High precision gyroscope module JY-901 Series

User Manual

1 Product Description

1) JY-901 series module integrates high-precision gyroscopes, accelerometers, geomagnetic sensor, high-performance microprocessors and advanced dynamics solver and dynamic Kalman filter algorithm to quickly solve the current real-time movement of the module attitude .
2) The use of advanced digital filtering technology, can effectively reduce the measurement noise and improve measurement accuracy.
3) Integrates gesture solver, with dynamic Kalman filter algorithm, can get the accurate attitude in dynamic environment, attitude measurement precision is up to 0.01 degrees with high stability, performance is even better than some professional inclinometers!
4) Integrate voltage stabilization circuit, working voltage is 3v ~ 6v, pin level compatible 3.3V and 5V embedded system .
5) Supports serial port and IIC interfaces. Serial port rate is adjustable from 2400bps ~ 921600 bps , IIC interface supports full 400K rate.
6) High[illegible]t 200Hz output data rate. The output data rate can be adjusted.
7) The [illegible]y expansion ports can configured as analog input, digital input, digital output, PWM output function.
8) With GPS connectivity. Acceptable in line with NMEA-0183 standard serial GPS data form GPS-IMU navigation unit.
9) Stamp hole gold plating PCB design, can be embedded in the user's PCB board.
10) 4layer PCB technology, thinner, smaller, and more reliable.

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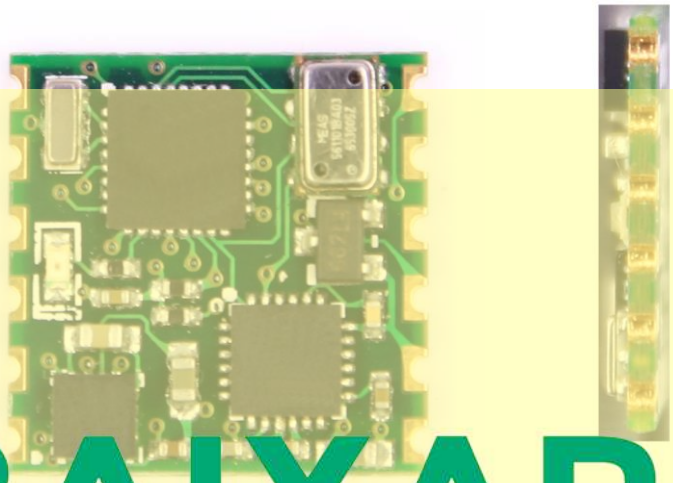
Technical Indicator

1) Input voltage: 3V-6V
2) Consumption current: <40mA
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:1D
6) Range: Acceleration: ± 16g, angular velocity: ± 2000 ° / s.
7) Resolution: Acceleration: 6.1e-5g, Angular velocity: 7.6e-3 ° / s.
8) Stability: Acceleration: 0.01g, angular speed 0.05° / s.
9) Attitude stabilization measurement: 0.01 °.

10) 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).
11) The data output frequency 0.1Hz to 200Hz.
12) Data Interface:
Serial (TTL level, baud rate support 2400,4800,9600,19200,38400,57600, 115200,230400,460800,921600), I2C (IIC maximum support high speed 400K)
13) Expansion port functions: analog input (0 ~ VCC), digital input, digital output, PWM output (period 1us-65535us, resolution 1us)
14) Provide single-chip analytical sample code.



