GNSS/INS GI410

Technical manual

V3.0

Introduction

GI410 adopts deep coupling integrated navigation technology, which deeply integrates IMU with RTK solution and observation preprocessing, and can provide real-time and high-precision navigation parameters such as position, speed and attitude. The integrated navigation algorithm uses the GPS data as initial data for operation. If GPS data is lost, the system will run the strapdown inertial navigation calculation alone, and the calculated data will be sent to the Kalman filter for processing.

Feature

- GNSS/INS high-precision vehicle-grade integrated navigation system
- Deeply coupled GNSS+INS integrated navigation
- Support raw data output and post-processing
- High-precision positioning and orientation
- Kalman filter
- Support precise point positioning PPP

Technical parameter

Performance Index

Horizontal positioning accuracy	RTK-G1410	1cm
Elevation Positioning Accuracy	RTK-G1410	2.5cm
Maximum data rate	GNSS Raw observations	20hz
	GNSS RTK position	20hz
	INS Combined navigation and positioning	100hz
	IMU Raw data rate	500hz
Orientation accuracy	Base line=2m	0.08°
	Base line=4m	0.05°

Internal IMU parameters

Gyro range	±400°/s	Gyro Bias Stability	6°/h（10s smooth） 0.5°/h（allan variance ）
Accelerometer range	±3.6g（defaulted± 1.2g）	Accelerometer Bias Stability	50ug（10s smooth）

Communication Interface

- **Interface Type**

ANT1	SMA External screw and internal needle	GNSS main antenna interface
ANT2	SMA External screw and internal needle	GNSS Secondary antenna interface
4G	SMA External screw and internal needle	4G Antenna interface
Aviation plug	WS16-9	Aviation plug interface

- **Serial port settings**

Baud rate	921600 / 460800 / 230400 / 115200 / 19200 / 9600 / 2400
Data bits	8
Stop bit	1 / 1.5 / 2
Check bit	Odd parity/even parity/no parity
default Setting	115200 8 1 no parity
Serial port optional	422 / 232

Product List

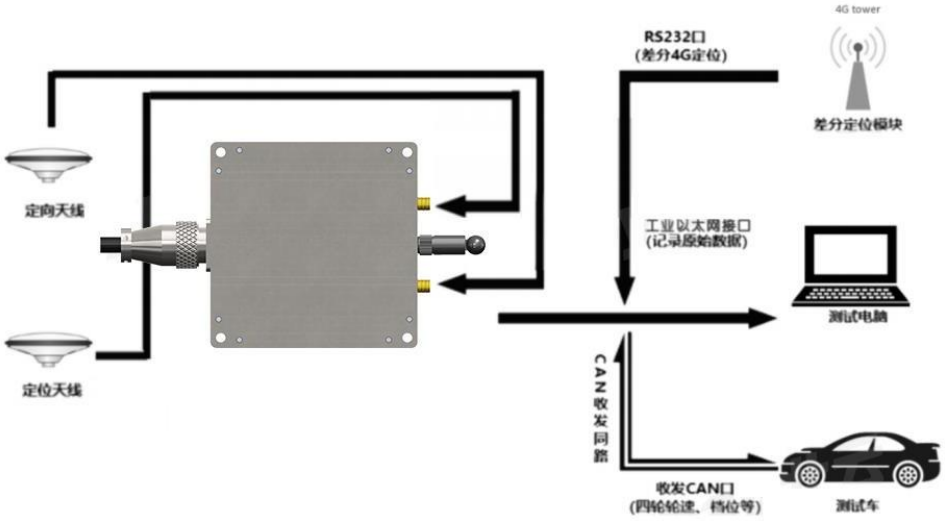
GI410	GIDL X 1	GPS antenna（ Mushroom head ） X 2	RF cable X 2	4G antenna X1

Installation and Requirements

- **Power Requirements**

  9-24V Power 10W

- **Connection relationship**



Mode configuration

- **Rover Mode**

  Automatically identify differential data input by serial port, support RTCM3.2
  Differential text can also use the differential positioning service provided by Qianxun through the built-in 4g module

  Raw observation data output

- **Base station mode**

  Independently optimize the coordinates of the base station, or input known coordinates, and send differential messages through the serial port

