10-axis IMU module communication protocol

LonL~LatH（latitude and longitude）
GPSHeight~GPSVH（GPS data）
q0~q3（quaternion）
SVNUM~VDOP（GPS positioning accuracy）
DELAYT（alarm signal delay）
XMIN~XMAX（X-axis angle alarm threshold）
BATVAL（voltage）
ALARMPIN（alarm pin mapping）
YMIN~YMAX（Y-axis angle alarm threshold）
GYROCALITHR（Gyro Still Threshold））
ALARMLEVEL（angle alarm level）
GYROCALTIME（Gyroscope Auto Calibration Time）
TRIGTIME（alarm continuous trigger time））
KEY（unlock）
WERROR（gyro change value）
TIMEZONE（GPS时区）
WZTIME（angular velocity continuous still time）
WZSTATIC（angular velocity integral threshold）
MODDELAY（485 data response delay）
XREFROLL~YREFPITCH（angle zero reference value））
NUMBERID1~NUMBERID6（(device number)）

Instructions for use:

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

1. **Enter unlock command**
2. **Enter commands that need to modify or read data**
3. **Save command**

Register table

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/factory reset	R/W	SAVE[15:0]															
01	01	CALSW	Calibration mode	R/W													CALSW[3:0]			
02	02	RSW	output content	R/W						GSA	QUATER	VELOCITY	GPS	PRESS	PORT	MAG	ANGLE	GYRO	ACC	TIME
03	03	RRATE	output rate	R/W													RRATE[3:0]			
04	04	BAUD	Serial port baud rate	R/W													BAUD[3:0]			
05	05	AXOFFSET	Acceleration X Bias	R/W	AXOFFSET[15:0]															
06	06	AYOFFSET	Acceleration Y Bias	R/W	AYOFFSET[15:0]															
07	07	AZOFFSET	Acceleration Z Bias	R/W	AZOFFSET[15:0]															
08	08	GXOFFSET	Angular velocity X Bias	R/W	GXOFFSET[15:0]															
09	09	GYOFFSET	Angular velocity Y Bias	R/W	GYOFFSET[15:0]															
0A	10	GZOFFSET	Angular velocity Z Bias	R/W	GZOFFSET[15:0]															
0B	11	HXOFFSET	Magnetic Field X Bias	R/W	HXOFFSET[15:0]															
0C	12	HYOFFSET	Magnetic Field Y Bias	R/W	HYOFFSET[15:0]															
0D	13	HZOFFSET	Magnetic Field Z Bias	R/W	HZOFFSET[15:0]															
0E	14	D0MODE	D0 Pin mode	R/W													D0MODE[3:0]			
0F	15	D1MODE	D1 Pin mode	R/W													D1MODE[3:0]			
10	16	D2MODE	D2 Pin mode	R/W													D2MODE[3:0]			
11	17	D3MODE	D3 Pin mode	R/W													D3MODE[3:0]			
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	Hibernate	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]															
2D	45	POWONSEND	command start	R/W													POWONSEND[3:0]			
2E	46	VERSION	version number	R	VERSION[15:0]															
30	48	YYMM	Year Month	R/W	MOUTH[15:8]	YEAR[7:0]														
31	49	DDHH	Day Hour	R/W	HOUR[15:8]	DAY[7:0]														
32	50	MMSS	Minute Second	R/W	SECONDS[15:8]	MINUTE[7:0]														
33	51	MS	Millisecond	R/W	MS[15:0]															

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
34	52	AX	Acceleration X	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 Field X	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]															
41	65	D0Status	D0 pin state	R	D0Status[15:0]															
42	66	D1Status	D1 pin state	R	D1Status[15:0]															
43	67	D2Status	D2 pin state	R	D2Status[15:0]															
44	68	D3Status	D3 pin state	R	D3Status[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	High low 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]															
5C	92	BATVAL	Supply voltage	R	BATVAL[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	NUMBERID1	Device ID 1-2	R	ID2[15:8]	ID1[7:0]														
80	128	NUMBERID2	Device ID 3-4	R	ID4[15:8]	ID3[7:0]														
81	129	NUMBERID3	Device ID 5-6	R	ID6[15:8]	ID5[7:0]														
82	130	NUMBERID4	Device ID 7-8	R	ID8[15:8]	ID7[7:0]														
83	131	NUMBERID5	Device ID 9-10	R	ID10[15:8]	ID9[7:0]														
84	132	NUMBERID6	Device ID 11-12	R	ID12[15:8]	ID11[7:0]														

Protocol format

Read format

- Data is sent in hexadecimal not ASCII.
- Each data is transmitted in sequence by low byte and high byte, and the two are combined into a signed short type of data. For example, data DATA1, in which DATA1L is the low byte and DATA1H is the high byte. The conversion method is as follows: Assuming that DATA1 is the actual data, DATA1H is the high byte part, and DATA1L is the low byte part, then: DATA1=(short)((short)DATA1H<<8|DATA1L). It must be noted here that DATA1H needs to be coerced into a signed short type of data before shifting, and the data type of DATA1 is also a signed short type, so that negative numbers can be represented.