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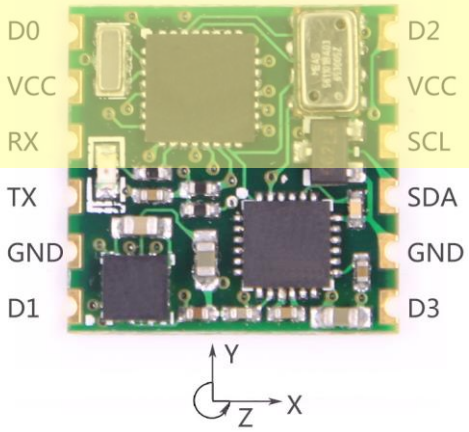
2 Pin Description



Name	Function
VCC	Power，3.3V or 5V Input
RX	Serial data input ， TTL level
TX	Serial data output ， TTL level
GND	GND
SCL	I2C Clock line
SDA	I2C Data line
D0	Extended port 0
D1	Extended port 1
D2	Extended port 2
D3	Extended port 3

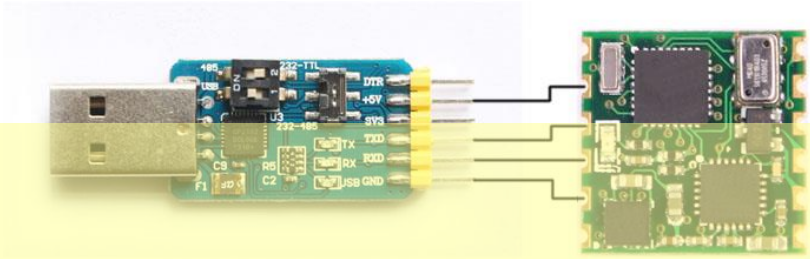
As shown in the figure above, the coordinates of the module are indicated, and the right is the X axis, the upper is Y axis, the Z axis is perpendicular to the surface of the paper to yourself. The direction of rotation is defined by the right hand rule, that is, the thumb of the right hand is pointed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

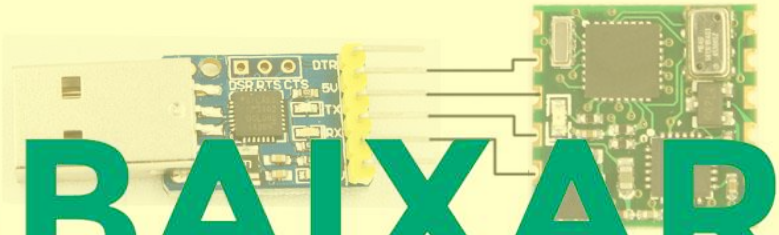
3 Hardware connection method

3.1 Connect to PC

USB to TTL tool connect to JY-901 module：USB to TTL tool:+5V，TXD，RXD，GND are respectively connected JY901 module :VCC，RX，TX，GND。Note TXD and RXD should be crossover。

(Notice： The switch of Six serial interface module needs to be configed as the following figure when connecting to 6050 module)





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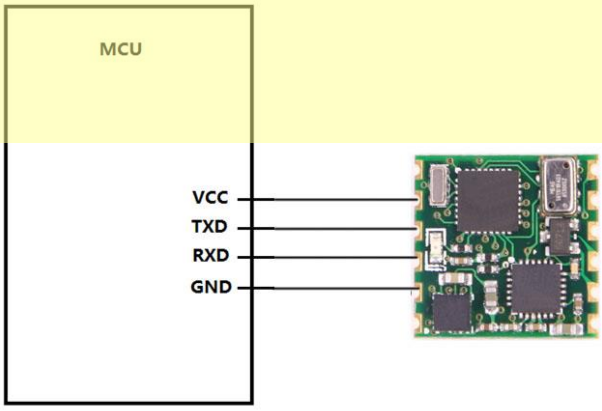
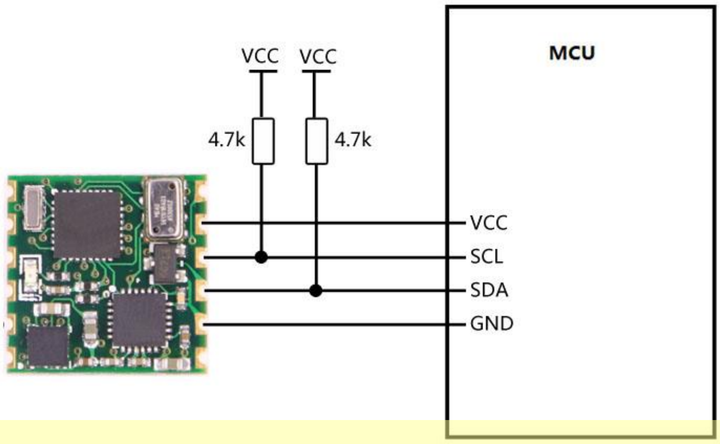
3.2 Connected to MCU



3.3 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.



