E108-GN04 Series User Manual

BDS/GPS/GLONASS/GALILEO MULTI-MODE SATELLITE POSITIONING AND NAVIGATION MODULE



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Chengdu Ebyte Electronic Technology Co.,Ltd.

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1 Product Overview

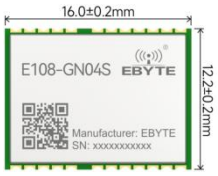
1.1 Product Introduction

The E108-GN04 series is a high-performance, highly integrated, low-power, low-cost multi-mode satellite positioning and navigation module that supports BDS/GPS/GLONASS/GALILEO satellite positioning. It is with small in size and low power consumption. It can be used in GNSS positioning applications such as vehicle navigation, smart wearables, and drones. It also provides software and hardware interfaces that are compatible with other suppliers' modulers, greatly reducing the user's development time cycle.

The module adopts the integrated design of RF base band, integrating DCDC, LDO, RF front end, low power application processor, RAM, Flash storage, RTC and power management, etc. It can power RTC and backup RAM through button battery or farad capacitor to reduce the first positioning time. It also supports multiple ways to connect with other peripherals, supports UART, GPIO,RS232,RS485 interface, if you need I2C, SPI,USB interface, please contact customer service for customization.



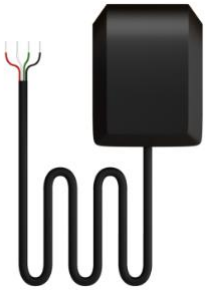
E108-GN04



E108-GN04S



E108-GN04D



E108-GN04G-xxx

1.2 Features

- Support BDS/GPS/GLONASS/GALILEO multi-system joint positioning and single-system independent positioning;
- Support BeiDou B1I and B1C;
- The maximum positioning information update rate in single-system independent positioning mode can reach 25Hz;
- Support PPS output;
- Support A-GNSS service;
- Built-in reset controller;
- Support UART,GPIO,RS232,RS485 interface interface;
- E108-GN04G series with shell, support IP67 waterproof;
- With active antenna detection and protection;
- Output format: Support NMEA 4.11;
- High sensitivity: cold start -148dBm, hot start -159dBm, recapture -160dBm, tracking -167dBm;
- The software and hardware are compatible with those of other manufacturers, which greatly reduces the user's development time cycle;

1.3 Application Scenario

- Vehicle positioning and navigation equipment;
- Wearable devices, such as GPS trackers;

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- UAV positioning, industrial computers, etc.
- Industrial equipment that requires GNSS positioning or navigation;
- Asset tracking;

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2 Specifications

2.1 Working Parameters

The main parameters	performance			Remark
	Minimum	Typical Value	Maximum	
E108-GN04 operating voltage (V)	2.7	3.3	3.6	Over 3.6V may burn the module
E108-GN04S operating voltage (V)				
E108-GN04D operating voltage (V)	2.7	5.0	5.5	Over 5.5 V may burn the module
E108-GN04G Series Operating Voltage (V)				
Communication level (V)	-	3.3	-	use 5V TTL has the risk of burning out
Operating temperature (℃)	- 40	-	+85	Industrial-grade design
Storage temperature	-50℃	-	-125℃	
humidity	5%	-	-95%RH	No condensation

2.2 Hardware Parameters

The main parameters	describe	Remark
Baud rate (bps)	4800～921600	Default 38400
Data bits	8bit	-
Stop bits	1	-
E108-GN04 communication interface	UART	-
E108-GN04S communication interface		-
E108-GN04D communication interface		-
E108-GN04G-TTL communication interface		-
E108-GN04G-232 communication interface	RS232	-
E108-GN04G-485 communication interface	RS485	-
E108-GN04 packaging	SMD	-
E108-GN04S packaging		-
E108-GN04 Dimensions	9.7*10.5*2.4mm	±0.2mm
E108-GN04S Dimensions	12.2*16.0*2.4mm	
E108-GN04D Dimensions	20.0*22.0*7.8mm	
E108-GN04G Series	50.4*38.4*17.0mm	

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dimensions			
E108-GN04 Antenna Interface		Stamp Holes	-
E108-GN04S Antenna Interface			-
E108-GN04D Antenna Interface		Ceramic Antenna	-
E108-GN04G Series Antenna Interface			-
E108-GN04G series cable length		3000mm	±50mm
letter of agreement		NMEA 4.11 and earlier are supported	-
Positioning update rate		3Hz ~ 25Hz	The maximum fixed update frequency can reach 25Hz
Supported positioning systems		BDS/GPS/GLONASS/GALILEO	GPS L1 C/A, QZSS L1 C/A/S, GLONASS L10F, BeiDou B1I/B1C, GALILEO E1B/C, SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
Work restrictions	high	80000m	-
	speed	500m/s	-
	Gravity acceleration	＜4g	-
product weight	E108-GN04	0.5g	±0.1g
	E108-GN04S	0.9g	
	E108-GN04D	7.9g	
	E108-GN04G Series	65.2g	±0.5g

