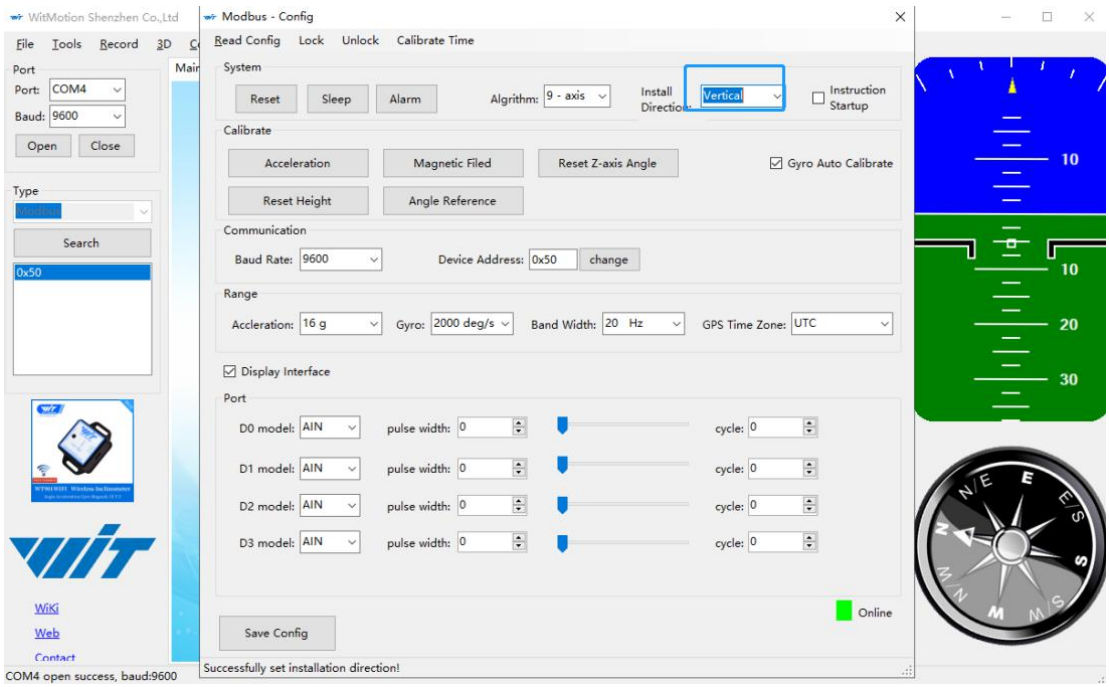
2.4.3 Placement Direction

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 "Config" menu

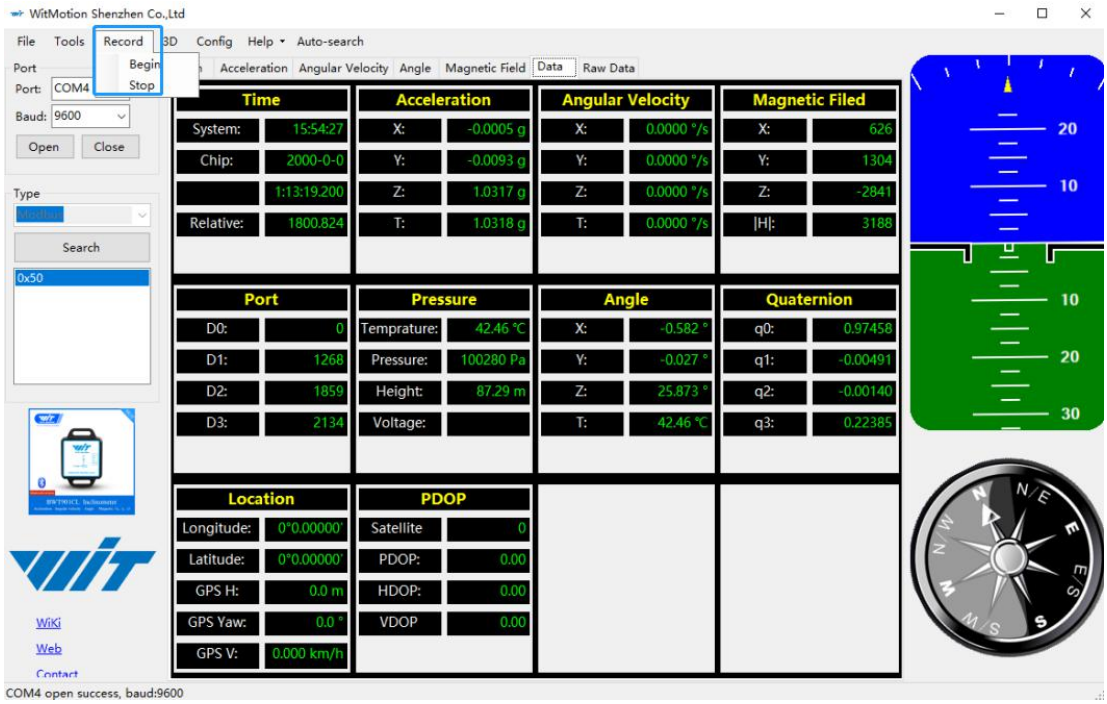


2.4.4 Data Recording

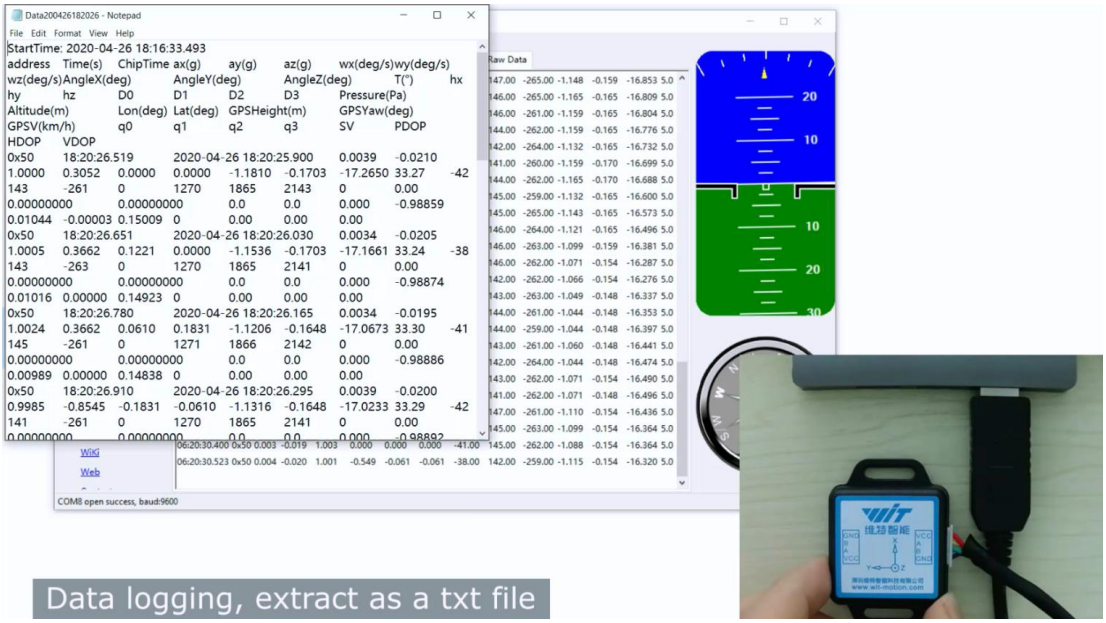
Method are as follows:

Step 1: Click “Record” and “Begin”

Step 2: Click “Stop”



