

GNSS Module ME3RGR01



Datasheet
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Version Note

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1 PRODUCT INTRODUCTION

1.1 General Description

ME3RGR01 is a multi-constellation GNSS module capable of concurrent multi-frequency L1+L5 positioning. It features an integrated RTK positioning engine. Within its multi-constellation RF front-end architecture, all four major GNSS constellations (GPS, BeiDou, GLONASS, and Galileo) can be received simultaneously, while also supporting QZSS, IRNSS/NAVISAT, and SBAS satellites. This enables the receiver to deliver outstanding sensitivity and acquisition capability. Superior interference suppression characteristics ensure reliable positioning even under challenging signal conditions. The multi-constellation combination significantly increases the number of visible satellites when navigating dense urban canyons, reducing time to first fix and enhancing positioning accuracy. Precise positioning is achievable even in harsh environments. Combined with RTK (carrier phase differential) technology, the ME3RGR01 achieves centimeter-level positioning accuracy, greatly improving device positioning precision while maintaining ultra-low power consumption.

The exceptional positioning performance of ME3RGR01 makes it an ideal choice for industrial and consumer applications such as vehicle locators, two-wheeler tracking, shared e-bikes, T-Boxes, in-vehicle navigation, transportation sectors (e.g., fleet management for commercial and operational vehicles), handheld terminals, land surveying, and inspection operations.

1.2 Key Parameters

ME3RGR01 Parameters	
Satellite Systems	GPS: L1 C/A, L5 BDS: B1I, B1C, B2a, GLONASS: L1 GALILEO: E1, E5a QZSS: L1 C/A, L5 SBAS: WAAS,EGNOS,MSAS,GAGAN,SDCM IRNSS/NAVIC: L5
Operating Frequency	GPS/QZSS L1: 1575.42±1.023 MHz L5: 1176.45MHz±10.23 MHz BDS B1I: 1561.098MHz±2.046 MHz B1C: 1575.42±16.368 MHz B2a: 1176.45MHz±10.23 MHz GLONASS G1: 1598.063 -1605.375 MHz GALILEO E1: 1575.42±2.046 MHz E5a: 1176.45MHz±10.23 MHz IRNSS/NAVIC: L5 L5: 1176.45MHz±10.23 MHz SBAS L1 C/A: 1575.42±1.023 MHz
Sensitivity ¹	Cold Start: -148dBm; Recapture: -159dBm; Tracking: -165dBm;
First positioning time ¹	Cold start: ≤24 seconds; Hot start: 1 sec;
Positional Accuracy ²	Single-point localization: Open sky: <1.0 meters CEP RTK: Horizontal positioning accuracy: 1cm+1PPM CEP Elevation accuracy: 2cm+1PPM CEP



Speed Accuracy ²	<0.05 m/s
Time Accuracy ²	20 nanoseconds
Operating Temperature	Operating temperature: -40°C to +85°C
Refresh rate	Default GNSS: 1Hz, maximum support up to 10Hz
Baud	Main Serial Port 115200bps (factory default)
RTCM Differential Output	RTCM 3.x Output
Supported Protocols	NMEA 0183 Protocol Ver. 4.0/4.1 RTCM 3.x



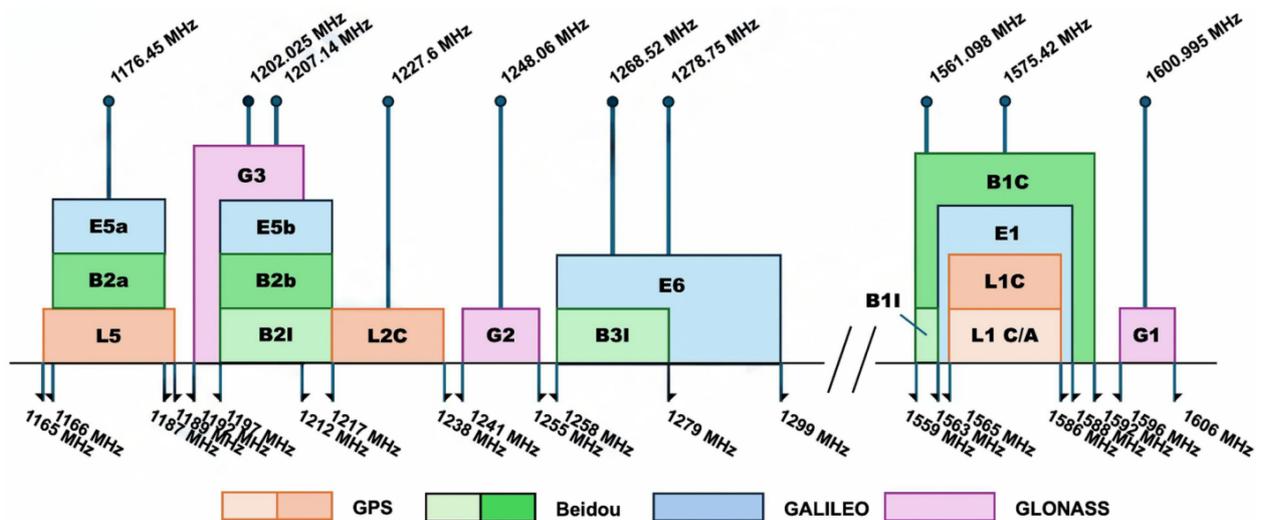
Remarks:

