MINEWSEMI

GNSS Module
MS37SN2

Datasheet

V 1.0.0

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Michelle, Leo	2024.06.07	

Part Number

Model	Hardware Code
MS37SN2	4NN

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https://en.minewsemi.com/file/MS37SN2_Datasheet_EN.pdf

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1 PRODUCT INTRODUCTION

1.1 General Description

MS37SN2 is a multi-system, concurrent positioning GNSS module. It features an advanced MTK GNSS SoC chip built on advanced technology, integrating a main frequency of up to 530MHz ARM Cortex-M4 with FPU and MPU. The module supports multiple satellite systems, including GPS, BDS, GLONASS, GALILEO, and QZSS, providing excellent positioning performance while maintaining low power consumption.

By leveraging multiple satellite systems, MS37SN2 significantly increases the number of visible satellites in dense urban and canyon environments, reducing initial positioning time and enhancing accuracy. It achieves precise positioning even in challenging conditions.

With its outstanding performance, MS37SN2 is an ideal choice for applications in the automotive industry (such as T-Box and in-car navigation), transportation sector (including industrial and operational vehicles), trackers, shared electric bicycles, smart agriculture, and inspections.

1.2 Features

- Supports full constellation solutions for BDS, GPS, GALILEO, GLONASS, and QZSS.
- Standard SMD package size with excellent I/O compatibility.
- Supports SBAS differential correction.
- Low power consumption support.

1.3 Key Parameters

MS37SN2 Parameters	
Engine (loanword)	MTK 530MHz ARM Cortex-M4 FPU and MPU
Constellation	PS: L1 C/A BDS: B1I GLONASS: L1 GALILEO: E1 QZSS: L1 C/A SBAS: WAAS,EGNOS,MSAS,GAGAN,SDCM
Operating Frequency	GPS/QZSS : 1575.42±1.023MHz BDS : 1561.098MHz±2.046MHz GLONASS : 1601.71875MHz±3.91175MHz GALILEO 1575.42±2.046MHz
(Level of) Sensitivity1	Cold Start: -148dBm Reacquisition: -160dBm Tracking: -165dBm
First Positioning Time1	Cold Start: ≤24 seconds Hot Start: 1 second AGPS Assist: <6 seconds
Positional Accuracy2	Single Point Positioning: Open Sky: <2.0 meters 1σ Complex Urban Environments: <3.0 meters 1σ

Velocity Accuracy2	<0.05 m/s
Time Accuracy2	20ns
Operating Temperature	Operating Temperature: -40°C to +85°C
Refresh Rate	GNSS: 1Hz； configurable
Baud Rate	Main Serial Port 115200 (factory default, configurable)
Supported Protocols	NMEA 0183 Protocol Ver 4.1

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

2 TECHNICAL INFORMATION

2.1 Supporting Constellations

MS37SN2 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 MHz±4 MHz (GLONASS).

2.2 SBAS

MS37SN2 supports the reception of SBAS broadcast signals. These systems supplement GNSS data with augmentation data in other regions or wide-area GPS enhancement. By providing satellite broadcast ranging corrections and integrity information, the GNSS receiver can utilize this data to enhance result accuracy. SBAS satellites can serve as additional satellites for ranging (navigation), further improving availability. Supported SBAS types include: GAGAN, WAAS, EGNOS, and MSAS.

Typology	Satellite Navigation System	Operation and Maintenance Country/Region
Master Navigation System (GNSS)	GPS Beidou (BDS) GLONASS GALILEO	United States of America China Georgia EU
local Navigation system	QZSS NAVIC/IRNSS	Japanese India
Star-based Wide Area Strengthening (SBAS)	WASS EGNOS MSAS GAGAN	United States of America EU Japanese India

2.3 QZSS

The Quasi-Zenith Satellite System (QZSS) is a navigation satellite coverage system for the Pacific region of Japan and Australia that transmits other GPS L1C/A and L5 signals. The module is able to receive and track these signals simultaneously with GPS, improving usability, especially in maintaining positioning in harsh signal conditions such as urban canyons.

