E108-GN07 Series User Manual

DUAL-FREQUENCY

RTK

INERTIAL NAVIGATION

GNSS POSITIONING MODULE



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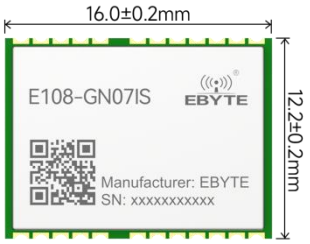
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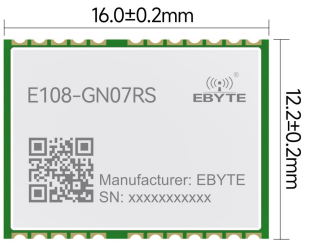
1 Product Overview

1.1 Product Introduction

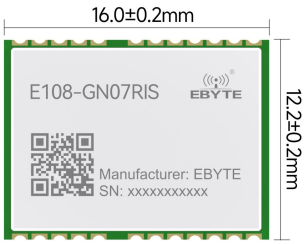
The E108-GN07 Series is a high-performance GNSS positioning module developed by Chengdu EBYTE Electronic Technology Co., Ltd. Equipped with inertial navigation + RTK + dual frequency (L1/L5 or L1/L2) functions, meeting the requirements of low-power and high-performance industrial applications. The module also supports the next-generation BeiDou-3 signal system and global civil navigation satellite systems including BDS, GPS, GLONASS, Galileo, SBAS, QZSS, and IRNSS, providing a high-precision, high-sensitivity, and low-power solution for GNSS navigation applications. Customizable SPI, USB, CAN, and I2C interface outputs are available.



E108-GN07IS



E108-GN07RS



E108-GN07RIS

1.2 Features

- Supports global civil navigation satellite systems including BDS, GPS, GLONASS, Galileo, SBAS, QZSS, IRNSS, etc.
- 200 tracking channels and a dedicated search engine;
- Cold start sensitivity: -148 dBm;
- Hot start sensitivity: -159 dBm;
- Reacquisition sensitivity: -159 dBm;
- Tracking sensitivity: -165 dBm;
- Update frequency: 1-20 Hz;
- Single point positioning accuracy: horizontal 1.0 m CEP vertical 2.0 m CEP;
- RTK positioning accuracy: Horizontal 1.0 cm + 1 ppm CEP; Vertical 1.5 cm + 1 ppm CEP[1];
- Ground speed accuracy: 0.1 m/s CEP;
- Cold start first positioning time: 28 s;
- AGPS first positioning time: 1.5 s;
- Hot start positioning time: 1.0 s
- Support SBAS;
- Support AGPS;
- Support RTCM3.X;
- Support NMEA0183 V4.10;
- Support for the combined navigation function of the six-axis inertial measurement unit (IMU)[2], The cumulative error of the inertial navigation system is 3% CEP.

[1] Only E108-GN07RS, E108-GN07RIS support RTK;
[2] Only E108-GN07IS and E108-GN07RIS support inertial navigation.

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1.3 Application Scenario

- Vehicle positioning and navigation equipment;
- Wearable devices, such as GPS locators;
- UAV positioning, industrial computers, etc.
- Industrial equipment that requires GNSS positioning or navigation;
- Portable devices such as mobile phones, tablets, etc.
- Asset tracking;

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2 Specifications

2.1 Working parameters

Main parameters	performance			Remark
	Minimum	Typical values	Maximum	
Operating voltage (V)	3.0	3.3	3.6	Over 3.6V may burn the module
Communication level (V)	-	3.3	-	-
Operating temperature (°C)	- 40	-	+85	Industrial-grade design
humidity	5%	-	-95%RH	No condensation

