# BE-881

GNSS 模块使用说明书

深圳市北天通讯有限公司

深圳市龙华区福城街道福民社区狮径路 15 号福城数字创新园一单元 901-905 九楼整层

电话: 0755-22225474　　　传真: 0755-22225474

www.beitian.com

修订记录

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　　只有在下列情况下，北天认为应对模块的安全、可靠性和性能的有关问题负责：
装配、扩充、重新调整、改进或维修均由公司认可的人员进行操作；设备的使用按操作要求进行。

修订记录

目录

1. 功能描述

1.1. 概述

　　BE-881 GNSS 模块是一款高性能卫星定位模块，为所有 L1 GNSS 系统提供了卓越的灵敏度和采集时间。<15 毫瓦的极低功耗在连续跟踪模式下，使得所有电池供电设备如资产追踪器能够拥有强大的续航能力，同时不牺牲 GNSS 性能。

　　BE-881 支持同时接收四个 GNSS (GPS、格洛纳斯、伽利略和北斗）。高可见卫星数量使接收器能够选择最佳信号，从而最大化位置可用性，特别是在城市深峡谷等具有挑战性的条件下。BE-881（超级信号）技术提供出色的射频灵敏度，通过小型天线或非视距场景可将动态位置精度提高多达 25%。

　　BE-881 检测干扰和欺骗事件，并向主机报告，以便系统对此类事件作出反应。先进的滤波算法减轻了射频干扰和干扰的影响，从而使产品能够按预期运行。

1.2. 产品特性

- 功耗低于 15 毫瓦，且不影响 GNSS 性能

- 并行接收四大 GNSS 系统信号，实现最高定位可用性

- 经实践验证，即便使用小型天线也具卓越性能

- 具备先进的欺骗和干扰检测功能

- 支持 FLASH，可以更改配置，断电不丢失。

- 支持软件升级，上位机可通过串口实现软件升级功能。

- 支持 LED 灯显示

- 内部带电子罗盘 QMC5883P

- GPS+有源天线一体模块

1.3. 性能指标

表 1-1 BE-881 模块主要性能指标

参　数	说　明	
芯片特性	芯片	M10050
	频率	GPS L1 C/A, QZSS L1 C/A/S,BDS B1I/B1C, Galileo E1B/C, SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
	工作模式	GPS，BDS，GALILEO
	辅助系统	SBAS，QZSS
	通道	N/A
灵敏度	跟踪	-166dBm
	重捕	-160dBm
	冷启动	-148dBm
	热启动	-160dBm
精度	水平精度	2.0 米 CEP
	速度精度	0.05m/s
	动态航向角精度	0.3 deg
	PPS 时间精度	RMS 30ns
		99% 60ns
启动时间	冷启动	27s
	热启动	1s
	辅助启动	1s
输出数据	波特率	4800bps - 921600bps，默认 115200bps
	输出电平	TTL 电平
	输出协议	NMEA，UBX
	NMEA 语句	RMC，VTG，GGA，GSA，GSV，GLL
	更新频率	0.25Hz-18Hz，默认 1Hz
	FLASH	带 FLASH，可以更改配置，断电不丢失
	秒脉冲	0.25 Hz to 10 MHz 可配置，默认周期 1s，高电平持续 100ms
工作限制	高度	80,000m
	速度	500m/s
	重力加速度	<4g
电源消耗	电压	直流 3.6V-5.5V，典型:5.0V
	电流	15mA/5.0V
物理参数	尺寸	28mm*28mm*11mm
	重量	12.0 克
	连接器	1.25 间距 6pin 座子
环境	操作温度	-40 °C ~ +85°C
	存储温度	-40°C ~ +105°C
指示灯	TX 灯	上电蓝灯闪烁，表示有数据输出
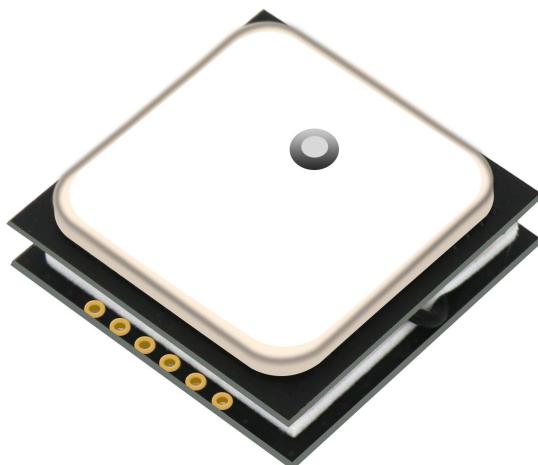
	PPS 灯	未定位该灯不亮；3D 定位后，开始闪烁
罗盘	罗盘	内部带电子罗盘 QMC5883P

