Modbus Communication

Instructions for use：

The serial port sending command must be completed within 10S, otherwise it will be automatically locked. In order to avoid automatic locking, the following steps can be performed first.

1.Enter the unlock command

2. Enter the command that needs to modify or read the data

3. Save the command

Register

ADDR (Hex)	ADDR (Dec)	REGISTER NAME	FUNCTION	SERIAL I/F	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
00	00	SAVE	save/reboot/ reset	R/W	SAVE[15:0]															
01	01	CALSW	Calibration mode	R/W													CALSW[3:0]			
04	04	BAUD	Serial port baud rate	R/W													BAUD[3:0]			
05	05	AXOFFSET	Acceleration X zero bias	R/W	AXOFFSET[15:0]															
06	06	AYOFFSET	Acceleration Y zero bias	R/W	AYOFFSET[15:0]															
07	07	AZOFFSET	Acceleration Z zero bias	R/W	AZOFFSET[15:0]															

08	08	GXOFFSET	Angular velocity X zero bias	R/W	GXOFFSET[15:0]
09	09	GYOFFSET	Angular velocity Y zero bias	R/W	GYOFFSET[15:0]
0A	10	GZOFFSET	Angular velocity Z zero bias	R/W	GZOFFSET[15:0]
0B	11	HXOFFSET	Magnetic field X zero bias	R/W	HXOFFSET[15:0]
0C	12	HYOFFSET	Magnetic field Y zero bias	R/W	HYOFFSET[15:0]
0D	13	HZOFFSET	Magnetic Field Z zero Bias	R/W	HZOFFSET[15:0]
1A	26	IICADDR	Device address	R/W	IICADDR[7:0]
1B	27	LEDOFF	Turn off the LED lights	R/W	LEDOFF
1C	28	MAGRANGX	Magnetic Field X Calibration Range	R/W	MAGRANGX[15:0]
1D	29	MAGRANGY	Magnetic Field Y Calibration Range	R/W	MAGRANGY[15:0]
1E	30	MAGRANGZ	Magnetic Field Z Calibration Range	R/W	MAGRANGZ[15:0]

1F	31	BANDWIDTH	Bandwidth	R/W												BANDWIDTH[3:0]								
20	32	GYRORANGE	Gyroscope range	R/W												GYRORANGE[3:0]								
21	33	ACCRANGE	Acceleration range	R/W												ACCRANGE[3:0]								
22	34	SLEEP	Sleep	R/W																				SLEEP
23	35	ORIENT	Installation direction	R/W																				ORIENT
24	36	AXIS6	algorithm	R/W																				AXIS6
25	37	FILTK	Dynamic filtering	R/W	FILTK[15:0]																			
26	38	GPSBAUD	GPS baud rate	R/W												GPSBAUD[3:0]								
27	39	READADDR	read register	R/W									READADDR[7:0]											
2A	42	ACCFILT	acceleration filter	R/W	ACCFILT[15:0]																			
2E	46	VERSION	version number	R	VERSION[15:0]																			
30	48	YYMM	Year/monthSleep	R/W	MOUTH[15:8]								YEAR[7:0]											
31	49	DDHH	day/time	R/W	HOUR[15:8]								DAY[7:0]											
32	50	MMSS	minutes/seconds	R/W	SECONDS[15:8]								MINUTE[7:0]											
33	51	MS	millisecond	R/W	MS[15:0]																			

34	52	AX	AccelerationX	R	AX[15:0]
35	53	AY	Acceleration Y	R	AY[15:0]
36	54	AZ	Acceleration Z	R	AZ[15:0]
37	55	GX	Angular velocity X	R	GX[15:0]
38	56	GY	Angular velocity Y	R	GY[15:0]
39	57	GZ	Angular velocity Z	R	GZ[15:0]
3A	58	HX	Magnetic FieldX	R	HX[15:0]
3B	59	HY	Magnetic field Y	R	HY[15:0]
3C	60	HZ	Magnetic field Z	R	HZ[15:0]
3D	61	Roll	Roll angle	R	Roll[15:0]
3E	62	Pitch	Pitch angle	R	Pitch[15:0]
3F	63	Yaw	Heading	R	Yaw[15:0]
40	64	TEMP	Temperature	R	TEMP[15:0]
45	69	PressureL	Air pressure low 16 bits	R	PressureL[15:0]
46	70	PressureH	Air pressure high 16 bits	R	PressureH[15:0]
47	71	HeightL	Height lower 16 bits	R	HeightL[15:0]

48	72	HeightH	Height high 16 bits	R	HeightH[15:0]
49	73	LonL	Longitude lower 16 bits	R	LonL[15:0]
4A	74	LonH	Longitude high 16 bits	R	LonH[15:0]
4B	75	LatL	Latitude lower 16 bits	R	LatL[15:0]
4C	76	LatH	Latitude high 16 bits	R	LatH[15:0]
4D	77	GPSHeight	GPS Altitude	R	GPSHeight[15:0]
4E	78	GPSYAW	GPS heading angle	R	GPSYAW[15:0]
4F	79	GPSVL	GPS ground speed low 16 bits	R	GPSVL[15:0]
50	80	GPSVH	GPS ground speed high 16 bits	R	GPSVH[15:0]
51	81	q0	Quaternion 0	R	q0[15:0]
52	82	q1	Quaternion 1	R	q1[15:0]
53	83	q2	Quaternion 2	R	q2[15:0]
54	84	q3	Quaternion 3	R	q3[15:0]
55	85	SVNUM	Number of satellites	R	SVNUM[15:0]
56	86	PDOP	Position accuracy	R	PDOP[15:0]

