SKG8212R规格书
L1+L5 RTK定位模块
SKG8212R Datasheet
L1+L5 RTK
GNSS Module

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目录/Contents

1 产品简介/Product Introduction 4
2 典型应用/Application 4
3 产品特点/Features 5
5 传输及外设接口/Transmission and peripheral interface 5
5.1 PPS 5
5.2 UART 5
5.3 通信频率/Frequency of communication 6
5.4 通信协议/Communication protocol 6
5.5 控制命令/Control command 6
5.6 睡眠模式控制/ Sleep mode control 6
6 电气特性/Electrical specification 7
7 性能指标/Performance evaluation 7
8 管脚定义/PIN Definition 9
9 管脚描述/Pin description 9
10 机械尺寸/Machine Dimension 11
11 参考电路/Reference circuit 12
12 Layout 注意事项/ Layout Considerations 12
12.1 元件布局/ Placing Components 12
12.2 无源天线设计/ Passive Antenna Design 13
12.3 阻抗匹配/ Impedance Matching 13
12.4 微带线设计/ Microstrip line design 13
13 软件说明/ Software description 14
13.1 NMEA 0183 协议/ The NMEA 0183 protocol is available 14
13.2 GGA-定位数据信息/GGA- Location information 15
13.3 GSA-当前卫星信息/GSA- GNSS satellites in using 16
13.4 GSV-可见卫星信息//GSV- GNSS Satellites in View 17
13.5 RMC-推荐定位信息/ RMC- Recommended locating information 19
14 联系方式/ Contact Information 20

1 产品简介/Product Introduction

SKG8212R 是一款高性能的、双频多系统导航的 RTK 定位模块。该模块支持新一代的北斗三号信号体制。模块能够同时支持 L1+L5 频段，并且能同时支持全球全部卫星定位系统：GPS、BDS、GLONASS、GALILEO、QZSS、IRNSS(NAVIC)，支持 SBAS。启动时间短，定位精度高，可靠性强，可以为车载和便携式手持等定位终端产品的制造提供了高灵敏度、高精度、低成本的定位、导航等解决方案，能满足专业定位的严格要求与个人消费需要。外形尺寸紧凑，兼容市场上国际主流导航定位模块，采用 SMD 焊盘，支持标准取放及回流焊接。

SKG8212R is a high-performance, dual-band multi-system navigation RTK GNSS module. The module can support L1+L5 bands at the same time, as well as global full satellite GNSS systems: GPS, BDS, GLONASS, GALILEO, QZSS, IRNSS(NAVIC), and SBAS. With short startup time, high positioning accuracy and strong reliability, it can provide high-sensitivity, high-precision, low-cost positioning, navigation and other solutions for the manufacturing of vehicle mounted and portable handheld positioning terminal products, which can meet the strict requirements of professional positioning and personal consumption needs. Compact size, compatible with international mainstream navigation andGNSS modules in the market, SMD pads are used, and standard placement and reflow welding are supported.

图 1：SKG8212R 正视图/Top view

2 典型应用/Application

- 汽车导航/ Auto navigation
- 个人导航设备/ Personal navigation equipment
- 汽车保全系统/ Car security system
- IRNSS 应用/ IRNSS application

3 产品特点/Features

◆ 支持 GPS L1, BDS B1I,BDS B1C, Galileo E1, QZSS L1, GLONASS G1/ Supports GPS L1, BDS B1I, BDS B1C,Galileo E1, QZSS L1, GLONASS G1

◆ 支持 GPS L5, BDS B2A, Galileo E5, QZSS L5, IRNSS/ Supports GPS L5, BDS B2A, Galileo E5, QZSS L5, IRNSS

◆ 支持 SBAS(WAAS, EGNOS, MSAS, GAGAN)/ Support SBAS(WAAS, EGNOS, MSAS, GAGAN)

◆ 标准通信协议 NEMA0183/Plug and play standard communication protocol NEMA0183

◆ 支持 AGNSS / Support AGNSS

◆ 200 个具有快速搜索引擎的跟踪频道/200 tracking channels with fast search engine

◆ 符合 RoHS, FCC, CE /Compliance with RoHS, FCC, CE

5 传输及外设接口/Transmission and peripheral interface

5.1 PPS

秒脉冲（PPS）：SKG8212R 提供非常精准的时间脉冲 PPS 信号，PPS 信号可为外部系统提供授时功能，脉冲宽度可调，精度 20ns，每秒输出一个脉冲。

Second pulse (PPS): The SKG8212R provides a very accurate time pulse PPS signal, the PPS signal can provide the timing function for the external system, the pulse width is adjustable, the accuracy is20ns, it output a pulse per second.

