The **GY953** module

User Manual V2.0

Overview

The GY953 is a low cost AHRS module.
The working voltage of 3-5v low power consumption, small size.
The working principle, is by the gyroscope and
Acceleration transmission, magnetic field sensors by data fusion
The algorithm finally get direct angle data.
This module, there are two ways to read the data, i.e.
Serial (TTL level) or SPI (4 lines)
The means of communication. The products of high precision, high stability.
To obtain accurate angle at any position,
The serial baud rate with 9600bps and 115200bps
A continuous output and ask the output in two ways,
To adapt to different working environment.
Connected with the single chip microcomputer and computer all
(1), small size
(2), high performance price ratio
(3), serial communication format
(4), SPI communication format
Three, product application
(1), handheld instrumentation
(2), robot navigation, positioning
(3), sailing aeromodelling system
(4), the balance of the car
(5), antenna elevation positioning

Pins

Pin1 VCC power + (3v-5v)

Pin 2 GND power supply

Pin3 TX serial data transmission

Pin 4 RX serial data receiver

Pin 5 SWD for internal use, do not need to connect, hanging

Pin 6 SWC for internal use, do not need to connect, hanging

Pin 7 B0 for internal use, do not need to connect, hanging

Pin 8 INT data interrupt pin, the output

Pin 9 MOSI SPI data

Pin 10 MISO SPI data

Pin 11 SCK SPI clock

Pin 12 CS SPI chip select

Byte2 0x15 0x25 0x35 0x45 0X55 0x65 0x75 0x85

Meaning: acceleration

The original number of gyroscope

The original number of magnetometer

The original number of Euler angle

Data retention

No four elements

Data sensor

Degree, frequency sensor

Range

Communication protocol

Serial port

(1), serial port communication parameters (the default baud rate value of 115200 BPs, through the software setting)

The baud rate: 9600 BPS parity bits: N data bits: 8 stop bit: 1

The baud rate: 115200 BPS parity bits: N data bits: 8 stop bit: 1

(2), the format of the output module, each frame contains 11-13 bytes (sixteen m):

The.Byte0: 0x5A frame head logo

The.Byte1: 0x5A frame head logo

The.Byte2: 0X45 data type of the frame (reference meaning description)

The.Byte3: 0x06 data volume (6 following 3 data groups as an example)

The.Byte4: 0x00~0xFF data of 1 high 8

The.Byte5: 0x00~0xFF data of 1 low 8

The.Byte6: 0x00~0xFF data of 2 high 8

The.Byte7: 0x00~0xFF data of 2 low 8

The.Byte8: 0x00~0xFF data of 3 high 8

.Byte9: 0x00~0xFF data of 3 low 8

The.Byte10: 0x00~0xFF checksum (front of data accumulation and, leaving only the lower 8 bits)

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(3), the data calculation method

Euler angle calculation method: angle = high 8 <<8| low 8 (results for the actual angle multiplied by 100)

Example: a frame data

<0x5A -0x5A -0x45-0x06 -0x00-0x64-0x03-0XE8-0x27-0x10-0x85>

Representation of Euler angle: Roll=1.00 degrees, Pitch=10.00 degrees, Yaw=100.00 degrees

The calculation method of gyro magnetic acceleration: original data the original data = high 8 <<8| low 8

Example: a frame data

<0x5A -0x5A -0x15-0x06 -0x00-0x64-0x03-0xE8-0x27-0x10-0x55>

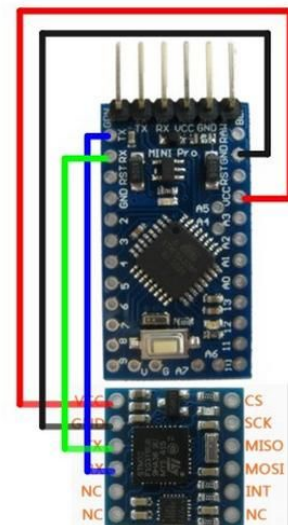That acceleration of original data:

