

G2

# Hardware User Guide

Issue 2.1 Date 2019-08-20



**Copyright © Neoway Technology Co., Ltd 2019. All rights reserved.**

No part of this document may be reproduced or transmitted in any form or by any means without prior written consent of Neoway Technology Co., Ltd.

neoway 有方 is the trademark of Neoway Technology Co., Ltd.

All other trademarks and trade names mentioned in this document are the property of their respective holders.

**Notice**

This document provides guide for users to use G2.

This document is intended for system engineers (SEs), development engineers, and test engineers.

THIS GUIDE PROVIDES INSTRUCTIONS FOR CUSTOMERS TO DESIGN THEIR APPLICATIONS. PLEASE FOLLOW THE RULES AND PARAMETERS IN THIS GUIDE TO DESIGN AND COMMISSION. NEOWAY WILL NOT TAKE ANY RESPONSIBILITY OF BODILY HURT OR ASSET LOSS CAUSED BY IMPROPER OPERATIONS.

THE INFORMATION IN THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE DUE TO PRODUCT VERSION UPDATE OR OTHER REASONS.

EVERY EFFORT HAS BEEN MADE IN PREPARATION OF THIS DOCUMENT TO ENSURE ACCURACY OF THE CONTENTS, BUT ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS DOCUMENT DO NOT CONSTITUTE A WARRANTY OF ANY KIND, EXPRESS OR IMPLIED.

Neoway provides customers complete technical support. If you have any question, please contact your account manager or email to the following email addresses:

Sales@neoway.com

Support@neoway.com

**Website:** <http://www.neoway.com>

# Contents

<b>1 About G2</b> .....	<b>1</b>
1.1 Overview .....	1
1.2 Block Diagram.....	1
1.3 Specifications .....	2
<b>2 Pad Layout and Pin Definition</b> .....	<b>4</b>
2.1 Pad Layout .....	4
2.2 Pin Definition .....	5
<b>3 Application Interfaces</b> .....	<b>6</b>
3.1 Power Supply .....	6
3.1.1 VBAT.....	6
3.1.2 VBACKUP .....	6
3.1.3 Work Modes .....	6
3.2 UART.....	7
3.3 1PPS .....	8
<b>4 Antenna Interface</b> .....	<b>9</b>
4.1 Ceramic Patch Antenna .....	9
4.2 PCB Design.....	9
<b>5 Electrical Feature and Reliability</b> .....	<b>11</b>
5.1 Electrical Features .....	11
5.1.1 Extreme Operating Voltage .....	11
5.1.2 Recommended Operating Voltage .....	11
5.2 Temperature .....	12
5.3 ESD Protection.....	12
<b>6 Mechanical Features</b> .....	<b>13</b>
6.1 Dimensions.....	13
6.2 Label/Appearance .....	14
6.3 Packaging.....	14
6.3.1 Tape & Reel Packaging .....	14
6.3.2 Moisture-Sensitive .....	16
<b>7 Application Design and SMT</b> .....	<b>17</b>
7.1 G2 Foot Print.....	17
7.2 Recommended Footprint.....	18
7.3 Stencil.....	18
7.4 Solder Paste.....	18
7.5 Reflow Profile .....	19
<b>8 Safety Recommendations</b> .....	<b>21</b>
<b>A Abbreviation</b> .....	<b>22</b>

## Table of Figures

Figure 1-1 Block diagram .....	2
Figure 2-1 G2 pin definition (top view) .....	4
Figure 3-1 UART connection .....	8
Figure 3-2 1PPS timing .....	8
Figure 6-1 G2 dimensions (Unit: mm) .....	13
Figure 6-2 G2label .....	14
Figure 7-1 G2 foot print (bottom view) .....	17
Figure 7-2 Recommended PCB footprint (top view) .....	18
Figure 7-3 Temperature curve .....	19

## Table of Tables

Table 1-1 Version and bands.....	1
Table 2-1 IO types .....	5
Table 2-2 Pin definition.....	5
Table 3-1 Power status, clock status, and current in different work modes.....	7
Table 4-1 G2 ceramic patch antenna .....	9
Table 5-1 G2 extreme operating voltage.....	11
Table 5-2 G2recommended operating voltage.....	11
Table 5-3 Temperature feature .....	12
Table 5-4 G2 ESD feature .....	12

# About This Document

## Scope

This document is applicable to G2 series.

It defines the features, indicators, and test standards of the G2 module and provides reference for the hardware design of each interface.




## Audience

This document is intended for [system engineers \(SEs\)](#), [development engineers](#), and [test engineers](#).

## Change History

Issue	Date	Change	Changed By
1.0	2018-08	Initial draft	Zhuo Jianzheng
2.0	2019-01	<ul style="list-style-type: none"><li>Modified some parameters</li><li>Changed pin names of I2C function</li><li>Deleted sleep mode</li></ul>	Zhuo Jianzheng
2.1	2019-08	<ul style="list-style-type: none"><li>Deleted I2C</li><li>Modified the channel quantity of capturing and tracking</li></ul>	Gong Hualiang

## Conventions

Symbol	Indication
	This warning symbol means danger. You are in a situation that could cause fatal device damage or even bodily damage.
	Means reader be careful. In this situation, you might perform an action that could result in module or product damages.
	Means note or tips for readers to use the module

## Related Documents

*Neoway\_G2\_Datasheet*

*Neoway\_G2\_Product\_Specifications*

*Neoway\_G2\_AT\_Command\_Manual*

*Neoway\_G2\_EVK\_User\_Guide*

# 1 About G2

G2 is a GNSS module that supports BDS B1, GPS L1, and GLONASS L1. It adopts a unified chipset integrating baseband and RF and embeds LNA and ceramic patch antenna. This architecture facilitates the application design and reduces the cost. It is an optimal navigation solution to demands for high sensitivity, low power consumption, and low cost in different navigation devices

## 1.1 Overview

G2 series including the following variants and band configurations.

