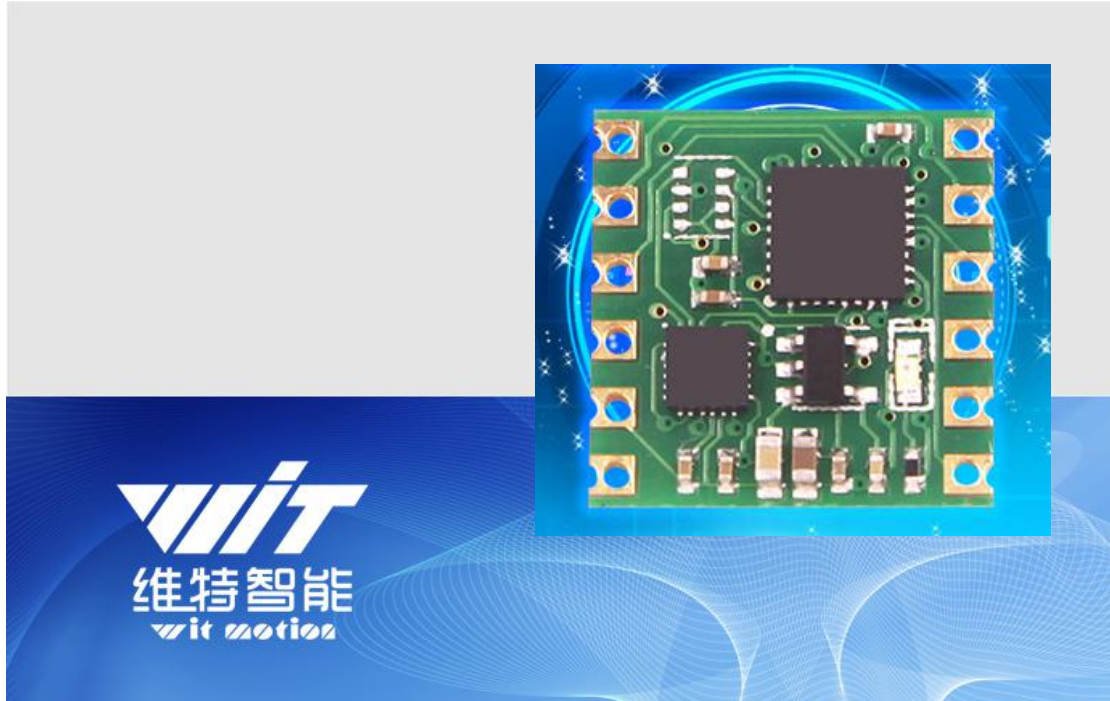


# JY901 Attitude Angle Sensor SPECIFICATION



Model : JY901

Description : Nine axis attitude angle sensor

Production Standard

Enterprise quality system standard: ISO9001:2016

Tilt switch production standard: GB/T191SJ 20873-2016

Criterion of detection: GB/T191SJ 20873-2016

Revision date: 2017.9.21

Version	Update content	Author	Date
V4.0	Release	Snow	20170921

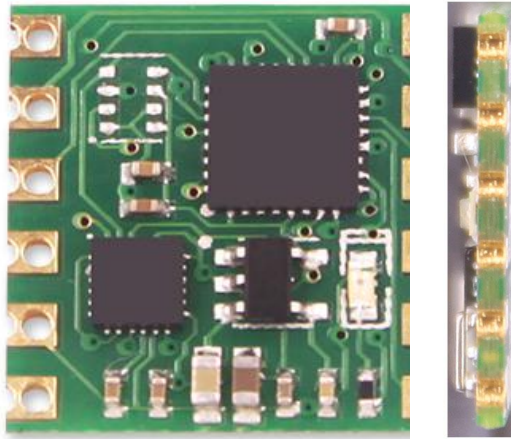
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# 1 Description

- ◆ JY901 series 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 Inclinometer!
- ◆ Integrate voltage stabilization circuit, working voltage is 3.3v ~ 5v, pin level compatible 3.3V and 5V embedded system .
- ◆ Supports serial port and IIC interfaces. Serial port rate is adjustable from 2400bps ~ 921600 bps , IIC interface supports full 400K rate.
- ◆ Highest 200Hz output data rate. The output data and rate can be adjusted.
- ◆ The 4-way expansion ports can configured as analog input, digital input, digital output, PWM output function.
- ◆ With GPS connectivity. Acceptable in line with NMEA-0183 standard serial GPS data form GPS-IMU navigation unit.
- ◆ Stamp hole gold plating PCB design, can be embedded in the user's PCB board.
- ◆ 4layer PCB technology, thinner, smaller, and more reliable.

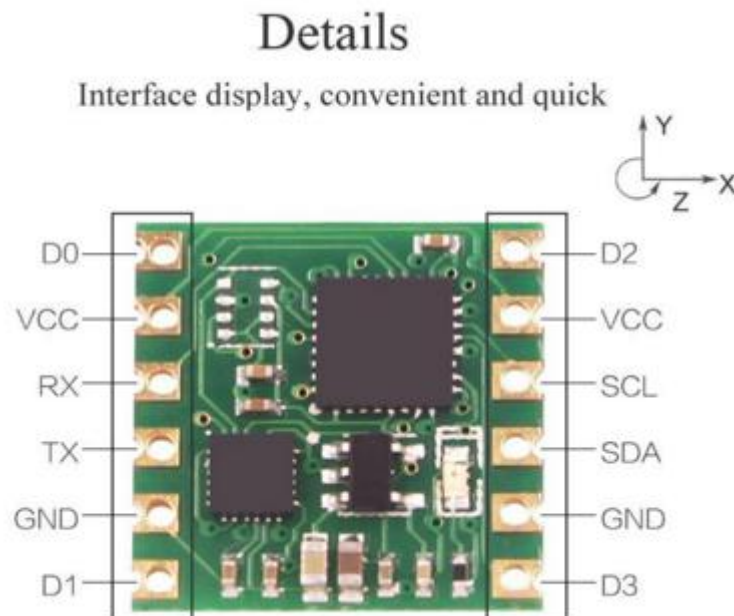


# 2 Features

- 1) Input voltage: 3.3V-5V
- 2) Consumption current: <25mA
- 3) Volume: 15.24mm X 15.24mm X 2mm
- 4) Pad pitch: up and down 100mil (2.54mm), left and right 600mil (15.24mm)

- 5) Measuring dimensions: Acceleration: 3D Angular Velocity: 3D Attitude angle: 3D Magnetic field: 3D Atmospheric pressure: 1D GPS: 3D
- 6) Range: Acceleration:  $\pm 16g$ , angular velocity:  $\pm 2000^\circ / s$ .
- 7) Stability: Acceleration: 0.01g, angular speed  $0.05^\circ / s$ .
- 8) Attitude stabilization measurement:  $0.01^\circ$ .
- 9) Data output: time, acceleration, angular velocity, angle, field, port status, pressure (JY-901B), height (JY-901B), latitude and longitude (to be connected to GPS), ground speed (to be connected to GPS).
- 10) The data output frequency 0.1Hz to 200Hz.
- 11) Data Interface:  
 Serial (TTL level baud rate support 2400, 4800, 9600(default), 19200, 38400, 57600, 115200, 230400, 460800, 921600), I2C (IIC maximum support high speed 400K)
- 12) Expansion port functions: analog input (0 ~ VCC), digital input, digital output, PWM output (period 1us-65535us, resolution 1us)

### 3 Pin Description



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

SCL	IIC clock line
SDA	IIC data line
D0	Extended port 0
D1	Extended port 1
D2	Extended port 2
D3	Extended port 3

## 4 Axial Direction

As shown in the figure above, the coordinates of the module are indicated, and the right is the X axis, the upper is Y axis, the Z axis is perpendicular to the surface of the paper to yourself. The direction of rotation is defined by the right hand rule, that is, the thumb of the right hand is pointed to the axial direction, and the four is the direction of the bending of the right hand.

## 5 Hardware Connection

### 5.1 Serial Connection

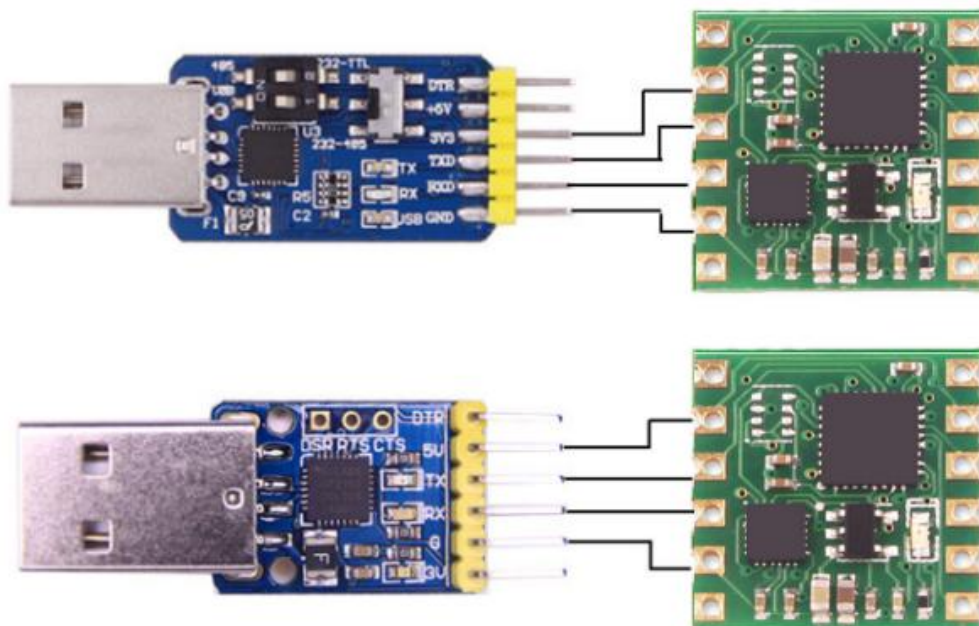
#### 5.1.1 Connect to PC

When connected to the PC software, you need a USB -TTL module. Recommend the following two USB -TTL module:



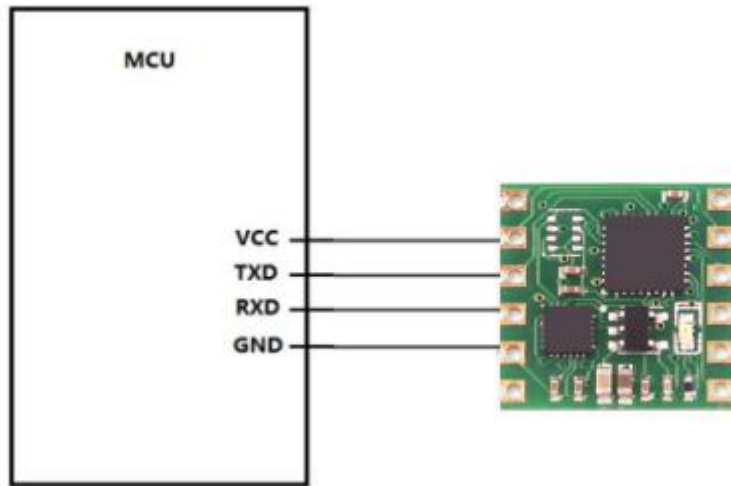


1. Serial module TTL: Firstly connect the module with the USB - TTL and then connect them to the computer. The ways of connecting module with USB -TTL are:  
VCC TX RX GND of the module connected to +5V/3.3V RX TX GND of the serial module respectively. It is noteworthy that TX and RX need to be crossed--- RX connected to TX,TX connected to RX.
2. Serial debugging artifacts: set switch 1 to ON, set switch 2 to (silk) 2, switch S1 dial to the lower (near the figure near “other” silk screen), VCC TX RX GND of the module connected to +5V/3.3V RX TX GND of the serial module respectively.





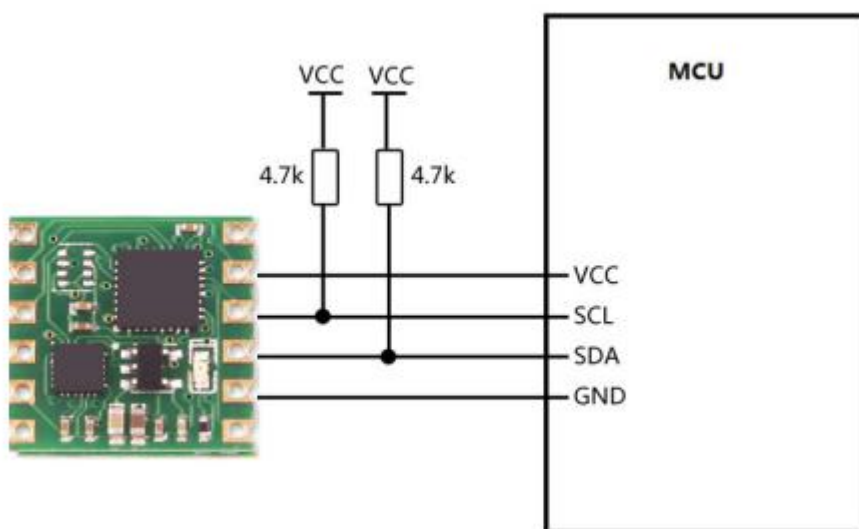
## 5.1.2 Connect to MCU



## 5.2 IIC Connection

JY-901 modules can be connected through the IIC interface to MCU, connection method as shown below. Note that, in order to connect several modules on IIC bus, module IIC bus is open-drain output, MCU need a 4.7K resistor pulled to VCC when connecting the module.

Reminder: The power supply VCC is 3.3V which should be powered by other power. The direct use of the power supply of the module may cause voltage drop, so that the actual voltage of the module can not reach to 3.3-5V.