5.2 UART

SKG8212R 模块使用 UART 接口，可提供全双工、异步串行通信，波特率可达 6Mbps，默认波特率为 115200bps。支持 5/6/7/8 位数据，以及偶数、奇数或无奇偶校验。支持数据传输、固件升级功能，输入、输出信号类型为 LVTTL 电平。

The SKG8212R module uses UART interface to provide full duplex, asynchronous serial communication. The baud rate can reach 6Mbps, and the default baud rate is 115200bps. Supports 5/6/7/8-bit data, and even, odd, or no parity. It supports data transmission and firmware upgrade, and the input/output signal type is LVTTL level .

5.3 通信频率/Frequency of communication

目前，系统支持输出 1/2/5/10/20Hz 的数据刷新频率，默认频率为 1Hz。

At present, the system supports the output of 1/2/5/10/20Hz data refresh frequency, and the default frequency is 1Hz.

5.4 通信协议/Communication protocol

目前，SKG8212R 支持 UART 接口，默认波特率 115200。模块支持数据协议 NMEA0183 和 RTCM3。使用 RTK 功能时，需要将 RTCM 数据通过 UART0_RX 传输至模块。

At present, SKG8212R module supports UART interface, and the default baud rate is 115200. The module supports data protocol NMEA0183 and RTCM3. When using the RTK function, RTCM data needs to be transferred to the module via UART0_RX.

5.5 控制命令/Control command

SKG8212R 系统支持用户通过串口发送控制命令，并且自动保存设置，即 SKG8212R 每次上电都是按控制指令修改后的方式输出。

The SKG8212R system supports the user to send control commands through the serial port and automatically save the settings, that is, SKG8212R is output in the way modified by the control command every time it is powered on.

5.6 睡眠模式控制/ Sleep mode control

SKG8212R 支持两种睡眠模式控制。第一种是用户通过串口发送控制命令进入睡眠模式，进入该模式后通过发送任意字节数据唤醒，功耗为 10mA（3.3V）。第二种方式是通过控制 SKG8212R 的电源实现：维持 V_BACKUP 引脚供电，同时切断 VCC 供电，恢复 VCC 供电即可唤醒，功耗为 22uA（3.3V）。

SKG8212R supports two sleep mode controls. The first is that the user sends control commands through the serial port to enter the sleep mode. After entering this mode, the user wakes up by sending any byte of data, and the power consumption is 10mA (3.3V). The second way is to control the power supply of SKG8212R: maintain V_ BACKUP pin power supply and cut off VCC power supply, restore VCC power supply will wake up the system, in this case, the power consumption is 22uA (3.3V).

6 电气特性/Electrical specification

◆ **极限参数/limit Parameter**

参数/Parameter	符号/Symbol	最小值/Min.	最大值/Max.	单位/Unit
电源/power supply				
供电电压/Supply Voltage	VCC	-0.3	4.2	V
输入输出/ IO				
I/O 特性/I/O Features	VIO	-0.3	3.6	V
RF 输入功率/RF Input power	RF_IN		0	dBm
静电保护/ESD	RF_IN		2000	V
环境/Environment				
存储温度/Storage temperature	Tstg	-40	85	° C
湿度/Humidity			95	%

◆ **电气特性/Electrical specification**

参数/Parameter	符号 /Symbol	条件 /Condition	最小值 /Min.	典型值 /Type	最大值 /Max.	单位 /Unit
电源电压/Supply voltage	VCC		2.4	3.3	4.2	V
电源电压/Supply voltage	V_BCKP		2.4	3.3	4.2	V
输入高压/input high voltage	V_{IH}		2.4		3.6	V
输入低压/input low voltage	V_{IL}		0		0.7	V
输出高压/output high voltage	V_{OH}	I_{oh}=4mA	2.8			V
输出低压/output low voltage	V_{OL}	I_{ol}=4mA			0.4	V
工作温度/Operating temperature	T_{opr}		-40		85	°C

7 性能指标/Performance evaluation

参数/Parameter	描述/Description		
接收机类型/Receiver type	L1	1602 MHz	GLONASS G1
		1575.42 MHz	BDS B1C GPS L1

