

# **GNSS Module**

## **MS33SN2**

### **Datasheet**

**V 1.1.0**

<b>Applicable Product Model</b>
MS33SN2

## Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Coral	2023.03.08	
1.1.0	Layout Changes	Michelle	2023.08.30	

# Index

1 Product Introduction .....	5
1.1 General description .....	5
1.2 Key Parameter .....	5
2 Technical Information .....	6
2.1 Supporting Constellations .....	6
2.2 AGPS .....	6
2.3 Satellite-based Augmentation System (SBAS) .....	6
2.4 Quasi-Zenith Satellite (QZSS) .....	6
2.5 crystal oscillator .....	6
2.6 Real Time Clock (RTC) .....	7
2.7 power system .....	7
3 Electrical Specification .....	8
3.1 Absolute maximum rating .....	8
3.2 Electrical parameters .....	8
4 Package Definition .....	10
4.1 Module Pin Definitions .....	10
5 Integration Guide .....	11
5.1 power supply .....	11
5.2 connection with high-ranking officials .....	11
5.3 serial port communication .....	12
6 software protocol .....	13
6.1 NMEA0183 protocol .....	13
6.2 Common Commands .....	13
7 Package Specification .....	15
7.1 sizes .....	15
7.2 Mechanical dimensions .....	15
8 reference design .....	16
8.1 schematic design .....	16

---

8.2 PCB Package Reference .....	17
8.3 LAYOUT Notes .....	17
9 Packaging and Protection .....	18
9.1 wrap .....	18
9.2 Carrier belts and trays .....	19
9.3 stockpile .....	20
9.4 ESD protection .....	20
10 Ordering Information .....	21
10.1 Ordering Model .....	21
Quality .....	22
Contact Us .....	22
Copyright Statement .....	23

# 1 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. GALILEO of the United States, and QZSS of Japan, and realize multi-system joint positioning.

MS33SN2 adopts standard SMD industrial grade design with 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 Parameter

MS33SN2 Parameter	
<b>Satellite systems</b>	GPS, BDS, GLONASS, GALILEO, QZSS, SBAS
<b>(level of) sensitivity</b>	Tracking:-165dBm; Recapture:-160dBm; Cold Start -148dBm
<b>cold start<sup>1</sup></b>	24 seconds
<b>hot start</b>	Average 1 second
<b>AGPS Assist</b>	Average 10 seconds
<b>accurate<sup>2</sup></b>	Autonomous level: $\leq 2.5$ m (1 $\sigma$ ) Velocimetry accuracy: $\leq 0.1$ m/s (1 $\sigma$ )
<b>baud</b>	115200bps (factory default)
<b>Update Frequency</b>	1-10 Hz (software adjustable)
<b>pact</b>	NMEA0183 version 4.1 is supported by default.
<b>characterization</b>	Support GPS, BDS, GLONASS, GALILEO, QZSS parallel reception and joint positioning, "five stars receive together".

Remarks: 1 .CN0 $\geq$ 40dB, SV $\geq$ 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),  $1561.098 \pm 2.046$  MHz (BDS) and  $1602.5625 \text{ MHz} \pm 4 \text{ MHz}$  (GLONASS).

### 2.2 AGPS

The MS33SN2 supports the AGPS TCP Accelerated Positioning Scheme. Please refer to the AGPS Integration Guide.pdf for details on how to use it.

### 2.3 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.

### 2.4 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.

### 2.5 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.

## 2.6 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.

## 2.7 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 only a very small current (about 8uA) to maintain the RTC clock and backup RAM, and the Farad capacitor of the module mounts for a certain period of time.

### 3 Electrical Specification

#### 3.1 Absolute maximum rating

parameters	minimum value	maximum values	unit (of measure)
Power Supply Voltage	-0.5	3.6	V
Backup Power Supply Voltage	-0.5	3.6	V
Serial Port Input Voltage	-0.5	3.6	V
ESD Contact	-	3000	V
Storage Temperature	-40°C	+85°C	°C

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 values	unit (of measure)
Power Supply Voltage	2.8V	3.3	3.6	V
Supply Current (Acquisition)	20	33	40	mA
Supply Current (Tracking)	15	20	25	mA
Operation Temperature	-40	+25	+85	°C

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.

## 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	name (of a thing)	I/O	descriptive
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
14	LNA_EN	O	External LNA enable pin, high/dangling enable.
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 Integration Guide

### 5.1 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.

### 5.2 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.

### 5.3 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.

## 6 software protocol

### 6.1 NMEA0183 protocol

The NMEA protocol is an ASCII-based protocol where records begin with a \$ and start with a carriage return/line feed character. GNSS-specific messages all begin with \$GNxxx, where xxx is the three-letter identifier of the message data that follows. NMEA messages have checksums that can be used to detect corrupted data transmissions. \$GPxxx is used for GPS.

