

# GNSS Module

## ME32GR03



## 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
ME32GR03	4NN

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# 1 PRODUCT INTRODUCTION

## 1.1 General Description

ME32GR03 is a dual-frequency, single BeiDou, meter-level precision positioning module supporting BeiDou 3, with 150 tracking channels, 32-bit 350 MHz DSP, and dedicated search engine. ME32GR03 has a built-in high-sensitivity, low-power, dual-frequency BeiDou Soc chip and RF devices, and is oriented to the single BeiDou application, which supports BDS B1I, B1C, B2a, and B2b frequencies. It supports BDS B1I, B1C, B2a and B2b frequencies, providing users with fast, accurate and high-performance positioning experience of China BeiDou.

ME32GR03 adopts standard SMD industrial grade design, ROHS process, with high sensitivity, low power consumption, anti-polygon, strong anti-jamming ability and high precision BDS positioning technology, built-in anti-jamming technology for interference detection and removal. The product supports L1 single-frequency single-point positioning and raw observation output, and is suitable for products and fields such as vehicle navigation, handheld devices, and drones.

## 1.2 Key Parameters

ME32GR03 Parameters	
Satellite Systems	BeiDou B1I: 1561.098±2.046MHz BeiDou B1C: 1575.420±1.023MHz BeiDou B2a: 1176.450±20.460MHz BeiDou B2b: 1207.140±20.460MHz BeiDou B2I: 1207.140+2.046 MHz
Sensitivity	Cold Start: -143dBm; Hot start:-155dBm; Recapture: -155dBm; Tracking: -158dBm;
First Positioning Time	Cold start: ≤30 seconds Hot start: 1.5 seconds A-BDS: 2 seconds
Positional Accuracy	Horizontal 1.5 m CEP    Vertical 2.5 m CEP
Speed Accuracy	<0.1 m/s CEP
Time Accuracy	20 ns
Storage Temperature	-40°C to +85°C
Working Temperature	-40°C to +85°C
Refresh Rate	Default: NMEA output 1Hz, maximum support 20Hz
Baud	Main serial port 115200 (factory default)
RTC Differential Output	RTCM3.x output
Supported Protocols	NMEA 0183 Protocol Ver. 4.0/4.1.    RTCM 3

## 2 TECHNICAL INFORMATION

### 2.1 Supporting Constellations

The ME32GR03 is designed for single BeiDou applications and supports BDS B1I, B1C, B2a and B2b frequencies. The reception frequencies are: 1561.098±2.046 MHz (B1I), 1575.42 MHz (B1C), 1176.45 MHz (B2a) and 1207.14 MHz (B2b).

### 2.2 Satellite-based Augmentation System (SBAS)

The ME32GR03 supports the reception of BD SBAS broadcast signals. The system broadcasts distance correction and integrity information via satellite, which can be used by GNSS receivers to improve result accuracy. SBAS satellites can be used as add-on satellites for ranging (navigation) to further improve availability.

### 2.3 Crystal Oscillators

The ME32GR03 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°C to +85°C), making it a reliable positioning module for positioning.

### 2.4 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.

### 2.5 Power System

ME32GR02 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 10uA) to maintain the RTC clock and backup RAM.

### 2.6 Working Mode

The ME32GR03 supports two power consumption modes, Sleep mode and Active mode. It is possible to switch from Active mode to Sleep mode through software and hardware.

Active Mode: Normal mode of operation where the DSP core is active and all peripherals are available.

Sleep Mode: In this mode, the Soc DSP core, all digital logic (except the RTC Always-On logic), and major portions of the analog/RF circuits are stopped and powered down so that total current can be minimized. In this mode, only the GPIO (serial port) or RTC timer can wake up the system to Active mode.

In Sleep mode, the BeiDou reference time will run in the RTC timer. The ephemeris and other BeiDou data will be saved to flash periodically for fast startup. If AGNSS/ABD is available, the time and ephemeris will be downloaded to the Soc chip, so if AGNSS/ABD is available or if you don't care about the hot start TTFF, you don't need to switch to Sleep mode, just don't provide the backup power supply and turn off the VCC main power supply when you don't need to use the positioning function.

