XW-G6615D2

Instruction for use

BeiJing StarNeto Technology Co., Ltd.

V2.0 In August 2016

XW-G6615 The user manual

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Product guarantee

Warranty period: a period of one year from the date of the factory. Warranty coverage does not include product misuse, accident, and incorrect installation, maintenance and application. Without the starnet yu company authorization, to repair or replace the shell product is not in the scope of our company to accept.

User support

Welcome to contact us at any time, we will provide enthusiastic, timely and thoughtful service!

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1 Product introduction

1 XW-G661 navigation system

XW-G6615Starnet is yu da company using multi-sensor data fusion technology combining GPS and inertial measurement, launched a can provide a variety of navigation parameters of the new integrated navigation products. Products in terms of satellite positioning using GPS/GLONASS (beidou/GNSS dual-mode scheme is optional), on the basis of the global satellite positioning system GNSS can choose to join beidou satellite positioning system of independent research and development in our country, with all-weather, global coverage, high precision, fast to save time the advantages of high efficiency and wide application. At the same time, in view of the satellite signal are susceptible to tall objects, such as buildings, trees shade, satellite lost locks or multipath effects positioning accuracy, and motion carrier in the process of the motor is not easy to capture and track the satellite signals, etc,XW-6615 Built-in EMES gyroscope and accelerometer, and support external auxiliary odometer information, with the help of a new generation of accurate calibration technology and multi-sensor data fusion technology, greatly improving the system reliability, accuracy and dynamic, and can also provide satellite navigation information such as course, can't provide.

XW-G6615Built-in inertial measurement unit, double GNSS (BD optional) positioning directional unit and odometer interface, system support beidou (optional), GNSS systems. Azimuth system combination output system, is more suitable for the traffic measurement, use of surveying and mapping;

When the satellite signal is obscured, into the model of inertial navigation system, with the inertial navigation and odometer information, in a certain period of time can still maintain good measuring precision. XW-G6615This feature provides than using GNSS/BD (optional) alone or INS more accurate and more reliable solution. Has been successfully applied in road traffic measurement, driving road test system, navigation, aviation, and many other areas.

1.1 The component of product

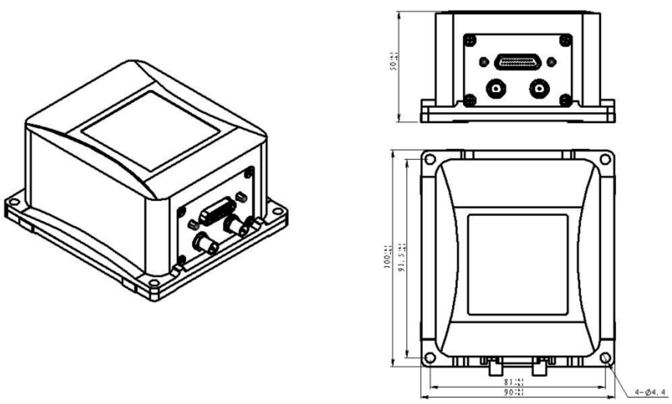
- **XW-G6615 Host (1):** Product host built-in 3 axis EMES gyro, 3 axis built-in EMES accelerometer and double GNSS (optional) BD receiver, through a new generation of satellite/inertial integrated navigation algorithm, can provide accurate, high real time capability and the reliability of the multi-parameter navigation information;
- **Satellite antenna (2):** Product configuration 2 GNSS (BD optional) locating antenna;
- **Feeder (2):** Antenna TNC head, SMA male head equipment end, the standard is 5 meters, satellite antenna are connected at one end, and connected to one product host;
- **Magnetic base (2):** Magnetic stand for fixed antenna, used for powerful magnet sucker;
- **Data/power cable (1):** Support two RS - 232 interface, A RS - 232 / RS - 422 (configurable) interface, a USB interface, a CAN interface, a speedometer interface, a PPS interface, support the rated 24 VDC power supply, to adapt to the 10 ~ 32 VDC wide pressure range.

2 Technical parameters

2.1 system main technical parameters

system precision	course	single point: 0.1 ° (1 sigma, GNSS/BD signal is good, the baseline length of 2 m or higher); Post-processing: 0.05 ° (1 sigma, GNSS/BD signal is good, the baseline length of 2 m or higher);
	posture	0.1 ° (1 sigma, GNSS/BD signal good);
	location	single point: 1.5 m (CEP) (GNSS/BD signal good) RTK: 2 cm + 1 PPM (CEP) (GNSS/BD signal good) Post-processing: 1 cm + 1 PPM (CEP)
	Data update rate	1Hz/5Hz/10Hz/100Hz(adjustable)
interface Features.	The interface way	RS-232 / RS-422
	Baud rate	115200 bps(adjustable)
physical features	supply voltage	Rated 24 VDC（10～32VDC）
	Rated power	≤10W
	Working temperature	-40℃～+75℃
	Physical size	100mm×90mm×50mm
	The weight	≤0.5Kg(not including antenna and cable)

2.2 Host appearance and installation dimensions



2 XW-G6615 The shape and size chart

3 Equipment installation

XW-G6615 Installation of the equipment includes equipment power supply, equipment involved radio host, GNSS/BD antenna, difference, notebook computer, and cable and power cable.

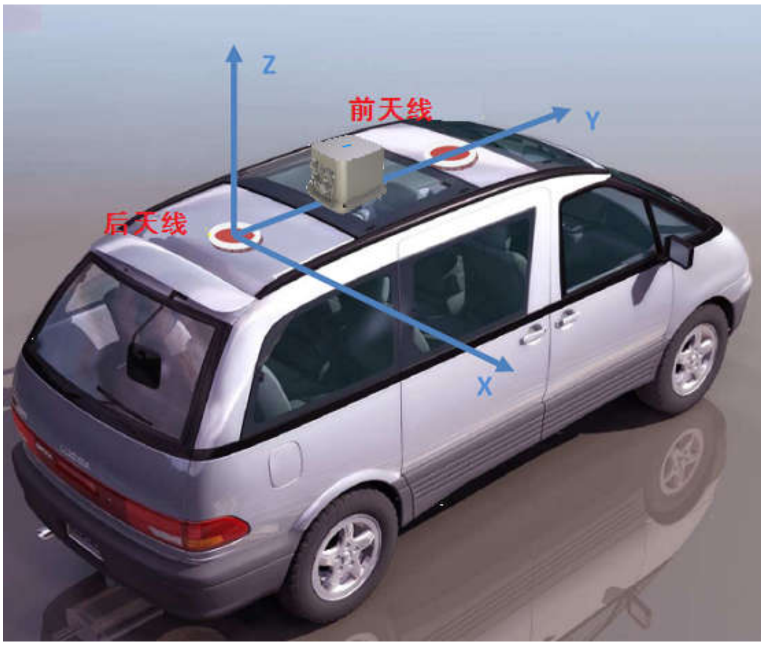
3.1 The antenna installation

GNSS/BD antenna rotary screw respectively to the two magnetic base and fixed on the test vehicle in the forward direction and backward direction, as far as possible put it in the test vehicle with guaranteed to receive the highest good of GNSS/BD signal, at the same time to ensure that the two GNSS/BD antenna phase center form attachment and test center of a carrier in the same direction or parallel.

3.2 Install the

Will XW - G6615 host installed on the vehicle, as shown in figure 5, the host nameplate marking the coordinate system of XOY plane parallel to the datum plane with the carrier as far as possible, Y axis direction and carrier center axis parallel (with connector panel carrier backward direction, no connector panel toward the direction vector).