2.3 GPS performance parameters

Category	Indicator		Typical Value	unit
Positioning time (Test condition 1)	Cold start		28	s
	Hot Start		1	s
	Recapture		1	s
Sensitivity (Test Condition 2)	Cold start		-148	dBm
	Hot Start		-159	dBm
	Recapture		-160	dBm
	Track		-167	dBm
Accuracy (Test Condition 3)	Horizontal positioning accuracy CEP		1.5	m
	Speed positioning accuracy		0.05	m/s
	Timing accuracy	RMS	30	ns
		99%	60	ns
Power consumption	E108-GN04 Capture Current		17	mA

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(Test condition 4)	E108-GN04S Capture Current	27	
	E108-GN04D Capture Current	25	
	E108-GN04G-TTL Capture Current	17	
	E108-GN04G-485 Capture Current	20	
	E108-GN04G-232 Capture Current	19	
	E108-GN04 Tracking Current	15	mA
	E108-GN04S Tracking Current	25.2	
	E108-GN04D Tracking Current	22.5	
	E108-GN04G-TTL Tracking Current	17	
	E108-GN04G-485 Tracking Current	20	
	E108-GN04G-232 Tracking Current	19	
	E108-GN04D Sleep Current	4	uA

Note: The above results are for GPS/ Beidou dual-mode operation ; the highest altitude can reach 18,000 meters, but the accuracy of the data will deviate after exceeding 10,000 meters.

[Test condition 1] : The number of received satellites is greater 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 10 meters.

[Test Condition 2] : External LNA noise coefficient 0.8 , number of received satellites greater than 6 , received signal strength value under lock or no loss of lock conditions within 5 minutes.

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

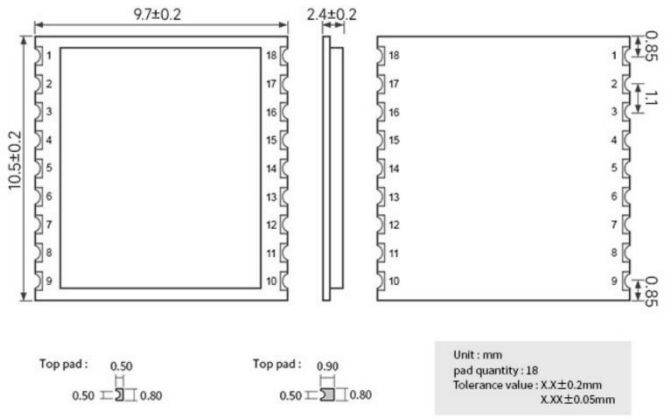
[Test condition 4] : The number of received satellites is greater than 6 , and the signal strength of all satellites is -130dBm .

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3 Mechanical dimensions and pin definition