ME32GR03 in software mode, when the module receives the host hibernation command and switches from Active mode to Sleep mode, the system shall keep power supply state. After entering Sleep mode, the VCC main power can be further turned off to save power, but it is necessary to ensure that V\_BCKP is powered at this time.

In hardware mode, the ME32GR03 will automatically switch to sleep mode if the module is in Active mode, VCC is powered off and V\_BCKP remains active high. When the module is in sleep mode, all IOs connected to the module should remain in a low or high impedance state. If any of the connected IO pins are high, the leakage of the ME32GR03 sleep circuitry will increase. When the ME32GR03 wakes up from sleep mode (triggered by an RTC timer or GPIO), the VCC main power supply must remain active.

## 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	°C
T-solder	Reflow temperature	--	250	°C

Pressurizing the equipment beyond the "Absolute Maximum Rating" may cause permanent damage.

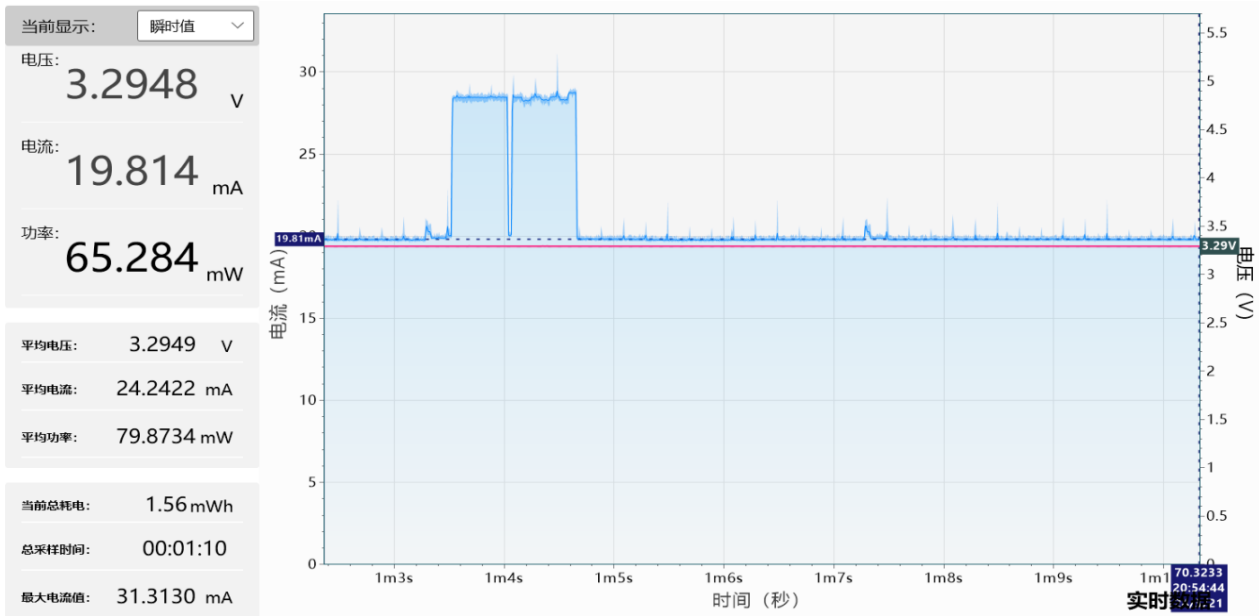
The above figures are pressure ratings only. Products are not overvoltage or reverse voltage protected. If necessary, voltage spikes exceeding the supply voltage specifications listed in the table above must be limited to the specified range using an appropriate protection diode.

### 3.2 Electrical Parameters

Parameters	Min	Average	Max	Unit
Power Supply Voltage	2.8	3.3	3.6	V
Supply Current (Acquisition)	-	24	-	mA
Supply Current (Tracking)	-	21	-	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.

