ROHS， TS16949， ISO9001

ST802D

多频多模亚米级

定位模组

目录 Contents

1. 描述 Description

ST802D双频定位模组是一款高性能的 GNSS 定位模组，该模块基于高精度导航定位 SOC 芯片设计，支持并行接收 L1（GPS L1、BDS B1I、Galileo E1）、L5（GPS L5、BDS B2a、Galileo E5a）频段卫星导航信号，可进行多系统多频点联合定位。模块内部集成功分器、滤波器、TCXO、RTC、变频通道、以及数字基带部分等单元，为电单车、无人机巡航等提供低功耗、小尺寸、高性能定位解决方案。

ST802D dual-frequency positioning module is a high-performance GNSS positioning module. The module is designed based on intellectual property rights of high-precision navigation and positioning SOC chip, and supports parallel receiving L1（GPS L1、BDS B1I、Galileo E1）、L5（GPS L5、BDS B2a、Galileo E5a） frequency band satellite navigation signal, can carry out multi-system multi-frequency joint positioning. The module integrates splitter, filter, TCXO, RTC, frequency conversion channel, digital baseband and other units, which can provide low-power, small-size, high-performance positioning solutions for motorcycles, cruise drones, etc.

2. 特点 Characteristics

- 支持D-GNSS辅助增强功能
  Support D-GNSS assist enhancement
- 灵敏度≤-165dBm
  Sensitivity≤-165dBm
- 支持北斗三代卫星
  Support the third generation of Beidou satellites
- 定位精度≤1m（CEP）
  Positioning accuracy≤1m (CEP)
- 模块尺寸12.2mm×16.0mm×2.6mm(公差：±0.2mm)
  Module size 12.2mm×16.0mm×2.6mm (tolerance: ±0.2mm)
- 封装尺寸兼容主流同尺寸高精度定位模块
  The package size is compatible with mainstream high-precision positioning modules of the same size
- 内置天线检查、天线馈电、短路保护功能
  Built-in antenna check, antenna feed, short circuit protection functions
- 多径信号检测与消除技术
  Multipath signal detection and cancellation technology
- 多频点干扰消除技术
  Multi-frequency interference cancellation technology

3. 器件特征 Device characteristics

器件名称 Device name	封装形式 Package form	封装尺寸 Package size	工作温度 Operating temperature
ST802D	金属非空封 Metal non-empty seal	12.2×16.0×2.6mm ^{3}	-40℃～85℃

4. 功能框图 Block diagram

原理框图如图1所示。

The block diagram is shown as in Fig. 1.

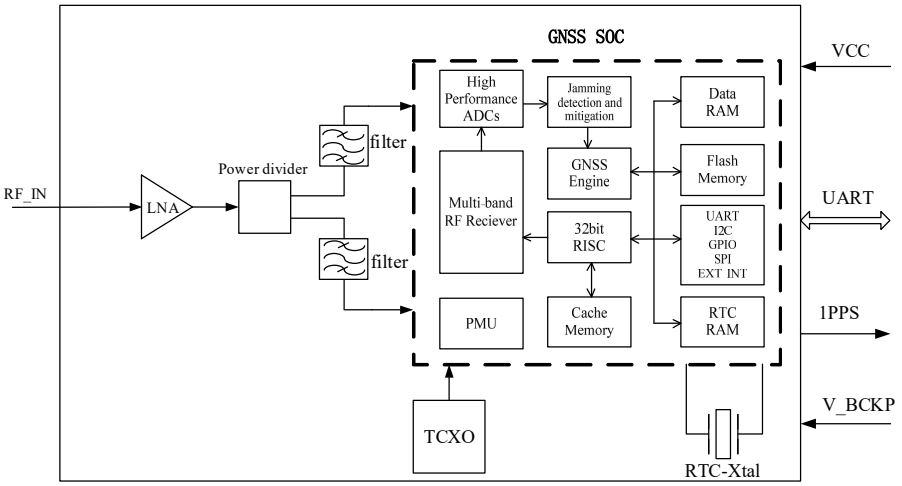


图1. ST802D原理框图

Fig 1. ST802D Block Diagram

5. 电特性 Electrical characteristics

项目 Items	性能指标 Performance	
接收信号 receive signal	GPS/QZSS L1/L5，BeiDou B1I/B2a，Galileo E1/E5a	
接收通道数 receiving channels number	230 通道 230 channels	
数据更新率 Data update rate	最大 10Hz，默认 1Hz Maximum 10Hz, default 1Hz	
首次定位时间（TTFF） First fix time	启动 start up	30s
	AGNSS①	3s
	热启动 Hot Start	1s
	重捕 Recapture	1s
灵敏度 Sensitivity	冷启动 cold Start	-148dBm
	热启动 Hot Start	-157dBm
	重捕获	-160dBm

