MINEWSEMI

GNSS Module

MS34SN2

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
MS34SN2	4NN

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https://en.minewsemi.com/file/MS34SN2_Datasheet_EN.pdf

INDEX

1 PRODUCT INTRODUCTION

1.1 General Description

MS34SN2 is a five-star, ten-frequency, L1+L5 GNSS module with integrated RTK positioning engine. Built-in 12nm advanced process GNSS Soc chip, integrated main frequency up to 530MHz ARM Cortex-M4 FPU and MPU, the module supports GPS, BeiDou, GLONASS, Galileo and QZSS multi-satellite system, combined with RTK (carrier phase difference) technology, MS34SN2 can achieve centimeter level positioning accuracy. It greatly improves the device's positioning accuracy while maintaining ultra-low power consumption.

The multi-satellite combination greatly increases the number of satellites visible when traveling in dense urban canyon environments, reducing the time to first fix and improving positioning accuracy, even up to 65 satellites in open environments! The RTK algorithm engine allows for centimeter-level positioning accuracy on open roadways. The superior positioning performance of the MS34SN2 makes it ideal for industrial and consumer applications in the automotive sector (e.g. T-Box, in-vehicle navigation, V2X), transportation sector (e.g. industrial vehicles, operational vehicle monitoring), trackers, ride-sharing bikes, smart agriculture, inspection, etc.

1.2 Key Parameters

MS34SN2 Parameters	
Engine (loanword)	MTK 530MHz ARM Cortex-M4 FPU and MPU, 12nm advanced process
Constellation	GPS: L1 C/A, L5 BDS: B1I, B2a. GLONASS: L1 GALILEO: E1, E5a QZSS: L1 C/A, L5 sbas: waas, egnos, msas, gagan, sdcm NAVIC*: L5 (optional)
Operating Frequency	GPS/QZSS L1: 1575.42±1.023MHz L5: 1176.45MHz±10.23MHz BDS B1I: 1561.098MHz ± 2.046MHz B2a: 1176.45MHz ± 20.46MHz GLONASS G1: 1601.71875MHz ± 3.91175MHz GALILEO E1: 1575.42±2.046MHz E5a: 1176.45MHz±10.23MHz NAVIC*: L5 (optional) L5: 1176.45MHz±10.23MHz
(Level of) Sensitivity1	Cold Start: -148dBm; Recapture: -160dBm; Tracking: -165dBm;
First Positioning Time1	Cold start: ≤24 seconds; Hot start: 1 sec; AGPS Assist: <6 seconds;
Positional Accuracy2	Single-point localization: Open sky: <1.2 meters CEP Complex urban environments: <2.5 m CEP RTK: Horizontal positioning accuracy: 1cm+1PPM CEP Elevation accuracy: 2cm+1PPM CEP

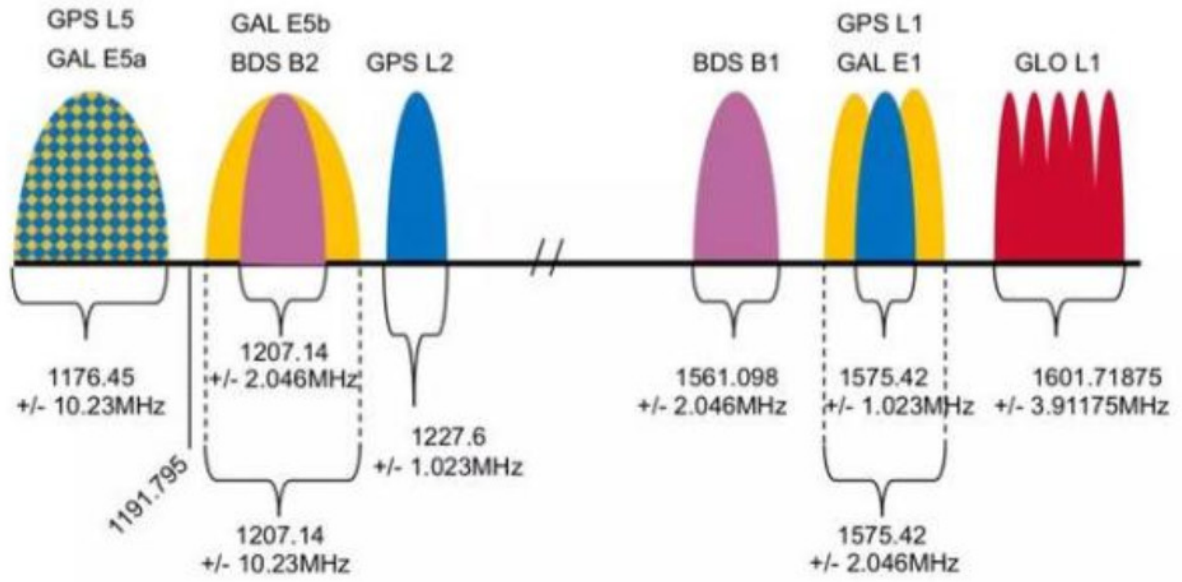
Fixed solution convergence time	≤10 seconds
Speed Accuracy2	<0.05 m/s
Time Accuracy2	20 nanoseconds
Operating Temperature	Operating temperature: -40°C to +85°C
Refresh Rate	GNSS RTK: 1Hz、2Hz、5Hz、10Hz；；
Baud	Main Serial Port 115200bps (factory default)
RTCM Differential Output	Supports RTCM2.x, RTCM3.x outputs, MSM4/MSM7 support
Supported Protocols	NMEA 0183 Protocol Ver. 4.0/4.1 RTCM 2.3/2.4/3.0/3.2