Step 3: Extract the data as “txt” file



Notice: If there is repeated “TIME” of data, that’s caused by low-resolution of the Windows system’s time. The changes in other data is correct.

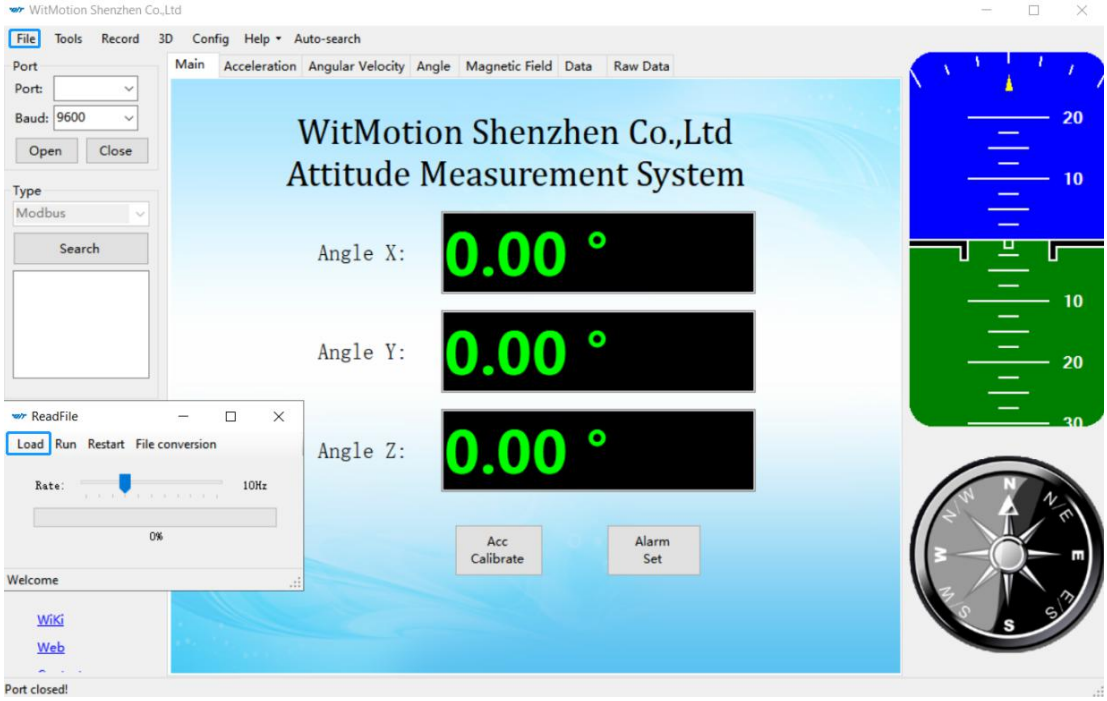
It is highly recommended that data can be pasted to an Excel file. In this way, all data will be shown in order.