	Recapture	
	跟踪 tracking	-165dBm
数据电平 data level	3.3V LVTTL level	
定位精度 positioning accuracy	＜1 m CEP	
测速精度 Speed measurement accuracy	GNSS	0.05m/s
GNSS 信息输出频率 Information output frequency	10Hz(默认输出 1Hz) 10Hz(default output 1Hz)	
应用极限 Application limit	速度 Speed	515m/s
	高度 Height	18000m
	加速度 Accelaeration	4g
授时精度 Timing accuracy	≤12ns	
天线状态检测② Antenna status detection	内置天线短路保护、开路检测功能。 Built-in antenna short circuit protection and open circuit detection functions.	
数据输出格式 Data output format	NMEA-0183 V4.1 /swid binary	
波特率 Baud rate	4800 / 9600 / 38400 / 115200	
功耗 Power consumption	捕获模式 Capture mode	70mA@3.3V
	跟踪模式 Tracking mode	60mA@3.3V
备注：①AGNSS 功能需要服务器支持 ②需使用天线馈电功能 Notes: ①AGNSS function requires server support ②Need to use antenna feed function		

6. 引脚定义 Pin configuration

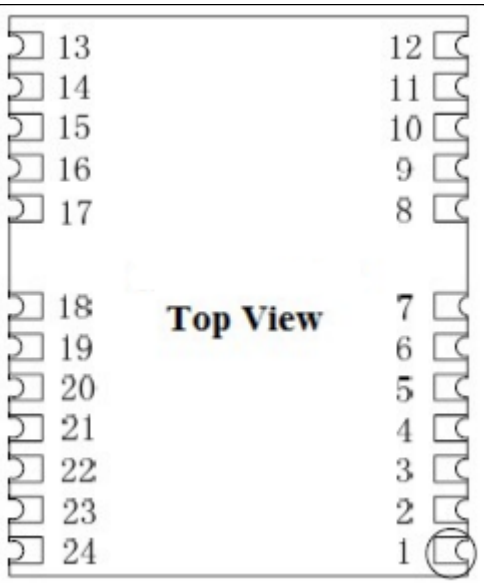


图2.　ST802D引出端排列（俯视图）

Fig 2.　ST802D Terminal arrangement (top view)

编　号 NO.	名称 Name	类型 Type	功能描述 Function description
1	MODE	-	模式选择，默认悬空 Mode selection, the default is floating
2	RSV	-	保留引脚，悬空 Reserved pin, floating
3	1PPS	O	1PPS 秒脉冲输出 1PPS Second pulse output
4	RSV	-	保留引脚，悬空 Reserved pin, floating
5	RSV	-	保留引脚，悬空 Reserved pin, floating
6	RXD2	-	UART 串口,保留 UART Serial port, reserved pin
7	RSV	-	保留引脚，悬空 Reserved pin, floating
8	RSTN	I	外部复位信号输入，低电平复位。内部上电自动复位，不使用外部复位，则该引脚悬空。 External reset signal input, low level reset. The internal power-on resets automatically. If the external reset is not used, the pin is left floating.
9	RSV	-	保留引脚，悬空 Reserved pin, floating
10	GND	I	地 Ground

11	RF_IN	I	射频输入，天线馈电输出，输出电压为 V_{CC}，该引脚可直接连接有源天线，并为天线提供电源电。 RF input, antenna feed output, output voltage is VCC, this pin can be directly connected to the active antenna and provide power for the antenna.
12	GND	I	地 Ground
13	GND	I	地 Ground
14	ANT_EN	I	可控制 RF_IN 打开或关断天线馈电功能（预留功能），不用时悬空。 It can control RF_IN to turn on or off the antenna feed function (reserved function), and it can be left floating when not in use.
15	RSV	-	保留引脚，悬空 Reserved pin, floating
16	RSV	-	保留引脚，悬空 Reserved pin, floating
17	RSV	-	保留引脚，悬空 Reserved pin, floating
18	RSV	-	保留引脚，悬空 Reserved pin, floating
19	RSV	-	保留引脚，悬空 Reserved pin, floating
20	TXD	O	UART 串口 UART serial port
21	RXD	I	UART 串口 UART serial port
22	V_BCKP	I	备用电池电源，SRAM 与 RTC 的备份电源输入，推荐外接贴片纽扣电池，连接方法参考典型应用电路图，不可悬空。 Backup battery power, backup power input for SRAM and RTC, it is recommended to connect an external patch button battery, the connection method refers to the typical application circuit diagram, and it cannot be left floating.
23	VCC	I	3.3V 电源输入，外接 100nF 滤波电容 3.3V power input, external 100nF filter capacitor
24	GND	I	地 Ground

