

GNSS Module

MS31SN1

Datasheet

V 1.1.0

Applicable Product Model
MS31SN1

Version Note

Version	Details	Contributor(s)	Date	Notes
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1 Product Introduction

1.1 General description

MS31SN1 series is a GNSS multi-mode, low-power navigation and positioning module. MS31SN1 has a built-in high-sensitivity, low-power GNSS chip and RF devices, which supports a variety of satellite navigation systems, including China's BeiDou satellite navigation system BDS, the United States of America's GPS, Russia's GLONASS, and Japan's QZSS, etc., and realizes the joint positioning of multi-systems.

MS31SN1 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 vehicle navigation and positioning, locator, tachograph, car recorder, OBD, wearable devices and other scenarios.

1.2 Key Parameter

MS31SN1 Parameter	
Satellite systems	GPS, BDS, GLONASS, SBAS, QZSS
Sensitivity	Tracking: -162dBm Reacquisition: -160dBm Cold Start: -148dBm
Cold Start ¹	≤32seconds
Hot Start	Average 1 second
AGPS Assist	Average 10 seconds
Accurate ²	Autonomy level: ≤2.5m (1σ) Velocimetry accuracy: ≤0.1m/s (1σ)
Baud	9600bps (factory default)
Update Frequency	1-5 Hz (software adjustable)
Operating temperature	-40°C ~ +85°C
Protocols	NMEA0183 version 4.1 is supported by default.
Characterization	Support GPS, BDS, GLONASS, QZSS parallel reception and joint positioning Support BeiDou 3 satellite

Notice: ¹ CN0 ≥ 40dB, SV ≥ 6 satellites ²24 hours, OPEN SKY environment, CN0 is excellent

2 Technical Information

2.1 Supported Constellations

MS31SN1 supports multiple satellite constellations due to its multi-constellation RF front-end architecture. It can simultaneously receive signals from GPS, BDS, GLONASS, GALILEO, QZSS, and Satellite-Based Augmentation Systems (SBAS) such as WAAS, EGNOS, GAGAN, and MSAS. The receiving frequencies are: 1575.42 MHz (GPS, GALILEO, QZSS), 1561.098 ± 2.046 MHz (BDS), and $1602.5625 \text{ MHz} \pm 4 \text{ MHz}$ (GLONASS).

2.2 AGPS

The MS31SN1 supports support for the AGPS TCP accelerated positioning scheme. Please refer to "AGPS Integration Guide.pdf" for specific usage methods.

2.3 Satellite-based augmentation system (SBAS)

The MS31SN1 supports the 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 MS31SN1 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-booting.

2.7 Power systems

The MS31SN1 module has full working mode and battery backup mode.

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

Battery Backup Mode: The module only needs a very small current (about 8uA) to maintain the RTC clock and backup RAM, and the Farad capacitor mounted on the module is used for a certain period of time.

3 Electrical Specification

3.1 Absolute maximum rating

parameters	minimum value	average value	maximum values	unit (of measure)
Power Supply Voltage	2.8V	3.3	3.6	V
Supply Current (Acquisition)	25	36	40	mA
Supply Current (Tracking)	20	25	35	mA
Operation Temperature	-40	+25	+85	°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)	25	30	40	mA
Supply Current (Tracking)	20	25	35	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 Pin Information

4.1 Pin assignment

The MS31SN1 is available in a 10.1*9.7mm, LGA-18pin package and is defined as follows:

10	GND	RESET	9
11	RF_IN	VCC	8
12	GND	NC	7
13	NC	V_back up	6
14	VCC_RF	NC	5
15	NC	1PPS	4
16	NC	RXD	3
17	NC	TXD	2
18	NC	GND	1

functionality	Pin Name	Pin Number	Signal Type	descriptive
power supply	VCC	8	Power	Mains Power-Input. Ensure that the power input is clean and stable.
	V_backup	6	Power	Backup power input. It is recommended to connect the backup supply voltage to this pin in order to position the module for hot start and warm start functions. If no backup power supply is available, connect V_backup to the main power supply or suspend the
	GND	1,10,12	GND	Ensure that all GND pins on the module are well grounded.
connection with high-ranking officials	RF_IN	11	I	Antenna input, impedance 50Ω
	VCC_RF	14	O	Antenna bias voltage output for external active antennas.
serial port (computing) /IO	TXD	2	O	UART output, GPS_TX
	RXD	3	I	UART input, GPS_RX
	PPS	4	O	Second pulse signal. Suspend if not used.
	RESET	9	I	Reset signal. Not enabled, please hover.
(sth. or sb) else	NC	5,7,13~18	-	NC, no definition, please hover