Table 1-1 Version and bands

Module	Variants	GPS	BDS	GLONASS	Support GAGAN
G2	G2-B1	√	√		
	G2-D1	√		√	√

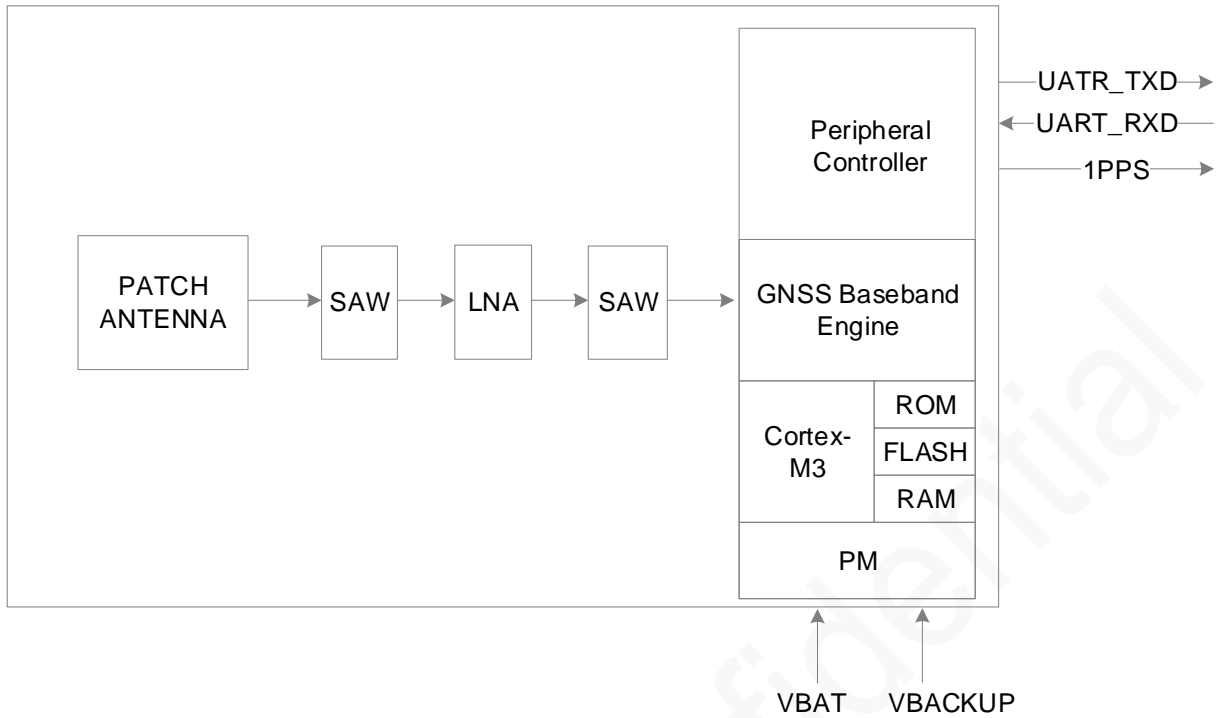
## 1.2 Block Diagram

G2 consists of the following functional units:

- GNSS baseband
- RF front end components
- RTC
- Peripheral interfaces



Figure 1-1 Block diagram



### 1.3 Specifications

Parameter	Description	Min.	Typ.	Max	Unit	Remarks
Positioning precision (open air)	Horizontal		<2		m	
	Elevation		<4.5		m	
Speed precision			<0.1		m/s	
Channel quantity	Capturing		32			
	Tracking		32			
TTFF (@-130dBm)	Cold start		<32		s	
	Hot start		1		s	
	Recapture		1		s	
Sensitivity	Cold start		-148		dBm	
	Hot start		-156		dBm	
	Recapture		-160		dBm	
	Tracking		-162		dBm	
Baud rate		4800	9600	2560400	bps	9600bps by

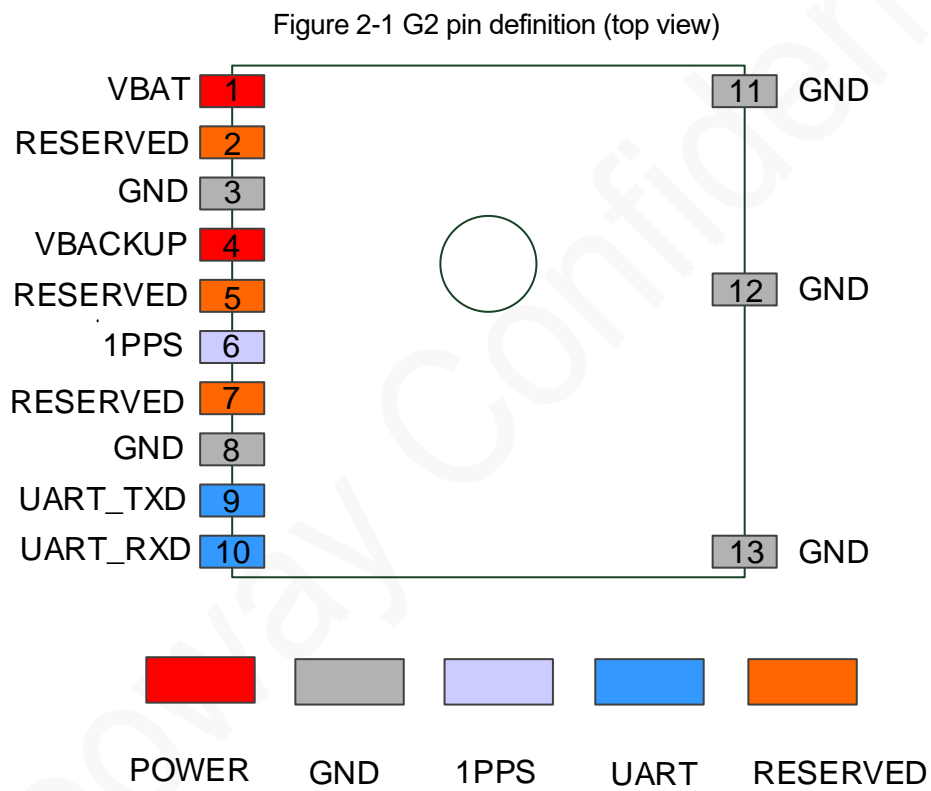
						default
Update frequency			1	10	Hz	1Hz by default
Operating voltage	VBAT	2.7	3.3	3.6	V	
	VBACKUP	1.4	3.3/3.0	3.6	V	
Current (@instrument)	Capturing		30		mA	3.3 V
	Tracking		28		mA	3.3 V
	Idle		10		μA	3.3 V

## 2 Pad Layout and Pin Definition

There are 13 pins on G2 and their pads are in LCC package.

