TYPE 50 FIBER STRAPDOWN INERTIAL NAVIGATION SYSTEM

PRODUCT DESCRIPTION

Type 50 Optical Fiber Integrated Navigation System, a cutting-edge solution meticulously engineered to provide unrivaled performance. This system encompasses a compact and lightweight three-axis integrated closed-loop fiber optic gyroscope, accelerometer, and guidance card, offering exceptional cost-effectiveness. Leveraging advanced multi-sensor fusion and navigation algorithms, it delivers precise measurements of attitude, heading, and position information with remarkable accuracy.

Designed with versatility in mind, the Type 50 system finds its perfect application in medium to high precision mobile measurement systems and medium to large unmanned aerial vehicles (UAVs). Its seamless integration and reliable performance make it an invaluable asset for various industries, including surveying, mapping, aerial photography, and more.

Experience the pinnacle of navigation technology with the Type 50 Optical Fiber Integrated Navigation System, enabling you to unlock new levels of precision and efficiency in your operations.

MAIN FUNCTION

The system offers a combined inertial/satellite navigation mode and a pure inertial mode.
In the inertial/satellite integrated navigation mode, the internal GNSS receiver uses the satellite positioning information for integrated navigation and outputs the carrier's pitch, roll, heading, position, speed, and time information. When the signal is lost, the output includes the position, velocity, and attitude calculated by inertia, with a requirement to maintain accurate pitch and roll, along with a short-term course holding function and meter-level positioning accuracy.
The pure inertial mode (no GPS fusion occurs after powering on, and if lock is lost again after fusion, it enters the integrated navigation mode) features an accurate attitude measurement function, and can output pitch, roll, heading, and perform static north searching based on pure inertia.

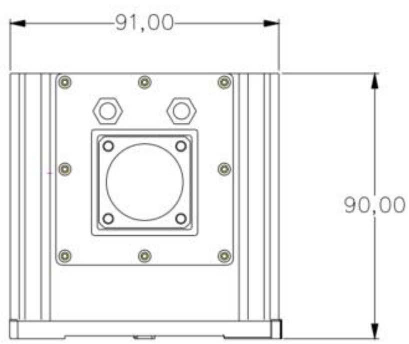
PERFORMANCE INDEX

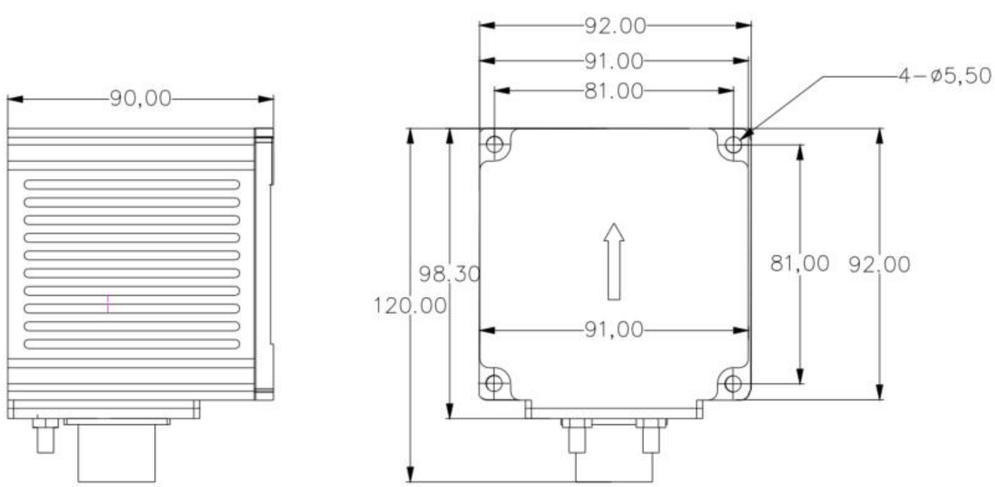
Project	Test condition	Index
Positioning accuracy	GNSS works, a la carte	1.5m
	GNSS is valid, RTK	2cm+1ppm
	Pure inertial horizontal positioning (Alignment efficiency)	80m/5min（CEP） 500m/10min（CEP） 1.5nm/30min（CEP）
	Airspeed combination horizontal positioning hold (It is used on board, and there is turning maneuver before airspeed combination. The test takes 150km/h flight speed as an example, and the wind field is stable)	0.8nm/30min (CEP)
Course accuracy	Single antenna (RMS)	0.1° (Vehicle conditions, need to maneuver)
	Dual antenna (RMS)	0.2°/L (L is the baseline length) (RMS)
	Course keeping (RMS)	0.2°/30min（RMS），0.5°/h
	Self-seeking north accuracy (RMS)	0.2°SecL, dual alignment for 15min 1.0°SecL, unit for 5-10 minutes

Attitude accuracy	GNSS valid	0.02°（RMS）
	Attitude retention (GNSS failure)	0.2°/30min（RMS），0.5°/h（RMS）
Velocity accuracy	GNSS valid, single point L1/L2	0.1m/s（RMS）
Gyroscope	Measuring range	±400°/s
	Zero bias stability	≤0.3°/h
Accelerometer	Measuring range	±20g
	Zero bias stability	≤100μg
Physical dimensions and electrical characteristics	Voltage	9-36V DC
	Power consumption	≤12W (steady state)
	I Interface	2 channel RS232,1 channel RS422,1 channel PPS (LVTTL/422 level)
	Dimension	92.0 mm×92.0mm×90.0mm
Environmental characteristics	Operating temperature	-40℃~+60℃
	Storage temperature	-45℃~+70℃
	Vibration	5~2000Hz, 6.06g(with shock absorption)
	Impact	30g, 11ms(with Shock absorption)
	Life span	>15 years
	Continuous working time	>24h

OVERALL DIMENSION

The inertial measurement unit adopts an integrated design scheme, and the system outline is shown in the figure below.
System dimensions: 92.0mm × 92.0mm ×90.0mm.





