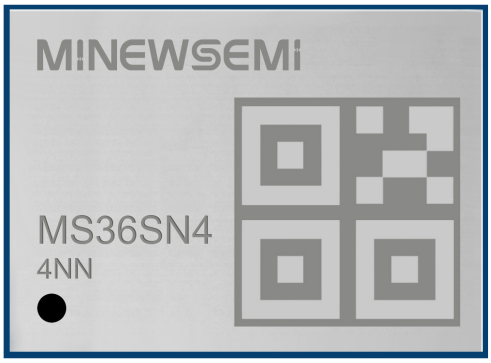
MINEWSEMI

GNSS Module
MS36SN4



Datasheet

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Version Note

Version	Details	Contributor(s)	Date	Notes
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Part Number

Model	Hardware Code
MS36SN4	4NN

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https://en.minewsemi.com/file/MS36SN4_Datasheet_EN.pdf

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1 PRODUCT INTRODUCTION

1.1 General Description

MS36SN4 is a full-system, five-star, ten-frequency, L1+L5 GNSS positioning and orientation 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 systems, combined with RTK (Carrier Phase Difference) technology, the MS36SN4 can achieve centimeter level positioning accuracy, which greatly improves the device positioning accuracy while maintaining ultra-low power consumption. The MS36SN4 can achieve centimeter-level positioning accuracy in combination with RTK (Carrier Phase Differential Kinematics) technology, which greatly improves the device's positioning accuracy while maintaining ultra-low power consumption. The combination of the two chips enables precise azimuth output and posturing in static scenarios, and the MS36SN4's superior positioning performance makes it ideal for drones, lawnmowers, and precision agriculture applications.

1.2 Eatures

- System-wide Dual-Frequency RTK Positioning Scheme and GNSS Dual-Antenna Directional Solving
- Support BDS B1I/B2a、GPS L1/L5、GALILEO E1/E5a、GLONASS G1、QZSS L1/L5
- Supports mobile and base station switching
- Dual Antenna Input
- Supports low-power antennas
- Supports inertial fusion
- 21 mm x 16 mm x 2.6 mm Standard SMD mounting

1.3 Key Parameters

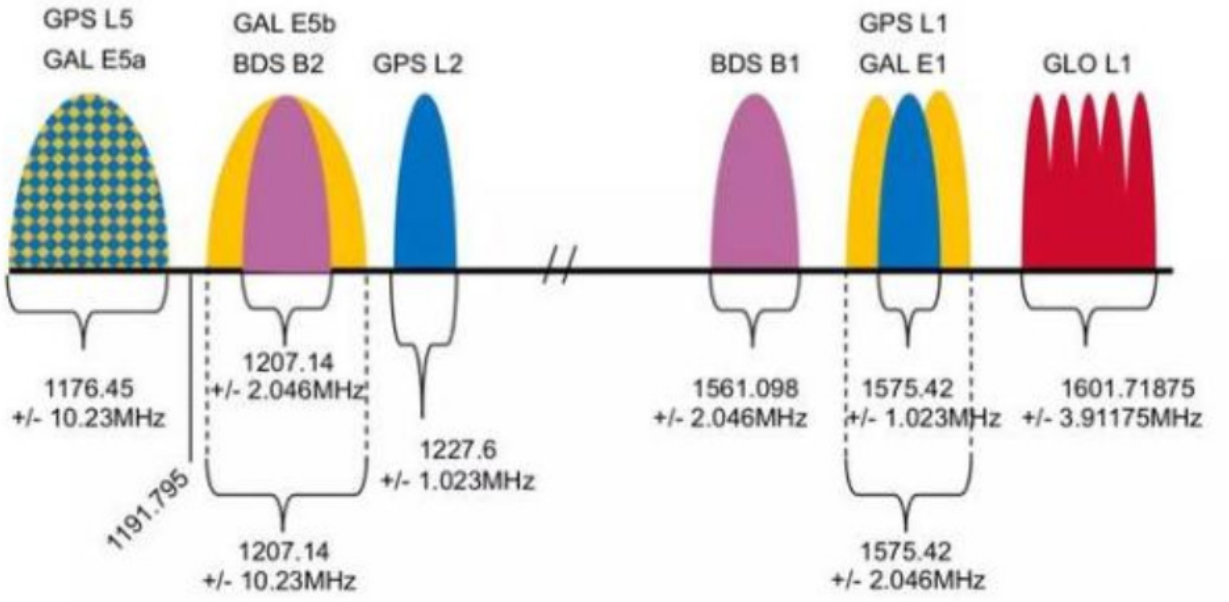
MS36SN4 Parameters	
Engine (loanword)	MTK 530MHz ARM Cortex-M4 FPU and MPU*2, 12nm advanced process
Constellation	GPS: L1 C/A, L5 BDS: B1I, B2a GLONASS: L1 GALILEO: E1, E5a QZSS：L1 C/A, L5 SBAS: WAAS,EGNOS,MSAS,GAGAN,SDCM NAVIC*：L5 (optional)
Operating Frequency	GPS/QZSS L1：1575.42±1.023MHz L5: 1176.45MHz±10.23MHz BDS B1I：1561.098MHz±2.046MHz B2a: 1176.45MHz±20.46MHz GLONASS L1：1601.71875MHz±3.91175MHz GALILEO E1: 1575.42±2.046MHz E5a: 1176.45MHz±10.23MHz NAVIC*: L5 (optional) L5: 1176.45MHz±10.23MHz