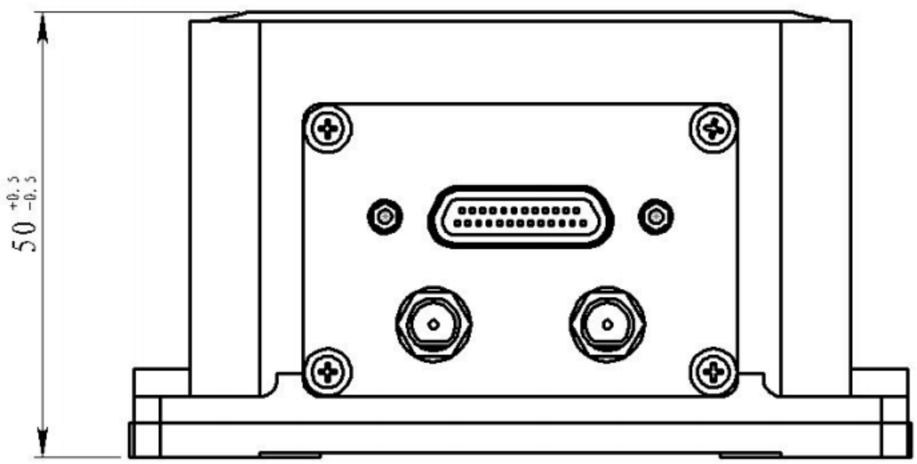
Note: XW-G6615 host unit must be measured carrier is even, and install the bottom should be parallel to the datum of the tested vehicle, Y axis pointing to host nameplate marking must be consistent with the measured vector direction.



5 XW-G6615Install the schematic

3.3 Cable connection

Connect antenna feeder to GNSS/BD antenna and host unit "Front (antenna)", "Back after (antenna)" on the interface, use above should be shining, avoid electric plug pull plug-in.



6 Cable connection socket

3.4 The power supply connection

Connect the red and black alligator clip to the dc regulated power supply (power supply voltage: 12 or 24 v power supply current: 1 a), pay attention to distinguish the polarity of the two leads, and shielding respectively with insulating tape, prevent short circuit.

4 XW - G6615 instructions

4.1 XW - G6615 coordinate system definition

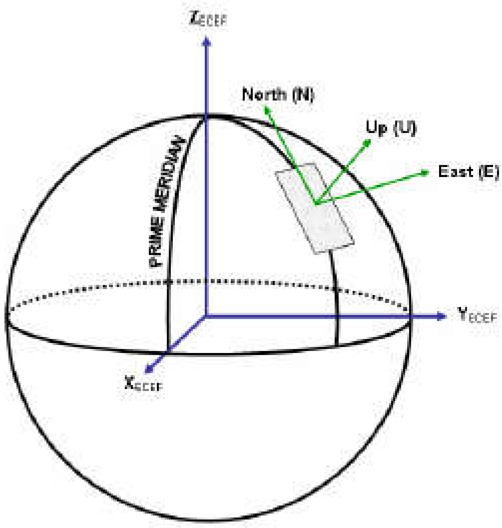
XW - G6615 coordinate system commonly used include:

- Local geographic coordinate system;
- Equipment coordinate system;
- Carrier coordinate system。

4.1.1 The local geographic coordinate system

The local geographical coordinates are defined as follows:

- Y - pointing north;
- Z - to point to the day;
- X - pointing to the east;



7 The local geographic coordinate system schematic diagram

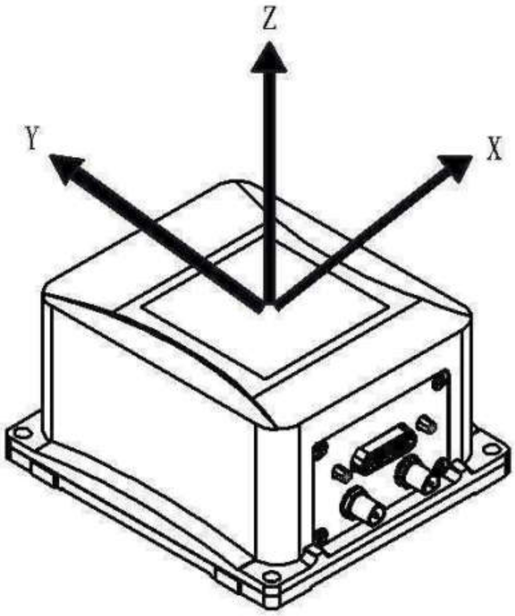
4.1.2 Device coordinate system

The device coordinate system are defined as follows:

- Z - Perpendicular to the surface of shell, the shell to point to the day;

- Y - direction of an air plug - shell;
- X - Right to point to shell, perpendicular to the Z, Y direction。

Coordinate system for the equipment shell as shown in the equipment, as shown below:

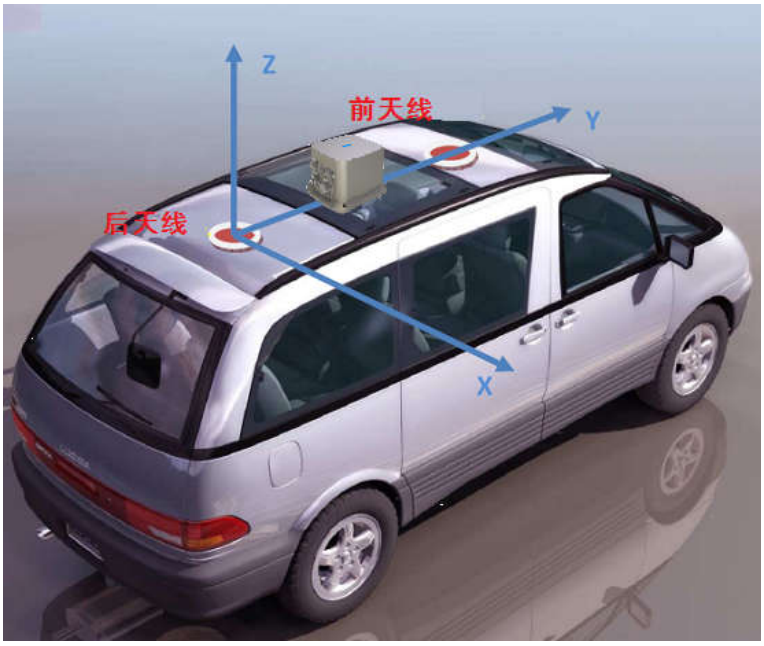


8 Device coordinate diagram

4.1.3 Carrier coordinate system

Carrier coordinate system are defined as follows:

- Z — The earth surface, the car body to point to the day;
- Y — Point to the direction vector;
- X — Comply with the right hand coordinate system, pointing to the body to the right。



9 Carrier coordinate system schematic diagram。

4.2 XW - G6615 operation instructions

4.2.1 The initial alignment state

XW - G6615 product after power up, the first thing you need to enter the initial alignment model, the role of the model through the gyro, accelerometer measurement and corresponding decoding based navigation initial heading, posture and speed, position reference information, so that later on the basis of the navigation solution. Initial to remain still need products on time to place 40 seconds, so that through calculating to establish initial benchmark. After the completion of the initial alignment equipment that is entered into a state of normal navigation.

Note:

The equipment is in a state of initial alignment carrier should try to keep still, to avoid shaking impact on the precision of initial alignment.

4.2.2 Satellite integrated navigation state

Equipment to complete the initial alignment function after into the normal state of integrated navigation. In the condition of the function, through the device's built-in high-performance integrated navigation processor, built-in high precision fiber optic gyro strapdown navigation and quartz accelerometer information, at the same time, the results of the navigation and localization of GNSS/BD input for the built-in Kalman filter are combined to obtain a more accurate after the combination of the vehicle location, speed and heading, many parameters, such as navigation information.