NMEA Record	Description	Default
GNGGA	Global positioning system fixed data	Y
GNGLL	Geographic position-latitude/longitude	Y
GNGSA	GNSS DOP and active satellites	Y
GPGSV	GNSS satellites in view for GPS	Y
GLGSV	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 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>

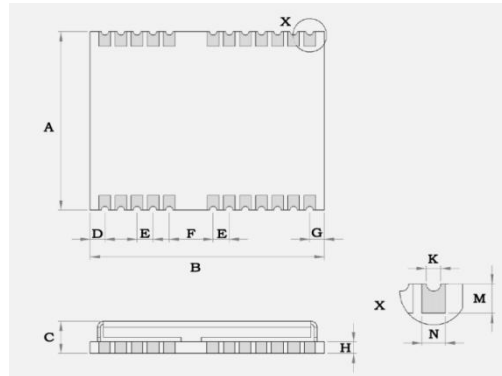
Warm Restart	\$PAIR005*3F<CR><LF>
Cold Restart	\$PAIR006*3C<CR><LF>
Search GPS satellites only	\$PAIR066,1,0,0,0,0,0,0*3B<CR><LF>
Search GPS and BDS satellites	\$PAIR066,1,0,0,1,0,0*3A<CR><LF>
Search GPS and GLONASS satellites	\$PAIR066,1,1,0,0,0,0,0*3A<CR><LF>
Search GPS,BDS,GLO,GAL,QZSS satellites	\$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. All software configurations expire after charging and powering up the module's main power supply VCC, and need to be initialized again after powering up the module if needed;
2. Since MS33SN1 supports full constellation satellite system, configuring baud rate 9600 may cause blocking of serial port data.

## 7 Package Specification

### 7.1 sizes



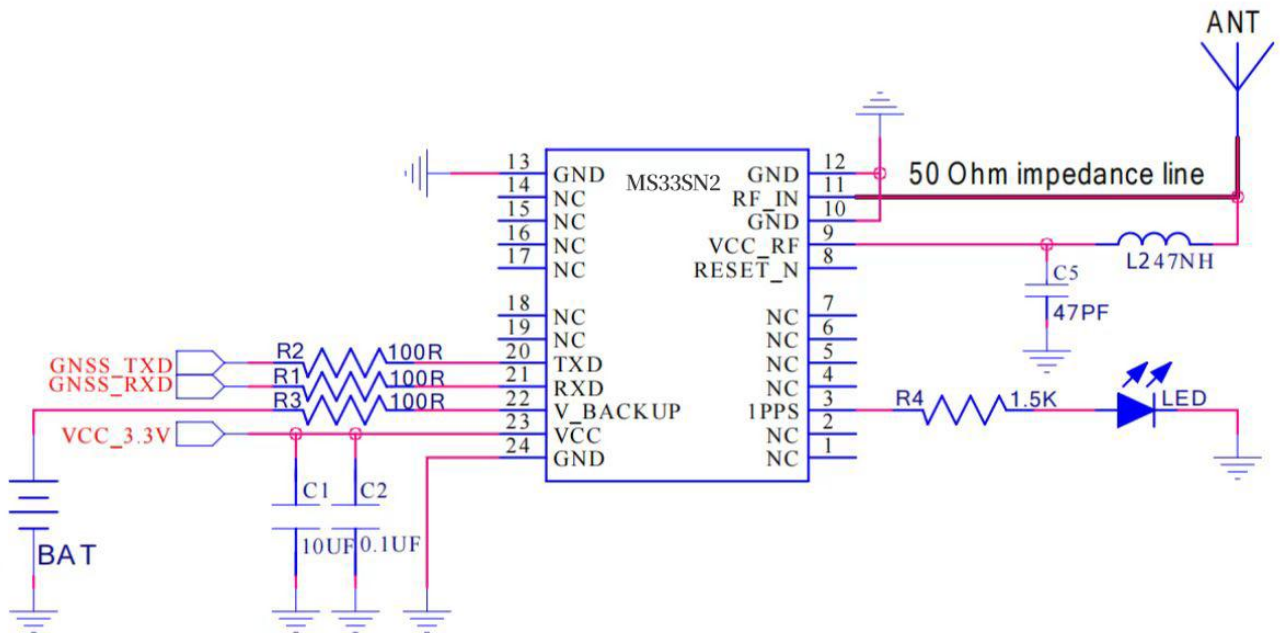
### 7.2 Mechanical dimensions

serial number	Minimum (mm)	Typical values (mm)	Maximum value (mm)
A	12.0	12.2	12.4
B	15.8	16.0	16.2
C	2.2	2.4	2.5
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