Current test plot in captured state:



### 3.3 Antenna Gain Requirements

Since the ME32GR03 has built-in LNA to support passive antennas, external antenna

Notation	Parameters	Min	Max	Unit
RFgain	Input Gain	0	30	dB

## 4 PACKAGE DEFINITION

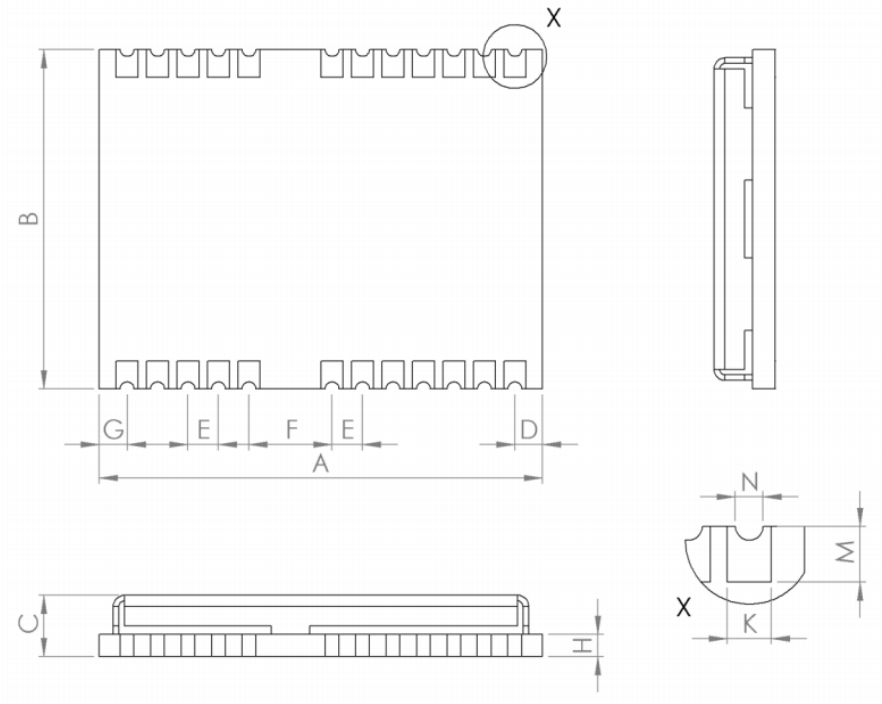
### 4.1 Module Pin Definitions

The ME32GR03 is available in the industry's most common 16\*12mm, LCC-24pin package, defined as follows:

13	GND	GND	12
14	NC	RF_IN	11
15	NC	GND	10
16	NC	VCC_RF	9
17	NC	RESET	8
TOP VIEW			
18	NC	NC	7
19	NC	NC	6
20	TXD	NC	5
21	RXD	NC	4
22	V_BACKUP	1PPS	3
23	VCC	NC	2
24	GND	NC	1

Serial Number	Name	I/O	Description
3	1PPS	O	Time-second pulse, default 1PPS Output is 1ms per second Active High
8	RESET_N	I	Hardware reset, active low. Please suspend or pull high for normal operation.
9	VCC_RF	O	RF antenna power supply 3.3V
11	RF_IN	I	Antenna signal input, 50 ohm impedance
18	SDA	I/O	I2C Interface, SDA
19	SCL	I/O	I2C Interface, SCL
20	TXD	O	Main Serial, TX
21	RXD	I	Main Serial, RX
22	V_BACKUP	I	Backup power supply with hardware hot start support
23	VCC	I	Mains 3.3V
	GND	-	Grounding, PIN 10, 12, 13, 24