4.2.3 Displacement sensor (DMI) integrated navigation state

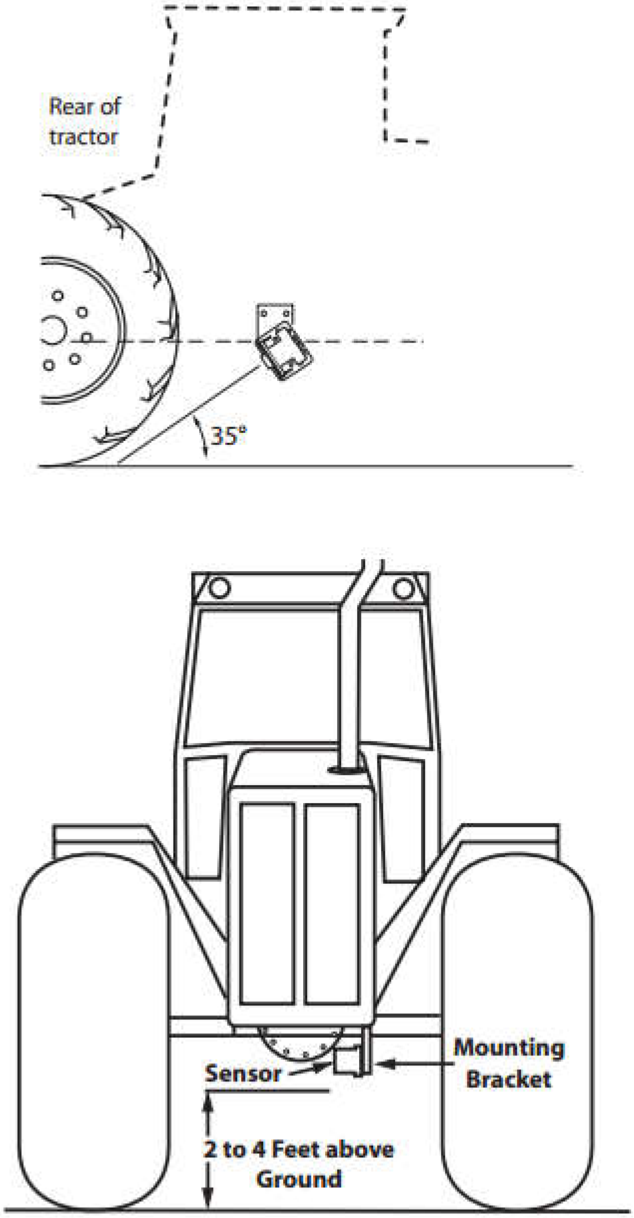
XW - G6615 product support displacement sensor (DMI) integrated navigation function, covers the odometer, SuLei and DVL, satellite auxiliary is not necessary in this mode, can use the auxiliary of DMI sensor shows a high precision navigation information for a long time. The realization of the function of DMI integrated navigation first need to SuLei odometer, or the DVL installation configuration, such as specific installation configuration instructions is as follows:

Displacement sensor selection:

XW - G6615 product support pulse type or CAN DMI sensor serial communication type, support including vehicle odometer, SuLei reach different sensor types such as underwater DVL. XW - G6615 for pulse displacement sensor, support 5 v ~ 24 v pulse voltage range, single pulse signals or plus or minus reversible double pulse signals.

Pulse sensor installation steps:

- Ready to dc regulated power supply or batteries, laptop, marked on the product packing list items;
- Install the DMI sensor fixed on the vehicle, installation and installation Angle depending on the displacement sensor requirements, recommend to SuLei sensor installation method as shown in figure 31:



31 DMI Sensors installation diagram

Pulse type DMI sensor Settings can also be through to the serial port to send instructions to complete the configuration as follows:$cmd,set,pulseX,mode*ff

PulseX - according to the actual connection choose pulse1 ~ pulse3;

Mode - optional none, dmi, dmiphase, on behalf of the dmi sensor, single pulse signal or both positive and negative double pulse signals.

Note:

After the first installation DMI sensors should be DMI equipment calibration, to determine the DMI scale and its installation Angle error and to compensate.

4.2.4 Displacement sensor (DMI) calibration model

First time using a combination of DMI sensor function, need operation DMI sensor calibration. Specific operation process is as follows:

- Connect the product all the cable connection is good, odometer.
- For equipment to complete the initial alignment function into the BD/GNSS integrated navigation status;
- Start speedometer calibration, send a speedometer calibration "$CMD, set, navmode, dmicali * ff", G positioning board message set GPFPD status bit will be DMI calibration status.
- Calibration process, try to keep in the open and flat road, about two kilometers, drive to ensure the normal order of the GNSS/BD position, after the completion of the calibration GI positioning board message set GPFPD state automatically restore GNSS/BD directional state, speedometer calibration is complete;
- Calibration system and meet DMI integrated navigation conditions, after the completion of the GNSS/BD invalid automatically turn to DMI portfolio model, under the condition of high accuracy navigation information is given for a long time

4.2.5 Vertical gyro (VG) mode

XW - G6615 products can be in the normal navigation mode input $CMD, set, navmode, vg, on * ff command into the vg model, in this mode without GNSS/BD or odometer auxiliary equipment, can provide high precision dynamic and static horizontal posture to measure information (pitch, roll), and the accuracy of measurement is not with the gyro drift. VG model device speed, location, navigation information is not available, send $CMD, set, navmode, VG, closed off * ff VG model.

Note::

1, the equipment on the initial report should try to keep the carrier still 40 seconds, to avoid shaking impact on the precision of initial alignment.

2, the equipment on the initial electric 40 seconds, enter $CMD, set, navmode, vg, on * ff command into the vg model.

4.2.6 Navigation post-processing function Settings

In order to provide high precision position meet street view application requirements, such as XW - G6615 introduced post-processing function. Post-processing function of the realization of the first need to establish differential reference station, XW - G6615 product of form a complete set the benchmark for GNSS1061 station equipment, connection method such as section 4.3.8, GNSS1061 configuration commands are as follows:

- Log comX rangecmpb ontime 1(newline)
- Log comX rawephemb onchanged(newline)

You need the XW - G6615 product agreement COM0 mouth connection to a data acquisition device, and the mouth COM0 configuration is as follows:

$cmd,through,com0,rangecmpb,1*ff

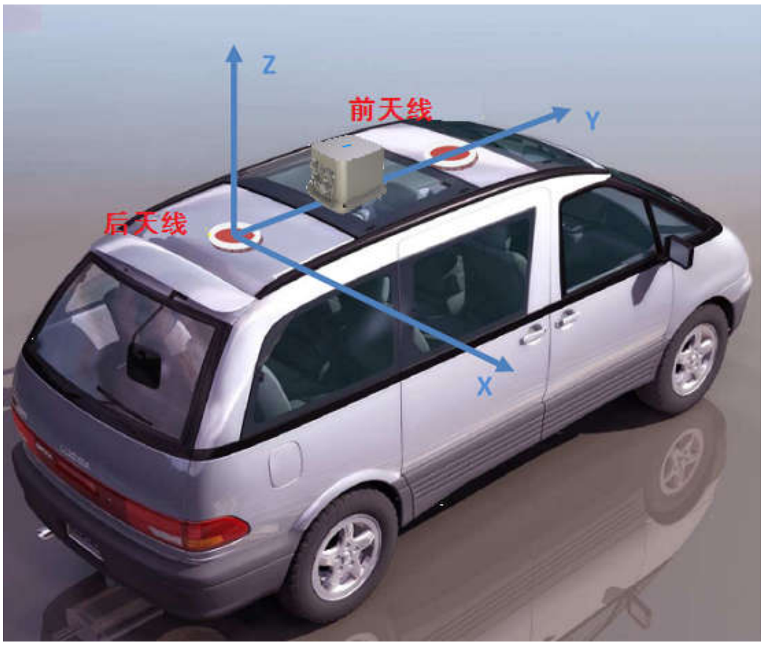
$cmd,through,com0,rawephemb,new*ff

$cmd,output,com0,rawimusb,0.01*ff

Collection devices available ComCenter serial records such as software or internal storage data, finally, the base station, COM0 output data will be recorded in the post-processing software for processing, can get the precise position data information (post-processing data storage format is compatible with Novatel post-processing software InertialExploer).