StartTime: 2020-04-11 16:54:24.437

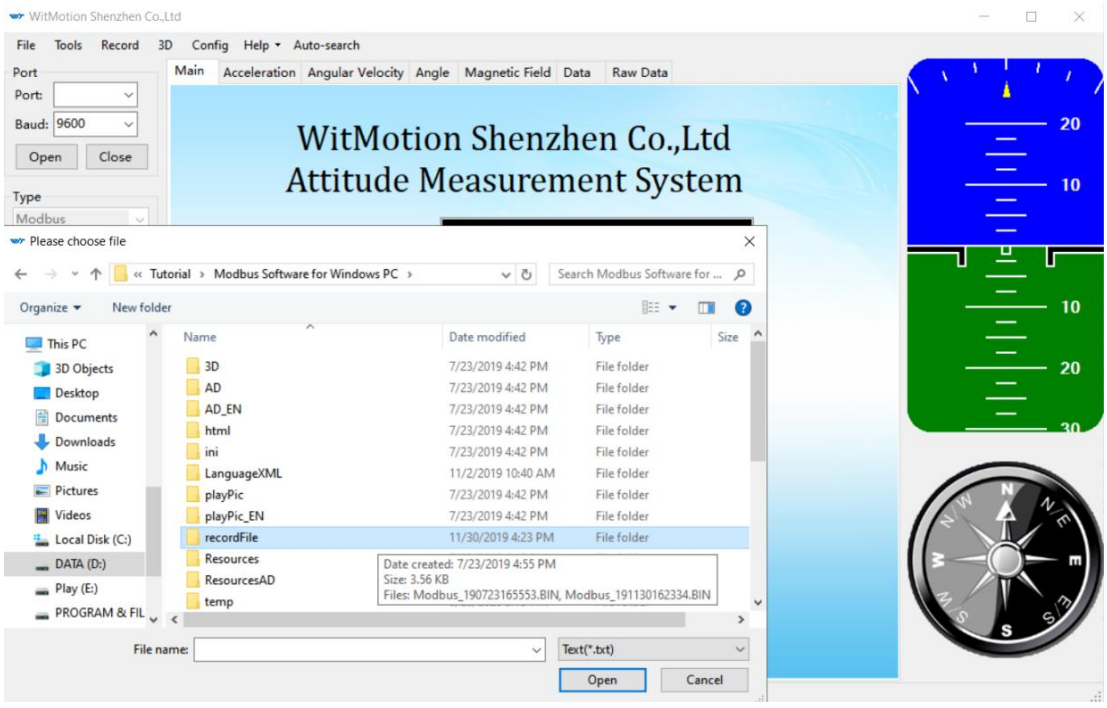
address	Time(s)	ChipTime	ax(g)	ay(g)	az(g)	wx(deg/s)	wy(deg/s)	wz(deg/s)	AngleX(deg	AngleY(deg	AngleZ(deg)	T(°)	hx	hy	hz
0x50	43:06.4	02:40.4	0.4443	0.1777	-0.8696	3.1738	-0.3662	-29.541	166.0364	-29.2072	120.6299	29.97	0	50	313
0x50	43:06.5	02:40.5	0.02	0.5796	-0.7739	-192.0166	283.9355	-700.2563	142.0532	-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