7. 典型应用电路 Typical application circuit

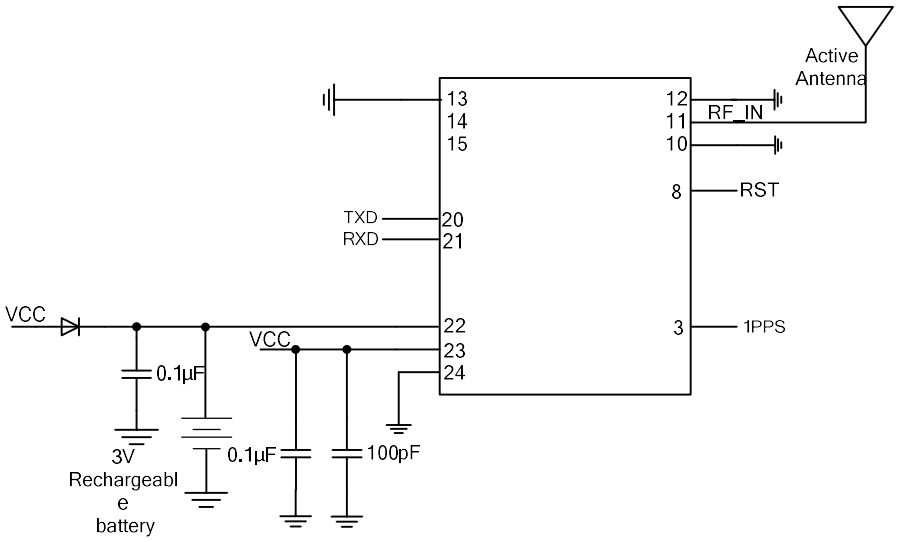


图3.　ST802D典型应用原理图

Fig 3. ST802D typical application schematic diagram

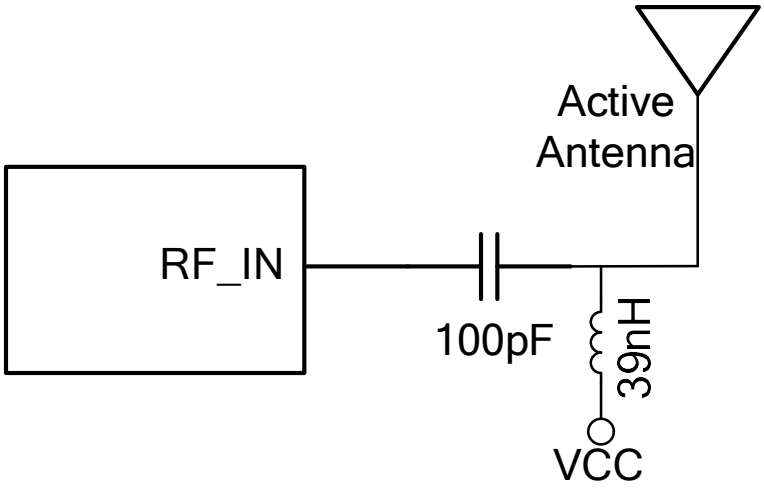


图4.　外部天线供电

Fig 4. External antenna power supply

注：①模块内部自带馈电功能，馈电电压为3.0V，如果天线工作电流＞50mA或者工作电压不能满足，请参考图4应用方案。

②使用外部电路为天线供电，需在RFIN添加隔直电容，且模组无法检测天线状态

③备用电池引脚如果不使用热启动功能，可直接将V_BACK连接到VCC，不可悬空或接地。

Note:

① The module has its own feeding function, and the feeding voltage is 3.0V. If the working current of the antenna is greater than 50mA or the working voltage cannot be satisfied, please refer to the application scheme in

Figure 4.

②When an external circuit is used to power the antenna, a DC blocking capacitor needs to be added to RFIN, but the antenna detection function cannot be provided when an external power supply is used.

