

BE-252Q

GNSS Module User Manual



Shenzhen Beitian Communication Co., Ltd.

Whole Floor 9, Building 1, Phase 5, Fucheng Digital Innovation Park, Shijing Road, Fucheng Street, Longhua District, Shenzhen

Tel: 0755-22225474

Fax: 0755-22225474

www.beitian.com

Revision History

Revisions	Revision History	Date
P1.0	Updated version	2025-04-25
P2.0	Updated Baud rate	2025-07-08

Declaration

Beitian owns the copyright of this non-publicly published instruction manual and has the right to treat it as confidential information. This instruction manual is only used as a reference for operating, maintaining and repairing the product, and no one else has the right to disclose this instruction manual to others.

This instruction manual contains proprietary information protected by copyright law. All rights reserved. No part of this instruction manual may be photographed, copied or translated into other languages without Beitian's written consent.

The contents of this instruction manual may be changed without notice.

Manufacturer's Responsibilities

Beitian is responsible for the safety, reliability and performance of the module only in the following cases:

Assembly, expansion, readjustment, improvement or repair are performed by personnel approved by the company; the equipment is used in accordance with the operating requirements.

Catalog

GNSS Module User Manual	1
Declaration	2
Manufacturer's Responsibilities	2
1. FUNCTIONAL DESCRIPTION	4
1.1. OVERVIEW	4
1.3. PERFORMANCE.....	5
.....	
Figure 1-3 Module size diagram	9
2. Module interface description	9
2.2.0 MODULE INTERFACE DESCRIPTION	10
3. Mechanical properties	16
4. Precautions.....	16
4.1. Other	16

1. FUNCTIONAL DESCRIPTION

1.1. OVERVIEW



The BE-252Q GNSS module is a high-performance satellite positioning module that provides superior sensitivity and acquisition time for all L1 GNSS systems. The extremely low power consumption of < 15 milliwatts in continuous tracking mode enables all battery-powered devices such as asset trackers to have strong endurance without sacrificing GNSS performance.

The BE-252Q supports simultaneous reception of four GNSS (GPS, GLONASS, Galileo and BeiDou). The high number of visible satellites allows the receiver to select the best signal to maximize position availability, especially in challenging conditions such as deep canyons in cities. BE-252Q (Super Signal) technology provides excellent RF sensitivity and can improve dynamic position accuracy by up to 25% with small antennas or non-line-of-sight scenarios.

BE-252Q detects jamming and spoofing events and reports them to the host so that the system can react to such events. Advanced filtering algorithms mitigate the effects of RF interference and interference, allowing the product to operate as intended.

1.2. PRODUCT FEATURES

- Power consumption is less than 15 mW without compromising GNSS performance
- Receive signals from four GNSS systems in parallel to achieve the highest positioning availability
- Proven to deliver superior performance even with small antennas
- Advanced spoofing and jamming detection
- Support FLASH, you can change the configuration, no loss when the power is off.
- Ceramic antenna 4mm.
- GPS antenna integrated module
- Support software upgrade, the host computer can realize the software upgrade function through the serial port.
- Support LED light display
- Inside with electronic compass QMC5883L

1.3. PERFORMANCE

Table 1-1 BE-252Q module main performance indicators

Item	Description	
Electrical Characteristic	Chip	M10050
	Receiver type	GPS L1 C/A, QZSS L1 C/A/S,BDS B1I/B1C, Galileo E1B/C,SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
	Default position system	GPS, BDS, GALILEO
	Augmentation system	SBAS, QZSS
	Channel	N/A
Sensitivity	Tracking & Navigation	-166dBm
	Reacquisition	-160dBm
	Cold start	-148dBm
	Hot Start	-160dBm
Accuracy	Horizontal position	2.0m CEP
	Velocity	0.05m/s
	Dynamic heading	0.3 deg
	Time pulse	RMS 30ns
		99% 60ns
Acquisition	Cold start	27s
	Hot start	1s
	Aided start	1s
Data Output	Baud rate	4800bps - 921600bps,default 115200bps
	Level	TTL level
	UBX messages	PVT
	Protocol	NMEA,UBX
	NMEA messages	RMC,VTG,GGA,GSA,GSV,GLL
	Update rate	0.25Hz-18Hz,default 10Hz
	FLASH	With FLASH, the configuration can be changed, and the power will not be lost
	Frequency of time pulse signal	Configurable from 0.25 Hz to 10 MHz, the default period is 1s, and the high level lasts for 100ms
Operational Limits	Altitude	80,000m
	Velocity	500m/s
	Dynamics	<4g
Power Consumption	Voltage	DC 3.6V-5.5V, typical: 5.0V
	Current	30mA/5.0V
Physical Specifications	Dimension	25*25*8mm
	Weight	13.5g
	Connector	1.00/6P unlocked, horizontal SMD socket

