

GNSS Module

MS33SN2



Datasheet

V 1.0.0



Version Note

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Part Number

Model	Hardware Code
MS33SN2	4NN

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PRODUCT INTRODUCTION

1.1 General Description

MS33SN2 series is a GNSS navigation and positioning module that supports all constellations. MS33SN2 has a built-in high-sensitivity, low-power GNSS chip and RF devices, which supports "five-star simultaneous reception", including China's BeiDou Navigation System (BDS), the U.S. GPS, Russia's GLONASS, the EU's GALILEO, and Japan's QZSS, etc., and realizes multi-system joint positioning.

MS33SN2 adopts standard SMD industrial grade design and ROHS process, featuring high sensitivity, anti-interference, high performance and low power consumption. The product is suitable for wearable devices, vehicle navigation and positioning, locator, car recorder, OBD and other scenes.

1.2 Key Parameters

MS33SN2 Parameters	
Satellite Systems	GPS, BDS, GLONASS, GALILEO, QZSS, SBAS
(level of) Sensitivity	Tracking:-165dBm; Recapture:-160dBm; Cold Start -148dBm
Cold Start1	24 seconds
Hot Start	Average 1 second
AGPS Assist	Average 10 seconds
Accurate2	Autonomous level: ≤2.0 m (1σ) Velocimetry accuracy: ≤0.1m/s (1σ)
Baud	115200bps (factory default)
Update Frequency	1-10 Hz (software adjustable)
Pact	NMEA0183 version 4.1 is supported by default.
Characterization	Support GPS, BDS, GLONASS, GALILEO, QZSS parallel reception and joint positioning, "five stars receive together".
	Remarks: 1 .CN0≥40dB, SV≥6pcs 2 .24 hours, OPEN SKY environment, CN0 excellent

2 TECHNICAL INFORMATION

2.1 Supporting Constellations

The MS33SN2 supports concurrent GNSS satellite constellations and can receive and track GPS (including SBAS and QZSS) signals, BDS signals, GLONASS signals, and GALILEO signals individually or simultaneously. The reception frequencies are: 1575.42 MHz (GPS, GALILEO), 1561.098±2.046 MHz (BDS) and 1602.5625 MHz±4 MHz (GLONASS).

2.2 Satellite-based Augmentation System (SBAS)

The MS33SN2 supports reception of SBAS broadcast signals. These systems supplement GNSS data with other regional or wide-area GPS augmentation data. The system broadcasts distance correction and integrity information via satellite, which can be used by GNSS receivers to improve the accuracy of results. SBAS satellites can be used as additional satellites for ranging (navigation) to further improve availability. The following SBAS types are supported: GAGAN, WAAS, EGNOS and MSAS.

2.3 Quasi-Zenith Satellite (QZSS)

The Quasi-Zenith Satellite System (QZSS) is a navigation satellite overlay system for the Pacific Ocean covering Japan and Australia that transmits other GPS L1C/A signals. The module is capable of receiving and tracking these signals simultaneously with GPS, which improves availability and maintains positioning especially in poor signal conditions such as urban canyons.

2.4 Crystal Oscillator

The MS33SN2 uses TCXO to allow weak signal acquisition, resulting in faster start-up and re-acquisition times. TCXO allows the product to ensure that it is stable and immune to frequency interference over its entire operating range (-40° to + 85°C), making it a reliable positioning module for positioning.

2.5 Real Time Clock (RTC)

The RTC is driven by a 32 kHz oscillator using an RTC crystal. If the mains voltage fails, some parts of the receiver will shut down, but the RTC will still operate to provide a timing reference for the receiver. This mode of operation is called "Hardware Backup Mode" and allows all relevant data to be saved in backup RAM for later hot start.

2.6 Power System

The MS33SN2 module is available in full operating mode and battery backup mode.

Full working mode: All power supplies are normally supplied and the module is in full working mode for normal signal reception and interpretation.

Battery Backup Mode: The module requires very little current (~8uA) to maintain the RTC clock and backup RAM.