4.2.7 GNSS/BD lever arm error Settings

GNSS/BD relative inertial navigation system is the lever arm effects of GNSS/BD antenna component installation location and the location of the center is not coincidence of inertial navigation system and velocity measurement error, will appear in the process of the customer's specific use distance both location makes the error to the point of cannot be ignored, then must to error compensation lever arm.



32 The lever arm error map

GNSS/BD antenna and inertial navigation equipment installation method as shown in figure 32, and we will compensate after antenna and the error between the lever arm of inertial navigation devices.

Compensation is input through the upper machine life $CMD, set, leverarm, GNSS, x_offset, y_offset, z_offset * ff

X_offset: X direction error of the lever arm

Y_offset: Y direction error of the lever arm

Z_offset: Z direction error of the lever arm

By manual measurement can be obtained in the X direction between the distance of d, there is no distance in Y direction and Z direction, so get x_offset is 0, y_offset − d, z_offset is 0, the input device can complete compensation lever arm measurement results above.

4.2.8 RTK feature set

Carrier phase difference is also called the gps-rtk technology (Real Time Kinematic), real-time processing is based on two station on the basis of carrier phase. It can provide real-time observation point of three-dimensional coordinates, and reach the centimeter level accuracy. Equipment in the condition of difference, first using the known exact 3 d coordinate differential GNSS/BD benchmark station, pseudorange correction or position correction is obtained, then the correction sent to real-time XW - G6615 equipment, measuring data of equipment modification, in order to improve positioning accuracy.

The realization of the function of difference first need to establish differential reference station, XW - G6615 product of form a complete set of benchmark for GNSS1061 station equipment. Next station need to difference output information through the wireless digital radio transmission XW - G6615 products, wireless digital radio data output should connect XW - G6615 differential input interface. Specific difference setup instructions as follows:

5 XW - G6615 interface definitions

5.1 Device interface

The connector some	define	note
1	COMO-TX	
3	COMO-RX	
5	GND	
7	COM1-TX	
9	COM1-RX	
11	GND	Two way RS232
13	RS422-RX+	
15	RS422-RX-	All the way RS422
17	RS422-TX-	
19	RS422-TX+	
2	EXTI1	
4	EXTI2	
6	EXTGND	
8	CANH	
10	CANL	
12	IO	
14	GND	
16	USB+5V	
18	USBD-	
20	USBD+	
21	GND	
22, 23	24V	
24, 25	24VGND	

(1) before the antenna: standard SMA female head, the feeder and GNSS antenna connection before/BD

(2) after the antenna: standard SMA female head, after feeder with GNSS/BD antenna connection.

6 XW – G6615 agreement

6.1 Data output protocol description

1) GPFPD:Standard GI positioning board message set

The data format:

$GPFPD, GPSWeek, GPSTime, Heading, Pitch, Roll, Lattitude, Longitude, Altitude, Ve , Vn, Vu, Baseline, NSV1, NSV2, Status *cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	Header	FPD Head agreement	$GPFPD	$GPFPD
2	GPSWeek	Since the 1980-1-6 to the current number of weeks (GMT)	wwww	1451
3	GPSTime	Since this Sunday 0:00:00 to the current number of seconds (GMT)	ssssss.sss	368123.300
4	Heading	Yaw Angle（0～359.99）	hhh.hh	102.40
5	Pitch	Pitching Angle（-90～90）	+/-pp.pp	1.01
6	Roll	Roll Angle（-180～180）	+/-rrr.rr	-0.80
7	Lattitude	latitude（-90～90）	+/-ll.lllllll	34.1966004
8	Longitude	longitude（-180～180）	+/-lll.lllllll	108.8551924
9	Altitude	Height, the unit (m)	+/-aaaaa.aa	80.60
10	Ve	East to speed, the unit (m/s)	+/-eee.eee	4. 717
11	Vn	North to speed, the unit (m/s)	+/-nnn.nnn	10. 206
12	Vu	Days to speed, the unit (m/s)	+/-uuu.uuu	-0.020
13	Baseline	The baseline length, the unit (m)	bb.bbb	13.898
14	NSV1	1 satellite antenna number	nn	11
15	NSV2	2 satellite antenna number	nn	12
16	Status	**The system state：** The lower half byte ASCII： 0：There is no GPS 1：Coarse alignment 2：Fine alignment 3：GPS positioning 4：GPS orientation 5：RTK 6：DMI combination 7：DMI calibration 8：Pure inertial 9：Zero velocity correction A：VG model	ss	2F

		B：The RTK directional C：Initialize F：Abnormal state High half a byte ASCII: 0：single point 4：GPS static solution 5：GPS floating point solution		
17	Cs	check	*hh	*58
18	<CR> <LF>	Fixed package tail		<CR> <LF>

2) GPFPS: Heikki GI positioning board message set (only for heikki extended product)

The data format:

$GPFPS,GPSWeek,GPSTime,Heading,Pitch,Roll,Lattitude,Longitude,Altitude,Head_dc,Heave,Ve,Vn,Vu,Baseline,NSV1,NSV2,Status*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	Header	FPD Head agreement	$GPFPS	$GPFPS
2	GPSWeek	Since the 1980-1-6 to the current number of weeks (GMT)	wwww	1451
3	UTCTime	Since this Sunday 0:00:00 to the current number of seconds (GMT)	ssssss.sss	368123.300
4	Heading	Yaw Angle（0～359.99）	hhh.hh	60.10
5	Pitch	Pitching Angle（-90～90）	+/-pp.pp	1.02
6	Roll	Roll Angle（-180～180）	+/-rrr.rr	1.01
7	Lattitude	latitude（-90～90）	+/-ll.lllllll	34.1966004
8	Longitude	longitude（-180～180）	+/-lll.lllllll	108.8551924
9	Altitude	Height, the unit (m)	+/-aaaaa.aa	80.10
10	Head_dc	Drift Angle	+/-hh.hh	1.02
11	Heave	Heave, the unit (m)	+/-hh.hh	0.05
12	Ve	East to speed, the unit (m/s)	+/-eee.eee	8. 000
13	Vn	North to speed, the unit (m/s)	+/-nnn.nnn	-2. 000
14	Vu	Days to speed, the unit (m/s)	+/-uuu.uuu	0.010
15	Baseline	The baseline length, the unit (m)	bb.bbb	13.898
16	NSV1	1 satellite antenna number	nn	11
17	NSV2	2 satellite antenna number	nn	12
18	Status	**The system state：** The lower half byte ASCII： 0：There is no GPS 1：Coarse alignment 2：Fine alignment	ss	2F

		3：GPS positioning 4：GPS orientation 5：RTK 6：DMI combination 7：DMI calibration 8：Pure inertial 9：Zero velocity correction A：VG model B：The RTK directional C：Initialize F：Abnormal state High half a byte ASCII: 0：single point 4：GPS static solution 5：GPS floating point solution		
19	cs	check	*hh	*58
20	<CR> <LF>	Fixed package tail		<CR> <LF>

3) GPFPA: Air GI positioning board message set (only for empty extended product)

The data format:

$GPFPA,GPSWeek,GPSTime,Heading,Pitch,Roll,Lattitude,Longitude,Altitude, Head_dc, airpeed,Ve,Vn,Vu,Baseline,NSV1,NSV2,Status*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	Header	FPD Head agreement	$GPFPA	$GPFPA
2	GPSWeek	Since the 1980-1-6 to the current number of weeks (GMT)	wwww	1451
3	UTCTime	Since this Sunday 0:00:00 to the current number of seconds (GMT)	ssssss.sss	368123.300
4	Heading	Yaw Angle（0～359.99）	hhh.hh	320.00
5	Pitch	Pitching Angle（-90～90）	+/-pp.pp	1.01
6	Roll	Roll Angle（-180～180）	+/-rrr.rr	0.90
7	Lattitude	latitude（-90～90）	+/-ll.lllllll	34.1966004
8	Longitude	longitude（-180～180）	+/-lll.lllllll	108.8551924
9	Altitude	Height, the unit (m)	+/-aaaaa.aa	80.00
10	Head_dc	Drift Angle	+/-hh.hh	1.02
11	airpeed	Airspeed, the unit (m/s)	+/-aaa.aaa	0.050
12	Ve	East to speed, the unit (m/s)	+/-eee.eee	4. 904
13	Vn	North to speed, the unit (m/s)	+/-nnn.nnn	10. 035
14	Vu	Days to speed, the unit (m/s)	+/-uuu.uuu	-0.020

15	Baseline	The baseline length, the unit (m)	bb.bbb	13.898
16	NSV1	1 satellite antenna number	nn	11
17	NSV2	2 satellite antenna number	nn	12
18	Status	**The system state：** The lower half byte ASCII： 0：There is no GPS 1：Coarse alignment 2：Fine alignment 3：GPS positioning 4：GPS orientation 5：RTK 6：DMI combination 7：DMI calibration 8：Pure inertial 9：Zero velocity correction A：VG model B：The RTK directional C：Initialize F：Abnormal state High half a byte ASCII: 0：single point 4：GPS static solution 5：GPS floating point solution	ss	2F
19	cs	check	*hh	*58
20	<CR> <LF>	Fixed package tail		<CR> <LF>

4) GTIMU：Time，the IMU data display message set

The data format:

$GTIMU,GPSWeek,GPSTime,GyroX,GyroY,GyroZ,AccX,AccY,AccZ,Tpr*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GTIMU	IMU Head agreement	$GTIMU	$GTIMU
2	GPSWeek	Since the 1980-1-6 to the current number of weeks (receiver)	wwww	1550
3	GPSTime	The number of seconds a week (GPS) receiver time	ssssss.sss	298625.000
4	GyroX	Angular rate gyro X axis, the unit (c/s)	±ggg.gggg	0.0140
5	GyroY	Angular rate gyro Y axis, the unit (c/s)	±ggg.gggg	0.0012
6	GyroZ	Angular rate gyro Z axis, the unit (c/s)	±ggg.gggg	0.0032
7	AccX	The accelerometer X axis acceleration, the unit is (g)	±aaa.aaaa	0.0001

8	AccY	The accelerometer Y axis acceleration, the unit is (g)	±aaa.aaaa	0.0001
9	AccZ	The accelerometer Z axis acceleration, the unit is (g)	±aaa.aaaa	1.0001
10	Tpr	Temperature, the unit is C	±tt.t	-35.7
11	Cs	check	*hh	*56
12	<CR><LF>	Fixed package tail		<CR><LF>

5) GPHPD:GNSS positioning directional message set

The data format:

$GPHPD, GPSWeek, GPSTime, Heading, Pitch, Track, Latitude, Longitude, Altitude, Ve , Vn, Vu,Baseline, NSV1, NSV2*cs<CR><LF>

The highest output rate: 5 hz (specific depending on the GNSS receiver)

Field no.	The name	instructions	format	For example,
1	Header	HPD Message protocol header	$GPHPD	$GPHPD
2	GPSWeek	Since the 1980-1-6 to the current number of weeks (receiver)	wwww	1451
3	GPSTime	The number of seconds a week (GPS) receiver time	ssssss.sss	368123.300
4	Heading	Yaw Angle（0~359.99）	hhh.hh	90.01
5	Pitch	Pitching Angle（-90~90）	+/-pp.pp	0.12
6	Track	Speed relative to true north direction Angle（0~359.99）	+/-ttt.tt	90.11
7	Latitude	latitude(-90～90)	+/-ll.lllllll	34.1966004
8	Longitude	longitude(-180～180)	+/-lll.lllllll	108.8511121
9	Altitude	Height, the unit (m)	+/-aaaaa.aa	394.98
10	Ve	East to speed, the unit (m/s)	+/-eee.eee	-0.157
11	Vn	North to speed, the unit (m/s)	+/-nnn.nnn	0.019
12	Vu	Days to speed, the unit (m/s)	+/-uuu.uuu	-0.345
13	Baseline	The baseline length, the unit (m)	bb.bbb	3.898
14	NSV1	1 satellite antenna number	nn	6
15	NSV2	2 satellite antenna number	nn	6
16	Status	**State of the system:** The low byte ASCII: 0：There is no GPS 1：GPS directional locking 2：GPS positioning 3：GPS orientation lock 5：The differential positioning B：The differential directional	ss	11

		High half a byte ASCII: 0： single point 4： GPS static solution 5： GPS floating point solution		
17	Cs	check	*hh	*0B
18	<CR> <LF>	Fixed package tail		<CR> <LF>

6) GPHDT :GNSS directional information

The data format： $GPHDT ,Heading,True*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPHDT	HDT Message protocol header	$GPHDT	$GPHDT
2	Heading	Yaw Angle 0~360	hhh.hhh	180.123
3	True	Fixed field	String	T
4	Cs	check	*hh	*3C
5	<CR> <LF>	Fixed package tail		<CR> <LF>

7) GPGGA: GNSS positioning information

The data format::

$GPGGA,hhmmss.ss,Latitude,N,Longitude,E,FS,NoSV,HDOP,msl,m,Altref,m,DiffAge,DiffStation*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPGGA	GGA Message protocol header	$GPGGA	$GPGGA
2	hhmmss.ss	UTC time	hhmmss.ss	092725.00
3	Latitude	Degree of latitude, format, leading digit less than zero padding	dddmm.mmmm	4717.1139
4	N	Latitude hemisphere N (north) or S (south)	c	N
5	Longitude	Degree of longitude, format, leading digit less than zero padding	dddmm.mmmm	00833.9159
6	E	E longitude hemisphere (east longitude) or W (n)	c	E
7	FS	GPS status: 0 = initialization, 1 = single point positioning, 2 = code difference, 4 = fixed solution, 5 = floating point solution, 6 = are estimated, 7 = artificial fixed value, 8 = traffic forecast model, 9 = WAAS difference.	x	1
8	NoSV	Are using calculating the number of	xx	08

		satellite position, leading digit less than zero padding		
9	HDOP	HDOP Horizontal dilution of precision （0.5~99.9）	x.x	1.1
10	msl	The altitude	xxxxx.xx	499.60
11	m	Unit, M	c	M
12	Altref	The earth ellipsoid height of relative geoid	xxxx.xx	48.00
13	m	Unit, M	c	M
14	DiffAge	Difference time, when leading digit less than zero, since the latest receives the difference the number of seconds, if not the differential positioning will be empty	xx	00
15	DiffStation	Difference station ID, when leading digit less than zero, if not the differential positioning will be empty	xxxx	0000
16	cs	check	*hh	*5B
17	<CR> <LF>	Fixed package tail		<CR> <LF>

8) GPGSV:GNSS satellites the main distribution

The data format: $GPGSV,NoMsg,MsgNo,NoSv,{,sv,elv,az,cno}*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPGSV	GSV Message protocol header	$GPGSV	$GPGSV
2	NoMsg	GSV The total number of statements	x	3
3	MsgNo	This sentence GSV Numbers	x	1
4	NoSv	When the total number of visible satellites, a leading digit less than zero	xx	05
5	sv	PRN code (pseudo random noise code), the leading digit less than zero padding	xx	23
6	elv	Satellite elevation (00-90), the unit (c), a leading digit less than zero padding	xx	38
7	az	Satellite azimuth (000 ~ 359), the unit (c), a leading digit less than zero padding	xxx	230
8	cno	Signal-to-noise ratio (00-99), the unit (dB), a leading digit less than zero padding	xx	44
9	…	Information will be carried out in accordance with the each satellite cycle, according to each GSV statements can be displayed at most four satellite information. Other satellite information will be the next sequence of NMEA0183 statement output. Less than four satellites when the field is empty		

…	...			
	cs	check	*hh	*7F
	<CR> <LF>	Fixed package tail		<CR> <LF>

This agreement fully in accordance with relevant provisions of the format of the output characters in length.

