



GI4100 Series

GNSS INS

Technical Manual



Feature

BW-GI4100 is a high-performance and high-precision fiber-optic combined navigation system developed by BWSENSING for the field of aerial surveying and mapping, unmanned aerial vehicle (UAV), sea base and road base. Built-in three-axis fiber optic gyroscope, three-axis accelerometer, optional three-axis magnetic sensor, high-precision barometric pressure sensor, including a BD/GPS/GLONASS three-mode receiver. It can measure the carrier's speed, position, attitude, as well as output the compensated angular rate, acceleration, magnetic field, air pressure, temperature and other information.

BW-GI4100 is equipped with a new combined navigation sensor fusion algorithm engine and optimized design for multi-path interference situation, which can well meet the demand for long time, high accuracy and high reliability navigation applications in urban and field complex environments. The product supports a variety of sensors such as GNSS/Odometer/DVL/Barometric Altimeter, which has excellent expandability. By using multi-sensor data fusion technology to combine inertial measurement with satellite navigation, odometer information and other information, the system's geographical adaptability and robustness can be greatly improved.

BW-GI4100 combined navigation system adopts tight-coupling technology to tightly combine the high-precision, professional-grade, multi-channel, dual-antenna single-frequency carrier-phase and pseudo-range GPS receiver and high-precision fiber-optic inertial measurement unit, featuring small size, light weight and high performance.

Application

- Space stabilization platform, antenna system stabilization
- Attitude/orientation reference system, multi-beam attitude sensing
- Unmanned vehicle, unmanned aircraft, unmanned ship navigation and control
- Spatial stabilization platform, intelligent control of mining roadheaders and coal excavators
- Automatic farming, container tracking