2.2 Hardware Parameters

Main parameters	describe	Remark
Baud rate (bps)	1200~460800	Default 115200bps
Data bits	8bit	-
Stop bits	1	-
L1 frequency	Supports GPS L1, Beidou B1I, Beidou B1C, Galileo E1, QZSS L1, GLONASS G1	-
L5 frequency	Support GPS L5, Beidou B2A, Beidou B2B, Beidou B2I, Galileo E5, QZSS L5, IRNSS	-
L2 frequency	Support GPS L2C, Beidou B3I, Glonass G2, Galileo E6, QZSS L6	-
Output format	NMEA0183 V4.0/4.1 and earlier versions RTCM 2.3/2.4/3.0/3.2 Cynosure GNSS Receiver Protocol	-
Positioning update rate	1~20Hz	-
Supported positioning systems	BDS/GPS/GLONASS/Galileo/ QZSS/SBAS	-
Communication interface	UART	-
Packaging	SMD	-
size	12.2*16*2.4mm	±0.2mm
Antenna interface	stamp holes	-
Product weight	0.5	±0.1g

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2.3 GNSS performance parameters

category	Indicator	Typical values	unit
Positioning time (test condition 1)	Cold Start	≤28	s
	Hot start	≤1	s
Sensitivity (test condition 2)	Cold Start	-110~-148	dBm
	Hot start	-110~-159	dBm
	Recapture	-159	dBm
	track	-165	dBm
Accuracy (Test Condition 3)	Horizontal positioning accuracy	<1	m
	Speed positioning accuracy	3	m/s
	Timing accuracy	25	ns
Power consumption (test condition 4)	Capture current (average current)	≈43	mA
	Tracking current (average current)	≈43	mA

Note:

[Test condition 1] : The number of received satellites is greater than 6 , the signal strength of all satellites is -120dBm , the average value of 10 tests is taken , and the positioning error is less than 10 meters.

[Test Condition 2] : External LNA noise figure 0.8 , number of received satellites greater than 6 , received signal strength value under the condition of locking or not losing lock within 5 minutes.

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

[Test Condition 4] : Test the capture current (power consumption when no satellite is found) and tracking current (power consumption when a satellite is found and the system is positioning the satellite in real time) in two modes respectively.

2.4 Selection Reference Table

Model	Inertial Navigation	RTK
E108-GN07IS	√	/
E108-GN07RIS	√	√
E108-GN07RS	/	√

2.5 IMU sensing the axis direction

If the sensor is subjected to acceleration and/or rotation in the specified direction, the corresponding channel of the device will output a positive acceleration and/or yaw rate signal (dynamic acceleration); if the sensor is in a stationary state and without any rotation, and the direction of the gravitational force is opposite to the specified direction, the output value of the corresponding acceleration channel will be positive, while the output value of the corresponding gyroscope channel will be "zero" (static acceleration).

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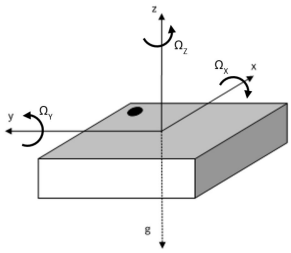
For example: If the sensor is in a stationary state or moving at a constant speed in the gravitational field (as shown in the figure below), its output signal is:

ax accelerometer channel: ±0 g; Ωx gyroscope channel: ±0°/s;

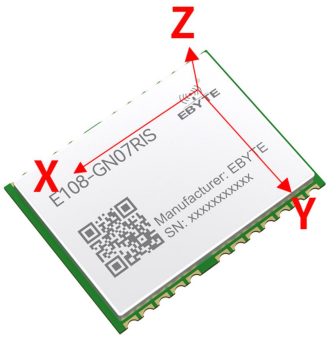
ay accelerometer channel: ±0 g; Ωy gyroscope channel: ±0°/s;

az accelerometer channel: +1 g; Ωz gyroscope channel: ±0°/s.