Remarks:
1.All satellites signal at -130 dBm
2 CEP, 50%, 24 hours static, -130 dBm, > 20 SVs
3 Assuming Airborne < 4 g platform

2 TECHNICAL INFORMATION

2.1 Supporting Constellations

Due to the multi-constellation RF front-end architecture, the MS34SN2 can simultaneously receive dual-band (L1+L5) satellite signals supporting GPS, BDS, GLONASS, GALILEO, IRNSS, QZSS, and the satellite-based augmentation systems SBAS (WAAS, EGNOS, GAGAN, and MSAS).The main frequencies of the GNSS are schematically shown in the figure below.



2.2 Satellite-based Augmentation System (SBAS)

The MS34SN2 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.

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 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 Satellite enhancement

With multi-mode dual-frequency L1+L5 carrier phase difference function, the received input base station information should follow RTCM3.2 protocol. The base station can be a directly connected station or a virtual CORS station. The supported differential message types are listed in the table below.

message type	typology
1005 / 1006	Base Station Antenna Location Information
1074	Base station GPS observation message group
1084	Base station GLONASS observation volume message sets
1124	Base station BDS observation volume message set
1094	Base station GALILEO observation volume message sets
1114	Base station QZSS observation volume message set

2.5 Carrier phase technology - RTK

The module supports GPS, BeiDou, GLONASS, Galileo and QZSS multi-satellite systems, as well as L1+L5 frequency points. Combined with RTK (carrier phase differential) technology, the MS34SN2 can achieve centimeter-level positioning accuracy, which greatly improves the device's positioning accuracy while maintaining ultra-low power consumption. Differential positioning is a necessary condition for centimeter-level accuracy, and the application needs to ensure that the receiver receives stars well.

2.6 Satellite augmentation - Differential DGNSS

The MS34SN2 can also be downgraded to use the Code Differential function, D-GNSS, to access pseudo-range correction information in RTCM 2.3 or user-defined formats when RTK use is limited. The MS34SN2 used as a mobile station will attempt to provide the best possible positional accuracy depending on the correction data received. Upon receipt of the RTCM message input stream, it will immediately enter differential mode. Improvements in positioning accuracy can be expected after entering D-GNSS mode.
D-GNSS is a differential system in which mobile stations use reference data from a reference station. If the RTCM correction function is not available, it will operate as a stand-alone precision receiver for GNSS satellite-based or single-point positioning.