Indicators

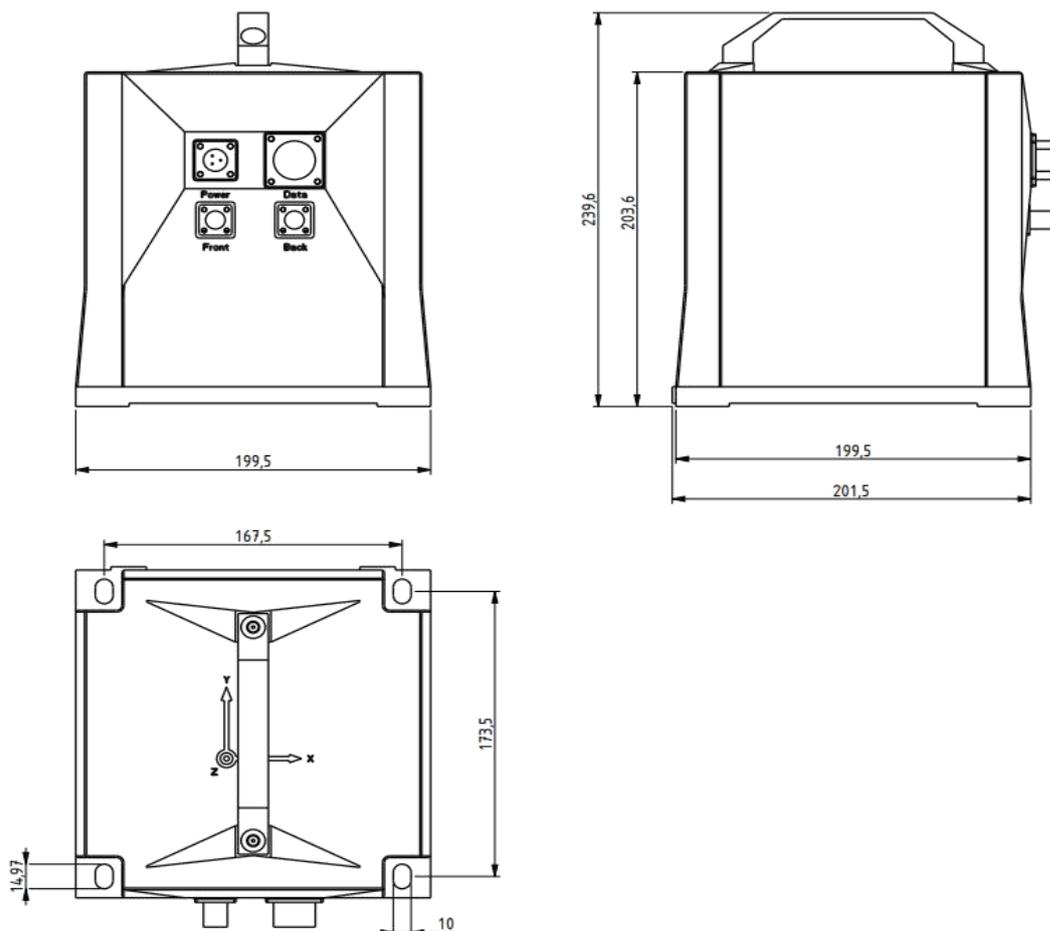
 **Performance indicators**

| | | |
|--------------------------------|--------------------------------------|---|
| External GPS valid 4m baseline | North seeking accuracy (deg) | $\leq 0.03 \cdot \text{Secant Latitude}$ |
| | Azimuth Accuracy(deg) | ≤ 0.008 |
| | Attitude Angle Accuracy(deg) | ≤ 0.003 |
| | Velocity Accuracy(m/s) | $\leq 0.03/\text{RTK } 0.01$ |
| | Position Accuracy(m) | $\leq 2\text{m}/\text{RTK } 2\text{cm}$ |
| GPS Invalid | Azimuth Holding Accuracy(deg) | $\leq 0.006, 1\text{h}$ |
| | Attitude Angle Holding Accuracy(deg) | $\leq 0.003, 1\text{h}$ |
| | Position accuracy(km) | $\leq 0.5, 1\text{h}$ $\leq 0.02, 5\text{min}$ |
| System Measurement Range | Azimuth Measuring Range(deg) | ± 180 |
| | Attitude Measuring range(deg) | ± 90 |
| Environmental parameters | Operating Temperature(°C) | -45 ~ +70 |
| | Storage temperature (°C) | -55 ~ +80 |
| | Vibration (Hz, q2/Hz) | 20 ~ 500,0.06 |
| | Shock (g, ms) | 30,11 |
| Electrical Parameters | Input Voltage (Vdc) | +18~+36 |
| | Power (W) | 20 |
| | Data Output Format | RS-422/RS-232 |
| | Data Refresh Rate (Hz) | 100 |
| Physical parameters | Dimension (mm) | 199.5×199.5×203.6(handle not included) |
| | Weight (kg) | 9 |
| | Connector | XCE12F3Z1D1; XCE24F26Z1D1 |



Product Size

Product Size: L199.5×W199.5×H203.6 (mm)



Note: Unannotated dimensional tolerances are implemented according to GB/T1804-2000 Grade C.

Installation

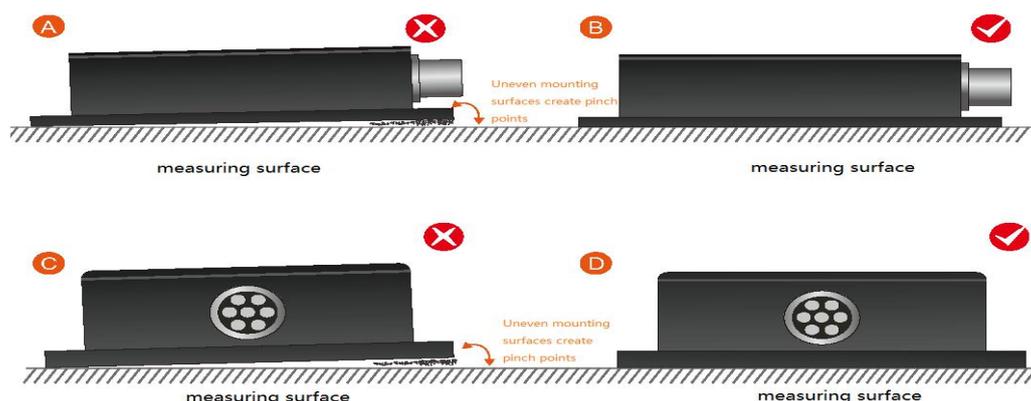
The GPS antennas we routinely use are zero-phase measurement type antennas, and general navigation type antennas cannot be used for this product. Although some navigation type antennas can also be oriented, the accuracy will be greatly reduced and may also lead to errors. If the user replaces an antenna that is not configured or specified by the Company and the system does not work properly or other consequences occur, the Company is not responsible for this.

Correct installation can avoid measurement errors. The combined navigation system is manufactured with a CNC mill to produce absolutely smooth surfaces on the bottom and measuring surfaces to facilitate installation, which should be done as follows:



First of all, to ensure that their own equipment has two absolutely smooth plane, and the two surfaces are absolutely perpendicular, as far as possible and the body coordinate system coincide, in order to reduce the installation error.