57	87	HDOP	Horizontal accuracy	R	HDOP[15:0]			
58	88	VDOP	vertical accuracy	R	VDOP[15:0]			
59	89	DELAYT	Alarm signal delay	R/W	DELAYT[15:0]			
5A	90	XMIN	X-axis angle alarm minimum value	R/W	XMIN[15:0]			
5B	91	XMAX	X-axis angle alarm maximum value	R/W	XMAX[15:0]			
5D	93	ALARMPIN	Alarm Pin Mapping	R/W	X-ALARM[15:12]	X+ALARM[11:8]	Y-ALARM[7:4]	Y+ALARM[3:0]
5E	94	YMIN	Y-axis angle alarm minimum value	R/W	YMIN[15:0]			
5F	95	YMAX	Y-axis angle alarm maximum value	R/W	YMAX[15:0]			
61	97	GYROCALITHR	Gyro Still Threshold	R/W	GYROCALITHR[15:0]			
62	98	ALARMLEVEL	Angle alarm level	R/W				ALARMLEVEL[3:0]
63	99	GYROCALTIME	Gyro auto calibration time	R/W	GYROCALTIME[15:0]			

68	104	TRIGTIME	Alarm continuous trigger time	R/W	TRIGTIME[15:0]										
69	105	KEY	unlock	R/W	KEY[15:0]										
6A	106	WERROR	Gyroscope change value	R	WERROR[15:0]										
6B	107	TIMEZONE	GPS time zone	R/W									TIMEZONE[7:0]		
6E	110	WZTIME	Angular velocity continuous rest time	R/W	WZTIME[15:0]										
6F	111	WZSTATIC	Angular velocity integral threshold	R/W	WZSTATIC[15:0]										
74	116	MODDELAY	485 data response delay	R/W											
79	121	XREFROLL	Roll angle zero reference value	R	XREFROLL[15:0]										
7A	122	YREFPITCH	Pitch angle zero reference value	R	YREFPITCH[15:0]										
7F	127	NUMBERID 1	Device No.1-2	R	ID2[15:8]								ID1[7:0]		
80	128	NUMBERID 2	Device No. 3-4	R	ID4[15:8]								ID3[7:0]		

81	129	NUMBERID 3	Device No. 5-6	R	ID6[15:8]	ID5[7:0]
82	130	NUMBERID 4	Device No. 7-8	R	ID8[15:8]	ID7[7:0]
83	131	NUMBERID 5	Device No. 9-10	R	ID10[15:8]	ID9[7:0]
84	132	NUMBERID 6	Device No. 11-12	R	ID12[15:8]	ID11[7:0]

Protocol format

Read Register Format

- Data is sent in hexadecimal, not ASCII.
- Each register address, the number of read registers, and the read data are represented by two bytes. The high and low bits of the register address are represented by ADDRH and ADDRL, the high and low bits of the number of registers to be read are represented by LENH and LENL, and the high and low bits of the read data are represented by DATA1H and DATA1L.
- The last two bits of the read command are standard CRC check bits. It can be calculated using the CRC check digit calculation tool, and the CRC online calculation website.

command send

Modbus address	Function code	Register upper 8 bits	Register lower 8 bits	Read length high 8 bits	Read length lower 8 bits	Check digit high 8 bits	Check digit lower 8 bits
ID	0x03 （read）	ADDRH[15:8]	ADDRL[7:0]	LENH[15:8]	LENL[7:0]	CRCH[15:8]	CRCL[7:0]

Data return

Modbus address	Function code	read length	Data high 8 bits	Data lower 8 bits	Data high 8 bits	Data lower 8 bits	Data high 8 bits	Data lower 8 bits	Check digit high 8 bits	Check digit lower 8 bits
ID	0x03 （read）	LEN[7:0]	DATA1H[15:8]	DATA1L[7:0]	……	……	DATAnH	DATAnL	CRCH[15:8]	CRCL[7:0]

Write Register Format

- Data is sent in hexadecimal, not ASCII.
- For each register address, write data is represented by two bytes. The high and low bits of the register address are represented by ADDRH and ADDRL, and the high and low bits of the written data are represented by DATAH and DATAL.

Command send

Modbus address	Function code	Register upper 8 bits	Register low 8 bits	Data high 8 bits	Data lower 8 bits	Check digit high 8 bits	Check digit lower 8 bits
ID	0x06（write）	ADDRH[15:8]	ADDRL[7:0]	DATAH[15:8]	DATAL[7:0]	CRCH[15:8]	CRCL[7:0]

Data return

Modbus 地址	Function code	Register upper 8 bits	Register low 8 bits	Data high 8 bits	Data lower 8 bits	Check digit high 8 bits	Check digit lower 8 bits
ID	0x06（write）	ADDRH[15:8]	ADDRL[7:0]	DATAH[15:8]	DATAL[7:0]	CRCH[15:8]	CRCL[7:0]

Register Description

All the following examples are commands when the Modbus address is 0x50 (default). If you change the Modbus address, you need to change the address and CRC check bit in the command accordingly.