IMU



E108-GN07RIS



E108-GN07IS

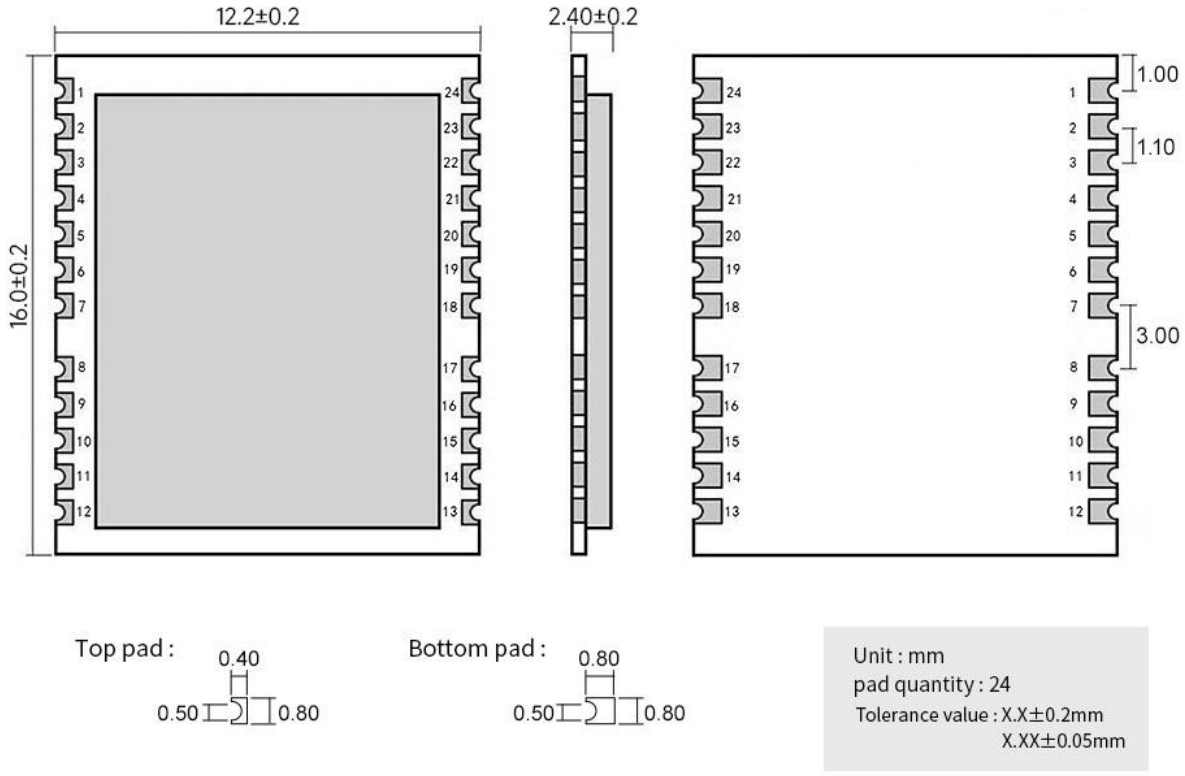


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3 Mechanical Dimensions and Pin Definitions

3.1 E108-GN07 Series



Pin number	Pin Name	Pin direction	Pin Purpose
1	NC	-	Dangling
2	NC	-	Reserved pin, general digital input and output GPIO, left floating when not in use
3	1PPS	Output	1 Pulse Per Second
4	NC	-	Reserved, hanging
5	NC	-	Reserved, hanging
6	NC	-	Dangling
7	NC	-	Dangling
8	RESET_N	Input	Reset pin, external reset input, internal pull-up, low level of more than 1ms is effective, must be left floating if not used
9	VCC_RF	Output	Active antenna power output, supply current <= 50mA, supply voltage 2.7-3.1V adjustable
10	GND	-	Module ground
11	RF_IN	Input	Antenna interface
12	GND	-	Module ground
13	GND	-	Module ground
14	NC	-	Dangling
15	NC	-	Dangling