## 4.2 Dimensions





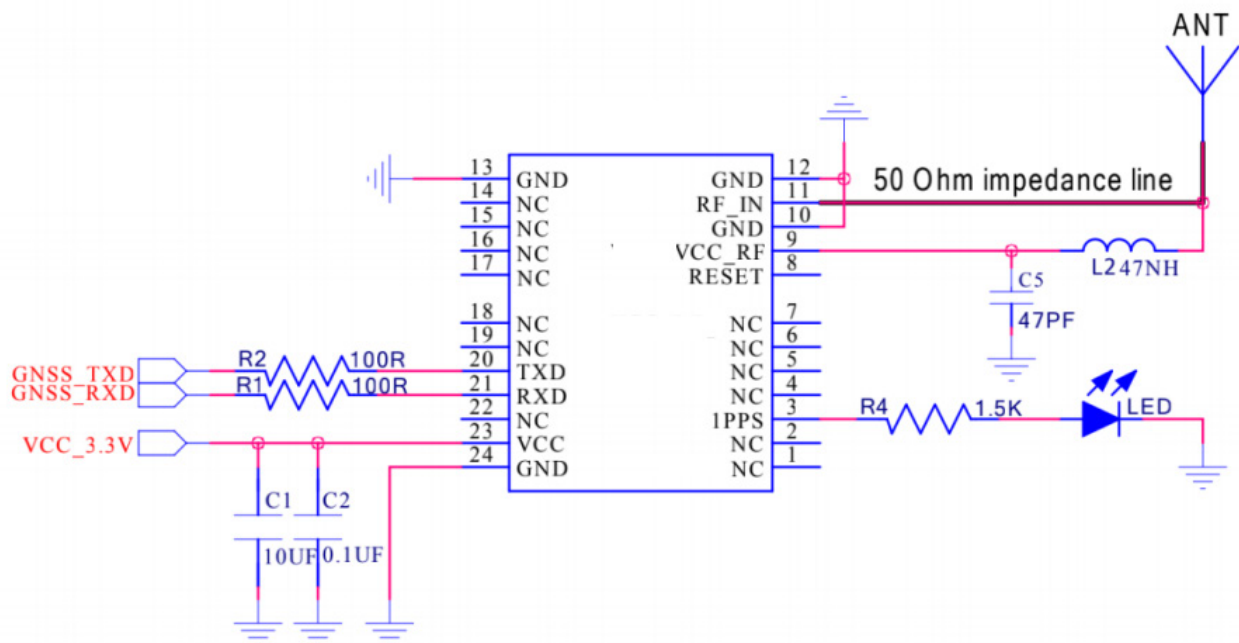


Serial Number	Minimum (mm)	Typical Values (mm)	Maximum Value (mm)
A	16.2	16.4	16.6
B	12.0	12.2	12.4
C	2.4	2.6	2.8
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H	0.7	0.8	0.9
K	0.4	0.5	0.6
M	0.8	0.9	1.0

## 5 REFERENCE DESIGN

### 5.1 Schematic Design

The reference design of ME32GR03 is shown below. When connecting an active antenna, please make sure the 47nH inductors are in the SMD state for powering the active antenna; when connecting a passive antenna, the 47nH inductors are not required. The characteristic impedance from the RF\_IN pin to the antenna connector is 50  $\Omega$ . Due to the ME32GR03's power-on self-reset, RESET can be left empty.



## 5.2 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.

## 5.3 Power Supply

The ME32GR03 Positioning Module is equipped with two power supply pins: VCC and V\_BCKP. The main power supply is fed to the module through the VCC pin, and the backup power supply 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.

## 5.4 Antenna

The ME32GR03 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 via 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..

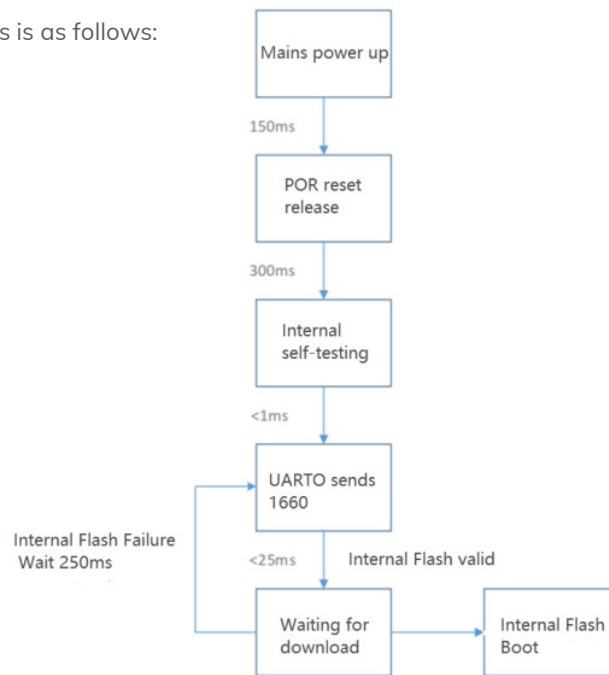
## 5.5 Serial Port Communication

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 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.