			QZSS L1 SBAS L1 QZSS L1 Galileo E1
		1561.098 MHz	BDS B1I
	L5	1176.45 MHz	GPS L5 QZSS L5 Galileo E5A BDS B2A IRNSS L5
首次定位时间 TTFF	冷启动/Cold Start≤28s		
	热启动/Hot Start≤1s		
	AGPS 启动/AGPS start≤1.5s		
灵敏度/Sensitivity	跟踪/Tracking：-162dBm		
	重捕获/Re-acquisition：-159dBm		
	冷启动/Cold Start：-148dBm		
	热启动/Hot Start：-159dBm		
定位精度（全开方天空）/ precision(OPEN SKY)	自主定位/Autonomous positioning≤1.5m CEP		
	SBAS≤1m CEP		
	DGNSS ≤1m CEP		
	RTK FIX 1.0cm+1ppm(H)		
	RTK FIX 3.0cm+1ppm(V)		
PPS 精度/PPS precision	≤20ns		
速度精度/Speed precision	0.05m/s		
功耗/ Power dissipation	Continuous L1/L5 mode :45mA(3.3V) Sleep mode: 22μA		
尺寸/Dimension	16.4*12.2*2.4 mm		
工作环境/Operational constraint	动态/Dynamic<=4g		
	高度/Altitude<=50,000m		