- 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

ME3RGR01 employs a multi-constellation RF front-end architecture, enabling simultaneous reception of dual-frequency (L1+L5) satellite signals from GPS, BDS, GLONASS, GALILEO, IRNSS/NAVIC, QZSS, and satellite-based augmentation systems (SBAS) such as WAAS, EGNOS, GAGAN, and MSAS. The primary GNSS frequencies are illustrated in the diagram below.



2.2 Satellite-based Augmentation System (SBAS)

ME3RGR01 supports reception of SBAS broadcast signals. These systems supplement GNSS data with regional or wide-area GPS augmentation data. The system broadcasts distance correction and integrity information via satellite, which GNSS receivers can utilize to enhance accuracy. SBAS satellites can serve as additional satellites for ranging (navigation), thereby 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 Russia 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 regional satellite navigation covering the Asia-Oceania region, including Japan and Australia. This system transmits additional GPS L1C/A and L5 signals. The module can simultaneously receive and track these signals alongside GPS, thereby enhancing availability and maintaining positioning accuracy even under challenging signal conditions such as urban canyons.

2.4 Satellite enhancement

For the multi-mode dual-frequency L1+L5 carrier phase difference function, the input data from the must comply with the 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 signals. Combined with RTK (carrier phase differential) technology, the ME3RGR01 can achieve centimeter-level positioning accuracy, which greatly improves the device's positioning performance 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 maintains good satellite reception.

2.6 Satellite augmentation - Differential DGNSS

The ME3RGR01 supports code differential functionality and D-GNSS, capable of receiving RTCM2.3 or user-defined pseudorange correction data. When operating as a rover, the ME3RGR01 will attempt to provide optimal positioning accuracy based on the received correction data. Upon receiving an RTCM message input stream, it will immediately enter differential mode. Once in D-GNSS mode, an improvement in positioning accuracy can be expected. 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.

2.7 Crystal Oscillator

The ME3RGR01 utilizes a TCXO, enabling weak signal acquisition and achieving faster start-up and reacquisition times. The TCXO ensures the product remains stable and immune to frequency interference across its entire operating range (-40° to +85°C), making it a reliable positioning module.

2.8 Real-Time Clock (RTC)

The RTC is driven by a 32 kHz oscillator using an RTC crystal. If the main power supply voltage fails, certain sections of the receiver will shut down, but the RTC will continue to operate, providing a timing reference for the receiver. This operating mode is called "hardware backup mode," which enables all relevant data to be preserved in backup RAM for a subsequent warm start.

2.9 Power System

The ME3RGR01 module operates in two modes: Full Power Mode and Battery Backup Mode.

Full Power Mode: All power supplies are active, and the module functions normally, receiving and processing signals.

Battery Backup Mode: The module requires only a minimal current (approximately 40uA) to maintain the RTC clock and backup RAM. The module's built-in farad capacitor provides backup power for a limited duration.

2.10 Working Mode

ME3RGR01 supports two power consumption modes: Sleep Mode and Active Mode. Switching from Active mode to Sleep mode can be performed via software or hardware.

Active Mode: The normal operating mode where the DSP core is active and all peripherals are available.

Sleep Mode: In this mode, the SoC DSP core, all digital logic (except RTC Always-On logic), and the majority of analog/RF circuits cease operation and power down, minimizing total current consumption. Only GPIO (serial port) or the RTC timer can wake the system to Active Mode.