Protocol Head	data content	Data lower 8 bits	Data high 8 bits	Data lower 8 bits	Data high 8 bits	Data lower 8 bits	Data high 8 bits	Data high 8 bits	Data high 8 bits	SUMCRC
0x55	TYPE【1】	DATA1L[7:0]	DATA1H[15:8]	DATA2L[7:0]	DATA2H[15:8]	DATA3L[7:0]	DATA3H[15:8]	DATA4L[7:0]	DATA4H[15:8]	SUMCRC【2】

【1】TYPE(data content):

TYPE	Remark
0x50	Time
0x51	Acceleration
0x52	Angular velocity
0x53	Angle
0x54	Magnetic field
0x55	Port status
0x56	Barometric altitude
0x57	Latitude and longitude
0x58	Ground speed
0x59	Quaternion
0x5A	GPSpositioning accuracy
0x5F	Read

【2】SUMCRC(data sum check):

SUMCRC=0x55+TYPE+DATA1L+DATA1H+DATA2L+DATA2H+DATA3L+DATA3H+DATA4L+DATA4H

SUMCRC is a char type, taking the lower 8 bits of the checksum

Time output

0x55	0x50	YY	MM	DD	HH	MN	SS	MSL	MSH	SUM

Name	Describe	Remark
YY	Year	
MM	Moon	
DD	Day	
HH	Hour	
MN	Minute	
SS	second	
MSL	ms lower 8 bits	Millisecond calculation formula: ms=((MSH<<8)|MSL)
MSH	ms high 8 bits	

Name	Describe	Remark
SUM	checksum	SUM=0x55+0x50+YY+MM+DD+HH+MN+SS+MSL+MSH

Acceleration output

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

Name	Describe	Remark
AxL	Acceleration X low 8 bits	Acceleration X=((AxH<<8)|AxL)/32768*16g(g is the acceleration of gravity, preferably 9.8m/s2)
AxH	Acceleration X high 8 bits	
AyL	Acceleration Y low 8 bits	Acceleration Y=((AyH<<8)|AyL)/32768*16g(g is the acceleration of gravity, preferably 9.8m/s2)
AyH	Acceleration Y high 8 bits	
AzL	Acceleration Z low 8 bits	Acceleration Z=((AzH<<8)|AzL)/32768*16g(g is the acceleration of gravity, preferably 9.8m/s2)
AzH	Acceleration Z high 8 bits	
TL	Temperature low 8 bits	Temperature calculation formula：Temperature=((TH<<8)|TL)/100 ℃
TH	Temperature high 8 bits	
SUM	checksum	SUM=0x55+0x51+AxL+AxH+AyL+AyH+AzL+AzH+TL+Th

Angular velocity output

0x55	0x52	WxL	WxH	WyL	WyH	WzL	WzH	VolL	VolH	SUM

Name	Describe	Remark
WxL	Angular velocity X low 8 bits	Angular velocity X=((WxH<<8)|WxL)/32768*2000°/s
WxH	Angular velocity X high 8 bits	
WyL	Angular velocity Y low 8 bits	Angular velocity Y=((WyH<<8)|WyL)/32768*2000°/s

Name	Describe	Remark
WyH	Angular velocity Y high 8 bits	
WzL	Angular velocity Z low 8 bits	Angular velocity Z=((WzH<<8)|WzL)/32768*2000°/s
WzH	Angular velocity Z high 8 bits	
VolL	Voltage low 8 bits	（Non-Bluetooth Products，the data is invalid) Voltage calculation formula: voltage=((VolH<<8)|VolL) /100 ℃
VolH	Voltage high 8 bits	
SUM	checksum	SUM=0x55+0x52+WxL+WxH+WyL+WyH+WzL+WzH+VolH+VolL

Angle output

0x55	0x53	RollL	RollH	PitchL	PitchH	YawL	YawH	VL	VH	SUM

Name	Describe	Remark
RollL	Roll angle X low 8 bits	Roll angle X=((RollH<<8)|RollL)/32768*180(°)
RollH	Roll angle X high 8 bits	
PitchL	Pitch angle Y low 8 bits	Pitch angle Y=((PitchH<<8)|PitchL)/32768*180(°)
PitchH	Pitch angle Y high 8 bits	
YawL	Yaw angle Z low 8 bits	Yaw angle Z=((YawH<<8)|YawL)/32768*180(°)
YawH	Yaw angle Z high 8 bits	
VL	Version number low 8 bits	Version number calculation formula: Version number=(VH<<8)|VL
VH	Version number high 8 bits	
SUM	checksum	SUM=0x55+0x53+RollH+RollL+PitchH+PitchL+YawH+YawL+VH+VL

Magnetic field output

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

Name	Describe	Remark
HxL	Magnetic field X lower 8 bits	Magnetic field X=((HxH<<8)|HxL)
HxH	Magnetic field X high 8 bits	
HyL	Magnetic field Y lower 8 bits	Magnetic field Y=((HyH <<8)|HyL)
HyH	Magnetic field Y high 8 bits	
HzL	Magnetic field Z lower 8 bits	Magnetic field Z=((HzH<<8)|HzL)
HzH	Magnetic field Z high 8 bits	
TL	Temperature low 8 bits	Temperature calculation formula: temperature=((TH<<8)|TL) /100 ℃
TH	Temperature high 8 bits	
SUM	checksum	SUM=0x55+0x54+HxH+HxL+HyH+HyL+HzH+HzL+TH+TL

Port status output

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

Name	Describe	Remark
D0L	D0 status lower 8 bits	D0 state=((D0H<<8)|D0L)
D0H	D0 state high 8 bits	
D1L	D1 status lower 8 bits	D1 state = ((D1H<<8)|D1L)
D1H	D1 status high 8 bits	

Name	Describe	Remark
D2L	D2 status lower 8 bits	D2 state=((D2H<<8)|D2L)
D2H	D2 status upper 8 bits	
D3L	D3 status lower 8 bits	D3 state = ((D3H<<8)|D3L)
D3H	D3 status upper 8 bits	
SUM	checksum	SUM=0x55+0x54+D0L+D0H+D1L+D1H+D2L+D2H+D3L+D3H

illustrate:

- When the port mode is set to analog input, the port status data represents the analog voltage. The actual voltage is calculated according to the following formula:

U=DxStatus/1024*Uvcc

- Uvcc is the power supply voltage of the chip. Since there is an LDO on the chip, if the power supply voltage of the module is greater than 3.5V, Uvcc is 3.3V. If the module power supply voltage is less than 3.5V, Uvcc=power supply voltage -0.2V.
- When the port mode is set to digital input, the port status data indicates the digital level status of the port, high level is 1, low level is 0.
- When the port mode is set to high-level output mode, the port status data is 1.
- When the port mode is set to low output mode, the port status data bit is 0.

