



E108-GN02 User Manual

GK9501 Positioning module



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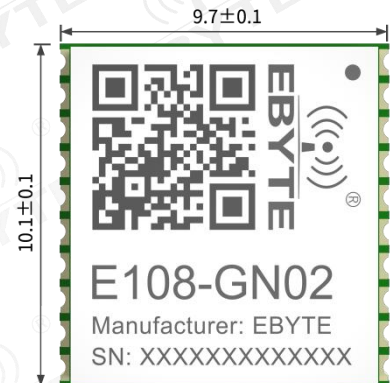
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1 Overview

1.1 Brief introduction

E108-GN02 is a multi-mode satellite positioning and navigation module with high performance, high integration, low power consumption and low cost, which can be used in GNSS positioning applications such as vehicle navigation intelligent wear, UAV, etc. It also provides software and hardware interfaces compatible with other manufacturers' modules, which greatly reduces the development cycle of users. It supports BDS / GPS / GLONASS / Galileo / QZSS / SBAS.

The module adopts the integrated design of RF baseband, integrates DC / DC, LDO RF front-end, low-power application processor, RAM, Flash storage, RTC and power management. It supports external LNA control and active antenna power supply interface. It can supply power to RTC and backup RAM through button battery or farad capacitor to reduce the first positioning time. The module also supports a variety of ways to connect with other peripherals, such as UART, GPIO, etc.



1.2 Features

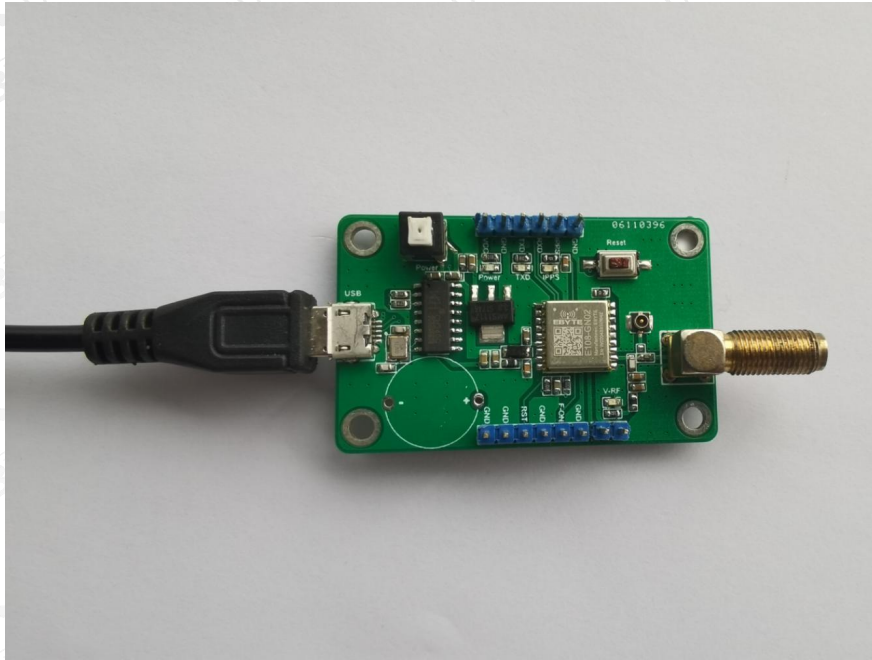
- It supports BDS/GPS/GLONASS/GALILEO/QZSS/SBAS multi system joint positioning and single system independent positioning;
- D-GNSS differential positioning, A-GNSS aided positioning, ephemeris prediction, DR integrated navigation application, the fastest data update rate is 10Hz;
- 32 bit application processor, the highest frequency is 133MHz, support frequency dynamic adjustment;
- It supports PPS output and the default cycle is 1s;
- Built in reset controller;
- It supports UART communication interface;
- RTC: supports 32.768 kHz ± 20 ppm crystal oscillator, 1.1V RTC clock output, support external signal wake-up;
- Output format: supports NMEA0183 v4.1 and earlier versions, and the maximum fixed update frequency can reach 10Hz;
- High sensitivity: capture cold start - 149dBm, hot start - 162dBm, track - 166dBm;
- Ultra low power consumption: capture 30mA, track 20mA;
- 10.1*9.7 super small size, software and hardware compatible with products of other manufacturers, greatly reducing the development cycle of users.