2.4 DGNSS

MS37SN2 can receive pseudorange correction information in RTCM format. When used as a rover station, MS37SN2 will attempt to provide the best possible positioning accuracy based on the received correction data. Upon receiving RTCM message input, it will immediately enter differential mode. Improved positioning accuracy can be expected in D-GNSS mode. D-GNSS is a differential system where the rover station uses reference data from a reference station. If RTCM correction functionality cannot be utilized, it will operate as an independent precision receiver, performing GNSS standalone positioning.

3 ELECTRICAL SPECIFICATION

3.1 Absolute Maximum Rating

Notation	Parameters	Minimum Value	Maximum Value	Unit
VCC	Main Power Supply Volt.	-0.5	4.3	V
VBAT	Backup Power Supply Volt.	-0.5	4.6	V
VI-max	I/O Pin input Volt.	-0.5	3.63	V
Vhbm	ESD Contact	-	2000	V
T-storage	Storage temperature	-40	+85	℃
T-solder	Reflow Soldering Temperature	--	250	℃

Applying pressure beyond the "absolute maximum ratings" to the device may cause permanent damage.
The provided data represents pressure levels only. The product does not have overvoltage or reverse voltage protection. If necessary, appropriate protection diodes must be used to limit voltage spikes above the specified range of power supply voltage specifications mentioned in the table.

3.2 DC Characteristics

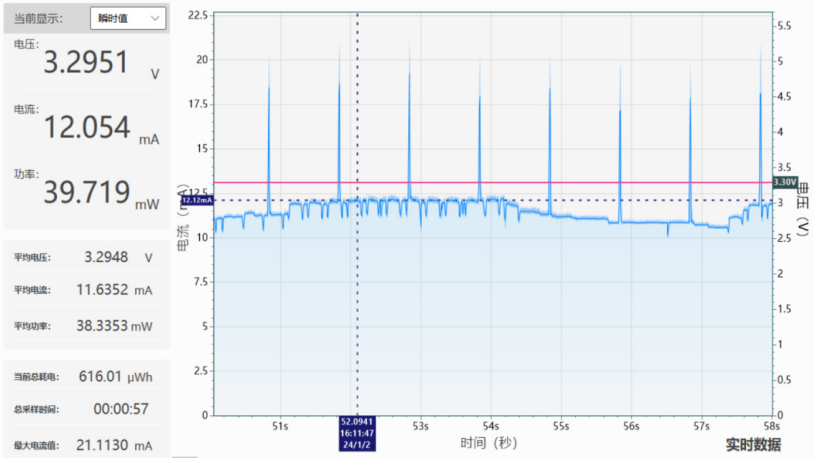
Notation	Parameters	Minimum Value	Typical Value	Maximum Value	Unit
VCC	Mains voltage	2.8	3.3	3.6	V
VBAT	Backup power supply voltage	2.3	3.3	3.6	V
ICCmax	Maximum operating current on VCC	--	3.3	200	mA
Tenv	Operating temperature	-40	--	85	°C