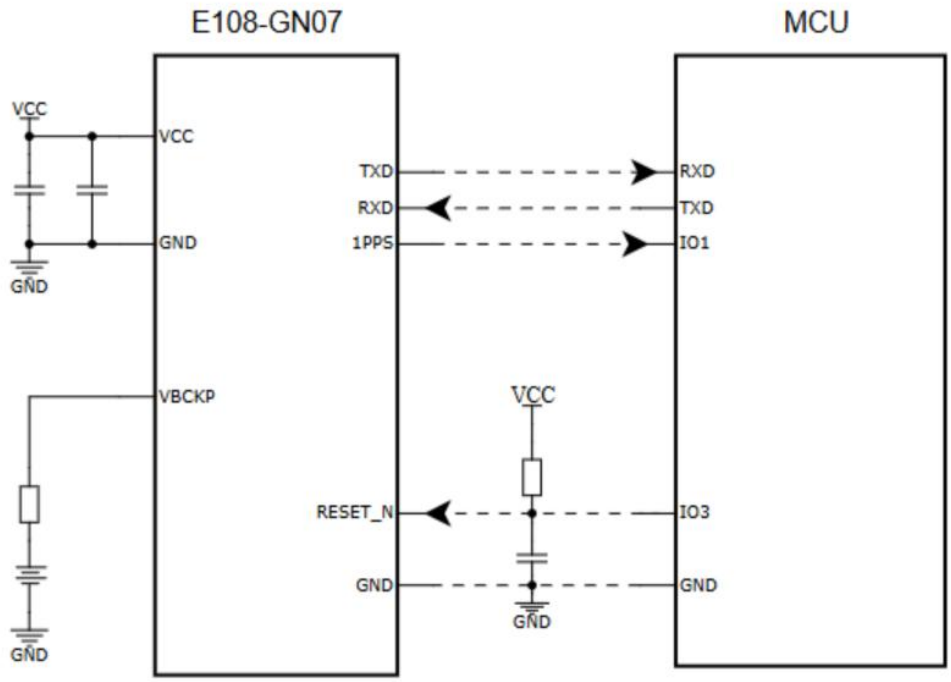
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16	NC	-	Dangling
17	NC	-	Dangling
18	NC	-	Dangling
19	NC	-	Dangling
20	TXD	Output	Serial port output, 3.3V level
21	RXD	Input	Serial port input, 3.3V level
22	VBCKP	Input	Backup power input, voltage range: 1.8V-3.6V, can be left floating when not in use
23	VCC	Input	Main power input, voltage range: 3.0-3.6V, recommended voltage: 3.3V
24	GND	-	Module ground

4 Recommended Connection Diagram

4.1 E108-GN07 Series



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5 Hardware Design

- It is recommended to use a DC regulated power supply to power the module. The power ripple should not exceed 50mV, and the module must be reliably grounded.
- 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 within the recommended power supply voltage. Exceeding the maximum value may cause permanent damage to the module.
- The serial port TXD and RXD are LV TTL level. If connected to a PC, RS232 level conversion is required. Users can use this serial port to receive positioning information data and software upgrades ;
- This module is a temperature-sensitive device. Rapid temperature changes will cause its performance to degrade. Keep it away from high-temperature airflow and high-power heating devices during use .
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, which is conducive to long-term stable operation of the entire machine;
- , such as power supplies, transformers, and high-frequency traces. High-frequency digital traces, high-frequency analog traces, and power traces must be kept away from under the module. If necessary, they must pass under the module .
- Assuming the module is soldered on the TopLayer, lay ground copper on the TopLayer of the module contact part (all copper is laid and well grounded), which must be close to the digital part of the module and routed on the BottomLayer;
- If 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 module's spurious emission and receiving sensitivity to varying degrees.
- If there are devices with large electromagnetic interference around the module, it will greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If there are traces with strong electromagnetic interference around the module (high-frequency digital, high-frequency analog, power supply traces), it will greatly affect the module's performance. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- The antenna installation structure has a significant impact on module performance. Make sure the antenna is exposed and preferably vertically upward.
- When the module is installed inside the case, you can use a high-quality antenna extension cable to extend the antenna to the outside of the case;
- The antenna must not be installed inside a metal shell, as this will significantly reduce the transmission distance.