Air pressure altitude output

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

Name	Describe	Remark
P0	Air Pressure [7:0]	Air pressure=(P3<<24)|(P2<<16)|(P1<<8)|P0(Pa)
P1	Air Pressure [15:8]	
P2	Air pressure [23:16]	
P3	Air pressure [31:24]	
H0	height[7:0]	Height=(H3<<24)|(H2<<16)|(H1<<8)|H0(cm)
H1	Height [15:8]	
H2	Height [23:16]	
H3	Height [31:24]	

Name	Describe	Remark
SUM	checksum	SUM=0x55+0x56+P0+P1+P2+P3+H0+H1+H2+H3

Latitude and longitude output

0x55	0x57	Lon0	Lon1	Lon2	Lon3	Lat0	Lat1	Lat2	Lat3	SUM

name	describe	Remark
Lon0	Longitude [7:0]	Longitude=(Lon3<<24)|(Lon2<<16)|(Lon1<<8)|Lon0
Lon1	Longitude [15:8]	
Lon2	Longitude [23:16]	
Lon3	Longitude [31:24]	
Lat0	Latitude[7:0]	Latitude=(Lat3<<24)|(Lat2<<16)|(Lat1<<8)|Lat0
Lat1	Latitude[15:8]	
Lat2	Latitude [23:16]	
Lat3	Latitude [31:24]	
SUM	checksum	SUM=0x55+0x57+Lon0+Lon1+Lon2+Lon3+Lat0+Lat1+Lat2+Lat3

illustrate:

- 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)

GPS data output

0x55	0x58	GPSHeightL	GPSHeightH	GPSYawL	GPSYawH	GPSV0	GPSV1	GPSV2	GPSV3	SUM

name	describe	Remark
GPSHeightL	GPS Altitude [7:0]	GPS Height=((GPSHeightH<<8)|GPSHeightL)/10(m)
GPSHeightH	GPS altitude [15:8]	
GPSYawL	GPS heading [7:0]	GPS heading angle=((GPSYawH<<8)|GPSYawL)/100(°)
GPSYawH	GPS heading [15:8]	

name	describe	Remark
GPSV0	GPS Ground Speed [7:0]	GPS ground speed = ((GPSV3<<24)|(GPSV2<<16)|(GPSV1<<8)|GPSV0)/1000(km/h)
GPSV1	GPS ground speed [15:8]	
GPSV2	GPS ground speed [23:16]	
GPSV3	GPS ground speed [31:24]	
SUM	checksum	SUM=0x55+0x58+GPSHeightL+GPSHeightH+GPSYawL+GPSYawH+GPSV0+GPSV1+GPSV2+GPSV3

Quaternion output

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

Name	Describe	Remark
Q0L	Quaternion 0 low 8 bits	q0=((Q0H<<8)|Q0L)/32768
Q0H	Quaternion 0 high 8 bits	
Q1L	Quaternion 1 lower 8 bits	q1=((Q1H<<8)|Q1L)/32768
Q1H	Quaternion 1 high 8 bits	
Q2L	Quaternion 2 lower 8 bits	q2=((Q2H<<8)|Q2L)/32768
Q2H	Quaternion 2 high 8 bits	
Q3L	Quaternion 3 lower 8 bits	q3=((Q3H<<8)|Q3L)/32768
Q3H	Quaternion 3 high 8 bits	
SUM	checksum	SUM=0x55+0x59+Q0L+Q0H+Q1L +Q1H +Q2L+Q2H+Q3L+Q3H

GPS positioning accuracy output

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

Name	Describe	Remark

Name	Describe	Remark
SNL	Satellite number low 8 bits	Number of GPS satellites=((SNH<<8)|SNL)
SNH	8-bit high number of satellites	
PDOPL	Position positioning accuracy is low 8 bits	Position positioning accuracy=((PDOPH<<8)|PDOPL)/100
PDOPH	Position positioning accuracy is high 8 bits	
HDOPL	Horizontal positioning accuracy is 8 bits lower	Horizontal positioning accuracy=((HDOPH<<8)|HDOPL)/100
HDOPH	High 8-bit horizontal positioning accuracy	
VDOPL	Vertical positioning accuracy is 8 bits lower	Vertical positioning accuracy=((VDOPH<<8)|VDOPL)/100
VDOPH	High vertical positioning accuracy of 8 bits	
SUM	checksum	SUM=0x55+0x5A+SNL+SNH+PDOPL+PDOPH+HDOPL+HDOPH+VDOPL+VDOPH

Read register return value

- Used to read the value of the user-specified register, read REG1, then return the value of 4 registers of REG1~REG4, the protocol must return 4 registers