9) G1GSV:GNSS from satellite distribution

The data format: $G1GSV,NoMsg,MsgNo,NoSv,{,sv,elv,az,cno}*cs<CR><LF>

This agreement and GPGSV agreement in addition to the head.

10) GPGSA:GNSS main factor value accuracy and available satellites

The data format: $GPGSA,Smode,FS{,sv},PDOP,HDOP,VDOP*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPGSA	GSA Message protocol header	$GPGSA	$GPGSA
2	Smode	Pattern, M = manual, A = automatically	c	A
3	FS	Position type, 1 = no positioning, 2 = 2 d positioning, 3 = 3 d positioning	x	3
4	Sv	1 channel are using satellite, leading digit less than zero padding	xx	03
…	...	…		
15	Sv	12 channel are using satellite, leading digit less than zero padding	xx	21
16	PDOP	PDOP position dilution of precision （0.5~99.9）	x.x	1.9
17	HDOP	HDOP horizontal dilution of precision （0.5~99.9）	x.x	1.1
18	VDOP	VDOP vertical dilution of precision （0.5~99.9）	x.x	1.5
19	cs	check	*hh	*0D
20	<CR> <LF>	Fixed package tail		<CR> <LF>

11) G1GSA:GNSSFrom standing dilution of precision value and available satellites

The data format: $G1GSA,Smode,FS{,sv},PDOP,HDOP,VDOP*cs<CR><LF>

This agreement and GPGSA agreement in addition to the head.

12) GPVTG: GNSSInformation on the ground,

The data format: $GPVTG,cogt,T,cogm,M,sog,N,kph,K,mode*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPVTG	VTG Message protocol header	$GPVTG	$GPVTG
2	cogt	True north as the ground of the reference benchmark course, unit (c), range（0~359.999）	xxx.xxx	77.208
3	T	Fixed field	c	T
4	cogm	Magnetic north as the ground of the reference benchmark course, unit (c), range （0~359.999）	xxx.xxx	80.101
5	M	Fixed field	c	M
6	sog	Rate of the ground, the unit (day)	xxxx.xxx	0.465
7	N	Fixed field	c	N
8	kph	Rate of the ground, the unit (km/h)	xxxx.xxx	0.802
9	K	Fixed field	c	K
10	mode	Pattern instructions (A = autonomous positioning, D = difference, E = estimation, N = invalid data))	c	A
11	cs	check	*hh	*0B
12	<CR> <LF>	Fixed package tail		<CR> <LF>

13) GPRMC:GNSSRecommended location information

The data format:

$GPRMC,hhmmss,status,latitude,N,longitude,E,spd,cog,ddmmyy,mv,mvE,mode*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPRMC	RMC Message protocol header	$GPRMC	$GPRMC
2	hhmmss	UTC time, HHMMSS (minutes)	hhmmss.ss	083559.00
3	status	Positioning, effective positioning, A = V = null and void	c	A
4	latitude	Degree of latitude, format, leading digit less than zero padding	ddmm.mmmm	4717.1143
5	N	N latitude hemisphere (northern hemisphere) or S (southern)	c	N
6	longitude	Degree of longitude, format, leading digit less than zero padding	ddmm.mmmm	00833.9152
7	E	E longitude hemisphere (east longitude) or W (n)	c	E
8	Spd	Rate of the ground, the unit (day)	x.xxx	0.402

9	cog	Ground course (0 ~ 359.99), the unit (c), a benchmark for true north	x.x	77.5
10	ddmmyy	UTC date ddmmyy (the sun)	ddmmyy	091202
11	mv	Magnetic declination, the unit (c), a leading figures when zero padding	x.x	0.0
12	mvE	The direction of the magnetic declination, E (east), or W (west)	c	E
13	mode	Pattern instructions (A = only independent positioning, D = difference, E = estimation, N = data is invalid	c	A
14	cs	check	*hh	*53
15	<CR> <LF>	Fixed package tail		<CR> <LF>

14) GPGLL:GNSS Geodetic coordinate information

The data format:

$GPGLL,latitude,N,longitude,E,hhmmss.sss,mode*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPGLL	GLL Message protocol header	$GPGLL	$GPGLL
2	latitude	Degree of latitude, format, leading digit less than zero padding	ddmm.mmmm	4717.1143
3	N	N latitude hemisphere (northern hemisphere) or S (southern)	c	N
4	longitude	Degree of longitude, format, leading digit less than zero padding	ddmm.mmmm	00833.9152
5	E	E longitude hemisphere (east longitude) or W (n)	c	E
6	hhmmss	UTC time, HHMMSS format (minutes), a leading digit less than zero padding	hhmmss.ss	083559.00
7	mode	A = positioning, V = not positioning)	c	A
8	cs	check	*hh	*53
9	<CR> <LF>	Fixed package tail		<CR> <LF>

15) GPZDA:GNSS UTC time and date

The data format:

$GPZDA,hhmmss,dd,mm,yyyy,pp,ff*cs<CR><LF>

Field no.	The name	instructions	format	For example,
1	$GPZDA	ZDA Message protocol header	$GPZDA	$GPZDA
2	hhmmss	UTC time, unit seconds, leading digit less than zero padding	hhmmss.ss	083559.00

3	dd	UTC date, leading digit less than zero padding	dd	30
4	mm	Zero padding when insufficient in UTC, leading figures	mm	10
5	yyyy	UTC years	yyyy	2013
6	pp	The local time zone hours offsets, leading digit less than zero padding	xx	00
7	ff	Minutes of the local time zone offset, leading digit less than zero padding	xx	00
8	cs	check	*hh	*53
9	<CR> <LF>	Fixed package tail		<CR> <LF>

16) GPFPD_BIN:GI Positioning of informant message set

Message structure		message header	Frame no.	data fields	check	length
		0xAA 0x55	0x01	49 Bytes	CK	53 Bytes
The data fields						
Byte offset	**The data format**	**The name**	**unit**	**instructions**		
0	U16	Week of GPS		Since the 1980-1-6 to the current number of weeks (GMT)		
2	U32	GPS seconds		From 0:00:00 on Sunday to the current number of seconds (GMT), the ratio of 0.001		
6	Float	Yaw Angle	degree	0～360		
10	Float	Pitching Angle	degree	-90～90		
14	Float	Roll Angle	degree	-180～180		
18	U32	latitude	degree	-90～90, The proportional coefficient of 1 e - 7		
22	U32	longitude	degree	-180～180, The proportional coefficient of 1 e - 7		
26	U32	highly	m	Ratio of 0.001		
30	Float	East to speed	m/s	4. 904		
34	Float	North to speed	m/s	10. 035		
38	Float	Days to speed	m/s	-0.020		
42	Float	The baseline length	m	13.898		
46	U8	1 satellite antenna number		11		
47	U8	2 satellite antenna number		12		
48	U8	The system state		With GPFPD		

17) GPFPA_BIN:Air GI positioning board message set (only for empty extended product)