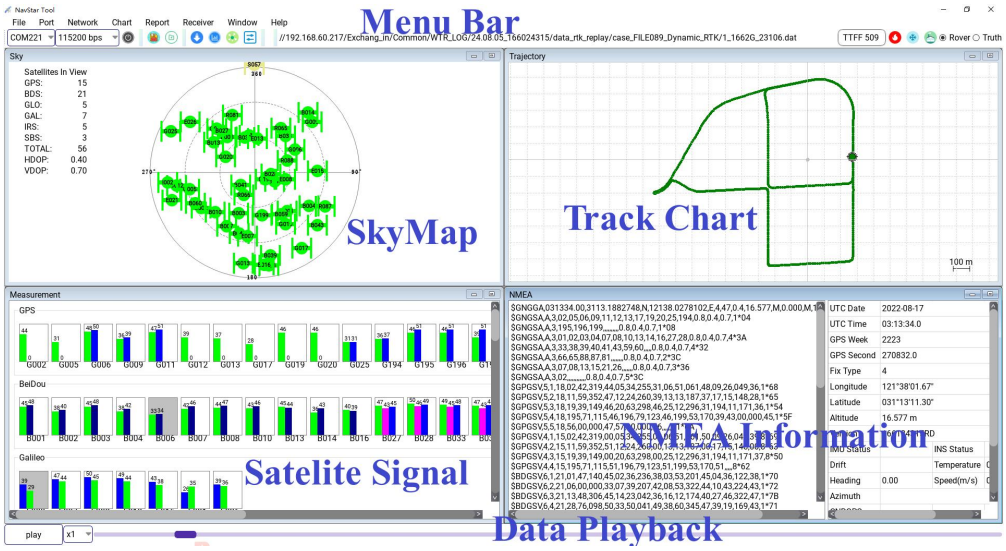
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6 E108-GN07 Series Product Getting Started Test Guide

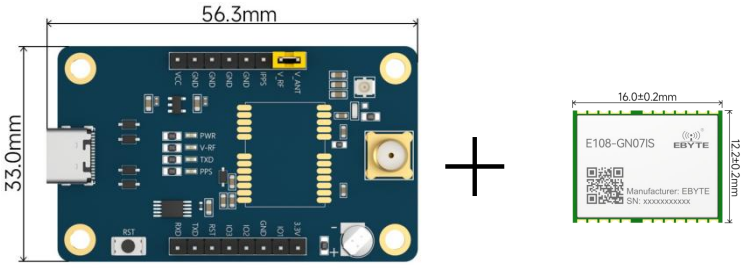
6.1 GNSS NavStar Tool Software Introduction

The GNSS NavStar Tool is a software tool for using, testing, and debugging the E108-GN07 Series module . It facilitates navigation and positioning performance testing. For detailed instructions, download the "NavStarTool_" file from the Ebyte official website .



Schematic diagram of the host computer interface

6.2 Test Suite Usage



The E108-TB-01 test board supports Type-C power delivery and has all module pins exposed , significantly reducing development cycles and facilitating quick testing . For more information, please visit the official website to download relevant documentation for this model .

6.3 Test Precautions

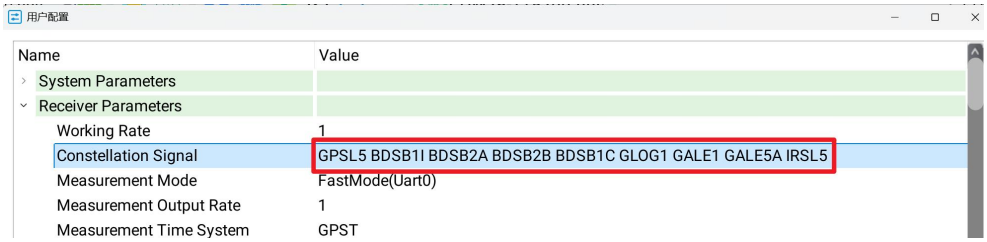
6.3.1 Do Not Use the QZSS L1S Frequency Band for RTK Positioning

For RTK firmware versions, it is not recommended to use the QZSS L1S frequency band. This band is mainly used for SBAS