3.1 E108-GN04 Pin Definition

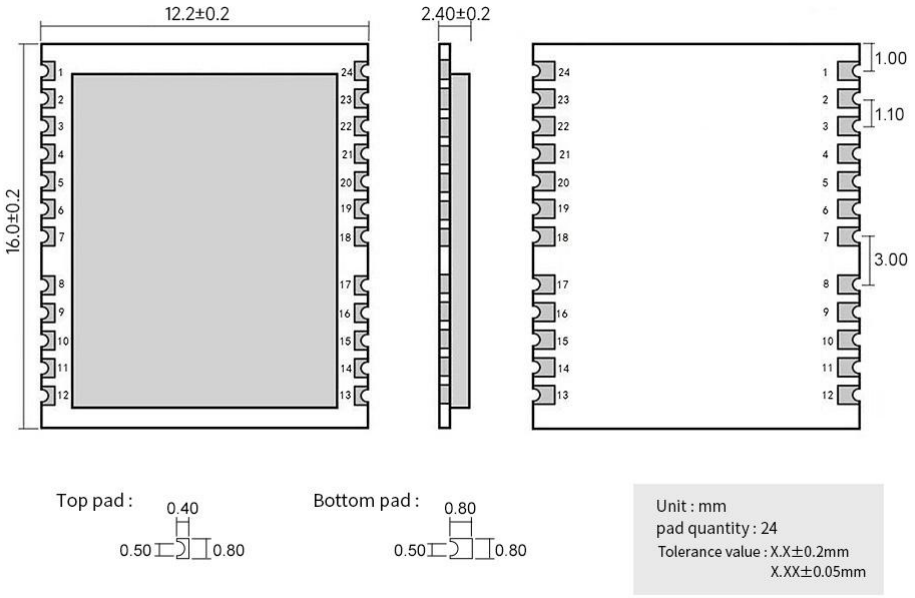


Pin number	Pin Name	Pin Direction	Pin Purpose
1	GND	-	Module Ground
2	TXD	Output	Serial port output, 3.3V level
3	RXD	Input	Serial port input, 3.3V level
4	1PPS	Output	Timing pulse signal (shared with SAFEBOOT_N pin)
5	EXTINT	Input	External interrupt, dangling handling
6	V_BCKP	Input	Backup voltage supply
7	V_IO	Input	Module IO power supply, when VIO_SEL=GND, power supply range: 1.68V-1.98V, 1.8V recommended
			Module IO power supply, when VIO_SEL= floating, power supply range: 2.7V-3.6V, 3.3V recommended
8	VCC	Input	Module power supply, power supply range: 2.7V-3.6V
9	RESET_N	Input	Reset pin, external reset input, internal pull-up, pull low for more than 1ms to reset, must be left floating if not used
10	GND	-	Module Ground
11	RF_IN	Input	Antenna interface
12	GND	-	Module Ground
13	LNA_EN	Output	Switch external LNA or active antenna. If not, it can be suspended.
14	VCC_RF	Output	RF power supply and detection, used to power active antennas (output power supply voltage equals VCC)
15	VIO_SEL	-	Voltage selector for V_IO supply. Connect to GND for 1.8 V supply, or leave open for 3.3 V supply.
16	NC	-	-
17	NC	-	-
18	SAFEBOOT_N	Input	To enter safe start mode, set this pin to low when the receiver starts. Dangling if not used, the SAFEBOOT_N pin is internally connected to the 1PPS pin through a 1kΩ series resistor.

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3.2 E108-GN04S Pin Definition

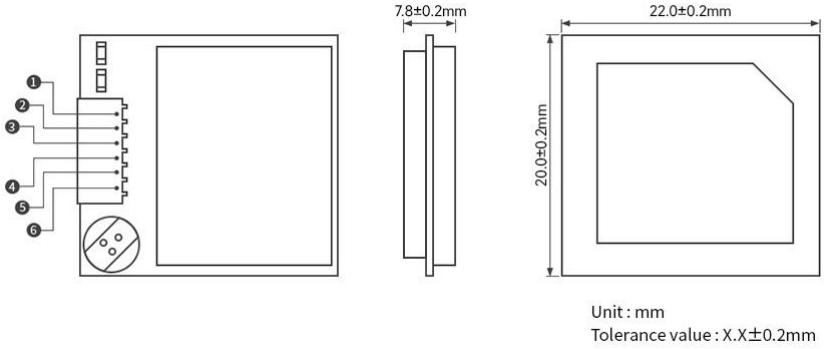


Pin number	Pin Name	Pin Direction	Pin Purpose
1	NC	-	-
2	SAFEBOOT_N	Input	To enter safe start mode, set this pin to low when the receiver starts. Dangling if not used, the SAFEBOOT_N pin is internally connected to the 1PPS pin through a 1kΩ series resistor.
3	1PPS	Output	Time pulse signal, 1 Pulse Per Second
4	EXTINT	Input	External interrupt, dangling handling
5	NC	-	-
6	NC	-	-
7	NC	-	-
8	RESET_N	Input	Reset pin, external reset input, internal pull-up, pull low for more than 1ms to reset, must be left floating if not used
9	VCC_RF	Output	RF power output, used to power the active antenna (output power voltage equals VCC)
10	GND	-	Module Ground
11	RF_IN	Input	Antenna interface
12	GND	-	Module Ground
13	GND	-	Module Ground
14	LNA_EN	Output	Switch external LNA or active antenna. If not, it can be suspended.
15	NC	-	-
16	NC	-	-
17	NC	-	-
18	NC	-	-
19	NC	-	-
20	TXD	Output	Serial port output, 3.3V level
21	RxD	Input	Serial port input, 3.3V level
22	V_BCKP	Input/Output	RTC power supply, can charge external battery
23	VCC	Input	Power supply pin, power supply range: 2.7V-3.6V
24	GND	-	Module Ground

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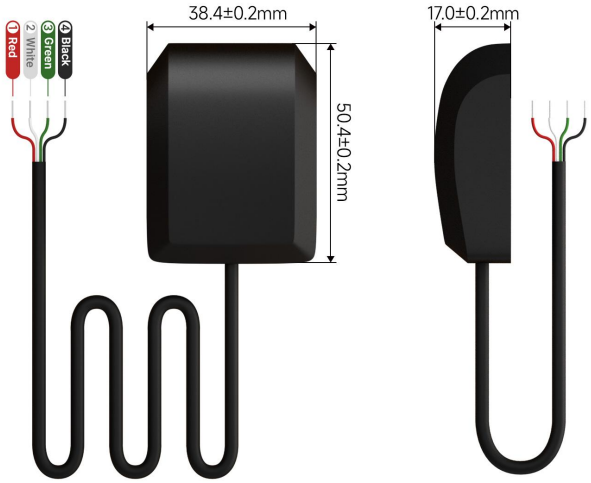
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3.3 E108-GN04D Pin Definition



Pin number	Pin Name	Pin Direction	Pin Purpose
1	CE	Input	Power enable terminal, can be pulled low to enter low power mode (default is high)
2	1PPS	Output	Time pulse signal, 1 Pulse Per Second
3	GND	-	Module power ground
4	TXD	Output	Serial port output, 3.3V level
5	RxD	Input	Serial port input, 3.3V level
6	VCC	Input	Module power supply, power supply range: 2.7V-5.5V