3 ELECTRICAL SPECIFICATION

3.1 Absolute Maximum Rating

Notation	Parameters	Minimum value	Maximum value	Unit
VCC	Mains voltage	-0.5	4.3	V
VBAT	Backup power supply voltage	-0.5	4.6	V
VI-max	I/O Pin Input Voltage	-0.5	3.63	V
Vhbm	ESD Contact	-	2000	V
T-storage	Storage temperature	-40	+85	℃
T-solder	Reflow temperature	--	250	℃

Pressurizing the equipment beyond the "Absolute Maximum Rating" may cause permanent damage.

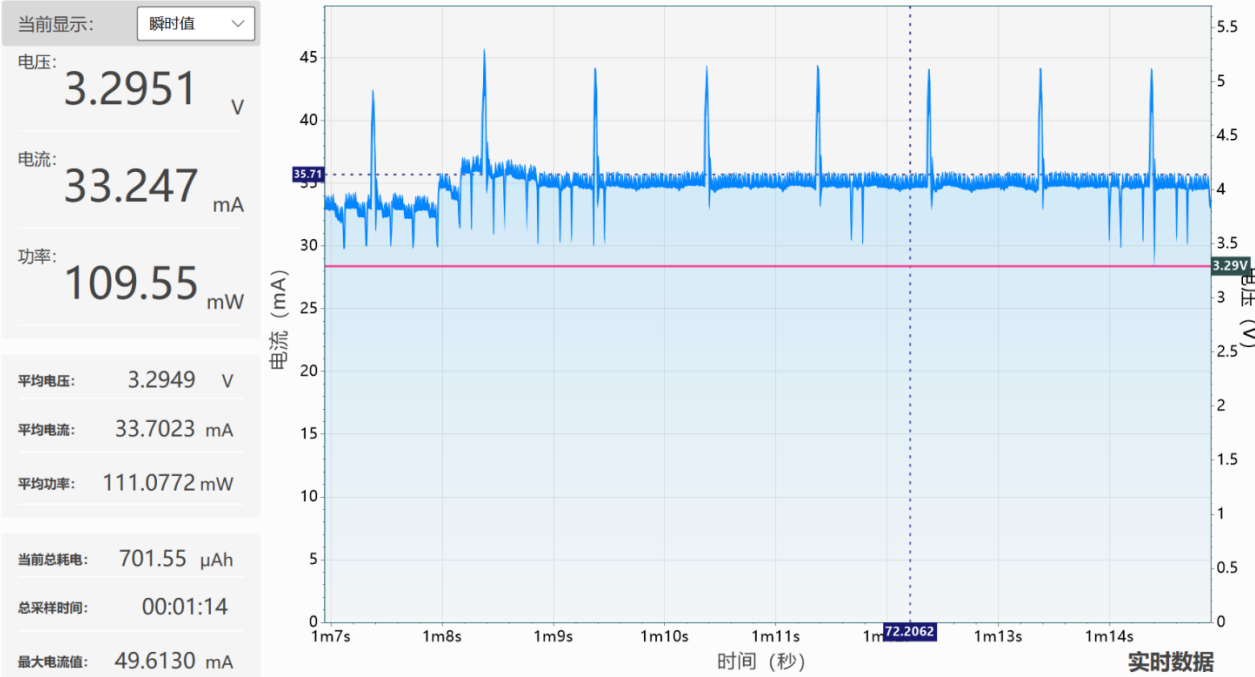
The above figures are pressure ratings only. Products are not overvoltage or reverse voltage protected. If necessary, voltage spikes exceeding the supply voltage specifications listed in the table above must be limited to the specified range using an appropriate protection diode.

3.2 Electrical parameters

Parameters	Minimum value	Average value	Maximum value	Unit
Power Supply Voltage	2.8V	3.3	3.6	V
Supply Current (Acquisition)	-	33	-	mA
Supply Current (Tracking)	-	30	-	mA
Operation Temperature	-40	+25	+85	℃

All specifications are made at an ambient temperature of 25°C. Extreme operating temperatures can seriously affect specification values. Applications operating near temperature limits. The values in the table are for customer reference only and are intended as examples of typical power requirements only. Values are characterized as samples and actual power requirements will vary depending on the firmware version used, external circuitry, number of satellites tracked, signal strength, type of activation as well as time, duration, and test conditions.