SAVE（save/reboot/reset）

Register Name: SAVE

Register Address: 0 (0x00)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	SAVE[15:0]	Save: 0x0000 Reboot: 0x00FF Reset: 0x0001

Example：

Send：50 06 00 00 00 FF C4 0B（reboot）

Return：50 06 00 00 00 FF C4 0B

CALSW（Calibration mode）

Register Name: CALSW

Register Address: 1 (0x01)

Read and write direction: R/W

Defaults: 0x0000

Bit	NAME	FUNCTION
15:4		
3:0	CAL[3:0]	To set the calibration mode: 0000(0x00): normal working mode 0001(0x01): Auto adder calibration 0011(0x03): height reset 0100(0x04): Set the heading angle to zero 0111(0x07): Magnetic Field Calibration (Spherical Fitting) 1000(0x08): set angle reference 1001(0x09): Magnetic Field Calibration (Dual Plane Mode)

Example:

Send: 50 06 00 01 00 04 D4 48 (the heading angle is set to zero)

Return: 50 06 00 01 00 04 D4 48

BAUD（Serial port baud rate）

Register Name: BAUD

Register Address: 4 (0x04)

Read and write direction: R/W

Default: 0x0002

Bit	NAME	FUNCTION
15:4		
3:0	BAUD[3:0]	Set the serial port baud rate: 0001(0x01): 4800bps 0010(0x02): 9600bps 0011(0x03): 19200bps 0100(0x04): 38400bps 0101(0x05): 57600bps 0110(0x06): 115200bps 0111(0x07): 230400bps 1000(0x08): 460800bps (only supported by WT931/JY931/HWT606/HWT906) 1001(0x09): 921600bps (only supported by WT931/JY931/HWT606/HWT906)

Example：Send：50 06 00 04 00 06 45 88（Set the serial port baud rate:115200）

Return：50 06 00 04 00 06 45 88

AXOFFSET~HZOFFSET（Zero offset setting）

Register Name: AXOFFSET~HZOFFSET

Register Address: 5~13 (0x05~0x0D)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	AXOFFSET[15:0]	Acceleration X-axis bias, actual acceleration offset=AXOFFSET[15:0]/10000(g)
15:0	AYOFFSET[15:0]	Acceleration Y-axis bias, actual acceleration offset=AYOFFSET[15:0]/10000(g)
15:0	AZOFFSET[15:0]	Acceleration Z-axis bias, actual acceleration offset=AZOFFSET[15:0]/10000(g)
15:0	GXOFFSET[15:0]	Angular velocity X-axis bias, actual angular velocity offset=GXOFFSET[15:0]/10000(°/s)
15:0	GYOFFSET[15:0]	Angular velocity Y-axis bias, actual angular velocity offset=GYOFFSET[15:0]/10000(°/s)
15:0	GZOFFSET[15:0]	Angular velocity Z-axis bias, actual angular velocity offset=GZOFFSET[15:0]/10000(°/s)
15:0	HXOFFSET[15:0]	Magnetic field X-axis zero bias
15:0	HYOFFSET[15:0]	Magnetic field Y axis zero bias
15:0	HZOFFSET[15:0]	Magnetic field Z axis zero bias

Example: Send: 50 06 00 05 03 E8 94 F4 (set acceleration X-axis zero bias 0.1g),
0x03E8=1000, 1000/10000=0.1(g)

Return: 50 06 00 05 03 E8 94 F4

IICADDR（Device address）

Register Name: IICADDR

Register Address: 26 (0x1A)

Read and write direction: R/W

Default: 0x0050

Bit	NAME	FUNCTION
15:8		
7:0	IICADDR[7:0]	Set the device address for I2C and Modbus communication 0x01~0x7F

Example:

Send: 50 06 00 1A 00 02 24 4D (set the device address to 0x02)

Return: 50 06 00 1A 00 02 24 4D

LEDOFF（Turn off the LED lights）

Register Name: LEDOFF

Register Address: 27 (0x1B)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:1		
0	LEDOFF	1: Turn off the LED light 0: Turn on the LED light

Example:

Send: 50 06 00 1B 00 01 35 8C (turn off the LED light)

Return: 50 06 00 1B 00 01 35 8C

MAGRANGX~MAGRANGZ（Magnetic Field Calibration Range）

Register Name: MAGRANGX~MAGRANGZ

Register Address: 28~30 (0x1C~0x1E)

Read and write direction: R/W

Default: 0x01F4

Bit	NAME	FUNCTION
15:0	MAGRANGX[15:0]	Magnetic field calibration X-axis range
15:0	MAGRANGY[15:0]	Magnetic field calibration Y-axis range
15:0	MAGRANGZ[15:0]	Magnetic field calibration Z-axis range

Example:

Send: 50 06 00 1C 01 F4 45 9A (set the magnetic field calibration X-axis range to 500)

Return: 50 06 00 1C 01 F4 45 9A

BANDWIDTH（Bandwidth）

Register Name: BANDWIDTH

Register Address: 31 (0x1F)