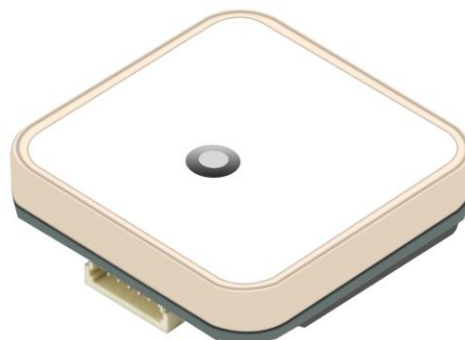
Temperature	Operating	-40 ℃ ~ +85 ℃
	Storage	-40 ℃ ~ +105 ℃
LED	Built-in LED	TX LED: blue. The data output, TX LED flashing
		PPS LED: red. PPS LED not bright when GPS not fixed, flashing when fixed
Compass	Compass	Built-in compass, With electronic compass IC QMC5883L

1.4. PIN DEFINITION

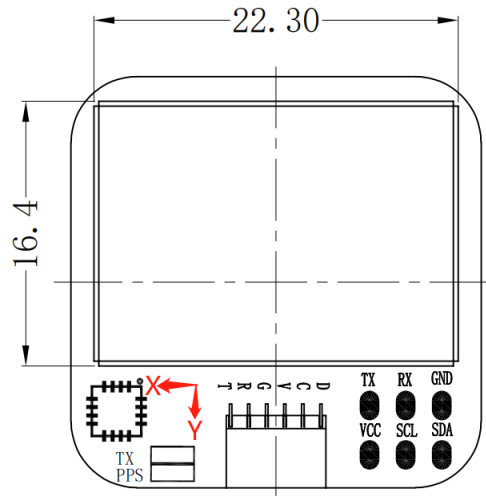


PIN	Name	I/O	Description
1	TX	O	Serial Data Output.
2	RX	I	Serial Data input.
3	GND	G	Ground
4	VCC	I	DC 3.6V~ 5.5V supply input, Typical: 5.0V
5	SCL	I	Compass SCL
6	SDA	O	Compass SDA

1.5. REAR VIEW



The position of the electronic compass IC QMC5883L , indicating the direction:



1.6. LED

1. Blue light, TX light, blue light flashing when powered on, indicating that there is data output.
2. Red light, PPS light, the light is not lit if it is not positioned; After 3D positioning, it starts flashing.

1.7. Application

- ◆ Vehicle positioning and navigation
- ◆ Timing
- ◆ Wearables
- ◆ IoT positioning devices
- ◆ UAV, flight control field