MS36SN4 Parameters	
(Level of) Sensitivity1	Cold Start: -148dBm; Recapture: -160dBm; Tracking: -165dBm;
First Positioning Time1	Cold start: ≤27 seconds; Hot start: ≤2 seconds; 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	≤10seconds
Orientation accuracy	0.2 degrees/1m baseline
Speed Accuracy2	<0.05 m/s
Time accuracy2	20 nanoseconds
Operating temperature	Operating temperature: -40°C to +85°C
Refresh rate	GNSS: 1-5Hz； IMU：50Hz/100Hz/200Hz
Connector	UART*3，PPS
Baud	Main serial port 115200bps (factory default)
RTCM differential output	Support RTCM3.x output, support MSM4/MSM7, default MSM4
Supported Protocols	NMEA 0183 Protocol Ver. 4.1 RTCM 3.3

2 TECHNICAL INFORMATION

2.1 Supporting Constellations

Due to the multi-constellation RF front-end architecture, the MS36SN4 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 MS36SN4 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 Real-time Kinematic（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 MS36SN4 can achieve centimeter-level positioning accuracy, which greatly improves the positioning accuracy of the device 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 - Code Differential DGNSS

The MS35SN2 can also be downgraded to use the Code Differential function when RTK use is limited, D-GNSS, with access to pseudo-range correction messages in RTCM 2.3 or a user-defined format.The MS35SN2 is used as a mobile station, and will attempt to provide the best possible positioning 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, they will operate as stand-alone precision receivers for GNSS satellite-based or single-point positioning.

2.7 Module and Dual Antenna Installation Considerations

1. When installing the module, the default direction is the arrow pointing to the position of the module toward the direction of the carrier forward, the front of the module is facing the sky, the back of the module is pointing to the ground; antenna mounted and fixed to the carrier, it is best not to have a cover, the module and the antenna need to ensure that the process of the movement will not produce a relative displacement of the two antennas, the default master antenna to the slave antenna for the carrier in the direction of advancement (such as rotating can be configured according to the following way).

2. Confirm whether the module direction angle is consistent with the dual-antenna direction, if not, you need to send AT+IMU_ANGLE=x,y,z to configure the module mounting angle.

3. If the dual antenna direction is not consistent with the carrier's direction of travel, the dual antenna angle needs to be adjusted to ensure that it is consistent with the carrier's direction of travel by sending the command AT+YAW_ANGLE=0,0,z (z is the angle of rotation, following the right-handed coordinate system, with the thumb pointing in the positive direction of the z-axis, and positively clockwise, with the dual antenna direction shifted to the direction of the carrier's movement).