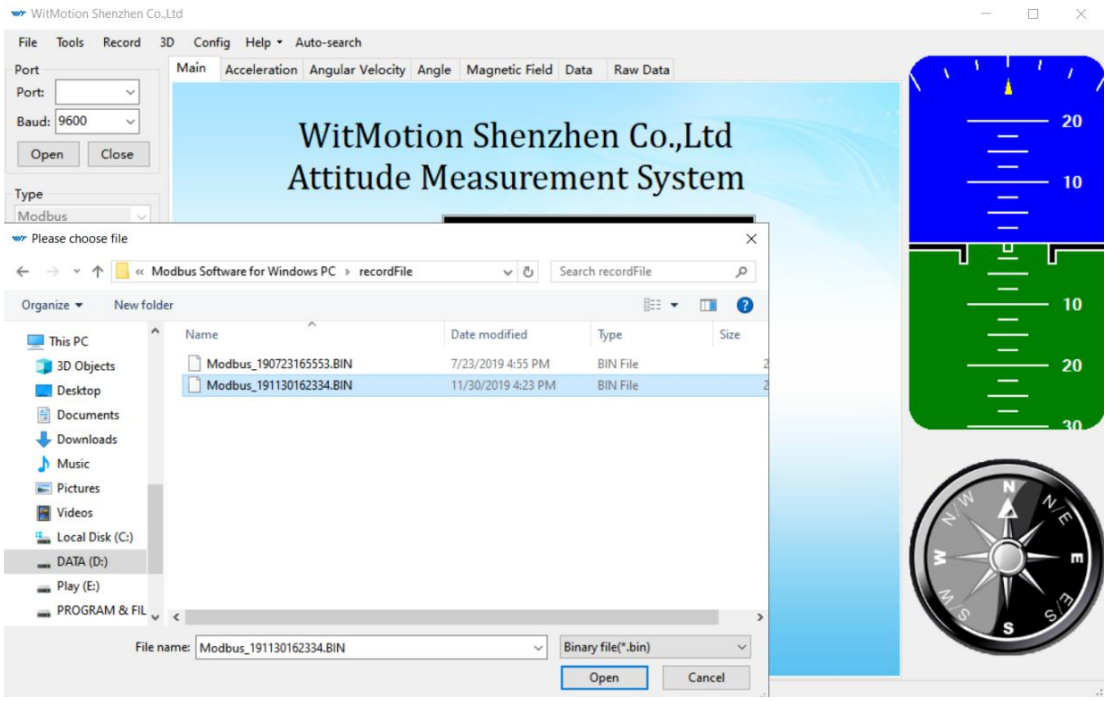
2.4.5 Data Playback

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"