	速度/Speed<=500m/s

8 管脚定义/PIN Definition

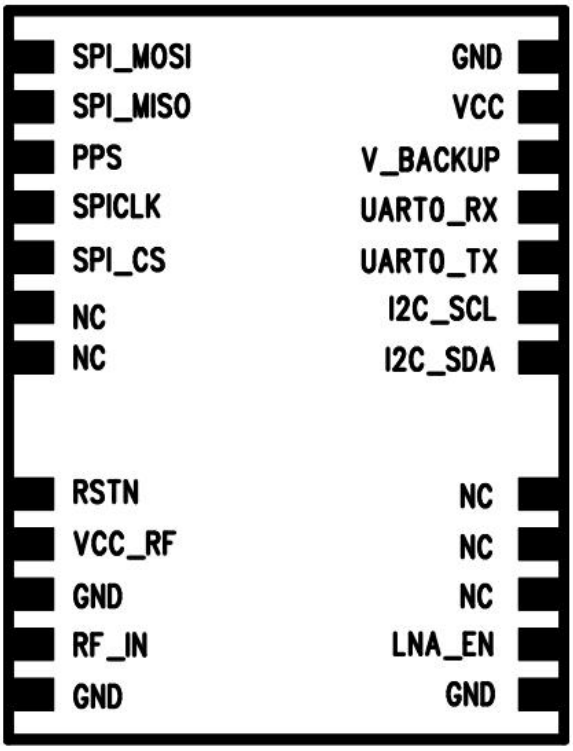


图 3：SKG8212R 管脚定义/pin definitions

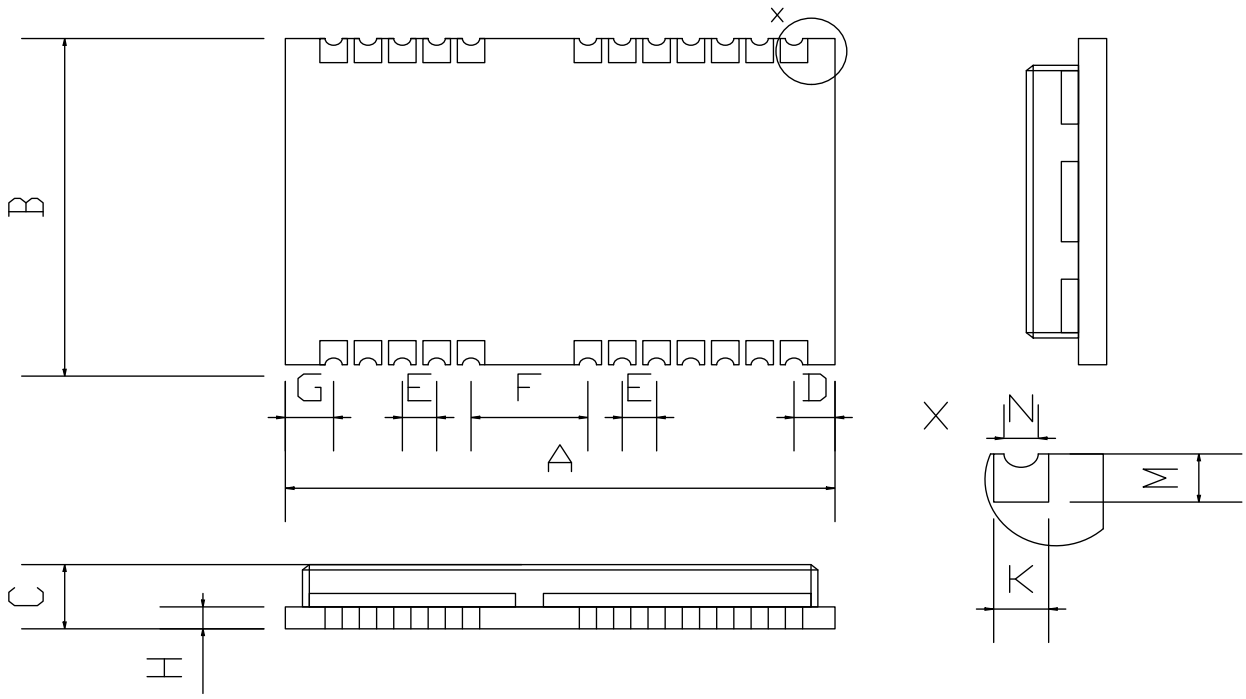
9 管脚描述/Pin description

管脚编号 /Pin No.	管脚定义 /Pin name	描述/Description	备注/Remark
1	SPI_MOSI	主设备输出和从设备输入引脚/Master device output and slave device input pins	预留，默认关闭/ Reserved, closed by default
2	SPI_MISO	主设备输入和从设备输出引脚/ Master input and slave output pins	预留，默认关闭/ Reserved, closed by default
3	PPS	秒脉冲信号输出/Second pulse signal output	不使用时悬空/Leave open if not used
4	SPI_CLK	SPI 时钟脚/ SPI clock	预留，默认关闭/ Reserved, closed by default
5	SPI_CS	SPI 片选脚/SPI chip selection	预留，默认关闭/ Reserved, closed by

6	NC	/	/
7	NC	/	/
8	RSTN	模块复位/Module reset	低电平触发/ Active at low level
9	VCC_RF	有源天线供电输出/ Active antenna power output	输出 3.3V/Output 3.3V
10	GND	电源地/Ground	
11	RF_IN	GNSS 天线接口/ Antenna interface pin	输入端 50 欧姆阻抗匹配/ 50 ohm impedance matching at the input
12	GND	电源地/Ground	/
13	GND	电源地/Ground	/
14	LNA_EN	外部 LNA 使能/ External LNA enable	输出 3.3V/Output 3.3V
15	NC	/	/
16	NC	/	/
17	NC	/	/
18	I2C_SDA	I2C 数据脚/ I2C data pin	预留，默认关闭/ Reserved, closed by default
19	I2C_SCL	I2C 时钟脚/ I2C clock pin	预留，默认关闭/ Reserved, closed by default
20	UART0_TX	串口发送/Serial port to send	默认数据输出脚/ Default data output pin
21	UART0_RX	串口接收/Serial port to receive	默认数据输入脚/ Default data input pin
22	V_BACKUP	备份电源输入/ Backup power supply	工作电压范围 2.4-3.6V/ Operating voltage range：2.4V-3.6V
23	VCC	模块主电源输入/ Module main power supply	工作电压 3.3V/ Operating voltage 3.3V

24	GND	电源地/Ground	/

10 机械尺寸/Machine Dimension



符号/Symbol	最小值/Min.(mm)	典型值/Type(mm)	最大值/Max.(mm)
A	15.9	16.0	16.6
B	12.1	12.2	12.3
C	2.2	2.4	2.6
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H	0.7	0.82	0.9
M	0.7	0.8	0.9
N	0.8	0.9	1.0
K	0.4	0.5	0.6
Weight	1.6g		