0x55	0x5F	REG1L	REG1H	REG2L	REG2H	REG3L	REG3H	REG4L	REG4H	SUM

Name	Describe	Remark
REG1L	Register 1 low 8 bits	REG1[15:0]=((REG1H<<8)|REG1L)
REG1H	Register 1 high 8 bits	
REG2L	Register 2 low 8 bits	REG2[15:0]=((REG2H<<8)|REG2L)
REG2H	Register 2 high 8 bits	
REG3L	Register 3 low 8 bits	REG3[15:0]=((REG3H<<8)|REG3L)
REG3H	Register 3 high 8 bits	
REG4L	Register 4 low 8 bits	REG4[15:0]=((REG4H<<8)|REG4L)
REG4H	Register 4 high 8 bits	
SUM	checksum	SUM=0x55+0x5F+REG1L+REG1H+REG2L+REG2H+REG3L+REG3H+REG4L+REG4H

E.g:

- Read register "AXOFFSET", return: 0x55 0x5F AXOFFSET[7:0] AXOFFSET[15:8] AYOFFSET[7:0] AYOFFSET[15:8] AZOFFSET[7:0] AZOFFSET[15:8] GXOFFSET[7:0] GXOFFSET[15:8] SUM

Write format

- The following data, all use Hex code hexadecimal
- All settings need to operate the unlock register (KEY) first

protocol header	protocol header	register	Data lower 8 bits	Data high 8 bits
0xFF	0xAA	ADDR	DATAL[7:0]	DATAH[15:8]

- Data is sent in hexadecimal, not ASCII.
- Each data is transmitted in sequence by low byte and high byte, and the two are combined into a signed short type of data. For example, data DATA, where DATAL is the low byte and DATAH is the high byte. The conversion method is as follows: Assuming that DATA is the actual data, DATAH is its high-byte part, and DATAL is its low-byte part, then: DATA=(short)((short)DATAH<<8|DATAL). It must be noted here that DATAH needs to be converted to a signed short type of data before shifting, and the data type of DATA is also a signed short type, so that negative numbers can be represented.

SAVE（save/reboot/factory reset)

Register Name: SAVE Register Address: 0 (0x00) Read and write direction: R/W Default value: 0x0000		
Bit	NAME	FUNCTION
15:0	SAVE[15:0]	save: 0x0000 reboot: 0x00FF factory reset: 0x0001
E.g：FF AA 00 FF 00（reboot)		

CALSW（Calibration Mode)

Register Name: CALSW Register Address: 1 (0x01 Read and Write Direction: R/W Default Value: 0x0000		
Bit	NAME	FUNCTION
15:4		

Register Name: CALSW Register Address: 1 (0x01 Read and Write Direction: R/W Default Value: 0x0000		
3:0	CAL[3:0]	Set calibration mode: 0000(0x00): Normal working mode 0001 (0x01): Auto add-up calibration 0011 (0x03): Height reset 0100 (0x04): Heading angle reset 0111 (0x07): Magnetic Field Calibration (Spherical Fitting) 1000 (0x08): Set the angle reference to 1001 (0x09): Magnetic Field Calibration (Dual Plane Mode)
E.g：FF AA 01 04 00（Heading angle reset)		

RSW（output content)

Register Name: RSW Register Address: 2 (0x02) Read and Write Direction: R/W Default Value: 0x001E		
Bit	NAME	FUNCTION
15:11		
10	GSA (0x5A)	0: off 1: on
9	QUATER (0x59)	0: off 1: on
8	VELOCITY (0x58)	0: off 1: on
7	GPS (0x57)	0: off 1: on
6	PRESS (0x56)	0: off 1: on
5	PORT (0x55)	0: off 1: on
4	MAG (0x54)	0: off 1: on
3	ANGLE (0x53)	0: off 1: on

Register Name: RSW Register Address: 2 (0x02) Read and Write Direction: R/W Default Value: 0x001E		
2	GYRO (0x52)	0: off 1: on
1	ACC (0x51)	0: off 1: on
0	TIME (0x50)	0: off 1: on
E.g：FF AA 02 3E 00（Set to output only acceleration, angular velocity, angle, magnetic field, port status）		

RRATE（output rate）

Register Name: RRATE Register Address: 3 (0x03) Read and Write Direction:R/W Default Value: 0x0006		
Bit	NAME	FUNCTION
15:4		
3:0	RRATE[3:0]	Set output rate: 0001(0x01): 0.2Hz 0010(0x02):0.5Hz 0011(0x03): 1Hz 0100(0x04): 2Hz 0101(0x05): 5Hz 0110(0x06): 10Hz 0111(0x07): 20Hz 1000(0x08): 50Hz 1001(0x09): 100Hz 1011(0x0B): 200Hz 1011(0x0C):Single return 1100 (0x0D): no return
E.g：FF AA 03 03 00（Set output rate 1Hz）		

BAUD（Serial port baud rate）

Register Name: BAUD Register Address: 4 (0x04) Read and write direction: R/W Default value: 0x0002		

Register Name: BAUD Register Address: 4 (0x04) Read and write direction: R/W Default value: 0x0002		
Bit	NAME	FUNCTION
15:4		
3:0	BAUD[3:0]	Set 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）
e.g：FF AA 04 06 00 （Set serial port baud rate115200）		

AXOFFSET~HZOFFSET（Bias settings)

Register Name: AXOFFSET~HZOFFSET Register Address: 5~13 (0x05~0x0D) Read and write direction: R/W Default value: 0x0000		
Bit	NAME	FUNCTION
15:0	AXOFFSET[15:0]	Acceleration X-axis Bias, actual acceleration Bias =AXOFFSET[15:0]/10000(g)
15:0	AYOFFSET[15:0]	Acceleration Y-axis Bias, actual acceleration Bias =AYOFFSET[15:0]/10000(g)
15:0	AZOFFSET[15:0]	Acceleration Z-axis Bias, actual acceleration Bias =AZOFFSET[15:0]/10000(g)
15:0	GXOFFSET[15:0]	Angular velocity X-axis Bias, actual angular velocity Bias =GXOFFSET[15:0]/10000(°/s)