4 Software Operation

4.1 Installation USB-TTL module driver

First, the module is connected via USB-TTL module to the computer, install the USB-TTL module driver.

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

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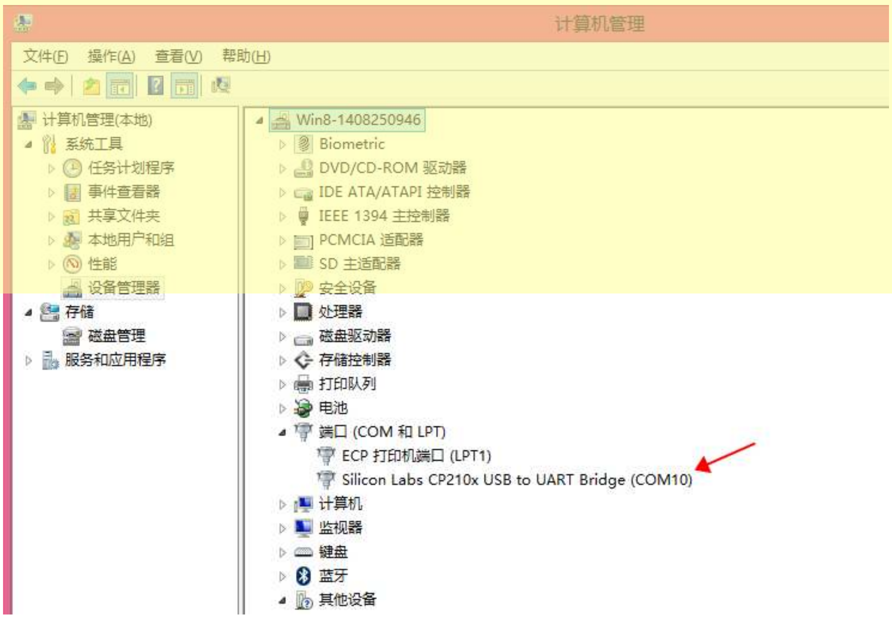
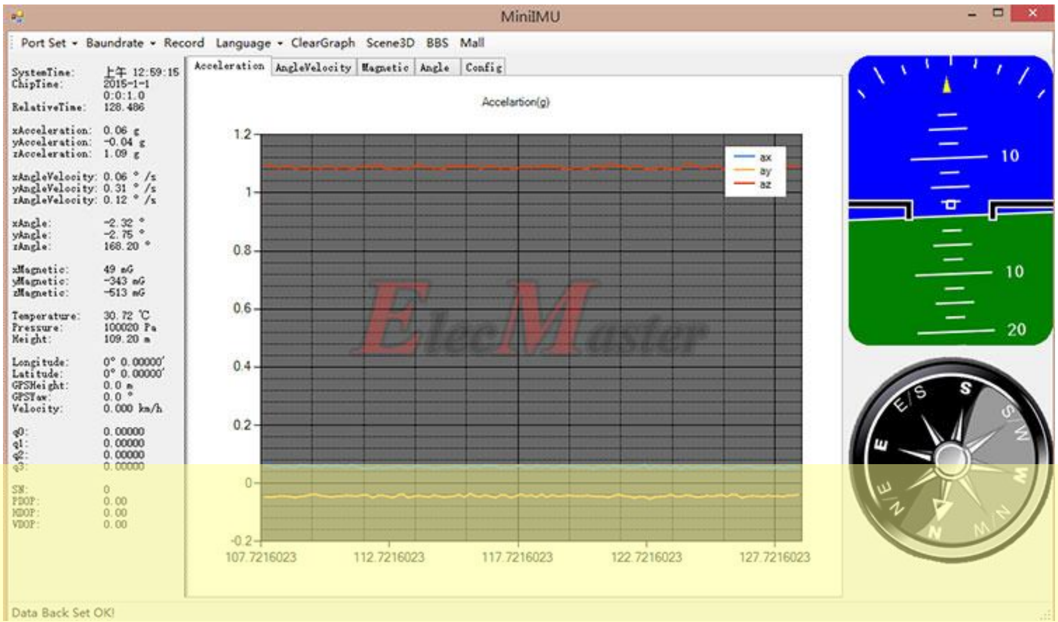