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
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 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	°C

3.3 Power wastage

Notation	Parameters	Measurement Pins	Typical Value	Unit
ICCRX1 [1]	capture phase	VCC [2]	30	mA
ICCRX2 [1]	tracking stage	VCC [2]	25	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.

3.4 Power wastage

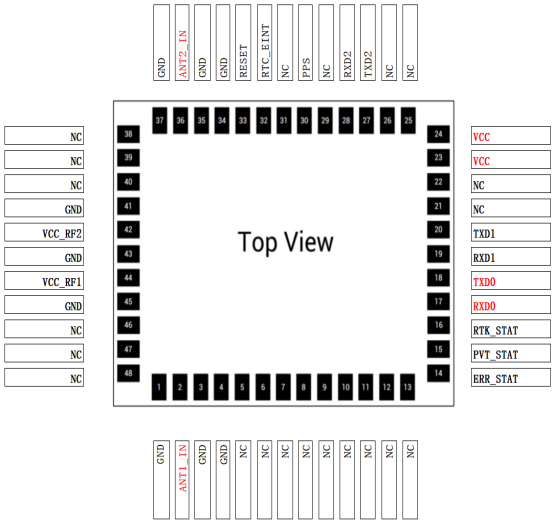
The MS36SN4 requires the use of a GNSS active antenna, with gain controlled with care.

Notation	Parameters	MIN	MAX	Unit
Gain	Input Gain	15	30	dB

4 PACKAGE DEFINITION

4.1 Module Pin Definitions

The MS36SN4 is available in a 121*16mm，LGA-48pin package and is defined as follows:

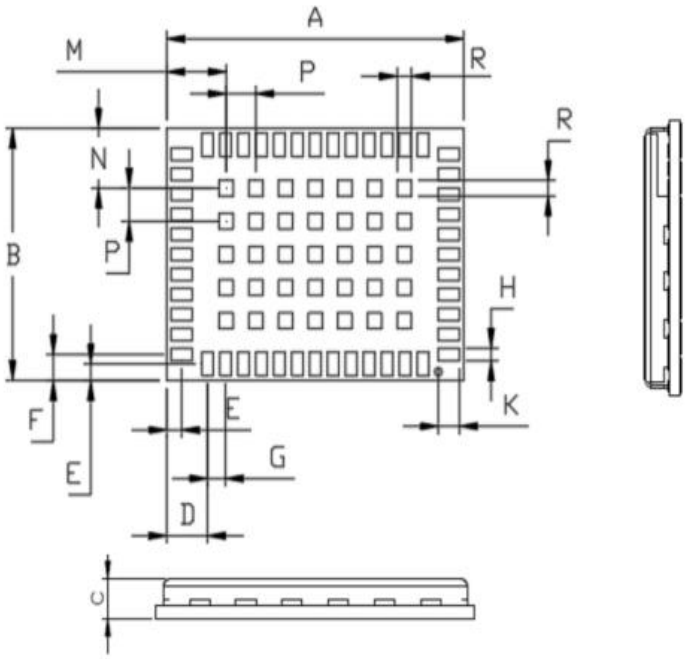


Serial Number	Pin Name	I/O	Description
1	GND	—	GND
2	ANT1_IN	I	GNSS antenna signal input (main antenna)
3~4	GND	—	GND
5~13	NC	—	vacant
14	ERR_STAT	O	Abnormal status output, active high
15	PVT_STAT	O	PVT positioning indication, active high

Serial Number	Pin Name	I/O	Description
16	RTK_STAT	O	RTK position indication, active high
17	RXD0	I	Serial port 0 receive
18	TXD0	O	Serial Port 0 Transmit
19	RXD1	I	Serial port 1 receive
20	TXD1	O	Serial Port 1 Transmit
21~22	NC	—	vacant
23	VCC	POWER	Power supply 3.3V
24	VCC	POWER	Power supply 3.3V
25~26	NC	—	vacant
27	TXD2	O	Serial Port 2 Transmit
28	RXD2	I	Serial port 2 receive
29	NC	—	vacant
30	PPS	O	second pulse (physics)
31	NC	—	vacant
32	RTC_EINT	I	Low Power Wakeup
33	RESET	I	system reset
34~35	GND	—	GND
36	ANT2_IN	I	GNSS antenna signal input (from antenna)
37	GND	—	GND
38~40	NC	—	vacant
41	GND	—	GND
42	VCC_RF2	POWER	Active Antenna Power Supply, 3.3V
43	GND	—	GND
44	VCC_RF1	POWER	Active Antenna Power Supply, 3.3V
45	GND	—	GND
46~48	NC	—	vacant