WORKING PRINCIPLE

Product Composition

The composition of the product is as follows Figure 1.

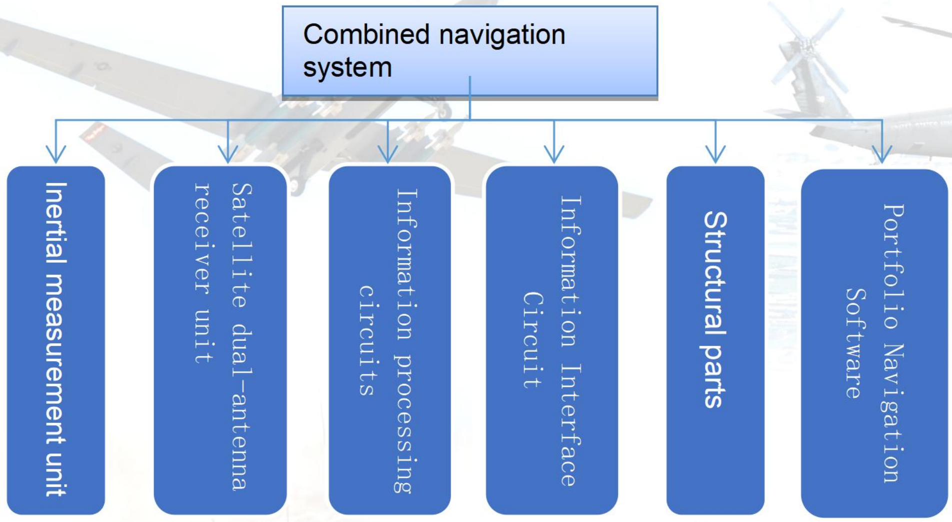


Figure 1 System Composition

Fundamentals

The inertial measurement unit consists of three accelerometers and three fiber optic gyroscopes, which are responsible for measuring the acceleration and angular velocity of the carrier and sending this information to the information processing circuit. The information processing circuit uses the acceleration and angular velocity measured by the inertial measurement unit for navigation settlement, and also receives satellite navigation information from the satellite receiver as a reference for combined navigation, corrects the navigation error of the inertial guidance, and outputs the navigation information through the information interface unit.

The basic principle is shown in the following figure:

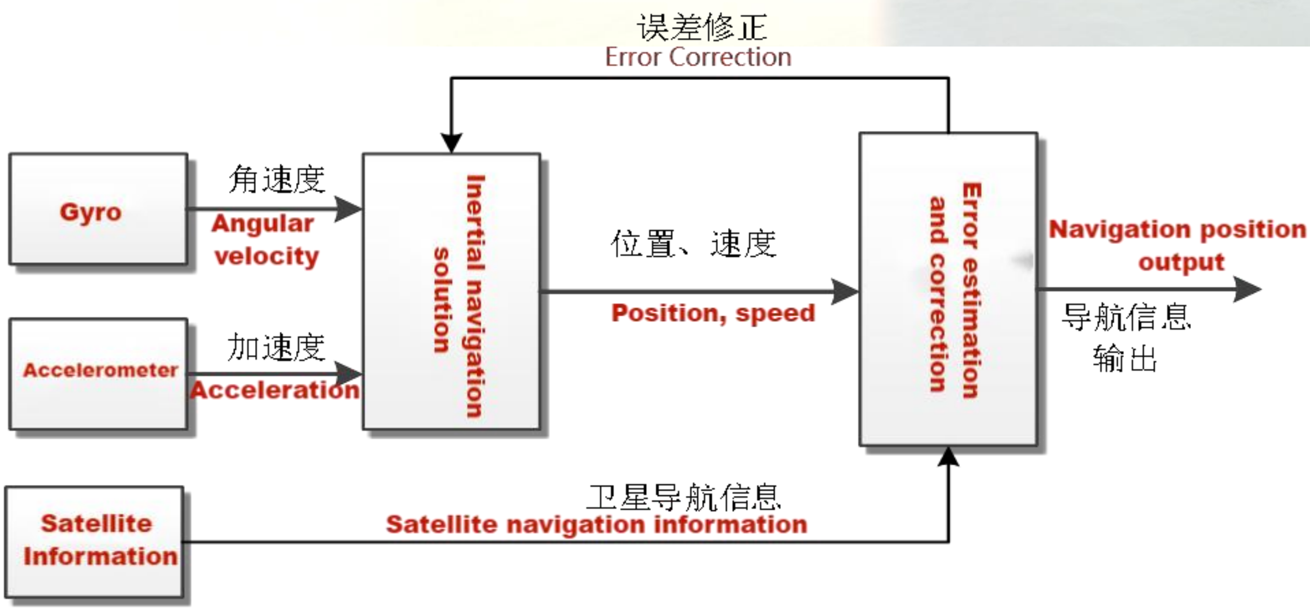


Figure 2 schematic diagram of working principle

INSTRUCTIONS FOR USE

Electrical Interface

The system has 1 external connector:

- Power supply and communication interface X1.
- 1 cable is connected to X1 at one end, the other end is divided all the way to power the red and black clips as well as divided into 3 serial ports, respectively COM1~COM3, where COM1 is RS422, COM2 and COM3 are RS232. COM1 can be used to send working mode commands;
- The external connector points are defined as shown in Table 1:

Table 1. X1 connector point definition

Connection point 1 (J599/26FD35PHA)		Connection point 2			Terminal number definition (connection point 1)		Remarks
Plug wire label code	Terminal number	Plug wire label code	Terminal number				
X1	30	COM4(L138)	3		COM4_232R		Main processor program upgrade port, RS232
X1	16		2		COM4_232T		
X1	23		5		GND		
X1	20	COM2	1	3	COM2_422R+	COM2_232R	Inertial guide serial port COM2 422/232 can be matched Default 422
X1	2		2		COM2_422R-		
X1	19		3		COM2_422T+		
X1	1		4	2	COM2_422T-	COM2_232T	
X1	23		5	5	GND	GND	
X1	21	COM1	1	3	COM1_422R+	COM1_232R	Inertial guide serial port COM1 422/232 can be matched Default 422
X1	3		2		COM1_422R-		
X1	17		3		COM1_422T+		
X1	18		4	2	COM1_422T-	COM1_232T	
X1	24		5	5	GND	GND	
X1	35	Satellite Navigation COM1	3		Satellite Navigation COM1_RXD		Guardian Card Serial Port 1 232
X1	36		2		Satellite Navigation COM1_TXD		
X1	24		5		GND		
X1	5	COM3	3		COM3_RXD		Inertial guide serial port COM3 232
X1	22		2		COM3_TXD		
X1	34		5		GND		
X1	4	Satellite Navigation EVENT			Dump Line		
X1	34	GND			Dump wire		
X1	6	24V_2			Red Alligator Clips		Guiding board EVENT
X1	7	24V_1			Red Alligator Clip		
X1	8	24VGND			Black Alligator Clip		Power input
X1	11	ETHER_TX_P	Orange and white		ETHER_TX_P		Power input ground Network port
X1	25	ETHER_TX_N	Orange		ETHER_TX_N		
X1	9	ETHER_RX_P	Green-white		ETHER_RX_P		
X1	10	ETHER_RX_N	Green		ETHER_RX_N		
X1	12	PPS+_1			Dump Cable		
X1	26	PPS-_1			Dump Line		
X1	14	DI1+			Dump Line		PPS (default input)
X1	28	DI1-			Dump Line		

X1	13	DI2+		Dump Line	First odometer
X1	27	DI2-		Dump Line	
X1	15	DO1+		Dump Line	Second odometer
X1	29	DO1-		Dump Line	
X1	37	CAN1H		Dump Line	Output
X1	31	CAN1L		Dump Line	
X1	32	CAN2H		Dump Line	First CAN
X1	33	CAN2L		Dump line	

Instructions for use

1、**System Workflow**

The inertial guidance system consists of two workflows, a combined navigation process and a pure inertial navigation process.

1.1、Start-up prompt message

Connect the cable, power up the system, monitor the COM1 interface information through the serial debugging tool of the test computer, and send workflow commands to the COM1 interface through the serial debugging tool after the interface displays "Please enter NaviMode within 20s! "If the command is not sent within 20s, the system will automatically enter the internal saved workflow after 20s.

1.2、Portfolio navigation process

After entering the combined navigation process, the first binding satellite information, if the satellite does not position, it is in the state of waiting for satellite information; when the satellite information is valid, it enters the alignment state, alignment time 1min, alignment period requires the inertial guide stationary, alignment is complete, the inertial guide can move, the system is in the combined navigation state.

1.3、Pure inertial navigation process

After entering the pure inertial navigation process, the first 1min coarse alignment, if the satellite information is valid, the binding satellite information for 1500s fine alignment, if there is no satellite information, the static base must be aligned 1500s; alignment is completed after the transfer to the pure inertial navigation state, the inertial guidance can move.

2、System configuration commands

2.1、Configuration options and saving

The inertial guidance system provides 3 external serial ports (configuration number: com1, com2, com3), and provides an internal storage channel (configuration number: file), 3 serial ports can be configured, each serial port function assignment and related configuration as follows:

Table 2. Inertial guidance system serial port function assignment table

Configuration number	Input Items	Output items	Default
COM1	1. working mode commands and process control commands; 2. COM1, COM2, COM3 baud rate configuration; 3. COM1, COM2, COM3 protocol and update rate configuration; 4. Storage file port protocol configuration.	1.SNCNAVPVTA/SNCNAVPVTB； 2.INSPVASA/INSPVASB； 3.BDFPD； 4. RAWIMUSB (fixed 200Hz SPAN-ISA-100C format); 5. configuration prompt messages;	RS422； 460800bps； Output ： BDFPD；
COM2	Same as COM1	Same as COM1	RS422； 460800bps； Output: None
COM3	Same as COM1	Same as COM1	RS232； 460800bps； Output: None

file	The system automatically saves the stored information according to the user's configuration. The saved data file is named RECORDX.txt, where X is the file number. When a configuration query is made, the current latest file name is displayed.	1. Fixed will have SNCPOSTB protocol and can not be canceled, the protocol for data backup. 2. System in the case of power on, the network port side plugged into the computer for storage data export status.	None

After the system is powered on and the serial port displays the startup information, you can input commands such as COM1, COM2, COM3 serial port baud rate configuration, serial protocol and update rate setting, etc. If each command output is successful, it will return "cmd ok" or "<OK ", otherwise "cmd error" or "<ERR" will be displayed. After inputting, type "saveconfig" to save this configuration, and the next reboot will automatically call this configuration, if you don't input this command, the configuration of serial port will be restored to the last saved configuration after next reboot.