### 2.1 Pad Layout

Figure 2-1 shows the pad layout of G2.



## 2.2 Pin Definition

Table 2-1 lists the IO types

Table 2-1 IO types

IO types	
DO	Digital output, COMS logic level
DI	Digital input, COMS logic level
PI	Power input
DC feature description	
P1	Power type of digital IO interface
	3.3V: V <sub>IH</sub> =2.6V~3.6V, V <sub>IL</sub> = -0.3V~0.6V V <sub>OH</sub> =2.9V~3.3V, V <sub>OL</sub> =0V~0.4V

Table 2-2 Pin definition

Signal	Pin	I/O	Function	DC Feature	Remarks
<b>Power</b>					
VBAT	1	PI	Main supply	power 2.7V~3.6V (Typ:3.3V)	Supply a maximum current of 100 mA
VBACKUP	4	PI	Backup supply input	power 1.4V~3.6V (Typ:3.3/3.0V) I <sub>norm</sub> =10μA	Supply power to RTC and backup RAM. Leave it floating if not used.
GND	3,8,11,12,13				Ensure that all GND pins are grounded.
<b>GPIO</b>					
1PPS	6	DO	Pulse per second	P1	Pulled up by default. Leave it floating if not used.
<b>UART</b>					
UART_TXD	9	DO	Data transmitting	P1	Used for data transmission.
UART_RXD	10	DI	Data receiving	P1	Leave it floating if not used.
<b>Others</b>					
RESERVED	2, 5, 7		Reserved pins		Leave it floating if not used.

## 3 Application Interfaces

G2 provides power supply interface, UART interface, I2C interface, and 1PPS interface.

This chapter describes how to use each interface and the design precautions.

### 3.1 Power Supply

Signal	Pin	I/O	Function	Remarks
VBAT	1	PI	Main power supply	2.7V~3.6V(Typ:3.3V)
VBACKUP	4	PI	Backup power supply	1.4V~3.6V(Typ:3.3/3.0/2.7V) Supply power to RTC and backup RAM. Leave it floating if not used.
GND	3,8,11,12,13			Ensure that all GND pins are grounded.

#### 3.1.1 VBAT

VBAT is the power supply input pin of the module. Its input voltage ranges from 2.7 V to 3.6V and the typical value is 3.3 V. In addition to baseband, it supplies power to RF power and LNA. The performance of the VBAT power supply is a critical path to module's performance and stability.

To ensure the optimal performance of the module, use low-noise LDO specifically for RF to supply power.

#### 3.1.2 VBACKUP

VBACKUP is the backup power supply of the module. It is used to supply power to RTC and backup RAM so that the module can save key ephemeris data for hot start, warm start, and ephemeris computation after VBAT is shut down.

The input voltage of the backup power supply ranges from 1.4 V to 3.6 V. The recommended value is 3.3/3.0. It can be connected to a button battery or capacitor.

#### 3.1.3 Work Modes

G2 supports the following two work modes:

- Positioning mode

In positioning mode, the capturing engine is enabled all the time and it will automatically switch to tracking status to decrease operating current after finding valid location information, all ephemeris and data.

- Idle mode

The module enters idle mode after VBAT is shut down. Only RTC backup part works normally. The power and clocks of all other functions are shut down.

After VBAT is supplied power, the module enters positioning mode.

To support hot start and warm start, VBACKUP must be able to supply power after VBAT is shut down.

To position quickly, keep the power supply of the VBACKUP.

Table 3-1 lists the power status, clock status, and current in different modes.

Table 3-1 Power status, clock status, and current in different work modes

Work Mode	VBAT	VBACKUP	Main Clock	RTC Clock	Current
Positioning	ON	ON	ON	ON	$I_{VBAT} = 30\text{mA}$
Idle	OFF	ON	OFF	ON	$I_{VBACKUP} = 20\mu\text{A}$

## 3.2 UART

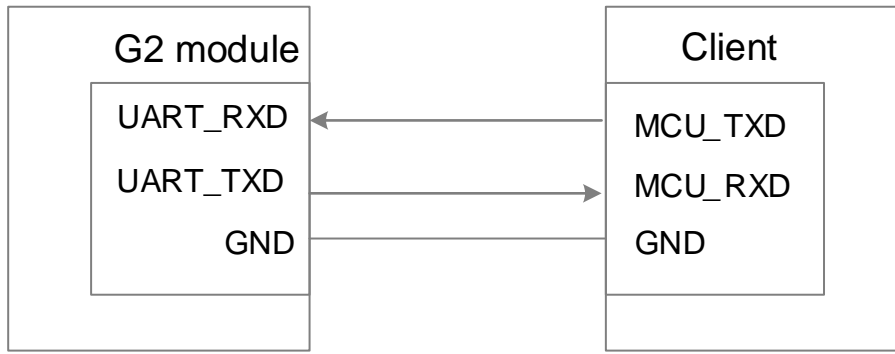
Signal	Pin	I/O	Function	Remarks
UART_TXD	9	DO	Data transmitting	9600 bps by default
UART_RXD	10	DI	Data receiving	

UART outputs NMEA data at UTC second boundary. Users can also switch the work mode and baud rate through UART on the host. The module supports baud rate ranging from 4800bps to 2560400bps. The default baud rate is 9600bps. Data format: 1 start bit, 8 data bits, 1 stop bit, no checksum bit.