4.2 Open PC program of JY901

Open the PC software, first click on the baud rate menu, select the baud rate module, the

default setting is 9600. Then click Serial port Settings menu, select the Port number the same as the USB-TTL module which query in 2.2. As shown below.



After you open the serial port, if there was no data of the image, check wiring is correct, then confirm the baud rate is set correctly, if you forget the module baud rate is the number, you can click on the menu baud -> Auto. The software will automatically search the baud rate , Prerequisite for automatic search module ,the output rate should be greater than 5Hz, if the rate is too low, the [illegible]atic dete[illegible]on mod[illegible]e w[illegible] not [illegible]rk.If it [illegible]e this, [illegible] try t[illegible] module [illegible] facto[illegible] sett[illegible]gs.

[illegible]ck [illegible] rec[illegible] b[illegible] soft[illegible]are ca[illegible]ord d[illegible]xt fi[illegible] on t[illegible] record [illegible]utt[illegible], a[illegible]hen f[illegible]ord[illegible]g ,need[illegible] c[illegible]k t[illegible] stop [illegible]e will b[illegible]wr[illegible]en to [illegible] h[illegible], the file path to the root directory of the PC program of JY-901 module,the file name is the start time.

Click on the language menu, you can switch the language between Chinese and English

Click clear diagram button, you can clear the data displayed in the chart. When collecting this data with the previous data collection interval for a long time, the chart will update slower, then you can click on the clear button, It will become faster.

Click the three-dimensional buttons, call up the three-dimensional display screen, displaying three-dimensional posture of the module. After starting the three-dimensional model, the default interface is full screen, and to change back to the window mode, you can press the [F] key, if you can not switch, press ctrl + Space to change the input method to English,then press [F]key.

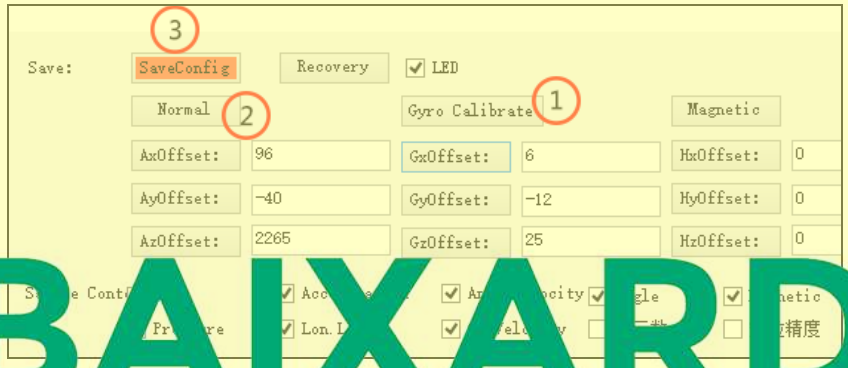
4.3 Module calibration

First, the module needs to be calibrated. Calibration module includes a gyroscope calibration, Magnetic calibration and height set to 0.