5 PACKAGE SPECIFICATIONS

5.1 Dimensions



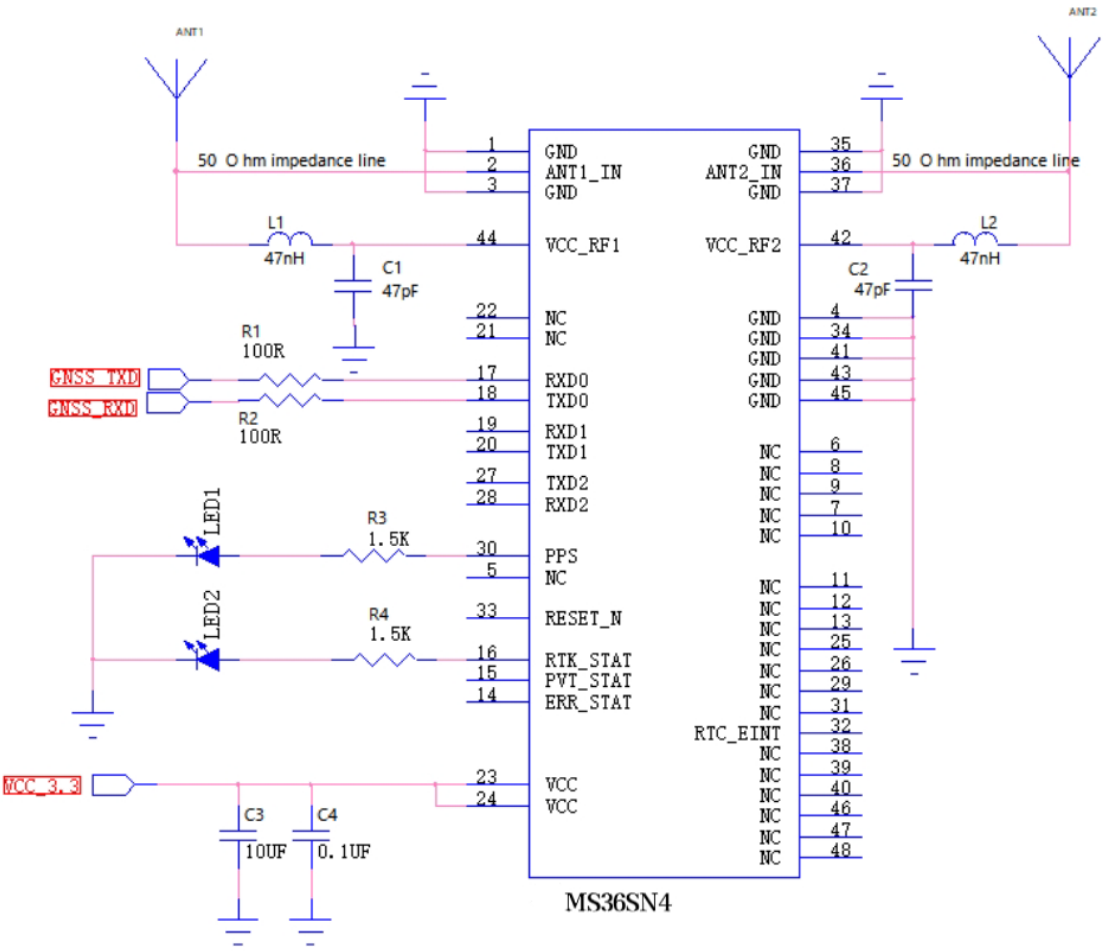
5.2 Mechanical dimensions

Serial Number	Minimum (mm)	Typical value (mm)	Maximum value (mm)
A	20.80	21.00	21.50
B	15.80	16.00	16.50
C	2.40	2.60	2.80
D	2.78	2.88	2.98
E	0.95	1.05	1.15
F	1.55	1.65	1.75
G	1.17	1.27	1.37
H	0.70	0.80	0.90
K	1.40	1.50	1.60
M	4.10	4.20	4.30
N	3.70	3.80	3.90
P	2.05	2.10	2.15
R	0.90	1.00	1.10