In Sleep Mode, BeiDou reference time continues to be maintained by the RTC timer. BeiDou data such as ephemeris is periodically saved to flash memory to enable fast startup. If AGNSS/AGPS is available, time and ephemeris data will be downloaded to the SoC chip. Therefore, if AGNSS/AGPS is present or TTFF during warm start is not a concern, there is no need to switch to Sleep mode. Instead, simply disable the backup power supply and turn off the main VCC power when positioning functionality is not required.

For the ME3RGR01 in software mode, when the module receives a host sleep command and transitions from Active mode to Sleep mode, the main power (VCC) must remain powered. After entering Sleep mode, the VCC main power supply can be turned off to save power, but V_BACKUP must remain powered.

In hardware mode, if the module is in Active Mode, VCC power is disconnected, and V_BACKUP remains active high, the ME3RGR01 will automatically switch to Sleep Mode. When the module is in Sleep Mode, all I/O pins connected to the module should remain in a low or high-impedance state. If any connected I/O pin is in a high state, leakage current in the ME3RGR01 sleep circuit will increase. When the ME3RGR01 wakes from Sleep Mode (triggered by the 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 DC Characteristics

Notation	Parameters	Minimum Value	Typical Value	Maximum Value	Unit
VCC	Mains voltage	2.5	3.3	3.6	V
VBAT	Backup power supply voltage	2.5	3.3	3.6	V
ICC _{max}	Maximum operating current on VCC	--	3.3	45	mA
T _{env}	Operating temperature	-40	--	85	°C

3.3 Power Wastage

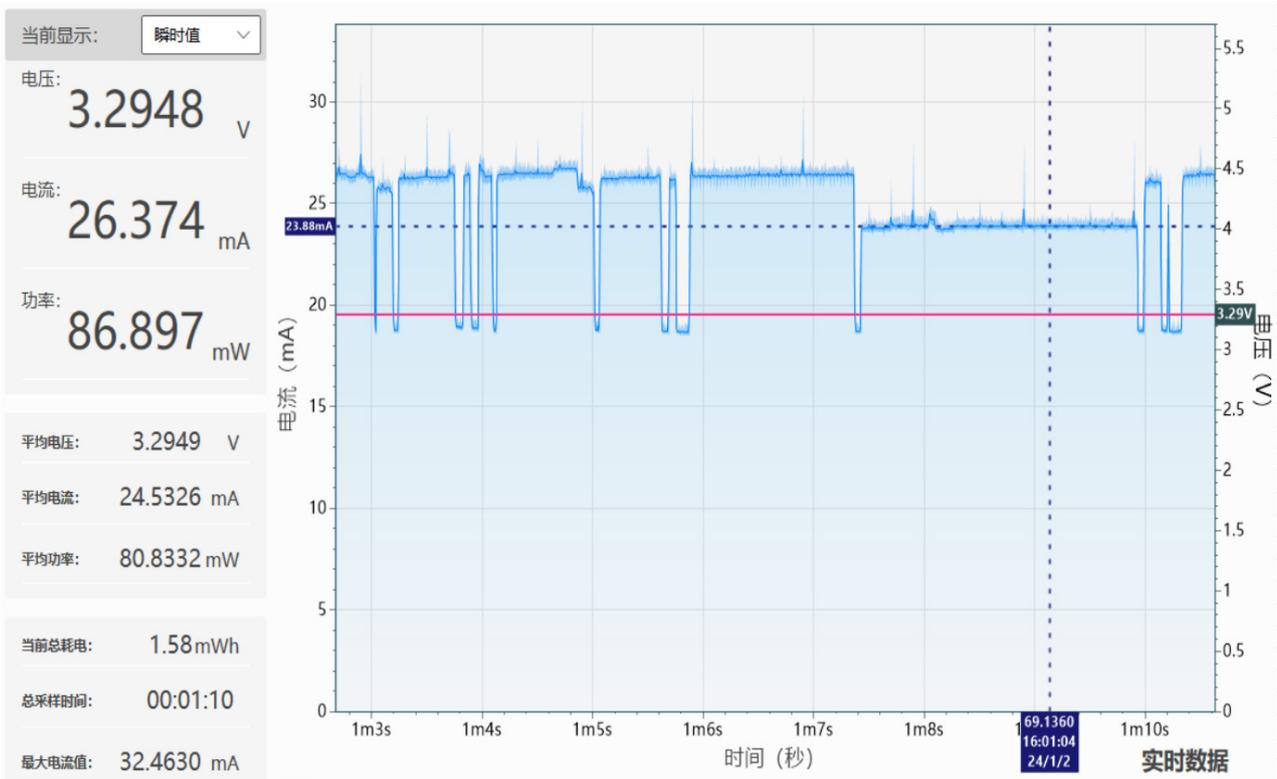
Notation	Parameters	Measurement Pins	Typical Value	Unit (of measure)
ICCRX1 [1]	capture phase	VCC [2]	25	mA
ICCRX2 [1]	tracking stage	VCC [2]	23	mA
ICCDBM	Dormant	VBAT[3]	22	uA