Gyroscope calibration measurement is used to remove the gyroscope bias. When the module is still, if the angular speed is not near 0 ° / s, then need to calibrate the gyro. Click the Settings tab, and enter the settings page. Click on "Gyro calibration" button, when GXOFFSET, GYOFFSET, GZOFFSET are stable, then click on "normal" button to complete the calibration. Then click the “Save Config” button to save the bias data to the module's internal FLASH in order to Power-down save. Then at the stationary state, the gyro output will return to 0 ° / s vicinity.

The calibration value of the gyroscope can be set up manually, and the corresponding value is filled in the GxOffset GyOffset GzOffset.

It should be noted that the calibration process is not applied to acceleration. Normally it is no need . Advanced users can manually use set bias acceleration. It is the same as gyro calibration method .



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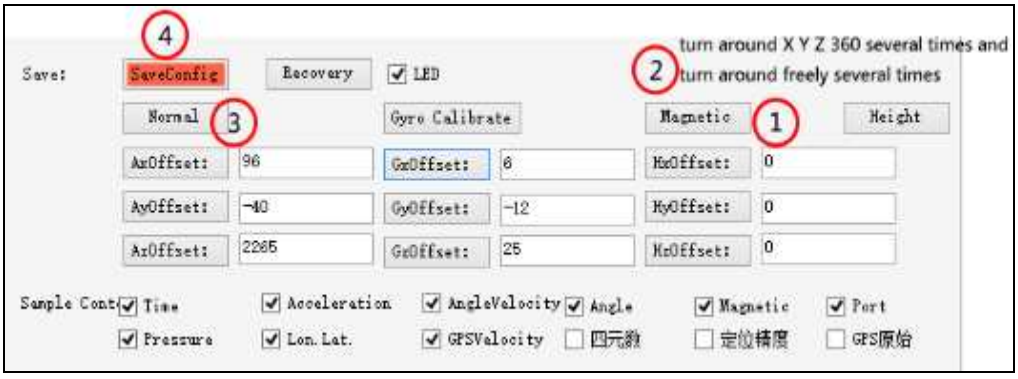
Magnetic field sensor calibration for the removal of bias. Generally there will be magnetic error in the when manufactured, if not calibration, measurement errors will bring great impact on angle measurement accuracy. During calibration, first connect the module and the computer, the module is placed in a place where far away from magnetic interference, then open the PC software. Click the Settings tab, and enter the settings page. Click on "magnetic" button, rotate around X-axis 360 ° several times, and then turn around the Y-axis 360 ° several times, and then turn around the Z-axis 360 ° several times, then freely rotate a few times, when HxOffset, HyOffset, HzOffset are still, and then click on "normal " button to complete the calibration. Then click the “Save Config” button to save the bias data to the module's internal FLASH in order to power-down save. Thereafter, the angle will be accurate.



Calibration of the magnetic field can also be manually set, after input value, click on the

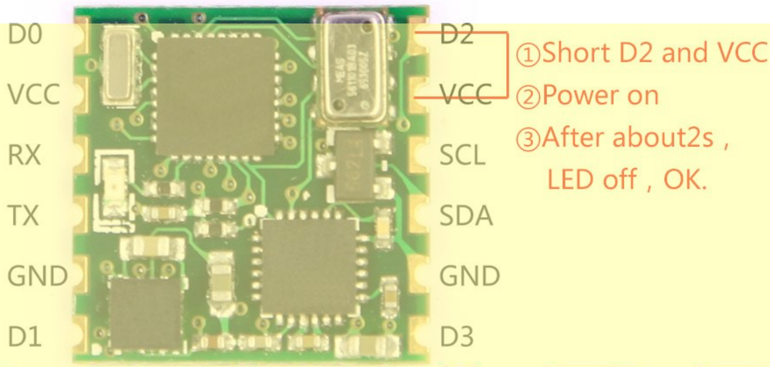
button on HxOffset to set the X axis magnetic bias, empathy click HyOffset can set the Y-axis magnetic bias.