0x0064, Y=0x03E8, Z= 0x2710 X=

Calculation method of four elements: data = high 8 <<8| low 8 (results for actual multiplied by 10000)

Example: a frame data

<0x5A -0x5A -0x65-0x08 -0x00-0x64-0x03-0xE8-0x03-0xE8-0x03-0xE8-0x46>

Said the four element data:

Q0=0.01, q1=0.1, q2=0.1, q3=0.1

(4), by an external controller command byte, sent to the GY953 module (sixteen m)

1, the frame header: 0xa5

Instruction format: frame head + Command + checksum (such as automatic reading of Euler angle instruction =0xa5+0x45+ checksum and 8bit)

2, the command instruction:

The serial baud rate setting instruction: (after each modification need to power on the entry into force, with the power down save)

0xa5+0xaf+0x54------------------115200 (default value)

0xa5+0xae+0x53------------------9600

The sensor configuration instructions:

0xa5+0x51+0x F6----------------ON/OFF accelerometer sensor

0xa5+0x52+0x F7----------------ON/OFF gyro sensor

0xa5+0x53+ 0x F8----------------ON/OFF magnetic field sensor

0xa5+0x57+ 0x FC---------------- plus the gyro calibration, calibration data automatic storage

The 0xa5+0X58+0x FD---------------- field calibration, calibration data automatic storage

0xa5+0X59+0x FE---------------- restore factory settings (after each modification need to electric force)

0xa5+0xa4+ 0x 49---------------- data output rate of 50Hz

0xa5+0xa5+ 0x 4A---------------- data output rate of 100Hz

0xa5+0xa6+ 0x 4B---------------- data output rate of 200Hz

Automatic output order: (with switch function, the first transmission to open, second send off):

Acceleration of 0xa5+0x15+0xBA---------------- raw data

The original data of 0xa5+0x25+0xCA---------------- gyroscope

A magnetic field of 0xa5+0x35+0xDA---------------- raw data

0xa5+0x45+0xEA ---- the Euler angles (default 50HZ)

0xa5+0x55+0xFA ---- Euler angle character form (with serial assistant selection character display)

0xa5+0x65+0x0A ---- four yuan number

The query output instruction:

The accuracy of 0xa5+0x75+0x1A ---- three sensor, the output frequency

0xa5+0x85+0x2A ---- obtain gyroscope range, plus range, the magnetic field range

0xa5+0x95+0x3A ---- Euler angle

0xa5+0xb5+0x5A ---- four yuan number

0xa5+0xc5+0x6A ---- raw accelerometer data

0xa5+0xd5+0x7A ---- gyro raw data

0xa5+0xe5+0x8A ---- the original data of magnetic field

SPI interface

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CR7 1: restore factory settings
CR5 this bit must be 0
CR4 this bit must be 1
CR3 1: the field to start the calibration; automatic data storage
CR2 1: self inspection and calibration of accelerometer and gyro meter; automatic data storage
CR0 this bit must be 1
CR7 this bit must be 0
The default CR6 CR6=1, when CR6=0 is closed magnetic field meter sensor, 1 open
The default CR5 CR5=1, when CR5=0 is off the gyro sensor, 1 open
The default CR4 CR4=1, when CR4=0 is closed and meter sensor, 1 open
CR3 this bit must be 1
CR2 to CR0 set the data output rate: 3:50hz, 4:100hz, 5:200hz
CR2 CR1 CR0 data output rate
011 50Hz (default)
100 100Hz
101 200Hz
ACC_X_L D7-D0
0x04 X acceleration low 8 bits of data
B control register CR7 CR6 CR5 CR4 CR3 CR2 CR1 CR0
0x02 (write / read) delivered 001 CC self 01
ACC_X_H D15-D8
0x03 X axis acceleration and high 8 bit data
ACC_Y_H D15-D8
0x05 Y axis acceleration and high 8 bit data