1.3 Applications

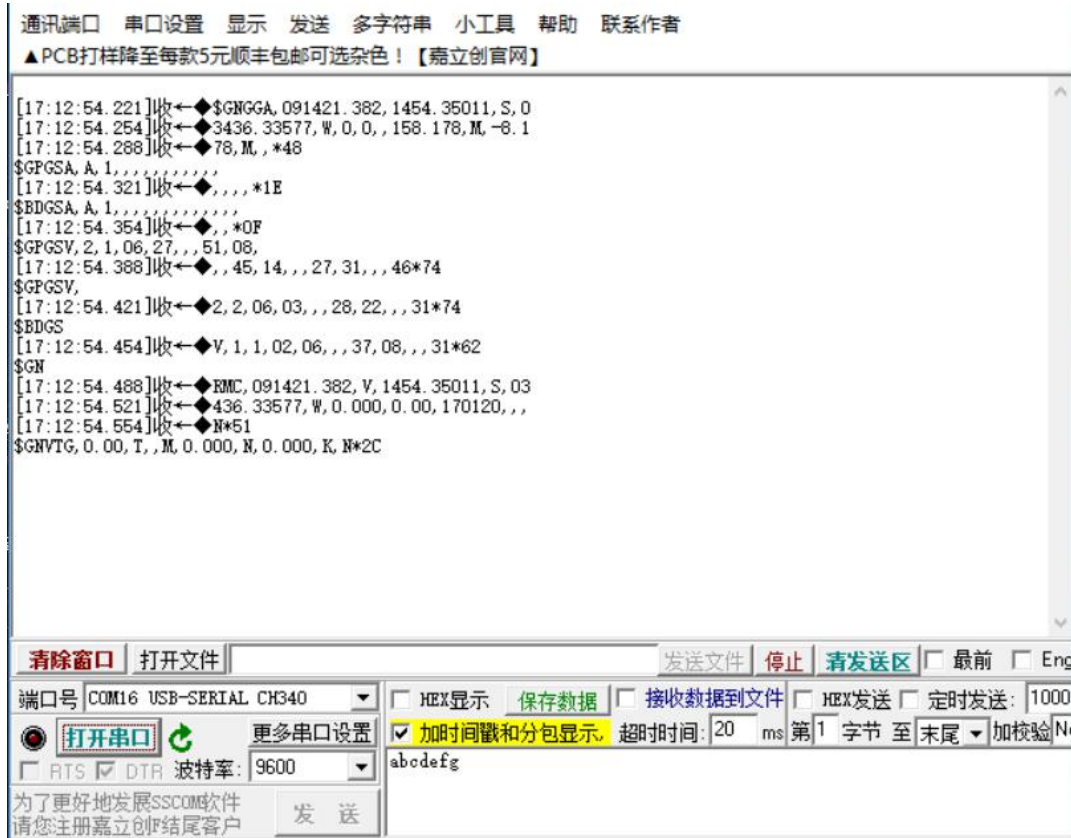
- Vehicle positioning and navigation equipment;
- Wearable devices, such as GPS tracker, etc;
- UAV positioning, industrial computer, etc;
- Industry equipment with demand for GNSS positioning or navigation.

2 Quick start

This chapter is based on the E108-GN02-TB test board. If you don't have test board, please design one referring to the schematic diagram of the test board.



1. After connecting the GPS antenna, connect the computer through USB cable, and then press the switch button to start the device.
2. Please note that when using an active antenna, the two pins of RF_POWER need to be short-circuited with a jumper.
3. You can open the serial port assistant to view the data reported by the serial port, or use our naviTrack to view it.