6 REFERENCE DESIGN

6.1 Schematic design

The reference design of MS36SN4 is shown below. When connecting the active antenna, please make sure that the 47nH inductors at L1 and L2 are in the SMD state, which are used to supply power to the active antenna; the inductors need to be piggybacked on the RF line when PCB layout is done to avoid branching and affecting the signal; the characteristic impedance from the ANT pin to the antenna connector is 50Ω. When applying the antenna, the performance of the antenna is vital to the system, make sure to ensure that the technical parameter of the dual-band high-precision antenna is controlled 15-25dB in terms of the gain. MS36SN4 does not support hardware hot start, but supports RTC_EINT software wake-up, high level effective.



6.2 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.

6.3 Electric Power Source

The MS36SN4 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 dangling.

6.4 Antennas

The MS36SN4 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 underneath the module.

6.5 Serial 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 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 to set the serial port to the state of Input State + Pull-down Resistor or High Resistance State + Pull-down Resistor.

7 DATA PROTOCOLS

7.1 GPHPR

$GPHPR,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>*<10><CR><LF>

<1> UTC timing，format hhmmss.sss

<2> Tow seconds per week

<3> roll angle(°)

<4> tilt(°)

<5> heading angle(°)

<6> Standard deviation of roll angle

<7> standard deviation of pitch angle

<8> Standard deviation of heading angle

<9> synchronous age

<10> checksum of differences or checksums

Sample Statements：

$GNHPR,033636.993,358614.993,-0.872,1.316,291.356,0.146,0.146,0.052,0.993*64

7.2 GPIMU

$GPIMU,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>*<9><CR><LF>
<1> UTC timing，format hhmmss.sss
<2> x-axis acceleration（g）
<3> y-axis acceleration（g）
<4> z-axis acceleration（g）
<5> Gyro x-axis direction(°/s)
<6> Gyro y-direction(°/s)
<7> Gyro z-direction(°/s)
<8> sensor temperature(°C)
<9> checksum of differences or checksums
Example statement:$GPIMU,054752.002,0.000,0.007,-1.032,-0.003,0.053,-0.016,26.00*59

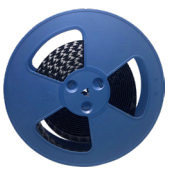
7.3 GNSXT

$GNSXT,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>*<11><CR><LF>
<1> UTC timing hhmmss.sss
<2> Distance from antenna to main antenna （m）
<3> North-facing position with the main antenna as origin （m）
<4> Orientation position with the main antenna as the origin （m）
<5> Zenithward position with primary antenna as origin （m）
<6> Standard deviation of northward facing positions
<7> Standard deviation of easterly positions
<8> Standard deviation of zenithward position
<9> Number of satellites used for settlement from antennas
<10> Positioning quality from antenna (0: not available, 4: fixed solution)
<11> checksum
Example statement:$GNSXT,032423.200,9.903,3.484,9.270,-0.003,0.012,0.022,0.015,31,4*7B