管脚定义：
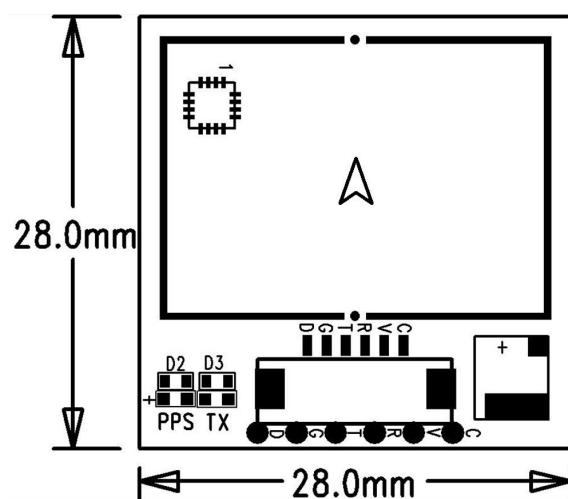
序　号	名　称	I/O	描　述	特　性
1	SDA	O	串行数据-I2C 总线主/从数据	罗盘数据引脚
2	GND	G	接　地	接　地
3	TX	O	UART 通讯接口,TTL 电平	GPS 数据输出引脚
4	RX	I	UART 通讯接口,TTL 电平	GPS 数据输入引脚
5	VCC	I	主电源，直流输入	DC 3.6V-5.5V；推荐 5.0V
6	SCL	I	串行时钟- I2C 总线主/从时钟	罗盘时钟引脚