3.4 E108-GN04G Series Pin Definition



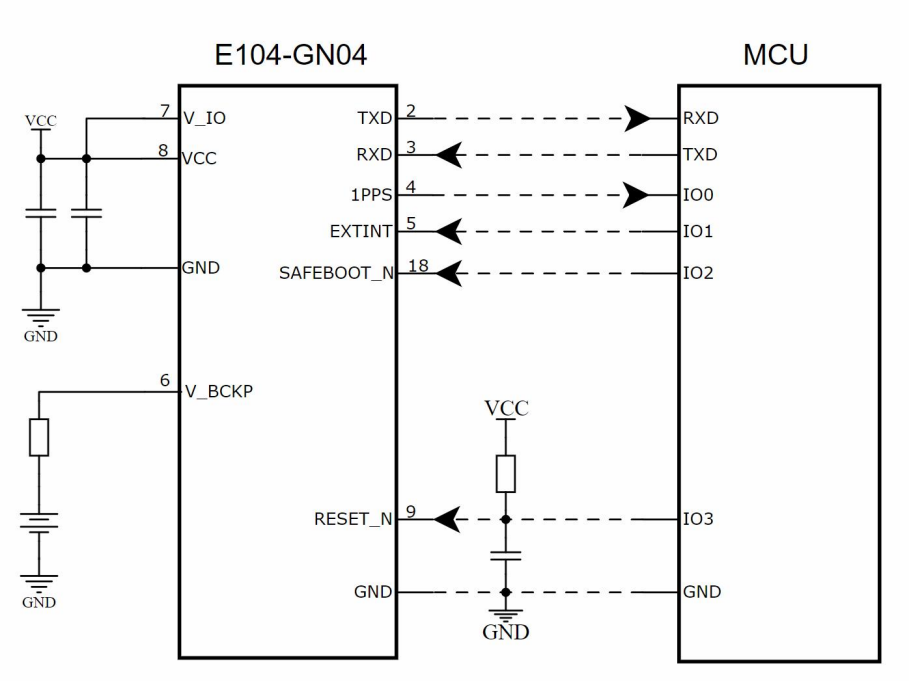
Pin number	Color of cable	Pin Name	Pin Direction	Pin Purpose
1	RED	VCC	-	Module power supply, power supply range: 2.7V-5.5V
2	WHITE	RXD/B	-	Serial input, 3.3V level /RS232 input /RS485-B line
3	GREEN	TXD/A	-	Serial output, 3.3V level /RS232 output /RS485-A line
4	BLACK	GND	-	Module Ground

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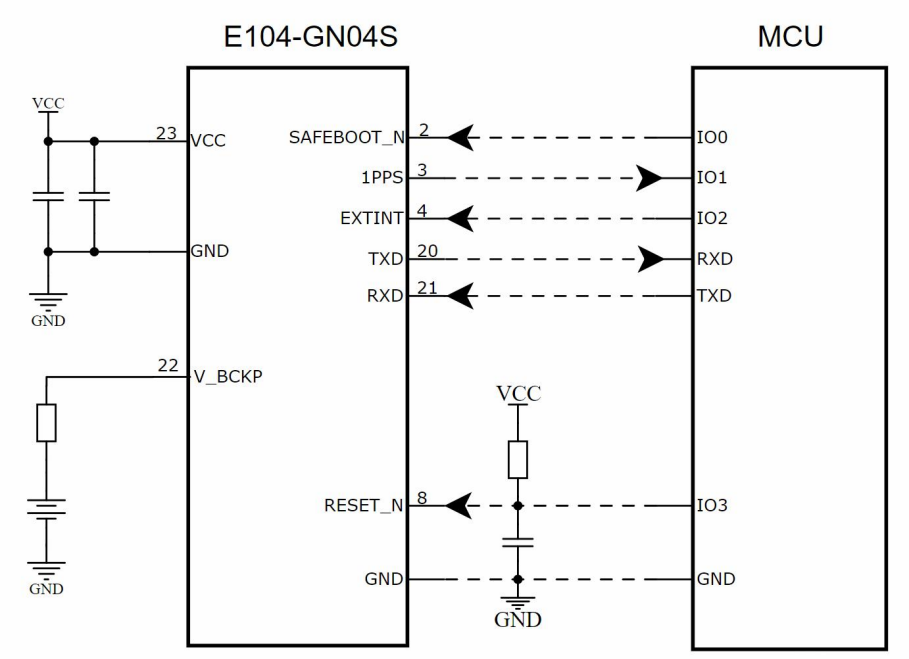
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4 Recommended Connection Diagram