1.8. Functional Frame Diagram

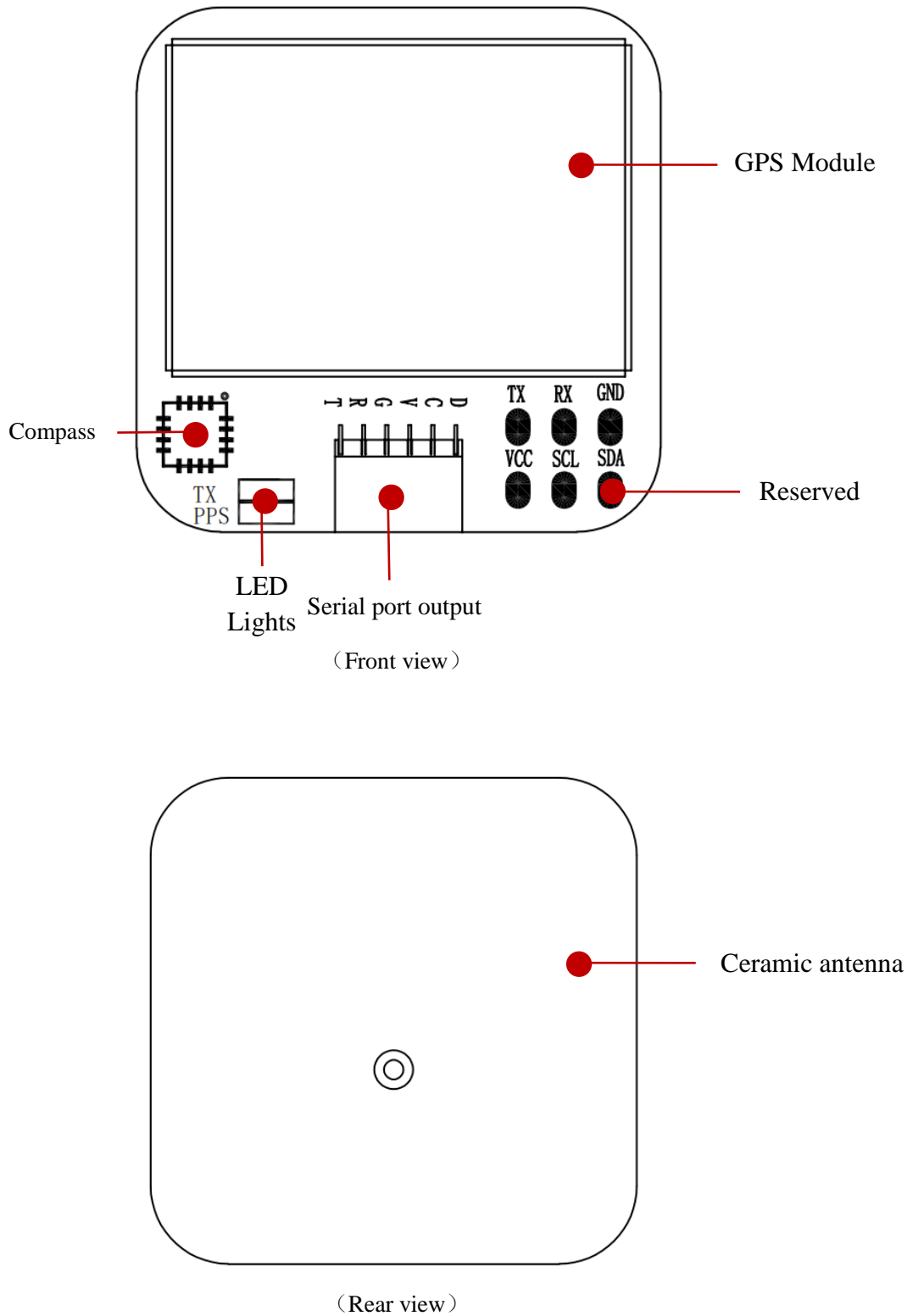


Figure 1-2 BE-252Q module functional block diagram



1.9.Dimension

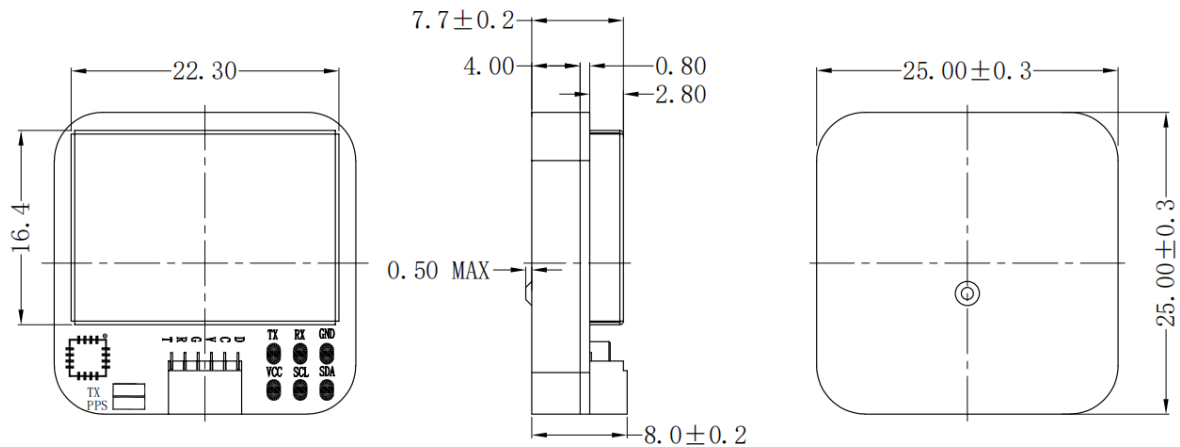


Figure 1-3 Module size diagram

2. Module interface description

2.1. Hardware Interface

2.1.1 Power supply

The module has a power input pin VCC, where VCC is the main power supply for the module; the farad capacitor stores energy and supplies power to the RTC circuit when the main power supply VCC is powered off, ensuring that key information is not lost, so as to achieve the hot start function.

2.1.2 Module serial port

Pin interface:

1.00 6pin: TX、RX、GND、VCC、SCL、SDA

2.1.3 1PPS Signal Interface

NO

2.1.4 UART Interface

The module is designed with UART serial port 1.00 pitch 6pin socket, which are (TX) and (RX)

respectively. The serial port outputs NMEA data at the UTC second boundary, and the host computer can also switch the working mode and upgrade the software of the module through the serial port. The baud rate supported by the module ranges from 4800bps - 921600bps, and the default is 115200bps. The data format is 1 bit for the start bit, 8 bits for the data bit, 1 bit for the stop bit, and no check bit. It can be used to output data in a custom format and can also be used for software upgrades.

2.2.0 MODULE INTERFACE DESCRIPTION

Data output protocol

Joint Mode Protocol Header - GN

GPS Mode Protocol Header-GP

GLONASS Mode Protocol Header-GL

Beidou mode protocol header - GB or BD

Unlocated:

\$GNRMC,,V,,,,,,,,,N,V*37

\$GNVTG,,,,,,,,N*2E