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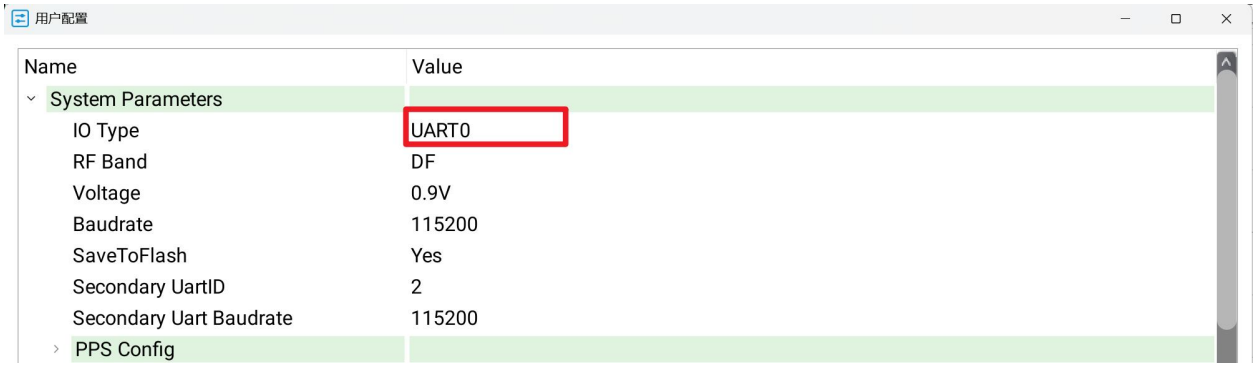
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positioning and does not participate in RTK resolution. Keep the default configuration, as shown in the figure below.



6.3.2 Do Not Change the UART Port

Only UART0 is allowed for the serial port, as shown in the figure below. Changing it to any other UART port is prohibited.



7 Instruction format

7.1 Instruction Format

For detailed instruction formats, please refer to the "BK166X Series Interface Manual" document downloaded from the Ebyte official website.

7.2 Support NMEA0183 protocol

supports NMEA0183 V4.1 protocol and is compatible with previous versions. For detailed information about NMEA0183 V4.1, please refer to the official NMEA 0183 V4.1 documentation. Common output formats are as follows:

GGA: time, position, number of satellites

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

RMC : time, date, position, speed;

ZDA:UTC time

GSV: visible GPS satellite information, elevation, azimuth, signal-to-noise ratio RMC: time, date, position, speed

VTG: Ground speed information

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7.2.1 Statement identifier

Identifier	meaning
BD	Beidou Navigation Satellite System (BDS)
GP	GPS
GL	GLONASS
GA	Galileo
GN	GNSS, Global Navigation Satellite System

7.2.2 GGA

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,xx,xx,M,xx,M,xx,xxxx*hh

Sample data: $GPGGA,065545.789,2109.9551,N,12023.4047,E,1,9,0.85,18.1,M,8.0,M,,*5E

name	Example	unit	describe
Message ID	$GPGGA		GGA protocol header
UTC time	065545.789		hhmmss.sss
latitude	2109.9551		ddmm.mmmm
N/S indication	N		N=North, S=South
longitude	12023.4047		dddmm.mmmm
E/W instructions	E		W=West, E=East
Positioning Indicator			0: Not positioned 1: SPS mode, positioning is valid 2: Differential, SPS mode, positioning valid 3:PPS mode, positioning is valid
Number of satellites	9		Range 0 to 12
HDOP	0.85		Horizontal accuracy
MSL amplitude	18.1	rice	
unit	M	rice	
Earth	-2.2	rice	
unit	M		-
Differential Time	8.0	Second	Invalid when there is no DGPS
Differential ID	0000		
Checksum	*5E		
<CR><LF>			End of message

7.2.3 GSA

$--GSA,a,a,x,x,x,x,x,x,x,x,x,x,x,x,x,x,xx,xx,xx*hh

Sample data: $GPGSA,A,3,10,24,12,32,25,21,15,20,31,,,,1.25,0.85,0.91*04

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name	Example	unit	describe
Message ID	$GPGS		GSA protocol header
Mode 1	A		M=Manual, force 2D or 3D mode A=Automatic
Mode 2	3		1: Positioning invalid ; 2: 2D positioning ; 3: 3D positioning
Satellite use	10		Channel 1
Satellite use	twenty four		Channel 2
Satellite use	12		Channel 3
Satellite use	32		Channel 4
Satellite use	25		Channel 5
Satellite use	twenty one		Channel 6
Satellite use	15		Channel 7
Satellite use	20		Channel 8
...	...	...	...
Satellite use			Channel 12
PDOP	1.25		Position accuracy
HDOP	0.85		Horizontal accuracy
VDOP	0.91		Vertical accuracy
Checksum	*04		
<CR><LF>			End of message