1.5. 背面图

电子罗盘 IC QMC5883P 的位置，指示方向：
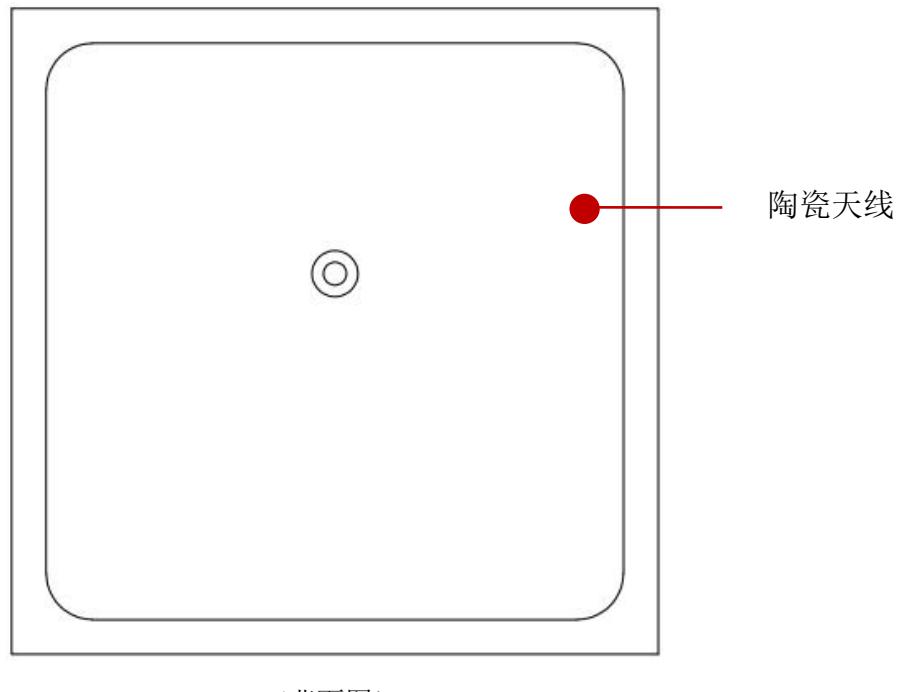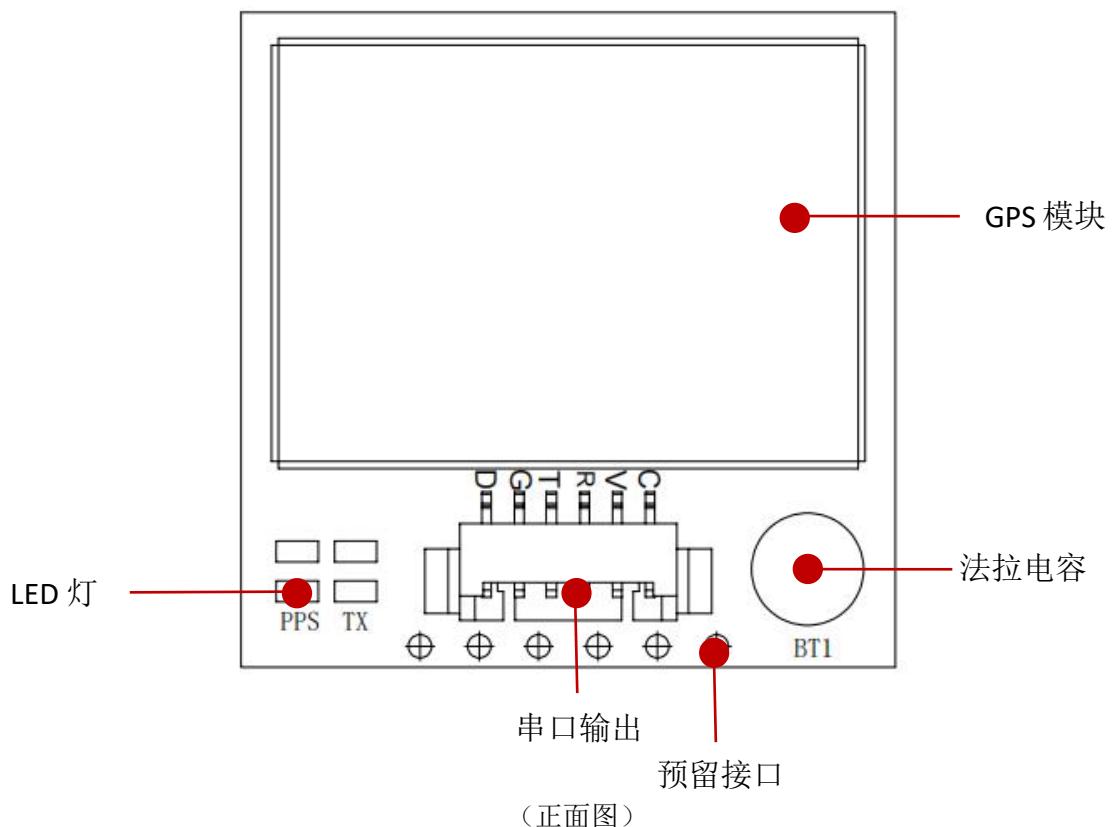
1.6. LED灯