\$GNGGA,,,,,0,00,99.99,,,,, *56

\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,1*33

\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,3*31

\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,4*36

\$GNGSA,A,1,,,,,,,,,99.99,99.99,99.99,5*37

\$GPGSV,1,1,00,0*65

\$GAGSV,1,1,00,0*74

\$GBGSV,1,1,00,0*77

\$GQGSV,1,1,00,0*64

\$GNGLL,,,,,V,N*7A

Positioned:

\$GNRMC,054411.00,A,2243.08151,N,11401.10827,E,0.008,,230423,,A,V*1E

\$GNVTG,T,M,0.008,N,0.016,K,A*32

\$GNGGA,054411.00,2243.08151,N,11401.10827,E,1,12,0.56,93.2,M,-2.7,M,,*64

\$GNGSA,A,3,30,03,14,06,07,17,01,19,,,,,1.15,0.56,1.00,1*0D

\$GNGSA,A,3,30,13,15,34,27,02,,,,,1.15,0.56,1.00,3*01

\$GNGSA,A,3,27,28,30,01,02,03,37,38,40,,,,,1.15,0.56,1.00,4*04

\$GNGSA,A,3,02,07,03,04,,,,,,1.15,0.56,1.00,5*00

\$GPGSV,3,1,12,01,27,034,37,03,44,087,39,06,38,241,42,07,15,180,35,1*64

\$GPGSV,3,2,12,14,78,359,45,17,43,333,38,19,28,303,39,30,34,212,39,1*6C

\$GPGSV,3,3,12,39,29,252,33,40,20,257,40,41,46,237,44,50,60,149,39,1*65

\$GPGSV,1,1,01,11,00,228,,0*5C

\$GAGSV,2,1,06,02,30,136,38,13,23,238,40,15,68,289,42,27,37,324,30,7*7E

\$GAGSV,2,2,06,30,83,091,42,34,41,026,41,7*70

\$GBGSV,3,1,11,01,47,123,36,02,46,234,37,03,63,189,38,04,,31,1*49

\$GBGSV,3,2,11,05,,34,27,52,351,44,28,24,046,37,30,31,283,40,1*46

\$GBGSV,3,3,11,37,43,178,40,38,70,172,40,40,57,034,39,1*48

\$GQGSV,1,1,04,02,63,125,42,03,59,044,39,04,38,131,38,07,60,149,36,1*6C

\$GNGLL,2243.08151,N,11401.10827,E,054411.00,A,A*71

\$xxGGA,time,lat,NS,lon,EW,quality,numSV,HDOP,alt,altUnit,sep,sepUnit,diffAge,diffStation*c

s<CR><LF>

Example:

\$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,08,1.01,499.6,M,48.0,M,,*5B

Field No.	Name	Unit	Format	Example	Description
0	xxGGA	-	string	\$GPGGA	GGA Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	time	-	hhmmss.ss	092725.00	UTC time, see note on UTC representation
2	lat	-	ddmm. mmmm	4717.11399	Latitude (degrees & minutes), see format description
3	NS	-	character	N	North/South indicator
4	lon	-	dddmm. mmmm	00833.91590	Longitude (degrees & minutes), see format description
5	EW	-	character	E	East/West indicator
6	quality	-	digit	1	Quality indicator for position fix, see position fix flags description Flags in NMEA 4.10 and above
7	numSV	-	numeric	08	Number of satellites used (range: 0-12)
8	HDOP	-	numeric	1.01	Horizontal Dilution of Precision
9	alt	m	numeric	499.6	Altitude above mean sea level
Field No.	Name	Unit	Format	Example	Description
10	altUnit	-	character	M	Altitude units: M (meters, fixed field)
11	sep	m	numeric	48.0	Geoid separation: difference between ellipsoid and mean sea level
12	sepUnit	-	character	M	Geoid separation units: M (meters, fixed field)
13	diffAge	s	numeric	-	Age of differential corrections (null when DGPS is not used)
14	diffStation	-	numeric	-	ID of station providing differential corrections (null when DGPS is not used)
15	cs	-	hexadecimal	*5B	Checksum
16	<CR><LF>	-	character	-	Carriage return and line feed

\$xxGLL,lat,NS,lon,EW,time,status,posMode*cs<CR><LF>

Example:

\$GPGLL,4717.11364,N,00833.91565,E,092321.00,A,A*60

Field No.	Name	Unit	Format	Example	Description
0	xxGLL	-	string	\$GPGLL	GLL Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	lat	-	ddmm. mmmm	4717.11364	Latitude (degrees & minutes), see format description
2	NS	-	character	N	North/South indicator
3	lon	-	dddmm. mmmm	00833.91565	Longitude (degrees & minutes), see format description
4	EW	-	character	E	East/West indicator
5	time	-	hhmmss.ss	092321.00	UTC time, see note on UTC representation
6	status	-	character	A	Data validity status, see position fix flags description
7	posMode	-	character	A	Positioning mode, see position fix flags description (only available in NMEA 2.3 and later)
Field No.	Name	Unit	Format	Example	Description
8	cs	-	hexadecimal	*60	Checksum
9	<CR><LF>	-	character	-	Carriage return and line feed

\$xxGSA,opMode,navMode{,svid},PDOP,HDOP,VDOP,systemId*cs<CR><LF>

Example:

\$GPGSA,A,3,23,29,07,08,09,18,26,28,,,,,1.94,1.18,1.54,1*0D

Field No.	Name	Unit	Format	Example	Description
0	xxGSA	-	string	\$GPGSA	GSA Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	opMode	-	character	A	Operation mode: M = Manually set to operate in 2D or 3D mode A = Automatically switching between 2D or 3D mode
2	navMode	-	digit	3	Navigation mode, see position fix flags description
Start of repeated block (12 times)					
3 + 1*N	svid	-	numeric	29	Satellite number
End of repeated block					
15	PDOP	-	numeric	1.94	Position dilution of precision
16	HDOP	-	numeric	1.18	Horizontal dilution of precision
17	VDOP	-	numeric	1.54	Vertical dilution of precision

18	systemId	-	numeric	1	NMEA defined GNSS System ID, see Signal Identifiers table (only available in NMEA 4.10 and later)
19	cs	-	hexadecimal	*0D	Checksum
20	<CR><LF>	-	character	-	Carriage return and line feed