Register Name: AXOFFSET~HZOFFSET Register Address: 5~13 (0x05~0x0D) Read and write direction: R/W Default value: 0x0000		
15:0	GYOFFSET[15:0]	Angular velocity Y-axis Bias, actual angular velocity Bias =GYOFFSET[15:0]/10000(°/s)
15:0	GZOFFSET[15:0]	Angular velocity Z-axis Bias, actual angular velocity Bias =GZOFFSET[15:0]/10000(°/s)
15:0	HXOFFSET[15:0]	Magnetic field X-axis Bias
15:0	HYOFFSET[15:0]	Magnetic field Y-axis Bias
15:0	HZOFFSET[15:0]	Magnetic field Z-axis Bias
eg：FF AA 05 E8 03（Set acceleration X axis Bias 0.1g）,0x03E8=1000，1000/10000=0.1(g)		

D0MODE~D3MODE（port mode setting)

Register name: D0MODE~D3MODE Register address: 14~17 (0x0E~0x11) Read and write direction: R/W Default value: 0x0000		
Bit	NAME	FUNCTION
3:0	D0MODE[3:0]	Set D0 port mode 0000(0x00): analog input (default) 0001(0x01): digital input 0010(0x02): output digital high level 0011(0x03): output digital low level
3:0	D1MODE[3:0]	Set D1 port mode 0000(0x00): analog input (default) 0001(0x01): digital input 0010(0x02): output digital high level 0011(0x03): output digital low level 0101(0x05): set relative attitude

Register name: D0MODE~D3MODE Register address: 14~17 (0x0E~0x11) Read and write direction: R/W Default value: 0x0000		
3:0	D2MODE[3:0]	Set D2 port mode 0000(0x00): analog input (default) 0001(0x01): digital input 0010(0x02): output digital high level 0011(0x03): output digital low level
3:0	D3MODE[3:0]	Set D3 port mode 0000(0x00): analog input (default) 0001(0x01): digital input 0010(0x02): output digital high level 0011(0x03): output digital low level
eg：FF AA 0E 03 00（set D0 to output digital low level mode）		

IICADDR（device address)

Register Name: IICADDR Register Address: 26 (0x1A) Read and Write Direction: R/W Default Value: 0x0050		
Bit	NAME	FUNCTION
15:8		
7:0	IICADDR[7:0]	Set the device address, use 0x01~0x7F for I2C and Modbus communication
eg：FF AA 1A 02 00（set the device address to 0x02）		

LEDOFF（turn off the LED)

Register Name: LEDOFF Register Address: 27 (0x1B) Read and Write Direction: R/W Default Value: 0x0000		
Bit	NAME	FUNCTION
15:1		

Register Name: LEDOFF **Register Address: 27 (0x1B)** **Read and Write Direction: R/W Default Value: 0x0000**		
0	LEDOFF	1: Turn off the LED 0: Turn on the LED
eg：FF AA 1B 01 00（Turn off the LED）		

MAGRANGX~MAGRANGZ（magnetic field calibration range）

Register Name: MAGRANGX~MAGRANGZ **Register Address: 28~30 (0x1C~0x1E)** **Read and Write Direction: R/W Default Value: 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
eg：FF AA 1C F4 01（Set the magnetic field calibration X-axis range to 500）		

BANDWIDTH（bandwidth）

Register Name: BANDWIDTH **Register Address: 31 (0x1F)** **Read and Write Direction: R/W** **Default Value: 0x0004**		
Bit	NAME	FUNCTION
15:4		
3:0	BANDWIDTH[3:0]	Set bandwidth 0000(0x00): 256Hz 0001(0x01): 188Hz 0010(0x02): 98Hz 0011(0x03): 42Hz0100(0x04): 20Hz0101(0x05): 10Hz0110(0x06): 5Hz
eg：FF AA 1F 01 00（Set bandwidth 188Hz）		

GYRORANGE（gyroscope range）

Register Name: GYRORANGE Register Address: 32 (0x20) Read and Write Direction: R/W Default Value: 0x0003		
Bit	NAME	FUNCTION
15:4		
3:0	GYRORANGE[3:0]	Set gyroscope range 0011(0x03): 2000°/s default 2000°/s, fixed and cannot be set
eg：FF AA 20 03 00（set the gyro range to 2000°/s）		

ACCRANGE（accelerometer range）

Register Name: ACCRANGE Register Address: 33 (0x21) Read and Write Direction: R/W Default Value: 0x0000		
Bit	NAME	FUNCTION
15:4		
3:0	ACCRANGE[3:0]	Set the accelerometer range 0000(0x00): ±2g0011(0x03): ±16g This parameter cannot be set, the product's internal adaptive acceleration range, when the acceleration exceeds 2g, it will automatically switch to 16g
eg：FF AA 21 00 00（set the accelerometer range to 16g）		

SLEEP（sleep）

Register Name: SLEEP Register Address: 34 (0x22) Read and Write Direction: R/W Default Value: 0x0000		
Bit	NAME	FUNCTION
15:1		
0	SLEEP	Set sleep 1 (0x01): sleep any serial port data, can wake up
eg：FF AA 22 01 00（set sleep）		

ORIENT（installation orientation）

Register name: ORIENT Register address: 35 (0x23) Read and write direction: R/W Default value: 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)
eg：FF AA 23 01 00（set vertical installation）		

AXIS6（algorithm）

Register Name: AXIS6 Register Address: 36 (0x24) Read and Write Direction: R/W Default Value: 0x0000		
Bit	NAME	FUNCTION
15:1		