Read and write direction: R/W

Default: 0x0004

Bit	NAME	FUNCTION
15:4		
3:0	BANDWIDTH[3:0]	Set Bandwidth 0000(0x00): 256Hz 0001(0x01): 188Hz 0010(0x02): 98Hz 0011(0x03): 42Hz 0100(0x04): 20Hz 0101(0x05): 10Hz 0110(0x06): 5Hz

Example:

Send: 50 06 00 1F 00 01 74 4D (set the bandwidth to 188Hz)

Return: 50 06 00 1F 00 01 74 4D

GYRORANGE（Gyroscope range）

Register Name: GYRORANGE

Register Address: 32 (0x20)

Read and write direction: R/W

Default: 0x0003

Bit	NAME	FUNCTION
15:4		
3:0	GYRORANGE[3:0]	Set the gyro range 0011(0x03): 2000°/s The default is 2000°/s, fixed and cannot be set

Example:

Send: 50 06 00 20 00 03 C5 80 (set the gyro range to 2000°/s)

Return: 50 06 00 20 00 03 C5 80

ACCRANGE（Accelerometer range）

Register Name: ACCRANGE

Register Address: 33 (0x21)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:4		
3:0	ACCRANGE[3:0]	Set the accelerometer range 0000(0x00): ±2g 0011(0x03): ±16g This parameter cannot be set. The internal adaptive acceleration range of the product will automatically switch to 16g when the acceleration exceeds 2g.

Example:

Send: 50 06 00 21 00 03 94 40 (set the accelerometer range to 16g)

Return: 50 06 00 21 00 03 94 40

SLEEP

Register Name: SLEEP

Register Address: 34 (0x22)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:1		
0	SLEEP	set hibernate 1(0x01): sleep Any serial port data, can wake up

Example:

Send: 50 06 00 22 00 01 E5 81 (go to sleep)

Return: 50 06 00 22 00 01 E5 81

ORIENT（Installation direction）

Register Name: ORIENT

Register Address: 35 (0x23)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:1		
0	ORIENT	Set the installation direction 0 (0x00): horizontal installation 1(0x01): vertical installation (the Y-axis arrow of the coordinate axis must be upward)

Example:

Send: 50 06 00 23 00 01 B4 41 (set vertical installation)

Return: 50 06 00 23 00 01 B4 41

AXIS6（algorithm）

Register Name: AXIS6

Register Address: 36 (0x24)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:1		
0	AXIS6	set algorithm 0(0x00): 9-axis algorithm (magnetic field solution navigation angle, absolute heading angle) 1(0x01): 6-axis algorithm (integral solution navigation angle, relative heading angle)

Example:

Send: 50 06 00 24 00 01 05 80 (set the 6-axis algorithm mode)

Return: 50 06 00 24 00 01 05 80

FILTK（K value filter）

Register Name: FILTK

Register Address: 37 (0x25)

Read and write direction: R/W

Default: 0x001E

Bit	NAME	FUNCTION
15:0	FILTK[15:0]	Range: 1~10000, the default is 30 (it is not recommended to modify, once modified, if the angle does not meet the requirements for use, please modify it to 30) The smaller the FILTK[15:0], the stronger the seismic performance and the weaker the real-time performance. The larger the FILTK[15:0], the weaker the seismic performance and the stronger the real-time performance.

Example:

Send: 50 06 00 25 00 1E 15 88 (set K value filter to 30)

Return: 50 06 00 25 00 1E 15 88

ACCFILT（Acceleration filtering）

Register Name: ACCFILT

Register Address: 42 (0x2A)

Read and write direction: R/W

Default: 0x01F4

Bit	NAME	FUNCTION
15:0	ACCFILT[15:0]	Range: 1~10000, the default is 500 (it is not recommended to modify, once modified, if the angle does not meet the requirements for use, please modify it to 500) The smaller the ACCFILT[15:0], the stronger the seismic performance and the weaker the real-time performance. The larger the ACCFILT[15:0], the weaker the seismic performance and the stronger the real-time performance. This parameter is an empirical value, which needs to be debugged according to different environments. In the tractor environment, ACCFILT[15:0] can be adjusted to 100, because the vibration of the tractor is serious and the anti-vibration performance needs to be improved

Example: Send: 50 06 00 2A 01 F4 A5 94 (set acceleration filter 500)

Return: 50 06 00 2A 01 F4 A5 94

VERSION（Version number）

Register Name: VERSION

Register Address: 46 (0x2E)

Read and write direction: R

Default: none

Bit	NAME	FUNCTION
15:0	VERSION[15:0]	Different products, different version numbers

Example:

Send: 50 03 00 2E 00 01 E9 82 (read version number)

Return: 50 03 00 02 VH VL CRCH CRCL

VERSION[15:0]=(short)(((short)VH<<8)|VL)

YYMM~MS（On-chip time）

Register Name: YYMM~MS

Register address: 48~51 (0x30~0x33)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:8	YYMM[15:8]	mouth
7:0	YYMM[7:0]	year
15:8	DDHH[15:8]	hour
7:0	DDHH[7:0]	day
15:8	MMSS[15:8]	second
7:0	MMSS[7:0]	minute
15:0	MS[15:0]	millisecond

Example: Send: 50 06 00 30 03 16 05 7A (set year 22-03)