2.2、Configuration queries

Typing the "log loglist" command through the inertial guide serial port will list all the configurations of COM1, COM2 and COM3, including the following:

- Serial port number, serial port baud rate, serial port protocol and update rate.
- Function module open status: including zero speed correction status and smooth processing status, open as enable, close as disable; carrier type;
- Internal storage status information: including the file name of the last file, remaining space, etc;
- Initial binding latitude and longitude;
- System number and production date;
- Software version number: including preprocessing software version number and navigation software version number;
- Operating modes: including combined navigation (DGI) and pure inertial navigation (INS).

2.3、Baud rate configuration

- Enter the following command in this mode to enter the serial port baud rate configuration:

com comX BAUDRATA

- Where X is 1~3 and BAUDRATA is the baud rate in bps.

For example, to set the baud rate of COM2 port to 460800bps, enter the following command:
com com2 460800

2.4、Update Rate Configuration

The configuration of COM1~COM3 and memory file port SNCNAVPVTA/B, BDFPD, INSPVASA/B and other protocols through the inertial guide serial port is performed with the following configuration commands:

log comX/file LOG ontime updataTime

where comX can be com1~com3 configuration number, file for the memory interface configuration number; updataTime represents the update time, can be 5 (0.2Hz), 1 (1Hz), 0.2 (5Hz), 0.1 (10Hz), 0.01 (20Hz) and other periods that can be 200Hz frequency division, unit s.

LOG indicates the protocol name, can be inspvasa, inspvasb, bdfpd, etc.

For example, to configure the COM2 port to output 10Hz SNCNAVPVTA data, the following command can be entered through the inertial guide serial port:

log com2 sncnavpvta ontime 0.1

If you need to output 10Hz bdfpd data at COM2 at the same time, you can then enter the following command through the inertial guide serial port:

log com2 bdfpd ontime 0.1

As a further example, to store 1 Hz of the inspvasa protocol data into the internal memory of the inertial guide, the following command can be entered through the serial port of the inertial guide:

log file inspvasa ontime 1

If you want to turn off a protocol, the configuration command is as follows:

log comX/file LOG off

The configuration of the rawimusb protocol for COM1~COM3 ports and memory file port is performed through the inertial guide

serial port with the following configuration commands:
log comX/file rawimusb onchanged
If you want to turn off the rawimusb protocol for this serial port, the configuration command is as follows：
log comX/file rawimusb off
If you want to disable all protocols on the serial port, the following command is configured：
unlogall comX/file
Note that increasing the update rate or outputting several protocols at the same time, these will increase the amount of data sent by the serial port, and you need to configure the baud rate to match it before using it, otherwise it may cause lost numbers. In general, the larger the amount of data, the higher the baud rate required.

2.5、Initial value latitude and longitude configuration

Initial latitude and longitude configuration, the configuration command is：
initialpos LONGITUDE LATILUDE
where LONGITUDE and LATITUDE are the configured local latitude and longitude values, in degrees.

2.6、Function module configuration

The function modules with on configuration mainly include zero speed correction and output position smoothing.

2.6.1、"Zero speed correction" configuration

Zero speed correction function mainly refers to the inertial guide to detect the sensitive information, if the inertial guide is judged to be zero speed, then make the corresponding correction.
If the satellite information is invalid for a long time in the combined navigation state, and the user wants to get pure inertial navigation information, it is recommended to turn off the zero speed correction mode.
Zero speed correction configuration commands are as follows:
inszupt switch
The switch value is disable or enable, where disable means turn off the function and enable means turn on the function.

2.6.2 、"Position output smoothing" configuration

The position information in protocols such as INSPVASA and BDFPD is inertial guidance navigation position information. To get smoother position information, a position output smoothing function is added to the navigation software, and the smoothed position noise is smaller.
This product in the combination of navigation process "position output smoothing" default is off, in order to facilitate the user to choose, this function can be configured, configuration instructions are as follows:
possmooth SWITCH
The switch value is disable, enable, where disable means turn off the function, enable means turn on the function.

2.7 Carrier type configuration

According to the different carriers installed in the inertial guidance, the carrier type configuration is required, and for different carrier types, different algorithms are processed within the system.
The configuration commands are as follows:
carrier vehicle/ship/air
In order, they are vehicle, ship and airborne.
After the configuration is complete, you need to enter the save command saveconfig and then hard boot or enter the #reset command, the carrier type configuration will be valid after the boot. The inertial guide does not support the current configuration for current use during use, it must be restarted.
After the carrier type is configured as vehicle type, the inertial guide is required to be installed on the vehicle and fixed, and the inertial guide is oriented in the same direction as the front of the carrier vehicle, with an error of not more than 10 degrees.