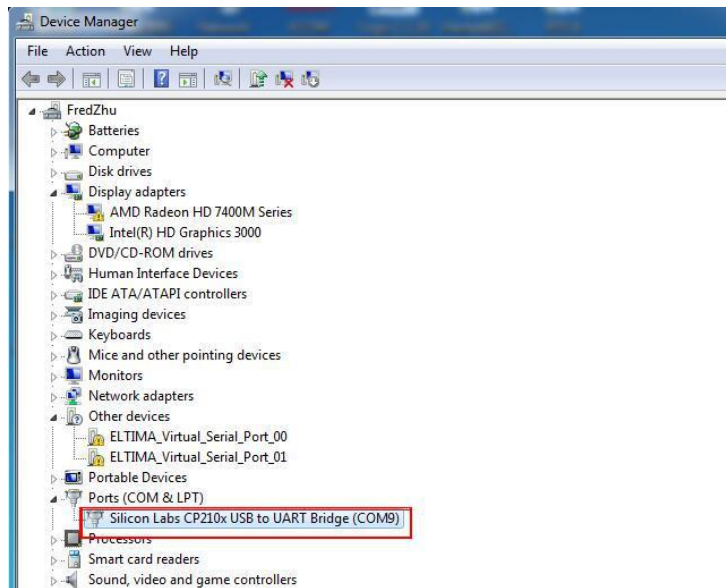


## 6 Software Methods

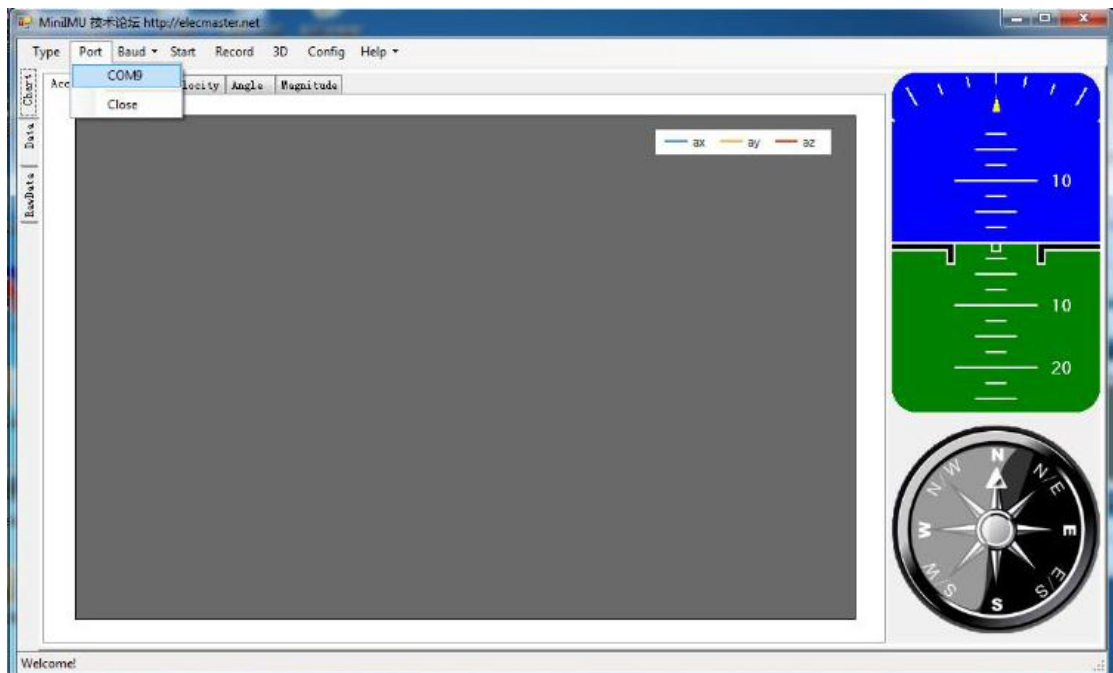
### 6.1 Installation USB - TTL Module Driver

First, the module is connected via USB-TTL module to the computer, install the USB-TTL module driver. The drive CP210X:<http://pan.baidu.com/s/1o6Rleae?frm=fujian>

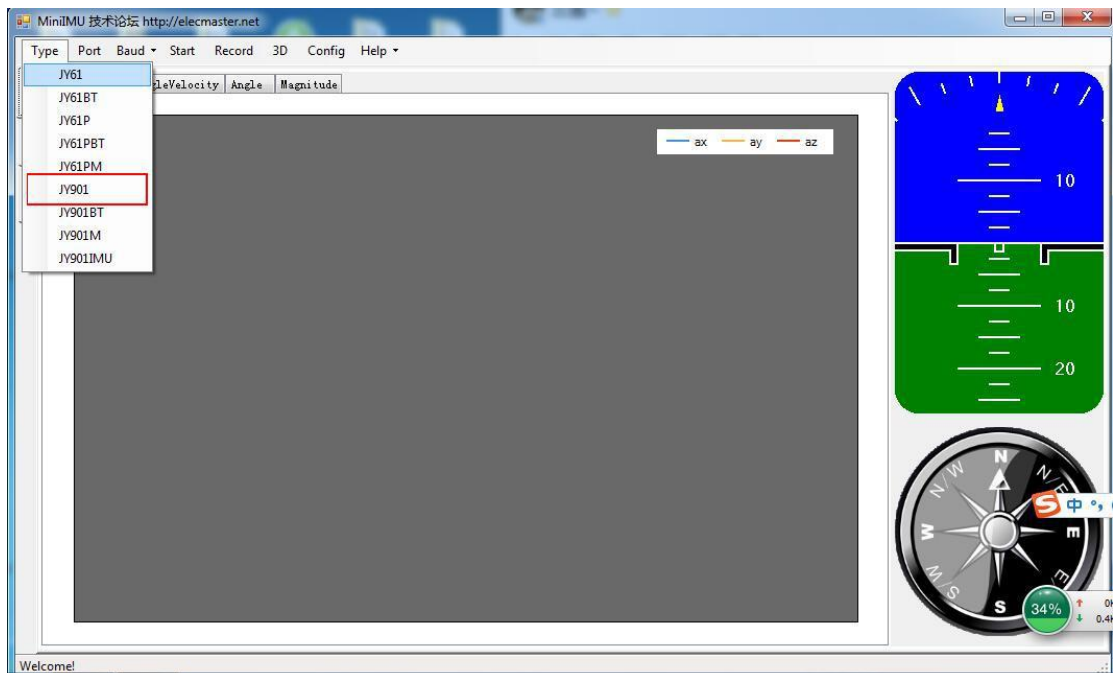
After installing the USB-TTL module driver, and then Device Manager can query corresponding serial number, as below figure shows:



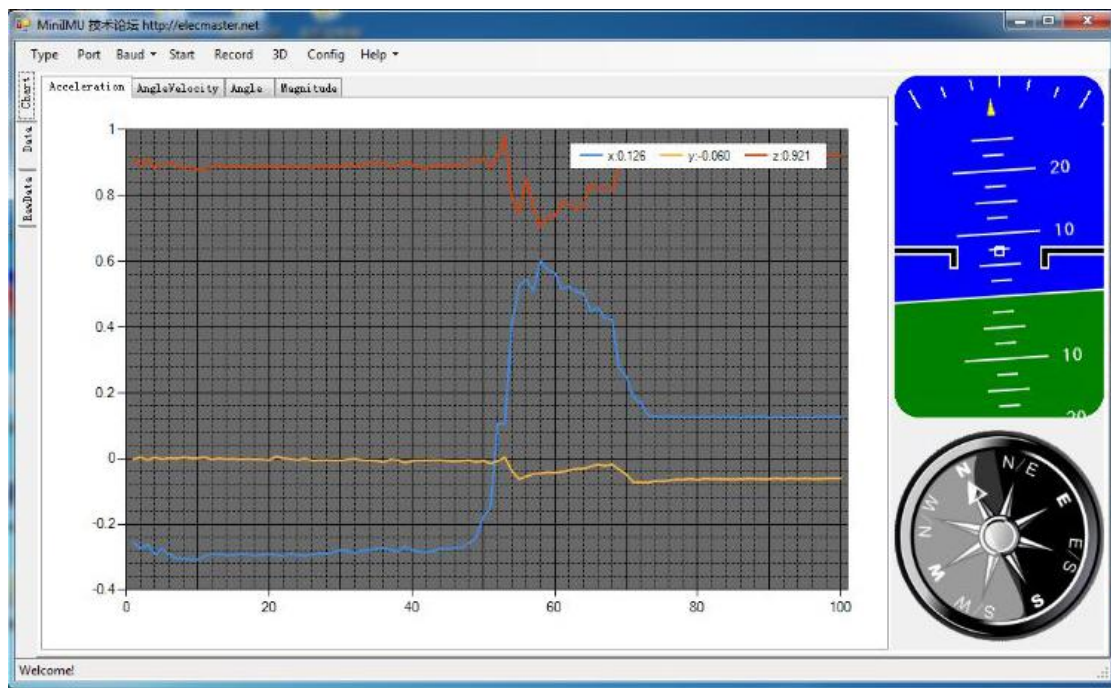
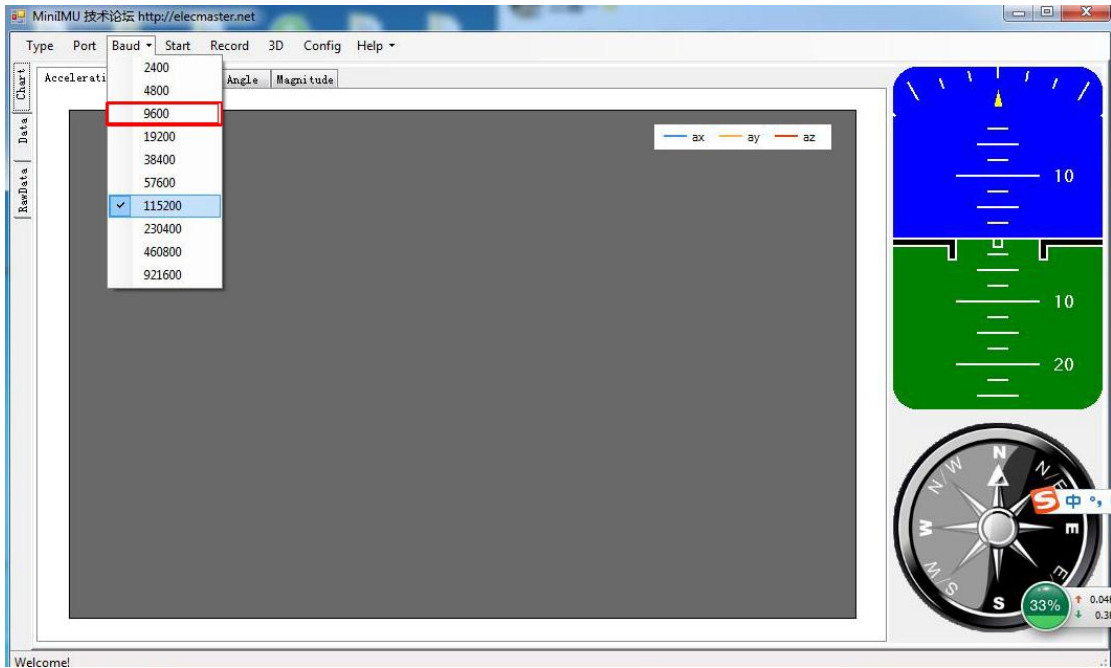
Open the software MiniIMU.exe, Click “Port” and select the com number you just saw in the device manager.



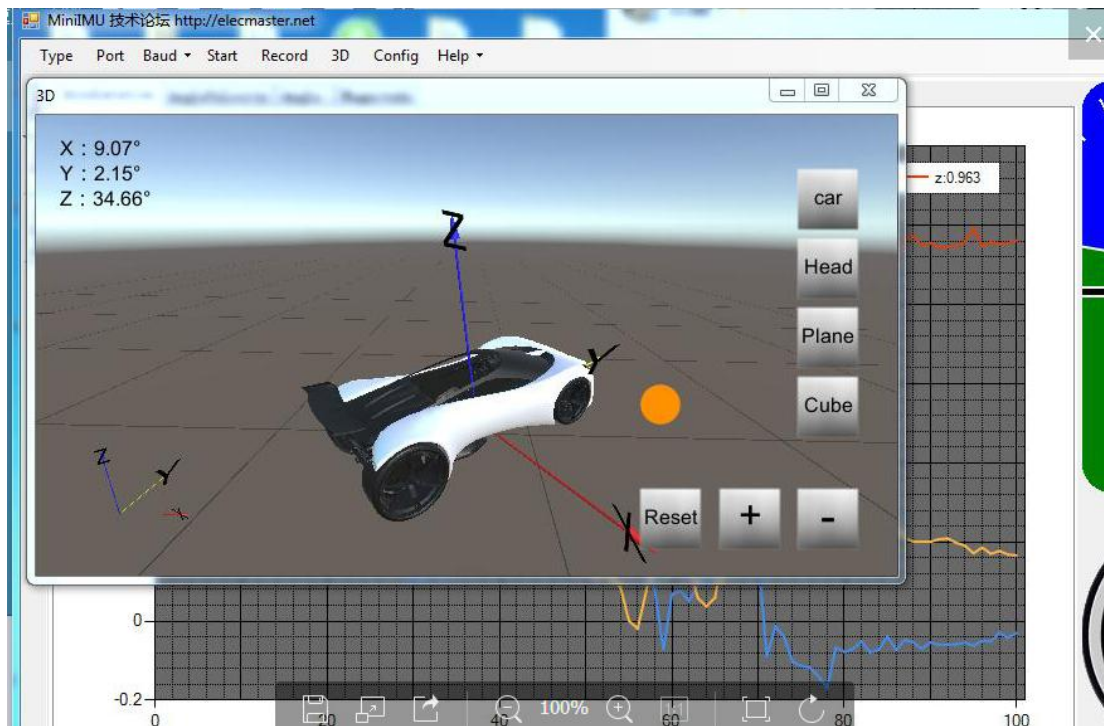
Click the “Type” and select model “JY901”.