Message structure	message header	Frame no.	data fields	check	length
	0xAA 0x55	0x03	57 Bytes	CK	61 Bytes
The data fields					
Byte offset	**The data format**	**The name**	**unit**	**instructions**	
0	U16	Week of GPS		Since the 1980-1-6 to the current number of weeks (GMT)	
2	U32	GPS seconds		From 0:00:00 on Sunday to the current number of seconds (GMT), the ratio of 0.001	
6	Float	Yaw Angle	degree	0～360	
10	Float	Pitching Angle	degree	-90～90	
14	Float	Roll Angle	degree	-180～180	
18	U32	latitude	degree	-90～90, The proportional coefficient of 1 e - 7	
22	U32	longitude	degree	-180～180, The proportional coefficient of 1 e - 7	
26	U32	highly	m	Ratio of 0.001	
30	Float	Drift Angle	degree		
34	Float	airspeed	m/s		
38	Float	East to speed	m/s	4. 904	
42	Float	North to speed	m/s	10. 035	
46	Float	Days to speed	m/s	-0.020	
50	Float	The baseline length	m	13.898	
54	U8	1 satellite antenna number		11	
55	U8	2 satellite antenna number		12	
56	U8	The system state		With GPFPA	

18) GPFPS_BIN:Heikki GI positioning board message set (only for heikki extended product)

Message structure	message header	Frame no.	data fields	check	length
	0xAA 0x55	0x03	57 Bytes	CK	61 Bytes
The data fields					

Byte offset	The data format	The name	unit	instructions
0	U16	Week of GPS		Since the 1980-1-6 to the current number of weeks (GMT)
2	U32	GPS seconds		From 0:00:00 on Sunday to the current number of seconds (GMT), the ratio of 0.001
6	float	Yaw Angle	degree	0～360
10	float	Pitching Angle	degree	-90～90
14	float	Roll Angle	degree	-180～180
18	U32	latitude	degree	-90～90, The proportional coefficient of 1 e - 7
22	U32	longitude	degree	-180～180, The proportional coefficient of 1 e - 7
26	U32	highly	m	Ratio of 0.001
30	Float	Drift Angle	degree	
34	Float	heave	m	
38	float	East to speed	m/s	4. 904
42	float	North to speed	m/s	10. 035
46	float	Days to speed	m/s	-0.020
50	float	The baseline length	m	13.898
54	U8	1 satellite antenna number		11
55	U8	2 satellite antenna number		12
56	U8	The system state		With GPFPS

19) GTIMU_BIN: IMU data message set

Message structure	message header	frame no.	length	The data fields	check
	0xAA 0x55	0x05	60	564Bytes	CK

The data fields:

Byte offset	The data format	The name	unit	instructions
0	U16	Week of GPS		Since the 1980-1-6 to the current number of weeks (GMT)
2	U32	GPS seconds		From 0:00:00 on Sunday to the current number of seconds (GMT), the ratio of 0.001
6	Double	GyroX	degree	Angular rate gyro X axis, the unit (c/s)
14	Double	GyroY	degree	Angular rate gyro Y axis, the unit (c/s)
22	Double	GyroZ	degree	Angular rate gyro Z axis, the unit (c/s)
30	Double	AccX	degree	The accelerometer X axis acceleration, the unit is (g)
38	Double	AccY	degree	The accelerometer Y axis acceleration, the

				unit is (g)
46	Double	AccZ	degree	The accelerometer Z axis acceleration, the unit is (g)
54	I16	The temperature	c	

20) RAWIMUB: Post-processing of IMU message set

The frame header:

Byte offset	data format	name	unit	instructions
0	Char	frame header		0xAA
1	Char	frame header		0x44
2	Char	frame header		0x13
3	Uchar	frame length		Do not include the frame head and CRC check frame length
4	Ushort	frame no.		325
6	Ushort	Week of GPS		Since the 1980-1-6 to the current number of weeks (GMT)
8	Ulong	GPS Milliseconds	ms	Since this Sunday 0:00:00 to the current number of milliseconds (GMT)

data:

Byte offset	data format	name	unit	instructions
0	Header	frame header		
H	Ulong	Week of GPS		Since the 1980-1-6 to the current number of weeks (GMT)
H+4	Double	GPS Milliseconds	ms	Since this Sunday 0:00:00 to the current number of milliseconds (GMT)
H+12	Long	IMU state		0x00000001 X State of gyro 1:normal 0:abnormal 0x00000002 Y State of gyro 1:normal 0:abnormal 0x00000004 Z State of gyro 1:normal 0:abnormal 0x00000010 X State of the acceleration 1:normal 0:abnormal 0x00000020 Y State of the acceleration 1:normal 0:abnormal 0x00000040 Z State of the acceleration 1:normal 0:abnormal
H+16	Long	Z acceleration output		Z acceleration in the period of an output variation
H+20	Long	-Y acceleration output		Y acceleration in the period of an output variation

H+24	Long	X acceleration output		X acceleration in the period of an output variation
H+28	Long	Z Gyro output		Z gyroscope in the period of an output variation
H+32	Long	Y Gyro output		Y gyroscope in the period of an output variation
H+36	Long	X Gyro output		X gyroscope in the period of an output variation
H+40	Hex	CRC		32-bitCRC check

Gyroscope Scale Factor: 0.1/(3600X256.0) rad/LSB
Acceleration Scale Factor: 0.05/2(15) m/s/LSB

21) RANGECMPB Post-processing using GPS message set

The frame header:

Byte offset	data format	name	unit	instructions
0	Char	frame header		0xAA
1	Char	frame header		0x44
2	Char	frame header		0x12
3	Uchar	frame length		28
4	Ushort	frame no.		140
6	Char	Reserved		
7	Uchar	Reserved		
8	Ushort	frame length		Do not include the frame head and CRC check frame length
10	Ushort	Reserved		
12	Uchar	Reserved		
13	Uchar	Reserved		
14	Ushort	Week		
16	Long	Ms		
20	Ulong	Reserved		
24	Ushort	Reserved		
26	Ushort	Reserved		

DATA:

Byte offset	data format	name	unit	instructions
0	Header	frame header		
H	Long	Number of satellites		#obs
H+4	24Bytes	First star data		Specific content see the table below（Range Record Format）
	Next rangecmp offset = H+4+(#obs*24)			
H+40	Hex	CRC		32-bitCRC

Range Record Format

An offset	length	Name	Scale factor	instructions
0 -31	32	Channel tracking state		
32-59	28	Doppler frequency	1/256	Hz
60-95	36	pseudorange（PSR）	1/128	m
96-127	32	ADR	1/256	Cycles
128-131	4	StdDev-PSR	0 ： 0.050 1 ： 0.075 2 ： 0.113 3 ： 0.169 4 ： 0.253 5 ： 0.380 6 ： 0.570 7 ： 0.854 8 ： 1.281 9 ： 2.375 10 ： 4.750 11 ： 9.500 12 ： 19.00 13 ： 38.00 14 ： 76.00 15 ： 152.0	m
132-135	4	StdDev-ADR	(n + 1)/512	Cycles
136-143	8	PRN/Slot	1	-
144-164	21	Lock Time	1/32	S
165-169	5	C/No	(20 + n)	dB-Hz
170-191	22	Reserved		

22) RAWEPHEMB Post-processing using GPS message set

Frame:

Byte offset	data format	name	unit	instructions
0	Char	frame header		0xAA
1	Char	frame header		0x44
2	Char	frame header		0x12
3	Uchar	frame length		28
4	Ushort	frame no.		41
6	Char	Reserved		
7	Uchar	Reserved		
8	Ushort	frame length		Do not include the frame head and CRC check

				frame length
10	Ushort	Reserved		
12	Uchar	Reserved		
13	Uchar	Reserved		
14	Ushort	Week		
16	Long	Ms		
20	Ulong	Reserved		
24	Ushort	Reserved		
26	Ushort	Reserved		

DATA:

Byte offset	data format	name	unit	instructions
0	Header	frame header		
H	Ulong	Prn		Satellite no.
H+4	Ulong	Ref Week		Ephemeris reference for weeks
H+8	Ulong	ref secs		Ephemeris reference number of seconds
H+12	Hex（30）	Subframe 1		
H+42	Hex（30）	Subframe 2		
H+72	Hex（30）	Subframe 3		
H+40	Hex	CRC		32-bitCRC