Secondly, when installing the product, the bottom surface of the combined navigation system and the bottom surface of the fuselage overlap, gently push the combined navigation system to make the combined navigation system measuring surface and the fuselage measuring surface overlap, to ensure that the two surfaces are close to each other, and there should not be any pinch angle as shown in Figures A and C. The correct installation method is shown in Figures B and D.



Finally, after the combined navigation system and the body are tightly affixed, screws are used for fixing to ensure tight fixation, flat contact and stable rotation, and to avoid measurement errors due to acceleration and vibration. Remember that the screws only play a role in fixing, not positioning, the screw holes of the combined navigation system are processed into an oval shape for easy adjustment.

Electrical connections

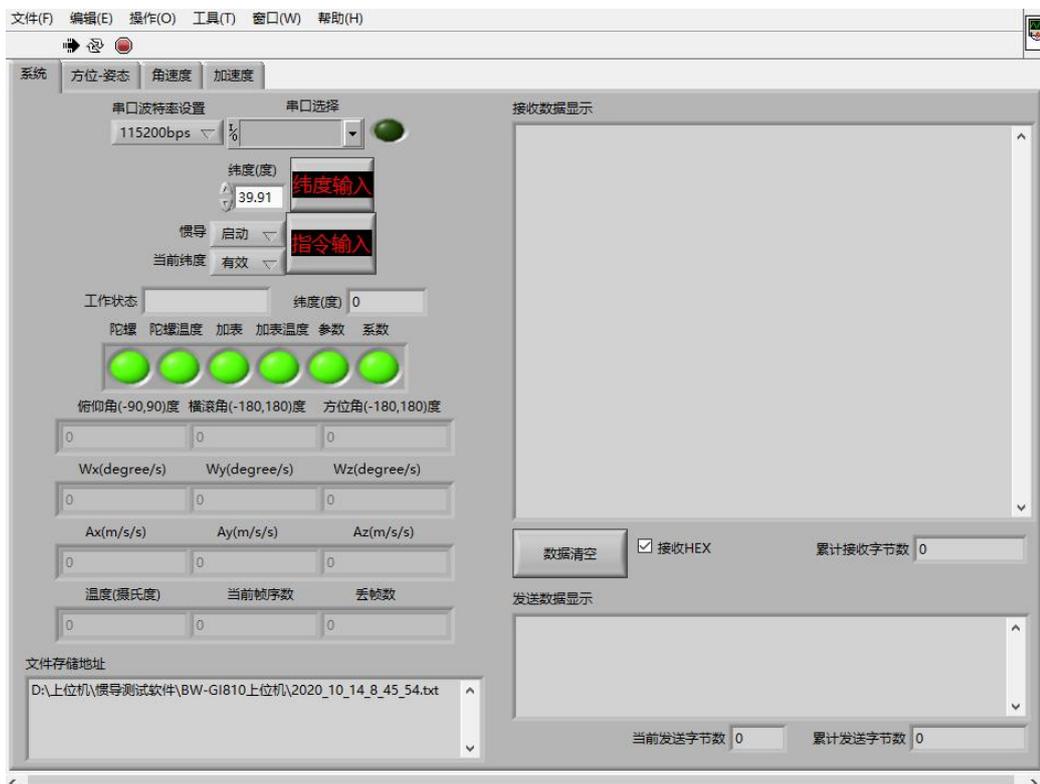
Data cable RS422 interface definition, DB9 female:

| DB9 Connector Pin | interface definition | Remarks |
|-------------------|----------------------|------------------|
| 1 | R+ | Receive Positive |
| 2 | R- | Receive Negative |
| 3 | T+ | Send Positive |
| 4 | T- | Negative |

Testing

Steps to use the software:

- ① Ensure that the inertial guidance is absolutely stationary, correctly connect the serial port hardware of the combined navigation, and connect the power supply.
- ② Select the computer serial port and baud rate and click to connect the serial port.
- ③ Input the correct geographic latitude and longitude, click the inertial guidance to start Command input, the working state on the screen shows static alignment, and so on the working state becomes INS navigation, then the inertial guidance enters the working state and can be used.



communication protocols

After the system is powered on, normal operation at 100Hz frequency, RS422 communication 115200bps, n, 8, 1