8 PACKAGING AND PROTECTION

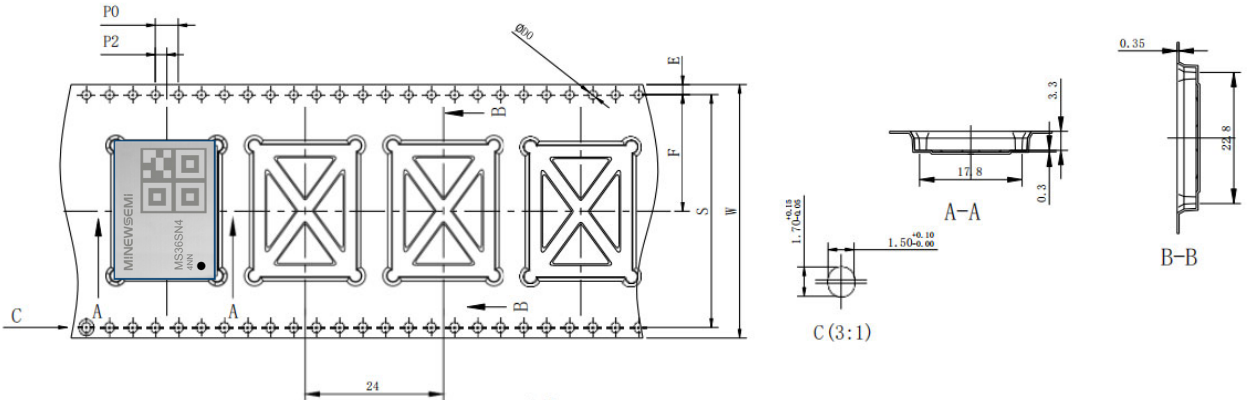
8.1 Wrap

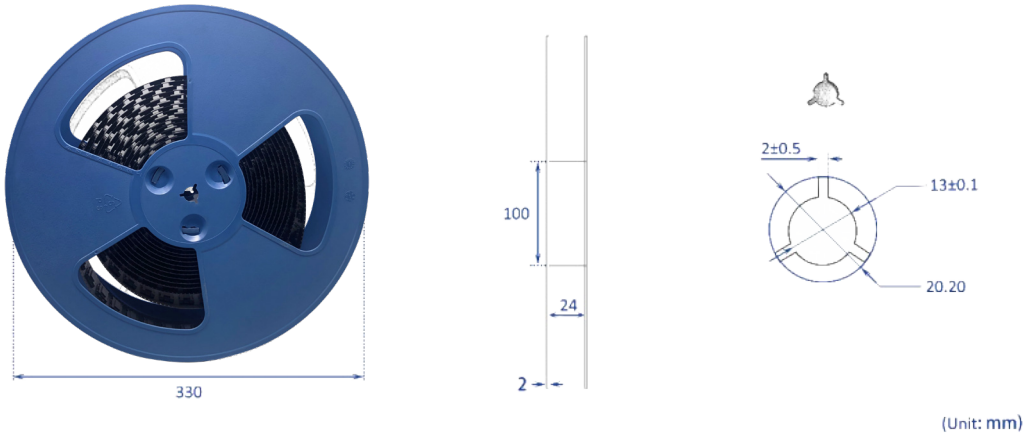
The MS36SN4 is humidity and static sensitive. It is important that you follow the handling requirements and take appropriate precautions to minimize product damage during packaging and shipping of the product. The following table shows the standard packaging structure for product transportation.

Offerings	Reels	Sealed Bags	Shipping Cartons
			
MS36SN4	500pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

8.2 Carrier belts and trays

The MS35SN2 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 installation and removal. The following picture shows the dimensional details of the tape reel.





(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;

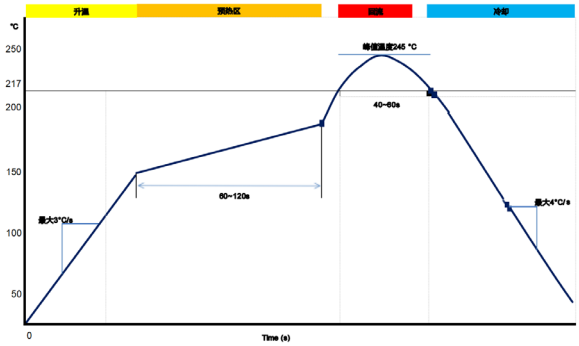
To prevent electrostatic discharge, do not expose the antenna area; if exposed by design, take appropriate ESD precautions and do not touch any exposed antenna area;

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 should 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
MS36SN4	GNSS Module	115200	Dual-frequency RTK + directional posturing	GPS/BDS/GLO/GAL/QZSS L1+L5 five stars and ten frequencies	21*16，LGA48

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

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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