Zero height is the height of module which can be setted to 0. JY-901B type has the function .The height of the output is calculated based on the pressure,so it is only for reference. height set to 0 operation is the current barometric pressure value as a zero height calculation.

4.4 Restore factory settings

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 : [illegible]01 module co[illegible]ed to a [illegible] a USB-TTL [illegible]dule, click the [illegible] tab, click 'Recovery', after [illegible]store factory settings, need [illegible]art the module again. ([illegible] method [illegible]es advance knowledge [illegible] know ba[illegible] rate of the module, if the [illegible]ate does not match the command will not take effect, try using a short-circuit recovery method)

4.5 Setting output content

Data output can be customized according to user needs, click on the Settings tab which needs to be output. After the setup is complete, click the Save Configuration button, otherwise settings will be lost after power-down content.

When power on, the time of the module is January 1, 2015 0: 0: 0. If you connect the GPS module, the time of the module is the GPS time. Note that GPS time is eight hours later than Beijing.

Pressure data is only equipped in JY-901B-type with pressure sensors.

When connect to GPS module successfully, and D1 expansion port function module setted to GPSRX , the PC program can get the latitude and longitude and ground speed information..

4.6 Set return rate

The default return rate is 10Hz, the return rate can reach up to 200Hz. To save the settings when power down, need to click Save Configuration button . if the output data is too much, at the same time communication baud rate is too low, it could not transfer so much data, the module will automatically change the output frequency.

4.7 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.

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

4.8 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.

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

4.9 Set the GPS baud rate

The default GPS baud rate is 9600. Change the IIC address only when the module connect to PC program successfully, and choose the GPS baud rate in the drop box and click the “change” button.

Note: The GPS baud rate of the module will not be changed immediately, and it will take effect when the module restart.

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4.10 Set Extended Mode

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.

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。

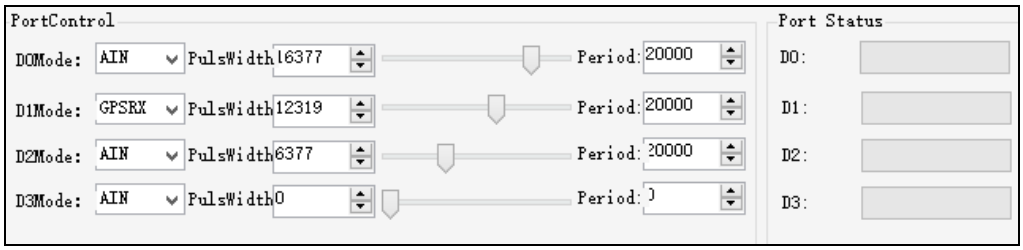
For digital input mode，if the voltage is high，DxStatus=1，else，DxStatus=0。

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.



4.11 Set LED

In some special cases, the user may not need to make the module's LED lights flashing, you can turn off the LED lamp by clicking on the LED button. For power saving settings, click the save configuration button.

5 Serial 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

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5.1 Module to PC protocol:

5.1.1 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<<8)|msL)

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

5.1.2 Acceleration output：

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

Calculate formula：

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

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

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

Temperature calculated formular：

T=((TH<<8)|TL) /100 ℃

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<<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.

5.1.3 Angular velocity output：

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

Calculated formular：

w_x=((wxH<<8)|wxL)/32768*2000(°/s)

w_y=((wyH<<8)|wyL)/32768*2000(°/s)

w_z=((wzH<<8)|wzL)/32768*2000(°/s)

Temperature calculated formular：

((TH<<8)|TL) /100 ℃

Checksum：

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

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5.1.4 Angle Output：

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

Calculated formular：

Roll（x axis）Roll=((RollH<<8)|RollL)/32768*180(°)

Pitch（y axis）Pitch=((PitchH<<8)|PitchL)/32768*180(°)

Yaw（z axis）Yaw=((YawH<<8)|YawL)/32768*180(°)

Temperature calculated formular：

T=((TH<<8)|TL) /100 ℃

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 ±90