The measured values of the capture phase current are as follows:



3.3 Antenna Gain Requirements

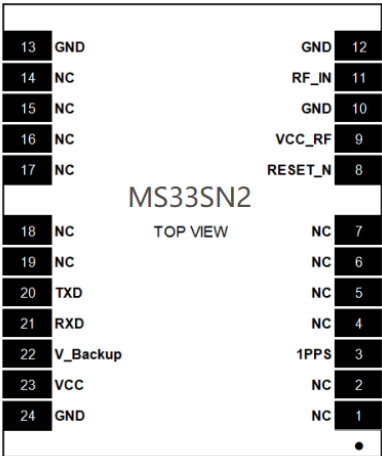
MS33SN2 has built-in LNA, supports passive GNSS antenna, external antenna gain note control.

Notation	Parameters	Min	Max	Unit
RFgain	Input Gain	0	30	dB

4 PACKAGE DEFINITION

4.1 Module Pin Definitions

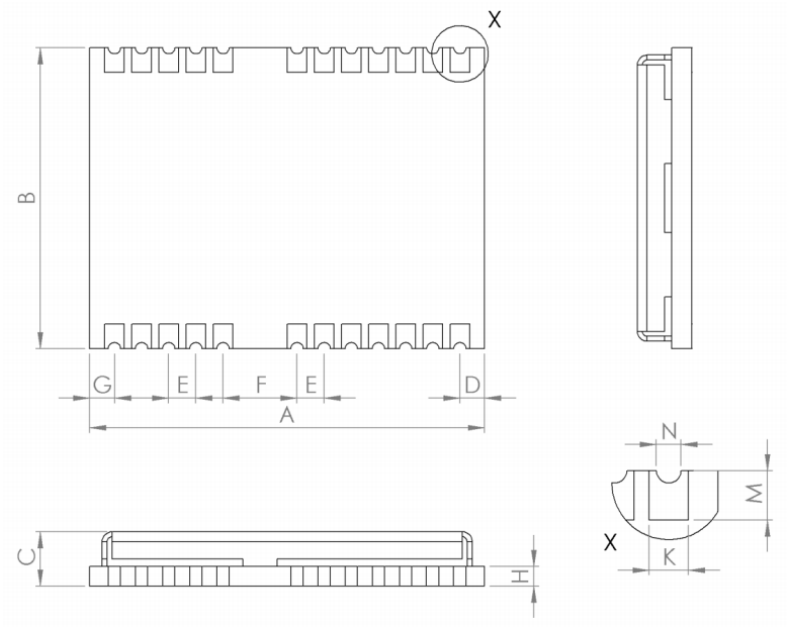
The MS33SN2 is available in a 16*12mm, LGA-24pin package and is defined as follows:



Serial Number	Pin Name	I/O	Description
3	1PPS	O	Time pulse, TTL level
8	RESET_N	I	Hardware Reset, TTL
9	VCC_RF	o	RF antenna power supply 3.3V, note that it can not be used at the same time as pin7.
11	RF_IN	I	Antenna Signal Input
20	TXD	O	Main serial port (same function as UART1_TXD)
21	RXD	I	Differential Data, AT Command, FOTA Upgrade
22	V_BACKUP	I	Backup power supply with hardware hot start support
23	VCC	I	main power
	GND	I	Grounding, PIN 10, 12, 13, 24

5 PACKAGE SPECIFICATION

5.1 sizes





5.2 Mechanical dimensions

Serial Number	Minimum (mm)	Typical Value (mm)	Maximum Value (mm)
A	12.0	12.2	12.4
B	16.2	16.4	16.6
C	2.4	2.6	2.8
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	0.8	0.9
K	0.4	0.5	0.6
M	0.8	0.9	1.0

6 SOFTWARE PROTOCOL

6.1 NEMA0183 Protocols

The NMEA protocol is an ASCII based protocol where the record starts with \$ and ends with a carriage return/line feed character, and the checksum of the NMEA message, which can be used to detect corrupted data transmission. The frame structure is as follows:

Start Character	Checksum Range			Checksum	End Flag
\$	Talker ID	Message ID	[,field 0]...[,field N]	*Checksum	<CR><LF>

The NEMA message output for the MS33SN2 is shown in the following table:

NMEA Record	Description	Default
GNGBA	Global positioning system fixed data	Y
GNGLL	Geographic position—latitude/longitude	Y
GNGBA	GNSS DOP and active satellites	Y
GNGBV	GNSS satellites in view for GPS	Y
GNGBV	GNSS satellites in view for GLONASS	Y



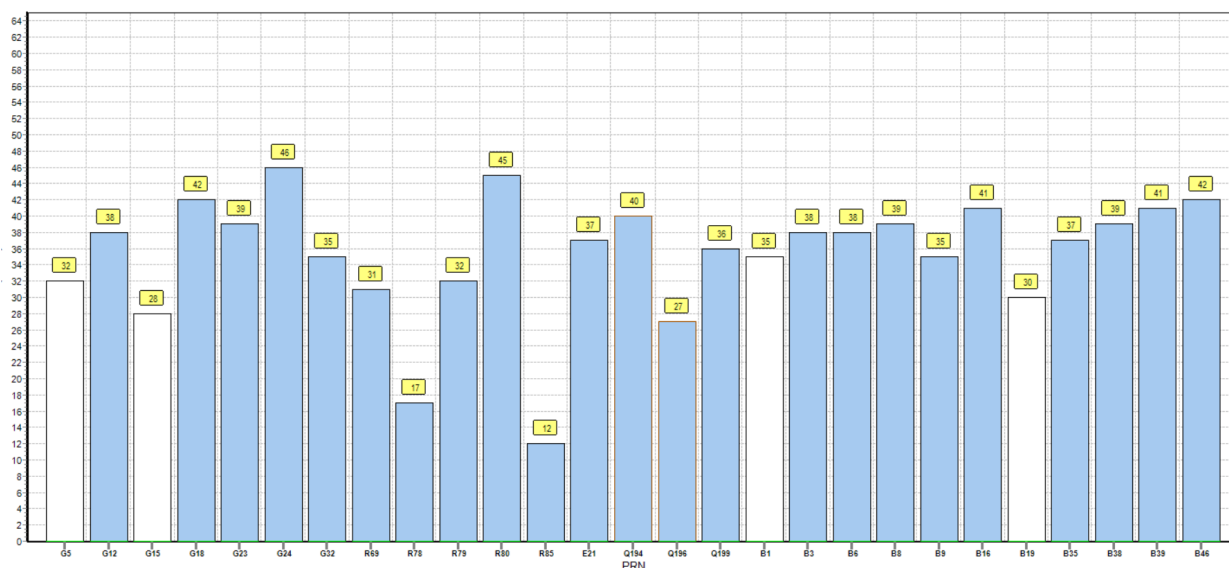
GBGSV	GNSS satellites in view for BD	Y
GAGSV	GNSS satellites in view for GALILEO	Y
GNRMC	Recommended minimum specific GNSS data	Y
GNVTG	Course over ground and ground speed	Y
GNZDA	Date and Time	Y