Return: 50 06 00 30 03 16 05 7A

Send: 50 06 00 31 09 0C D3 D1 (set date 12-09)

Return: 50 06 00 31 09 0C D3 D1

Send: 50 06 00 32 3A 1E B7 2C (set minutes and seconds 30:58)

Return: 50 06 00 32 3A 1E B7 2C

Send: 50 06 00 33 01 F4 74 53 (set milliseconds 500)

Return: 50 06 00 33 01 F4 74 53

AX~AZ（Acceleration）

Register Name: AX~AZ

Register address: 52~54 (0x34~0x36)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	AX[15:0]	Acceleration X=AX[15:0]/32768*16g (g is the acceleration of gravity, preferably 9.8m/s2)
15:0	AY[15:0]	Acceleration Y=AY[15:0]/32768*16g (g is the acceleration of gravity, preferably 9.8m/s2)
15:0	AZ[15:0]	Acceleration Z=AZ[15:0]/32768*16g (g is the acceleration of gravity, preferably 9.8m/s2)

Example:

Send: 50 03 00 34 00 03 49 84 (read three-axis acceleration)

Return: 50 03 06 AXH AXL AYH AYL AZH AZL CRCH CRCL

AX[15:0]=((short)AXH <<8)|AXL;

AY[15:0]=((short)AYH <<8)|AYL;

AZ[15:0]=((short)AZH <<8)|AZL;

GX~GZ（Angular velocity）

Register Name: GX~GZ

Register address: 55~57 (0x37~0x39)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	GX[15:0]	Angular velocity X=GX[15:0]/32768*2000°/s
15:0	GY[15:0]	Angular velocity Y=GY[15:0]/32768*2000°/s
15:0	GZ[15:0]	Angular velocity Z=GZ[15:0]/32768*2000°/s

Example:

Send: 50 03 00 37 00 03 B9 84 (read triaxial angular velocity)

Return: 50 03 06 GXH GXL GYH GYL GZH GZL CRCH CRCL

GX[15:0]=((short)GXH <<8)|GXL;

GY[15:0]=((short)GYH <<8)|GYL;

GZ[15:0]=((short)GZH <<8)|GZL;

HX~HZ（Magnetic field）

Register name: HX~HZ

Register Address: 58~60 (0x3A~0x3C)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	HX[15:0]	Magnetic field X=HX[15:0] (unit: LSB)
15:0	HY[15:0]	Magnetic field Y=HY[15:0] (unit: LSB)
15:0	HZ[15:0]	Magnetic field Z=HZ[15:0] (unit: LSB)

Example:

Send: 50 03 00 3A 00 03 28 47 (reading the three-axis magnetic field)

Return: 50 03 06 HXH HXL HYH HYL HZH HZL CRCH CRCL

HX[15:0]=((short)HXH <<8)|HXL;

HY[15:0]=((short)HYH <<8)|HYL;

HZ[15:0]=((short)HZH <<8)|HZL;

Roll~Yaw（Angle）

Register Name: Roll~Yaw

Register address: 61~63 (0x3D~0x3F)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	Roll[15:0]	Roll angle X=Roll[15:0]/32768*180°
15:0	Pitch[15:0]	Pitch angle Y=Pitch[15:0]/32768*180°
15:0	Yaw[15:0]	Heading angle Z=Yaw[15:0]/32768*180°

Example:

Send: 50 03 00 3D 00 03 99 86 (read three-axis angle)

Return: 50 03 06 RollH RollL PitchH PitchL YawH YawL CRCH CRCL

Roll[15:0]=((short)RollH <<8)|RollL;

Pitch[15:0]=((short)PitchH <<8)|PitchL;

Yaw[15:0]=((short)YawH <<8)|YawL;

TEMP（Temperature）

Register Name: TEMP

Register Address: 64 (0x40)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	TEMP[15:0]	temperature=TEMP[15:0]/100℃

Example:

Send: 50 03 00 40 00 01 88 5F (read chip temperature)

Return: 50 03 02 TEMPH TEMPL CRCH CRCL

TEMP[15:0]=((short)TEMPH <<8)|TEMPL ;

PressureL~HeightH（Air pressure altitude）

Register Name: PressureL~HeightH

Register address: 69~72 (0x45~0x48)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	PressureL[15:0]	Air pressure=((int)PressureH[15:0]<<16)|PressureL[15:0](Pa)
15:0	PressureH[15:0]	
15:0	HeightL[15:0]	Altitude=((int)HeightH[15:0]<<16)|HeightL[15:0](cm)
15:0	HeightH[15:0]	

LonL~LatH（latitude and longitude）

Register Name: LonL~LatH

Register address: 73~76 (0x49~0x4C)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	LonL[15:0]	Lon[31:0]=((int)LonH[15:0]<<16)|LonL[15:0](Pa)
15:0	LonH[15:0]	
15:0	LatL[15:0]	Lat[31:0]=((int)LatH[15:0]<<16)|LatL[15:0](cm)
15:0	LatH[15:0]	

Example:

Send: 50 03 00 49 00 04 98 5E (read latitude and longitude)

Return: 50 03 06 LonL0 LonL1 LonH0 LonH1 LatL0 LatL1 LatH0 LatH1 CRCH CRCL

LonL=((short)LonL0<<8)|LonL1;

LonH=((short)LonH0<<8)|LonH1;