5 Integration Guide

5.1 power supply

The MS31SN1 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) via 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 MS31SN1 has a built-in low noise figure LNA and SAW. it is recommended to use an active antenna with a gain of less than 36dB and a noise figure of less than 1.5dB. The module supplies power to the external active antenna through 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), data format: 1 bit start bit, 8 bit data bit, 1 bit stop bit, no parity bit, the default baud rate is 9600 bps. after the module is normally powered on, the serial port will automatically send NMEA data. The host computer can set the working mode and baud rate of the module through the serial port. When this module is used in 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

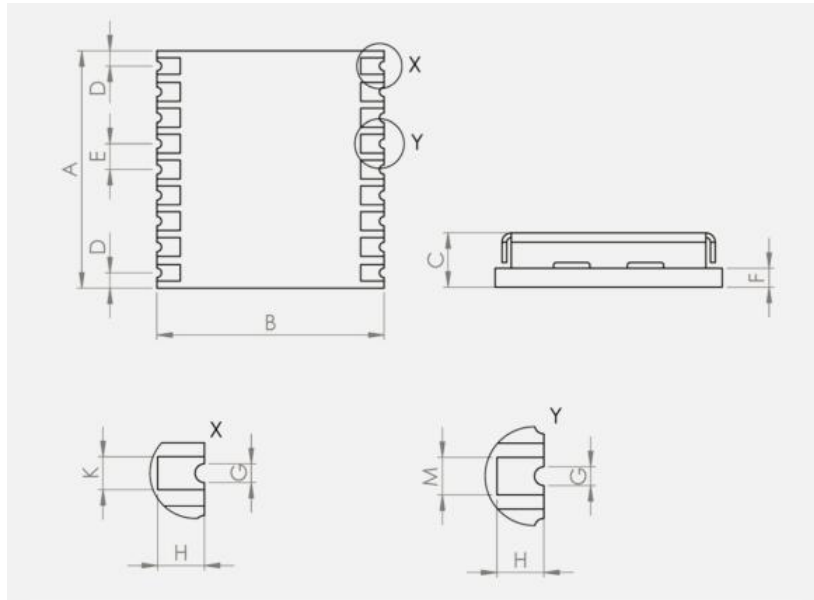
GLGSV	GNSS satellites in view for GLONASS	N
BDGSV	BDS satellites in view for BD	Y
GNRMC	Recommended minimum specific GNSS data	Y
GNVTG	Course over ground and ground speed	Y
GNZDA	Date and Time	N

6.2 Common Commands

CMD TYPE	CMD Example
Change Baud-rate to 9600	\$PCAS01,1*1D<CR><LF>
Change Baud-rate to 115200	\$PCAS01,5*19<CR><LF>
Hot Restart	\$PCAS10,0*1C<CR><LF>
Warm Restart	\$PCAS10,1*1D<CR><LF>
Cold Restart	\$PCAS10,2*1E<CR><LF>
Search GPS satellites only	\$PCAS04,1*18<CR><LF>
Search GPS and BDS satellites	\$PCAS04,3*1A<CR><LF>
Search GPS and GLONASS satellites	\$PCAS04,5*1C<CR><LF>
Search GPS, BDS and GLONASS satellites	\$PCAS04,7*1E<CR><LF>
Set Update rate to 1Hz	\$PCAS02,1000*2E<CR><LF>
Set Update rate to 2Hz	\$PCAS02,500*1A<CR><LF>
Set Update rate to 5Hz	\$PCAS02,200*1D<CR><LF>

7 Package Specification

7.1 sizes



7.2 Mechanical dimensions

serial number	Minimum (mm)	Typical values (mm)	Maximum value (mm)
A	9.9	10.1	10.3
B	9.5	9.7	9.9
C	2.3	2.5	2.7
D	0.55	0.8	0.95
E	1.0	1.1	1.2
F	0.6	0.8	-
G	0.4	0.5	0.6
H	0.7	0.8	0.9
K	0.7	0.8	0.9
M	0.8	0.9	1.0