2.8 、GNSS antenna pole arm configuration

Depending on the relative mounting relationship between the antenna and the inertial guide, an antenna rod arm configuration is required. The value of the rod arm between the configured inertial guide to the antenna must be measured to the nearest millimeter (mm), any rod arm measurement error will go directly into the position error of the inertial guide output, when installed and used, the inertial guide is as close as possible to the main antenna, especially in the horizontal position. This command is required before the inertial guide is aligned with the static base or in the middle and before the dynamic base is aligned. Once this configuration is complete, it needs to be saved via "saveconfig".

The configuration includes master antenna pole arm configuration and slave antenna pole arm configuration.

The master antenna configuration command is as follows:

setimutoantoffset1 armX army armZ

The slave antenna configuration command is as follows：

setimutoantoffset2 armX army armZ

Where armX, armY and armZ are the configured rod arm values in meters, representing the component of the vector from the inertial guide to the antenna phase center within the inertial guide vector coordinate system, which is chosen to be right front up (XYZ). For the example in Figure 4, armX and armY should have negative values and armZ should have positive values.

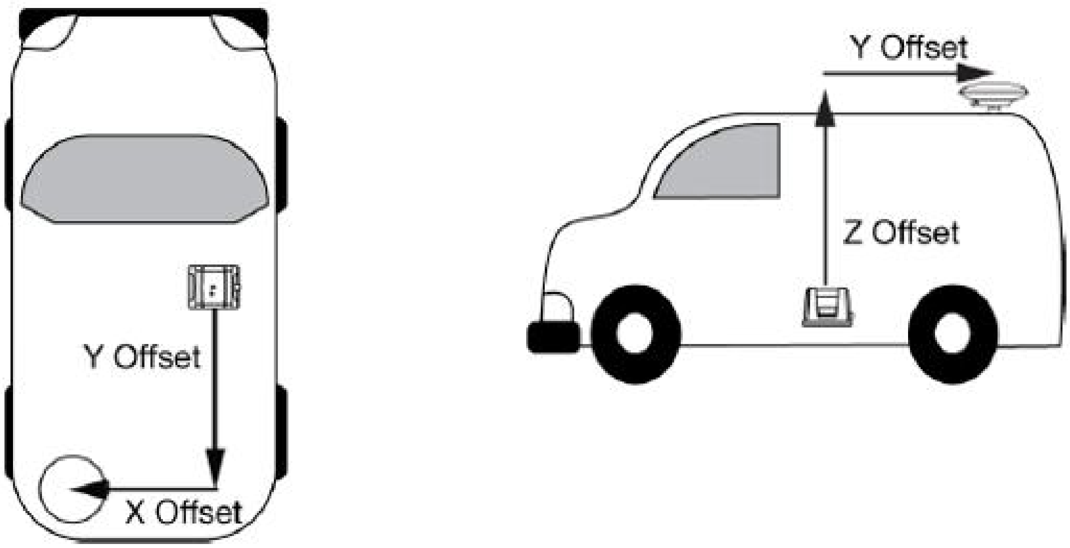


Figure 4 Schematic diagram of antenna pole arm

2.9、 Output lever arm setting

The default value for the product output lever arm configuration is [0, 0, 0] (upper right front), which is the position and velocity value at the output inertial guide. If you need to output the position and velocity of the user's test point, you need to set the output lever arm according to the relative mounting relationship between the test point and the inertial guide.

The bar arm value between the configured inertial guide and the test point must be measured to the nearest millimeter (mm) and any bar arm measurement error will go directly into the position error of the inertial guide output. This command is required before the inertial guide's static base is aligned or before the inertial guide's dynamic base is aligned. Once this configuration is complete, it needs to be saved via "saveconfig".

The output lever arm configuration command is as follows:

setimutosensoroffset armX armY armZ

where armX, armY and armZ are the configured rod arm values in meters, representing the component of the vector from the inertial guide to the test point in the inertial guide vector coordinate system, which is selected as right front up (XYZ). Figure 5 example, armY, armZ should be positive values.

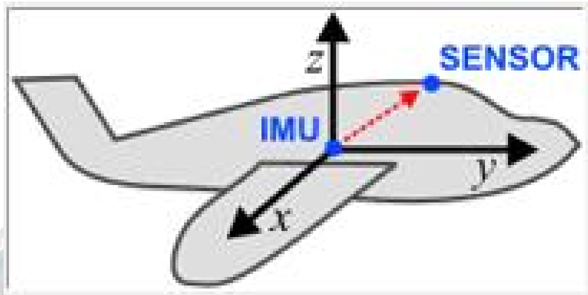


Figure 5 Schematic diagram of output lever arm

2.10、 Mounting angle setting

Both the attitude and heading information output by the product are the Euler angles of the product coordinate system with respect to the geographic coordinate system. The angular mounting relationship between the product and the carrier coordinate system is the mounting angle, and the configuration default value is [0, 0, 0] (pitch, heading, roll), which means that the product coordinate system is considered to overlap with the mounting carrier coordinate system. If there is a mounting angle for the product installed on the carrier, and the product is required to output the Euler angle of the carrier coordinate system relative to the geographic coordinate system, the mounting angle should be set according to the relative mounting relationship between the product and the carrier.

The installation angle configuration command is as follows:

vehiclebodyrotation angleX angleZ angleY

where angleX, angleZ, and angleY are configured mounting angle angle values in degrees, representing the angle from the carrier coordinate system to the combined navigation system coordinate system in the order of pitch, heading, and roll.