Sending navigation data outward in broadcast mode, 48 bytes of data per frame as shown in the table below:

| Navigation data | | | |
|-----------------|--|--|---|
| byte symbol | element | data type | byte count |
| 1-2 | Frame Header: 0X5A 0X A5 | Byte | 2 |
| 3 | Operating status: 0- Monitor status, | Byte | 1 |
| 4-5 | 1- Static Alignment, 2- INS Navigation | short int(low byte first, high byte last) | 2 |
| 6-7 | Inertial Pitch Angle ([-90, 90] degrees), unit 0.01 degrees | | 2 |
| 8-9 | Inertial guidance azimuth ([-180 , 180] degrees), NNE is negative, NW is positive, unit 0.01 degrees | | 2 |
| 10-11 | Inertial guidance X-axis angular rate Wx(degree/s) in 0.01 degree/s | | 2 |
| 12-13 | Inertial guidance Y-axis angular rate Wy(degree/s) in 0.01 deg/s | | 2 |
| 14-15 | Inertial guidance Z-axis angular velocity Wz(degree/s) in 0.01 deg/s | | 2 |
| 16-17 | Inertial guidance X-axis acceleration Ax(m/s/s) in 0.01 m/s/s | | 2 |
| 18-19 | Inertial guidance Y-axis acceleration Ay (m/s/s) in 0.01 m/s/sec. | | 2 |
| 20-21 | Inertial Guidance Z-axis acceleration Az (m/s/s) in 0.01 m/s/s | | 2 |
| 22-23 | Velocity after GPS satellite positioning in 0.1 m/s | | 2 |
| 24-25 | GPS track angle ([-180 , 180] degrees), negative for N.E., positive for N.W., unit 0.1 degree. | | 2 |
| 26-27 | GPS Satellite Number | | 2 |
| 28-29 | GPS altitude in 0.1 meters | | 2 |
| 30-33 | Latitude in degrees after GPS satellite positioning | | float (low byte first, high byte second) in the range [-90,90] degrees, positive for north |

| | | | |
|-------|---|---|---|
| | | latitude, negative for south latitude. | |
| 34-37 | Latitude in degrees after GPS satellite positioning | float (low byte first, high byte second) , value range [-180,180] degrees, east longitude is positive, west longitude is negative. | 4 |
| 38-41 | GPS UTC date (ddmmyy month, day, month and year) | range [-180,180] degrees, east longitude is positive, west longitude is negative. | 4 |
| 42-45 | UTC time (hhmmss hour minute second format) | | 4 |
| 46 | Transmit serial number (0-255 cyclic increment) | Byte | 1 |
| 47 | Parity byte, bytes 3 through 46 summed up | | 1 |
| 48 | End of frame: 0X55 | | 1 |

Executive standard

- Enterprise quality system standard: ISO9001:2008 standard (certificate number: 10114Q16846ROS)
- CE certification (Certificate No.: 3854210814)
- ROHS (Certificate No.: SO81426003)
- GB/T 191 SJ 20873-2003 General Specification for Tiltmeters and Leveling Devices
- GBT 18459-2001 Calculation method of main static performance index of sensor
- JJF 1059-1999 Measurement Uncertainty Assessment and Representation
- GBT 14412-2005 Mechanical vibration and shock Mechanical installation of accelerometers
- GJB 450A-2004 General Requirements for Equipment Reliability
- GJB 909A Quality control of critical and important components
- GJB 899 Reliability qualification and acceptance tests
- GJB150-3A High temperature test
- GJB150-4A Low temperature test
- GJB150-8A Rain test
- GJB150-12A Sand and dust test
- GJB150-16A Vibration test
- GJB150-18A Impact test
- GJB150-23A Tilt and sway test
- GB/T 17626-3A Radiofrequency electromagnetic field radiation immunity test
- GB/T 17626-5A Surge immunity test
- GB/T 17626-8A Magnetic field immunity test at industrial frequency
- GB/T 17626-11A Immunity to voltage dips, short-term interruptions and voltage variations
- GB/T 2423.22-2012 Environmental test Part 2: Test methods Test N: Temperature change (IEC60068-2-14:2009, IDT)
- GB/T 10125-2012 Artificial atmosphere corrosion test Salt spray test (ISO 9227:2006, IDT)

GI4100 series

GNSS INS

Wuxi Bewis Sensing Technology LLC

Add: Building 30, NO. 58,
Xiuxi Road, Binhu District,
Wuxi City, Jiangsu Province,
China

Tel: +86 18921292620

Mail: sales@bwsensing.com

Web: www.bwsensing.com