## 8 reference design

### 8.1 schematic design

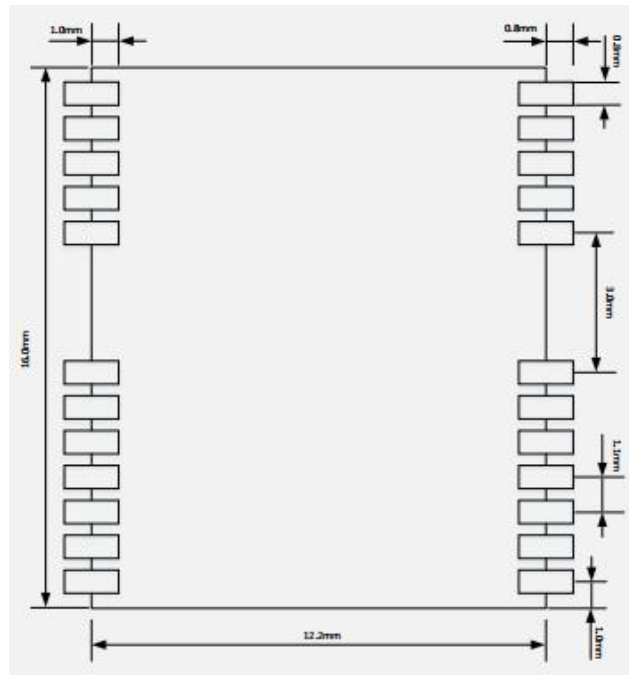
The reference design of the MS33SN2 is shown below. When connecting an active antenna, please make sure the 100nH inductor is in the SMD state for powering the active antenna; when connecting a passive antenna, the 100nH inductor is not required. The characteristic impedance from the RF\_IN pin to the antenna connector is 50 Ω. RESET can be left dangling due to the MS33SN2 power-on self-reset.





## 8.2 PCB Package Reference

The package reference recommendations for the MS33SN2 are as follows:



## 8.3 LAYOUT Notes

- (1) Decoupling capacitors are placed close to the module power supply pins, and ensure that the power supply alignment width is more than 0.5mm;
- (2) No wires are allowed to be routed at the bottom of the module patch;
- (3) The RF alignment between the RF port of the module and the antenna interface should be at least 0.2mm~0.3mm, and the coplanar waveguide impedance model should be adopted, and the spacing between the alignment and the ground copper skin should be controlled to be about 1 times of the spacing, and the impedance should be guaranteed to be 50Ω;
- (4) The alignment from the module RF port to the antenna connector references Layer 2 ground and ensures that the Layer 2 ground plane is relatively complete;
- (5) Modules should not be placed near sources of interference, such as communication module antennas, RF alignments, crystal oscillators, large inductors, and high-frequency digital signal lines.