Click the “Baud” and select “9600”, after all those selections are completed, the software can display data.



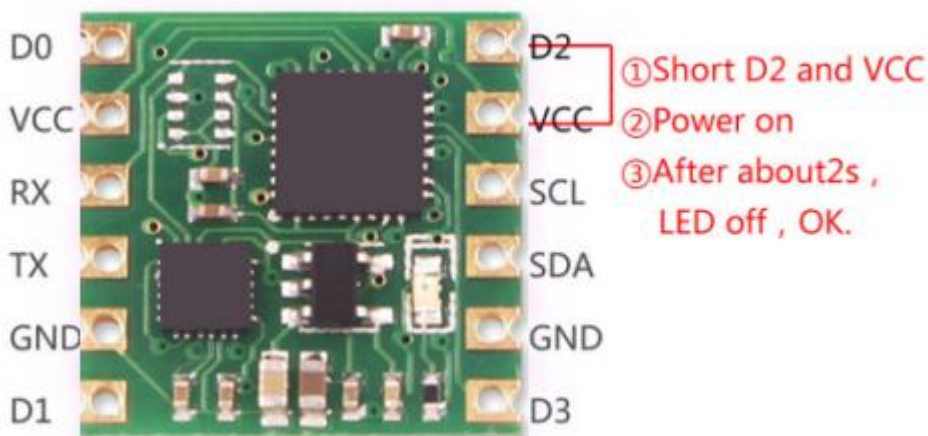
Click the “3D” and you can bring up the three-dimensional display interface, which displays the three-dimensional posture of the module.



## 6.2 Restore Factory Setting

There are two methods, short circuit method and instruction methods.

Short Circuit Method : D2 pin are short to VCC pin, then power on the module, the module LED lights long bright, lasts about two seconds, LED light is off, complete restore factory settings operation.



Instruction method : JY-901 module connected to a PC via USB-TTL module , click the Settings tab, click “Recovery”. After restore the factory settings ,need to restart the module again. (This method requires advance knowledge to know baud rate of the module, if the baud rate does not match the command will not take effect, try using a short-circuit recovery method).



## 6.3 Module Calibration

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.

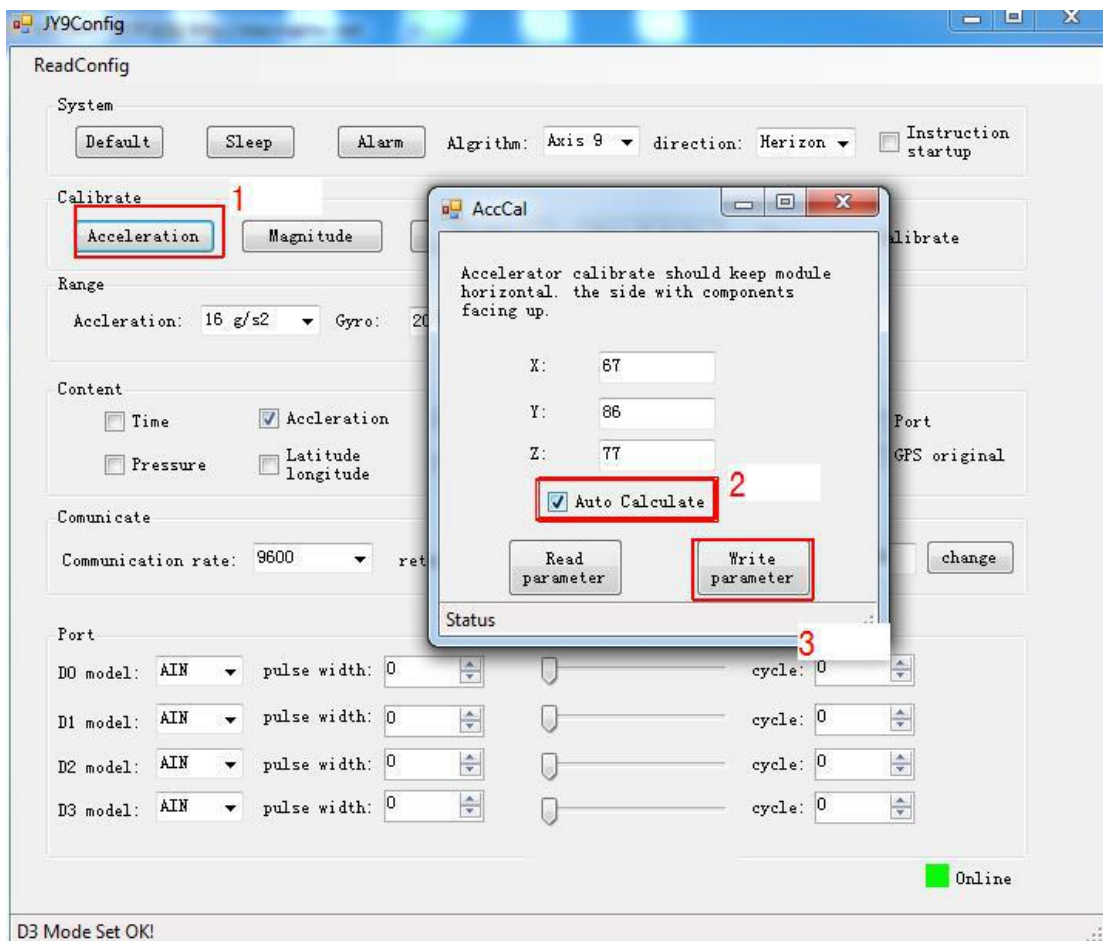
The module need to be calibrated before the module is used. The calibration of JY901 includes accelerometer calibration and magnetic calibration.

### 6.3.1 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 as follow:

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”



## 6.3.2 Magnetic Calibration

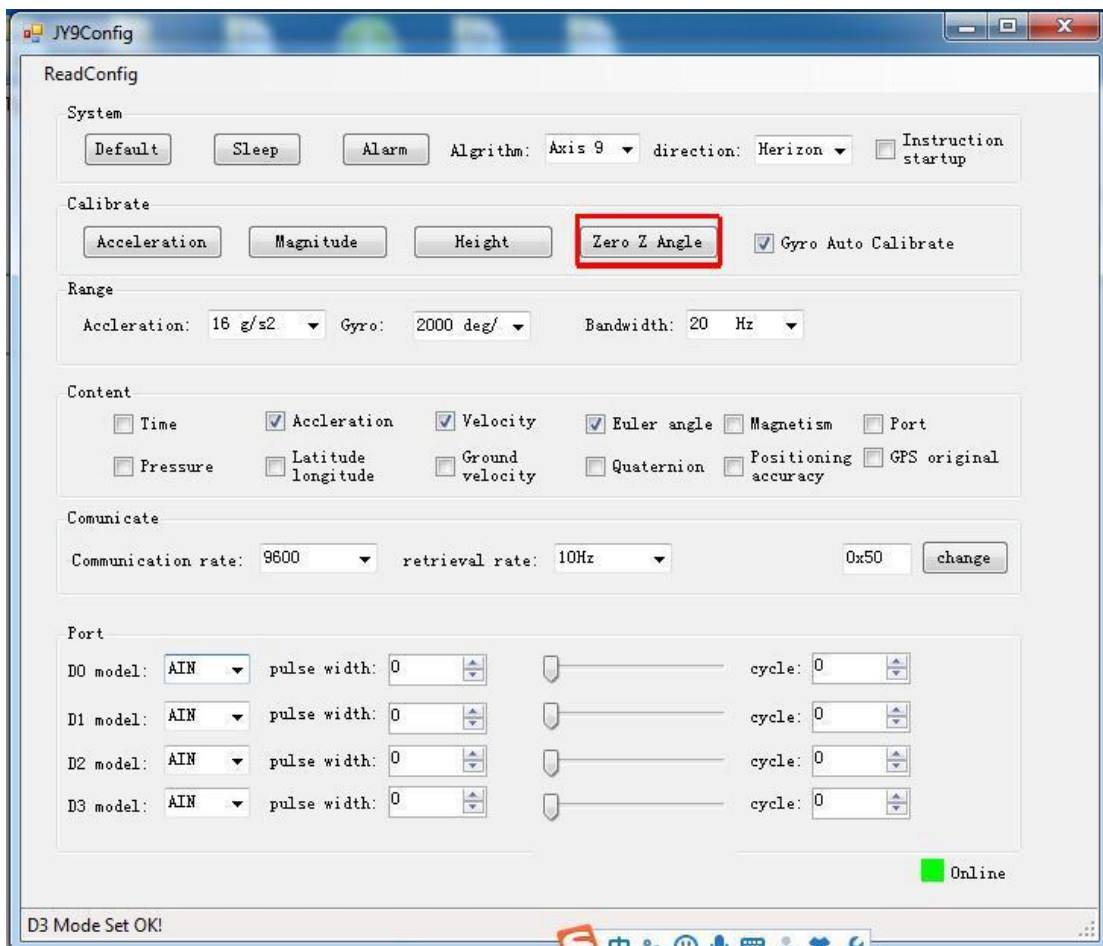
### 6.3.3 Z axis To 0

Reminder: Z axis to 0 is valid for JY61P only.

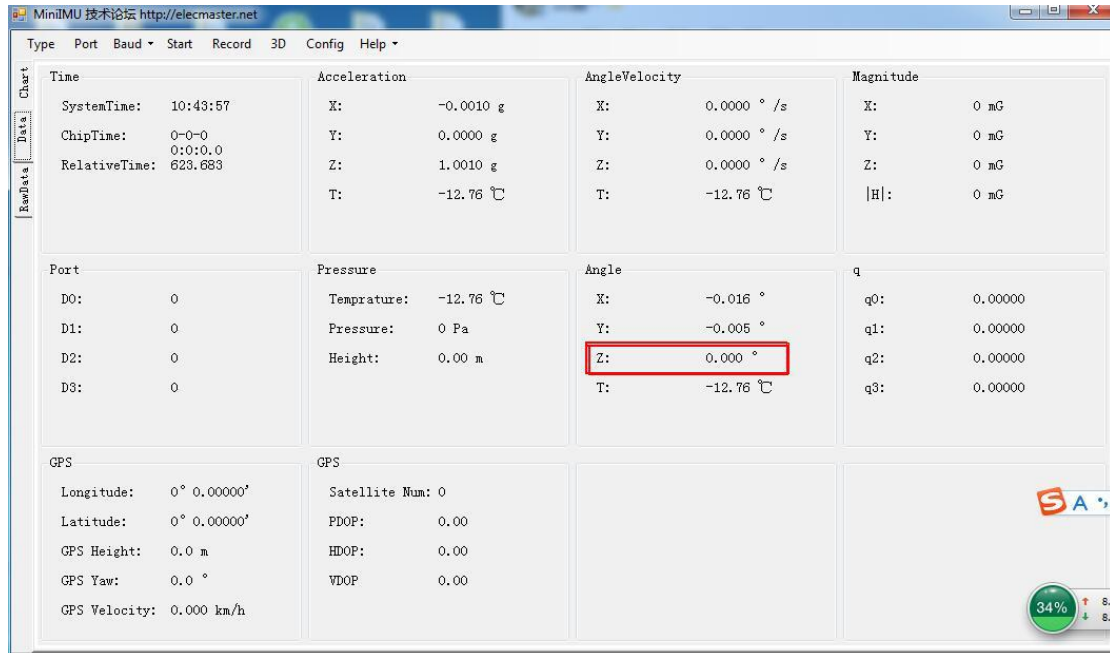
The z-axis angle is an absolute angle, and it takes the northeast sky as the coordinate system can not be relative to 0 degree.

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 “Zero Z Angle” option, you will see the the angle of the Z axis backs to 0 degree in the module data bar.







## 6.3.4 Height Setting 0

The height setting 0 is an operation to make the height of the module returns to 0, the height output of the module is calculated on the basic of the air pressure. Only with barometer modules(JY901B, JY61PB) output height.

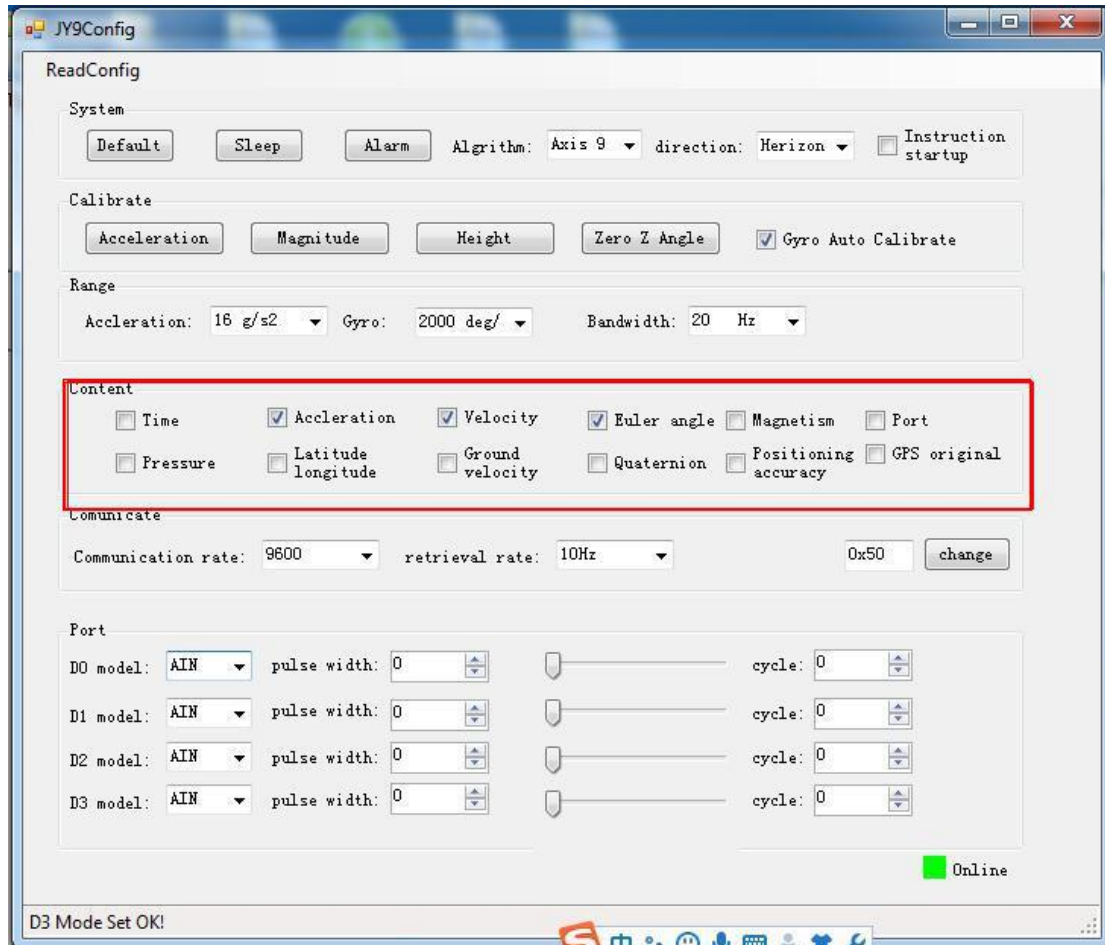
## 6.3.5 Gyroscope Automatic Calibration

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

## 6.4 Set Return Content

Setting method: The content of returned data can be customized according to the user's needs, click "Config" to open configuration bar, and hook the data content option that you want. Take JY901 as an example, the default output of the module is acceleration, angular velocity angle and magnetic field.