LatL=((short)LatL0<<8)|LatL1;

LatH=((short)LatH0<<8)|LatH1;

The NMEA8013 standard stipulates that the longitude output format of GPS is ddmm.mmmmm (dd is degrees, mm.mmmmm is minutes), and the decimal point is removed from the longitude/latitude output, so the degrees of longitude/latitude can be calculated as follows:

dd=Lon[31:0]/10000000;

dd=Lat[31:0]/10000000;

The longitude/latitude fraction can be calculated like this:

mm.mmmmm=(Lon[31:0]%10000000)/100000; (% means remainder operation)

mm.mmmmm=(Lat[31:0]%10000000)/100000; (% means remainder operation)

GPSHeight~GPSVH（GPS Data）

Register Name: GPSHeight~GPSVH

Register address: 77~80 (0x4D~0x50)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	GPSHeight[15:0]	GPS Altitude=GPSHeight[15:0]/10(m)
15:0	GPSYAW[15:0]	GPS heading=GPSYAW[15:0]/100(°)
15:0	GPSVL[15:0]	GPS ground speed=(((int)GPSVH[15:0]<<16)|GPSVL[15:0])/1000(km/h)
15:0	GPSVH[15:0]	

Example:

Send: 50 03 00 4D 00 04 D9 9F (read GPS data)

Returns: 50 03 06 GPSHH GPSHL GPSYAWH GPSYAWL GPSVL0 GPSVL1 GPSVH0 GPSVH1 CRCH CRCL

GPSHeight=((short)GPSHH <<8)|GPSHL ;

GPSVL=((short)GPSVL1<<8)|GPSVL0 ;

GPSVL=((short)GPSVL0<<8)|GPSVL1 ;

GPSVH=((short)GPSVH0<<8)|GPSVH1 ;

q0~q3（Quaternion）

Register name: q0~q3

Register address: 81~84 (0x51~0x54)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	q0[15:0]	Quaternion 0=q0[15:0]/32768
15:0	q1[15:0]	Quaternion 1=q1[15:0]/32768
15:0	q2[15:0]	Quaternion 2=q2[15:0]/32768
15:0	q3[15:0]	Quaternion 3=q3[15:0]/32768

Example:

send: 50 03 00 51 00 04 18 59 (read quaternion)

Return: 50 03 08 q0H q0L q1H q1L q2H q2L q3H q3L CRCH CRCL

q0[15:0]=((short)q0H <<8)|q0L ;

q1[15:0]=((short)q1H <<8)|q1L ;

q2[15:0]=((short)q2H <<8)|q2L ;

q3[15:0]=((short)q3H <<8)|q3L ;

SVNUM~VDOP（GPS positioning accuracy）

Register Name: SVNUM~VDOP

Register address: 85~88 (0x55~0x58)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	SVNUM[15:0]	Number of GPS satellites = SVNUM[15:0]
15:0	PDOP[15:0]	Position positioning longitude=PDOP[15:0]/100
15:0	HDOP[15:0]	Horizontal positioning longitude=HDOP[15:0]/100
15:0	VDOP[15:0]	Vertical positioning longitude=VDOP[15:0]/100

Example:

Send: 50 03 00 55 00 04 59 98 (read GPS positioning accuracy)

return:50 03 08 SVNUMH SVNUML PDOPH PDOPL HDOPH HDOPL VDOPH VDOPL CRCH CRCL

q0SVNUM15:0]=((short)SVNUMH <<8)|SVNUML;

PDOP[15:0]=((short)PDOPH<<8)|PDOPL ;

HDOP[15:0]=((short)HDOPH<<8)|HDOPL;

VDOP[15:0]=((short)VDOPH<<8)|VDOPL;

DELAYT（Alarm signal delay）

Register Name: DELAYT

Register Address: 89 (0x59)

Read and write direction: R/W

Default: 0x0000

Bit	NAME		FUNCTION
15:0	DELAYT[15:0]		Unit: ms After the angle alarm occurs, the port will generate a corresponding alarm signal. When the alarm disappears, the alarm signal will last for a delay of DELAYT[15:0] before disappearing.

Example:

Send: 50 06 00 59 03 E8 54 E6 (set the alarm signal delay 1000ms)

Return: 50 06 00 59 03 E8 54 E6

XMIN~XMAX（X-axis angle alarm threshold）

Register Name: XMIN~XMAX

Register address: 90~91 (0x5A~0x5B)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	XMIN[15:0]	Set the X-axis angle alarm minimum value X-axis angle alarm minimum value=XMIN[15:0]*180/32768(°)
15:0	XMAX[15:0]	Set the X-axis angle alarm maximum value X-axis angle alarm maximum value=XMAX[15:0]*180/32768(°)

Example:

Send: 50 06 00 5A FC 72 65 7D (set -5 degrees), 0xFC72=-910, -910*180/32768=-5

Return: 50 06 00 5A FC 72 65 7D

Send: 50 06 00 5B 03 8E 75 0C (set 5 degrees), 0x038E=910, 910*180/32768=5

Return: 50 06 00 5B 03 8E 75 0C

The X axis will not alarm between -5°~5°, once it exceeds this range, an alarm will occur

ALARMPIN（Alarm Pin Mapping）

Register Name: ALARMPIN

Register Address: 93 (0x5D)