\$xxGSV,numMsg,msgNum,numSV{svid,elv,az,cno},signalId*cs<CR><LF>

Example:

```
$GPGSV,3,1,09,09,,,17,10,,,40,12,,,49,13,,,35,1*6F
$GPGSV,3,2,09,15,,,44,17,,,45,19,,,44,24,,,50,1*64
$GPGSV,3,3,09,25,,,40,1*6E
$GPGSV,1,1,03,12,,,42,24,,,47,32,,,37,5*66
$GAGSV,1,1,00,2*76
```

Field No.	Name	Unit	Format	Example	Description
0	xxGSV	-	string	\$GPGSV	GSV Message ID (xx = GSV Talker ID, see NMEA Talker IDs table). Talker ID GN shall not be used
1	numMsg	-	digit	3	Number of messages, total number of GSV messages being output (range: 1-9)
2	msgNum	-	digit	1	Number of this message (range: 1-numMsg)
3	numSV	-	numeric	10	Number of known satellites in view regarding both the talker ID and the signalId

Start of repeated block (1..4 times)

4 + 4*N	svid	-	numeric	23	Satellite ID
5 + 4*N	elv	deg	numeric	38	Elevation (range: 0-90)
6 + 4*N	az	deg	numeric	230	Azimuth (range: 0-359)
7 + 4*N	cno	dB Hz	numeric	44	Signal strength (C/N0, range: 0-99), null when not tracking

End of repeated block

Field No.	Name	Unit	Format	Example	Description
5.. 16	signalId	-	numeric	0	NMEA defined GNSS Signal ID, see Signal Identifiers table (only available in NMEA 4.10 and later)
6.. 16	cs	-	hexadecimal	*7F	Checksum
7.. 16	<CR><LF>	-	character	-	Carriage return and line feed

\$xxRMC,time,status,lat,NS,lon,EW,spd,cog,date,mv,mvEW,posMode,navStatus*cs<CR><LF>

Example:

\$GPRMC,083559.00,A,4717.11437,N,00833.91522,E,0.004,77.52,091202,,,A,V*57					
Field No.	Name	Unit	Format	Example	Description
0	xxRMC	-	string	\$GPRMC	RMC Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	time	-	hhmmss.ss	083559.00	UTC time, see note on UTC representation
2	status	-	character	A	Data validity status, see position fix flags description
3	lat	-	ddmm. mmmm	4717.11437	Latitude (degrees & minutes), see format description
4	NS	-	character	N	North/South indicator
5	lon	-	dddmm. mmmm	00833.91522	Longitude (degrees & minutes), see format description
6	EW	-	character	E	East/West indicator
7	spd	kno ts	numeric	0.004	Speed over ground
8	cog	deg ree s	numeric	77.52	Course over ground
Field No.	Name	Unit	Format	Example	Description
9	date	-	ddmmyy	091202	Date in day, month, year format, see note on UTC representation
10	mv	deg ree s	numeric	-	Magnetic variation value. Only supported in ADR 4.10 and later
11	mvEW	-	character	-	Magnetic variation E/W indicator. Only supported in ADR 4.10 and later
12	posMode	-	character	A	Mode Indicator, see position fix flags description (only available in NMEA 2.3 and later)
13	navStatu s	-	character	V	Navigational status indicator: V (Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later)
14	cs	-	hexadecimal	*57	Checksum
15	<CR><L F>	-	character	-	Carriage return and line feed

\$xxVTG,cogt,cogtUnit,cogm,cogmUnit,so gn,so gnUnit,so gk,so gkUnit,posMode*cs<CR><LF>

Example:

\$GPVTG,77.52,T,,M,0.004,N,0.008,K,A*06

Field No.	Name	Unit	Format	Example	Description
0	xxVTG	-	string	\$GPVTG	VTG Message ID (xx = current Talker ID, see NMEA Talker IDs table)
1	cogt	degrees	numeric	77.52	Course over ground (true)
2	cogtUnit	-	character	T	Course over ground units: T (degrees true, fixed field)
3	cogm	degrees	numeric	-	Course over ground (magnetic). Only supported in ADR 4.10 and above
4	cogmUnit	-	character	M	Course over ground units: M (degrees magnetic, fixed field)
5	sogn	knots	numeric	0.004	Speed over ground
6	sognUnit	-	character	N	Speed over ground units: N (knots, fixed field)
Field No.	Name	Unit	Format	Example	Description
7	sogk	km/h	numeric	0.008	Speed over ground
8	sogkUnit	-	character	K	Speed over ground units: K (kilometers per hour, fixed field)
9	posMode	-	character	A	Mode Indicator, see position fix flags description (only available in NMEA 2.3 and later)
10	cs	-	hexadecimal	*06	Checksum
11	<CR><LF>	-	character	-	Carriage return and line feed

Flags in NMEA 4.10 and above

NMEA Message	GLL, RMC	GGA	GLL, VTG	RMC, GNS
Field	status	quality	posMode	posMode
No position fix (at power-up, after losing satellite lock)	V	0	N	N
GNSS fix, but user limits exceeded	V	0	N	N
Dead reckoning fix, but user limits exceeded	V	6	E	E
Dead reckoning fix	A	6	E	E
RTK float	A	5	D	F
RTK fixed	A	4	D	R
2D GNSS fix	A	1 / 2	A / D	A / D
3D GNSS fix	A	1 / 2	A / D	A / D
Combined GNSS/dead reckoning fix	A	1 / 2	A / D	A / D
	See below (1)	See below(2)	See below(3)	See below(3)

- (1) Possible values for status: V = Data invalid, A = Data valid
- (2) Possible values for quality: 0 = No fix, 1 = Autonomous GNSS fix, 2 = Differential GNSS fix, 4 = RTK fixed, 5 = RTK float, 6 = Estimated/Dead reckoning fix
- (3) Possible values for posMode: N = No fix, E = Estimated/Dead reckoning fix, A = Autonomous GNSS fix, D = Differential GNSS fix, F = RTK float, R = RTK fixed

3. Mechanical properties

3.1. INSTALLATION GUIDE

After removing the module, please carefully check whether the components are obviously loose or damaged. Users can also use other modules for installation in the same way.

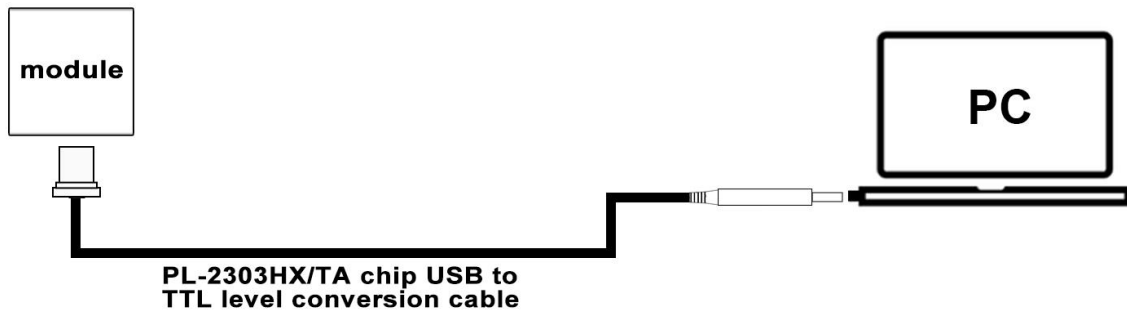


Figure 3-2 Connection diagram

4. Precautions

4.1. Other

- 1) The module's VCC power supply ripple should be controlled within 30mA/5.0V as much as possible, and interference on the power supply should be avoided.
- 2) Please ensure that the baud rate of the host computer is consistent with that of the module.
- 3) Please control the temperature when welding the module to avoid damage to the module.
- 4) To ensure the hot start function of the module, please ensure that the backup power supply is normal.

FCC Warning Statement

This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this product does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna of the radio/TV.
- Increase the separation between the equipment and receiver(radio/TV).
- Connect the equipment into an outlet on a circuit different from that to which the receiver(radio/TV) is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1)This device may not cause harmful interference.
- (2)This device must accept any interference received, including interference that may cause undesired operation.