Note: This function will cause the output angular velocity, acceleration, and attitude to change with the settings.

3、Protocol format

The output protocols supported by the product are shown in the following table.

Table 3. Description of output data protocols

Serial number	Data Protocol Name	Protocol Type	Output Type	Support Interface
1	SNCNAVPVTB	Binary	ontime	COM1-COM3
2	SNCNAVPVTA	ASCII	ontime	COM1-COM3
3	BDFPD	ASCII	ontime	COM1-COM3
4	INSPVASA	ASCII	ontime	COM1-COM3
5	INSPVASB	Binary	ontime	COM1-COM3
6	RAWIMUSB	Binary	onchanged	COM1-COM3

3.1 、SNCNAVPVTB

Example of inertial configuration commands:

log com2 sncnavpvtb ontime 1

Table 4. sncnavpvtb format

Byte Serial Number	Data	Data Type	Number of occupied bytes	Description
0	0x55	unsigned char	1	Fixed 0x55
1	0xAA	unsigned char	1	Fixed 0xAA
2	Class	unsigned char	1	Fixed 0x00
3	ID	unsigned char	1	Fixed 0x00
4-5	Frame length	unsigned short	2	
6-7	Frame count	unsigned short	2	Self-added 1 for each frame sent
8-9	Week(GPS time)	unsigned short	2	Unit is the first week

10-17	Weeks and seconds (in GPS time)	double	8	Unit is S
18-21	Heading	int	4	Units in degrees LSB=0.0001°
22-25	Tilt	int	4	Units in degrees LSB=0.0001°
26-29	Rolling	int	4	Units in degrees LSB=0.0001°
30-33	East speed	int	4	Units in degrees LSB=0.0001m/s
34-37	North speed	int	4	Units in degrees LSB=0.0001m/s
38-41	sky speed	int	4	Units in degrees LSB=0.0001m/s
42-45	Latitude	int	4	Units in degrees LSB=0.0000001°
46-49	Longitude	int	4	Units in degrees LSB=0.0000001°
50-53	Altitude	int	4	Unit is meter LSB=0.0001m
54-57	X-axis angular velocity(right-front-up)	int	4	Units in degrees LSB=0.000001°/s
58-61	Y-axis angular velocity (right-front-up)	int	4	Unit in degrees/second LSB=0.000001°/s
62-65	Z-axis angular velocity (right-front-up)	int	4	Unit in degrees/second LSB=0.000001°/s
66-69	X-axis acceleration (right-front-up)	int	4	Unit is m/s2 LSB=0.0000001 m/s2
70-73	Y-axis acceleration(right-front-up)	int	4	Unit is m/s2 LSB=0.0000001 m/s2
74-77	Z-axis acceleration (right-front-up)	int	4	Unit is m/s2 LSB=0.0000001 m/s2
78	Master antenna positioning stars	unsigned char	1	The unit is a grain LSB＝1
79	Slave antenna positioning stars	unsigned char	1	The unit is a grain LSB＝1
80	Navigation Status Word	unsigned char	1	Bit7-Bit0 0x00: Standby 0x10: Coarse alignment 0x20: Fine alignment 0x30: Combined navigation 0x31: Pure inertial navigation
81-82	GNSS Status Word	unsigned short	2	Bit2-Bit0 =0: invalid =1: single point positioning =2: pseudo-range differential =3: RTK differential positioning Bit3: Position velocity data valid =0: invalid =1: valid Bit4: GNSS dual antenna heading is valid =0: invalid =1: valid Bit5: GPS time data is valid =0: invalid =1: valid Bit6-Bit15: Reserved for 0
83-84	Fault status word	unsigned short	2	Bit0: X-axis gyro fault word =0: normal =1: Fault Bit1: Y-axis gyro fault word =0：Normal =1: Fault Bit2: Z-axis gyro fault word =0: normal =1: Fault Bit3: X-axis acceleration fault word =0: Normal =1: Fault Bit4: Y-axis acceleration fault word =0: Normal =1: Fault Bit5: Z-axis acceleration fault word

				=0: Normal =1: Fault Bit6: GNSS board hardware fault word =0: Normal =1: Fault Bit7-Bit15: Reserved for 0
85-92	Reserved	-	8	-
93-94	Checksum	-	2	2-92 Accumulation takes the lower 16 bits

3.2、 SNCNAVPVTA

Example of inertial guidance configuration commands:
log com2 sncnavpvta ontime 1

Table 5. SNCNAVPVTA format

Agreement Components		Example	Description
Frame hea der	Protocol header	$SNCNAVPVTA	Message Type
Content	Week (when GPS)	2203	GPS Time Week Number
	Seconds (GPS time)	122515.000	GPS time cycle in seconds, three decimal places
	Heading angle	yyy.yyy	3 decimal places, in °
	Pitch angle	pp.ppp	3 decimal places, in °
	Transverse roll angle	rr.rrr	3 decimal places, in °
	Longitude	lll.lllllll	7 decimal places, in °
	Latitude	lll.lllllll	7 decimal places, in °
	altitude	hhh.hhh	Altitude value, in meters
	East speed	XXX.XXX	3 decimal places, in m/s
	north speed	XXX.XXX	3 decimal places, in m/s
	Sky speed	XXX.XX	3 decimal places, in m/s
	X-angle velocity (front-up-right)	XX.XXX	3 decimal places, in °/h
	Y angular velocity (front-up-right)	XX.XXX	3 decimal places, in °/h
	Z angular velocity (front-up-right)	XX.XXX	3 decimal places, in °/h
	X acceleration (front-up-right)	XX.XXX	3 decimal places, in m/s^2
	Y acceleration (front-up-right)	XX.XXX	3 decimal places, in m/s^2
	Z acceleration (front-up-right)	XX.XXX	3 decimal places, in m/s^2
	Navigation status word		Bit7-Bit0 0x00: Standby 0x10: Coarse alignment 0x20: Fine alignment 0x30: Combined navigation 0x31: Pure inertial navigation

