GI910 Series

High-precision Fiber Optic Integrated Navigation System

Technical manual

V3.0

Introduction

The BW-GI910 by BWSensing is a compact fiber optic differential measurement system. It can be customized to make carriers follow specified trajectories, measuring speed, position, attitude, and outputting compensated angular velocity/acceleration. Featuring a fully solid-state design, it offers long lifespan, wide dynamic range, high bandwidth, and instant startup. Ideal for UAVs, transportation navigation, aviation stability control, mobile communication, high-end AGVs, and underwater ROV/AUV applications, it supports GNSS, odometer, DVL, barometric altimeter, etc., via multi-sensor fusion for enhanced adaptability. The tightly coupled integrated navigation system merges a high-precision dual-antenna GPS receiver with a fiber optic IMU, ensuring compact, lightweight, and high-performance operation.

Application

- Space stabilisation platform, antenna system stabilisation
- Attitude/orientation reference system, multi-beam attitude sensing
- Unmanned vehicles, unmanned aerial vehicles, unmanned ship navigation and control
- Space stabilisation platform, intelligent control of mining tunnelling machines and coal mining machines
- Automatic farming, container tracking

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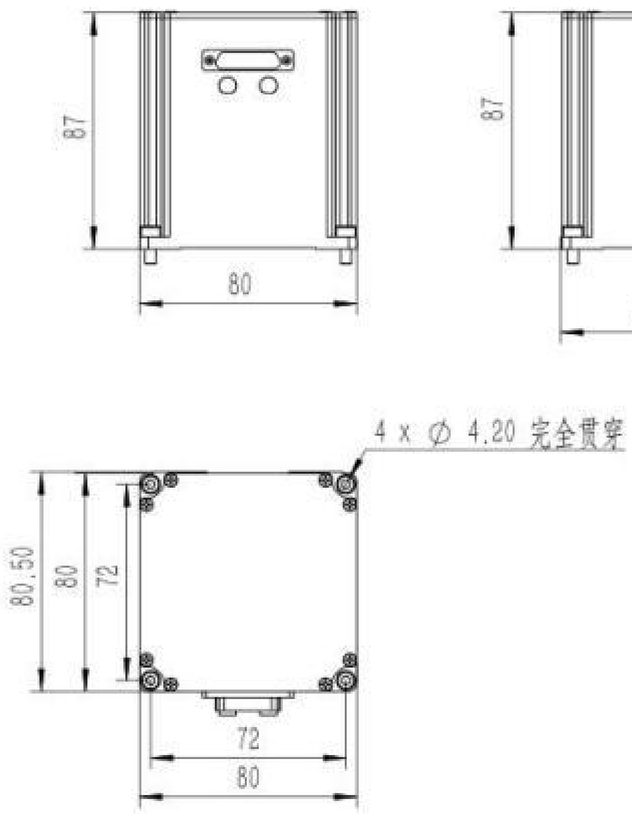
Performance Index

Parameter	Specification
North-Finding Accuracy	≤ 0.1*Secant Latitude
Heading Accuracy (deg)	≤ 0.03 (RMS, Single Antenna Dynamic Alignment)
Attitude Accuracy (deg)	≤ 0.01
Position Accuracy (m)	Inertial Navigation ≤1nm/h (cep)
	Satellite Integration ≤1.5 m (Single Point, RMS)
	DVL Integration 1% × D (D = Travel Distance)
	Odometer Integration 0.3% × D (D = Travel Distance)
Speed Accuracy	≤0.03 m/s (Satellite Integration, RMS)
GPS Failure - Azimuth Holding Accuracy (deg)	≤0.1, within 1h
GPS Failure - Attitude Holding Accuracy (deg)	≤0.03, within 1h
Position Accuracy (CEP50)	Pure Inertial (nm): ≤8, 1h
	Pure Inertial (m): ≤120, 5min
	Integration with USBL/LBL: ≥1x improvement
	Integration with DVL: 1.0%*Distance
Startup Time	≤5S
Alignment Time	≤1-2 min (Dual Antenna Satellite Aided)
Data Refresh Rate (Hz)	0.1 - 100

Gyroscope - Range	±1000°/s
Gyroscope - Bias Stability	≤0.05°/h
Accelerometer - Range	±30g
Accelerometer - Bias Stability	≤50μg
Power Supply Voltage	18-36V (DC)
Operating Temperature	-40℃ ~ 65℃
Storage Temperature	-50℃ ~ 80℃
Physical Dimensions	80 × 80 × 87 (mm)
Shock & Vibration	Complies with GJB150.16A-2009
Power Consumption	≤12W
Material	Aluminum Alloy
Weight	≤0.8kg
Interface Types	3 × RS232, 1 × RS422, 1 × PPS, 1 × CAN, 1 × RJ45