1. 蓝灯，TX 灯，上电蓝灯闪烁，表示有数据输出。
2. 红灯，PPS 灯，未定位该灯不亮；3D 定位后，开始闪烁。

1.7. 应用

◆ 车载定位与导航
◆ 授时
◆ 可穿戴设备
◆ 物联网定位设备
◆ 无人机、飞控领域

1.8. 功能框图

（正面图）

（背面图）

图 1-2 BE-881 模块功能框图

1.9. 模块尺寸
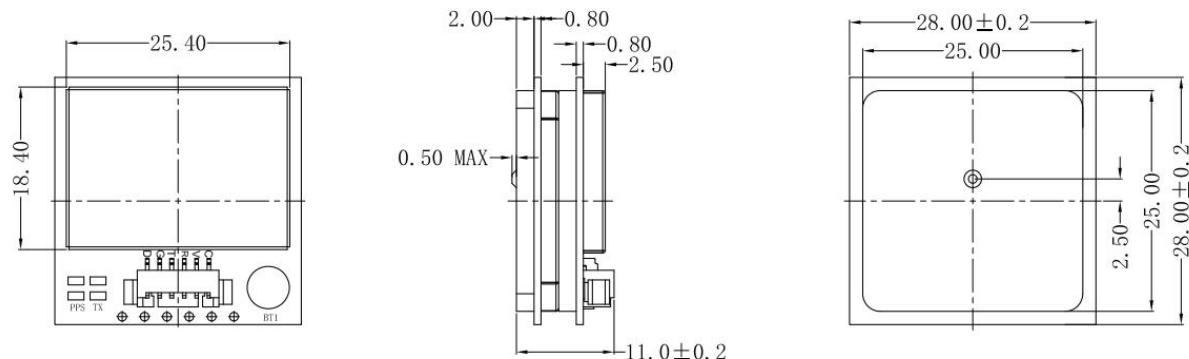
图 1-3 模块尺寸示意图

2. 模块接口说明

2.1. 硬件接口

2.1.1 电源

模块有电源输入管脚 VCC。其中 VCC 为模块的工作主电源；法拉电容储能，在主电源 VCC 断电时给 RTC 电路供电，确保关键信息不丢失，以实现热启动功能。

2.1.2 模块串口

管脚接口：

1.25 6pin：SDA、GND、TX、RX、VCC、SCL

2.1.3 1PPS 信号接口

无

2.1.4 UART 接口

模块设计 UART 串口 1.25 间距 6pin 座子，分别为（TX）和（RX）。串口在 UTC 秒边界输出 NMEA 数据，上位机也可以通过该串口对模块进行工作模式切换、软 件升级等操作。模块支持的波特率范围为 4800bps - 921600bps，默认 115200bps。 数据格式为：起始位 1 位、数据位 8 位、停止位 1 位、无校验位。用以输出自定义格式的数据，也可用于软件升级。

2.2. 软件接口协议

数据输出协议

联合模式协议头-GN

GPS 模式协议头-GP

GLONASS 模式协议头-GL

北斗模式协议头-GB 或 BD

未定位：

$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

已定位：

$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*cs<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.mmmmm	4717.11399	Latitude (degrees & minutes), see format description
3	NS	-	character	N	North/South indicator
4	lon	-	dddmm.mmmmm	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.mmmmm	4717.11364	Latitude (degrees & minutes), see format description

2	NS	-	character	N	North/South indicator
3	lon	-	dddmm. mmmmm	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. mmmmm	4717.11437	Latitude (degrees & minutes), see format description
4	NS	-	character	N	North/South indicator
5	lon	-	dddmm. mmmmm	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><LF>	-	character	-	Carriage return and line feed

$xxVTG,cogt,cogtUnit,cogm,cogmUnit,sogn,sognUnit,sogk,sogkUnit,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 Field	GLL, RMC status	GGA quality	GLL, VTG posMode	RMC, GNS 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. 机械特性

3.1. 安装导引

取出模块请仔细检查元器件是否有明显松弛或受损。用户也可使用其他的模块进行安装方法同此。
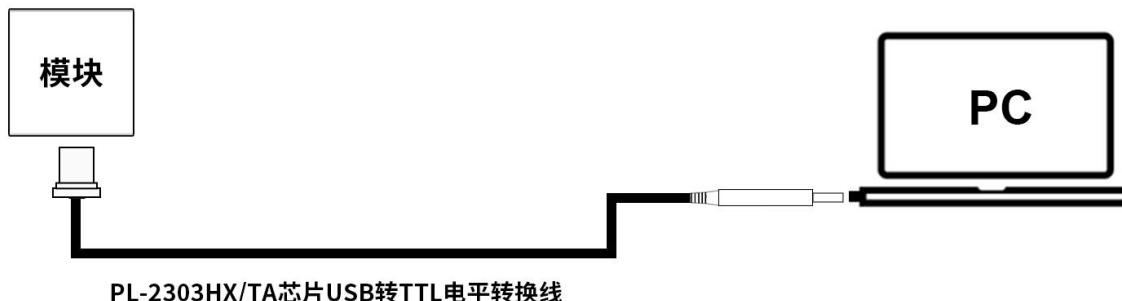
图 3-2 连接示意图

为保证高效的安装，请于安装模块前，准备好以下内容：

● 模块
● 串口调试线
● 带有串口的台式机或笔记本电脑（Win7 及以上系统)，并已经安装好相关串口驱动

4. 注意事项

4.1. 其他

1）模块的 VCC 供电电源纹波尽量控制在 15mA/5.0V 以内，并且避免电源上有干扰。

2）请确保上位机与模块设置的波特率保持一致。

3）模块焊接时请控制好温度，避免模块损坏。

4）为保证模块的热启动功能，请确保备份电源供电正常。