	GNSS Status Word		Bit2-Bit0 =0: Invalid =1: Single point positioning =2: Pseudorange differential =3: RTK differential positioning Bit3: Position-velocity data valid =0: invalid =1: valid Bit4: GNSS dual antenna heading is valid =0: invalid =1: valid Bit5: GPS time data is valid =0: invalid =1: valid Bit6-Bit15: Reserved for 0
	Fault status word		Bit0: X-axis gyro fault word =0: normal =1: Fault Bit1: Y-axis gyro fault word =0：Normal =1: Fault Bit2: Z-axis gyro fault word =0: normal =1: Fault Bit3: X-axis acceleration fault word =0: Normal =1: Fault Bit4: Y-axis acceleration fault word =0: Normal =1: Fault Bit5: Z-axis acceleration fault word =0: Normal =1: Fault Bit6: GNSS board hardware fault word =0: Normal =1: Fault Bit7-Bit15: Reserved for 0
	Checksum	*24	Start with '$' (but not $) and end with '*' (but not *), each byte in turn iso-or
End of frame	Protocol Tail	\r\n	Line feed return

3.3 BDFPD

Example of inertial configuration command:

log com2 bdfpd ontime 1

Inertial guidance output example

$BDFPD,2105,355160.246,90.96184,-1.14427,1.01899,39.71066564,116.11209956,46.076,-0.0037,-0.0065,0.0147,20,16,0*68

Table 6: BDFPD format

Serial number	Name	Meaning	Data Type	Unit
1	$BDFPD	Format header	-	—
2	GPSWeek	Current number of weeks since 1980-1-6 to present (GMT)	Integer	—
3	GPS Week Seconds	GPS week seconds	Floating Point	s
4	Yaw angle	Yaw angle 0~360 degrees, clockwise	Floating Point	°

Serial number	Name	Meaning	Data Type	Unit
5	Pitch angle	Pitch angle-90 degrees~90 degrees	Floating Point	°
6	Roll angle	Roll angle-180 degrees~180 degrees	Floating Point	°
7	Latitude	Inertial guidance output latitude -90 degrees ~ 90 degrees	Floating Point	°
8	Longitude	Longitude of inertial guidance output-180 degrees~180 degrees	Floating Point	°
9	altitude	Inertial guidance output altitude	Floating Point	m
10	East speed	Inertial guidance output east speed	Floating Point	m/s
11	North speed	Inertial guidance output north speed	Floating Point	m/s
12	Sky speed	Inertial guidance output sky speed	Floating-point	m/s
13	NSV1	Antenna 1 satellite number	Integer	PCS
14	NSV2	Antenna 2 satellites	Integer	PCS
15	Positioning type	postype in bestpos	Integer	—
16	Orientation Type	postype in heading	Integer	—
17	Checksum	Checksum	Hexadecimal	—
18	<CR><LF>	Fixed packet tail	—	—

3.4 Short Message Protocol Header

There are two types of short header protocol headers, one is ASCII and the other is binary.

Table 7. ASCII short header

Serial number	Name	Data Type	Meaning
1	%	Char	Fixed to '%'
2	Message name	Char	Message type for this protocol
3	GPS Week	Ushort	GPS weeks (in GPS time)
4	GPS Week Seconds	float	GPS Week Seconds (GPS time)

Table 8. short binary header

Serial number	Name	Data Type	Meaning	Binary Bytes	Binary Offset
1	Synchronization Byte	Char	Fixed Hex 0xAA	1	0
2	Synchronization Byte	Char	Fixed Hex 0x44	1	1
3	Synchronization byte	Char	Fixed Hex 0x13	1	2
4	Message Length	Uchar	Message length, without header and CRC checksum	2	3
5	Message ID	Ushort	Message ID	2	4
6	GPS Week	Ushort	GPS weeks (at GPS)	4	6
7	GPS Week Seconds	Int	GPS week seconds (in GPS time, in milliseconds)	4	8