Register Name: AXIS6 Register Address: 36 (0x24) Read and Write Direction: R/W Default Value: 0x0000		
0	AXIS6	Setting 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)
eg：FF AA 24 01 00（set 6-axis algorithm mode）		

FILTK（K value filter)

Register Name: FILTK Register Address: 37 (0x25) Read and Write Direction: R/W Default Value: 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, please modify it to 30) The smaller the FILTK[15:0], the stronger the seismic performance and the weaker the real-time performance FILTK[15:0] is larger, the seismic performance is weakened, and the real-time performance is enhanced.
eg：FF AA 25 1E 00(set K value filter to 30)		

GPSBAUD（GPS baud rate)

Register Name: GPSBAUD Register Address: 38 (0x26) Read and Write Direction: R/W Default Value: 0x0002		
Bit	NAME	FUNCTION
15:4		
3:0	GPSBAUD[3:0]	Set GPS baud rate： 0001(0x01): 4800bps0010(0x02): 9600bps0011(0x03): 19200bps0100(0x04): 38400bps0101(0x05): 57600bps0110(0x06): 115200bps0111(0x07): 230400bps
eg：FF AA 26 02 00 ((set GPS baud rate 9600)		

READADDR（read register)

Register Name: READADDR Register Address: 39 (0x27) Read and Write Direction: R/W Default Value: 0x00FF		
Bit	NAME	FUNCTION
15:8		
7:0	READADDR[7:0]	Read register range: Please refer to "Register Table"
eg: Send: FF AA 27 34 00 (read acceleration X-axis 0x34) Return: 55 5F AXL AXH AYL AYH AZL AZH GXL GXH SUM For details, please refer to "Read Register Return Value" in the "Read Format" chapter		

ACCFILT（acceleration filter）

Register Name: ACCFILT Register Address: 42 (0x2A) Read and Write Direction: R/W Default Value: 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 ACCFILT[15:0]] is larger, the seismic performance is weakened, and the real-time performance is enhanced. This parameter is an empirical value, which needs to be adjusted according to different environments. In the tractor environment, ACCFILT[15:0] can be adjusted to 100, because the tractor shakes seriously, it needs to be improved Seismic performance
eg：FF AA 2A F4 01(set acceleration filter 500)		

POWONSEND（power-on output）

Register Name: POWONSEND Register Address: 45 (0x2D) Read and Write Direction: R/W Default Value: 0x0001		
Bit	NAME	FUNCTION
15:4		

Register Name: POWONSEND Register Address: 45 (0x2D) Read and Write Direction: R/W Default Value: 0x0001		
3:0	POWONSEND[3:0]	Set command start: 0000(0x00): Turn off the power-on data output 0001(0x01): Turn on the power-on data output
eg：FF AA 2D 00 00（turn on power-on data output）		

VERSION（version number）

Register Name: VERSION Register Address: 46 (0x2E) Read and Write Direction: R Default Value: None		
Bit	NAME	FUNCTION
15:0	VERSION[15:0]	Different products, different version numbers
eg: Send:FF AA 27 2E 00 （read version number, 0x27 means read, 0x2E is version number register） Return: 55 5F VL VH XX XX XX XX XX XX SUMVERSION[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 value: 0x0000		
Bit	NAME	FUNCTION
15:8	YYMM[15:8]	moon
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

Register name: YYMM~MS Register address: 48~51 (0x30~0x33) **Read and write direction: R/W Default value: 0x0000**		
15:0	MS[15:0]	millisecond
eg:FF AA 30 16 03 (set the year, month 22-03) FF AA 31 0C 09 (set the day and hour 12-09) FF AA 32 1E 3A (set the minute and second 30:58) FF AA 33 F4 01 (set the millisecond 500) eg: send: FF AA 27 30 00 (read version number, 0x27 means read, 0x30 is year month register) return: 55 5F YYMM[7:0] YYMM[15:8] DDHH[7:0] DDHH [15:8] MMSS[7:0] MMSS[15:8] MS[7:0] MS[15:8] SUM		

AX~AZ（acceleration）

Register name: AX~AZ Register address: 52~54 (0x34~0x36) **Read and write direction: R** **Default value: 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)
read 3 acceleration：50 03 00 34		

GX~GZ（angular velocity）

Register name: GX~GZ Register address: 55~57 (0x37~0x39) **Read and write direction: R Default value: 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

Register name: GX~GZ Register address: 55~57 (0x37~0x39) Read and write direction: R Default value: 0x0000		
15:0	GZ[15:0]	Angular velocity Z=GZ[15:0]/32768*2000°/s

HX~HZ（magnetic field)

Register name: HX~HZ Register address: 58~60 (0x3A~0x3C) Read and write direction: R Default value: 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)

Roll~Yaw（angle)

Register name: Roll~Yaw Register address: 61~63 (0x3D~0x3F) Read and write direction: R Default value: 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°

TEMP（temperature)

Register Name: TEMP Register Address: 64 (0x40) Read and Write Direction: R Default Value: 0x0000		
Bit	NAME	FUNCTION

Register Name: TEMP Register Address: 64 (0x40) Read and Write Direction: R Default Value: 0x0000		
15:0	TEMP[15:0]	temperature=TEMP[15:0]/100℃

D0Status~D3Status（port status）

Register name: D0Status~D3Status Register address: 65~68 (0x41~0x44) Read and write direction: R Default value: 0x0000		
Bit	NAME	FUNCTION
15:0	D0Status[15:0]	D0 state value
15:0	D1Status[15:0]	D1 state value
15:0	D2Status[15:0]	D2 state value
15:0	D3Status[15:0]	D3 state value