Read and write direction: R/W

Default: 0x4365

Bit	NAME	FUNCTION
15:12	X-ALARM[15:12]	0001(0x01): D0 0010(0x02): D1 0011(0x03): D2 0100(0x04): D3 0101(0x05): SCL 0110(0x06): SDA
11:8	X+ALARM[11:8]	0001(0x01): D0 0010(0x02): D1 0011(0x03): D2 0100(0x04): D3 0101(0x05): SCL 0110(0x06): SDA
7:4	Y-ALARM[7:4]	0001(0x01): D0 0010(0x02): D1 0011(0x03): D2

		0100(0x04): D3 0101(0x05): SCL 0110(0x06): SDA
3:0	Y+ALARM[3:0]	0001(0x01): D0 0010(0x02): D1 0011(0x03): D2 0100(0x04): D3 0101(0x05): SCL 0110(0x06): SDA
Example: Set X-alarm signal to output on D3 port Set the X+ alarm signal to output at port D1 Set the Y-alarm signal to output on the SCL port Set the Y+ alarm signal to output at the SCL port Example: Send: 50 06 00 5D 42 55 E5 06 Return: 50 06 00 5D 42 55 E5 06		

YMIN~YMAX（Y-axis angle alarm threshold）

Register Name: YMIN~YMAX

Register address: 94~95 (0x5E~0x5F)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	YMIN[15:0]	Set the Y-axis angle alarm minimum value Y axis angle alarm minimum value=YMIN[15:0]*180/32768(°)
15:0	YMAX[15:0]	Set the Y-axis angle alarm maximum value Y-axis angle alarm maximum value=YMAX[15:0]*180/32768(°)

Example:

Send: 50 06 00 5E FC 72 24 BC (set -5 degrees), 0xFC72=-910, -910*180/32768=-5

Return: 50 06 00 5E FC 72 24 BC

Send: 50 06 00 5F 03 8E 34 CD (set 5 degrees), 0x038E=910, 910*180/32768=5

Return: 50 06 00 5F 03 8E 34 CD

The Y axis will not alarm between -5°~5°, once it exceeds this range, an alarm will occur

GYROCALITHR（Gyro Still Threshold）

Register Name: GYROCALITHR

Register Address: 97 (0x61)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	GYROCALITHR[15:0]	Set the gyroscope inactivity threshold: Gyro static threshold=GYROCALITHR[15:0]/1000(°/s)

Example:

Send: 50 06 00 61 00 32 54 40 (set the gyro static threshold to 0.05°/s)

Return: 50 06 00 61 00 32 54 40

When the angular velocity change is less than 0.05°/s and lasts for the time of "GYROCALTIME", the sensor recognizes it as stationary and automatically resets the angular velocity less than 0.05°/s to zero

The setting rule of the static threshold of the gyroscope can be determined by reading the value of the "WERROR" register. The general setting rule is: GYROCALITHR=WERROR*1.2, unit: °/s

This register needs to be used in conjunction with the GYROCALTIME register

ALARMLEVEL（Angle alarm level）

Register Name: ALARMLEVEL

Register Address: 98 (0x62)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:4		
3:0	ALARMLEVEL[3:0]	To set the alarm level: 0000(0x00): Low level alarm (high level when not alarming, low level when alarming) 0001(0x01): High level alarm (low level when not alarming, high level when alarming）

Example:

Send: 50 06 00 62 00 01 E4 55 (set high level alarm)

Return: 50 06 00 62 00 01 E4 55

GYROCALTIME（Gyro auto calibration time）

Register Name: GYROCALTIME

Register Address: 99 (0x63)

Read and write direction: R/W

Default: 0x03E8

Bit	NAME	FUNCTION
15:0	GYROCALTIME[15:0]	Set gyroscope auto-calibration time

Example: Set gyroscope auto-calibration time to 500ms

Send: 50 06 00 63 01 F4 74 42 (set high level alarm)

Return: 50 06 00 63 01 F4 74 42

When the angular velocity change is less than "GYROCALITHR" and lasts for 500ms, the sensor recognizes that it is stationary and automatically resets the angular velocity less than 0.05°/s to zero

This register needs to be used in conjunction with the GYROCALITHR register

TRIGTIME（Alarm continuous trigger time）

Register Name: TRIGTIME

Register Address: 104 (0x68)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	TRIGTIME[15:0]	Set the alarm continuous trigger time

Example: Set the alarm continuous trigger time to 500ms

Send: 50 06 00 68 01 F4 05 80 (set high level alarm)

Return: 50 06 00 68 01 F4 05 80

When the angle alarm occurs, the alarm signal will not be output immediately, and the alarm signal can be output only when the angle alarm lasts for 500ms. This register is used to filter out alarms caused by malfunctions

KEY（Unlock）

Register Name: KEY

Register Address: 105 (0x69)

Read and write direction: R/W

Default: 0x0000

Bit	NAME	FUNCTION
15:0	KEY[15:0]	Unlock register: When performing a write operation, you need to set this register first

Example:

Send: 50 06 00 69 B5 88 22 A1 (unlocked)

Return: 50 06 00 69 B5 88 22 A1

Unlock, write 0xB588 to this register (other values are invalid)