## 5.6 Startup Process

The module startup process is as follows:



# 6 SOFTWARE PROTOCOL

## 6.1 NEMA0183 Protocols

The NMEA protocol is an ASCII based protocol where the record starts with a \$ 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:

Start Character	Checksum Range			Checksum	End Flag
\$	Talker ID	Message ID	[,field 0]...[,field N]	*Checksum	<CR><LF>

The NEMA message output for the ME32GR03 is shown in the following table:

NMEA Record	Description	Default
BDGGA	BDS positioning system fixed data	Y
GNGLL	Geographic position—latitude/longitude	Y
BDGSA	BDS DOP and active satellites	Y
BDGSV	GNSS satellites in view for BD	Y
BDRMC	Recommended minimum specific GNSS data	Y
BDVTG	Course over ground and ground speed	Y
BDGST	Position error statistics	Y
POMSM	Differential data information	Y



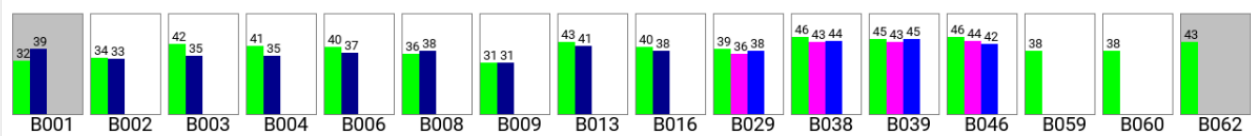
## 6.2 Example Data

Serial port data within 1 second of the example after positioning:

```
$BDGGA,065635.00,2234.9361171,N,11355.9866247,E,5,08,4.1,151.483,M,0.000,M,1.0,1237*6B
$BDGSA,A,3,03,04,06,09,16,38,39,46,,,,,7.9,4.1,6.7,4*3D
$BDGSV,5,1,19,01,00,000,32,02,46,234,34,03,62,188,41,04,32,111,40,1*78
$BDGSV,5,2,19,06,49,200,41,08,20,168,39,09,59,224,38,13,13,181,45,1*7A
$BDGSV,5,3,19,16,46,195,43,20,00,000,00,29,61,271,21,30,00,000,32,1*7F
$BDGSV,5,4,19,35,00,000,38,38,31,158,43,39,36,187,44,46,36,136,45,1*70
$BDGSV,5,5,19,59,49,130,37,60,43,238,38,62,00,000,44,,,,,1*4D
$BDGSV,2,1,06,29,61,271,25,30,00,000,26,35,00,000,33,38,31,158,40,2*7C
$BDGSV,2,2,06,39,36,187,42,46,36,136,43,,,,,,2*73
$BDVTG,0.00,T,,M,0.00,N,0.00,K,D*29
$BDRMC,065635.00,A,2234.9361171,N,11355.9866247,E,0.00,0.00,220224,,,F,V*3B
$BDGST,065635.00,,,,,15.40,27.50,31.52*40
$BDGLL,2234.9361171,N,11355.9866247,E,065635.00,A,D*70
$POMSM,180,0,00,180,2,12,180,0,00,180,0,00,180,0,00,9,6*67
```

## 6.3 Example of an Actual Star Search

BeiDou



## 6.4 Common Commands

CMD TYPE	CMD Example:
Change Baud-rate to 9600	\$PCAS01,1*1D<CR><LF>
hot start	\$POLCFGRESET,0
cold start	\$POLCFGRESET,1
Baud rate 115200	\$POLCFGPRT,115200,0
Baud rate 9600 (too many satellites may congest the serial port)	\$POLCFGPRT,9600,0
Turn off GSV output	\$POLCFGMSG,0,2,0
Turn off GSA output	\$POLCFGMSG,0,1,0
Turn off GLL output	\$POLCFGMSG,0,13,0
Turn off GST output	\$POLCFGMSG,0,12,0
Turn off VTG output	\$POLCFGMSG,0,3,0



Remarks:

1. All text format control commands should add Carriage Return (CR) and Line Feed (CF);
2. All software configurations are invalidated after the module main power supply VCC charging and powering up, if necessary, then need to be initialized again after powering up;
3. Due to the built-in Flash memory unit of ME32GR03, the data configuration can be effective after power off;
4. High refresh rates may require larger baud rates, such as 115200 or higher, to avoid serial port data congestion.

## 6.5 Baud Rate Configuration Recommendations

	1Hz	5Hz	10Hz
NMEA	115200	115200	115200
NMEA+RTCM	115200	115200	230400

Remarks:

1. Open RTCM raw observation value data can be realized RTK algorithm on external MCU or communication module to further improve the accuracy;
2. You can also contact the sales staff to carry out the module with its own RTK algorithm, and the best accuracy can reach the centimeter level.