③If the backup battery pin does not use the hot start function, V_BACK can be directly connected to VCC, and cannot be left floating or grounded.

8. 绝对最大额定值 Absolute maximum rating

（所有电压以GND为参考）

(All voltages are based on GND)

参数 Parameters	符号 Symbol	最小值 Min	最大值 Max	单位 unit
电源电压(VCC) Volt Current Condenser (VCC)	V_{CC}	-0.3	3.6	V
备用电池电源(V_BCKP) Backup battery power (V_BCKP)	*V_BCKP*	-0.3	3.6	V
RF_IN 输出电流 RF_IN output current	I_{CC_RF}	--	60	mA
RF_IN 最大输入功率 RF_IN maximum input power	RF_{in}	--	5	dBm
贮存温度 Storage temperature	T_{stg}	-45	90	℃

9. 工作条件 work condition

参数 Parameters	符号 Symbol	最小值 Min	典型值 Typical value	最大值 Max	单位 unit
工作温度范围 range of working temperature	T_A	-40	-	+85	℃
电源电压 Volt Current Condenser	V_{CC}	2.7	3.3	3.6	V
工作电流 Working current	I_{CC}	--	130	--	mA
输入低电平 Input low level	V_{IL}	--	--	0.8	V
输出低电平 Output low level	V_{OL}	--	--	0.5	V
输入高电平 Input high level	V_{IH}	2	--	--	V
输出高电平 Output high level	V_{OH}	2.4	--	--	V
备用电池电源 Backup battery power	*V_BCKP*	1.7	--	3.6	V
RFIN 输入阻抗 RFIN input impedance	*S11*	--	50	--	Ohm

10. 功耗

参数 Parameters	条件 conditions	典型值 Typical value	单位 unit
捕获电流 Capture current	RFIN=-130dBm V_{CC}=3.3V	70	mA
跟踪电流 Tracking current		60	mA
休眠电流 Sleep current		50	μA

11. 设计注意事项 Design Considerations

11.1 天线选择 Antenna Selection

本模块的射频部分内置双工器，外部推荐连接有源天线，天线的增益20~45dB，噪声系数小于2dB，天线相位中心小于2cm，有助于模组获得最佳性能。

模块内置有源天线开路检测与过流保护功能，可以检测有源天线正常连接、开路和短路的状态，并在NMEA数据发出提示信息，天线馈电输出电流50mA。

The RF part of this module has a built-in duplexer. It is recommended to connect an active antenna externally. The gain of the antenna is 20~45dB, the noise figure is less than 2dB, and the antenna phase center is less than 2cm, which helps the module to obtain the best performance.

The module has built-in active antenna open circuit detection and overcurrent protection functions, which can detect the normal connection, open circuit and short circuit status of the active antenna, and send a prompt message in the NMEA data, and the antenna feed output current is 50mA.

11.2 电源 power supply

为了保证工作，应尽量控制模块电源的纹波≤50mV, LDO供电120mA以上的，电源噪声会影响接收机灵敏度，旁路电容应放置在靠近VCC引脚的地方，其值根据电路线路上的噪声进行调整。

备用电源输入引脚（V_BACK）的作用是在模块断电时保持SRAM存储器和RTCM处于通电状态，使模块能在主电源切断后保持用于热启动的星历数据。备用电源可接电池、超级电容或其他电源，如无需热启动，备用电源应接到模块的VCC上，不可悬空或接地。

In order to ensure the work, the ripple of the power supply of the module should be controlled as far as possible ≤ 50mV. If the LDO power supply is more than 120mA, the power supply noise will affect the sensitivity of the receiver. The bypass capacitor should be placed close to the VCC pin, and its value depends on the noise on the circuit line. make adjustments.

The function of the backup power input pin (V_BACK) is to keep the SRAM memory and RTCM in the power-on state when the module is powered off, so that the module can keep the ephemeris data for warm start after the main power is cut off. The backup power supply can be connected to batteries, super capacitors or other power

sources. If no hot start is required, the backup power supply should be connected to the VCC of the module, and cannot be left floating or grounded.

11.3 PPS输出 PPS output

当接收机进入3D定位模式后，1PPS引脚会产生每秒1个脉冲信号（100ms持续高电平）。脉冲上升沿与UTC秒对齐，精度约为10ns，当定位失锁后，秒脉冲精度会明显降低。

When the receiver enters the 3D positioning mode, the 1PPS pin will generate a pulse signal per second (100ms continuous high level). The rising edge of the pulse is aligned with the UTC second, and the accuracy is about 10ns. When the positioning is lost, the second pulse accuracy will be significantly reduced.