For more information, see *Neoway\_G2/G7A\_Receiver\_Commands\_Manual*.

Figure 3-1 shows the connection of the UART interface. If the logic level of UART and MCU does not match, add a level shifter.

Figure 3-1 UART connection

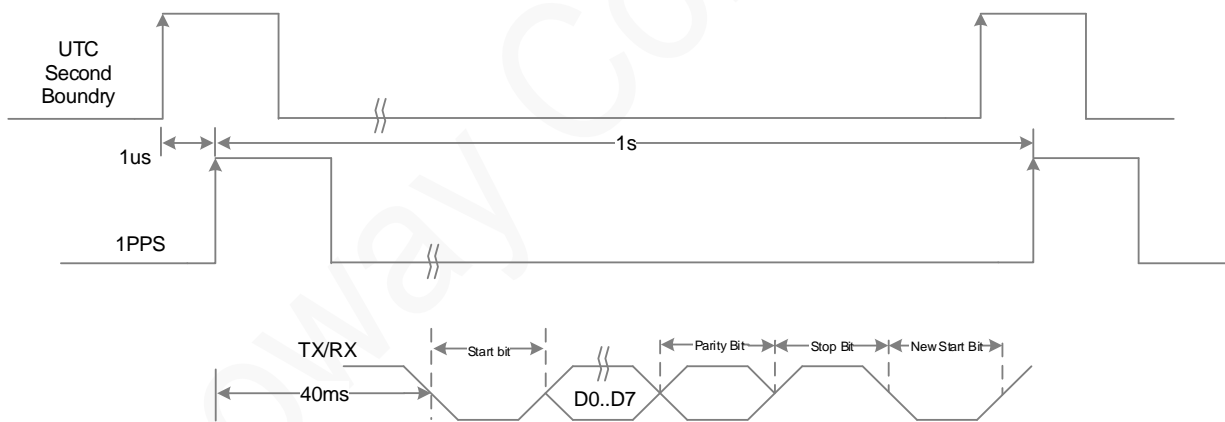


### 3.3 1PPS

1PPS signal is output several seconds after the module fixes position.

Figure 3-2 shows the timing of 1PPS signal.

Figure 3-2 1PPS timing



## 4 Antenna Interface

G2 requires a ceramic patch antenna for GNSS function. Comply with the PCB recommendations in your application design to ensure the optimal performance of antenna.

### 4.1 Ceramic Patch Antenna

Table 4-1 G2 ceramic patch antenna

Antenna Type	Parameter	Value	Remarks
Ceramic patch antenna	Dimensions	15.0×15.0×4.0mm	
	Frequency	GPS:1575.42MHz BDS:1561.098MHz GLONASS:1602.0MHz	The frequency of the antenna matches the version of the module.
	Bandwidth	>6MHz	
	Polarity	RHCP	
	SWR	<1.5	
	Gain	2dBic	

### 4.2 PCB Design

GNSS signals are easy to be affected by external factors. To obtain the optimal performance of the G2 module, follow the recommendations below in your application design:

- Ensure that the ceramic patch antenna is upwards and no conduction material is placed above it.
- Ensure that the BT/Wi-Fi/GSM/LTE RF systems are placed far away from the G2 module.
- Ensure that high-speed signals such as USB, LCD, and camera are laid out on the inner layer of the PCB and surrounded by grounds. Ensure that these signals are far away from the G2 module.
- Ensure that the power chipset and MCU are placed far away from the module or on the back of the PCB. Add a shield cover if necessary.



- Ensure that the module is surrounded by ground and the ground area should not be less than 30mm×30mm.
- Ensure that the G2 module is at least 10 mm away from other metal components. Otherwise, the antenna performance will be affected.

## 5 Electrical Feature and Reliability

This chapter describes the electrical features and reliability of G2.

### 5.1 Electrical Features

To ensure that G2 functions properly, operate it in recommended operating conditions.

#### 5.1.1 Extreme Operating Voltage

Table 5-1 G2 extreme operating voltage

Parameter	Description	Minimum Value	Maximum Value	Unit
VBAT	Power supply	-0.3	4.1	V
VBACKUP	Backup power supply	-0.3	4.1	V
VIO	IO voltage	-0.3	4.1	V



If the input voltage is lower than the minimum value, the module might fail to start. If the voltage exceeds the high threshold or there is a voltage burst during the startup, the module might be damaged permanently.

#### 5.1.2 Recommended Operating Voltage

Table 5-2 G2 recommended operating voltage

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
VBAT	2.7	3.3	3.6	V
VBACKUP	1.4	3.3/3.0	3.6	V

## 5.2 Temperature

Table 5-3 Temperature feature

Module Status	Minimum Value	Typical Value	Maximum Value
Operating	-40°C	25 °C	85°C
Storage	-50°C	/	125°C



If the module works in an environment where the temperature exceeds the thresholds of the operating temperature range, some of its RF performance indicators might be worse but it can still work properly.