6.2 sample data

Serial port data within 1 second after positioning example:

```
$GNGGA,131203.000,2242.2945,N,11401.6891,E,1,14,0.82,137.1,M,-2.5,M,,*6E
$GNGLL,2242.2945,N,11401.6891,E,131203.000,A,A*4A
$GNGSA,A,3,13,195,05,15,11,20,29,30,194,,,,,1.14,0.82,0.79,1*09
$GNGSA,A,3,81,67,66,88,82,,,,,,1.14,0.82,0.79,2*00
$GNGSA,A,3,,,,,,1.14,0.82,0.79,3*03
$GNGSA,A,3,,,,,,1.14,0.82,0.79,4*04
$GPGSV,3,1,11,13,74,141,48,195,63,103,47,05,51,342,48,15,50,220,48,1*53
$GPGSV,3,2,11,11,46,083,47,20,40,033,46,29,37,310,44,30,15,078,40,1*6A
$GPGSV,3,3,11,194,14,161,39,07,02,051,38,196,,,44,1*65
$GLGSV,2,1,06,81,70,042,50,67,64,267,49,66,45,013,50,88,34,129,46,1*74
$GLGSV,2,2,06,82,31,340,45,68,,,42,1*48
$GAGSV,1,1,03,05,,,38,03,,,45,08,,,45,7*75
$GBGSV,3,1,11,04,,,40,08,,,41,10,,,41,11,,,42,1*7B
$GBGSV,3,2,11,16,,,40,12,,,45,13,,,42,02,,,41,1*75
$GBGSV,3,3,11,03,,,44,01,,,43,05,,,38,1*7D
$GNRMC,131203.000,A,2242.2945,N,11401.6891,E,0.01,0.00,210324,,,A,V*00
$GNVTG,0.00,T,,M,0.01,N,0.02,K,A*20
$GNZDA,131203.000,21,03,2024,,*4E
```

6.3 Example of an actual star search





6.4 Common Commands

CMD TYPE	CMD Example
Change Baud-rate to 9600	\$PAIR864,0,0,9600*13<CR><LF>
Change Baud-rate to 115200	\$PAIR864,0,0,115200*1B<CR><LF>
Hot Restart	\$PAIR004*3E<CR><LF>
Warm Restart	\$PAIR005*3F<CR><LF>
Cold Restart	\$PAIR006*3C<CR><LF>
Search GPS satellites only	\$PAIR066,1,0,0,0,0,0*3B<CR><LF>
Search GPS and BDS satellites	\$PAIR066,1,0,0,1,0,0*3A<CR><LF>
Search GPS and GLONASS satellites	\$PAIR066,1,1,0,0,0,0*3A<CR><LF>
Search GPS,BDS,GLO,GAL,QZSS satellites	\$PAIR066,1,1,1,1,1,0*3B<CR><LF>
Set Update rate to 1Hz	\$PAIR050,1000*12<CR><LF>
Set Update rate to 2Hz	\$PAIR050,500*26<CR><LF>
Set Update rate to 5Hz	\$PAIR050,200*21<CR><LF>
Set Update rate to 10Hz	\$PAIR050,100*22<CR><LF>



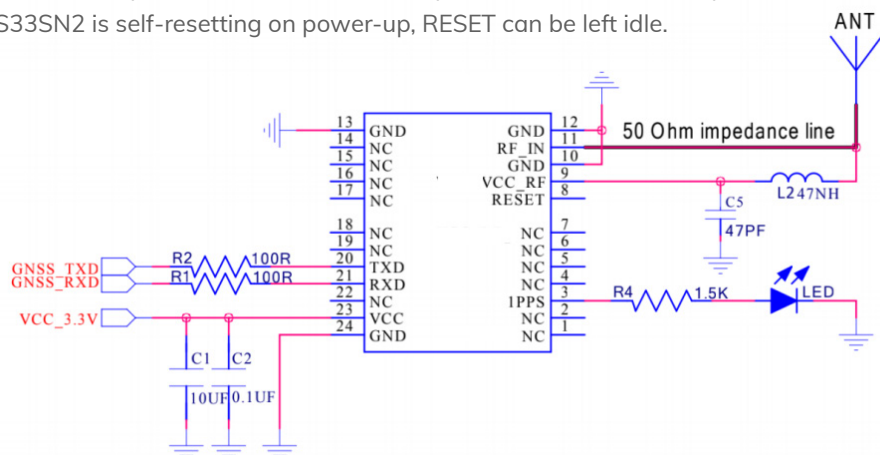
Remarks:

1. Text format control commands should be added carriage return (CR), line feed (CF)
2. All software configurations expire after the module main power supply VCC charging and powering up, if necessary, you need to initialize again after powering up;
3. As MS33SN1 supports full constellation satellite system, configuring baud rate 9600 may lead to serial port data blocking..