COMPASS_Z_H D15-D8
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ROLL_H D15-D8
0x15 roll angle high 8 bit data
PITCH_H D15-D8
0x17 pitch high 8 bit data
YAW_H D15-D8
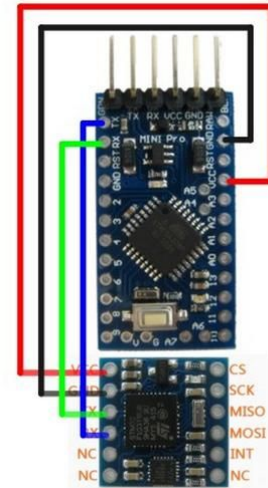0x19 heading angle high 8 bit data
Q0_H D15-D8
0x1B four element Q0 high 8 bit data
Q1_H D15-D8
0x1D four element Q1 high 8 bit data
Q2_H D15-D8
0x1F four element Q2 high 8 bit data

Q0_L D7-D0
0x1C four element Q0 low 8 bits of data
ROLL_L D7-D0
0x16 roll angle the low 8 bits of data
PITCH_L D7-D0
0x18 pitch low 8 bits of data
YAW_L D7-D0
0x1A heading lower 8 bits data
COMPASS_Z_L D7-D0
0x14 Z shaft magnetic low 8 bits of data
Q1_L D7-D0
0x1E four element Q1 low 8 bits of data
0x13 Z shaft magnetic high 8 bit data
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S7 1: data update, automatic reset after reading
S6 reserves
S5 to S4 to obtain the accelerometer calibration accuracy is highest, lowest, 11: 00
S3 to S2 to obtain the gyro meter calibration accuracy, the highest, lowest 11: 00
S1 to S0 to obtain the field calibration accuracy, the highest, lowest 11: 00
S7 to S6 reserves
S5 to S4 0: acceleration range; 2G; 1: 4G 2:; 8g; 3: 16g
S3 to S2 0:+250dps; 1:+500dps; gyroscope scale; 2:+1000dps; 3:+2000dps
S1 to S0 magnetic field range (0.6; 0:14bit t 4915; 1:16bit (selection) selection t 0.15) 4915
Q3_H D15-D8
0x21 four element Q3 high 8 bit data
Q2_L D7-D0
0x20 four element Q2 low 8 bits of data
Q3_L D7-D0
0x22 four element Q3 low 8 bits of data
C status register S6 S5 S4 S7 S3 S2 S1 S0
0x24 new 0 acceleration gyro magnetic field
COMPASS_SUM 8bit: magnetometer data accumulation and 6 data registers (0x0F~0x14)
0x27 COMPASS _X_H+ COMPASS _X_L+... COMPASS _Z_L
RPY_SUM 8bit: Euler angle 6 data register data accumulation and (0x15~0x1A)
0x28 ROLL _H+ ROLL _L+... YAW_L
D status register S6 S5 S4 S7 S3 S2 S1 S0
0x23 00001101
ACC_SUM 8bit: accelerometer data accumulation and 6 data registers (0x03~0x08)
0x25 ACC_X_H+ ACC_X_L+... ACC_Z_L
GYRO _SUM 8bit: gyroscope 6 data register data accumulation and (0x09~0x0E)
0x26 GYRO _X_H+ GYRO _X_L+... GYRO _Z_L
Q_SUM 8bit: four yuan number 8 data registers the data accumulation and (0x1B~0x22)
I 0x29 Q0_H Q0 _L+... Q3_L

Note: the magnetic field accuracy, can be used as magnetic field calibration complete flag

Methods of using module

1, module of data update frequency:
The output frequency is 50Hz by default, such as the need for higher output frequency, with the corresponding serial port or SPI please corresponding instruction
The configuration, please in the module initialization is successful, the module initialization is successful, the indicating lamp will light up, interrupt pin appear on the
L update along the existing data represents a module, this time also represents a module has been initialized, see specific incidental reference program.
2, data output module:
Please users try to interrupt pin reads data after the rising edge updates in the data. A large amount of data read in serial, please
Calculation of a good serial data transmission time, please try to ensure that the data transmission time is less than the data update cycle, to avoid data transmission
Impact of module. If the serial baud rate is 115200, then 115200/1000=115.2, said 1ms can transmit 115.2
Bit, serial transmission of a byte with start and stop bits 10bit, 115.2/10 said on 1ms serial port baud rate
115200 can transmit 11.52 bytes, the module of ACC, GYRO, MAG, RPY frame data are 11 bytes,
That is a data frame transmission need to 1ms, if the frequency of update module for 50Hz (20ms update), then the user in a
An update cycle can output all data frames; if 100Hz (10ms update), users can output all the number
According to the frame; if 200Hz (5ms update), users can output four data frame, because the number of serial data four yuan
The frame consists of 13 bytes, the need to 1.12ms and data processing module itself also needs time, so the proposal in the baud rate of 115200,
Data update frequency is 200Hz, a data update user period output data frame as the 3 best. The baud rate
9600, please users with corresponding calculations.