## 5.3 ESD Protection

Humidity: 45% Temperature: 25 °C

Table 5-4 G2 ESD feature

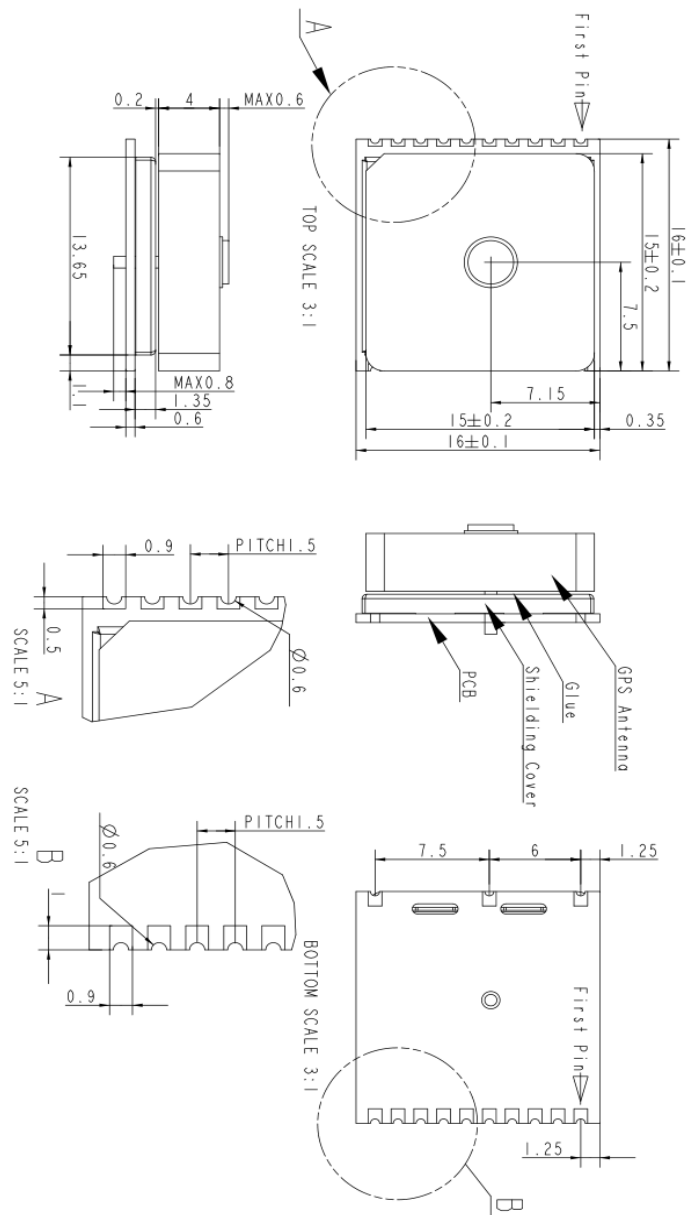
Testing Point	Contact Discharge	Air Discharge
VBAT	±8 kV	±15 kV
GND	±8 kV	±15 kV
ANT	±8 kV	±15 kV
Cover	±8 kV	±15 kV
Others	±2 kV	±4 kV

# 6 Mechanical Features

This chapter describes the mechanical features of G2.

## 6.1 Dimensions

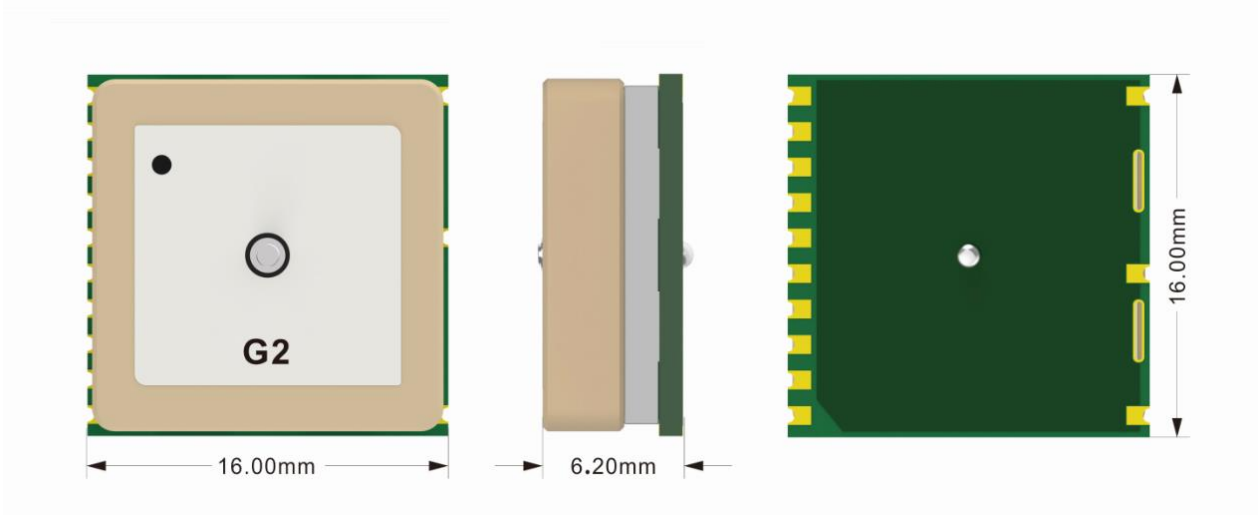
Figure 6-1 G2 dimensions (Unit: mm)



## 6.2 Label/Appearance

Figure 6-2 shows the label of G2.