11.1 UART接口 UART interface

本模块提供一路TTL电平的通用异步收发器（UART），串口1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。

This module provides one TTL level Universal Asynchronous Receiver/Transmitter (UART), serial port 1 outputs NMEA data at the UTC second boundary, and the host computer can also switch the working mode of the module through this serial por

12. NMEA Output Description

The output protocol supports NMEA‐0183 standard. The mplemented messages include GGA, GLL, GSA, GSV, VTG, RMC, DA and GNS messages. The NMEA message output has the following sentence structure:

$aaccc,c–c*hh<CR><LF>

The detail of the sentence structure is explained in Table 1.

Table 1: The NMEA sentence structure

Character	HEX	Description
“$”	24	Start of sentence.
Aaccc		Address field. “aa” is the talker identifier. “ccc” identifies the sentence type.
“,”	2C	Field delimiter.
C–c		Data sentence block.
“*”	2A	Checksum delimiter.
Hh		Checksum field.
<CR><LF>	0D0A	Ending of sentence. (carriage return, line feed)

Table 2: Overview of Swid receiver’s NMEA messages

$GPGGA	Time, position, and fix related data of the receiver.
$GNGLL	Position, time and fix status.
$GNGSA	Used to represent the ID’s of satellites which are used for position fix. When GPS satellites are used for position fix, $GNGSA sentence is output with system ID 1. When GLONASS satellites are used for position fix, $GNGSA sentence is output with system ID 2. When BDS satellites are used for position fix, $GNGSA sentence is output with system ID 4.

$GPGSV **$GLGSV** **$GAGSV** **$GBGSV**	Satellite information about elevation, azimuth and CNR, $GPGSV is used for GPS satellites, $GLGSV is used for GLONASS satellites, $GAGSV is used for GALILEO satellites, while $GBGSV is used for BDS satellites
$GNRMC	Time, date, position, course and speed data.
$GNVTG	Course and speed relative to the ground.
$GNZDA	UTC, day, month and year and time zone.

The formats of the supported NMEA messages are described as follows:

12.1 GGA – Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.

Structure:
$GPGGA,hhmmss.sss,ddmm.mmmmmmmm,a,dddmm.mmmmmmmm,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><
LF> 1 2 3 4 5 6 7 8 9 10 11 12

Example:
$GPGGA,033010.000,2447.0895508,N,12100.5234656,E,4,12,0.7,94.615,M,19.600,M,,0000*66<CR><LF>

Field	Name	Example	Description
1	UTC Time	033010.000	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0895508	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5234656	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
6	GPS quality indicator	4	GPS quality indicator 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential GPS mode 3: GPS PPS Mode, fix valid 4: Real Time Kinematic. System used in RTK mode with fixed integers 5: Float RTK. Satellite system used in RTK mode., floating integers 6: Estimated (dead reckoning) Mode 7: Manual Input Mode 8: Simulator Mode
7	Satellites Used	12	Number of satellites in use, (00 ~ 12)
8	HDOP	0.7	Horizontal dilution of precision, (0.0 ~ 99.9)
9	Altitude	94.615	mean sea level (geoid), (- 9999.9 ~ 17999.9)
10	Geoidal Separation	19.600	Geoidal separation in meters
11	Age pf Differential GPS data		Age of Differential GPS data NULL when DGPS not used
12	DGPS Station ID	0000	Differential reference station ID, 0000 ~ 1023
13	Checksum	66	

12.2 GLL – Latitude/Longitude

Latitude and longitude of current position, time, and status.

Structure:

$GNGLL,ddmm.mmmmmmmm,a,dddmm.mmmmmmmm,a,hhmmss.sss,A,a*hh<CR><LF

> 1 2 3 4 5 6 7 8

Example:

$GNGLL,2447.0895508,N,12100.5234656,E,033010.000,A,D*48<CR><LF>

Field	Name	Example	Description
1	Latitude	2447. 0895508	Latitude in ddmm.mmmmmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
3	Longitude	12100. 5234656	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	033010.000	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
6	Status	A	Status, 'A' = Data valid, 'V' = Data not valid
7	Mode Indicator	D	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode
8	Checksum	48	

12.3 GSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence and DOP values.

Structure:

```
$GNGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,x*hh<C
        R><LF> 1  2  3 3 3 3 3    3 3  3 3  3    3 3    4    5      6 7      8
```