3.3 Power wastage

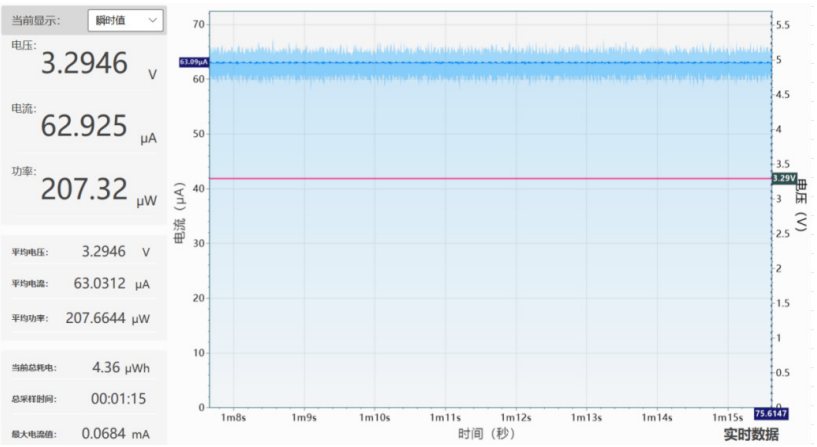
Notation	Parameters	Measurement Pins	Typical Value	Unit
ICCRX1 [1]	capture phase	VCC [2]	12	mA
ICCRX2 [1]	tracking phase	VCC [2]	9	mA
ICCDBM	sleep	VBAT[3]	63	μA

Notice:
1.Under open sky, in the GNSS L1 frequency band, tracking 16 satellites, successful positioning.
2.Conditions: VCC=3.3V, indoor temperature, all pins floating.
3.Conditions: VBAT=3.3V, indoor temperature, all pins floating.

All specifications are performed at an ambient temperature of 25°C. Extreme operating temperatures can severely affect specification values. Applications operating near temperature extremes.
The values in the table are for customer reference only and are only examples of typical power requirements. Values are sampled, actual power requirements will vary depending on firmware version used. external circuitry, number of satellites tracked, signal strength, type of start-up as well as time, duration and test conditions.
The measured values of the capture phase current are as follows:



The measured data of the current in the dormant phase are as follows:



3.4 Antenna Gain Requirements

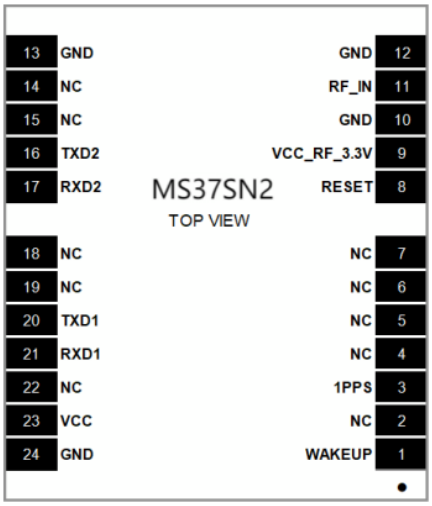
Due to the built-in LNA in MS37SN2 and support for passive GNSS antennas, external antenna gain should be carefully controlled.

Notation	Parameters	Min	Max	Unit
RFgain	Input Gain	0	30	dB

4 PACKAGE DEFINITION

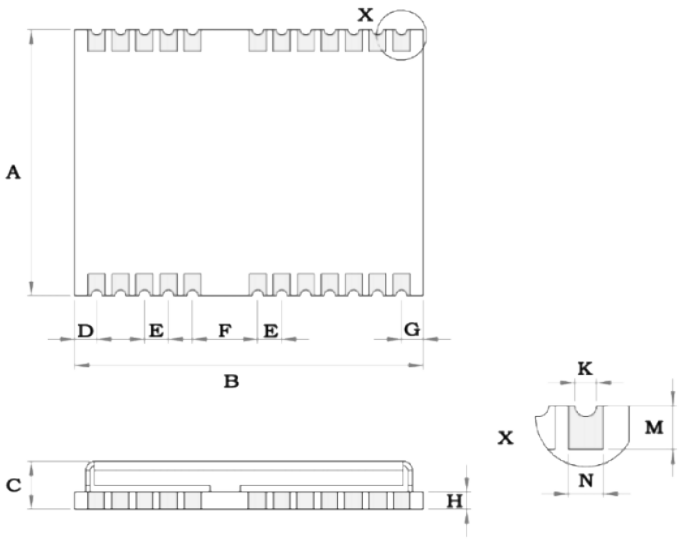
4.1 Module Pin Definitions

The MS34SN2 is available in a 16*12mm, LCC-24pin package and is defined as follows:



Serial Number	Pin Name	I/O	Description
1	WAKE_UP	I	Wake-up from standby mode
3	1PPS	O	Time pulse
8	RESET	I	Reset, low-level reset, recommended to float
9	VCC_RF 3.3V	O	RF antenna power supply: 3.3V
11	RF_IN	I	Antenna signal input
16	TXD1	O	NMEA-0183
17	RXD1	I	Differential data, AT commands, FOTA upgrades
20	TXD0	O	Main serial port (functions same as UART1_TXD)
21	RXD0	I	Differential data, AT commands, FOTA upgrades
22	V_BACKUP	I	Backup power supply, supports hardware hot start
23	VCC	I	Main power supply
	GND	I	Ground, PIN 10, 12, 13, 24

4.2 Dimensions

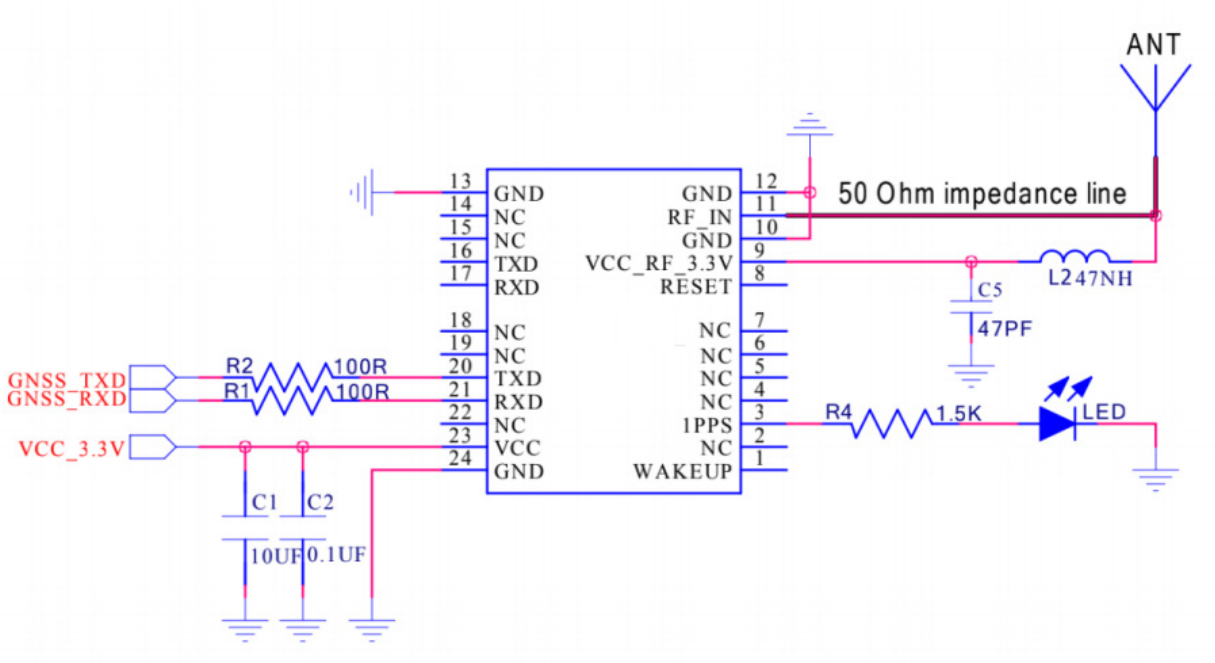


Serial Number	Minimum (mm)	Typical Value (mm)	Maximum Value (mm)
A	12.0	12.2	12.4
B	16.2	16.4	16.6
C	2.4	2.6	2.8
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H	0.7	0.8	0.9
K	0.4	0.5	0.6
M	0.8	0.9	1.0

5 ELECTRICAL SCHEMATIC

5.1 Schematic design

The MS37SN2 reference design is shown below. When connecting an active antenna, make sure the 47nH inductor in the L1 and L2 position is patched. This is used to power the active antenna. The characteristic impedance from the RF_IN pin to the antenna interface is 50Ω. In applications, the performance of the antenna is very important for the system, and the technical parameters of the dual-frequency precision antenna must be guaranteed. Pin22 can be connected to V_BACKUP backup power supply, supports hardware hot start, also supports Pin1 software wake up, high level is enabled.