The baud rate is set to 9600 bps. After opening the serial port, data will be reported all the time. Common output formats are as follows:

GGA: Time, location, number of satellites;

GSA: GPS receiver operation mode, satellites used for positioning, DOP value, positioning status;

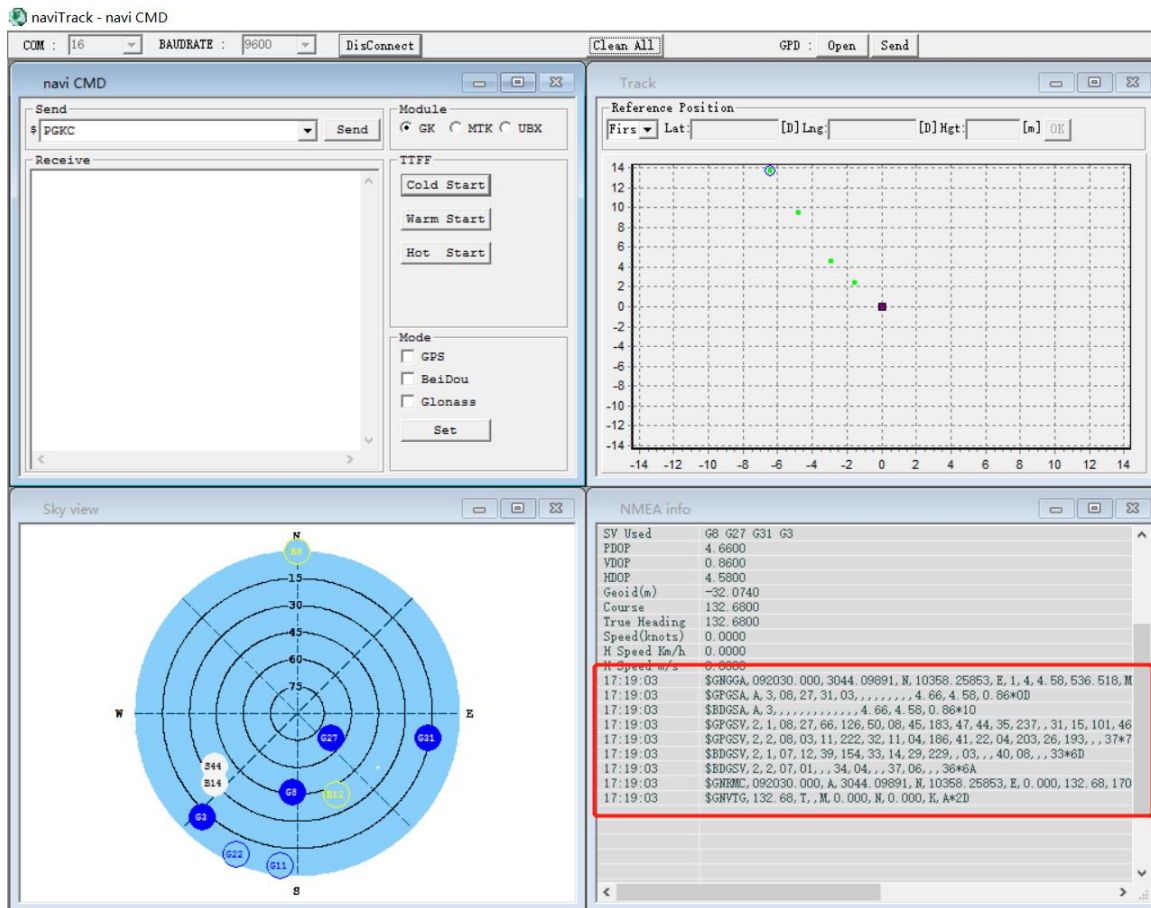
GSV: Visible GPS satellite information, elevation angle, azimuth angle, SNR;

RMC: Time, date, location, speed;

VTG: Ground speed information;

Please refer to section 3 NMEA0183 protocol for details.

For ease of use, we recommend using the exclusive tool TaviTrack for debugging. For detailed usage, please refer to "naviTrack User Manual".