Example:

```
$GNGSA,A,3,05,12,13,15,20,21,24,193,,,,,1.2,0.7,1.0,1*08<CR><LF>
$GNGSA,A,3,01,03,04,06,07,13,16,21,26,,,,1.2,0.7,1.0,4*34<CR><LF>
```

Field	Name	Example	Description
1	Mode	A	Mode 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
2	Mode	3	Fix type 1 = Fix not available 2 = 2D 3 = 3D
3	Satellite used 1~12	05,12,13,15,20,21,24,193	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS,
4	PDOP	1.2	Position dilution of precision (0.0 to 99.9)
5	HDOP	0.7	Horizontal dilution of precision (0.0 to 99.9)
6	VDOP	1.0	Vertical dilution of precision (0.0 to 99.9)
7	GNSS System ID	1	GNSS system ID* 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BDS 5 = IRNSS
8	Checksum	08	

*GNSS System ID identifies the GNSS system ID according to Table 3.

*GNSS Signal ID identifies the GNSS signal name according to Table 3.

Table 3: GNSS Identification Table for GSA, GSV

System	System ID (Talker)	Signal ID	Signal Name
GPS	1 (GP)	0	All signals
		1	L1 C/A
		2	L1
		3	P(Y)
		4	L1C
		5	L2 P(Y)
		6	L2C
		7	- M
		8	L2C
GLONASS	2 (GL)	0	All signals G1
		1	C/A
		2	G1P
		3	G2
		4	
GALILEO	3 (GA)	0	All signals
		1	E5 a
		2	E5 b
		3	E5 a+b E6
		4	
		5	
		6	
		7	
BDS	4 (BD)	0	All signals
		1	B1
		2	B2
		3	A
		4	B2
		5	
IRNSS	5 (GI)	0	All signals
		4	

12.4 GSV – GNSS Satellites in View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four satellites maximum per transmission.

Structure:
$GPGSV,x,x,xx,xx,xx,xxx,xx,…,xx,xx,xxx,xx,x *hh<CR><LF>
1 2 3 4 5 6 7 4 5 6 7 8 9

Example:
$GPGSV,3,1,10,24,83,125,48,193,66,057,44,21,53,277,45,15,43,034,47,1*58<CR><LF>
$GPGSV,3,2,10,20,40,325,43,05,16,113,40,13,15,050,39,12,14,146,42,1*6E<CR><LF>
$GPGSV,3,3,10,10,13,314,,32,06,261,,1*62<CR><LF>
$GPGSV,2,1,05,24,83,125,49,193,66,057,44,15,43,034,45,05,16,113,36,6*5B<CR><LF>
$GPGSV,2,2,05,12,14,146,37,6*57<CR><LF>
$GBGSV,3,1,09,13,65,247,45,06,60,334,43,03,59,204,41,26,58,153,47,1*7E<CR><LF>
$GBGSV,3,2,09,16,57,325,45,01,53,142,42,21,52,046,47,04,38,118,,1*7A<CR><LF>
$GBGSV,3,3,09,07,20,169,37,1*40<CR><LF>
$GBGSV,2,1,07,13,65,247,47,06,60,334,47,03,59,204,47,16,57,325,47,3*7C<CR><LF>
$GBGSV,2,2,07,01,53,142,49,04,38,118,45,07,20,169,43,3*44<CR><LF>

Field	Name	Example	Description
1	Number of message	3	Total number of GSV messages to be transmitted (1 - 5)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	10	Total number of satellites in view (00 ~ 20)
4	Satellite ID	24	01 ~ 32 are for GPS; 33 ~ 64 are for WAAS (PRN minus 87); 193 ~ 197 are for QZSS; 65 ~ 88 are for GLONASS (GL PRN) ; 01 ~ 36 are for GALILEO (GA PRN); 01 ~ 37 are for BDS (BD PRN). GPS, GLONASS, GALILEO and BDS satellites are differentiated by
5	Elevation	83	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	125	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	48	C/No in dB (00 ~ 99) Null when not tracking
8	Signal ID	1	Signal ID*
9	Checksum	58	

12.5 RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:

$GPRMC,hhmmss.sss,A,dddmm.mmmmmmmm,a,dddmm.mmmmmmmm,a,x.x,x.x,ddmmyy,,,a,a*hh<CR><LF

> 1 2 3 4 5 6 7 8 9 1011 12

Example:

$GNRMC,033010.000,A,2447.0895508,N,12100.5234656,E,000.0,000.0,111219,,,R,V*18<CR><LF>

Field	Name	Example	Description
1	UTC time	033010.000	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0895508	Latitude in dddmm.mmmmmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5234656	Longitude in dddmm.mmmmmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
7	Speed over ground	000.0	Speed over ground in knots (000.0 ~ 999.9)
8	Course over ground	000.0	Course over ground in degrees (000.0 ~ 359.9)
9	UTC Date	111219	UTC date of position fix, ddmmyy format
10	Mode indicator	R	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'F' = Float RTK. Satellite system used in RTK mode, floating integers 'M' = Manual Input Mode 'N' = Data not valid 'P' = Precise 'R' = Real Time Kinematic. System used in RTK mode with fixed integers 'S' = Simulator Mode
11	Navigation status	V	Navigation status indicator according to IEC61108 requirement on 'Navigational (or Failure) warnings and status indicators'. 'S' = Safe 'C' = Caution 'U' = Unsafe 'V' = Navigation status not valid, equipment is not providing navigation status indicator.
12	checksum	18	

12.6 VTG – Course Over Ground and Ground Speed

The actual course and speed relative to the ground.

Structure:
GPVTG,x.x,T,,M,x.x,N,x.x,K,a*hh<CR><LF>
1 2 3 4 5

Example:
$GNVTG,000.0,T,,M,000.0,N,000.0,K,D*16<CR><LF>

Field	Name	Example	Description
1	Course	000.0	True course over ground in degrees (000.0 ~ 359.9)
2	Speed	000.0	Speed over ground in knots (000.0 ~ 999.9)
3	Speed	000.0	Speed over ground in kilometers per hour (000.0 ~ 1800.0)
4	Mode	D	Mode indicator 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'N' = Data not valid 'P' = Precise
5	Checksum	16	

12.7 ZDA – TIME AND DATE

UTC, day, month, year and local time zone

Structure:
$GPZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>
1 2 3 4 5 6 7

Example:
$GNZDA,033010.000,11,12,2019,00,00*40<CR><LF>

Field	Name	Example	Units	Description
1	UTC time	033010.000		UTC time in hhmmss.ss format (000000.00 ~ 235959.999)
2	UTC Day	11		UTC time: day (01 ~ 31)
3	UTC Month	12		UTC time: month (01 ~ 12)
4	UTC Year	2019		UTC time: year (4 digit format)
5	Local zone hour	00		Local zone hours (00 ~ +/ - 13)
6	Local zone minutes	00		Local zone minutes (00 ~59)
7	Checksum	40		Checksum

13. 产品标识Product ID

产品标识内容包括：本公司商标、产品型号、检验批识别代码、电路编号。

Product ID(identification) includes: company trademark, product model, inspection batch identification code, circuit number.

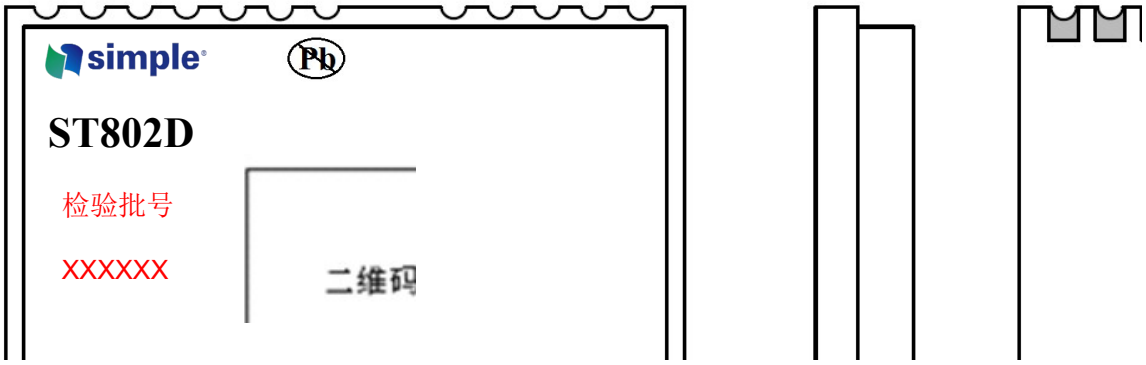
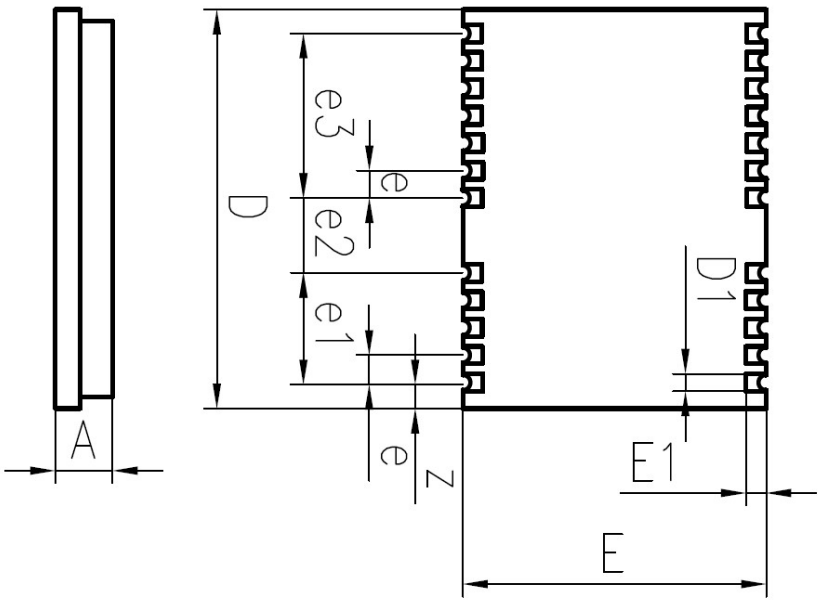