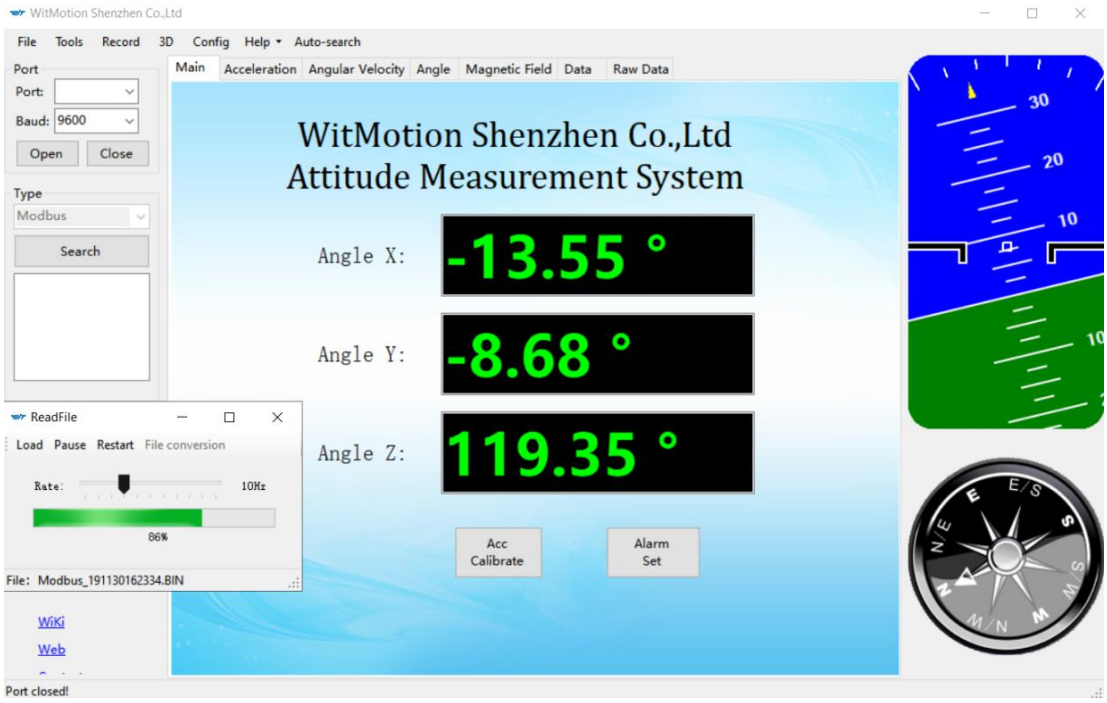


Step 3: Choose the original path of software installation and load the Bin file



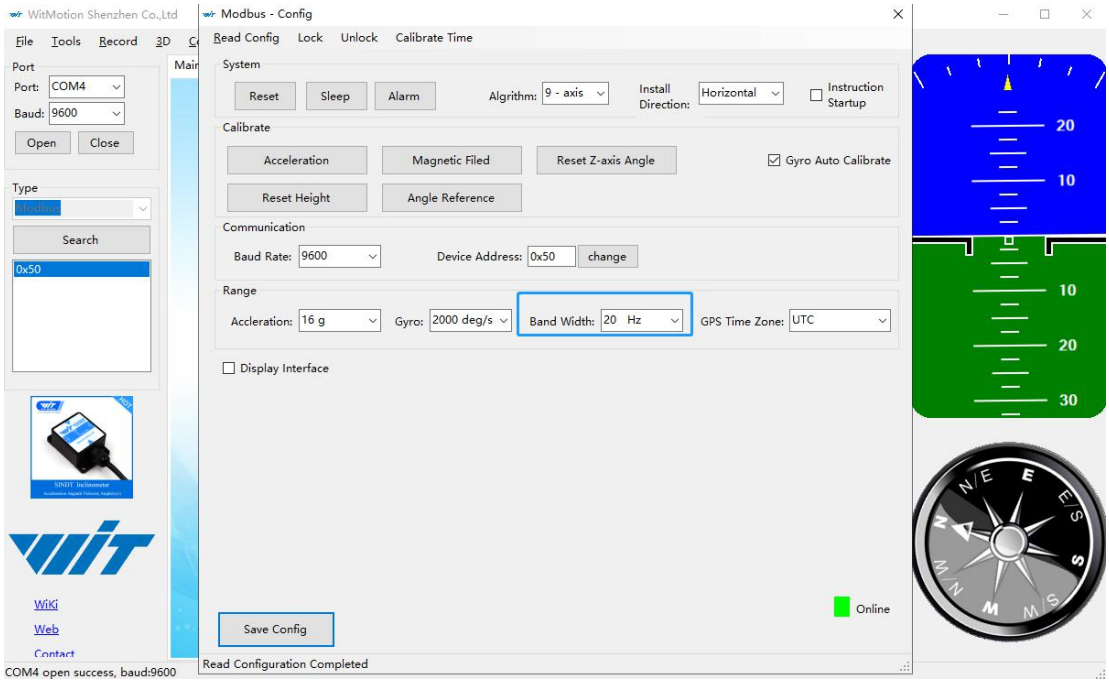


Step 4: Click "Run" and the Binary file will be playback
When playback, the rate can be editable.



2.4.6 Bandwidth

Default bandwidth is 20Hz.

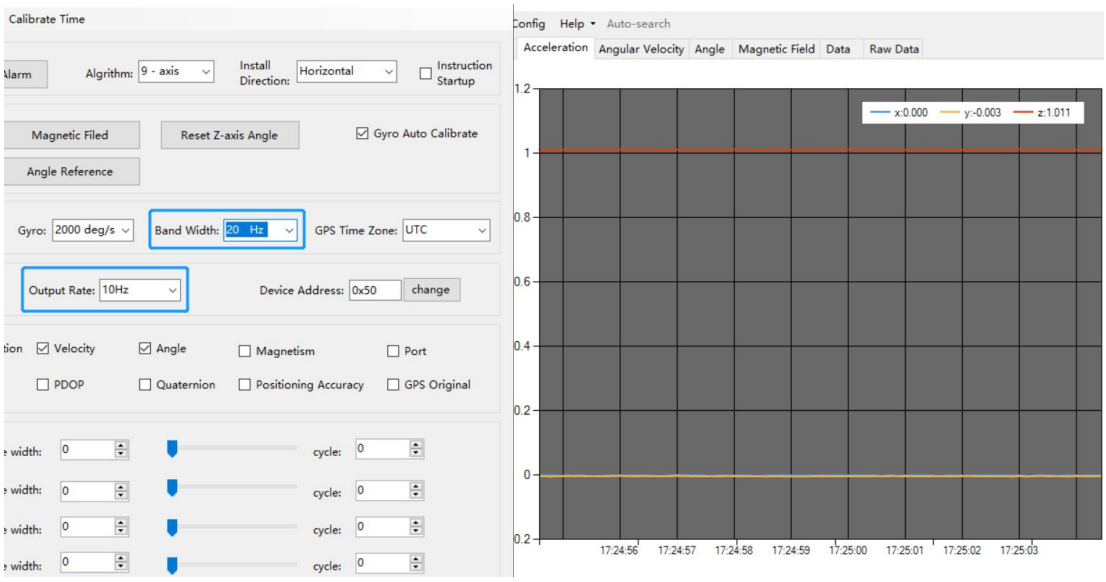


Function:

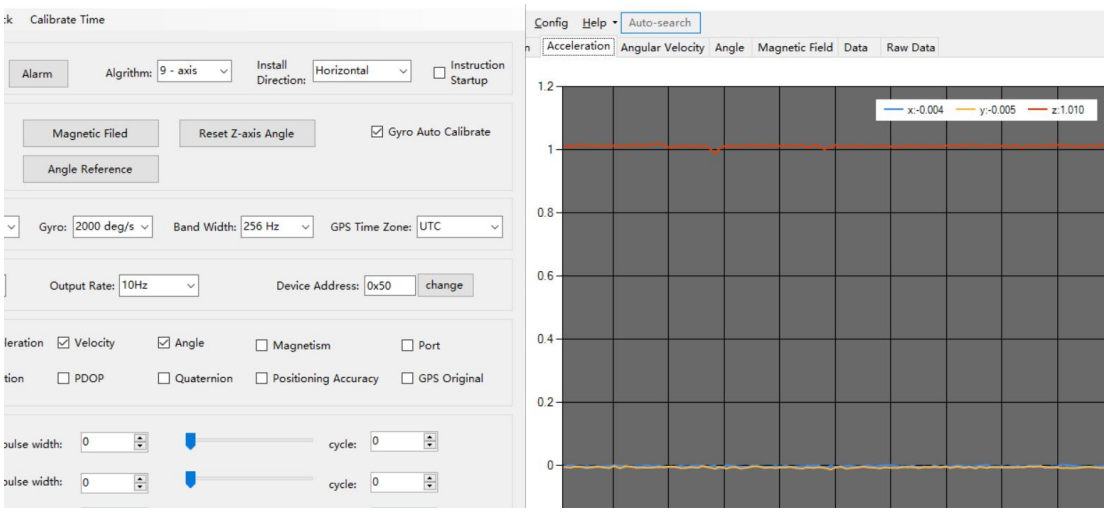
1. The higher rate of bandwidth setting will lead to the higher fluctuation in data waveform. Conversely, the lower rate of bandwidth, data will become more fluent.

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.



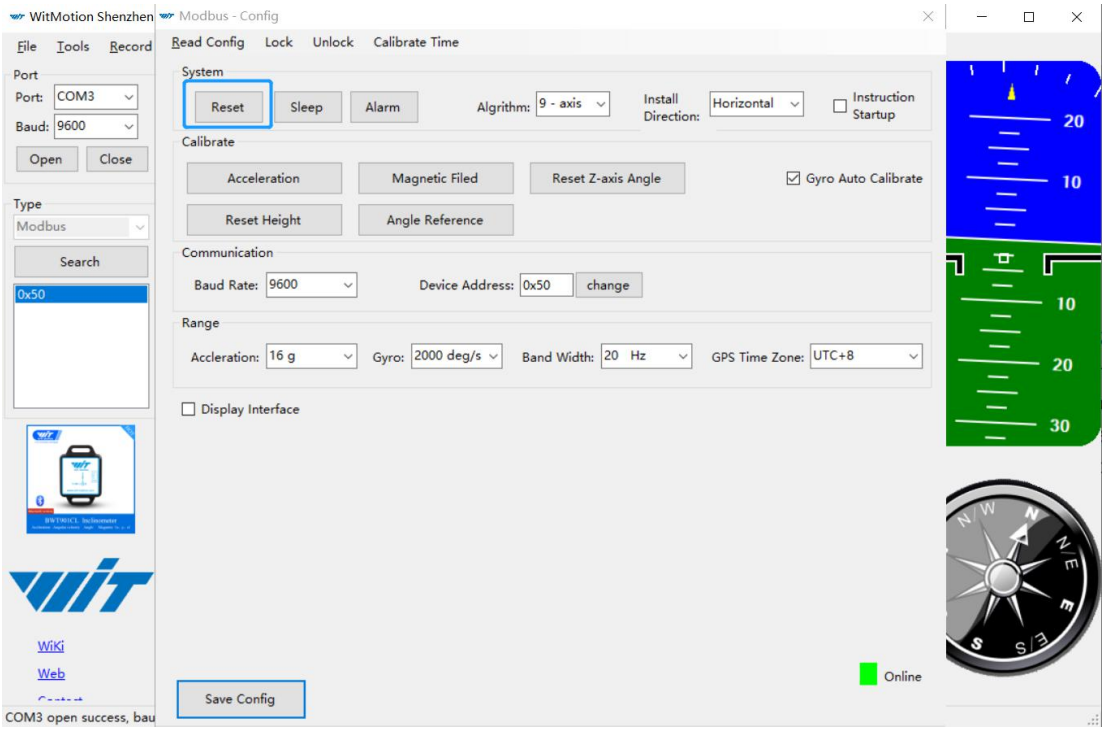
2. The higher rate of bandwidth will solve the data-repeating problem.

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.

2.4.7 Restore Factory Setting

Operation method:

Connect the WT901C module and the computer through the USB-RS485 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)



2.4.8 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.