3 ELECTRICAL SPECIFICATION

3.1 Absolute Maximum Rating

Notation	Parameters	Minimum Value	Maximum Value	Unit
VCC	Mains voltage	-0.5	3.63	V
VBAT	Backup power supply voltage	-0.5	3.63	V
VI-max	I/O Pin Input Voltage	-0.5	3.63	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 DC Characteristics

Notation	Parameters	Minimum Value	Typical Value	Maximum Value	Unit
VCC	Mains voltage	2.0	3.3	3.6	V
VBAT	Backup power supply voltage	2.5	3.3	3.6	V
ICCmax	Maximum operating current on VCC	--	3.3	200	mA
Tenv	Operating temperature	-40	--	85	℃

3.3 Power wastage

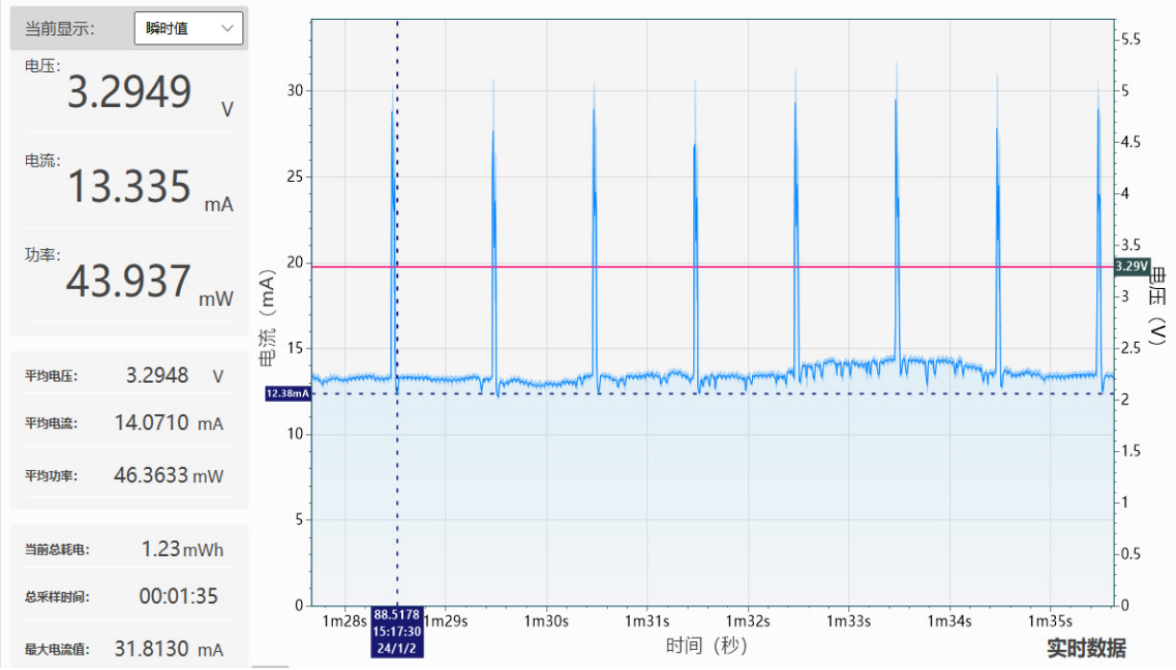
Notation	Parameters	Measurement Pins	Typical Value	Unit
ICCRX1 [1]	capture phase	VCC [2]	13	mA
ICCRX2 [1]	tracking stage	VCC [2]	10	mA

Remarks:
1. Under open sky, GNSS, L1 + L5 bands, tracking 32 satellites, successful positioning.
2. Conditions: VCC=3.3V, room temperature, all pins suspended

All of the above specifications are at 25°C ambient temperature. 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. 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:



3.4 Antenna Gain Requirements

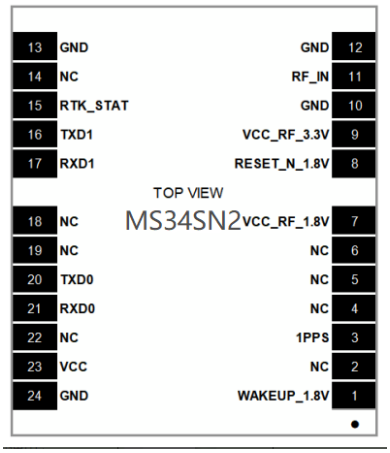
MS34SN2 requires a GNSS active antenna, external antenna gain control.