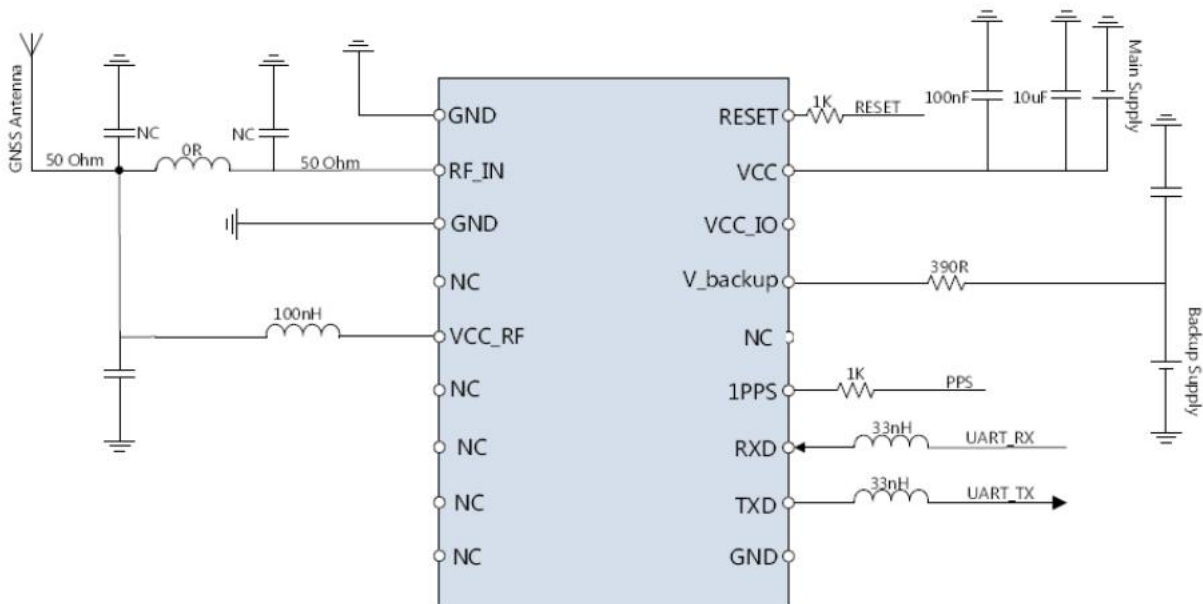
8 reference design

8.1 schematic design

The reference design of the MS31SN1 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.

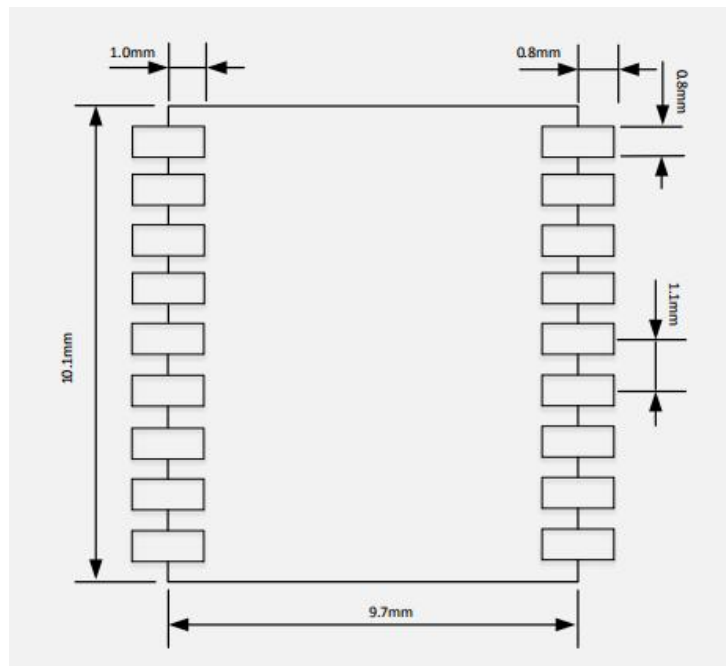
The characteristic impedance from the RF_IN pin to the antenna connector is 50 Ω.

RESET can be left dangling due to the MS31SN1 power-on self-reset.



8.2 PCB Package Reference

The package reference recommendations for the MS31SN1 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