Longitude and ground velocity information are effectively when connected to the GPS module. In order to get the correct data we need to set the content.



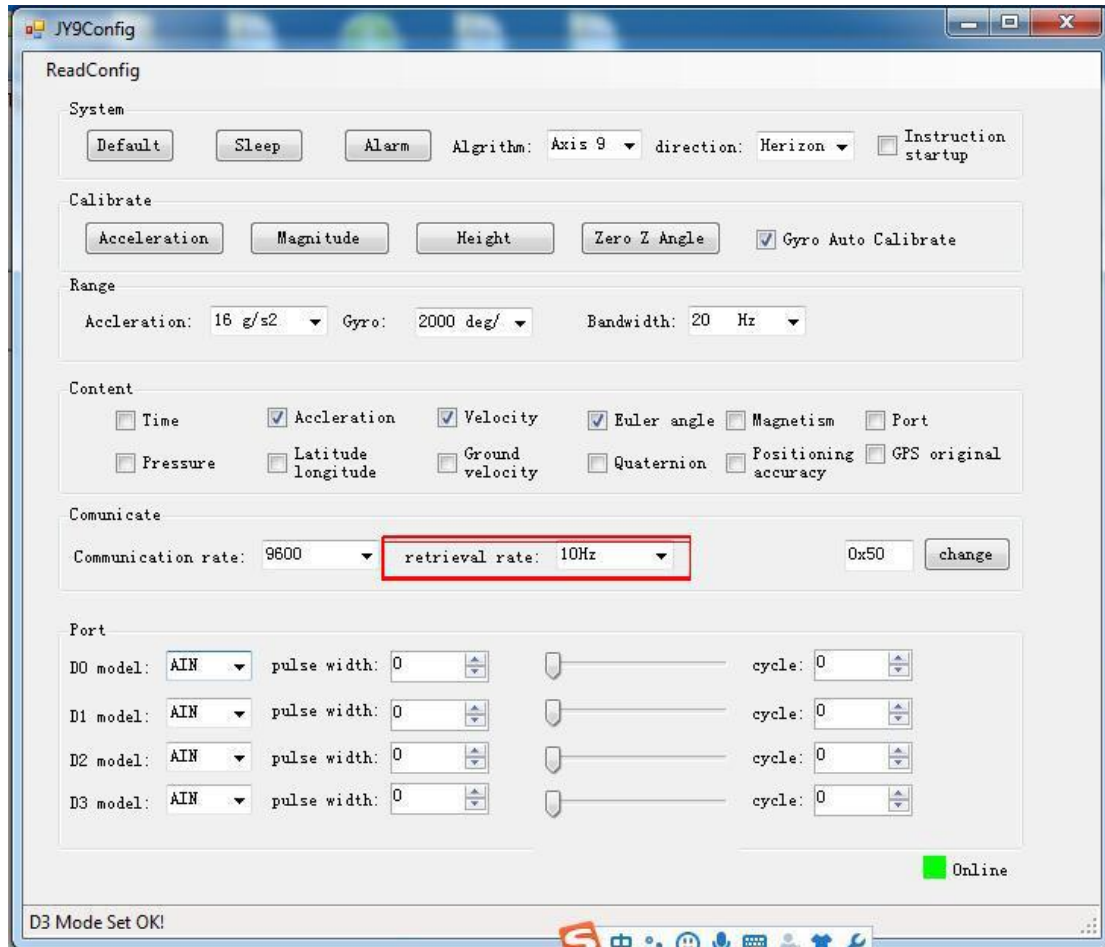
## 6.5 Set Return Rate

Setting methods: click “Config” to open configuration bar and then set the “retrieval rate” is 0.1HZ-200HZ optional.

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

10HZ refers to 10 packets returned every second. There contains 33bytes in a data packet in default.

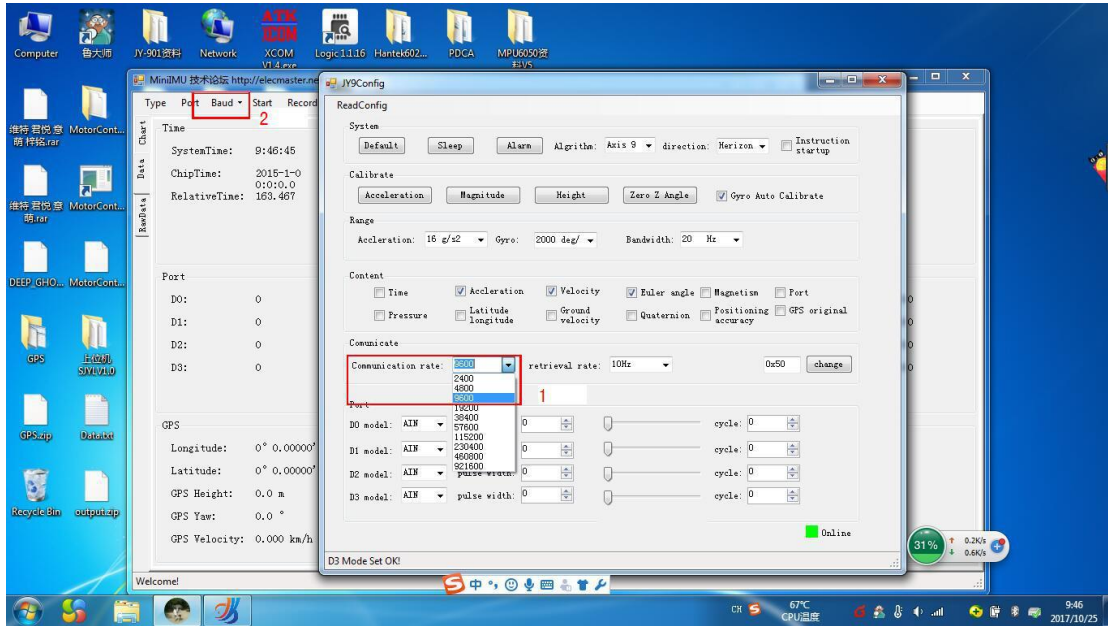
Reminder: If there being a lot of return content and low baud rate of communication, the module will automatically reduce the frequency and output at a maximum allowable output rate. The default baud rate is 115200.



## 6.6 Set Baud Rate

Module supports multiple baud, 9600 default. Change baud rate only when the module connect to PC program successfully, choose the baud rate and Click “Change” button.

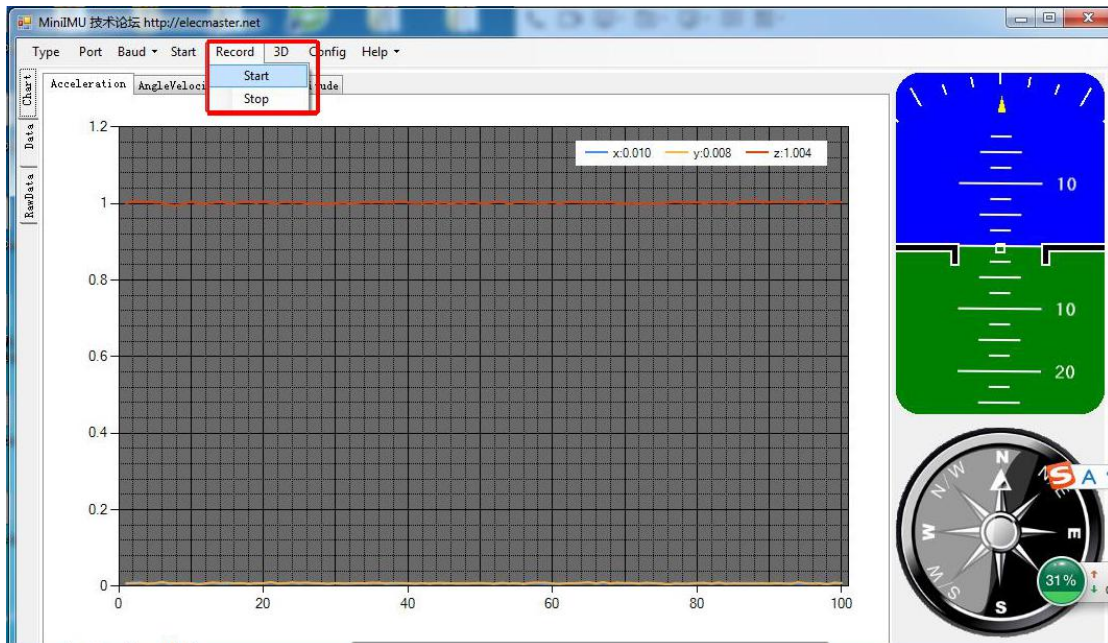
Reminder: After changing the baud rate, the module does not immediately take effect, need to re-power and then it will take effect.

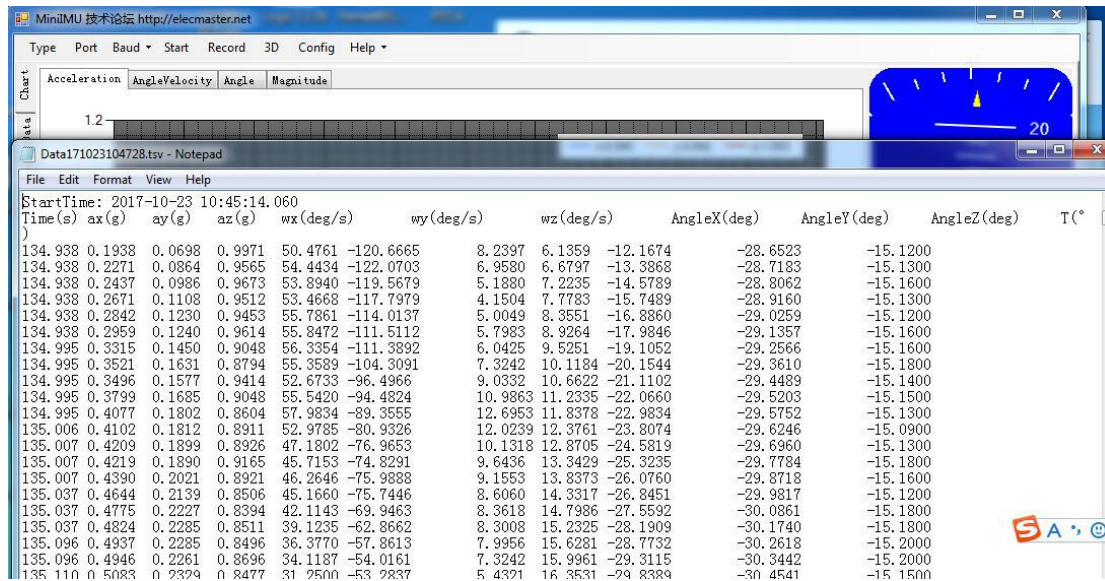


## 6.7 Data Recording

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

Method are as follows: Click “Record” and “Start” will save the data as a file.





The saved file is in the directory of the software Data.tsv:

The file begins with a value indicating the data. “Time” stands for time, “ax, ay, az” respectively represents the acceleration of X, Y, Z axis. “wx, wy, wz” respectively represents the angular velocity of X, Y, Z axis. “AngleX, AngleY, AngleZ” respectively represents the angle of the X, Y, Z axis. T represents the temperature.