## 9 Packaging and Protection

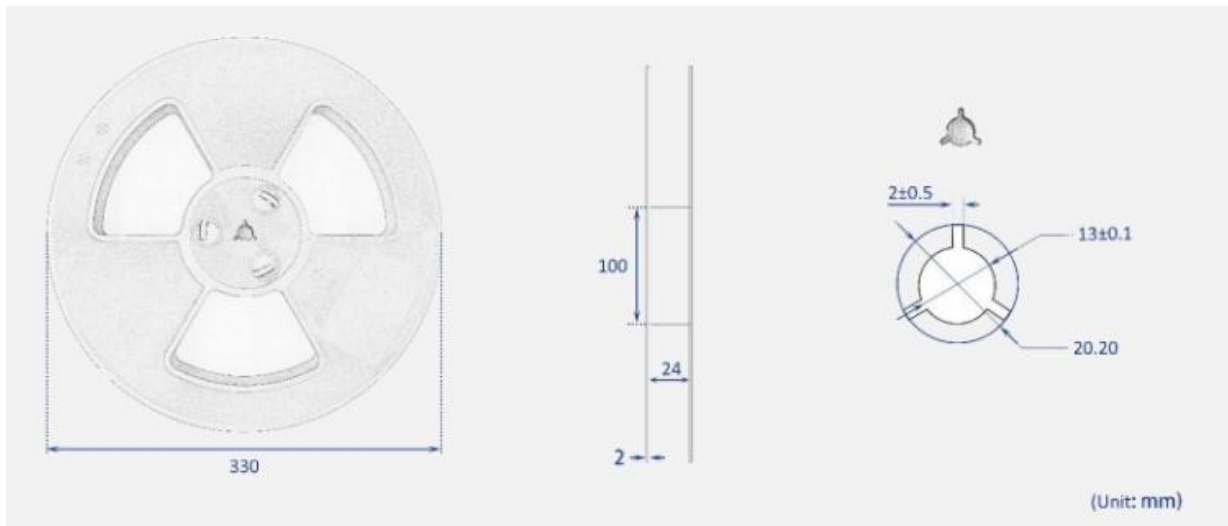
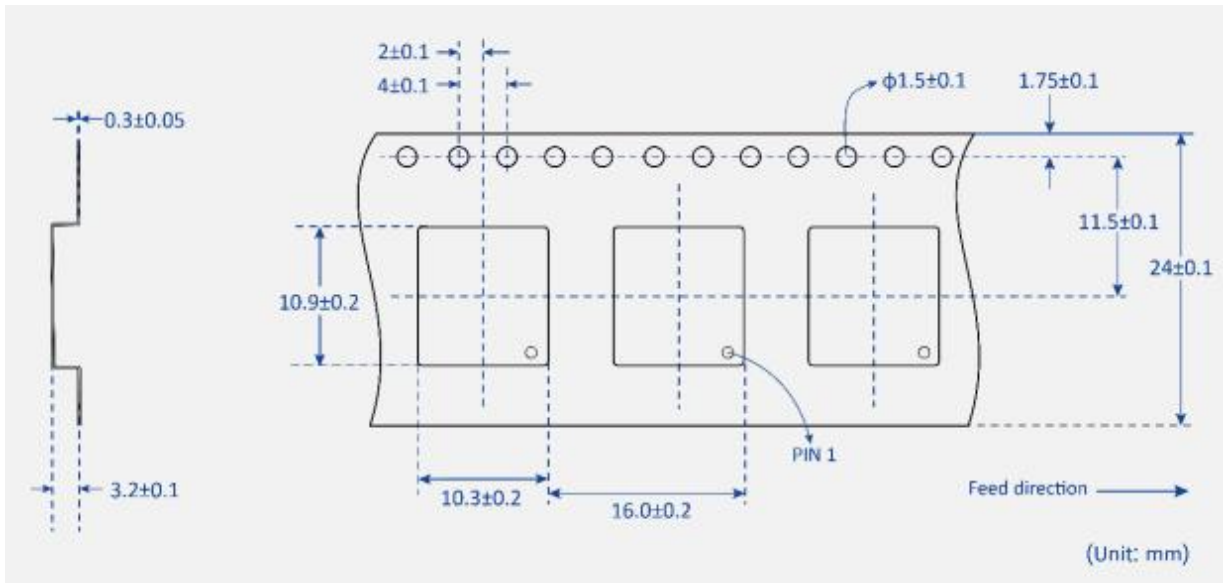
### 9.1 wrap

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
 <p>MS33SN2 4NN MINEWSEMI</p>			
module (in software)	1000pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

### 9.2 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.



### 9.3 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.

### 9.4 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



## 10 Ordering Information

### 10.1 Ordering Model

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

## ● 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, OHSAS18001, 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.

## ● Contact Us

Shenzhen Minewsemi Co., Ltd. is committed to swiftly delivering top-quality connectivity modules to our customers. For assistance and support, please feel free to contact our relevant personnel, or contact us as follows:

**Web:** [www.minewsemi.com](http://www.minewsemi.com)

**Email:** [minewsemi@minew.com](mailto:minewsemi@minew.com)

**Linkedin:** [www.linkedin.com/company/minewsemi](http://www.linkedin.com/company/minewsemi)

**Shop:** <https://minewsemi.en.alibaba.com/>

**Tel:** +86 0755-28010353

**Address:** 3rd Floor, I Building, Gangzhilong Science Park, NO.6, Qinglong Road, Longhua District, Shenzhen, China

**Click the icon to view and download  
the latest product documents electronically.**



## ● Copyright Statement

This manual and all the contents contained in it are owned by Shenzhen Minewsemi Co., Ltd. and are protected by Chinese laws and applicable international conventions related to copyright laws.

The certified trademarks included in this product and related documents have been licensed for use by MinewSemi. This includes but is not limited to certifications such as BQB, RoHS, REACH, CE, FCC, BQB, IC, SRRC, TELEC, WPC, RCM, WEEE, etc. The respective textual trademarks and logos belong to their respective owners. For example, the Bluetooth® textual trademark and logo are owned by Bluetooth SIG, Inc. Other trademarks and trade names are those of their respective owners. Due to the small size of the module product, the "@" symbol is omitted from the Bluetooth Primary Trademarks information in compliance with regulations.

The company has the right to change the content of this manual according to the technological development, and the revised version will not be notified otherwise. Without the written permission and authorization of the company, any individual, company, or organization shall not modify the contents of this manual or use part or all of the contents of this manual in other ways. Violators will be held accountable in accordance with the law.

# MINEWSEMI

Tel: 0086-755-2801 0353

Email: [minewsemi@minew.com](mailto:minewsemi@minew.com)

Web: [www.minewsemi.com](http://www.minewsemi.com)

Address: 3rd Floor, Building I, Gangzhilong Science Park, Qinglong Road Longhua District, Shenzhen 518109, China