Notation	Parameters	Min	Max	Unit
RFgain	Input Gain	0	30	dB

4 PACKAGE DEFINITION

4.1 Module Pin Definitions

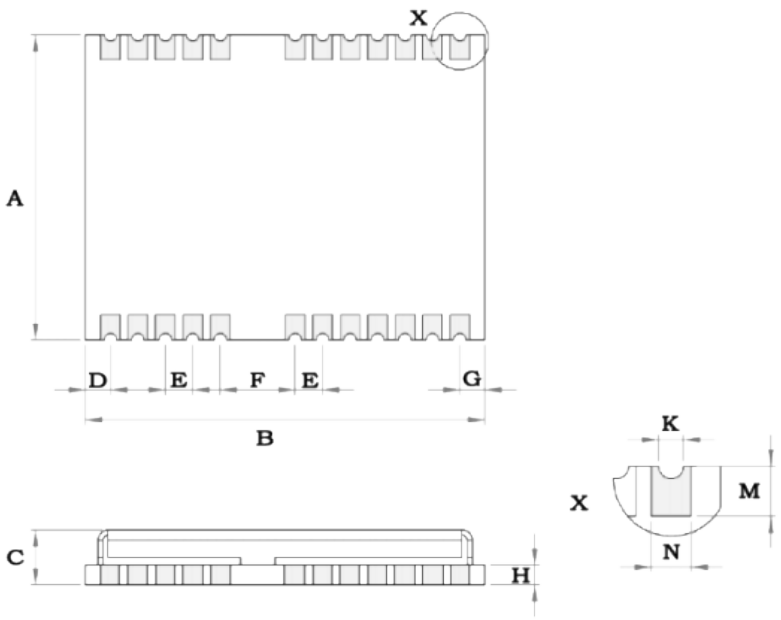
The MS34SN2 is available in a 16*12mm, LCC-24pin package and is defined as follows:



Serial Number	Pin Name	I/O	Description
1	WAKE_UP_1.8V	I	Wake-up from standby mode, 1.8V level, high pulse wake-up
3	1PPS	O	Time pulse, TTL 2.8V level
7	VCC_RF 1.8V	O	Low-power RF antenna power supply 1.8V, note that it cannot be used at the same time as pin9.
8	RESET	I	Hardware Reset, 1.8V Level, Low Reset
9	VCC_RF 3.3V	O	RF antenna power supply 3.3V, note that it can't be used at the same time as pin7.
11	RF_IN	I	Antenna Signal Input
15	RTK_STATE	O	RTK status indication, 2.8V level, high level -> fixed solution, low level -> not fixed solution
16	TXD1	O	NMEA-0183 , Base Station Mode RTCM3 Differential Outputs
17	RXD1	I	Differential Data, AT Commands, FOTA Upgrade
20	TXD0	O	Main serial port (same function as TXD1)
21	RXD0	I	Differential Data, AT Commands, FOTA Upgrade
23	VCC	I	main power
	GND	I	Grounding, PIN 10, 12, 13, 24