7.2.4 GSV

$--GSV,x,x,x,x,x,x,x,...*hh

Sample data:

$GPGSV,3,1,12,14,75,001,31,32,67,111,38,31,57,331,33,26,47,221,20*73

$GPGSV,3,2,12,25,38,041,29,29,30,097,32,193,26,176,35,22,23,301,30*47

$GPGSV,3,3,12,10,20,185,28,44,20,250,,16,17,217,21,03,14,315,*7D

name	Example	unit	describe
Message ID	$GPGSV		GSV protocol header
Number of messages	3		Range 1 to 3
Message number	1		Range 1 to 3
Number of satellites	12		
Satellite ID	14		Range 1 to 32
elevation	75	Spend	Maximum 90°
Azimuth	001	Spend	Range 0 to 359°
Carrier-to-noise ratio (C/No)	31	dBHz	Range 0 to 99, empty when no trace is being performed
Satellite ID	32		Range 1 to 32
elevation	67	Spend	Maximum 90°

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Azimuth	111	Spend	Range 0 to 359°
Carrier-to-noise ratio (C/No)	38	dBHz	Range 0 to 99, empty when no trace is being performed
Satellite ID	31		Range 1 to 32
elevation	57	Spend	Maximum 90°
Azimuth	331	Spend	Range 0 to 359°
Carrier-to-noise ratio (C/No)	33	dBHz	Range 0 to 99, empty when no trace is being performed
Satellite ID	26		Range 1 to 32
elevation	47	Spend	Maximum 90°
Azimuth	221	Spend	Range 0 to 359°
Carrier-to-noise ratio (C/No)	20	dBHz	Range 0 to 99, empty when no trace is being performed
Checksum	*73		
<CR><LF>			End of message

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7.3.5 RMC

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,xx,xx,xxxx,xx,a*hhSample data:

$GPRMC,100646.000,A,3109.9704,N,12123.4219,E,0.257,335.62,291216,,,A*59

name	Example	unit	describe
Message ID	$GPRMC		RMC protocol header
UTC time	100646.000		hhmmss.ss
state	A		A = data is valid; V = data is invalid
latitude	2109.9704		ddmm.mmmm
N/S indication	N		N=North, S=South
longitude	11123.4219		dddmm.mmmm
E/W instructions	E		W=West, E=East
Ground speed	0.257	Knot	
position	335.62	Spend	
date	291216		ddmmyy
Magnetic variables			-
Checksum	*59		
<CR><LF>			End of message

7.2.5 VTG

$--VTG,xx,T,xx,M,xx,N,xx,K*hh

Sample data: $GPVTG,335.62,T,,M,0.257,N,0.477,K,A*38

name	Example	unit	describe
Message ID	$GPVTG		VTG protocol header
position	335.62	Spend	
refer to	T		True
position	335.62	Spend	
refer to	M		Magnetic
speed	0.257	Knot	
unit	N		Festival
speed	0.477	km/h	
unit	K		km/h
unit	A		Positioning system mode indication: A—autonomous mode; D—differential mode; E—Estimation (dead reckoning) mode; M—Manual input mode; S—Simulator mode; N—The data is invalid.
Checksum	*10		
<CR><LF>			End of message

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8 Frequently Asked Questions

8.1 Module is easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. Exceeding the maximum value may cause permanent damage to the module .
- Please check the power supply stability, the voltage should not fluctuate greatly or frequently ;
- Please ensure anti-static operation during installation and use, as high-frequency components are sensitive to static electricity ;
- Please ensure that the humidity is not too high during installation and use, as some components are humidity sensitive .
- If there is no special requirement, it is not recommended to use it at too high or too low temperatures.