4.1 E108-GN04



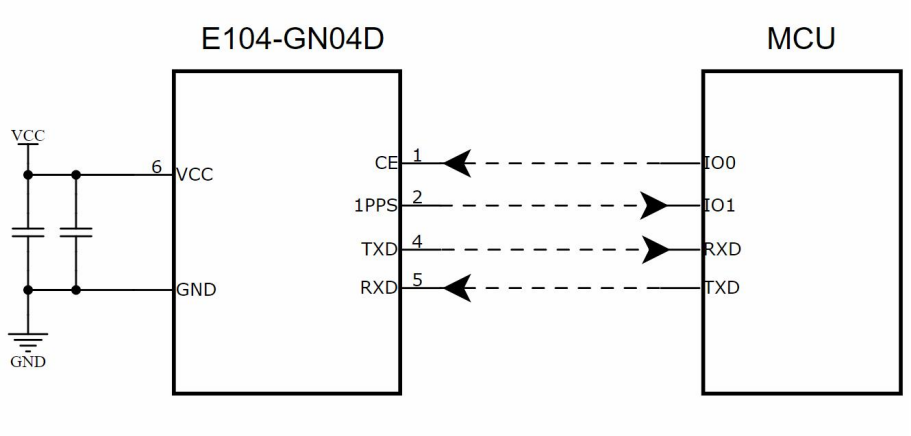
4.2 E108-GN04S



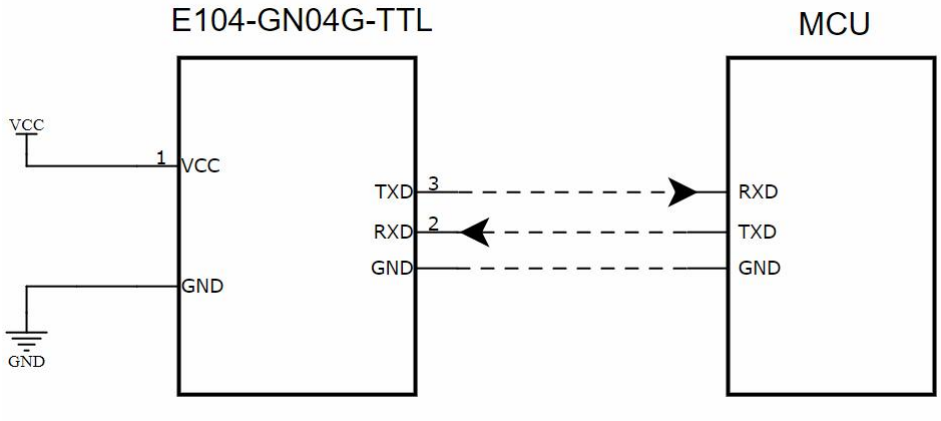
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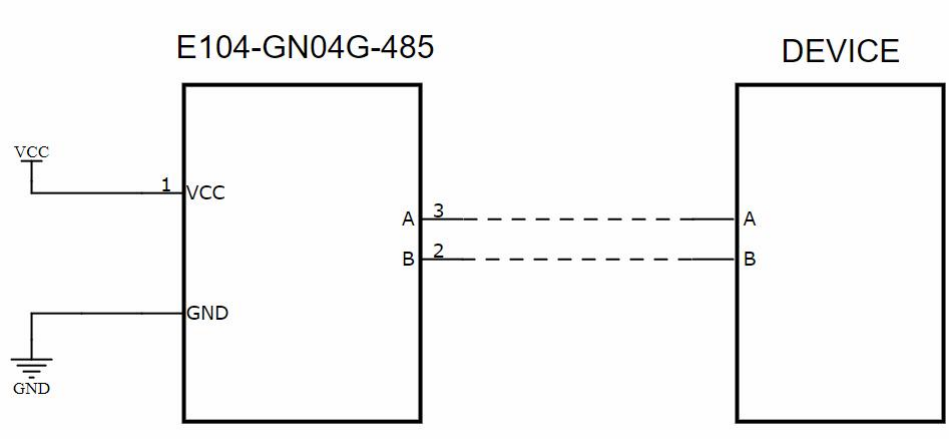
4.3 E108-GN04D