5 PACKAGE SPECIFICATIONS

5.1 Dimensions



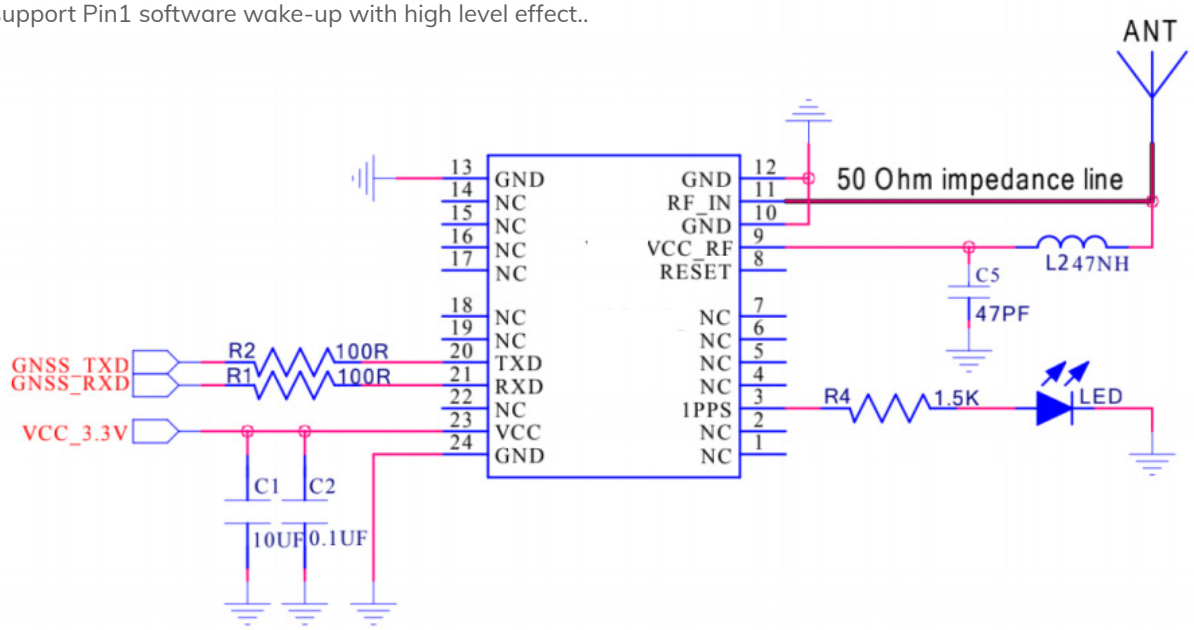
5.2 Mechanical Dimensions

Serial Number	Minimum (mm)	Typical Values (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 REFERENCE DESIGN

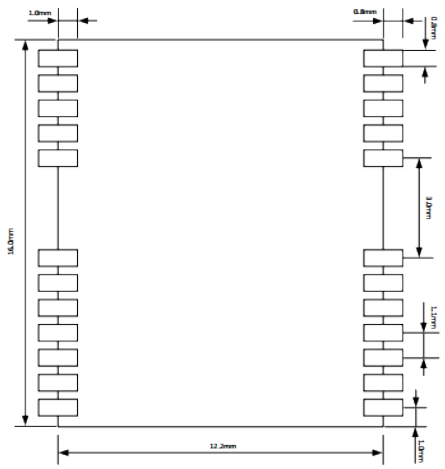
6.1 Schematic design

The reference design of the MS34SN2 is shown below. When connecting the active antenna, please make sure the 47nH inductance at L2 position is in the SMD state, which is used to supply power to the active antenna; the characteristic impedance from RF_IN pin to the antenna connector is 50Ω. When applying the antenna, the performance of the antenna is crucial to the system, and make sure to ensure the technical parameter of the dual-band high-precision antenna. the MS34SN2 doesn't support the hardware hot-start, but it supports the software wake-up of Pin1, which is effective on the high level. The MS34SN2 does not support hardware hot start, but does support Pin1 software wake-up with high level effect..



6.2 PCB Package Reference

The package reference recommendations for the MS34SN2 are as follows:



6.3 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.

6.4 Power Supply

The MS34SN2 Positioning Module is equipped with two power supply pins: VCC and V_BCKP. Primary power is fed to the module through the VCC pin, and alternate power is fed to the module through the V_BCKP 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 the Battery Backup RAM (BBR) through V_BCKP.
Therefore, even if the main power supply is disconnected, the ephemeris data can still be retained with the backup power supply and can be used for a hot or warm start when the system is powered up again. 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 backup power available, connect the V_BCKP pin to the VCC mains or leave it blank.

6.5 Connection with High-ranking Officials

The MS34SN2 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 through RF_IN. If the active antenna cable is long, an active antenna with at least 15dB of gain is required to compensate for line losses. To maintain ground integrity, it is recommended that no or as few wires as possible be routed under the module.

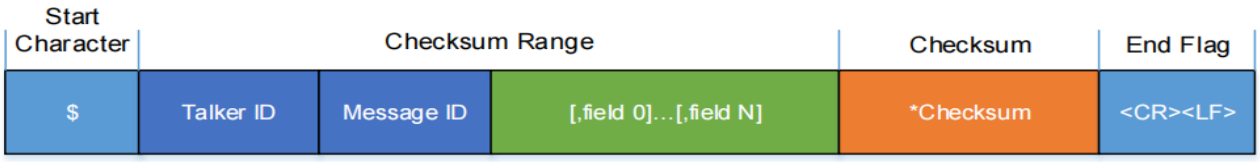
6.6 Serial Port Communication

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 9600bps. 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 to further reduce the power consumption.
In this case, 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 set the serial port to the state of input state + pull-down resistor or high resistance state + pull-down resistor.