7 REFERENCE DESIGN

7.1 Schematic design

The reference design of the MS33SN2 is shown below. When connecting an active antenna, please make sure the 47nH inductors are in the SMD state for powering the active antenna; when connecting a passive antenna, the 47nH inductors are not required. The characteristic impedance from the RF_IN pin to the antenna connector is 50 Ω. Since the MS33SN2 is self-resetting on power-up, RESET can be left idle.



7.2 LAYOUT Notes

- (1) The decoupling capacitor should be placed near the power supply pin of the module and the width of the power supply line should be more than 0.5mm;
- (2) The bottom of the module patch is prohibited;
- (3) The RF alignment from RF port of the module to the antenna interface should be at least 0.2mm~0.3mm, and adopt coplanar waveguide impedance model, and the spacing between the alignment and the ground copper skin should be controlled at about 1 times of the spacing, and the guaranteed impedance should be 50Ω;
- (4) The alignment from RF port to antenna interface of the module should refer to the second layer of ground and ensure that the second layer of ground plane is complete;
- (5) The module should not be placed near the interference sources, such as communication module antenna, RF alignment, crystal oscillator, large inductance and high frequency digital signal line.

7.3 Power Supply

The MS33SN2 Positioning Module is equipped with two power supply pins: VCC and V_BACKUP. the main power supply is fed to the module via the VCC pin, and the backup power supply is fed to the module via the V_BACKUP pin. To ensure the positioning performance of the module, the ripple of the module power supply should be controlled as much as possible. It is recommended to use an LDO supply with a maximum output current greater than 100mA. If the module's main power supply is disconnected, the system will provide power to the RTC and Battery Backup RAM (BBR) through V_BACKUP.

Therefore, even if the main power supply is disconnected, the ephemeris data can still be retained and a hot or warm start can be achieved when the system is powered up again with the support of the backup power supply. If no backup power supply is connected and no data is received by the module, then the system will perform a cold start when it is powered up again. Note: If there is no available backup power supply, connect the V_BACKUP pin to the VCC mains or leave it dangling.

7.4 Connection with High-ranking Officials

The MS33SN2 has a built-in low noise figure LNA and SAW. it is recommended to use an active antenna with a gain of less than 25dB and a noise figure of less than 1.5dB. The module supplies power to the external active antenna via RF_IN. If the active antenna cable is long, an active antenna with at least 15dB gain is required to compensate for the line loss.

In order to maintain ground integrity, it is recommended that no or as few wires as possible be routed under the module.

7.5 Serial Port Communication

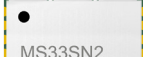



Provide one way TTL level universal asynchronous transceiver (UART), the data format is: 1 bit start bit, 8 bit data bit, 1 bit stop bit, no parity bit, the default baud rate is 115200bps. after the module is normally powered on, the serial port will automatically send NMEA data. The host computer can set the module working mode and baud rate through the serial port. When using this module for some specific application scenarios, the main power of the module may be turned off for power saving strategy, thus further reducing the power consumption.

At this time, in order to avoid the high level of the serial port affecting the normal operation of the module, it is strongly recommended to disconnect the serial port connection at the same time when disconnecting the main power supply, or to set the serial port to the state of input state + pull-down resistor or the state of high resistance state + pull-down resistor.