9 Welding operation instructions

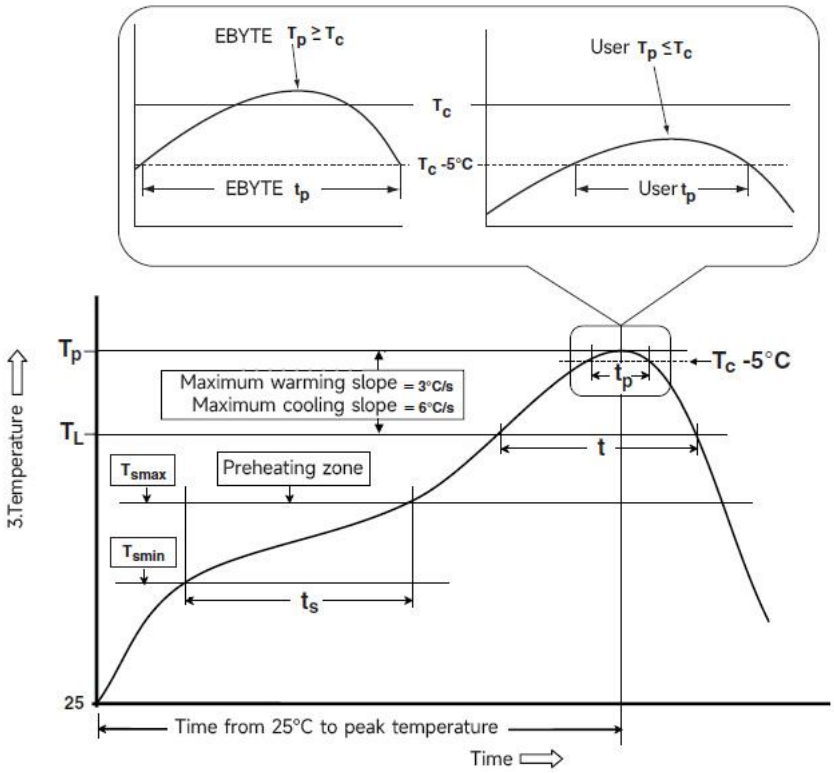
9.1 Reflow Temperature

Reflow profile characteristics		Leaded process assembly	Lead-free process assembly
Preheating/keeping warm	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Heating slope (TL~Tp)		3℃/second, maximum	3℃/second, maximum
Liquidus temperature (TL)		183℃	217℃
Keep time above TL		60-90 seconds	60-90 seconds
Package peak temperature Tp		Users must not exceed the temperature indicated on the product's "Moisture Sensitivity" label.	Users must not exceed the temperature indicated on the product's "Moisture Sensitivity" label.
The time (Tp) within 5°C of the specified classification temperature (Tc) is shown in the figure below.		20 seconds	30 seconds
Cooling slope (Tp~TL)		6℃/second, maximum	6℃/second, maximum
Time from room temperature to peak temperature		6 minutes, the longest	8 minutes, the longest
※The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user			

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9.2 Reflow Oven Curve



10 Related Models

Product Model	Chip Solutions	Satellite support	Package	Product size mm	Communication interface
E108 -GN02	-	BDS/GPS/GLONASS	patch	10.1*9.7*2.4	UART/GPIO
E108 -GN02D	-	BDS/GPS/GLONASS	-	22*20 * 7.8	UART
E108 -GN0 2 S	-	BDS/GPS/GLONASS	patch	16*12*2.4	UART/GPIO
E108 -GN04	-	BDS/GPS/GLONASS/GALILEO	patch	9.7*10.5*2.4	UART/GPIO
E108 -GN04S	-	BDS/GPS/GLONASS/GALILEO	patch	12.2*16.0*2.4	UART/GPIO
E108 - GN0 4D	-	BDS/GPS/GLONASS/GALILEO	-	20.0*22.0*7.8	UART

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Revision History

Version	Revision Date	Revision Notes	Maintainer
V1.0	2025-9-12	first edition	Hao
V1.1	2025-11-12	Edit content	Hao
V1.2	2026-08-21	New models: E108-GN087RS, E108-GN087RIS	Bin
V1.3	2026-10-08	Precautions for Adding a New Test Kit	Chi

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