图 4：SKG8212R 机械尺寸/Machine Dimension

11 参考电路/Reference circuit

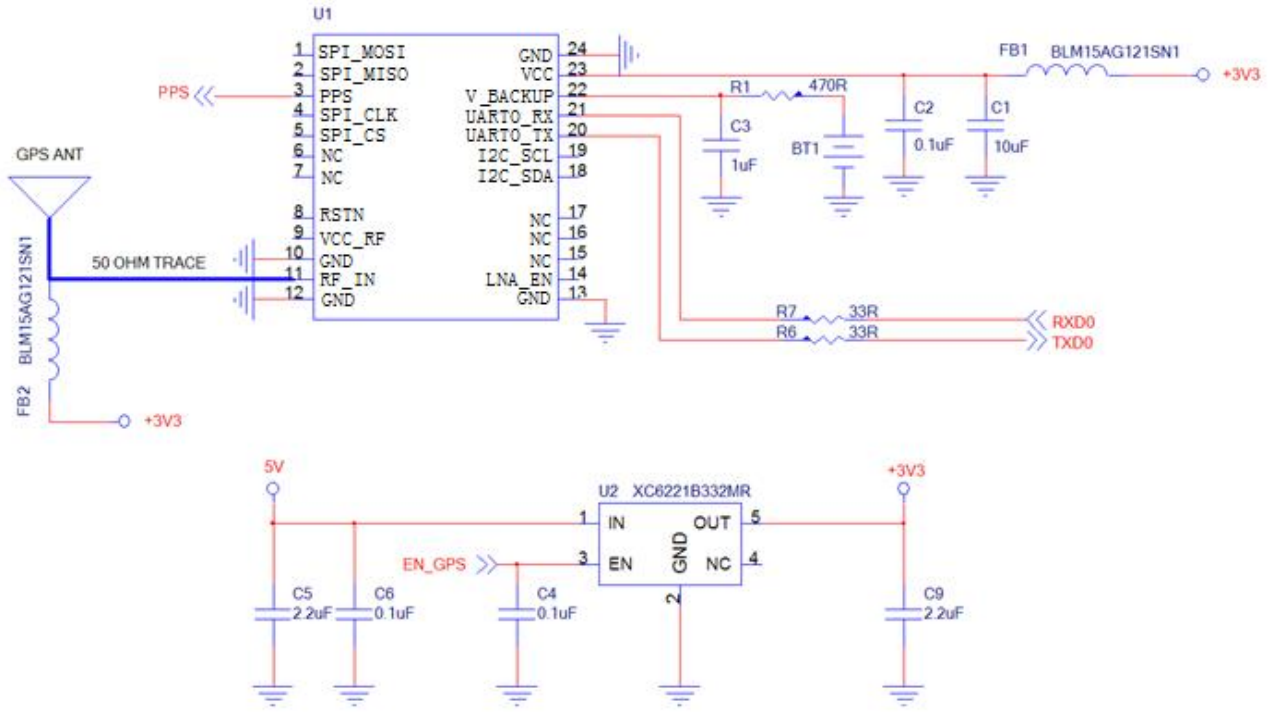


图 6：SKG8212R 参考电路/Reference circuit

12 Layout 注意事项/ Layout Considerations

12.1 元件布局/ Placing Components

GNSS 模块在 PCB 上的布局对于获得最佳的 GNSS 性能来说是至关重要的。与天线的连接应越短越好，避免对信号造成过大的衰减。 在系统板设计上，要确保射频电路跟其他数字电路严格分开，将模块远离 PCB 上的数字区域。同时还必须将 GNSS 模块远离发热量较大的区域。

The layout of GNSS modules on the PCB is critical for achieving optimal GNSS performance. The connection with the antenna should be as short as possible to avoid excessive attenuation of the signal. In the system board design, ensure that RF circuits are strictly separated from other digital circuits and that modules are kept away from the digital area on the PCB. At the same time, GNSS modules must be kept away from areas with high heat.

12.2 无源天线设计/ Passive Antenna Design

天线馈线的长度应尽可能短，且无源天线的下方要有一块完整的地。建议无源天线与 GNSS 模块放在 PCB 板相对的另一面。

The length of the antenna feeder should be as short as possible, and the passive antenna should have a complete ground below. It is recommended that the passive antenna and GNSS module be placed on the opposite side of the PCB board.

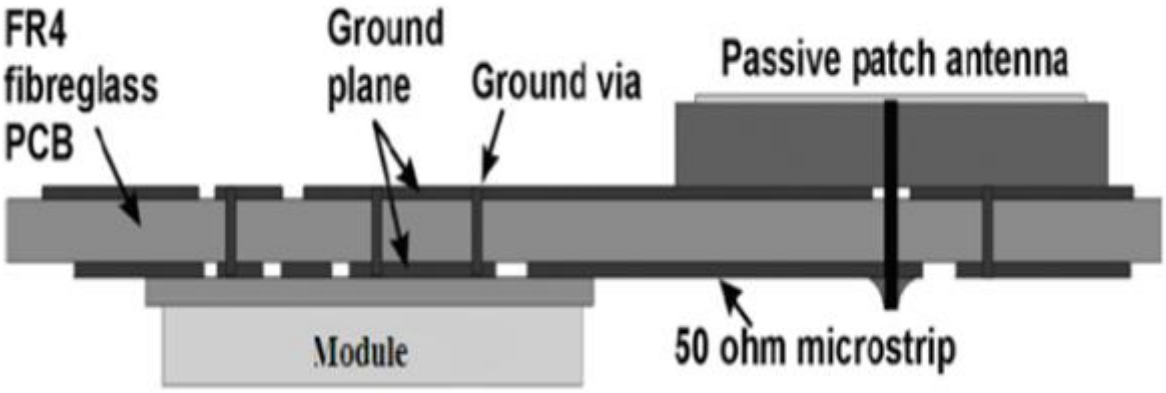


图 7：无源天线参考设计/ Passive Antenna eference design

12.3 阻抗匹配/ Impedance Matching

天线馈线的阻抗需为 50 Ohm，为了达到 50 Ohm 的阻抗，微带线的宽度 W 要根据导线和参考面的距离 H，PCB 介质板的介电常数 εr，以及 PCB 的结构来选择。