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

All of the above specifications are at 25°C ambient temperature. Extreme operating temperatures can seriously affect specification values. Applications operating near temperature limits should be carefully evaluated.

The values in the table are for customer reference only and are intended as examples of typical power requirements. Values are characterized from 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

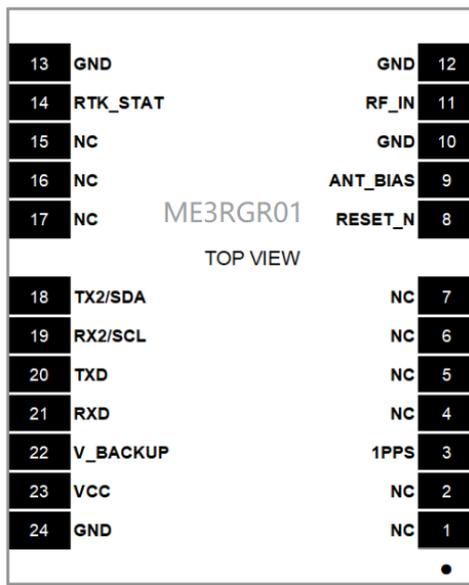
Since the ME3RGR01 incorporates an LNA and supports passive GNSS antennas, external antenna gain should be carefully controlled.

Notation	Parameters	Min	Max	Unit
RFgain	Input Gain	0	30	dB

4 PACKAGE DEFINITION

4.1 Module Pin Definitions

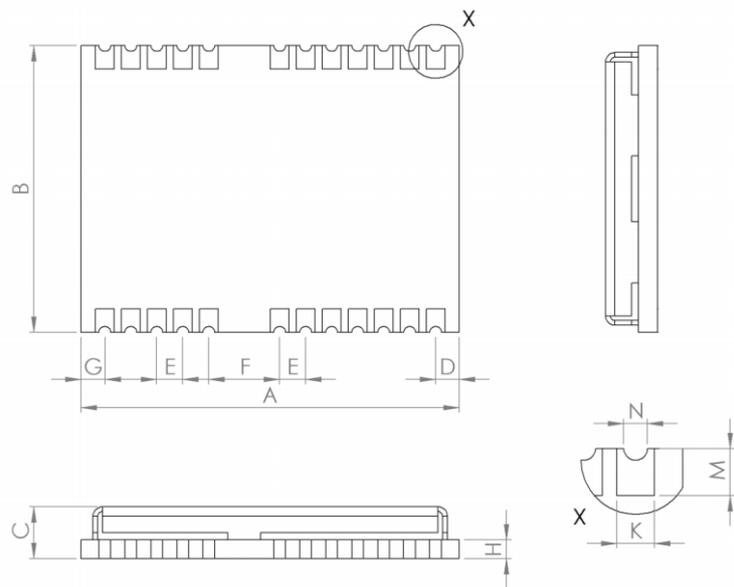
The ME3RGR01 is available in a 16*12mm, LCC-24pin package and is defined as follows:



Serial Number	Pin Name	I/O	Description
3	1PPS	O	Time Pulse/Second Pulse
8	RESET_N	I	Reset, low-level reset, recommended to leave floating
9	ANT_BIAS	O	RF antenna supply voltage: 3.3V, maximum operating current: 45mA, overload trigger protection.
11	RF_IN	I	Antenna signal input, no feed
14	RTK_STAT	O	RTK Status Indicator Bit RTK FIXED (Fixed Solution) High Level
18	TXD2/SDA	O	Secondary Serial Port, TXD2 / SDA
19	RXD2/SCL	I	Secondary Serial Port, RXD2 / SC:
20	TXD	O	Main Port, GNSS-> Host
21	RXD	I	Main Port, Host -> GNSS, Differential data, AT commands, FOTA upgrade
22	V_BACKUP	I	Backup power supply, supporting hardware hot start. Operating voltage 2.5-3.6V
23	VCC	I	Main power supply, operating voltage 2.0-3.6V
	GND	I	Grounding, PIN 10, 12, 13, 24
Other	NC	-	The remaining pins should be left floating.