8 PACKAGING AND PROTECTION

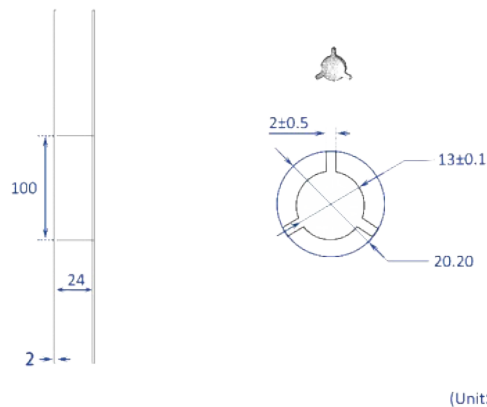
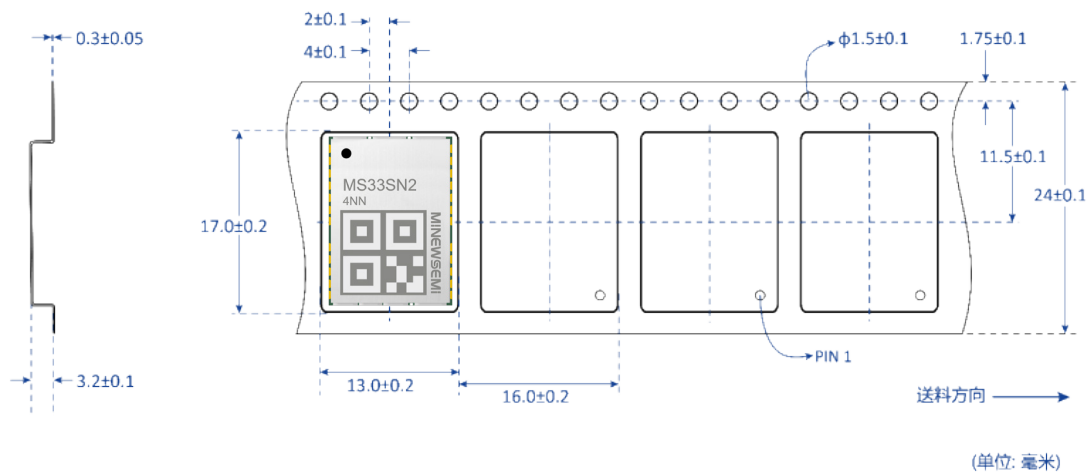
8.1 Wrap

The MS33SN2 is humidity and static sensitive. It is important that you follow the handling requirements and take appropriate precautions to minimize product damage during packaging and shipping of the product. The following table shows the standard packaging structure for product transportation.

Offerings	Reels	Sealed Bags	Shipping Cartons
			
MS33SN2	1500pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

8.2 Carrier belts and trays

The MS33SN2 is supplied on a reel (consisting of a tape and reel) and packaged in a ziplock bag with an anti-static effect to meet the customer's needs for efficient production, batch mounting and dismounting. The picture below shows the dimensional details of the reel tape.





8.3 Stockpile

In order to prevent the product from moisture and electrostatic discharge, the sealed bag of the product is equipped with desiccant and humidity indicator card, which allows the user to know the humidity condition of the environment in which the product is located. The product has a moisture sensitivity rating of MSL3.

8.4 ESD Protection

The GNSS positioning module contains highly sensitive electronics and is an electrostatic sensitive device (ESD). Please note the following precautions, as failure to follow these precautions may result in serious damage to the module!

Ground yourself before patching the antenna. Do not touch any charged capacitors and other devices (e.g., antenna patch ~10 pF; coaxial cable ~50 -80 pF/m; soldering iron) when bringing out the RF pin;

To prevent electrostatic discharge, do not expose the antenna area; if exposed by design, take appropriate ESD precautions and do not touch any exposed antenna area;

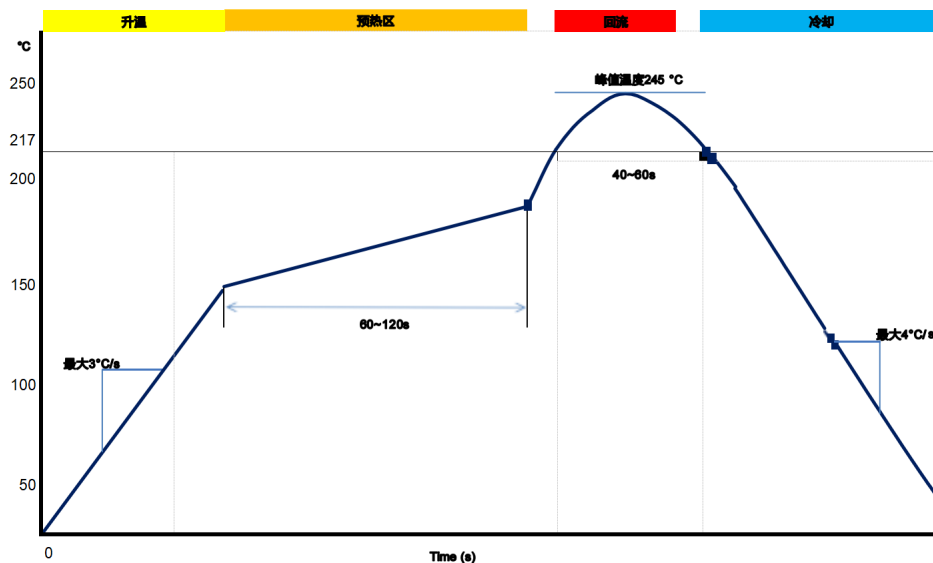
Be sure to use an ESD safe soldering iron when soldering RF connectors and antenna patches.