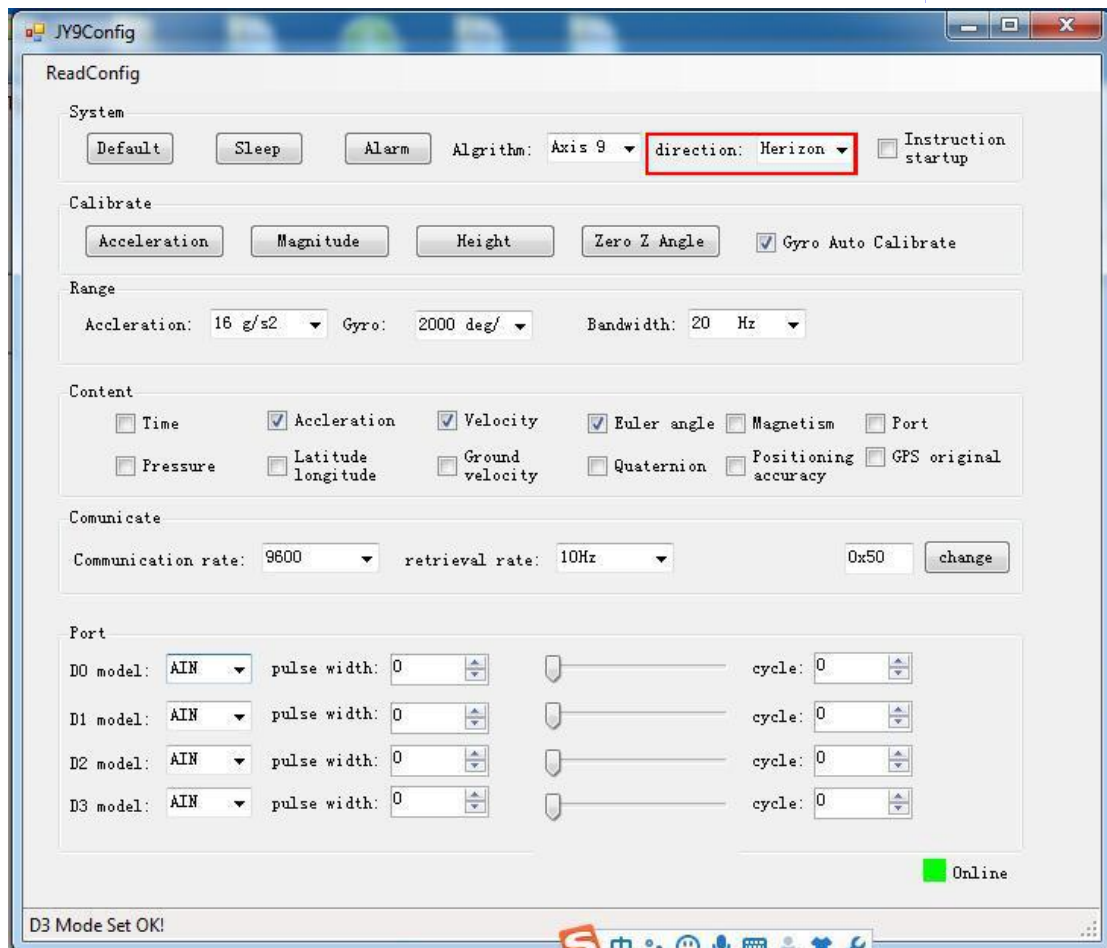
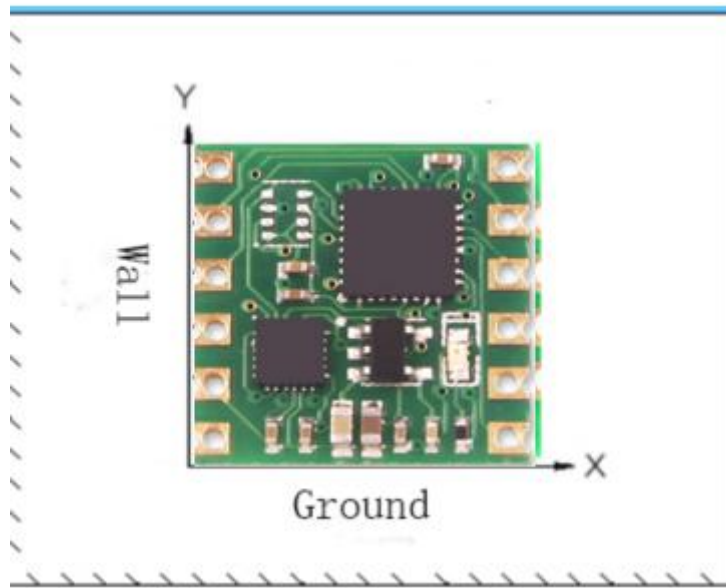
Data can be imported into the Excel or analysis in Matlab. In the Matlab environment running xxx.m document and it can plot of the data.

## 6.8 Installation Direction

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

Vertical installation method: Put the module around X-axis rotation 90 degrees vertical placement. In the “Config” of the software, click “Vertical” option. The calibration can be used after the setup is completed.





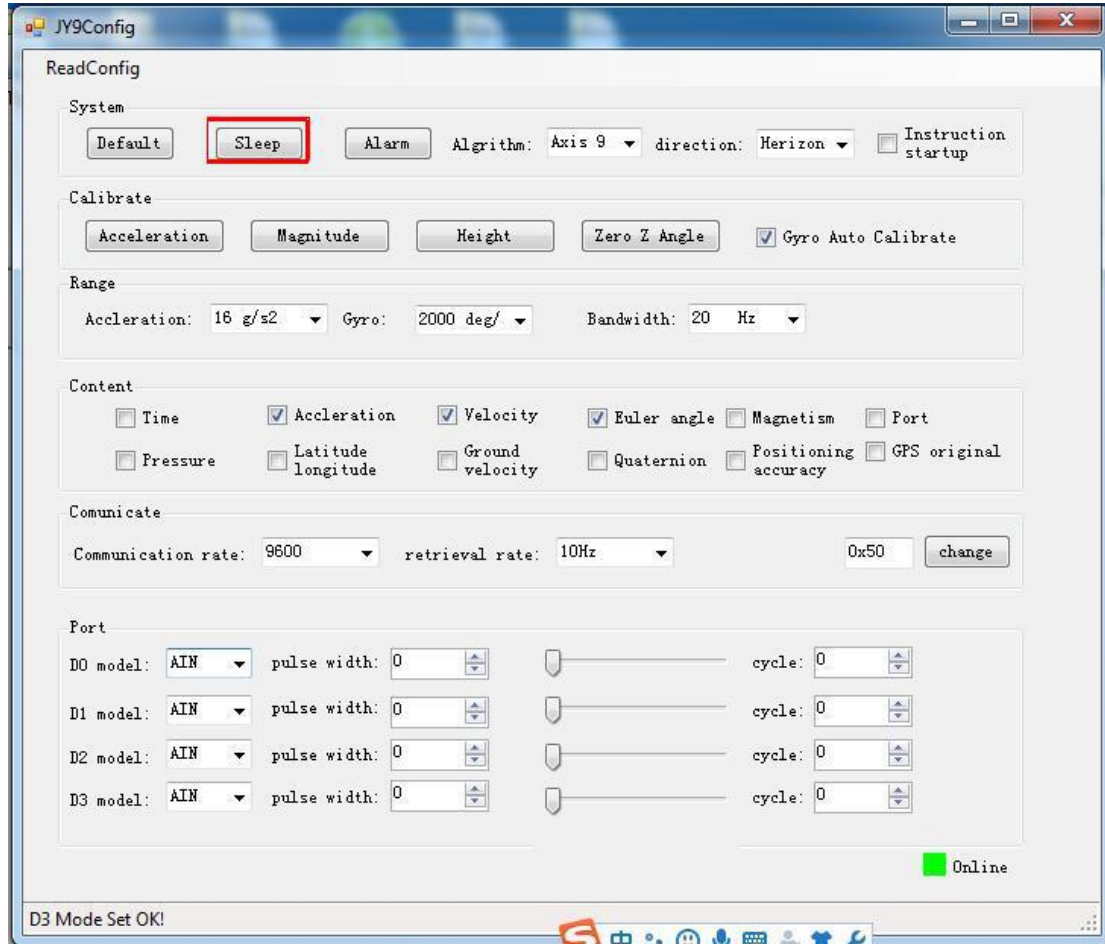
## 6.9 Sleep/ Wake up

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 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.

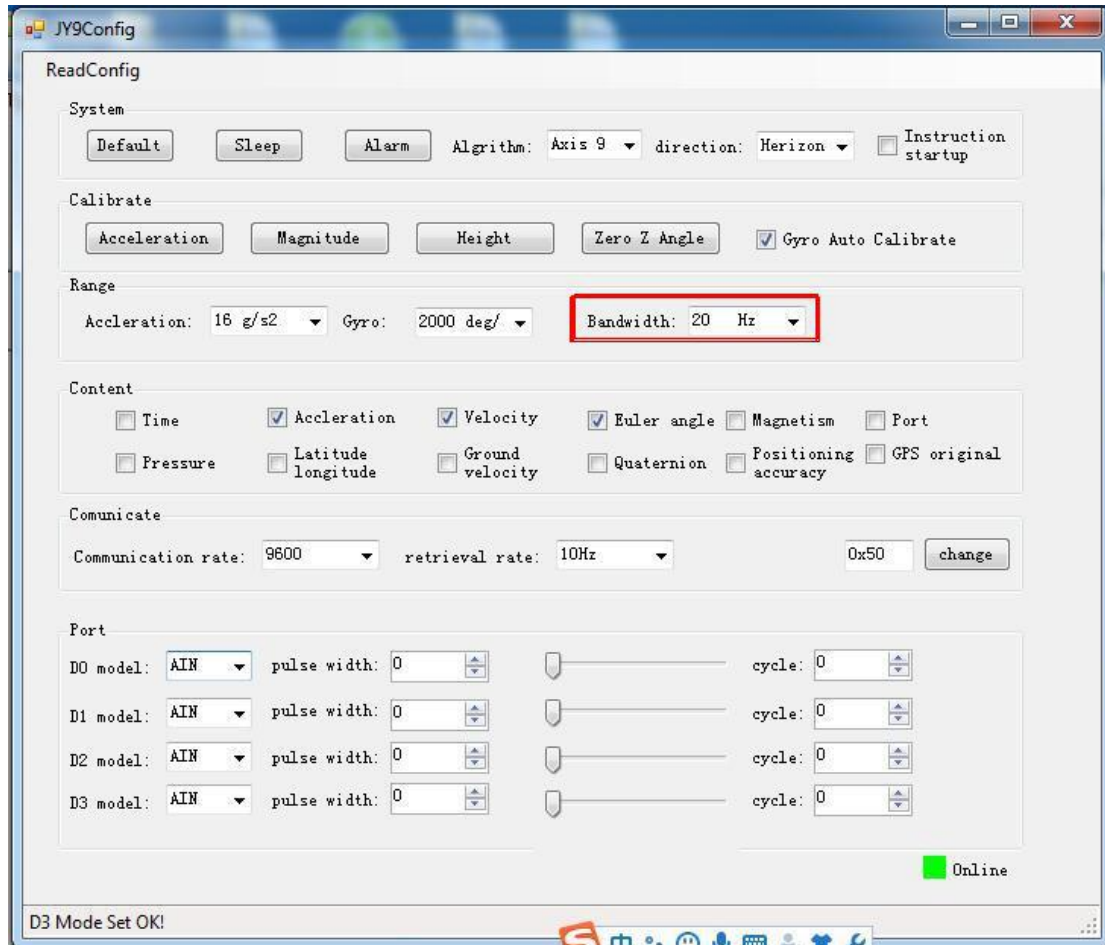


## 6.10 Set Bandwidth

Bandwidth: The module outputs only the data within the measurement bandwidth, and the data which is larger than the bandwidth will be filtered automatically.

In the “Config” of the software, click “Bandwidth” option to set it, the default setting is 20HZ.

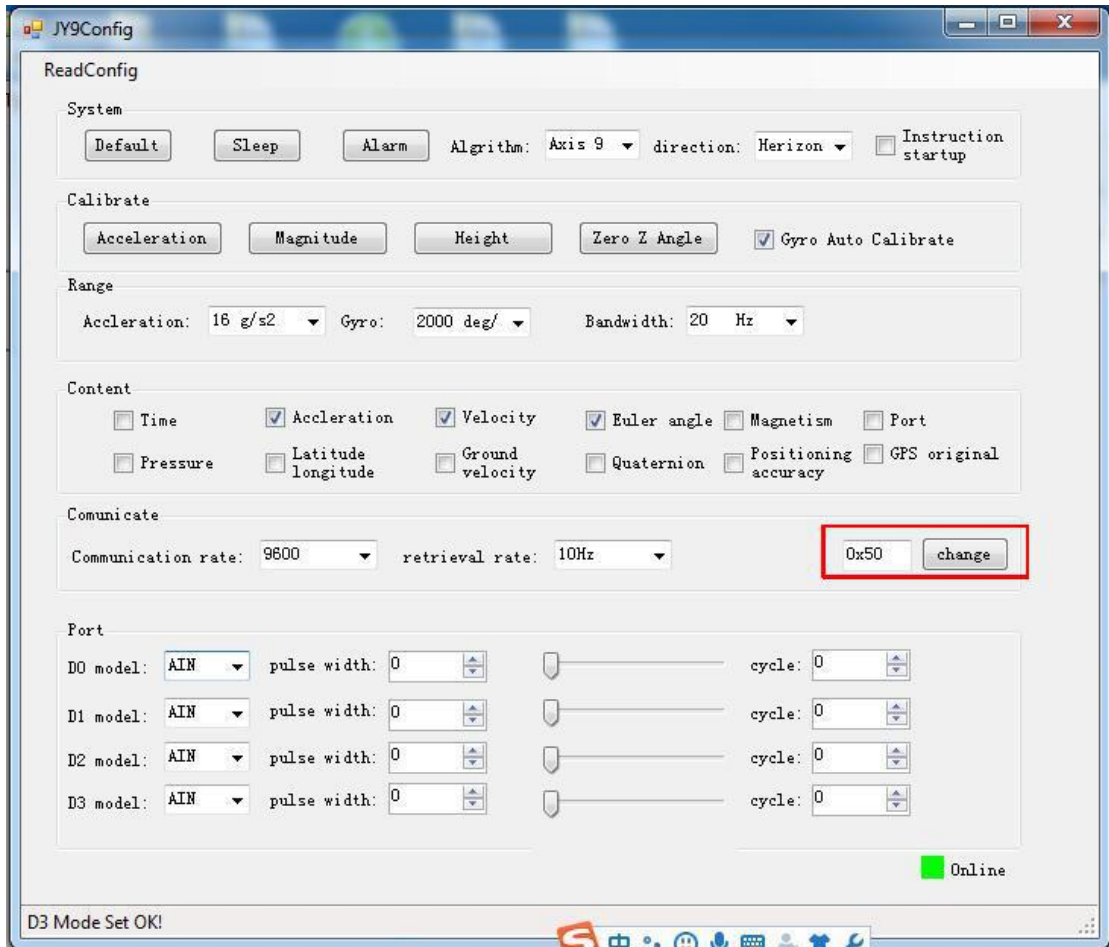




## 6.11 Set IIC Address

The module's IIC address is 0x50, which can be changed by software. Change the IIC address only when the module connect to PC program successfully, and enter the new 16 hexadecimal IIC address and click the “change” button.