5 PACKAGE SPECIFICATIONS

5.1 Dimensions



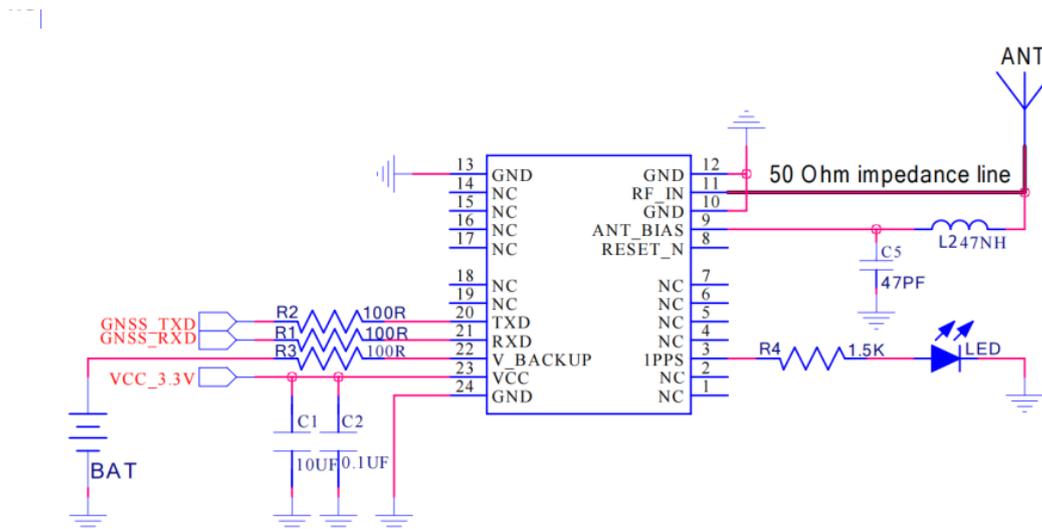
5.2 Mechanical Dimensions

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

6 REFERENCE DESIGN

6.1 Schematic Design

The reference design for ME3RGR01 is shown in the figure below. When connecting an active antenna, ensure the 47nH inductor at position L2 is in surface-mount configuration to power the active antenna. The characteristic impedance from the RF_IN pin to the antenna interface is 50Ω. Antenna performance is critical to system functionality; strictly adhere to the technical specifications for dual-band high-precision antennas. Pin 22 can be connected to the V_BACKUP backup power supply to support hardware hot-start capability.



6.2 Layout Notes

- (1) Decoupling capacitors are placed close to the module power supply pins, and ensure that the power supply trace width is more than 0.5mm;
- (2) No wires are allowed to be routed at the bottom of the module patch;
- (3) The RF trace 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 used, with the spacing between the trace and the ground copper controlled to achieve 50Ω impedance;
- (4) The trace 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 trace, crystal oscillators, large inductors, and high-frequency digital signal lines.

6.3 Power Supply

The ME3RGR01 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.

6.4 Antenna

The ME3RGR01 incorporates a low-noise-figure LNA and SAW filter. It is recommended to use an active antenna with a gain less than 25dB and a noise figure below 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 gain is required to compensate for line loss. To maintain ground integrity, routing traces beneath the module is not recommended or should be minimized.