7 SOFTWARE PROTOCOL

7.1 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 MS34SN2 is shown in the following table:

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	N
GNZDA	Date and Time	N
GNGST	Position error statistics	N

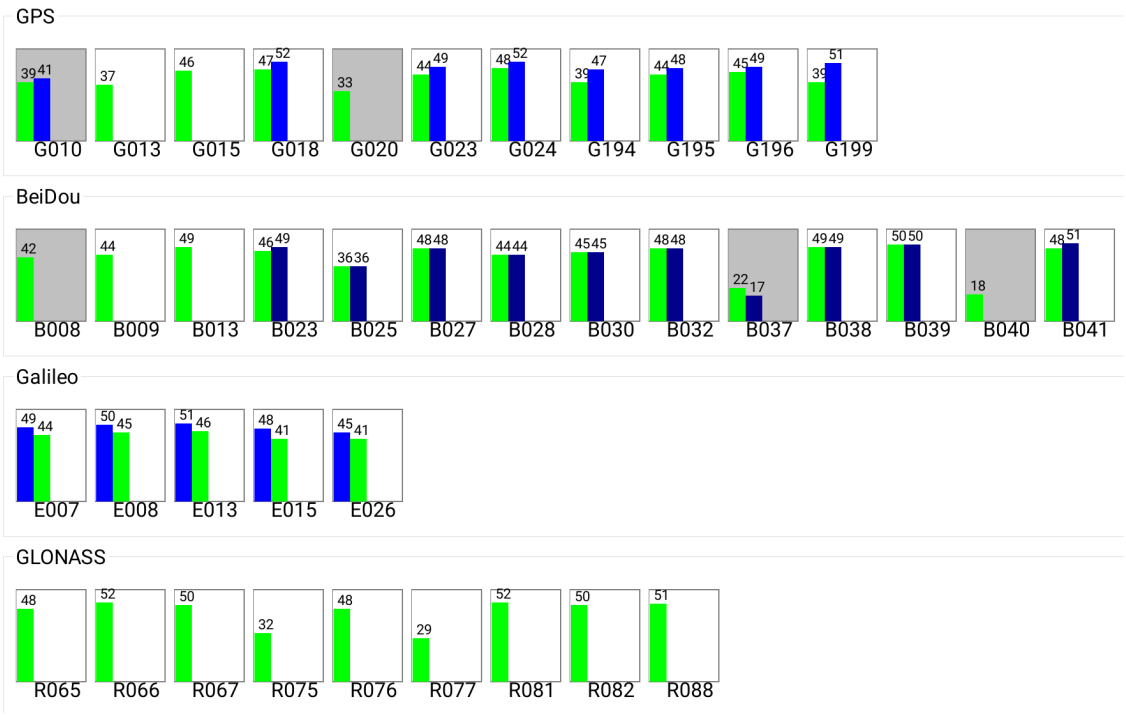
7.2 Sample data

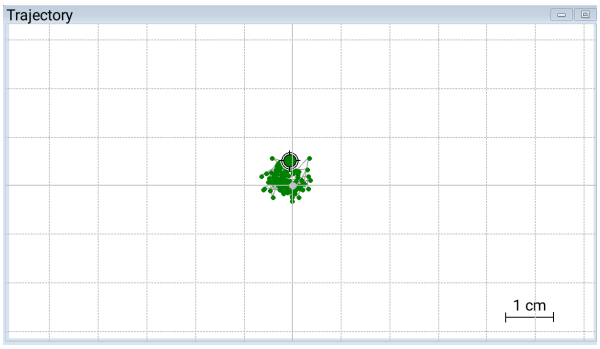
Serial port data within 1 second after positioning example:

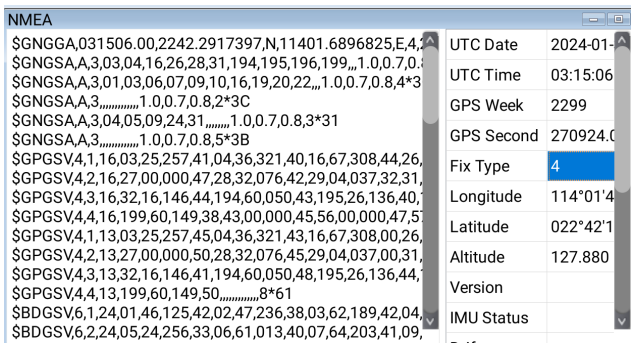
$GNGGA,034820.000,2240.0741375,N,11402.1491968,E,1,33,0.50,117.934,M,-2.367,M,0.0,0000*4B
$GNRMC,034820.000,A,2240.0741375,N,11402.1491968,E,0.004,127.03,041023,,,A,V*3B
$GNGSA,A,3,24,196,18,199,15,195,23,194,13,,,,0.91,0.48,0.77,1*03
$GNGSA,A,3,81,88,66,76,67,65,82,77,75,,,,0.91,0.48,0.77,2*04
$GNGSA,A,3,13,08,07,15,26,,,,,,,,0.91,0.48,0.77,3*0A
$GNGSA,A,3,39,38,13,09,27,41,23,25,32,28,30,,0.91,0.48,0.77,4*04
$GPGSV,3,1,11,24,72,120,48,196,65,055,45,18,63,307,47,199,60,149,39,1*6C
$GPGSV,3,2,11,15,46,021,46,195,43,161,44,23,34,327,44,194,19,140,39,1*65
$GPGSV,3,3,11,13,16,041,37,10,06,304,39,20,04,112,33,1*5E

$GPGSV,2,1,08,24,72,120,52,196,65,055,49,18,63,307,52,199,60,149,51,8*61
$GPGSV,2,2,08,195,43,161,48,23,34,327,49,194,19,140,47,10,06,304,41,8*6F
$GLGSV,3,1,09,81,55,283,52,88,40,194,51,66,38,346,52,76,31,109,48,1*72
$GLGSV,3,2,09,67,20,289,50,65,19,044,48,82,18,327,50,77,16,157,29,1*7D
$GLGSV,3,3,09,75,15,049,32,1*4B
$GAGSV,2,1,05,13,74,290,46,08,53,009,45,07,46,277,44,15,45,159,41,7*71
$GAGSV,2,2,05,26,22,322,41,7*44
$GAGSV,2,1,05,13,74,290,51,08,53,009,50,07,46,277,49,15,45,159,48,1*71
$GAGSV,2,2,05,26,22,322,45,1*46
$GBGSV,4,1,14,39,82,210,50,38,66,059,49,13,59,000,49,09,52,207,44,1*72
$GBGSV,4,2,14,27,46,245,48,41,46,019,48,23,37,146,46,25,36,083,36,1*76
$GBGSV,4,3,14,32,33,307,48,28,28,186,44,30,23,301,45,37,07,192,22,1*7A
$GBGSV,4,4,14,40,04,181,18,08,,,42,1*4C
$GBGSV,3,1,10,39,82,210,50,38,66,059,49,41,46,019,51,27,46,245,48,4*7F
$GBGSV,3,2,10,23,37,146,49,25,36,083,36,32,33,307,48,28,28,186,44,4*72
$GBGSV,3,3,10,30,23,301,45,37,07,192,17,4*7C

7.3 Example of an Actual Star Search







8 PACKAGING AND PROTECTION

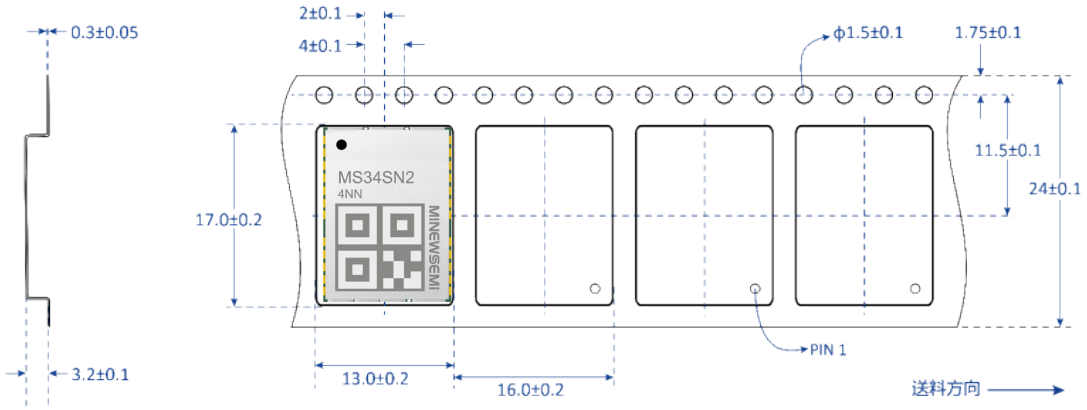
8.1 Wrap

The MS34SN2 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.