Figure 6-2 G2label

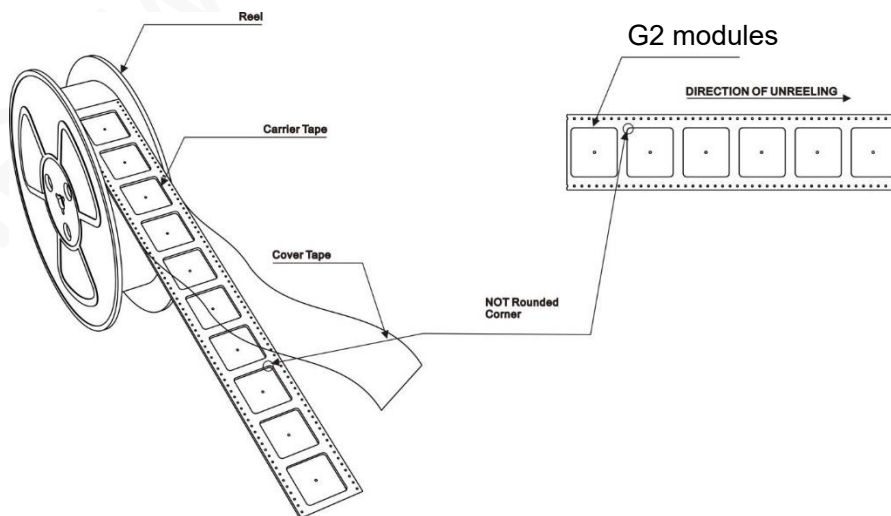


## 6.3 Packaging

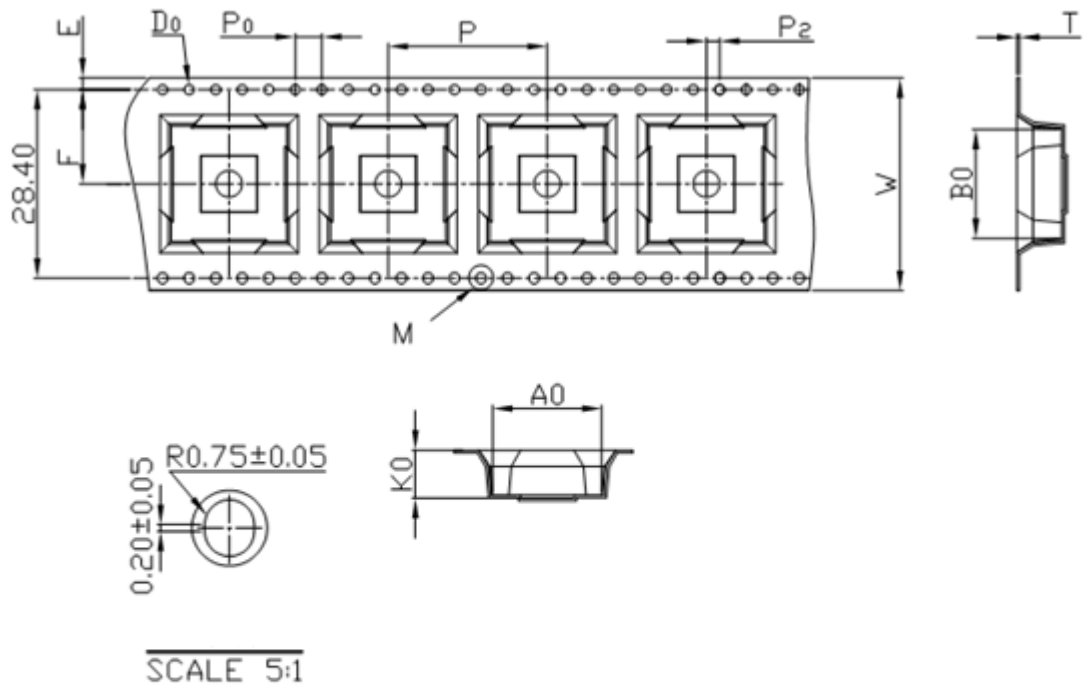
G2 modules are packed in sealed bags on delivery to guarantee a long shelf life. Follow the same package of the modules again in case of opened for any reasons.

### 6.3.1 Tape & Reel Packaging

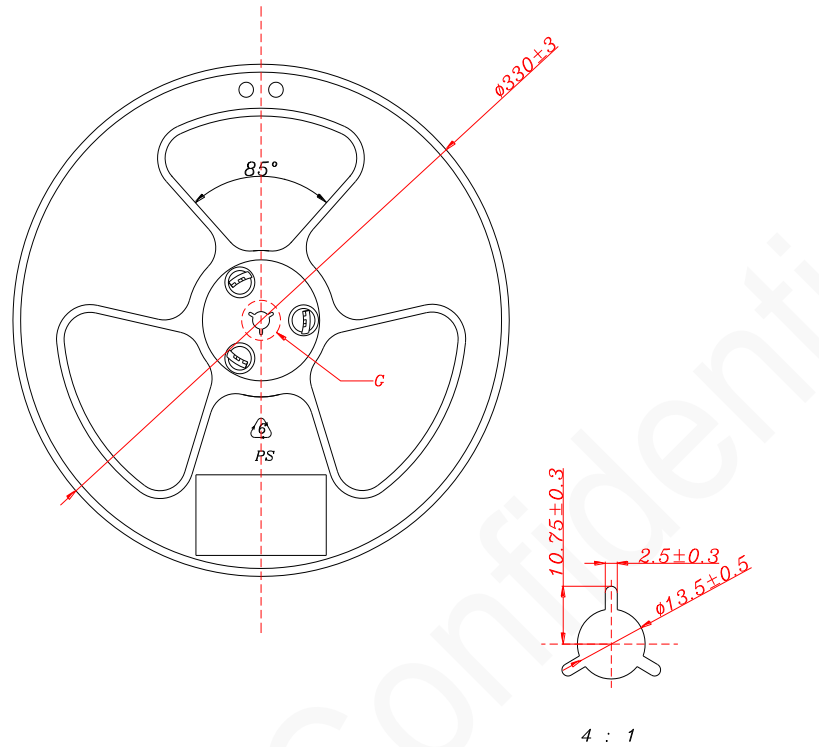
G2 in mass production are shipped in the following package.



Tape



Reel



### 6.3.2 Moisture-Sensitive

G2 is a level 3 moisture-sensitive electronic elements, in compliance with IPC/JEDEC J-STD-020 standard.