1. Run navitrack with administrator's permission and run the above page;
2. Select the corresponding com port and click connect. After the connection is successful, you can see the reported data in the NMEA window.

Please refer to section 3 NMEA0183 protocol for details

3. After the positioning is successful, the latitude and longitude information can be obtained in the \$GPRMC field reported by the serial port. For more detailed tool usage information, please refer to the user manual.

3 Parameters

3.1 GPS parameters

| Item | Parameter | Typical value | Unit |
|--|------------|---------------|------|
| Positioning time (Test condition 1) | Cold start | 27.5 | S |
| | Hot start | <1 | S |
| | Recapture | <1 | S |
| | A-GNSS | <10 | S |

| | | | |
|---|---------------------------------|-----------------------------|-----|
| Sensitivity (Test condition 2) | Cold start | -149 | dBm |
| | Hot start | -162 | dBm |
| | Recapture | -164 | dBm |
| | Track | -166 | dBm |
| Precision (Test condition 3) | Horizontal positioning accuracy | 2.5 | m |
| | Altitude positioning accuracy | 3.5 | m |
| | Speed positioning accuracy | 0.1 | m/s |
| | Timing accuracy | 30 | ns |
| Power consumption (Test condition 4) | Capture current | 30 | mA |
| | Track current | 20 | mA |
| Working temperature | -- | -35°C--85°C | -- |
| Storage temperature | -- | -55°C--100°C | -- |
| Humidity | -- | 5%--95%RH (No condensation) | -- |

Note: The above result is in the GPS/Beidou satellite dual mode working mode

[Test condition 1]: The number of received satellites is more than 6, the signal strength of all satellites is - 130dbm, the average value is taken after 10 tests, and the positioning error is less than 10m.

[Test condition 2]: The external LNA has a noise figure of 0.8, the number of received satellites is more than 6, and the received signal strength value under the condition of locking or not losing lock within five minutes.

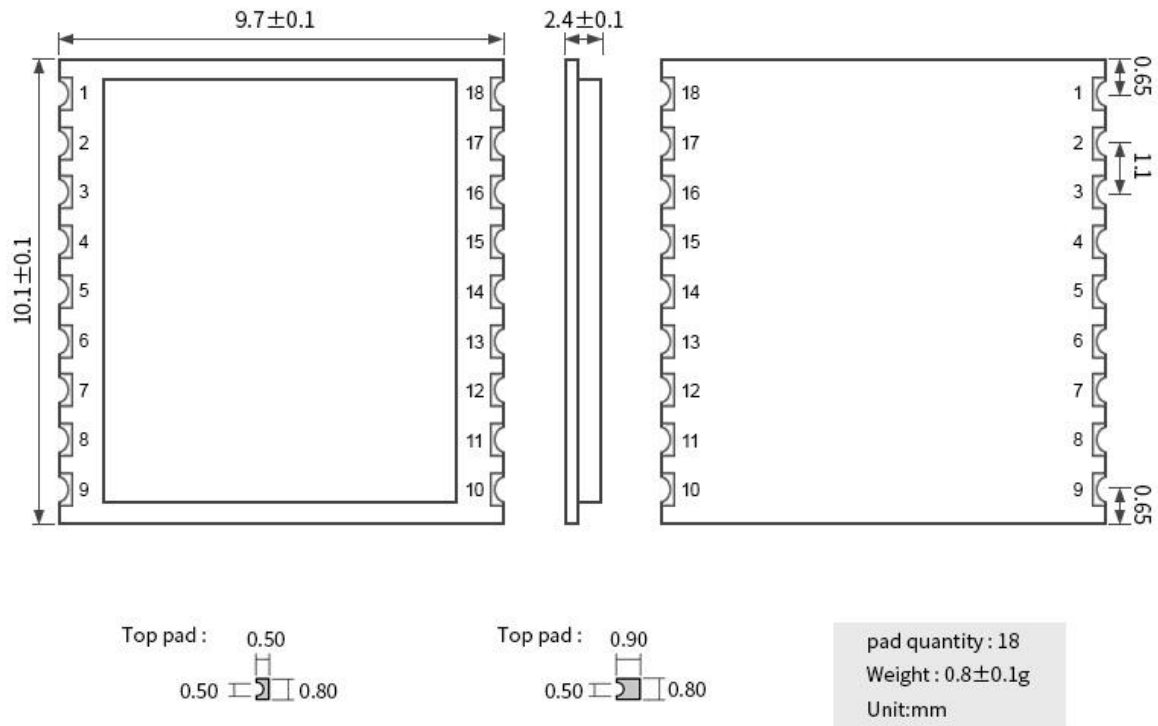
[Test condition 3]: Open and unobstructed environment, continuous 24-hour power on test, 50% CEP.