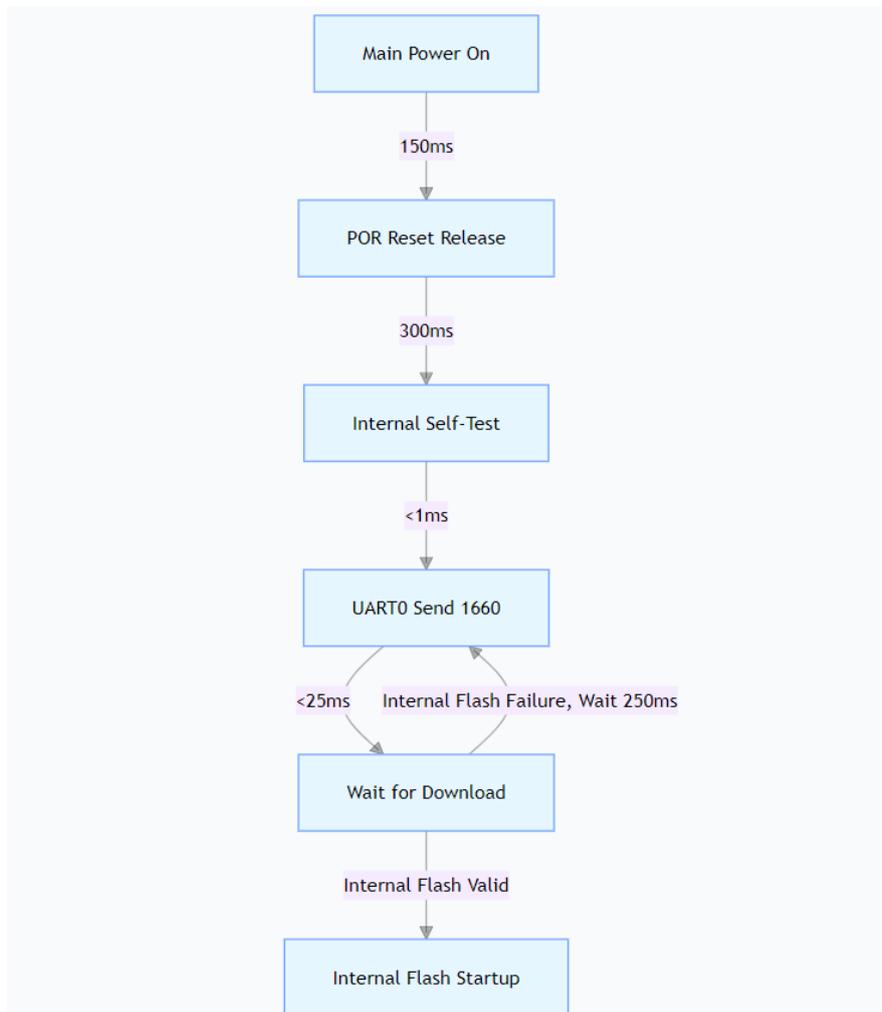
6.5 Serial Port Communication

The module provides a 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 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.

6.6 Startup Process

The module startup process is as follows:



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:

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

The NEMA message output for the ME3RGR01 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
BDGSV	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	Y
GNZDA	Date and Time	N
GNGST	Position error statistics	Y