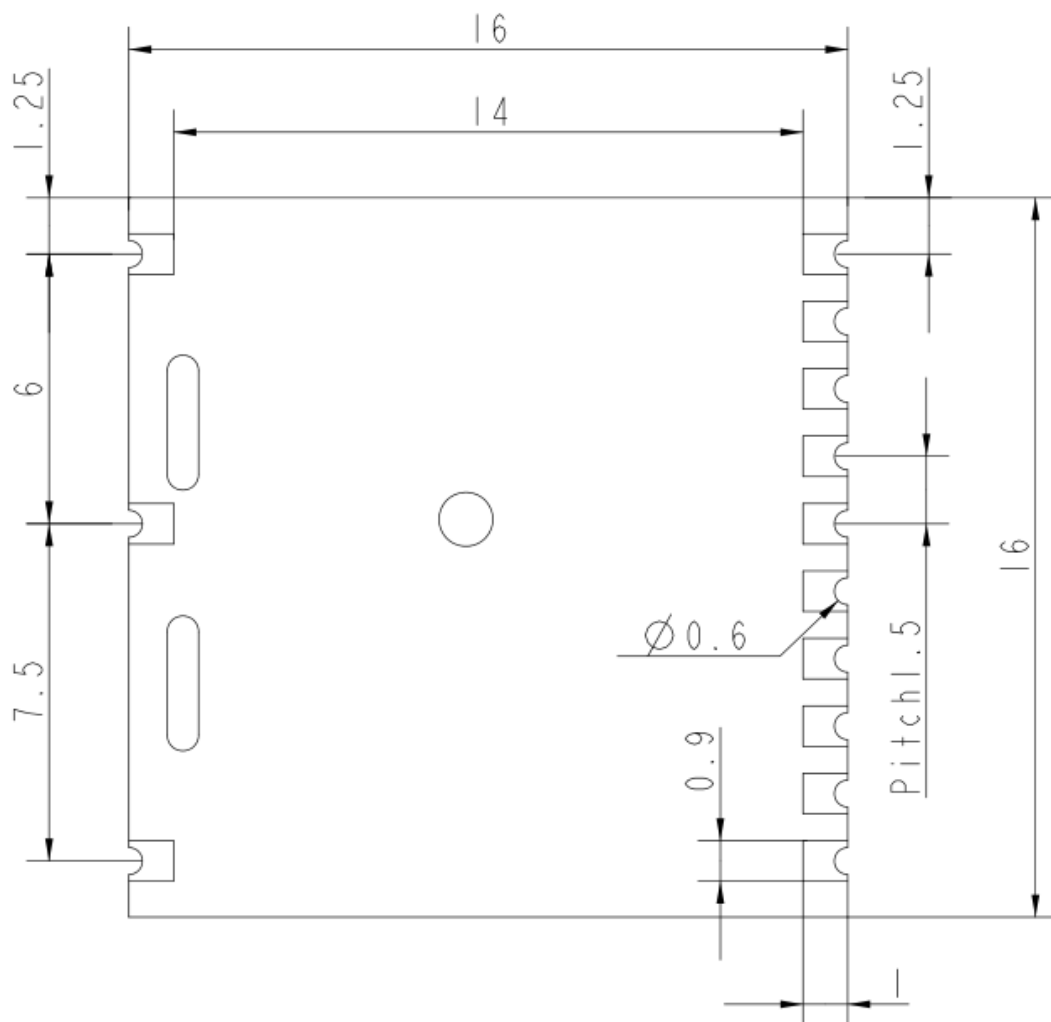
If the module is exposed to air for more than 48 hours at conditions not worse than 30°C/60% RH, bake it at a temperature higher than 90 degree for more than 12 hours before SMT.Or, if the indication card shows humidity greater than 20%, the baking procedure is also required.Do not bake modules with the package tray directly.

## 7 Application Design and SMT

G2 is introduced in LCC package. This chapter provides G2foot print, recommended PCB design and SMT information to guide users how to mount the module onto application PCB board.

### 7.1 G2 Foot Print

Figure 7-1 G2 foot print (bottom view)