[Test condition 4]: The number of received satellites is more than 6, and the signal strength of all satellites is - 130 dbm.

3.2 Basic parameters

| Item | Description | |
|--------------------------------|---|---------------------------|
| Communication protocol | Support NMEA0183 v4.1 and earlier versions, the maximum fixed update frequency can reach 10Hz | |
| Positioning system | Support BDS/GPS/GLONASS/GALILEO/QZSS/SBAS | |
| Peripheral Interface | Support UART (TXD/RXD) or GPIO | |
| Low power consumption | Support (Stop、 Sleep) | |
| Ultra low power consumption | Support | |
| Periodic low power consumption | Support | |
| Direct low power consumption | Support | |
| Parameter setting software | Support | |
| Certification | Pending | |
| Size | 10.1*9.7*2.4mm (L*W*H) | |
| Package | Half hole (SMT surface mount) | |
| Power supply | VCC | 2.8V—4.3V (3.3V) |
| Serial port | Communication level | 2.8V |
| | Baud (bps) | 9600~921600, default 9600 |
| | Data bit | 8bit |
| | Stop bit | 1 |
| | Check bit | None |

4 Size and pin definition



| No. | Pin | Description |
|-----|----------|--|
| 1 | GND | Ground |
| 2 | TXD | UART output (2.8V) |
| 3 | RXD | UART input (2.8V) |
| 4 | 1PPS | Second pulse output, users can set frequency, duration, etc. through commands |
| 5 | FORCE_ON | Sleep wake-up pin, pulled up when the module enters ultra-low power consumption The pin exits the ultra-low power consumption mode (the pin level is 1.1V, if the control pin level is not 1.1V, voltage splitting is required) |
| 6 | VBKP | RTC power input, RTC power must be supplied for the module to work normally (2v-4.2v) |
| 7 | NC | Reserved |
| 8 | VCC | Module power supply (2.8v-4.2v) |
| 9 | RSTN | Reset foot, default is pull up, reset when pull down |
| 10 | GND | Ground |
| 11 | RF_IN | RF input |
| 12 | GND | Ground |
| 13 | ANTON | External LNA or active antenna power control pin, 2.8V level |

| | | |
|----|--------|--|
| 14 | VCC_RF | RF power output, to supply power to the external active antenna (this VCC_RF output voltage is equal to VCC) |
| 15 | NC | Reserved |
| 16 | NC | Reserved |
| 17 | NC | Reserved |
| 18 | NC | Reserved |