The transmission speed of SPI can be simply calculated in accordance with the SPI clock, if the SPI clock frequency is 125Khz, a clock transmission 1bit,

The 1ms can transmit 15.62 bytes of data, the module consists of 41 registers (41 bytes), 41/15.62 = 2.62ms,

So SPI data read time less than the highest periodic update data module (5ms), you can read all the register.

Module serial port and SPI data output are check and output, serial port for frame check and output, SPI is the register number

According to the accumulation and the output, the user can receive in the data, do the check and the corresponding test, it can avoid the data transmission by the stem

Transmission error disturbance generated (refer to attached program).

4, restore factory settings:

Send the instruction after the restore factory settings, module will clear the calibration data preservation, MCU needs to reset force.

5, module three sensor status

The module comprises a gyro sensor, accelerometer and magnetometer, if the user does not need to use the heading angle, can send

Send corresponding commands will be closed magnetic sensor. The module does not support all the sensor off, default of three sensors are on.

6, plus the gyro calibration:

The accelerometer and gyroscope itself may exist error, have a certain influence on the accuracy and precision of the pitch, roll angle,

Therefore, before use of accelerometer gyro calibration, avoid the error caused by the sensor.

Calibration method:

As far as possible to ensure that module level still placed, and then send the instructions (by PC send calibration instructions), wait for

Angle stability after can, after calibration can check the calibration precision, when the accelerometer and gyro calibration accuracy is 3 indicates plus

Gyro calibration is successful.

7, the magnetic field calibration:

Due to the use of the module environment around the magnetic field complex, have a certain influence on the accuracy of course angle, so before use,

The need for field calibration of module, avoid the influence of the environment on the module.

Calibration method:

Please do not place objects in the surrounding magnetic large calibration module, module level after placement, sending calibration instructions (through

Host computer sends instruction), this calibration module indicator light is off, the magnetic field calibration accuracy will be set to 0, pick up the module are slowly around the

X, Y, Z (i.e., left and right, before and after in situ) three axis around, until the indicator lights up, completion of calibration, calibration precision of magnetic field will be 3,

The user can send corresponding instructions to check the calibration accuracy. If the calibration, the indicating lamp has not been lit, or use the module, magnetic

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Field calibration accuracy is 0, please see the module users around whether there exist hard iron or magnetic objects.

Note: This module has the ability to automatically detect the surrounding magnetic field, if there exist large objects with magnetic, magnetic field calibration module

Accuracy will be set at 0, the module course angle will appear error. When the module is far away from the magnetic object, magnetic field calibration precision module

Recovery after calibration accuracy 3, this time heading angle will resume.

8, sensor

Acceleration measuring range module for 2G gyroscope; +2000dps; magnetic field range: range: 4915 t selection

The end of seven,

(1), module power on self correction, need to keep more than 3 seconds rest state, is not recommended to take module by hand

(2), module with magnetometers, as far as possible from the iron, magnet, electromagnetic field interference, etc..

(3), the angle of Euler angle as the universal lock problem, roll, pitch will influence each other in 90 degrees when.

(4), I/O module is the TTL level, can be directly connected with the serial interface, can be directly and

PL2303, CH340, FT232 and other chips are connected, but not with the computer serial port directly connected to nine.

Addition :

ARDUINO SPI CONNECT
ARDUINO serial port terminal wiring diagram