PressureL~HeightH（pressure altitude）

Register name: PressureL~HeightH Register address: 69~72 (0x45~0x48) Read and write direction: R Default value: 0x0000		
Bit	NAME	FUNCTION
15:0	PressureL[15:0]	Pressure= ((int)PressureH[15:0] <<16)|PressureL15:0
15:0	PressureH[15:0]	
15:0	HeightL[15:0]	height= ((int)HeightH[15:0] <<16)|HeightL15:0
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 value: 0x0000**		
Bit	NAME	FUNCTION
15:0	LonL[15:0]	Lon[31:0]= ((int)LonH[15:0] <<16)|LonL15:0
15:0	LonH[15:0]	
15:0	LatL[15:0]	Lat[31:0]= ((int)LatH[15:0] <<16)|LatL15:0
15:0	LatH[15:0]	
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 when the longitude/latitude is output. so the degrees of longitude/latitude can be calculated like this: dd=Lon[31:0]/10000000;dd=Lat[31:0]/10000000. The fraction of longitude/latitude 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 value: 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(°)

Register name: GPSHeight~GPSVH Register address: 77~80 (0x4D~0x50 Read and write direction: R Default value: 0x0000		
15:0	GPSVL[15:0]	GPS ground speed=(((int)GPSVH[15:0] <<16)|GPSVL[15:0])/1000(km/h)
15:0	GPSVH[15:0]	

q0~q3（quaternion）

Register name: q0~q3 Register address: 81~84 (0x51~0x54) Read and write direction: R Default value: 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

SVNUM~VDOP（GPS positioning accuracy）

Register name: SVNUM~VDOP Register address: 85~88 (0x55~0x58) Read and write direction: R Default value: 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

Register name: SVNUM~VDOP Register address: 85~88 (0x55~0x58) **Read and write direction: R Default value: 0x0000**		
15:0	HDOP[15:0]	Horizontal positioning longitude =HDOP[15:0]/100
15:0	VDOP[15:0]	Vertical positioning longitude =VDOP[15:0]/100

DELAYT（alarm signal delay)

Register Name: DELAYT **Register Address: 89 (0x59)** **Read and Write Direction: R/W** **Default Value: 0x0000**		
Bit	NAME	FUNCTION
15:0	DELAYT[15:0]	Unit: ms When an alarm occurs at an angle, the port will generate a corresponding alarm signal. When the alarm disappears, the alarm signal will continue to delay DELAYT[15:0] before disappearing.
eg：FF AA 59 E8 03(set the alarm signal delay to 1000ms)		

XMIN~XMAX（X-axis angle alarm threshold)

Register name: XMIN~XMAX **Register address: 90~91 (0x5A~0x5B)** **Read and write direction: R/W** **Default value: 0x0000**		
Bit	NAME	FUNCTION

Register name: XMIN~XMAX Register address: 90~91 (0x5A~0x5B) Read and write direction: R/W Default value: 0x0000		
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 maximum value of X-axis angle alarm X-axis angle alarm maximum value =XMAX[15:0]*180/32768(°)
eg：FF AA 5A 72 FC (set -5 degrees) 0xFC72=-910,-910 180/32768=-5FF AA 5B 8E 03 (set 5 degrees) 0x038E=910，910*180/32768=5 5x axis at - There is no alarm between 5° and 5°. Once the range is exceeded, an alarm will occur.		

BATVAL（voltage)

Register Name: BATVAL Register Address: 92 (0x5C) Read and Write Direction: R Default Value: 0x0000		
Bit	NAME	FUNCTION
15:0	BATVAL[15:0]	voltage =BATVAL[15:0]/100 ℃

ALARMPIN（alarm pin mapping)

Register Name: ALARMPIN Register Address: 93 (0x5D) Read and Write Direction: R/W Default Value: 0x4365		
Bit	NAME	FUNCTION

Register Name: ALARMPIN Register Address: 93 (0x5D) **Read and Write Direction: R/W Default Value: 0x4365**		
15:12	X-ALARM[15:12]	0001(0x01): D00010(0x02): D10011(0x03): D20100(0x04): D30101(0x05): SCL0110(0x06): SDA
11:8	X+ALARM[11:8]	0001(0x01): D00010(0x02): D10011(0x03): D20100(0x04): D30101(0x05): SCL0110(0x06): SDA
7:4	Y-ALARM[7:4]	0001(0x01): D00010(0x02): D10011(0x03): D20100(0x04): D30101(0x05): SCL0110(0x06): SDA
3:0	Y+ALARM[3:0]	0001(0x01): D00010(0x02): D10011(0x03): D20100(0x04): D30101(0x05): SCL0110(0x06): SDA
eg: Set X-alarm signal output at D3 port Set X+ alarm signal output at D1 port Set Y- alarm signal output at SCL port Set Y+ alarm signal output at SCL port Send: FF AA 5D 55 42		

YMIN~YMAX (Y-axis angle alarm threshold)

Register name: YMIN~YMAX Register address: 94~95 (0x5E~0x5F) **Read and write direction: R/W Default value: 0x0000**		
Bit	NAME	FUNCTION

Register name: YMIN~YMAX Register address: 94~95 (0x5E~0x5F) **Read and write direction: R/W Default value: 0x0000**		
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 maximum value of Y-axis angle alarm Y-axis angle alarm maximum value =YMAX[15:0]*180/32768(°)
eg：FF AA 5E 72 FC(set -5 degrees)，0xFC72=-910，-910*180/32768=-5FF AA 5F 8E 03(set 5 degrees)，0x038E=910，*910*180/32768=5 Y axis at - There is no alarm between 5° and 5°. Once the range is exceeded, an alarm will occur.		