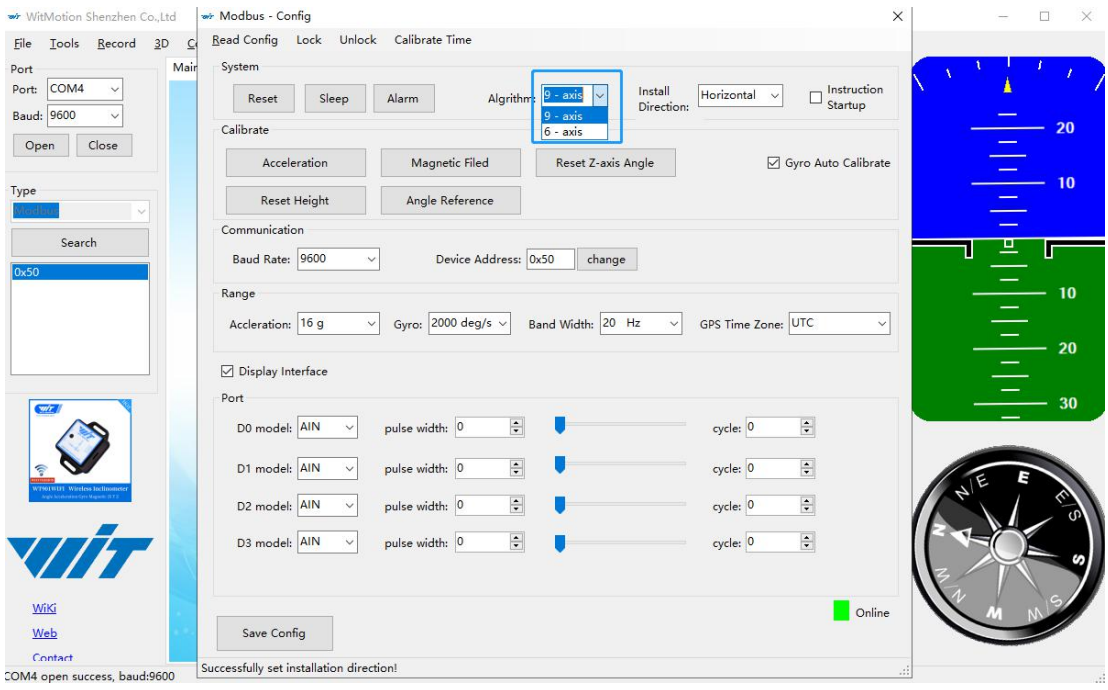
The default algorithm of WT901C is 9-axis. If there is magnetic field interference around installed environment, it is recommended to switch to 6-axis algorithm to detect the angle.

Method:

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

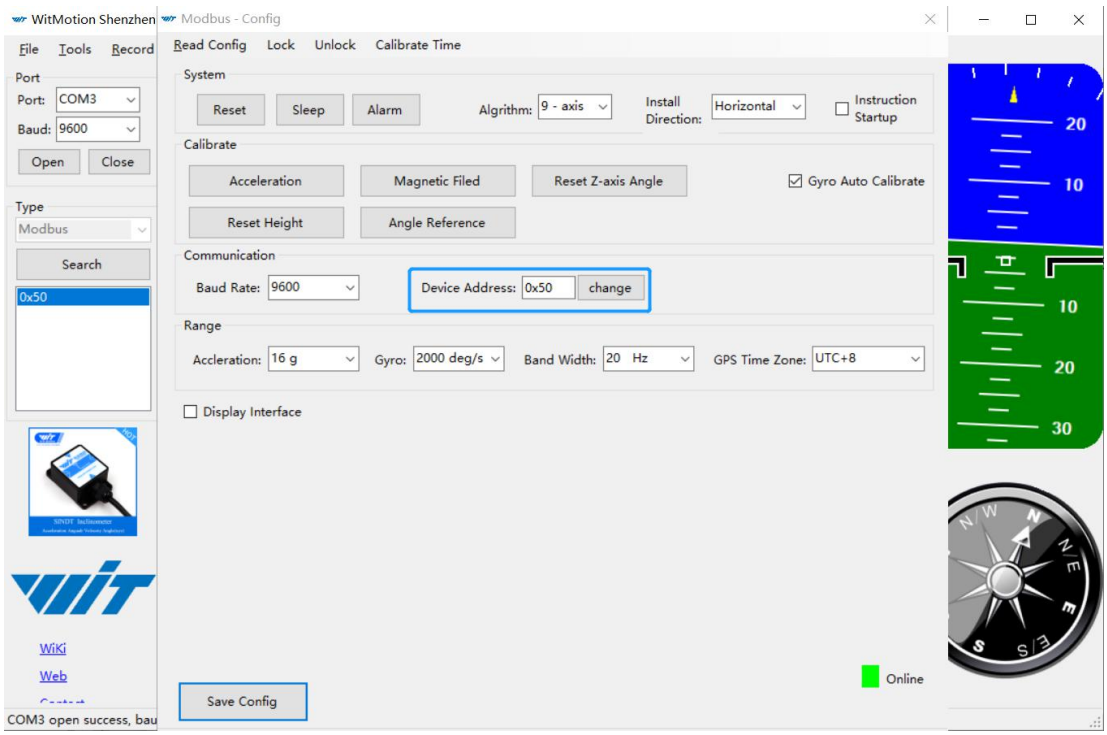
Step 2: Proceed the “Accelerometer calibration” and “Reset Z-axis angle” calibration.

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



2.4.9 Set MODBUS Address

The default address is 0x50 and can be changed via software. Enter the new hexadecimal one in the modbus address configuration tab, then click the "change".