5 Hardware design

- The schematic design of the module can refer to E108-GN02-TB-SCH;
- It is recommended to use DC regulated power supply for the module. The power ripple should not exceed 30mV, and the module should be grounded reliably;
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module;
- Serial port TXD, RXD are LVTTTL level, if connected with PC, it needs to be converted through RS232 level. Users can use this serial port to receive positioning information data and upgrade software;
- The module is a temperature sensitive device, and its performance will be reduced if the temperature changes sharply. It should be kept away from high-temperature airflow and high-power heating devices;
- When designing power supply circuit for modules, it is often recommended to reserve more than 30% margin, which is conducive to the long-term and stable operation of the whole device;
- The module should be far away from the power supply, transformer, high frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital traces, high-frequency analog traces, and power traces should not be under the module. If they must pass under the module, assuming that the module is soldered to the Top Layer, the top layer of the contact part of the module should be grounded (all copper and Good grounding), must be close to the digital part of the module and routed in Bottom Layer;
- Assuming that the module is soldered or placed on the Top Layer, it is also wrong to randomly route the wires on the Bottom Layer or other layers, which will affect the stray and receiving sensitivity of the module to varying degrees;
- Assuming that there are devices with large electromagnetic interference around the module, it will greatly affect the performance of the module. According to the intensity of the interference, it is recommended to stay away from the module. If the situation permits, proper isolation and shielding can be done;
- Assuming that there are large electromagnetic interference traces (high-frequency digital, high-frequency analog, power traces) around the module, it will also greatly affect the performance of the module. According to the intensity of the interference, it is recommended to stay away from the module. If the situation permits, proper isolation and shielding can be done;
- The antenna installation structure has a great influence on the performance of the module. Make sure that the antenna is exposed and it is best to be vertically upward;
- When the module is installed inside the case, a high-quality antenna extension cable can be used to extend the

antenna to the outside of the case;

- The antenna must not be installed inside the metal shell, which will greatly reduce the transmission distance.

6 Working mode

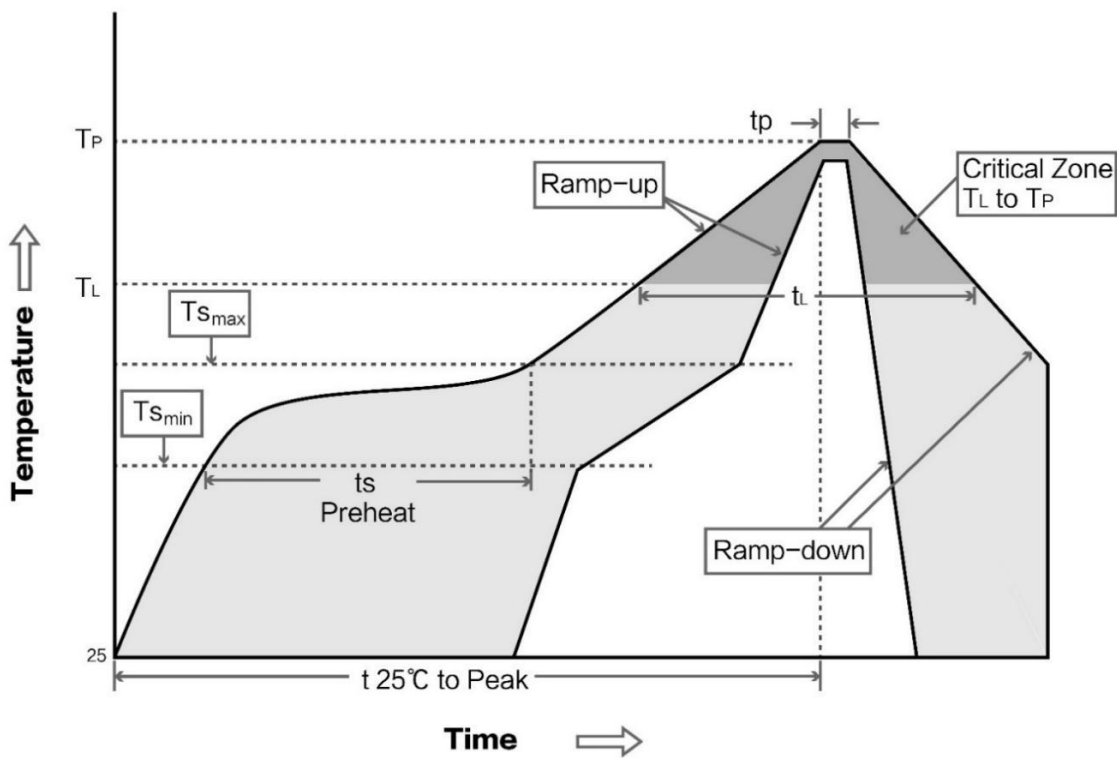
1. For the command format of the related software functions of the module, please refer to the file "GK9501 Input and Output Format".
2. This module supports AGPS settings. For detailed setting methods, please refer to the resource file "Goke AGPS User Manual".