5.2 Layout notice

(1)Place the decoupling capacitors close to the power pins of the module, and ensure that the width of the power traces is more than 0.5mm;
(2)No wiring is allowed at the bottom of the module patch;
(3)The RF trace from the module RF port to the antenna interface must be at least 0.2mm~0.3mm, and the co-planar wave guide impedance model is used, and the spacing between the trace and the ground copper is controlled at about 1 times the spacing , and the guaranteed impedance is 50Ω;
(4)The wiring from the module RF port to the antenna interface refers to the second layer ground, and ensure that the second layer ground plane is relatively complete;
(5)Do not place the module near interference sources, such as communication module antennas, RF traces, crystal oscillators, large inductor, and high-frequency digital signal lines.

5.3 Power Supply

The MS37SN2 positioning module is equipped with two power supply pins: VCC and V_BCKP. Through the VCC pin, the main power is input to the module; through the V_BCKP pin, the backup power is input to the module. In order 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 with a maximum output current greater than 100mA for power supply. If the module main power supply is disconnected, the system will provide power to the RTC and battery backup RAM (BBR) through V_BCKP.
Therefore, even if the main power supply is disconnected, with the support of the backup power supply, the ephemeris data can still be retained and a hot start or warm start can be achieved when the system is powered on again. If backup power is not connected and the module does not receive data, the system will perform a cold start when power is applied again. NOTE: If no backup supply is available, connect the V_BCKP pin to the VCC main supply or leave it unconnected.

5.4 Antennas

The MS37SN2 has 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 through RF_IN. If the active antenna cable is long, an active antenna with at least 15dB gain is needed to compensate for the line loss. In order to maintain the integrity of the ground wire, it is recommended that no wires or as few wires are routed under the module.

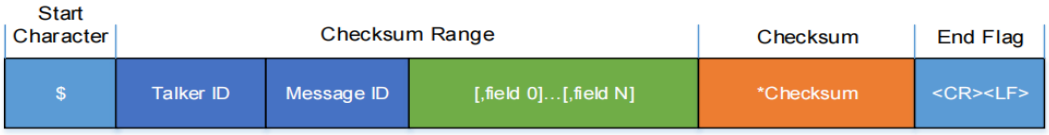
5.5 Serial communication

Provides a TTL level Universal Asynchronous Receiver Transmitter (UART). The data format is: 1 start bit, 8 data bits, 1 stop bit, no parity bit. The default baud rate is 115200bps. After the module is powered on normally, the serial port will automatically send NMEA data. The host computer can set the module working mode, baud rate, etc. 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, thereby further reducing power consumption.
At this time, in order to prevent the high level of the serial port from affecting the normal operation of the module, it is strongly recommended to disconnect the serial port at the same time when disconnecting the main power supply, or set the serial port to the state of input state + pull-down resistor or high impedance state + pull-down resistor status.

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:



The NEMA message output for the MS37SN2 is shown in the following table:

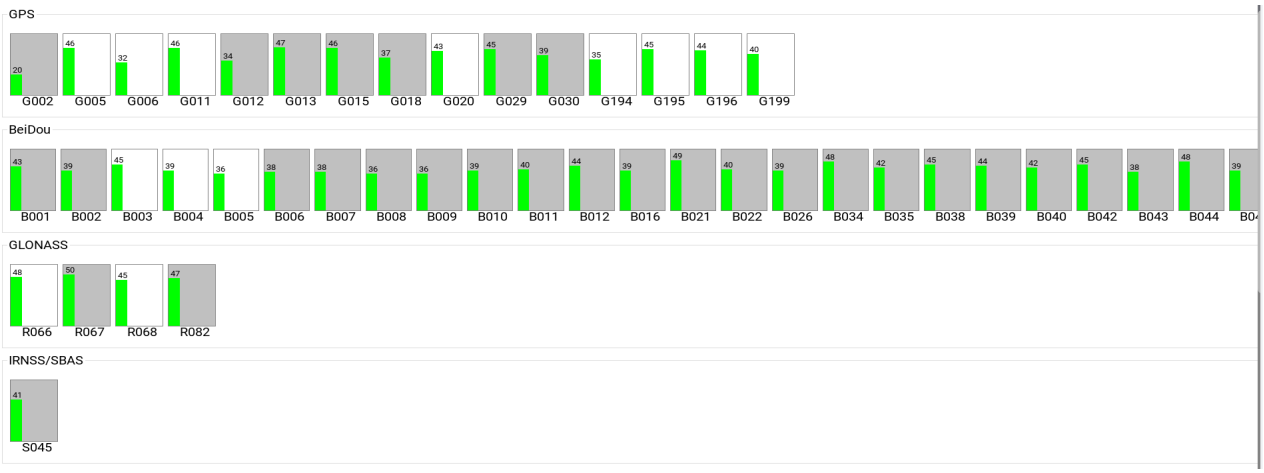
NMEA Record	Description	Default
GNGGA	Global positioning system fixed data	Y
GNGLL	Geographic position—latitude/longitude	N
GNGSA	GNSS DOP and active satellites	Y
GPGSV	GNSS satellites in view for GPS	Y
GLGSV	GNSS satellites in view for GLONASS	Y
GBGSV	GNSS satellites in view for BD	Y
GAGSV	GNSS satellites in view for GALILEO	Y
GNRMC	Recommended minimum specific GNSS data	Y
GNVTG	Course over ground and ground speed	N
GNZDA	Date and Time	N

6.2 Sample Data

Serial port data within 1 second after positioning example:

$GNGGA,124120.000,2242.2945,N,11401.6924,E,1,13,0.86,132.3,M,-2.5,M,,*63
$GNGSA,A,3,11,12,196,195,199,194,,,,,,1.13,0.86,0.74,1*02
$GNGSA,A,3,66,81,67,65,,,,,,,,1.13,0.86,0.74,2*07
$GNGSA,A,3,,,,,,,,,,,,1.13,0.86,0.74,3*0D
$GNGSA,A,3,03,04,05,,,,,,,,,1.13,0.86,0.74,4*08
$GPGSV,4,1,14,11,50,061,46,12,17,230,39,06,,,42,07,,,38,1*66
$GPGSV,4,2,14,13,,,48,15,,,43,30,,,36,05,,,47,1*6A
$GPGSV,4,3,14,29,,,41,20,,,46,196,69,065,45,195,63,092,46,1*6A
$GPGSV,4,4,14,199,60,149,40,194,17,163,40,1*64
$GLGSV,1,1,04,66,61,008,51,81,57,012,49,67,56,233,49,65,12,028,40,1*71
$GAGSV,1,1,00,7*73
$GBGSV,5,1,20,01,,,45,42,,,41,34,,,40,10,,,42,1*77
$GBGSV,5,2,20,40,,,45,38,,,46,22,,,47,21,,,49,1*72
$GBGSV,5,3,20,03,65,189,44,35,,,42,44,,,49,09,,,34,1*41
$GBGSV,5,4,20,02,,,39,11,,,36,12,,,43,13,,,41,1*7B
$GBGSV,5,5,20,39,,,42,04,34,109,40,05,24,255,37,16,,,35,1*73
$GNRMC,124120.000,A,2242.2945,N,11401.6924,E,0.05,108.06,210324,,,A,V*02

6.3 Example of an actual star search



6.4 Common Commands

NMEA Record	Description
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>

NMEA Record	Description
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 are to add a carriage return (CR), line feed (CF)
2. All software configurations expire after the module main power supply VCC charging and powering up, if necessary, then need to be initialized again after powering up;
3. As MS37SN2 supports the full constellation satellite system, configuring the baud rate 9600 may lead to serial port data blocking.