Reminder: The IIC address of the module will not be changed immediately, and it will take effect when the module restart.



## 6.12 Set Extended Port

The JY-901 module has 4 multiple function expansion ports, which can be set to different functions according to the need. Set extended port only when the module connect to PC program successfully.

The extended port supports analog input mode, digital input mode, digital output mode, PWM output mode. D1 port also supports GPSRX mode, port state by default is analog input mode.

The port status packet which the module exports contains the status information of the extended port. In different modes, the port state data DxStatus has the following meanings:

Mode	Implication
Analog input mode	Analog voltage
Digital input mode	Port high and low level state
Digital high level output mode	Port output state
Digital low level output mode	Port output state
PWM output mode	PWM high level width
CLR (D1)	The XY relative attitude 0

Analog input mode is used to measure the analog voltage on the port, such as a potentiometer or a sensor, etc.

Formula is As follows:

$$U = DxStatus / 4096 * U_{vcc}$$

Uvcc is the power supply voltage of the module, because the module has LDO, if the module power supply voltage is greater than 3.5V, Uvcc is 3.3V. If the module supply voltage is less than 3.5V, Uvcc equal to the supply voltage minus 0.2V。

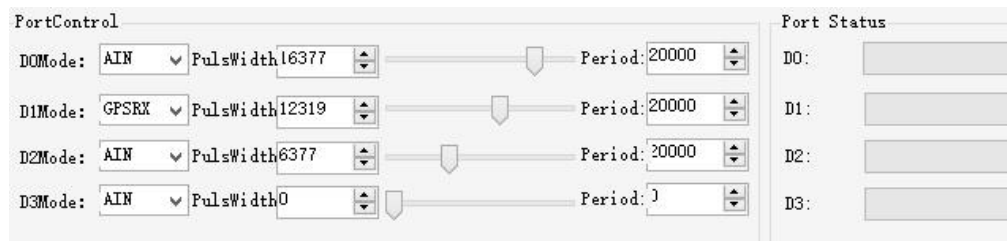
For digital input mode, if the voltage is high, DxStatus=1, else, DxStatus=0。

For digital output mode:

Voltage is high, DxStatus=1。

Voltage is low, DxStatus=0。

PWM output mode is used for the output of the PWM wave, the cycle and the high level width can be adjusted, the unit is us. In the PWM output mode, the port state data is used to indicate the high level of the PWM, the unit us.



## 6.13 Six axis/ Nine axis Algorithm

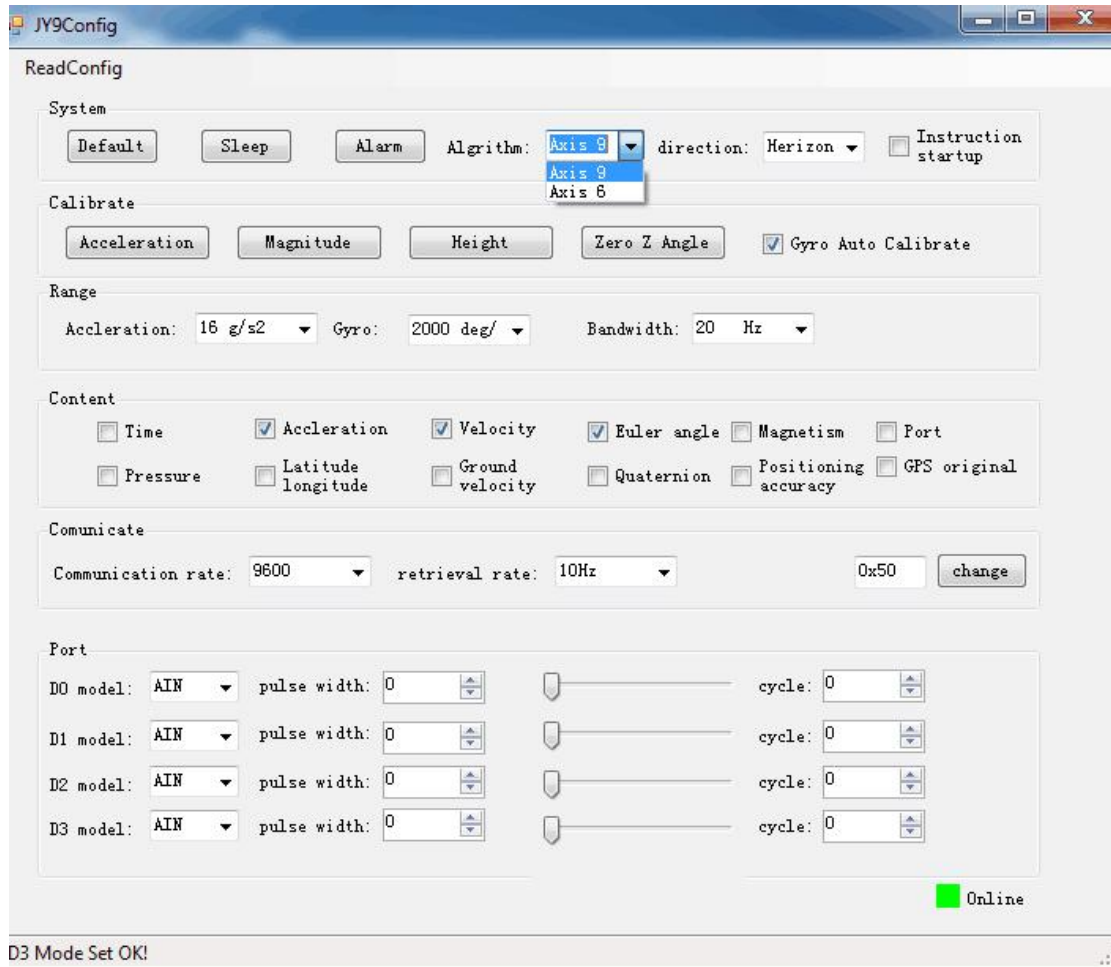
JY61P uses the 6 axis algorithm, and the z axis angle is calculated mainly according to the angular velocity integral.

JY901 uses the 9 axis algorithm, the z axis angle is mainly calculated according to the magnetic field, there will be no drift phenomenon.

When the JY901 environment is disturbed by magnetic field, the 6 axis algorithm can be used to detect the angle.

Nine axis algorithm to use 6 axis algorithm: in the PC configuration bar, the algorithm changed to "Axis6", and then additional calibration and Z axis zeroing calibration. The calibration will be ready for use.

Reminder: here only JY901 can do the algorithm conversion, and the system defaults to the 9 axis algorithm. JY61P is unable to convert algorithms.



## 7 Communication Protocol

Level: TTL level (non RS232 level, if the module is wrong to the RS232 level may cause damage to the module)

Baud rate: 2400, 4800, 9600 (default), 19200 38400, 57600, 115200, 230400, 460800, 921600, stop bit and parity bit 0

### 7.1 Module to PC Software

#### 7.1.1 Time Output

0x55	0x50	YY	MM	DD	hh	mm	ss	msL	msH	SUM
------	------	----	----	----	----	----	----	-----	-----	-----

YY: Year, 20YY Year

MM: Month

DD: Day

hh: hour

mm: minute

ss: Second

ms: Millisecond

Millisecond calculate formula:

$ms = ((msH \ll 8) | msL)$

$Sum = 0x55 + 0x51 + YY + MM + DD + hh + mm + ss + ms + TL$

## 7.1.2 Acceleration Output:

0x55	0x51	AxL	AxH	AyL	AyH	AzL	AzH	TL	TH	SUM
------	------	-----	-----	-----	-----	-----	-----	----	----	-----

Calculate formula:

$a_x = ((AxH \ll 8) | AxL) / 32768 * 16g$  (g is Gravity acceleration,  $9.8m/s^2$ )

$a_y = ((AyH \ll 8) | AyL) / 32768 * 16g$  (g is Gravity acceleration,  $9.8m/s^2$ )

$a_z = ((AzH \ll 8) | AzL) / 32768 * 16g$  (g is Gravity acceleration,  $9.8m/s^2$ )

Temperature calculated formular:

$T = ((TH \ll 8) | TL) / 100 \text{ } ^\circ\text{C}$

Checksum:

$Sum = 0x55 + 0x51 + AxH + AxL + AyH + AyL + AzH + AzL + TH + TL$

Note:

- 1、 the data is transmitted in accordance with the 16 hexadecimal, not ASCII code
- 2、 Each data is transmitted in a low byte and a high byte, and the two is combined into a short type of symbol. Such as X axis acceleration data Ax, where AxL is the low byte, AxH is high byte.

The conversion method is as follows:

Assuming Data is the actual data, DataH for its high byte, DataL for its low byte part, then:  $Data = ((short) DataH \ll 8) | DataL$ . Here we must pay attention to that force the DataH to be converted into a symbol of the short type of data and then after shift 8 bit, and the type of Data is also a symbol of the short type, so it can show a negative.

## 7.1.3 Angular Velocity Output

0x55	0x52	wxL	wxH	wyL	wyH	wzL	wzH	TL	TH	SUM
------	------	-----	-----	-----	-----	-----	-----	----	----	-----

Calculated formular:

$w_x = ((wxH \ll 8) | wxL) / 32768 * 2000(^{\circ}/s)$

$w_y = ((wyH \ll 8) | wyL) / 32768 * 2000(^{\circ}/s)$

$w_z = ((wzH \ll 8) | wzL) / 32768 * 2000(^{\circ}/s)$

Temperature calculated formular:

$T = ((TH \ll 8) | TL) / 100 \text{ } ^\circ\text{C}$

Checksum:

$Sum = 0x55 + 0x52 + wxH + wxL + wyH + wyL + wzH + wzL + TH + TL$

## 7.1.4 Angle Output:

0x55	0x53	RollL	RollH	PitchL	PitchH	YawL	YawH	TL	TH	SUM
------	------	-------	-------	--------	--------	------	------	----	----	-----

Calculated formular:

Roll ( x axis )  $Roll = ((RollH \ll 8) | RollL) / 32768 * 180(^{\circ})$

Pitch ( y axis )  $Pitch = ((PitchH \ll 8) | PitchL) / 32768 * 180(^{\circ})$

Yaw ( z axis )  $Yaw = ((YawH \ll 8) | YawL) / 32768 * 180(^{\circ})$

Temperature calculated formular:

$T = ((TH \ll 8) | TL) / 100 \text{ }^{\circ}C$

Checksum:

$Sum = 0x55 + 0x53 + RollH + RollL + PitchH + PitchL + YawH + YawL + TH + TL$

Note:

1. Attitude angle use the coordinate system for the Northeast sky coordinate system, the X axis is East, the Y axis is North, Z axis toward sky. Euler coordinate system rotation sequence defined attitude is z-y-x, first rotates around the Z axis. Then, around the Y axis, and then around the X axis.
2. In fact, the rotation sequence is Z-Y-X, the range of pitch angle (Y axis) is only  $\pm 90$  degrees, when the pitch angle (Y axis) is bigger than 90 degrees and the pitch angle (Y axis) will become less than 90 degrees. At the same time, the Roll Angle(X axis) will become larger than 180 degree. Please search on Google about more information of Euler angle and attitude information.
3. Since the three axis are coupled, the angle will be independent only when the angle is small. It will be dependent of the three angle when the angle is large when the attitude angle change, such as when the X axis close to 90 degrees, even if the attitude angle around the X axis, Y axis angle will have a big change, which is the inherent characteristics of the Euler angle

## 7.1.5 Magnetic output:

0x55	0x54	HxL	HxH	HyL	HyH	HzL	HxH	TL	TH	SUM
------	------	-----	-----	-----	-----	-----	-----	----	----	-----

Calculated formular:

Magnetic ( x axis )  $Hx = (( HxH \ll 8) | HxL)$

Magnetic ( y axis )  $Hy = (( HyH \ll 8) | HyL)$

Magnetic ( z axis )  $Hx = (( HzH \ll 8) | HzL)$

Temperature calculated formular:

$T = ((TH \ll 8) | TL) / 100 \text{ }^{\circ}C$

Checksum:

$Sum = 0x55 + 0x53 + HxH + HxL + HyH + HyL + HzH + HzL + TH + TL$

## 7.1.6 Data output port status:

0x55	0x55	D0L	D0H	D1L	D1H	D2L	D2H	D3L	D3H	SUM
------	------	-----	-----	-----	-----	-----	-----	-----	-----	-----

Calculated formular:

$$D0 = (D0H \ll 8) | D0L$$

$$D1 = (D1H \ll 8) | D1L$$

$$D2 = (D2H \ll 8) | D2L$$

$$D3 = (D3H \ll 8) | D3L$$

Note:

### Analog input port mode:

$$U = D_x \text{Status} / 1024 * U_{vcc}$$

$U_{vcc}$  is the power supply voltage of the module, because the module has LDO, if the module power supply voltage is greater than 3.5V,  $U_{vcc}$  is 3.3V. If the module supply voltage is less than 3.5V,  $U_{vcc}$  equal to the supply voltage minus 0.2V

### Digital input mode:

Voltage level is high, the data is 1,

Voltage level is low, the data is 0.

### Digital output mode:

Output is high, the data is 1.

Output is low, the data is 0.

### PWM output mode:

When the port is set to PWM output mode, port status data indicates high level width, the unit is us.