The impedance of the antenna feeder shall be 50 Ohm. In order to achieve the impedance of 50 Ohm, the width W of the microstrip line shall be selected according to the distance H between the wire and the reference plane, the dielectric constant εr of the PCB dielectric board, and the structure of the PCB.

12.4 微带线设计/ Microstrip line design

微带线的长度应该尽可能的短，标准 PCB 上应该尽量不选用超过 2.5 cm（1 inch）而又没有屏蔽层的微带线；

The length of microstrip lines should be as short as possible, and no microstrip lines exceeding 2.5cm (1 inch) without shielding layer should be selected on standard PCB as far as possible.

射频连接线的走线应避免靠近数字信号线；

Avoid routing RF cables close to digital signal cables.

在连接地平面时要采用尽可能多的过孔；

Wiring should be far away from noise sources, such as switching power supply, digital signal, crystal oscillator, processor, etc.

布线应远离噪声源，如:开关电源，数字信号，晶振，处理器等；

Wiring should be far away from noise sources, such as switching power supply, digital signal, crystal oscillator, processor, etc.

微带线相对应的参考地层应保持完整；

The reference strata corresponding to the microstrip line should be kept intact.

微带线特性阻抗必须为 50 ohm；

The characteristic impedance of microstrip line must be 50 ohm;

为了减小信号衰减，微带线走线时要避免锐角。

In order to reduce signal attenuation, the acute Angle should be avoided when microstrip lines are routed.

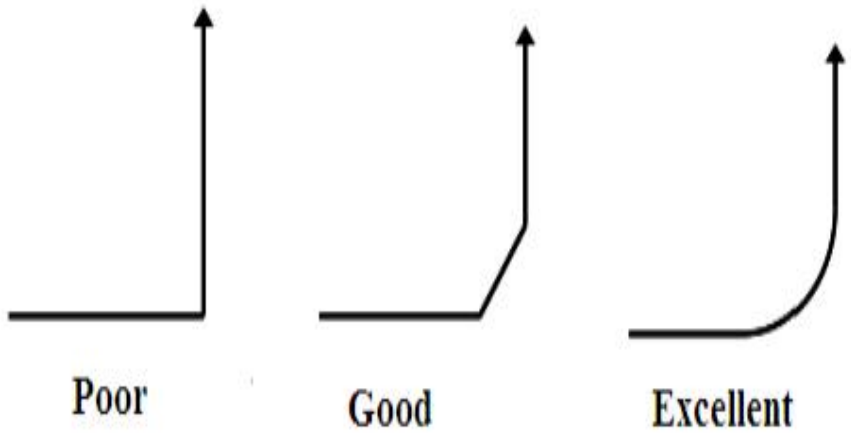


图 8：微带线设计推荐/ microstrip cable design

13 软件说明/ Software description

13.1 NMEA 0183 协议/ The NMEA 0183 protocol is available

NMEA 语句是 GNSS 的标准协议信息，每条语句都有一个前缀，以“$”开头，以回车符/换行符结束，为不超过 80 个字符的可见文本（含行终止符）。每条语句末尾都有一个校验和，读取数据的单元可

能会对其进行检查。校验和字段由 一个“*”和两个十六进制数字组成，代表“$”和“*”（不含这两个字符）之间所有字符的 8 位 异或结果。

NMEA statement is the standard protocol information of GNSS. Each statement has a prefix, starting with "$" and ending with carriage return/line feed, which is visible text (including line terminator) with no more than 80 characters. There is a checksum at the end of each statement, which may be checked by the unit reading the data. The checksum field consists of a "*" and two hexadecimal digits, representing the 8-digit XOR result of all characters between "$" and "*" (excluding these two characters). 表 1-1 NMEA-0183 输出信息/ Table 1-1 NMEA-0183 Output information

NMEA 协议/NMEA protocol	描述/Description	默认/Default
GGA	定位数据信息/ Global positioning system fixed data	打开/Y
GSA	当前卫星信息/ DOP and active satellites	打开/Y
GSV	可见卫星信息/ Satellites in view	打开/Y
RMC	推荐定位信息/Recommended minimum specific data	打开/Y

表 1-2 标识符助记码/Identifier mnemonic code

标识符/Identifier	数据类型/ Data type
GN	GNSS 模式/ GNSS mode
GB	北斗模式/ BDS mode
GP	GPS 模式/ GPS mode
GA	Galileo 模式/ Galileo mode
GL	GLONASS 模式/ GLONASS mode
IR	IRNSS(NAVIC)模式/ IRNSS(NAVIC) mode

13.2 GGA-定位数据信息/GGA- Location information

此语句包含定位位置、定位时间、定位精度。

Contains the location, time, and precision factor of navigation positioning.