3.5 、32-bit CRC checksum

The C code history is as follows

```
#define CRC32_POLYNOMIAL 0xEDB88320L
/* --------------------------------------------------------------------------
Calculate a CRC value to be used by CRC calculation functions.
-------------------------------------------------------------------------- */
unsigned long CRC32Value(int i)
{
    int j;
    unsigned long ulCRC;
    ulCRC= i;
    for ( j = 8 ; j >0; j-- )
```

```
    {
       if ( ulCRC&1 )
           ulCRC= ( ulCRC>>1 ) ^ CRC32_POLYNOMIAL;
       else
           ulCRC>>= 1;
    }
    return ulCRC;
}
/* ---------------------------------------------------------------------------
Calculates the CRC-32 of a block of data all at once
ulCount - Number of bytes in the data block
ucBuffer - Data block
--------------------------------------------------------------------------- */
unsigned long CalculateBlockCRC32( unsigned long ulCount, unsigned char*ucBuffer)
{
    unsigned long ulTemp1;
    unsigned long ulTemp2;
    unsigned long ulCRC= 0;
    while ( ulCount-- != 0 )
    {
       ulTemp1 = ( ulCRC>>8 ) &0x00FFFFFFL;
       ulTemp2 = CRC32Value( ((int) ulCRC^ *ucBuffer++ ) &0xFF );
       ulCRC= ulTemp1 ^ ulTemp2;
    }
    return( ulCRC );
}
```

3.6、 INSPVAS

The command is short message protocol output

Inertial guidance configuration command example:

log com2 inspvasa ontime 1

ASCII example

$INS,091202,083559.00,A,4717.11437,N,00833.91522,E,499.6,M,0.004,77.52,0.02,0.00,0.00,327.19,001.69,000.00,0.00,0.00,0.00,E*64

Table 9: INSPVAS format

Agreement Components		Example	Description
Frame header	Protocol Header	$INS	Message Type
Content	UTC Date	ddmmyy	Day, month, year format
	UTC Time	hhmmss.ss	Hour-minute-second format
	Data Status	A	A=valid, V=invalid
	Latitude	ddmm.mmmmm	Degree and minute format
	Latitude direction	N	N or S (north or south latitude)
	Longitude	dddmm.mmmmm	Degree-minute format
	Longitude direction	E	E or W (East or West)
	Height of the antenna above sea level	499.6	

	Altitude units	M	M indicates unit of meter
	Ground rate	0.004	
	Ground heading	77.52	Degree as unit, true north as reference base
	X-axis velocity	0.02	km/h
	Y-axis velocity	-0.07	km/h
	Z-axis speed	0.00	km/h
	Pitch angle	001.69	Degree units, -90 to 90°
	Heading angle	127.19	Degree unit, -180～180°
	Traverse angle	000.00	Degree unit, -180～180°
	Angular velocity		
	Acceleration		
	Magnetic declination angle		°
	Magnetic declination direction		E ((East) or W (West)
	Checksum	*64	Beginning with '$' (but not $) and ending with '*' (but not *), each byte in turn iso-or
End of frame	Protocol tail	\r\n	Line feed return

3.7、 RAWIMUS

The command is short message protocol output (output binary only)

Example of inertial configuration command:

log com2 rawimusb onchanged (binary)

Table 10: RAWIMUS format

Serial number	Name	Meaning	Data Type	Binary Byte	Binary Offse
1	RAWIMUS Header	Message Header	—	H	0
2	Week	GPS Week (in GPS time)	Ulong	4	H
3	Seconds	GPS Week Seconds (GPS time)	Double	8	H+4
4	IMU Status	IMU status word	Hex Ulong	4	H+12
5	Z Accel Output	Fixed 200HZ, divided by 250000.0 becomes Z acceleration m/s2 (right - front - top)	Long	4	H+16
6	- (Y Accel Output)	Fixed 200HZ, divided by -250000.0 becomes Y acceleration m/s2 (right-front-up)	Long	4	H+20
7	X Accel Output	Fixed 200HZ, divided by 2500000.0 becomes X acceleration m/s2 (right-front-up)	Long	4	H+24
8	Z Gyro Output	Fixed 200HZ, divided by 5000000.0 becomes Z angular velocity rad/s (right-front-up)	Long	4	H+28
9	- (Y Gyro Output)	Fixed 200HZ, divided by -5000000.0 becomes Y angular velocity rad/s (right-front-up)	Long	4	H+32

Serial number	Name	Meaning	Data Type	Binary Byte	Binary Offse
10	X Gyro Output	Fixed 200HZ, divided by 5000000.0 becomes X angular velocity rad/s (right-front-up)	Long	4	H+36
14	xxxx	32-bit CRC	Hex	4	H+40
15	[CR][LF]	Fixed endings (ASCII only)	-		—

4、Data logging

This product has data storage function, total storage space 16G (internal will contain system recovery partition and other files used by the system, so it will be less than the normal empty SD card). The system automatically saves the storage information according to the user's configuration. The saved data folder is named recordX, where X is the file number (the maximum is 39), and the number increases sequentially. When X is 39, the next storage will automatically overwrite record00, and X will still increase sequentially in the next storage. If the system is configured to store data state, the system will automatically delete the earliest data folder after each power-on operation, for example, if the current generated file is record08, there will be no record09 folder in the system memory. Users can use this as a basis to find the latest data file. In addition, the current latest file name is also displayed when a configuration query is made.

The recordX folder contains the protocol files configured by the user, each protocol is a separate file with the protocol name.

CAUTIONS

- Inertial guidance system power on and off time interval of not less than 30s, otherwise it is easy to cause damage to inertial devices;
- In the handling, installation and use of the process, should be light, avoid bumping, dropping and impact;;
- After the inertial guide is turned on, you need to wait for the inertial guide to complete coarse alignment before linear motion, coarse alignment time of about 1min, or affect the measurement accuracy;
- Carrier type configuration for the vehicle type, the inertial guide is required to be installed in the car fixed, and the inertial guide direction and the direction of the front of the carrier car, the error is not more than 10 degrees.