图5. 产品标识图

14. 封装外形 Package outline



单位：mm

尺寸符号 Size symbol	数值 Value			尺寸符号 size symbol	数值 value		
	最小 Min	公称 Nominal	最大 Max		最小 Min	公称 Nominal	最大 Max
E	12.1	--	12.4	*A*	2.2	--	2.6
D	15.9	--	16.6	*D1*	0.6	--	0.8
e	0.9	--	1.3	*e2*	2.8	--	3.2
e1	4.2	--	4.6	*e3*	6.4	--	6.8
z	0.8	--	1.2	*E1*	--	0.8	--

图6.　ST802D封装外形图

Fig6. ST802D package diagram

15. 注意事项

为了发挥模块最优的性能指标，在应用时需要注意如下事项：

1、本模块为静电敏感器件，在运输和使用中须使用防静电措施，同时防止高处跌落，损坏内部器件。

2、外接有源天线需求：推荐使用有源天线低噪声放大器增益 20dB~45dB,噪声系数优于 1.5dB。模块可通过射频输入端口对有源天线馈电，馈电电压为 VCC 电源，最大输出电流约 50mA，若超过最大输出电流，端口自动关闭馈电功能。

3、供电：推荐采用 LDO 为模块供电，保证良好的电源纹波。LDO 应尽量靠近模块电源引脚。

4、 电源旁路：本电路为射频、模拟、数字混合电路,电源引脚应采用推荐电容值的电容进行滤波处理，并确保电容尽量靠近器件引脚。

5、 防静电损伤：器件为静电敏感器件，传输、装配、测试过程中应采取充分的防静电措施。

6、产品说明书以发布日期为准，适时修改不另行说明。

15. Precautions

In order to give full play to the optimal performance indicators of the module, the following matters need to be paid attention to when applying:

1. This module is a static-sensitive device, and anti-static measures must be used during transportation and use, and at the same time, it should be prevented from falling from a high place and damaging the internal devices.

2. External active antenna requirements: It is recommended to use active antenna low noise amplifier with a gain of 20dB~45dB, and a noise figure better than 1.5dB. The module can feed

the active antenna through the RF input port, the feeding voltage is VCC power supply, and the maximum output current is about 50mA. If the maximum output current exceeds the maximum output current, the port will automatically turn off the power feeding function.

3. Power supply: It is recommended to use LDO to supply power to the module to ensure good power supply ripple. The LDO should be as close as possible to the module power pins.

4. Power supply bypass: This circuit is a radio frequency, analog, and digital hybrid circuit. The power supply pins should be filtered with capacitors with recommended capacitance values, and ensure that the capacitors are as close to the device pins as possible.

5. Anti-static damage: The device is a static-sensitive device, and adequate anti-static measures should be taken during transmission, assembly, and testing.

6. The product manual is subject to the release date, and it will be revised in due course without further explanation.

版本信息

版本号 version number	建立时间 Establishment time	描述 Description	更改页 Change page
Rev 1	2021.10.25	正式版 Formal edition	