$GNGGA,022326.000,2238.3443,N,11403.0962,E,1,22,0.72,104.0,M,-2.2,M,,*69

表 2-1 GGA 语句格式/GGA Data Format

名称/Name	举例/Example	单位/Units	描述/Description
语句 ID/Message ID	$GNGGA		表明语句为 GGA 信息/ GGA protocol header

UTC 时间/UTC Position	022326.000		hhmmss.sss 时分秒格式/Time seconds format
纬度/ Latitude	2238.3443		ddmm.mmmm 度分格式/Degree split format
纬度 N/S / N/S indicator	N		N=北纬 S=南纬/ N= north or S= South
经度/ Longitude	11403.0962		dddmm.mmmm 度分格式/Degree split format
经度 E/W / E/W Indicator	E		E=东经 W=西经/ N=north or S=south
定位状态/ Position Fix Indicator	1		见附表 2-2/ See Table 2-2
已使用卫星数量 /Satellites Used	22		范围 0 到 24/ Range 0 to 12
HDOP 水平精度因子	0.72		
海拔高度/MSL Altitude	104.0	米/m	
单位/Unit	M		
大地水准面高度/ Geoidal height	-2.2		
水准面划分单位/Level surface division unit	M	米/m	
校验值/ Checksum	*69		
EOL	<CR> <LF>		结束标志符/ End of message termination

表 2-2 定位状态描述/ Position Fix Indicators

数值/Value	描述//Description
0	未定位或定位信息不可用/ Unpositioned or positioned information is not available
1	GNSS 定位/ GNSS fix
2	差分 GNSS 定位 / Differential GNSS fix(DGNSS, SBAS)

13.3 GSA-当前卫星信息/GSA- GNSS satellites in using

此条语句包含模块的选定工作模式 ，定位类型，已使用卫星的 PRN 信息及 PDOP, HDOP, VDOP 等信息。

This statement contains the selected working mode of the module, positioning type, PRN information of used satellites, PDOP, HDOP, VDOP and other information.

$GNGSA,A,3,199,195,08,26,09,31,16,194,193,27,03,04,1.07,0.72,0.79,1*05

$GNGSA,A,3,67,66,,,,,,,,,,1.07,0.72,0.79,2*0E

$GNGSA,A,3,,,,,,,,,,,,1.07,0.72,0.79,3*0E

$GNGSA,A,3,37,20,07,,,,,,,,,1.07,0.72,0.79,4*08

表 3-1 GSA 语句格式/GSA Data Format

名称/Name	举例/Example	单位/Units	描述/Description
语句 ID/ Message ID	$GNGSA		表明语句为 GSA 信息/ Indicates that the statement is GSA information
模式 1/ Mode 1	A		表 3-3/ See Table 3-3
模式 2/ Mode 2	3		表 3-2/ See Table 3-2
已使用卫星 ID 信息/ ID of satellite used	199		第一信道的 Sv 信息/Sv on Channel 1
已使用卫星 ID 信息/ ID of satellite used	195		第二信道的 Sv 信息/Sv on Channel 2
…	…		…
已使用卫星 ID 信息/ ID of satellite used	<Null>		十二信道的 Sv 信息（未使用则为空）/ Sv on Channel 12 (Null fields when it is not Used)
PDOP	1.07		综合位置精度因子/Position Dilution of Precision
HDOP	0.72		水平精度因子/Horizontal Dilution of Precision
VDOP	0.79		垂直精度因子/Vertical Dilution of Precision
校验值	*05		
EOL	<CR> <LF>		结束标志符/End of message termination

表 3-2/Table 3-2

值/Value	描述/Description
1	未定位
2	2D 定位
3	3D 定位

表 3-3 /Table 3-3

值/Value	描述/Description
M	手动选择 2D 或者 3D 模式
A	自动选择 2D 或者 3D 模式

13.4 GSV-可见卫星信息//GSV- GNSS Satellites in View

此语句包含可见卫星的 PRNs，方位角和仰角等信息。

This sentence contains the mode of operation, type of fix, PRN of the satellites used in the solution as well as PDOP, HDOP and VDOP.