Add ESD diode to RF input to prevent ESD; add ESD diode to UART interface



8.5 Production Requirements

The recommended welding temperature profile is shown below:



In order to prevent the module from falling off during soldering, please do not design the module to be soldered on the back of the board, and it is better not to go through two soldering cycles.

The setting of soldering temperature depends on many factors in the product factory, such as the nature of the motherboard, paste type, paste thickness, etc. Please also refer to the relevant IPC standards and paste specifications.

Due to the relatively low temperature of leaded soldering, please prioritize other components on the board if using this soldering method. The openings of the stencil need to meet the customer's own product design requirements and inspection specifications, and the thickness of the stencil is recommended to be 0.15mm.

9 ORDERING INFORMATION

9.1 Order Part Number

Ordering Model	Pseudolaric acid	Default Baud Rate	Default Refresh Rate	Default Satellite Reception Frequency	Physical Interface
MS33SN2	GNSS Module	115200	1Hz	gps/bds/glo/gal/qzss/sbas	16*12, LCC24

10 STORAGE CONDITIONS

- Please use this product within 6 months after signing up for it.
 - This product should be stored without opening the package at an ambient temperature of 5~35°C and a humidity of 20~70%RH.
 - This product will be stored for more than 6 months after receipt. They must be confirmed before use.
 - Products must be stored in non-corrosive gases (Cl₂, NH₃, SO₂, NO_x, etc.).
 - To avoid damage to the packaging materials, no excessive mechanical impact shall be applied, including but not limited to sharp objects adhering to the packaging materials and products falling.
- This product is suitable for MSL3 (based on JEDEC standard J-STD-020).
 - After opening the package, the product must be stored under conditions of ≤30°C/<60%RH. It is recommended to use it within 168 hours after opening the package.
 - When the color of the indicator in the package changes, the product should be baked before welding.
- When exposed to (≥168h@30°C/60%RH) conditions, the recommended baking conditions:
 1. 120 ±5/-5°C, 8 hours, 1 time
Products must be baked individually on heat-resistant trays because the materials (base tape, roll tape and cover tape) are not heat-resistant and the packaging materials may deform when the temperature is 120°C;
 2. 90°C +8/-0°C, 24 hours, once
The base tape can be baked together with the product at this temperature, Please pay attention to even heating.

11 HANDLING CONDITIONS

- Be careful in handling or transporting products because excessive stress or mechanical shock may break products.
- Handle with care if products may have cracks or damages on their terminals. If there is any such damage, the characteristics of products may change. Do not touch products with bare hands that may result in poor solder ability and destroy by static electrical charge.

12 QUALITY

Cognizant of our commitment to quality, we operate our own factory equipped with state-of-the-art production facilities and a meticulous quality management system. We hold certifications for ISO9001, ISO14001, ISO27001, OHSA18001, BSCI.

Every product undergoes stringent testing, including transmit power, sensitivity, power consumption, stability, and aging tests. Our fully automated module production line is now in full operation, boasting a production capacity in the millions, capable of meeting high-volume production demands.

13 COPYRIGHT STATEMENT

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14 RELATED DOCUMENTS

- MinewSemi_Product_Naming_Reference_Manual_V1.0
https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf
- MinewSemi_Connectivity_Module_Catalogue_V2.0
https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf



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SHENZHEN MINEWSEMI CO., LTD.



0086-755-2801 0353

<https://minewsemi.com>minewsemi@minew.com<https://store.minewsemi.com>

No.8, Qinglong Road, Longhua District, Shenzhen, China