7 PACKAGING INFORMATION

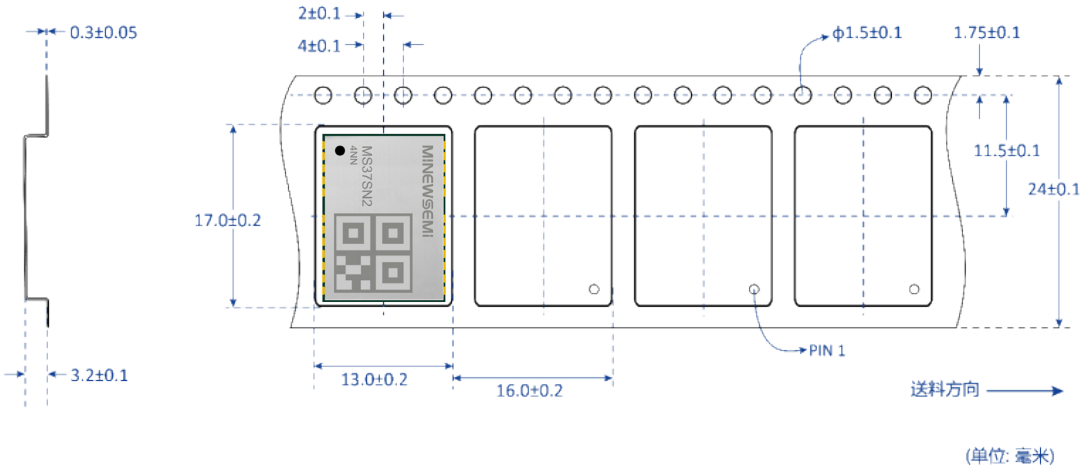
7.1 Package

MS37SN2 is a device sensitive to humidity and static electricity. During product packaging and shipping, be sure to follow the relevant handling requirements and take appropriate precautions to reduce product damage. The table below shows the standard packaging structure for product shipping.

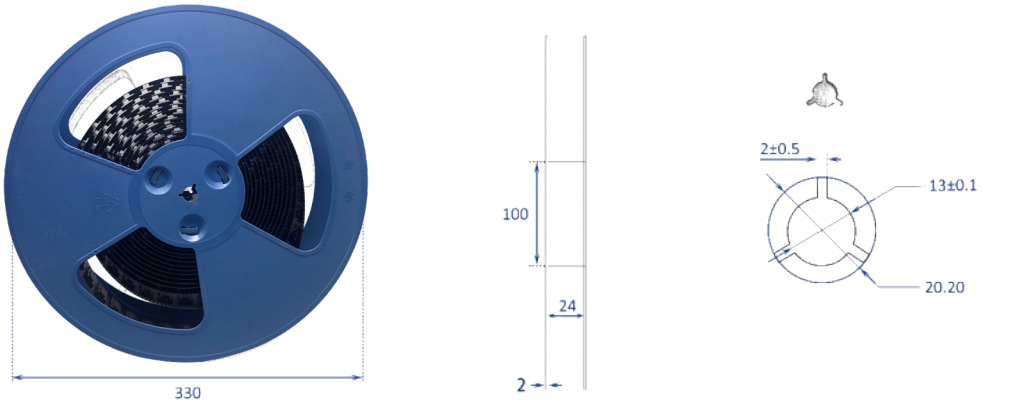
Offerings	Reels	Sealed Bags	Shipping Cartons
			
MS34SN2	1000pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

7.2 Tape and Reel

MS37SN2 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.