4.4 E108-GN04G-TTL



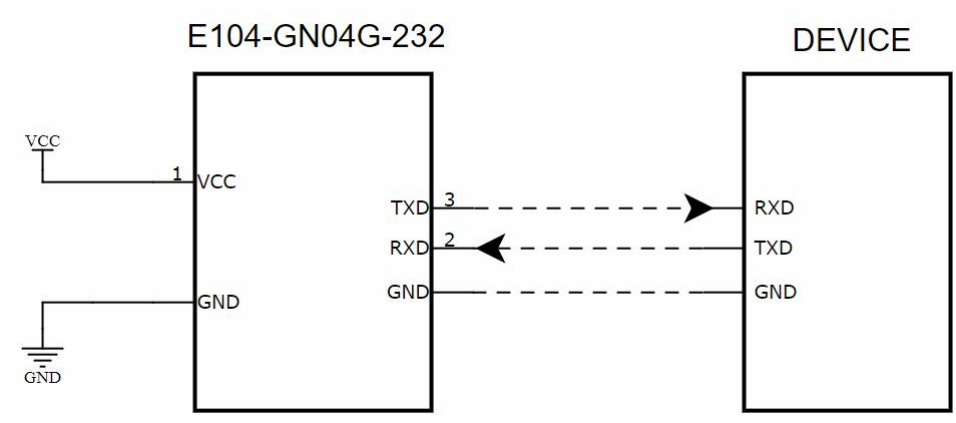
4.5 E108-GN04G-485



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4.6 E108-GN04G-232



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5 Hardware Design

- The application schematic design of the module can be directly referred to E108-GN04-TB-SCH in the Resources package.
- It is recommended to use a DC regulated power supply to power the module. The power ripple should not exceed 50mV, and the module needs to 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. If it exceeds the maximum value, the module will be permanently damaged.
- The serial port TXD and RXD are CMOS 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. Drastic temperature changes will cause its performance to deteriorate. Keep it away from high-temperature airflow and high-power heating devices when using it .
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, so that the whole machine can work stably for a long time;
- , such as power supplies, transformers, and high-frequency wiring. High-frequency digital wiring, high-frequency analog wiring, and power wiring 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;
- Assuming the module is soldered or placed on the TopLayer, it is also wrong to randomly route the wires on the BottomLayer or other layers, which will affect the module's spurious and receiving sensitivity to varying degrees;
- If there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module. It is recommended to keep 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 large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also 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.
- The antenna installation structure has a great impact on the 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 greatly reduce the transmission distance.

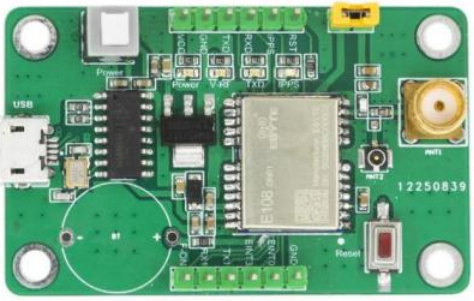
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6 Product Testing

6.1 Serial Port Assistant

The test is based on E108- GN04 -TB. If there is no test baseboard, you can refer to the baseboard schematic diagram in the data package (this test content is applicable to the whole E108-GN04 series) .



1. After connecting the GPS antenna, connect it to the computer via a USB cable. There is a USB port on the opposite side of the antenna on the board . Then press the power button to turn it on.

2. Note that when using an active antenna, the two RF_POWER pins 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 you can use u-center 2 to view it.



The baud rate is set to 38400 bps. After the serial port is opened, data will be reported continuously. The common output format is as follows:

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GGA : time, position, number of satellites;

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

GSV : visible GPS satellite information, elevation, azimuth, signal-to-noise ratio;

RMC : time, date, position, speed;

VTG : Ground speed information (for detailed meaning, please refer to NMEA0183 protocol;) ;

6.2 Run u-center 2

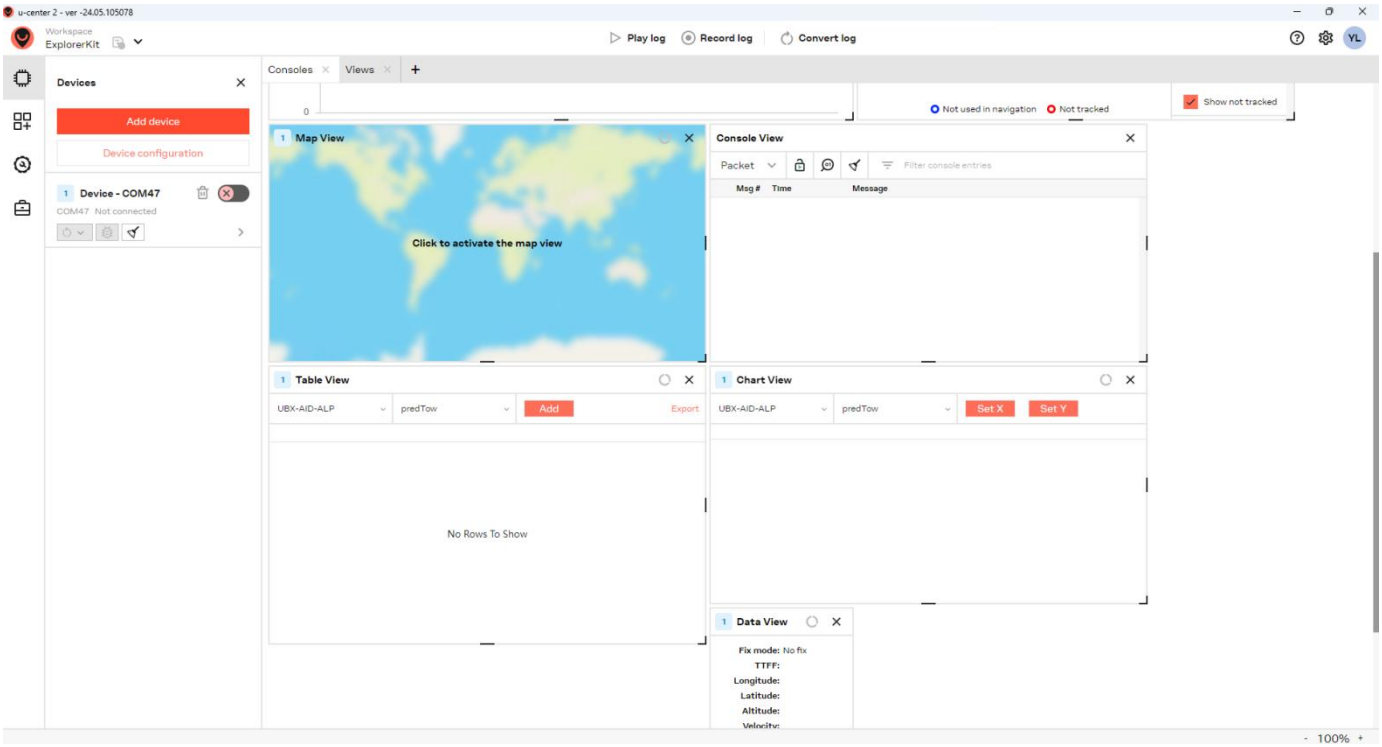
For ease of use, it is recommended to use the exclusive tool u-center 2 for debugging. For detailed usage, see the "u-center 2 User Manual" .