Note: After the change, the modbus address will not be changed immediately, and the device address needs to be searched again to take effect.

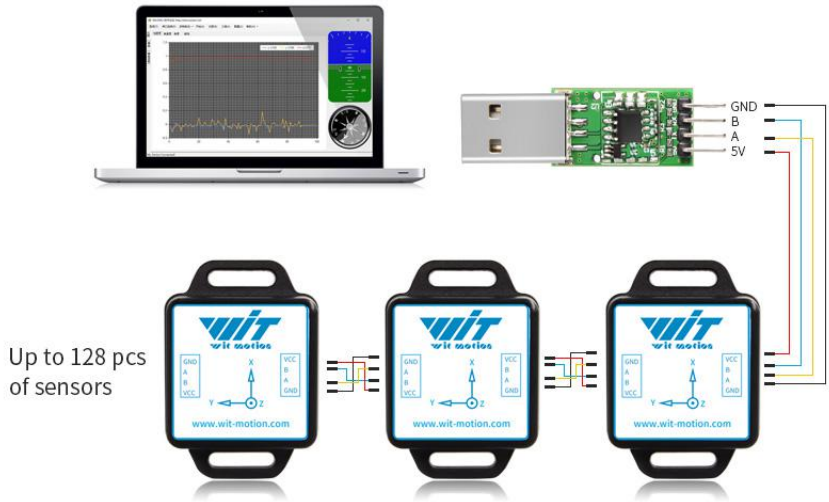
3 Multiple Module Cascades

Support multiple modules cascades, you can see the data of multiple devices on the PC software.

Tip:
1. Before cascading, you first need to change the module's MODBUS address to a different one on PC software one by one.
2. Decrease the baud rate to a lower level due to the data packet missing when BUS cable is too long.

Warning Statement:
1. Make sure each sensor powered with enough input voltage
2. Working voltage requires 3.3-5V input

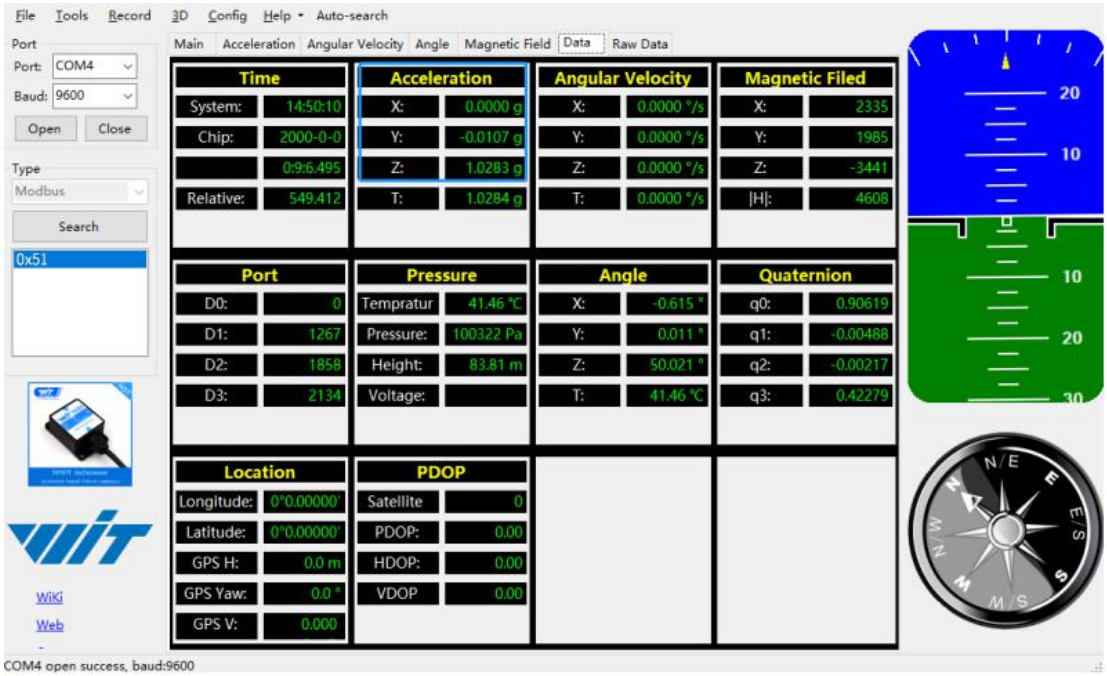
3. Hardware Connection Diagram



Note: when multiple cascades, check carefully for correct wiring between modules (VCC-VCC A-A B-B GND-GND).

3.1 Software Operation

Open PC software, select the model, serial port, baud rate (9600), and click the search button to find the device. You can search for multiple cascade device addresses.



Select the searched device address, you can see the data of different modules.

Note: When cascading multiple modules, you must remember the MODBUS address of the module (you can rotate the module to verify whether the data on the PC software is the data of the module).