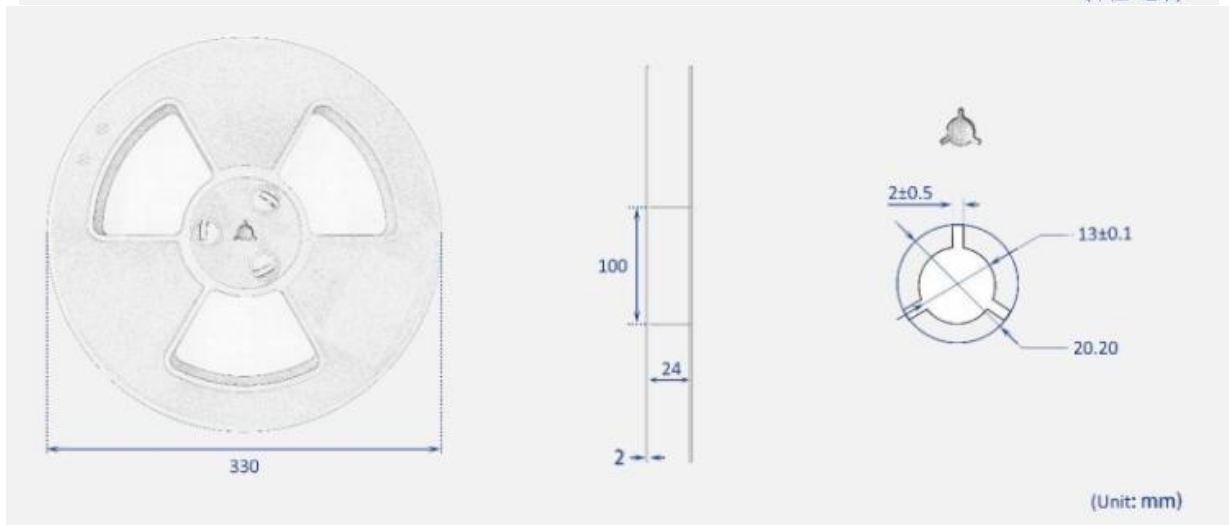
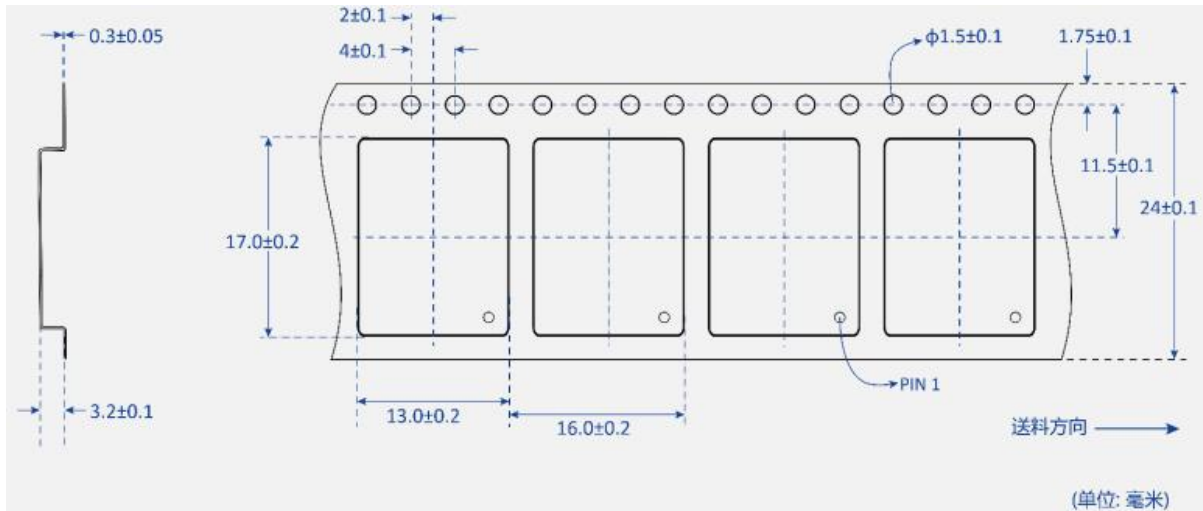
9.1 wrap

The MS31SN1 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
			
module (in software)	1000pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

9.2 Tape and Reel

MS31SN1 adopts the method of reel (consisting of tape and reel), and is packed in sealed bag with anti-static effect to meet the needs of customers for efficient production, batch installation and disassembly. The picture below shows the size details of the tape.



9.3 Storage

In order to prevent the product from being damp and electrostatic discharge, a desiccant and a humidity indicator card are attached in the sealed packaging bag of the product. The user can know the humidity condition of the environment where the product is located through the humidity indicator card. The moisture sensitivity level of the product is MSL3.

9.4 ESD protection

GNSS positioning modules contain highly sensitive electronics and are classified as electrostatic sensitive devices (ESD). Please pay attention to the following operation matters.

- If the following precautions are not followed, it may cause serious damage to the module!
- Do not touch any live capacitors and other devices when pulling out the RF pins (e.g. antenna patch ~10 pF; coaxial cable ~50 –80 pF/m; soldering iron);
- To prevent electrostatic discharge, do not expose the antenna area; if it is exposed due to design reasons, please take appropriate ESD protection measures and do not touch any exposed antenna area;
- When soldering RF connectors and antenna patches, please make sure to use an ESD safe soldering iron.
- Add an ESD diode to the RF input section and UART interface to prevent electrostatic discharge;



10 Ordering Information

10.1 Order Part Number

Ordering Model	Pseudolaric acid	Default Baud Rate	Default refresh rate	Default satellite reception frequency	physical interface
MS31SN1	GNSS Module	9600	1Hz	GPS/BDS/QZSS/SBAS	10.1*9.7mm, LGA18

● 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:

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