WERROR（Gyroscope change value）

Register Name: WERROR

Register Address: 106 (0x6A)

Read and write direction: R

Default: 0x0000

Bit	NAME	FUNCTION
15:0	WERROR[15:0]	Gyroscope change value=WERROR[15:0]/1000*180/3.1415926(°/s) When the sensor is stationary, the "GYROCALITHR" register can be set by changing this register

TIMEZONE（GPS time zone）

Register Name: TIMEZONE

Register Address: 107 (0x6B)

Read and write direction: R/W

Default: 0x0014

Bit	NAME	FUNCTION
15:8		
7:0	TIMEZONE[7:0]	Set GPS time zone： 00000000(0x0000): UTC-12 00000001(0x0001): UTC-11 00000010(0x0002): UTC-10 00000011(0x0003): UTC-9 00000100(0x0004): UTC-8 00000101(0x0005): UTC-7 00000110(0x0006): UTC-6 00000111(0x0007): UTC-5 00001000(0x0008): UTC-4 00001001(0x0009): UTC-3 00001010(0x000A): UTC-2 00001011(0x000B): UTC-1

		00001100(0x000C): UTC 00001101(0x000D): UTC+1 00001110(0x000E): UTC+2 00001111(0x000F): UTC+3 00010000(0x0010): UTC+4 00010001(0x0011): UTC+5 00010010(0x0012): UTC+6 00010011(0x0013): UTC+7 00010100(0x0014): UTC+8（Default East 8th District） 00010101(0x0015): UTC+9 00010110(0x0016): UTC+10 00010111(0x0017): UTC+11 00011000(0x0018): UTC+12
Example: Send: 50 06 00 6B 00 15 34 58 (set GPS time zone to East 9) Return: 50 06 00 6B 00 15 34 58		

WZTIME（Angular velocity continuous rest time）

Register Name: WZTIME

Register Address: 110 (0x6E)

Read and write direction: R/W

Default: 0x01F4

Bit	NAME	FUNCTION
15:0	WZTIME[15:0]	Angular velocity continuous rest time

Example:

Send: 50 06 00 6E 01 F4 E5 81 (set the angular velocity continuous static time 500ms)

Return: 50 06 00 6E 01 F4 E5 81

When the angular velocity is less than "WZSTATIC" and lasts for 500ms, the angular velocity output is 0, and the Z-axis heading angle is not integrated

This register needs to be used in conjunction with the "WZSTATIC" register

WZSTATIC（Angular velocity integral threshold）

Register Name: WZSTATIC

Register Address: 111 (0x6F)

Read and write direction: R/W

Default: 0x012C

Bit	NAME	FUNCTION
15:0	WZSTATIC[15:0]	Angular velocity integral threshold=WZSTATIC[15:0]/1000(°/s)

Example:

Send: 50 06 00 6F 01 F4 E5 81 (set the angular velocity integration threshold to 0.5°/s)

Return: 50 06 00 6F 01 F4 E5 81

When the angular velocity is greater than 0.5°/s, the Z-axis heading angle starts to integrate the acceleration

When the angular velocity is less than 0.5°/s, and the duration set by the register "WZTIME", the angular velocity output is 0, and the Z-axis heading angle is not integrated

This register needs to be used in conjunction with the "WZTIME" register

MODDELAY（485 Data response delay）

Register Name: MODDELAY

Register Address: 116 (0x74)

Read and write direction: R/W

Default: 0x0BB8

Bit	NAME	FUNCTION
15:0	MODDELAY[15:0]	Set 485 data response delay, default 3000, unit: us

Example:

Send: 50 06 00 74 03 E8 C4 EF (set 485 data response delay 1000us)

Return: 50 06 00 74 03 E8 C4 EF

When the sensor receives the Modbus read command, the sensor delays 1000us and returns data

This register only supports Modbus version of the sensor

XREFROLL~YREFPITCH（Angle zero reference value）

Register Name: XREFROLL~YREFPITCH

Register address: 121~122 (0x79~0x7A)

Read and write direction: R/W

Default: 0x00000

Bit	NAME	FUNCTION
15:0	XREFROLL[15:0]	Roll angle zero reference value=XREFROLL[15:0]/32768*180(°)
15:0	YREFPITCH[15:0]	Pitch angle zero reference value=YREFPITCH[15:0]/32768*180(°)

Example: The current roll angle is 2°, set the roll angle zero, subtract 2°, then XREFROLL[15:0]=2*32768/180=364=0x016C

FFAA 79 6C 01

Example: The current roll angle is 2°, set the roll angle zero, subtract 2°, then XREFROLL[15:0]=2*32768/180=364=0x016C

Send: 50 06 00 79 01 6C 54 2F

Return: 50 06 00 79 01 6C 54 2F

NUMBERID1~NUMBERID6（Device number）

Register Name: NUMBERID1~NUMBERID6

Register address: 127~132 (0x7F~0x84)

Read and write direction: R

Default: none

Bit	NAME	FUNCTION
15:0	NUMBERID1[15:0]	
15:0	NUMBERID2[15:0]	
15:0	NUMBERID3[15:0]	
15:0	NUMBERID4[15:0]	
15:0	NUMBERID5[15:0]	
15:0	NUMBERID6[15:0]	

Device label：WT4200000001