## 7.1.7 Atmospheric pressure and Height output:

0x55	0x56	P0	P1	P2	P3	H0	H1	H2	H3	SUM
------	------	----	----	----	----	----	----	----	----	-----

Calculated formular:

$$\text{Atmospheric pressure } P = ((P3 \ll 24) | (P2 \ll 16) | (P1 \ll 8) | P0) \text{ (Pa)}$$

$$\text{Height } H = ((H3 \ll 24) | (H2 \ll 16) | (H1 \ll 8) | H0) \text{ (cm)}$$

Checksum:

$$\text{Sum} = 0x55 + 0x56 + P0 + P1 + P2 + P3 + H0 + H1 + H2 + H3$$

## 7.1.8 Longitude and Latitude Output:

0x55	0x57	Lon0	Lon 1	Lon 2	Lon 3	Lat0	Lat 1	Lat 2	Lat 3	SUM
------	------	------	-------	-------	-------	------	-------	-------	-------	-----

Calculated formular:

$$\text{Longitude Lon} = ((Lon 3 \ll 24) | (Lon 2 \ll 16) | (Lon 1 \ll 8) | Lon 0)$$

In NMEA0183 standard, GPS output format is ddmm.mmmmm (dd for the degree, mm.mmmmm is after decimal point), JY-901 removed output decimal point, so the degree of longitude can be calculated:



dd=Lon/100000000;  
 mm.mmmmm=(Lon%10000000)/100000; (% calculate Remainder)

**Latitude Lat** = ((Lat 3<<24)| (Lat 2<<16)| (Lat 1<<8)| Lat 0 (cm)

In NMEA0183 standard , GPS output format is ddmm.mmmmm (dd for the degree, mm.mmmmm is after decimal point ), JY-901 removed output decimal point, so the degree of longitude can be calculated:

dd=Lat/100000000;  
 mm.mmmmm=(Lat%10000000)/100000; (% calculate Remainder)

Checksum:

Sum=0x55+0x54+ Lon 0+ Lon 1+ Lon 2+ Lon 3+ Lat 0+ Lat 1+ Lat 2+ Lat 3

### 7.1.9 Ground speed output:

0x55	0x58	GPSHeightL	GPSHeightH	GPSYawL	GPSYawH
GPSV0	GPSV 1	GPSV 2	GPSV 3	SUM	

Calculated formular:

GPSHeight = ((GPSHeightH<<8)| GPSHeightL)/10 (m)

GPSYaw =((GPSYawH <<8)| GPSYawL)/10 (°)

GPSV = (((Lat 3<<24)| (Lat 2<<16)| (Lat 1<<8)| Lat 0)/1000 (km/h)

Checksum:

Sum=0x55+0x54+ GPSHeightL + GPSHeightH + GPSYawL + GPSYawH + GPSV0+ GPSV 1+ GPSV 2+ GPSV 3

### 7.1.10 Quaternion:

0x55	0x59	Q0L	Q0H	Q1L	Q1H	Q2L	Q2H	Q3L	Q3H	SUM
------	------	-----	-----	-----	-----	-----	-----	-----	-----	-----

Calculated formular:

Q0=((Q0H<<8)|Q0L)/32768

Q1=((Q1H<<8)|Q1L)/32768

Q2=((Q2H<<8)|Q2L)/32768

Q3=((Q3H<<8)|Q3L)/32768

Checksum:

Sum=0x55+0x59+Q0L+Q0H+Q1L +Q1H +Q2L+Q2H+Q3L+Q3H

### 7.1.11 Satellite positioning accuracy output:

0x55	0x5A	SNL	SNH	PDOPL	PDOPH	HDOPL	HDOPH	VDOPL	VDOPH	SUM
------	------	-----	-----	-------	-------	-------	-------	-------	-------	-----

Calculated formular:

Satellite quantity:  $SN = ((SNH \ll 8) | SNL)$

Location positioning accuracy:  $PDOP = ((PDOPH \ll 8) | PDOPL) / 32768$

Horizontal positioning accuracy:  $HDOP = ((HDOPH \ll 8) | HDOPL) / 32768$

Vertical positioning accuracy:  $VDOP = ((VDOPH \ll 8) | VDOPL) / 32768$

Checksum:

$Sum = 0x55 + 0x59 + SNL + SNH + PDOPL + PDOPH + HDOPL + HDOPH + VDOPL + VDOPH$

## 7.2 Software to Module

Reminder:

1. Factory settings default to use serial port, band rate is 9600, frame rate is 10HZ. Configuration can be configured through PC software. All configuration are power down storage, so you just need to configure it just once on the line.
2. Data format

0xFF	0xAA	Address	DataL	DataH
------	------	---------	-------	-------

### 7.2.1 Register Address table

Address	Symbol	Meaning
0x00	SAVE	Save
0x01	CALSW	Calibration
0x02	RSW	Return data content
0x03	RATE	Return data Speed
0x04	BAUD	Baud rate
0x05	AXOFFSET	X axis Acceleration bias
0x06	AYOFFSET	Y axis Acceleration bias
0x07	AZOFFSET	Z axis Acceleration bias
0x08	GXOFFSET	X axis angular velocity bias
0x09	GYOFFSET	Y axis angular velocity bias
0x0a	GZOFFSET	Z axis angular velocity bias
0x0b	HXOFFSET	X axis Magnetic bias
0x0c	HYOFFSET	Y axis Magnetic bias
0x0d	HZOFFSET	Z axis Magnetic bias
0x0e	D0MODE	D0 mode
0x0f	D1MODE	D1 mode
0x10	D2MODE	D2 mode
0x11	D3MODE	D3 mode
0x12	D0PWMH	D0PWM High-level width
0x13	D1PWMH	D1PWM High-level width

0x14	D2PWMH	D2PWM High-level width
0x15	D3PWMH	D3PWM High-level width
0x16	D0PWMT	D0PWM Period
0x17	D1PWMT	D1PWM Period
0x18	D2PWMT	D2PWM Period
0x19	D3PWMT	D3PWM Period
0x1a	IICADDR	IIC address
0x1b	LEDOFF	Turn off LED
0x1c	GPSBAUD	GPS baud rate
0x30	YYMM	Year、Month
0x31	DDHH	Day、Hour
0x32	MMSS	Minute、Second
0x33	MS	Millisecond
0x34	AX	X axis Acceleration
0x35	AY	Y axis Acceleration
0x36	AZ	Z axis Acceleration
0x37	GX	X axis angular velocity
0x38	GY	Y axis angular velocity
0x39	GZ	Z axis angular velocity
0x3a	HX	X axis Magnetic
0x3b	HY	Y axis Magnetic
0x3c	HZ	Z axis Magnetic
0x3d	Roll	X axis Angle
0x3e	Pitch	Y axis Angle
0x3f	Yaw	Z axis Angle
0x40	TEMP	Temperature
0x41	D0Status	D0Status
0x42	D1Status	D1Status
0x43	D2Status	D2Status
0x44	D3Status	D3Status
0x45	PressureL	Pressure Low Byte
0x46	PressureH	Pressure High Byte
0x47	HeightL	Height Low Byte
0x48	HeightH	Height High Byte
0x49	LonL	Longitude Low Byte
0x4a	LonH	Longitude High Byte
0x4b	LatL	Latitude Low Byte
0x4c	LatH	Latitude High Byte
0x4d	GPSHeight	GPS Height
0x4e	GPSYaw	GPS Yaw
0x4f	GPSVL	GPS speed Low byte

0x50	GPSVH	GPS speed High byte
0x51	Q0	Quaternion Q0
0x52	Q1	Quaternion Q1
0x53	Q2	Quaternion Q2
0x54	Q3	Quaternion Q3

## 7.2.2 Save Configuration

0xFF	0xAA	0x00	SAVE	0x00
------	------	------	------	------

SAVE: Save

- 0: Save current configuration
- 1: set to default setting

## 7.2.3 Calibrate

0xFF	0xAA	0x01	CALSW	0x00
------	------	------	-------	------

CALSW: Set calibration mode

- 0: Exit calibration mode
- 1: Enter Gyroscope and Accelerometer calibration mode
- 2: Enter magnetic calibration mode
- 3: Set height to 0

## 7.2.4 Set Installation direction

0xFF	0xAA	0x23	DIRECTION	0x00
------	------	------	-----------	------

DIRECTION: set installation direction

- 0: set to horizontal installation
- 1: set to vertical installation

## 7.2.5 Sleep/ Wake up

0xFF	0xAA	0x22	0x01	0x00
------	------	------	------	------

Sent this instruction to enter sleep state, sent it once again, module enter the working state from the standby state.

## 7.2.6 Algorithm transition

0xFF	0xAA	0x24	ALG	0x00
------	------	------	-----	------

ALG: 6-axis/ 9-axis algorithm transition

0: set to 9-axis algorithm

1: set to 6-axis algorithm

## 7.2.7 Gyroscope automatic calibration

0xFF	0xAA	0x63	GYRO	0x00
------	------	------	------	------

GYRO: gyroscope automatic calibration

0: set to gyroscope automatic calibration

1: removed to gyroscope automatic calibration

## 7.2.8 Set return content

0xFF	0xAA	0x02	RSWL	RSWH
------	------	------	------	------

RSW byte definition

byte	7	6	5	4	3	2	1	0
Name	0x57	0x56	0x55	0x54	0x53	0x52	0x51	0x50
	pack	pack	pack	pack	pack	pack	pack	pack
default	0	0	0	1	1	1	1	0

0x50 pack: time pack

0: Not output 0X50 pack

1: Output 0X50 pack

0x51 pack: Acceleration pack

0: Not output 0x51 pack

1: Output 0x51 pack

0x52 pack: Angular velocity pack

0: Not output 0x52 packet

1: Output 0x52 pack

0x53 pack: Angle Pack

0: Not output 0x53 pack

1: Output 0x53 pack

0x54 pack: Magnetic Pack

0: Not output 0x54 pack

1: Output 0x54 pack

0x55 pack: Port status pack

- 0: Not output 0x55 pack
- 1: Output 0x55 pack
- 0x56 pack: Atmospheric pressure & Height Pack
  - 0: Not output 0x56 pack
  - 1: Output 0x56 pack
- 0x57 pack: Longitude and Latitude Output Pack
  - 0: Not output 0x57 pack
  - 1: Output 0x57 pack
- 0x58 pack: GPS speed Pack
  - 0: Not output 0x58 pack
  - 1: Output 0x58 pack
- 0x59 pack: Quaternion Pack
  - 0: Not output 0x59 pack
  - 1: Output 0x59 pack
- 0x5A pack: Satellite position accuracy
  - 0: Not output 0x5A pack
  - 1: Output 0x5A pack

## 7.2.9 Set return rate

0xFF	0xAA	0x03	RATE	0x00
------	------	------	------	------

RATE: return rate

- 0x01: 0.1Hz
- 0x02: 0.5Hz
- 0x03: 1Hz
- 0x04: 2Hz
- 0x05: 5Hz
- 0x06: 10Hz (default)
- 0x07: 20Hz
- 0x08: 50Hz
- 0x09: 100Hz
- 0x0a: 125Hz
- 0x0b: 200Hz
- 0x0c: Single
- 0x0d: Not output

After the setup is complete, need to click save, and re-power the module to take effect.

## 7.2.10 Set baud rate

0xFF	0xAA	0x04	BAUD	0x00
------	------	------	------	------

BAUD:

0x00: 2400  
 0x01: 4800  
 0x02: 9600 (default)  
 0x03: 19200  
 0x04: 38400  
 0x05: 57600  
 0x06: 115200  
 0x07: 230400  
 0x08: 460800  
 0x09: 921600

## 7.2.11 Set X axis Acceleration bias

0xFF	0xAA	0x05	AXOFFSETL	AXOFFSETH
------	------	------	-----------	-----------

AXOFFSETL: X axis Acceleration bias low byte

AXOFFSETH: X axis Acceleration bias high byte

$AXOFFSET = (AXOFFSETH \ll 8) | AXOFFSETL$

Note: When set the acceleration bias, the output equal the value of the acceleration sensor output value minus the bias value

## 7.2.12 Set Y axis Acceleration bias

0xFF	0xAA	0x06	AYOFFSETL	AYOFFSETH
------	------	------	-----------	-----------

AYOFFSETL: Y axis Acceleration bias low byte

AYOFFSETH: Y axis Acceleration bias high byte

$AYOFFSET = (AYOFFSETH \ll 8) | AYOFFSETL$

Note: When set the acceleration bias, the output equal the value of the acceleration sensor output value minus the bias value.

## 7.2.13 Set Z axis Acceleration bias

0xFF	0xAA	0x07	AZOFFSETL	AZOFFSETH
------	------	------	-----------	-----------

AZOFFSETL: Z axis Acceleration bias low byte

AZOFFSETH: Z axis Acceleration bias high byte

$AZOFFSET = (AZOFFSETH \ll 8) | AZOFFSETL$

Note: When set the acceleration bias, the output equal the value of the acceleration sensor output



value minus the bias value.

## 7.2.14 Set X axis Angular velocity bias

0xFF	0xAA	0x08	GXOFFSETL	GXOFFSETH
------	------	------	-----------	-----------

GXOFFSETL: Set X axis Angular velocity bias low byte

GXOFFSETH: Set Y axis Angular velocity bias high byte

$GXOFFSET = (GXOFFSETH \ll 8) | GXOFFSETL$

Note: When set the Angular velocity bias, the output equal the value of the sensor output value minus the bias value.

## 7.2.15 Set Y axis Angular velocity bias

0xFF	0xAA	0x09	GYOFFSETL	GYOFFSETH
------	------	------	-----------	-----------

GYOFFSETL: Set X axis Angular velocity bias low byte

GYOFFSETH: Set X axis Angular velocity bias high byte

$GYOFFSET = (GYOFFSETH \ll 8) | GYOFFSETL$

Note: When set the Angular velocity bias, the output equal the value of the sensor output value minus the bias value.