6.2 Command protocol specification

Response command for the system response using: is divided into three respectively set up success, set up failure, without this command.

name	content
Set up the success	$cmd,config,ok* cs<CR><LF>
Setup failed	$cmd,Config,failed* cs<CR><LF>
Without this command	$cmd,Bad,Command* cs<CR><LF>

1) Set the output format command

The command format:$cmd,output,comX,cmdname,rate*ff

name	format	example,	unit	instructions
$cmd	string	$cmd		cmd Message protocol header
command	string	output		The output
Attribute	string	Com1		The output port name comX
data1	string	gpfpd		The output message name Gpfpd,gpfpa,gpfps,gpzda,gpgll,gpvtg Rawimu,gtimu, Gpfpd_bin,gpfpa_bin,gpfps_bin,gtimu_bin, bestgpspos
data2	numeric	0.1	秒	The message data interval (unit: second) 0.01(100Hz) 0.05(20Hz) 0.1(10Hz) 0.2(5Hz) 0.5(2Hz) 1(1Hz) Null Shut down
cs	string	*ff		ff

Note: all messages and commands a case-insensitive; After completion of all the Settings command all needs to save the Settings, otherwise the reset command will be invalid after power on, $CMD, output, comX, null * ff can turn off all the output comX output.

2) Set up the GPS agreement passthrough

The command format:$cmd,through,comX,cmdname,rate*ff

name	format	example,	unit	instructions
$cmd	string	$cmd		cmd Message protocol header
command	string	through		The output
Attribute	string	Com1		The output port name comX
data1	string			The output message name Rangecmpb Rawephemb Gpgga
data2	numeric	1		The message data interval (unit: second) 0.2(5Hz) 1(1Hz) New

				Null Shut down
cs	string	*ff		ff

Note: all messages and commands a case-insensitive; After completion of all the Settings command all needs to save the Settings, otherwise the reset command will be invalid after power on, $CMD, throught, comX, null * ff for closed comX all through the output.

3) Set the serial port

The command format:$cmd,set,comX,baudrate,parity,Databit,Stopbit,Commode, Comtype*ff

name	format	example,	unit	instructions
$cmd	string	$cmd		cmd Message protocol header
Command	string	set		Set
attribute1	string	comX		Com0、com1、com2
data	numeric	baudrate	bps	波特率230400 115200 57600 38400 19200 9600
Data	String	parity		Parity bit odd even (odd) (I) none (no)
Data	numeric	databit		8
Data	numeric	Stopbit	位	Stop 1 2
Data	numeric	Mode		RS232、RS422
Data	string	type		The Log (user communication) RTK (RTK)
cs	hexadecimal	*ff		ff

4) Access to a serial port Settings

The command format:$cmd,get,com*ff

Return to command: $cmd,get,com0,115200,none,8,1,rs232,log*ff

$cmd,get,com1,115200,none,8,1, rs232,log *ff
$cmd,get,com2,115200,none,8,1, rs422,log *ff

5) Set the pulse input port mode

The command format:$cmd,set,pulseX,####,####*ff

name	format	example,	unit	instructions
$cmd	string	$cmd		cmd Message protocol header

command1	string	set		Set
command3	string	PulseX		NO pulse1 pulse2 pulse3 pulse
attribute	string	Dmi		Dmi (odometer) dmiphase (positive and negative pulse odometer) none (no)
cs	hexadecimal	*ff		ff

6) Pulse input port mode

The command format: $cmd,get,pulse*ff

Return to command: $cmd,get,pulse1,dmi*ff

7) Setting up the GNSS lever arm parameters

The command format: $cmd,set,leverarm,gnss,x_offset,y_offset,z_offset*ff

name	format	example,	unit	instructions
$cmd	string	$cmd		cmd Message protocol header
attribute1	string	set		
attribute2	string	Leverarm		
attribute2	String	Mode		Gnss（GNSS to the lever arm inertial navigation）
data1	Numeric	x_offset	m	X to the relative displacement
data2	Numeric	y_offset	m	Y to the relative displacement
data3	Numeric	z_offset	m	Z to the relative displacement
cs	hexadecimal	*ff		ff

8) Get GNSS lever arm parameters

The command format: $cmd,get,leverarm *ff

Return to command: $cmd,get,gnss,leverarm, x_offset, y_offset, z_offset*ff

9) Set NAVMODE mode

The command format: $cmd,set,navmode,mode,xxx*ff

name	format	example,	unit	instructions
$cmd	string	$cmd		cmd Message protocol header
attribute1	string	Set		
attribute2	string	Navmode		Navigation mode
Command	String	Mode		finealign：Fine alignment（on、off） gnss：gnss Mode（none，single，double）

				carmode：Car model（on、off） dmicali：speedometer calibration azicali：Antenna calibration vg：VG mode
Data	String	String		On,off,none
cs	hexadecimal	*ff		ff

10) Get NAVMODE mode

The command format：$cmd,get, navmode*ff

Return to command：$cmd,get,navmode ,###*ff

11) Set the coordinate

The command format：$cmd,set,coordinate,x,y,z*ff

名称	格式	举例	单位	说明
$cmd	string	$cmd		cmd Message protocol header
attribute1	string	Set		
attribute2	string	coordinate		Pour shaft set
Command	String	X		X axis as the current coordinate equipment, can be to x - x
Command	String	Y		Y as the current coordinate equipment, can be to y，-y
Command	String	Z		Z as the current coordinate equipment, can be to z，-z
cs	hexadecimal	*ff		*ff

Appendix A

The common failures and solutions

Users find products appear abnormal situation, should first check the cable connection is normal, after confirm the cable connection normal still cannot solve the problem, please cut off power supply, the personnel of the service with your company, don't remove the equipment without permission.

24 phone：18108614973

Q:Device does not locate;

A:Confirm satellite antenna is not subject to keep out, search star observation devices, such as search for zero or less than four, and will not be positioning, check the antenna connection. If still cannot solve the problem, please contact customer service personnel.

Q：Equipment positioning, but not orientation;

A：Confirm satellite antenna from the shade, locating orientation cases, after the antenna is normal, if not a connection problem, before and after the antenna can be exchange, exchange after still can't orientation, can eliminate the abnormal situation of the antenna. Problems may be on a host computer, can contact customer service to further determine the problem.

Q：You can't get a device data computer;

A：May be the computer serial port, cable, host problem;

Q：Equipment positioning orientation but not difference;

A：Confirm the benchmark station really determine the base station, can remove fixed base station information, to reset the base station; Check the base station and G6615 difference between hosts data link is normal. If still cannot solve the problem, please contact customer service personnel.

Q：Equipment return data and actual obvious discrepancy;

A：Confirm whether the host fixed firmly, whether the antenna fixed firmly, output GTIMU statements, product still placed, observe the three-axis gyroscope data consistency, such as discrepancy is likely larger gyro is abnormal.

Appendix B

Data protocol verification mode

NMEA standard statement of general format

Common format is as follows:
$AACCC，c—c*hh<CR><LF>
Among them：
$（24H）：Statements starting
AACCC： Address field, the former two said "sender", said after the three statement type
“，”（2Ch）Field separator
c—c： Statement of the data area
“*”（2Ah） The separator
hh Checksum, exclusive or operation, from "$" to" * "between all of the characters, but does not include" $" and "*". When transmitting high four and four low hex value is converted into two ASCII characters. High byte first.
<CR><LF>（0Dh，0Ah） End of the statement

Standard NMEA sentences allow empty fields, when one or more parameters of the information is not reliable or invalid, replaced with empty fields. According to the position in the statement, empty fields use two commas ",, "or," * "as the separator.

Check formula:

```
unsigned char CS = 0;
for (i=0; i< BUFFER_LENGTH; i++) // BUFFER_LENGTH The length of the data fields

{
    CS += Buffer[i];
}
```