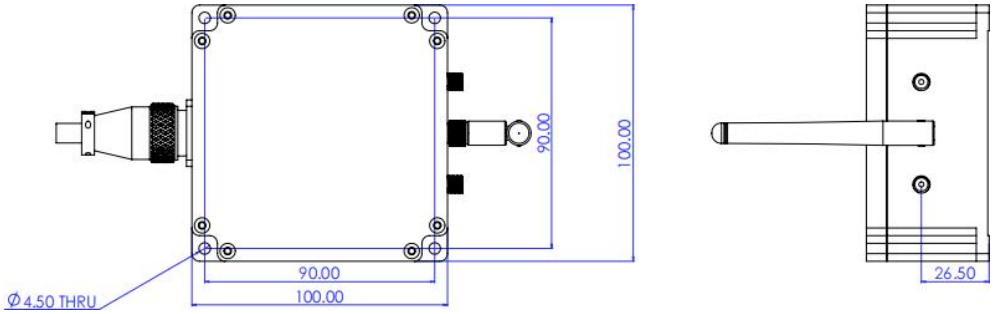
Differential data acquisition

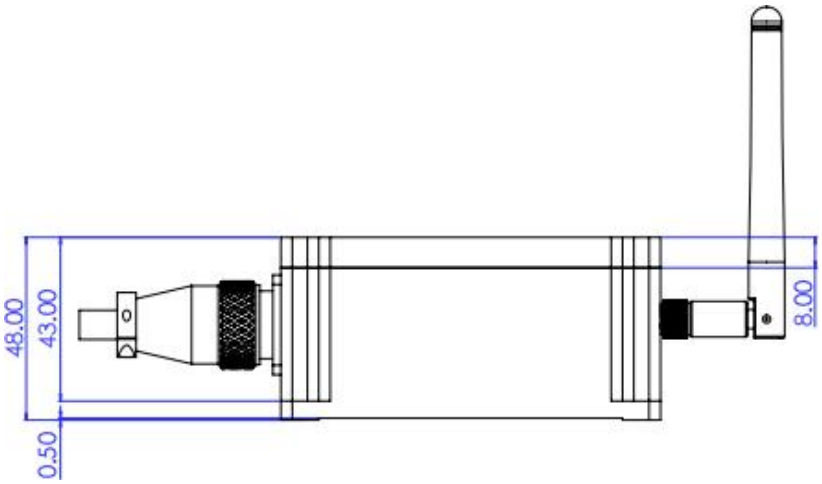
- **QIANXUN location**
- **LIUFEN Technology**
- **Self-base station**

Product feature

Package product size

Product size：L100*W100*H48（mm）





Command configuration

Bewis sensor high-precision integrated navigation input command supports simplified ASCII format. The simplified ASCII format without parity digit is more convenient for user's command input. All commands consist of a command header and configuration parameters (the parameter part can be empty, then the command has only one command header), and the header field contains the command name or message header. Common commands are shown in the following table:

Command	Description
config com1 115200	Set com1 baud rate to 115200 You can set com1, com2, com3 to any baud rate of 2400, 9600, 19200, 115200, 230400, 460800, 921600
version	Query version number
unlog	Disable all output of the current serial port
Inspvaa ontime 1	Output integrated navigation and positioning results, frequency: 1Hz
saveconfig	Save configuration

Serial port configuration

The serial port is the interface through which the receiver inputs and outputs data. Configure the serial port command with CONFIG as the command header, followed by the serial port device and serial port properties, which are used to set the serial port baud rate, data bits, parity, stop bit characteristics, etc.
The high-precision integrated navigation supports 2 serial ports, namely com1 and com2. The two serial ports have the same function, but the data input and output of each serial port work independently with their own configuration. In addition, the two serial ports can be configured with each other, that is, the serial port attributes of com2 can be configured through com1, and the serial port attributes of com1 can be configured through com2.

Command format is:

CONFIG [Serial device number] [Serial port property parameters]

Simplified ASCII syntax:

CONFIG COM1 115200

CONFIG COM1 115200 8 n 1

Serial device parameter list

command header	Serial device	No.	Serial port parameters	Parameter Description
CONFIG	COM1 COM2	1	Baud rate	Set the baud rate of the serial port.
		2	Data bits	Set the data bit of the serial port; if you want to set the data bit of the serial port, make sure that the previous baud rate cannot be empty. Note: Supported data bits in data transmission: 7 or 8, the current product only supports 8 bits.
		3	Parity	Set the parity of the serial port; if you want to set the parity of the serial port, make sure that the preceding parameters cannot be empty.

Inertial navigation installation angle configuration

This command is used to set the installation angle of the IMU relative to the XYZ direction of the carrier, so that the XYZ axis direction of the receiver inertial navigation device is consistent with the XYZ axis direction of the carrier.
The command format is:
CONFIG INS ANGLE [parameter]
Simplified ASCII syntax:
CONFIG INS ANGLE 0 9000 18000

Configure INS Mounting Corner

command header	Device	Angle	No.	Parameter	Parameter Description
CONFIG	INS	ANGLE	1	ANGLEX	The rotation angle of the X-axis of the inertial navigation module relative to the X-axis of the carrier coordinate (right-hand screw); unit: 0.01 degrees; range: 0-36000
			2	ANGLEY	The rotation angle of the Y-axis of the inertial navigation module relative to the Y-axis of the carrier coordinate (right-handed helix); unit: 0.01 degrees; range: 0-36000
			3	ANGELZ	The rotation angle of the inertial navigation module Z-axis relative to the carrier coordinate Z-axis (right-handed helix); unit: 0.01 degrees; range: 0-36000