1. Run u-center 2, the page is as follows :

2. Select the corresponding serial port and configure the baud rate (you can enable automatic baud rate detection without setting it). After the connection is successful, you can see the reported data in the NMEA window.

Note: For detailed meaning, please refer to the description in NMEA0183 protocol .

3. After successful positioning, you can get the latitude and longitude information in the fields reported by the serial port. For more detailed tool usage information, please refer to the User Guide in the software .



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7 Command Format

7.1 NMEA Custom Messages

7.3 Support NMEA 4.11 protocol

Supports NMEA 4.11 protocol and is compatible with previous versions. 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, azimuth, signal-to-noise ratio RMC: time, date, position, speed

VTG: Ground speed information

7.3.1 Statement Identifiers

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

7.3.2 GGA

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

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		ddddmm.mmmm
E/W indication	E		W=West, E=East
Positioning Instructions			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

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MSL Amplitude	18.1	Meter	
unit	M	Meter	
Earth	-2.2	Meter	
unit	M		-
Differential Time	8.0	Second	Invalid when there is no DGPS
Differential ID	0000		
Checksum	*5E		
<CR><LF>			End of message

7.3.3 GSA

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

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

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	24		Channel 2
Satellite use	12		Channel 3
Satellite use	32		Channel 4
Satellite use	25		Channel 5
Satellite use	21		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

7.3.4 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

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$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	Max. 90°
Azimuth	001	Spend	Range 0 to 359°
Carrier to Noise Ratio (C/No)	31	dBHz	Range 0 to 99, empty if no trace is being performed
Satellite ID	32		Range 1 to 32
Elevation	67	Spend	Max. 90°
Azimuth	111	Spend	Range 0 to 359°
Carrier to Noise Ratio (C/No)	38	dBHz	Range 0 to 99, empty if no trace is being performed
Satellite ID	31		Range 1 to 32
Elevation	57	Spend	Max. 90°
Azimuth	331	Spend	Range 0 to 359°
Carrier to Noise Ratio (C/No)	33	dBHz	Range 0 to 99, empty if no trace is being performed
Satellite ID	26		Range 1 to 32
Elevation	47	Spend	Max. 90°
Azimuth	221	Spend	Range 0 to 359°
Carrier to Noise Ratio (C/No)	20	dBHz	Range 0 to 99, empty if no trace is being performed
Checksum	*73		
<CR><LF>			End of message

7.3.5 RMC

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

Sample 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		ddddmm.mmmm
E/W indication	E		W=West, E=East

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Ground speed	0.257	Knot	
position	335.62	Spend	
date	291216		ddmmyy
Magnetic variables			-
Checksum	*59		
<CR><LF>			End of message

7.3.6 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

8 Common Problem

8.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly ;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate ;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground ;
- Seawater has a strong ability to absorb radio waves, so the test effect at the seaside is poor ;

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- If there are metal objects near the antenna, or the antenna is placed in a metal shell, the signal attenuation will be very serious ;
- The power register is set incorrectly, or the air rate is set too high (the higher the air rate, the closer the distance) ;
- The power supply voltage is lower than the recommended value at room temperature. The lower the voltage, the lower the power output .

8.2 Module is easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged .
- Please check the stability of the power supply. 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 devices ;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