GYROCALITHR（Gyro Still Threshold))

Register Name: GYROCALITHR **Register Address: 97 (0x61)** **Read and Write Direction: R/W** **Default Value: 0x0000**		
Bit	NAME	FUNCTION
15:0	GYROCALITHR[15:0]	Set the gyroscope static threshold: Gyro static threshold =GYROCALITHR[15:0]/1000(°/s)

Register Name: GYROCALITHR Register Address: 97 (0x61) Read and Write Direction: R/W Default Value: 0x0000		
eg： Set the static threshold of the gyroscope to 0.05°/sFF AA 61 32 00 When the angular velocity change is less than 0.05°/s and lasts for the time of "GYROCALTIME", the sensor recognizes that it is static 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 Value: 0x0000		
Bit	NAME	FUNCTION
15:4		
3:0	ALARMLEVEL[3:0]	Set the alarm level: 0000(0x00): low level alarm (when not alarming, high level, when alarming, low level) 0001(0x01): high level alarm (when not alarming, low level, when alarming , high level)
eg: Set high level alarm FF AA 62 01 00		

GYROCALTIME（Gyroscope Auto Calibration Time)

Register Name: GYROCALTIME Register Address: 99 (0x63) Read and Write Direction: R/W Default Value: 0x03E8		

Register Name: GYROCALTIME **Register Address: 99 (0x63)** **Read and Write Direction: R/W** **Default Value: 0x03E8**		
Bit	NAME	FUNCTION
15:0	GYROCALTIME[15:0]	Set gyroscope auto-calibration time
eg: Set the automatic calibration time of the gyroscope to 500msFF AA 63 F4 01 When the angular velocity change is less than "GYROCALITHR" and lasts for 500ms, the sensor recognizes that the sensor is stationary and automatically resets the angular velocity less than 0.05°/s to zero. This register needs to be combined with GYROCALITHR Register usage		

TRIGTIME（alarm continuous trigger time))

Register Name: TRIGTIME **Register Address: 104 (0x68)** **Read and Write Direction: R/W** **Default Value: 0x0000**		
Bit	NAME	FUNCTION
15:0	TRIGTIME[15:0]	Set the alarm continuous trigger time
Eg: Set the alarm continuous trigger time to 500ms FF AA 68 F4 01 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 value: 0x0000**		

Register name: KEY Register address: 105 (0x69) Read and write direction: R/W Default value: 0x0000		
Bit	NAME	FUNCTION
15:0	KEY[15:0]	Unlock register: When performing a write operation, you need to set this register first
Eg: Unlock, write 0xB588 to this register (other values are invalid) FF AA 69 88 B5		

WERROR（gyro change value)

Register Name: WERROR Register Address: 106 (0x6A) Read and Write Direction: R Default Value: 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时区）

Register Name: TIMEZONE Register Address:107 (0x6B) Read and Write Direction: R/W Default Value: 0x0014		
Bit	NAME	FUNCTION
15:8		

Register Name: TIMEZONE Register Address:107 (0x6B) Read and Write Direction: R/W Default Value: 0x0014		
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 8） 00010101(0x0015): UTC+9 00010110(0x0016): UTC+10 00010111(0x0017): UTC+11 00011000(0x0018): UTC+12
eg: FF AA 6B 15 00 (set GPS time zone to East 9)		

WZTIME（angular velocity continuous still time)

Register Name: WZTIME Register Address: 110 (0x6E) Read and Write Direction: R/W Default Value: 0x01F4		
Bit	NAME	FUNCTION

Register Name: WZTIME **Register Address: 110 (0x6E)** **Read and Write Direction: R/W** **Default Value: 0x01F4**		
15:0	WZTIME[15:0]	Angular velocity continuous rest time
eg：Set the continuous static time of angular velocity to 500ms FF AA 6E F4 01, 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 Value: 0x012C**		
Bit	NAME	FUNCTION
15:0	WZSTATIC[15:0]	Angular velocity integration threshold =WZSTATIC[15:0]/1000(°/s)
eg：Set the angular velocity integration threshold to 0.5°/s FF AA 6F F4 01 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, the setting of the register "WZTIME" continues. When 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 Value: 0x0BB8**		

Register Name: MODDELAY **Register Address: 116 (0x74)** **Read and Write Direction: R/W** **Default Value: 0x0BB8**		
Bit	NAME	FUNCTION
15:0	MODDELAY[15:0]	Set 485 data response delay, default 3000, unit: us
eg：Set 485 data response delay 1000usFF AA 74 E8 03 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 Value: 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 =YREFPITCH[15:0]/32768*180(°)
eg:The current roll angle is 2°, set the roll angle zero, subtract 2°, then XREFROLL[15:0]=2*32768/180=364=0x016CFF AA 79 6C 01		

NUMBERID1~NUMBERID6（(device number))

Register Name: NUMBERID1~NUMBERID6 **Register Address: 127~132 (0x7F~0x84)** **Read and Write Direction: R** **Default Value: None**		
Bit	NAME	FUNCTION
15:0	NUMBERID1[15:0]	
15:0	NUMBERID2[15:0]	
15:0	NUMBERID3[15:0]	
15:0	NUMBERID4[15:0]	

Register Name: NUMBERID1~NUMBERID6 **Register Address: 127~132 (0x7F~0x84)** **Read and Write Direction: R** **Default Value: None**		
15:0	NUMBERID5[15:0]	
15:0	NUMBERID6[15:0]	
Equipment label：WT4200000001		