# 7 PACKAGING AND PROTECTION

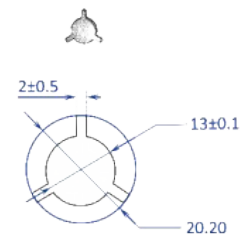
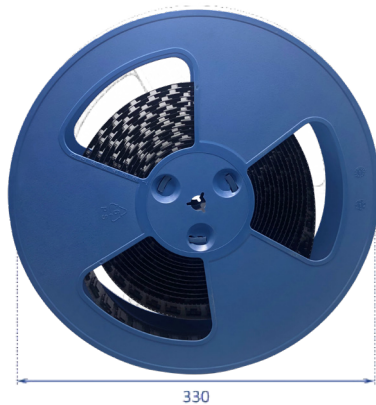
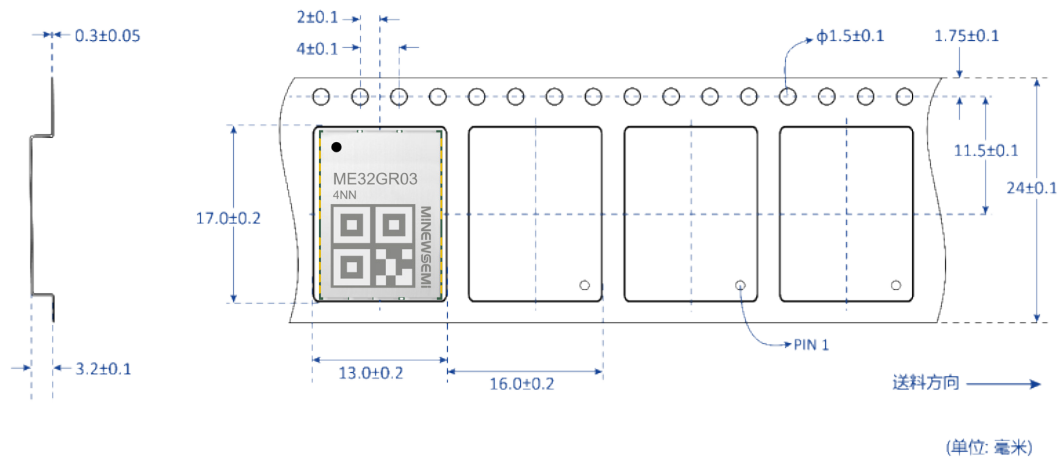
## 7.1 Wrap

The ME32GR02 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
			
ME32GR03	1000pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

## 7.2 Carrier Belts and Trays

The ME32GR02 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)

## 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;

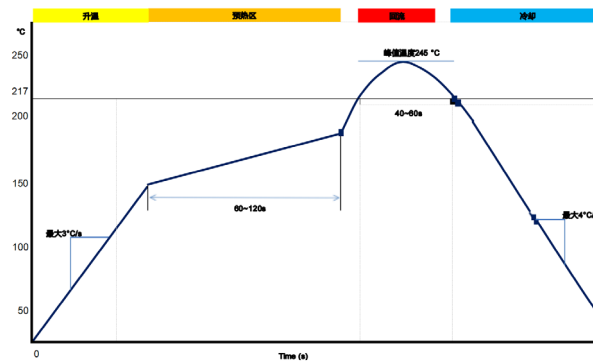
Be sure to use an ESD safe soldering iron when soldering RF connectors and antenna patches.

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 should 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 Ordering Model

Ordering Model	Product Name	Default Baud Rate	Default Refresh rate	Default Satellite Reception Frequency	Note
ME32GR03	Beidou Positioning Module	115200	1Hz	BDS B1I, B1C,B2a,B2b	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 (Cl<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>x</sub>, 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°C/60%RH) conditions, the recommended baking conditions:
  1. 120 +5/-5°C, 8 hours, 1 timeProducts 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°C +8/-0°C, 24 hours, onceThe 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)  
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[https://en.minewsemi.com/file/MinewSemi\\_Connectivity\\_Module\\_Catalogue\\_EN.pdf](https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf)



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MINEWSEMI



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