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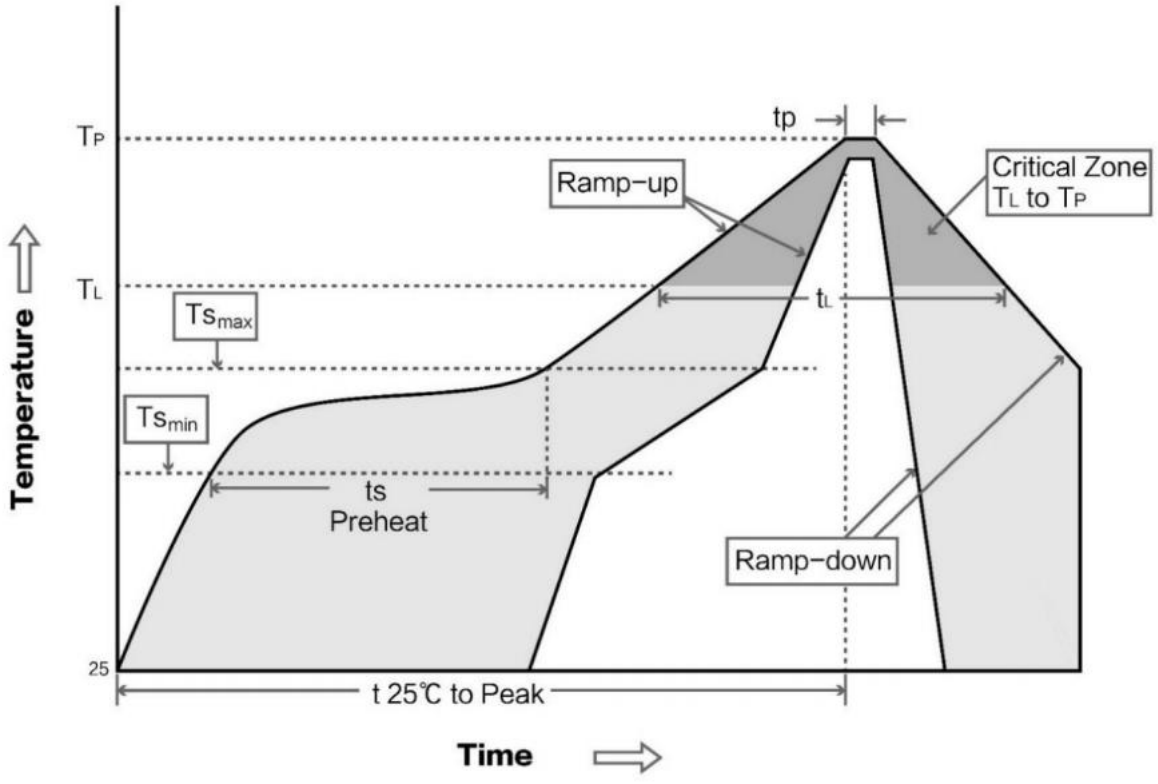
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9 Welding work instructions

9.1 Reflow Soldering Temperature

Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min(Tsmin)	Minimum preheating temperature	100℃	150℃
Preheat temperature max(Tsmax)	Maximum preheating temperature	150℃	200℃
Preheat Time(Tsmin to Tsmax)(ts)	Preheat time	60-120 sec	60-120 sec
Average ramp-up rate(TsmaxtoTp)	Average ascent rate	3℃/second max	3℃/second max
Liquidous Temperature(TL)	Liquidus temperature	183℃	217℃
Time(tL)MaintainedAbove(TL)	Time above liquidus	60-90 sec	30-90 sec
Peak temperature(Tp)	Peak temperature	220-235℃	230-250℃
Average ramp-downrate(TptoTsmax)	Average descent rate	6℃/second max	6C/second max
Time 25° to peak temperature 25℃	Time to peak temperature	6 minutes max	8 minutes max

9.2 Reflow Soldering Curve



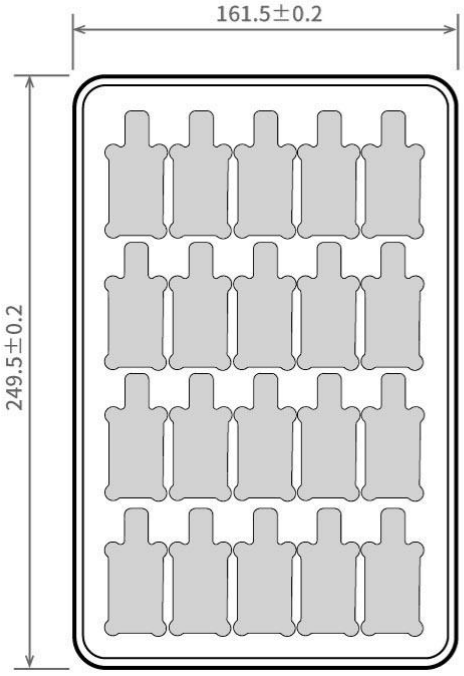
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10 Related Models

Product number	Chip Solution	Support satellite	Package	Product Size mm	Communication Interface
E108-GN02	-	BDS/GPS/GLONASS	SMD	10.1*9.7*2.4	UART/GPIO
E108-GN02D	-	BDS/GPS/GLONASS	-	22*20*7.8	UART
E108-GN01	-	BDS/GPS/GLONASS	SMD	16*12*2.4	UART/GPIO
E108-GN03	AT6558R	BDS/GPS/GLONASS	SMD	9.7*10.5*2.4	UART/GPIO
E108-GN03S	AT6558R	BDS/GPS/GLONASS	SMD	12.2*16.0*2.4	UART/GPIO
E108-GN03D	AT6558R	BDS/GPS/GLONASS	-	20.0*22.0*7.8	UART

11 Bulk Packaging Methods





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

Revise history

Version	Revision Date	Revision Notes	Maintenance man
V1.0	2024-08-08	initial version	Bin
V1.1	2024-11-01	New E108-GN04G-TTL, E108-GN04G-232, E108-GN04G-485	Bin

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