$GPGSV,4,1,13,27,78,149,46,199,60,149,39,04,59,289,43,194,56,045,44,1*64

$GPGSV,4,2,13,195,54,108,43,16,50,008,43,08,45,203,42,26,33,038,40,1*5A

$GPGSV,4,3,13,09,28,313,33,31,28,098,42,193,26,167,39,03,11,233,39,1*52

$GPGSV,4,4,13,22,,,35,1*60

$GPGSV,3,1,10,27,78,149,50,199,60,149,48,04,59,289,46,194,56,045,45,8*6C

$GPGSV,3,2,10,195,54,108,46,08,45,203,48,26,33,038,36,09,28,313,31,8*54

$GPGSV,3,3,10,193,26,167,44,03,11,233,43,8*55

$GLGSV,1,1,02,66,38,231,37,67,31,297,33,1*7A

$GAGSV,1,1,02,05,,,41,24,,,41,7*72

$GAGSV,1,1,02,05,,,45,24,,,41,1*70

$GBGSV,3,1,11,07,65,346,40,37,50,357,43,23,33,068,26,10,32,262,41,1*7A

$GBGSV,3,2,11,20,28,264,35,01,,,42,02,,,36,16,,,42,1*48

$GBGSV,3,3,11,03,,,40,05,,,28,32,,,38,1*74

$GBGSV,1,1,04,37,50,357,41,23,33,068,45,20,28,264,37,32,,,41,4*44

表 4-1 GSV 语句格式/ GSV Data Format

名称/Name	举例/Example	单位/Units	描述/Description
语句 ID/Message ID	$GPGSV		表明此语句为 GSV 信息/GSV protocol header
GSV 总数信息/ Number of Message	4		本次 GSV 语句的总条数/ Total number of GSV sentences
GSV 条数信息/ Message Number	1		本条语句为 GSV 语句中的第几条/ Sentence number of the total
可见卫星信息/ Satellites in View	13		当前可见卫星总数/Number of satellites in view
卫星 ID/Satellite ID	27		
卫星仰角/Elevation	78	度/degrees	范围 00 到 90/ Range 00 to 90
卫星方位角/Azinmuth	149	度/degrees	范围 000 到 359/ Range 000 to 359
信噪比(C/NO)/SNR(C/NO)	46	dB-Hz	范围 00 到 90（未使用则为空）/ Range 00 to 99, null when not tracking
…			…
可见卫星信息/ Satellites in View	194		

卫星 ID/Satellite ID	56	度/degrees	范围 00 到 90/ Range 00 to 90
卫星仰角/Elevation	045	度/degrees	范围 000 到 359/ Range 000 to 359
卫星方位角/Azinmuth	44	dB-Hz	范围 00 到 90（未使用则为空）/ Range 00 to 99, null when not tracking
校验值/Checksum	*64		
EOL	<CR> <LF>		结束标志符/End of message termination

13.5 RMC-推荐定位信息/ RMC- Recommended locating information

此语句包含推荐定位的卫星定位信息。

This statement contains the satellite positioning information for the recommended location.

$GNRMC,022326.000,A,2238.3443,N,11403.0962,E,0.01,169.33,120421,,,A,V*07

表 5-1: RMC 语句格式/ RMC Data Format

名称/Name	举例/Example	单位/Units	描述/Description
语句 ID/Message ID	$GNRMC		表明此语句为 RMC 信息/RMC protocol header
UTC 时间/UTS Position	022326.000		hhmmss.sss
使用状态/Status	A		A=数据已使用 V=数据未使用/A=data valid or V=data not valid
纬度/ Latitude	2238.3443		ddmm.mmmm
纬度 N/S/ N/S Indicator	N		N=北纬 S=南纬/N=north or S=south
经度/Longitude	11403.0962		dddmm.mmmm
经度 E/W /E/W Indicator	E		E=东经 W=西经/E=east or W=west
速度/ Speed Over Ground	0.01	节	
方位角/Course Over Ground	169.33	度	
UTC 日期/Date(UTC)	120421		ddmmyy
磁偏角/Magnetic variation	<Null>	度	未使用则为空/Null fields when it is not Used
磁偏角方位/Magnetic Variation Direction	<Null>		E=东经 W=西经 /E=east or W=west
定位模式/Fix Mode	A		A=自动, N=未定位, D=DGPS, E=DR/ A=autonomous, N = No fix, D=DGPS, E=DR
校验值/Checksum	*07		
EOL	<CR> <LF>		结束标志符/End of message termination

14 联系方式/ Contact Information

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