Product Size

L80 mm×W80 mm ×H87（mm）

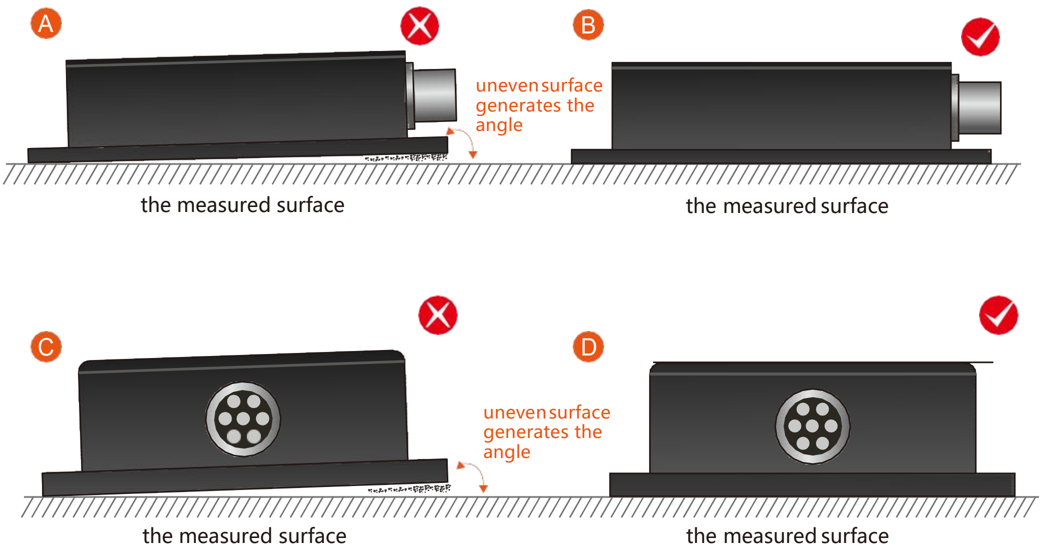


Attention：Unmarked dimensional tolerance is implemented according to GB/T1804-2000 grade C

Installation

The GPS antenna we routinely select is a zero-phase measurement one, and general navigation antennas cannot be used in this product. Although some navigation antennas can also be directional, the accuracy will be greatly reduced and errors may also result. If the user replaces an antenna that is not configured or designated by the company, the system will not work properly or other consequences will occur, and the company is not responsible for this. The correct installation method can avoid measurement errors. The integrated navigation system uses CNC grinding to machine the bottom surface and the measuring surface to make an absolutely smooth surface for easy installation. The following points should be done during installation:

First of all, you must ensure that your equipment has two absolutely smooth planes, and the two planes are absolutely perpendicular, and coincide with the body coordinate system as much as possible to reduce installation errors.
Secondly, while installing the product, the bottom surface of the integrated navigation system coincides with the bottom surface of the aircraft body. Gently push the integrated navigation system to make the combined navigation system and the aircraft surface overlap to ensure that the two surfaces are in close contact with each other. The angle shown is generated, and the correct installation method is shown in Figure B and Figure D.



Finally, after the integrated navigation system is closely attached to the body, use screws to ensure tight fixation, smooth contact, stable rotation, and avoid measurement errors due to acceleration and vibration. Remember that at this time, the screw only serves as a fixing function, not a positioning function. The screw hole of the integrated navigation system is processed into an oval shape for easy adjustment.

Electric Connections

Data cable RS422 interface definition, DB9 female::

DB9 Connector pin	Interface Definition	Remark
1	R+	Receiving positive
2	R-	Receiving negative
3	T+	Receiving positive
4	T-	Receiving negative

Debugging software

Steps for usage:

① Ensure that the inertial navigation is absolutely stationary, correctly connect the serial port hardware of the integrated navigation, and connect the power supply.

② Select computer serial port and baud rate, next click connects serial port.

③ Enter the correct geographic latitude, click Inertial Navigation Start → Command Enter, and the working state on the screen shows static alignment. After the working state becomes INS navigation, the inertial navigation enters the working state and can be used at this time.

Communication protocol

After the system works, it broadcast navigation data to the outside during normal operation on 100Hz Frequency and RS422 communication 115200bps, n, 8, 1, 48 bytes of data per frame is shown in the following table:

Navigation Data			
Byte No.	Content	Type of data	Type of data
1-2	Fra header: 0X5A 0X A5	Byte	2
3	Working data: 0- monitor status、 1-Static alignment、2-INS navigation	Byte	1
4-5	Inertial navigation pitch ([-90， 90]°)， Unit 0.01°	short int (Low byte first, High byte last)	2
6-7	Inertial navigation roll ([-180， 180]°)， Unit 0.01°		2
8-9	Inertial navigation azimuth([-180， 180]°) , North to east is negative, north to west is positive， Unit 0.01°		2
10-11			2
12-13			2
14-15			2
16-17			2
18-19			2
20-21			2
22-23	Speed after GPS satellite positioning， Unit0.1 m/s		2
24-25	GPS Track angle([-180， 180]°) , North to east is negative, north to west is positive, Unit0.1°		2
26-27	GPS Number of satellites		2
28-29	GPS altitude， Unit0.1m		2
30-33	GPS Latitude after satellite positioning, Unit degree	float (Low byte first, High byte last) , Ranges[-90,90] °， The north latitude is positive and the south latitude is negative.	4
34-37	Longitude after GPS satellite positioning, unit degree	float (Low byte first, High byte last) , Ranges[-180,180]°, The east longitude is positive and the west longitude is negative.	4

<table>
<tr><td>38-41</td><td>GPS UTC date (ddmmyy day month year)</td><td rowspan="2">float (Low byte first, High byte last)</td><td>4</td></tr>
<tr><td>42-45</td><td>UTC time (hhmmss hour, minute, second format)</td><td>4</td></tr>
<tr><td>46</td><td>Sending sequence number (0-255 cyclically increasing)</td><td rowspan="3">Byte</td><td>1</td></tr>
<tr><td>47</td><td>Check byte, cumulative sum of bytes 3 to 46</td><td>1</td></tr>
<tr><td>48</td><td>End of frame： 0X55</td><td>1</td></tr>
</table>

Executive standard

- National Standard for Static Calibration Specifications for Dual-Axis Inclination Sensors (Draft)
- GB/T 191 SJ 20873-2003 General Specification for Inclinometers and Levels

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