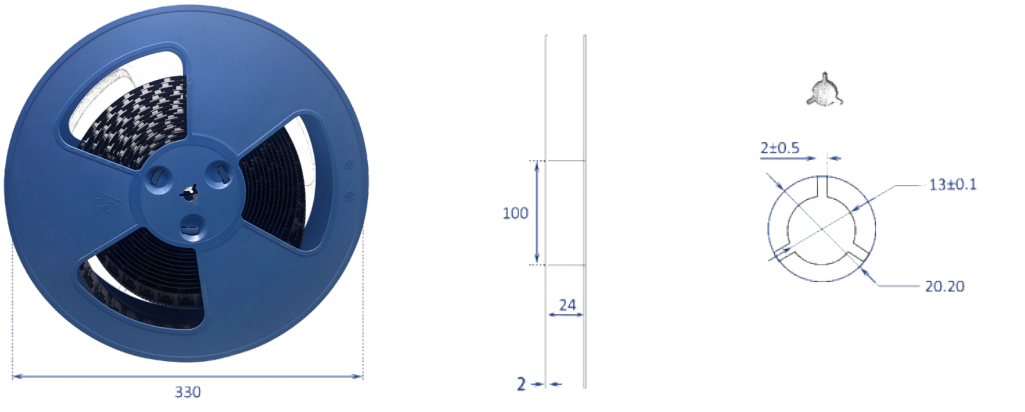
Offerings	Reels	Sealed Bags	Shipping Cartons
			
MS34SN2	1500pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

8.2 Carrier belts and trays

The MS34SN2 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.



(单位: 毫米)



(Unit: mm)

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;

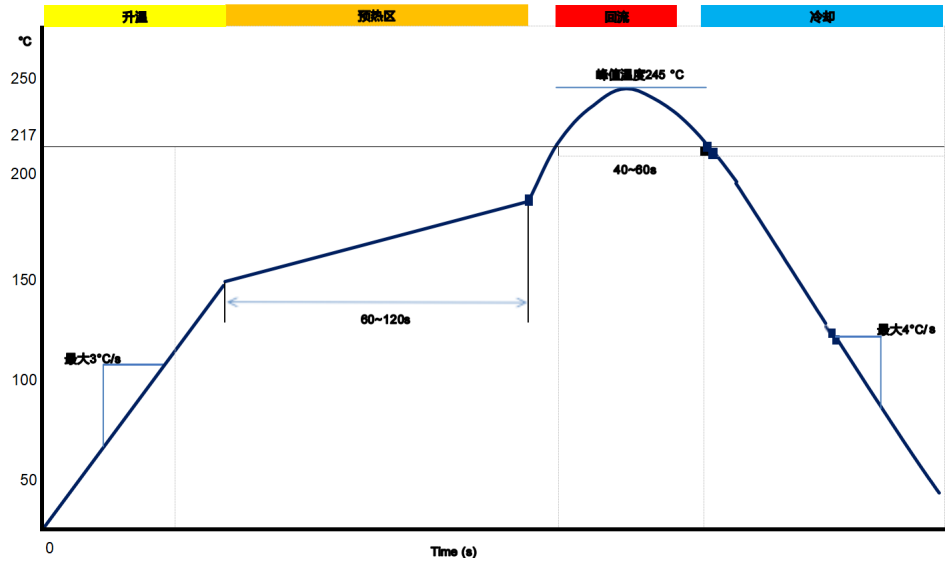
To prevent electrostatic discharge, do not expose the antenna area; if exposed by design, take appropriate ESD precautions and do not touch any exposed antenna area;

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	Feature	Default Satellite Reception Frequency	Physical Interface
MS34SN2	GNSS Module	115200	Dual-frequency RTK	GPS/BDS/GLO/GAL/QZSS L1+L5 five stars and ten frequencies	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, 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.

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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MINEWSEMI

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