IMU to main antenna mast arm parameter configuration

Use this command to enter the offset between the IMU and the GNSS main antenna phase center, the inertial to main antenna mast arm parameter. When measuring lever arm parameters, it should be as accurate as possible, especially in RTK mode, the error is preferably within 1mm. Any errors in the lever arm parameters will translate directly into errors in the inertial navigation system position. X, Y, and Z represent the vectors from the IMU to the phase center of the main antenna. The a, b and c fields are used to enter any possible errors in the measurement. For example, if the 'X' offset is measured in centimeters, enter 0.01 in the 'a' field. To improve accuracy, install the IMU as close as possible to the main GNSS antenna in the horizontal direction.

Command format:

CONFIG IMUTOANT OFFSET x y z [a] [b] [c]

Simplified ASCII syntax:

CONFIG IMUTOANT OFFSET 0.54 0.32 1.20 0.03 0.03 0.05

IMU to main antenna mast arm parameter

Command header	Parameter	Parameter Description
CONFIG IMUTOANT OFFSET	X	Offset in X direction, unit: meter, range -100~100
	Y	Y direction offset, unit: meter, range -100~100
	Z	Offset in Z direction, unit: meter, range -100~100
	a	The error of the offset in the X direction, unit: meters, range 0.01~10; (default is 10% of x-direction offset to minimum 0.01 m)
	b	The error of the offset in the Y direction, unit: meters, range 0.01~10; (default is 10% of y-direction offset to minimum 0.01 m)
	c	Error of offset in Z direction, unit: meters, range 0.01~10; (default is 10% of the z-direction offset to a minimum of 0.01 m)

INSPVA Combined navigation position, velocity and attitude information

Set the result of outputting the combined navigation positioning, the ASCII statement starts with "#INSPVA"

Recommended input:

LOG INSPVAA ONTIME 1

INSPVA data structure

ID	Field	Data description	Type	Number of bytes	Byte offset
1	INSPVA	Log head		H	0
2	Week	GNSS week	Ulong	4	H+4
3	Seconds	Week seconds	Double	8	H+12
4	Latitude	Latitude (WGS84) [degrees]	Double	8	H+20
5	Longitude	Longitude (WGS84) [degrees]	Double	8	H+28
6	Height	Ellipsoid height (WGS84) [m]	Double	8	H+36
7	North Velocity	North speed (negative value is south) [m/s]	Double	8	H+44
8	East Velocity	Easting speed (negative value is west) [m/s]	Double	8	H+52
9	Up Velocity	Sky speed [m/s]	Double	8	H+60
10	Roll	Roll angle (right-handed helix along the Y axis) [degrees]	Double	8	H+68
11	Pitch	Pitch angle (right-handed helix along the X axis) [degrees]	Double	8	H+76
12	Azimuth	Heading angle, clockwise from north (left-handed spiral around the Z axis), which is the inertial azimuth calculated by the IMU gyro through the combined filter	Double	8	H+84
13	Status	INS state	Enum	4	H+76
14	xxxx	32-bit CRC	Hex	4	H+88
15	[CR][LF]	statement terminator (only ASCII)	-	-	-

Inertial navigation solution status

Binary	Field	Data description
0	INS_INACTIVE	IMU data is stored, but alignment has not started; INS does not resolve
1	INS_ALIGNING	INS Alignment Mode
2	INS_HIGH_VARIANCE	The INS has entered navigation mode, but the heading error is out of tolerance. For most IMUs, the default threshold is 2 degrees. The INS solution is still valid, but you should monitor the solution uncertainty in the INSSTDEV log. You may encounter this state when GNSS is used to help INS
3	INS_SOLUTION_GOOD	Enter navigation mode and INS solution is OK.
4	INS_SOLUTION_FREE	The INS filter is in navigation mode and the GNSS solution is suspected to be wrong. This could be due to multipath or limited satellite visibility. Combination filter has rejected GNSS position and is waiting for its quality to improve
5	INS_ALIGNMENT_COMPLETE	The INS filter is in navigation mode, but there is not enough vehicle dynamics yet to meet the specification.
6	DETERMINING_ORIENTATION	INS is using gravity to determine IMU axis.
7	WAITING_INITIALPOS	INS filter determines IMU orientation and waits for initial position estimate to begin alignment process
8	WAITING_AZIMUTH	The INS filter has orientation, initial bias, initial position and effective roll and pitch estimates. No further work begins until the initial bearing is entered
9	INITIALIZING_BIASES	INS filter estimates initial bias during the first 10 seconds of static data
10	MOTION_DETECT	INS filter is not fully aligned, but motion has been detected

GNSS/INS GI410

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