7 Soldering guidance

7.1 Reflow Soldering Temperature

| Profile Feature | Curve feature | Sn-Pb Assembly | Pb-Free Assembly |
|--|------------------------------------|----------------|------------------|
| Solder Paste | Solder paste | Sn63/Pb37 | Sn96.5/Ag3/Cu0.5 |
| Preheat Temperature min (T _{smin}) | Minimum preheating temperature | 100°C | 150°C |
| Preheat temperature max (T _{smax}) | Maximum preheating temperature | 150°C | 200°C |
| Preheat Time (T _{smin} to T _{smax})(ts) | Preheating time | 60-120 sec | 60-120 sec |
| Average ramp-up rate (T _{smax} to T _p) | Average rising rate | 3°C/second max | 3°C/second max |
| Liquidous Temperature (TL) | Liquid phase temperature | 183°C | 217°C |
| Time (t _L) Maintained Above (TL) | Time above liquidus | 60-90 sec | 30-90 sec |
| Peak temperature (T _p) | Peak temperature | 220-235°C | 230-250°C |
| Aveage ramp-down rate (T _p to T _{smax}) | Average descent rate | 6°C/second max | 6°C/second max |
| Time 25°C to peak temperature | Time of 25 ° C to peak temperature | 6 minutes max | 8 minutes max |

7.2 Reflow Soldering Curve



8 Related models

| Part number | Chipset | Satellite supported | Package | Size/ mm | Communication interface |
|---------------------------|---------|-----------------------------------|---------|--------------|-------------------------|
| E108-GN01 | GK9501 | BDS/GPS/GLONASS/GALILEO/QZSS/SBAS | SMD | 16*12*2.4 | UART/GPIO |
| E108-CN02 | GK9501 | BDS/GPS/GLONASS/GALILEO/QZSS/SBAS | SMD | 10.1*9.7*2.4 | UART/GPIO |

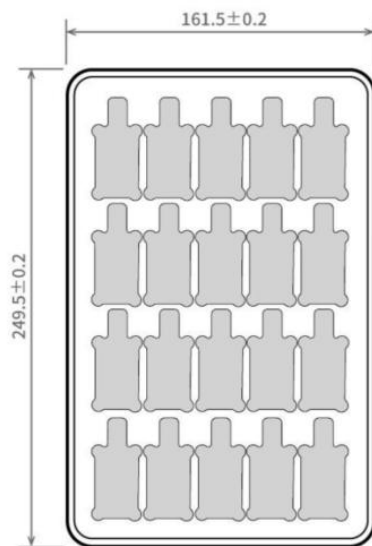
9 Antenna guide

9.1 Antenna recommendation

Antennas are an important role in the communication process. Inferior antennas will greatly affect the communication system, so we recommend some antennas with excellent antenna performance and reasonable price.

| Part number | Type | Frequency/ Hz | interface | Gain/ dBi | Size/mm | Cable/ cm | Feature |
|---------------------|--------|---|-----------|--------------|------------|--------------|--|
| <u>TXGB-AZ-300</u> | Sucker | 1575.042±1.023MHz~ 1561.098±2.046MHz | SMA-J | 4.0 | 50*38*16.7 | 300 | Directional antenna, LNA gain 28dBi |
| <u>TXGPS-XP-300</u> | Sucker | Beidou/GPS/Galileo/ Glonass | SMA-J | 5.0 | 100*30 | 300 | Small sucker antenna, high cost-effective |

10 Batch packaging



Unit: mm
Each Layer: 20 pcs
Each Package: 5 layers

Revision history

| Version | Date | Description | Issued by |
|---------|------------|-----------------|-----------|
| 1.0 | 2020-08-06 | Initial version | Linson |

About us

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