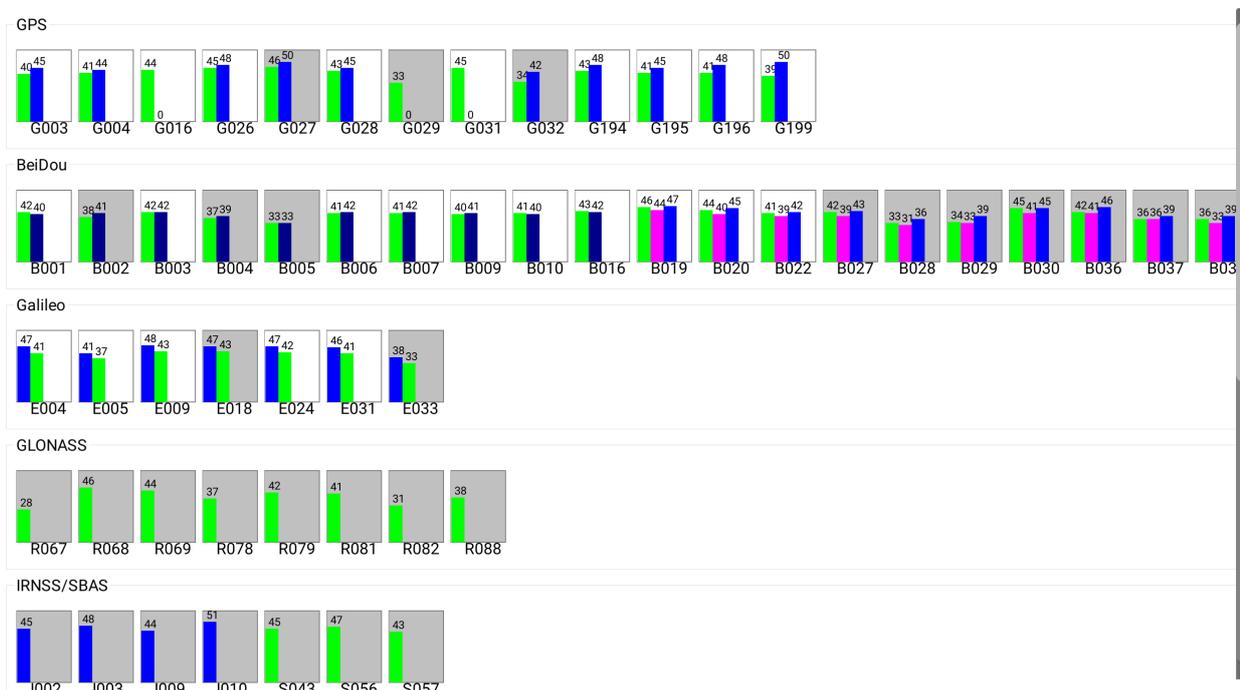
7.2 Sample Data

Serial port data within 1 second after positioning example:

```
$GNGGA,031639.00,2242.2917383,N,11401.6896846,E,4,25.0,7.127,889,M,0.000,M,1.0,0107*60
$GNGSA,A,3,03,04,16,26,28,31,194,195,196,199,,,1.0,0.7,0.8,1*3D
$GNGSA,A,3,01,03,06,07,09,10,16,19,20,22,,,1.0,0.7,0.8,4*3C
$GNGSA,A,3,,,,,,,,,1.0,0.7,0.8,2*3C
$GNGSA,A,3,04,05,09,24,31,,,,,,,,,1.0,0.7,0.8,3*31
$GNGSA,A,3,,,,,,,,,1.0,0.7,0.8,5*3B
$GPGSV,4,1,16,03,25,256,40,04,36,320,41,16,67,310,43,26,53,013,44,1*61
$GPGSV,4,2,16,27,00,000,43,28,32,077,43,29,03,037,35,31,47,048,45,1*6D
$GPGSV,4,3,16,32,16,146,41,194,60,050,43,195,26,136,39,196,44,175,42,1*50
$GPGSV,4,4,16,199,60,149,38,43,00,000,45,56,00,000,47,57,00,000,44,1*57
$GPGSV,4,1,13,03,25,256,45,04,36,320,43,16,67,310,00,26,53,013,48,8*61
```

\$GPGSV,4,2,13,27,00,000,50,28,32,077,46,29,03,037,00,31,47,048,00,8*61
 \$GPGSV,4,3,13,32,16,146,42,194,60,050,48,195,26,136,45,196,44,175,48,8*55
 \$GPGSV,4,4,13,199,60,149,50,,,,,,,,,8*61
 \$BDGSV,6,1,24,01,46,125,42,02,47,236,38,03,62,189,43,04,32,112,37,1*79
 \$BDGSV,6,2,24,05,24,256,33,06,61,013,41,07,64,204,41,09,52,344,40,1*7C
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7.3 Example of an Actual Star Search



8 PACKAGING AND PROTECTION

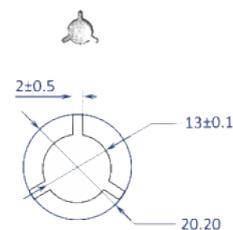
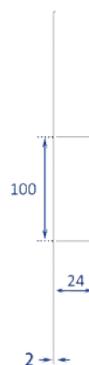
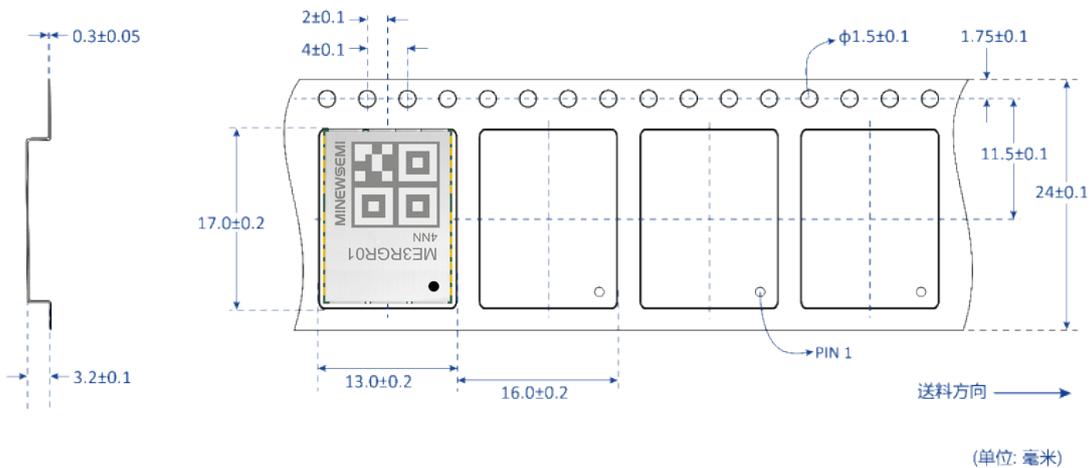
8.1 Wrap