## 7.2.16 Set Z axis Angular velocity bias

0xFF	0xAA	0x0a	GZOFFSETL	GZOFFSETH
------	------	------	-----------	-----------

GZOFFSETL: Set Z axis Angular velocity bias low byte

GZOFFSETH: Set Z axis Angular velocity bias low byte

$GZOFFSET = (GZOFFSETH \ll 8) | GZOFFSETL$

Note: When set the Angular velocity bias, the output equal the value of the sensor output value minus the bias value.

## 7.2.17 Set X axis magnetic bias

0xFF	0xAA	0x0b	HXOFFSETL	HXOFFSETH
------	------	------	-----------	-----------

HXOFFSETL: Set X axis magnetic bias low byte

HXOFFSETH: Set X axis magnetic bias high byte

$HXOFFSET = (HXOFFSETH \ll 8) | HXOFFSETL$

Note: When set the magnetic bias, the output equal the value of the sensor output value minus the bias value.

## 7.2.18 Set Y axis magnetic bias

0xFF	0xAA	0x0c	HXOFFSETL	HXOFFSETH
------	------	------	-----------	-----------

HXOFFSETL: Set Y axis magnetic bias low byte

HXOFFSETH: Set Y axis magnetic bias high byte

$HXOFFSET = (HXOFFSETH \ll 8) | HXOFFSETL$

Note: When set the magnetic bias, the output equal the value of the sensor output value minus the bias value.

## 7.2.19 Set Z axis magnetic bias

0xFF	0xAA	0x0d	HXOFFSETL	HXOFFSETH
------	------	------	-----------	-----------

HXOFFSETL: Set Y axis magnetic bias low byte

HXOFFSETH: Set Z axis magnetic bias high byte

$HXOFFSET = (HXOFFSETH \ll 8) | HXOFFSETL$

Note: When set the magnetic bias, the output equal the value of the sensor output value minus the bias value.

## 7.2.20 Set port D0 mode

0xFF	0xAA	0x0e	D0MODE	0x00
------	------	------	--------	------

D0MODE:

0x00: Analog Input ( default )

0x01: Digital Input

0x02: Digital Output high

0x03: Digital Output low

0x04: PWM Output

## 7.2.21 Set port D1 mode

0xFF	0xAA	0x0f	D1MODE	0x00
------	------	------	--------	------

D1MODE:

0x00: Analog Input ( default )

0x01: Digital Input

0x02: Digital Output high

0x03: Digital Output low

0x04: PWM Output

0x05: Connect to TX of GPS

## 7.2.22 Set port D2 mode

0xFF	0xAA	0x10	D2MODE	0x00
------	------	------	--------	------

D2MODE:

0x00: Analog Input (default)

0x01: Digital Input

0x02: Digital Output high

0x03: Digital Output low

0x04: PWM Output

## 7.2.23 Set port D3 mode

0xFF	0xAA	0x11	D3MODE	0x00
------	------	------	--------	------

D3MODE:

0x00: Analog Input (default)

0x01: Digital Input

0x02: Digital Output high

0x03: Digital Output low

0x04: PWM Output

## 7.2.24 Set the PWM width of Port D0

0xFF	0xAA	0x12	D0PWMHL	D0PWMHH
------	------	------	---------	---------

D0PWMHL: the PWM width of Port D0 low byte

D0PWMHH: the PWM width of Port D0 high byte

$D0PWMH = (D0PWMHH \ll 8) | D0PWMHL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500.

## 7.2.25 Set the PWM width of Port D1

0xFF	0xAA	0x13	D1PWMHL	D1PWMHH
------	------	------	---------	---------

D1PWMHL: the PWM width of Port D1 low byte

D1PWMHH: the PWM width of Port D1 high byte

$D1PWMH = (D1PWMHH \ll 8) | D1PWMHL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500.

## 7.2.26 Set the PWM width of Port D2

0xFF	0xAA	0x14	D2PWMHL	D2PWMHL
------	------	------	---------	---------

D2PWMHL: the PWM width of Port D2 low byte

D2PWMHH: the PWM width of Port D2 high byte

$D2PWMH = (D2PWMHH \ll 8) | D2PWMHL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500.

## 7.2.27 Set the PWM width of Port D3

0xFF	0xAA	0x15	D3PWMHL	D3PWMHL
------	------	------	---------	---------

D3PWMHL: the PWM width of Port D3 low byte

D3PWMHH: the PWM width of Port D3 low byte

$D3PWMH = (D3PWMHH \ll 8) | D3PWMHL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500.

## 7.2.28 Set period of Port D0

0xFF	0xAA	0x16	D0PWMTL	D0PWMTH
------	------	------	---------	---------

D0PWMTL: PWM period of Port D0 low byte

D0PWMTH: PWM period of Port D0 high byte

$D0PWMT = (D0PWMTH \ll 8) | D0PWMTL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500. Period is 20000us, just set D0PWMT 20000.

## 7.2.29 Set period of Port D1

0xFF	0xAA	0x17	D1PWMTH	D1PWMTL
------	------	------	---------	---------

D1PWMTL: PWM period of Port D1 low byte

D1PWMTH: PWM period of Port D1 high byte

$D1PWMT = (D1PWMTH \ll 8) | D1PWMTL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500. Period is 20000us, just set D0PWMT 20000.

## 7.2.30 Set period of Port D2

0xFF	0xAA	0x18	D2PWMTH	D2PWMTL
------	------	------	---------	---------

D2PWMTL: PWM period of Port D2 low byte

D2PWMTH: PWM period of Port D2 high byte

$D2PWMT = (D2PWMTH \ll 8) | D2PWMTL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500.Period is 20000us, just set D0PWMT 20000.

### 7.2.31 Set period of Port D3

0xFF	0xAA	0x19	D3PWMTH	D3PWMTL
------	------	------	---------	---------

D3PWMTL: PWM period of Port D3 low byte

D3PWMTH: PWM period of Port D3 high byte

$D3PWMT = (D3PWMTH \ll 8) | D3PWMTL$

Note: The unit of PWM high-level width and period is us, such as high-level width is 1500us, just set D0PWMH 1500.Period is 20000us, just set D0PWMT 20000.

### 7.2.32 Set IIC Address

0xFF	0xAA	0x1a	IICADDR	0x00
------	------	------	---------	------

IICADDR:

IIC address of the module, default is 0x50. IIC address using 7bit address, can not exceed the maximum 0x7f. After the setup is complete , need to click save, and re-power the module to take effect.

### 7.2.33 Set LED

0xFF	0xAA	0x1b	LEDOFF	0x00
------	------	------	--------	------

LEDOFF:

0x01: Turn off LED

0x00: Turn on LED

### 7.2.34 Set GPS baud

0xFF	0xAA	0x1c	GPSBAUD	0x00
------	------	------	---------	------

GPSBAUD:

Baud: Time information pack

0x00: 2400

0x01: 4800

0x02: 9600 (default)

0x03: 19200

0x04: 38400  
 0x05: 57600  
 0x06: 115200  
 0x07: 230400  
 0x08: 460800  
 0x09: 921600

After set it up, you need to save the configuration button and then restart the module.

## 8 IIC Protocol

JY-901 module can be fully accessed through IIC, the maximum IIC communication speed support 400khz, slave module address is 7bit, default address is 0x50, you can change the command through the serial port or the methods of IIC writing address ways. Many GY-901 modules can be connect to IIC bus at the same time, The precondition is that the module has the different IIC address.

IIC protocol module using the register address accessible way. The length of each address are 16bits, two bytes. The register address is defined in the following table:

RegAddr	Symbol	Meaning
0x00	SAVE	Save
0x01	CALSW	Calibration
0x02	RSW	Return data content
0x03	RATE	Return data Speed
0x04	BAUD	Baud rate
0x05	AXOFFSET	X axis Acceleration bias
0x06	AYOFFSET	Y axis Acceleration bias
0x07	AZOFFSET	Z axis Acceleration bias
0x08	GXOFFSET	X axis angular velocity bias
0x09	GYOFFSET	Y axis angular velocity bias
0x0a	GZOFFSET	Z axis angular velocity bias
0x0b	HXOFFSET	X axis Magnetic bias
0x0c	HYOFFSET	Y axis Magnetic bias
0x0d	HZOFFSET	Z axis Magnetic bias
0x0e	D0MODE	D0 mode
0x0f	D1MODE	D1 mode
0x10	D2MODE	D2 mode
0x11	D3MODE	D3 mode
0x12	D0PWMH	D0PWM High-level width
0x13	D1PWMH	D1PWM High-level width
0x14	D2PWMH	D2PWM High-level width
0x15	D3PWMH	D3PWM High-level width
0x16	D0PWMT	D0PWM Period

0x17	D1PWMT	D1PWM Period
0x18	D2PWMT	D2PWM Period
0x19	D3PWMT	D3PWM Period
0x1a	IICADDR	IIC address
0x1b	LEDOFF	Turn off LED
0x1c	GPSBAUD	GPS baud rate
0x30	YYMM	Year、Month
0x31	DDHH	Day、Hour
0x32	MMSS	Minute、Second
0x33	MS	Millisecond
0x34	AX	X axis Acceleration
0x35	AY	Y axis Acceleration
0x36	AZ	Z axis Acceleration
0x37	GX	X axis angular velocity
0x38	GY	Y axis angular velocity
0x39	GZ	Z axis angular velocity
0x3a	HX	X axis Magnetic
0x3b	HY	Y axis Magnetic
0x3c	HZ	Z axis Magnetic
0x3d	Roll	X axis Angle
0x3e	Pitch	Y axis Angle
0x3f	Yaw	Z axis Angle
0x40	TEMP	Temperature
0x41	D0Status	D0Status
0x42	D1Status	D1Status
0x43	D2Status	D2Status
0x44	D3Status	D3Status
0x45	PressureL	Pressure Low Byte
0x46	PressureH	Pressure High Byte
0x47	HeightL	Height Low Byte
0x48	HeightH	Height High Byte
0x49	LonL	Longitude Low Byte
0x4a	LonH	Longitude High Byte
0x4b	LatL	Latitude Low Byte
0x4c	LatH	Latitude High Byte
0x4d	GPSHeight	GPS Height
0x4e	GPSYaw	GPS Yaw
0x4f	GPSVL	GPS speed Low byte
0x50	GPSVH	GPS speed High byte
0x51	Q0	Quaternion Q0
0x52	Q1	Quaternion Q1

0x53	Q2	Quaternion Q2
0x54	Q3	Quaternion Q3

## 8.1 IIC Write the Module

When IIC write the module, the format is as below:

IICAddr<<	RegAddr	Data1L	Data1H	Data2L	Data2H	.....
1						

First IIC host sends a Start signal to JY-901 module, then write IICAddr to register address and then write RegAddr, write the Data1L Data1H Data2L Data2H .... Sequentially, when the last data has been written, the host sends a stop signal to the module to release the IIC bus.

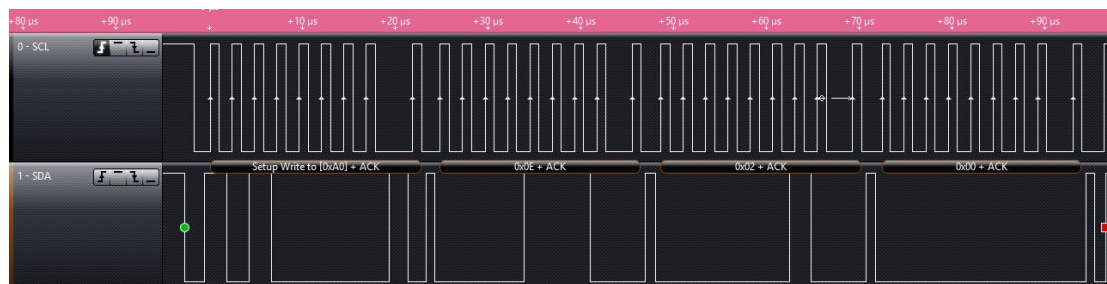
When finish writing the data, the register will be updated and module will execute the order. At the same time, the address of the module will add 1 automatically. The address Pointer will point to next address. So it can be written Continuously

For example:

Set D0 as Digital output high

RegAddr :0x0e DataL:0x02 DataH:0x00

Logic Analyzer captures waveforms as shown below:



Register set up by the module approach is consistent with the serial protocol, please refer 7.1

## 8.2 IIC Read the Module

IIC read the module, the format is as follow

IICAddr<<1	RegAddr	(IICAddr<<1) 1	Data1L	Data1H	Data2L	Data2H	.....
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First IIC host sends a Start signal to JY-901 module, then write IICAddr to register address, then IIC host sends a read signal(IICAddr<<1)|1) to JY-901 module, if the IIC address is 0x50(default),then the host send 0xa0

Thereafter the module will export the data follow the rule: low byte first, high byte Sequentially. The host will make SDA bus low after receiving each byte, and sends a response signal to the module. After the specified number of data has been received completely, the host stop sending response signal back to the module, then the module will stop export data. The host send a stop signal to end this operation.

For example:



Read the Angle of the module,  
 RedAddr: 0x3d, read 6 bytes continuously, the logic analyzer captures waveforms as shown below:



Start reading out data from 0x3d, the data is 0x9C, 0x82, 0x28, 0xFF, 0xE6, 0x24. That means X-axis angle is 0x829C, Y-axis angle is 0xFF28, Z-axis angle is 0x24E6. According to section 5.1.4, X axis angle is  $-176.33^\circ$ , Y-axis angle is  $-1.19^\circ$ , Z-axis angle is  $51.89^\circ$

## 9 Application Area

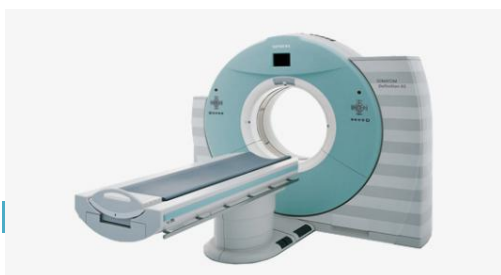
Agricultural machinery



Solar energy



Medical instruments



Internet of things



Power monitoring



Construction machinery



Geological monitoring



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