(单位: 毫米)



(Unit: mm)

7.3 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.

7.4 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;

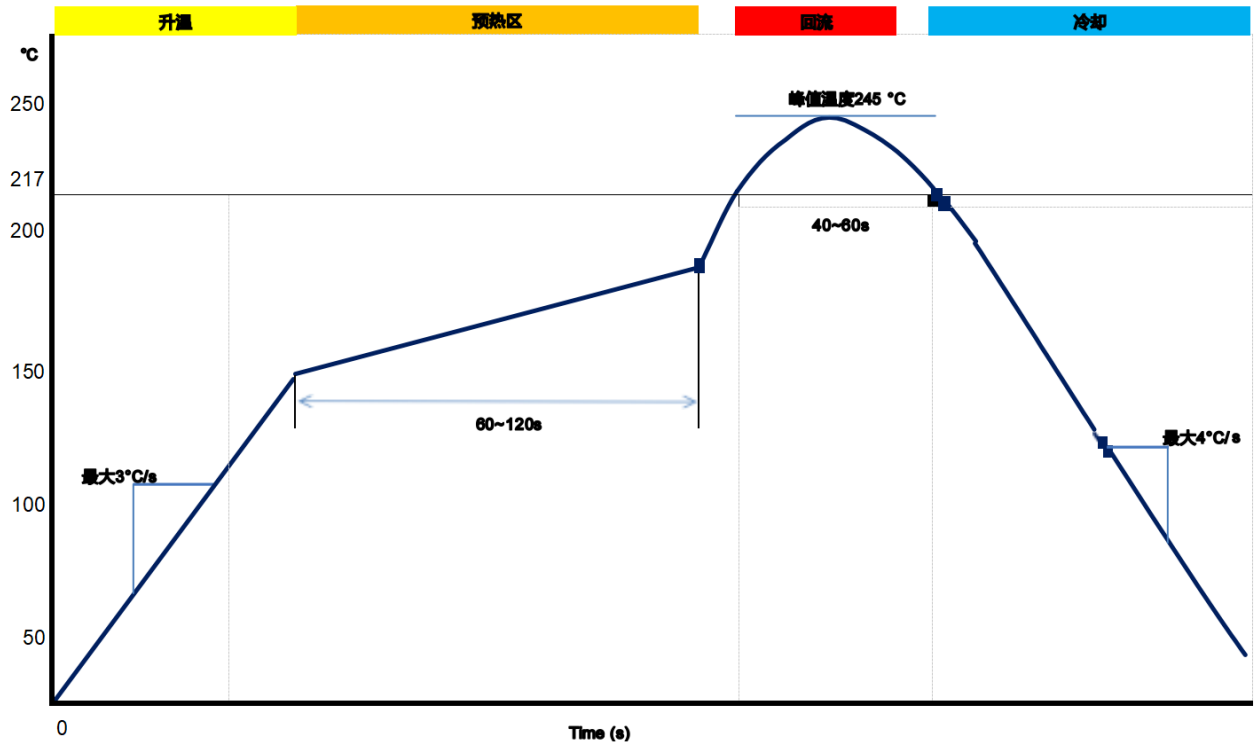
To prevent electrostatic discharge, do not expose the antenna area; if exposed by design, take appropriate ESD precautions and do not touch any exposed antenna area;

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

7.5 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.

8 ORDERING INFORMATION

8.1 Order Part Number

Ordering Model	Pseudolaric acid	Default Baud Rate	Default Satellite Reception Frequency	Physical Interface
MS37SN2	GNSS Module	115200	GPS/BDS/GLO/GAL/QZSS	16*12, LCC24

9 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, NOx, 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℃/60%RH) conditions, the recommended baking conditions:**
  1. 120 +5/-5℃, 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℃ +8/-0℃, 24 hours, once
  The base tape can be baked together with the product at this temperature, Please pay attention to even heating.

10 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.

11 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.

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13 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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