The ME3RGR01 is sensitive to both humidity and static electricity. During packaging and transportation, strictly adhere to relevant handling requirements and implement appropriate preventive measures to minimize product damage. The table below outlines the standard packaging structure for product shipment.

Offerings	Reels	Sealed Bags	Shipping Cartons
			
ME3RGR01	1000pcs/roll	1 roll/bag	1 bag/box, 3 boxes/ctn

8.2 Carrier belts and trays

The ME3RGR01 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.



(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

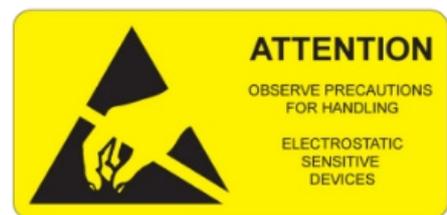
The GNSS positioning module contains highly sensitive electronics and is an electrostatic sensitive device (ESD). Please note the following precautions, as failure to follow these precautions may result in serious damage to the module!

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;

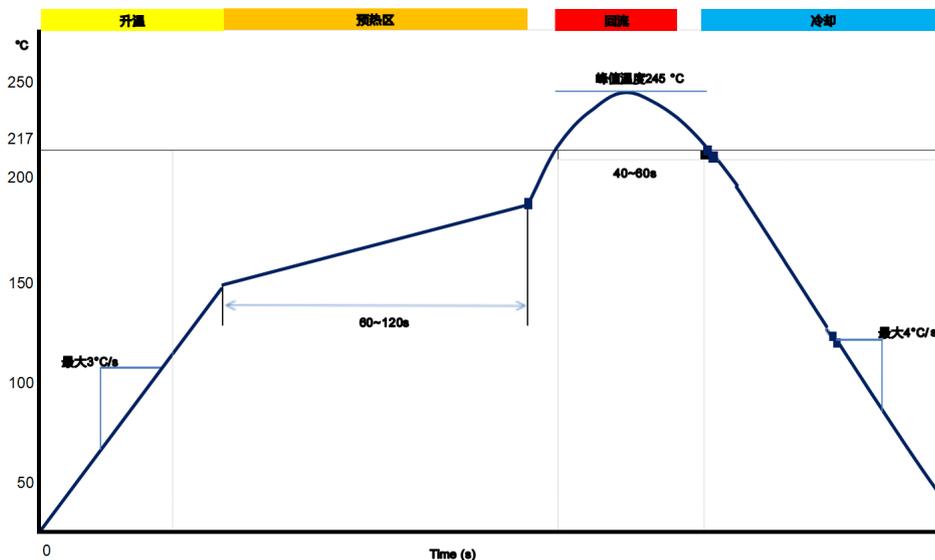
Be sure to use an ESD safe soldering iron when soldering RF connectors and antenna patches.

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
ME3RGR01	GNSS Module	115200	Dual-Frequency RTK L1+L5	GPS/BDS/GLO/GAL/IRNSS/QZSS	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, NO_x, 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 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°C +8/-0°C, 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, OHSAS18001, BSCI.

Every product undergoes stringent testing, including transmit power, sensitivity, power consumption, stability, and aging tests. Our fully automated module production line is now in full operation, boasting a production capacity in the millions, capable of meeting high-volume production demands.

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14 RELATED DOCUMENTS

- [MinewSemi_Product_Naming_Reference_Manual](https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf)
https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf
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