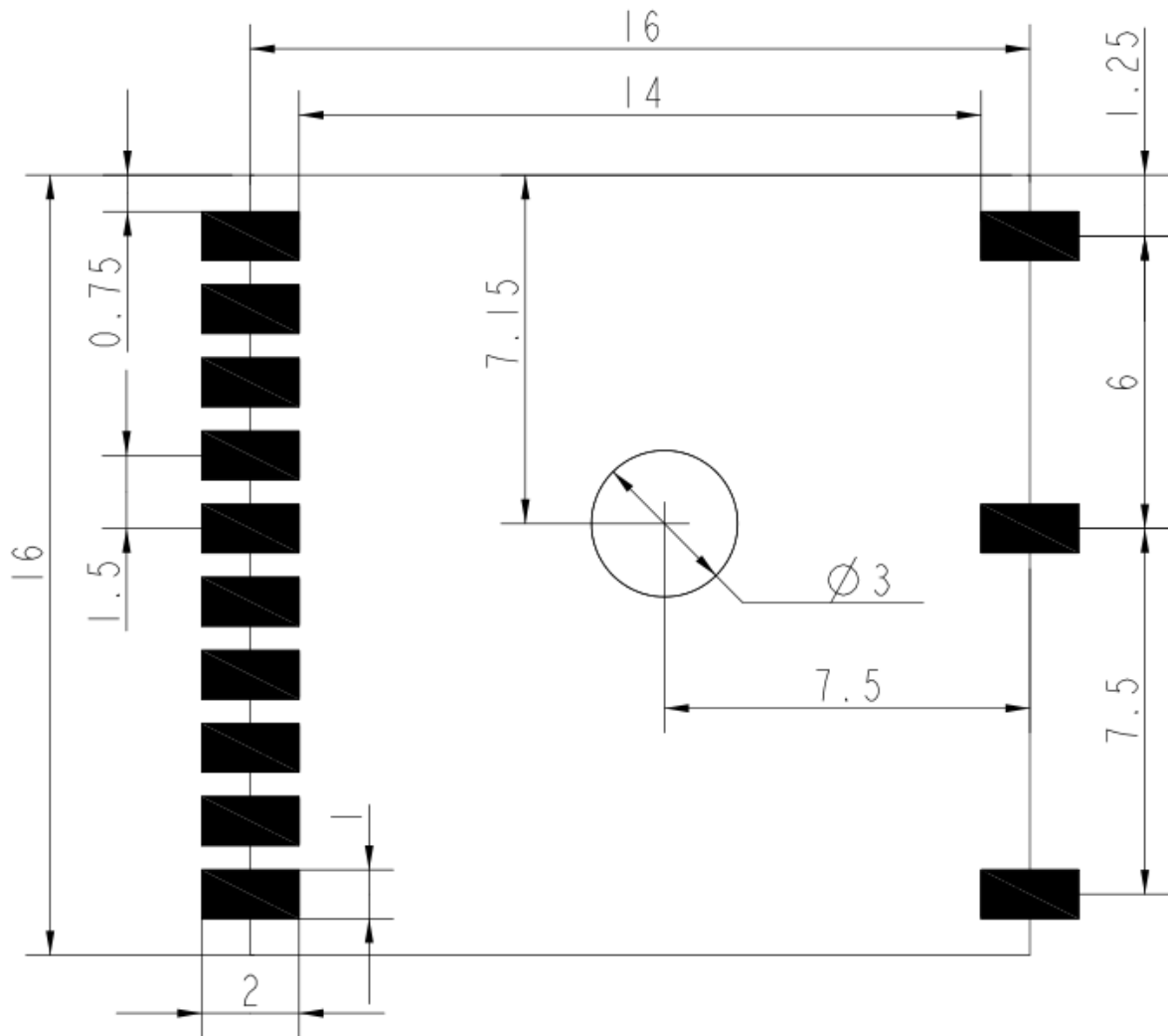




## 7.2 Recommended Footprint

Figure 7-2 shows the recommended application PCB footprint. (Unit: mm)

Figure 7-2 Recommended PCB footprint (top view)



## 7.3 Stencil

The recommended stencil thickness is at least 0.12 mm to 0.15 mm.

## 7.4 Solder Paste

Do not use a kind of solder paste different from our module technique.

- The melting temperature of solder paste with lead is 35°C lower than that of solder paste without lead. It is easy to cause faulty joints for LCC inside the module after second reflow soldering.
- When using only solder pastes with lead, please ensure that the reflow temperature is kept at 220 °C for more than 45 seconds and the peak temperature reaches 240 °C.

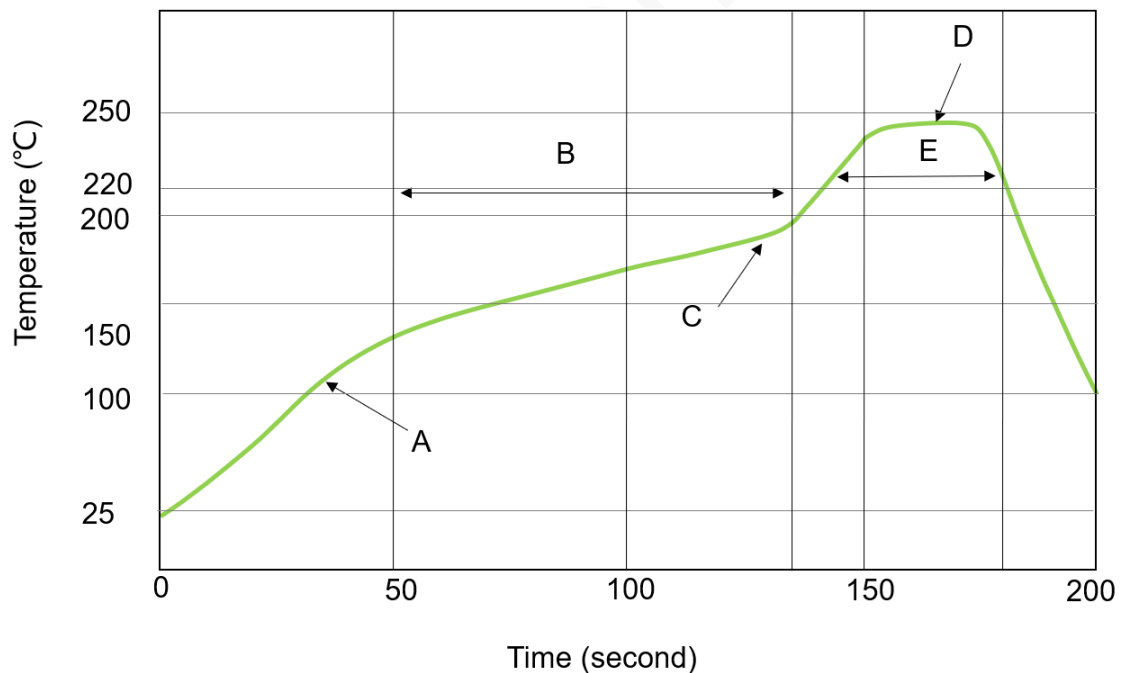
## 7.5 Reflow Profile

G2 is compatible with industrial standard reflow profile for lead-free SMT process.

The reflow profile is process dependent, so the following recommendation is just a start point guideline:

- Only one flow is supported.
- Quality of the solder joint depends on the solder paste volume. Minimum of 0.12 mm to 0.15 stencil thickness is recommended.
- Use bigger aperture size of the stencil than actual pad size.
- Use a low-residue, no-clean type solder paste.

Figure 7-3 Temperature curve



X: Time (s) Y: Temperature (°C)

Technical parameters:

- Ramp up rate: 1 to 4°C/sec
- Ramp down rate: -3 to -1°C/sec

- Soaking zone: 150-180°C for 60-100 seconds
- Reflow zone: >220°C for 40-90 seconds
- Peak temperature: 235-245°C



Neoway will not provide warranty for heat-responsive element abnormalities caused by improper temperature control.

---

For information about cautions in G2 storage and mounting, refer to *Neoway Module Reflow Manufacturing Recommendations*.

To maintain and manually desolder it, use heat guns with great opening, adjust the temperature to 245 degrees (depending on the type of the solder paste), and heat the module till the solder paste is melt. Use tweezers to remove the module. Do not shake the module in high temperature while removing it. Otherwise, the components inside the module might be misplaced.

## 8 Safety Recommendations

Ensure that this product is used in compliant with the requirements of the country and the environment. Please read the following safety recommendations to avoid body hurts or damages of product or work place:

- Do not use this product at any places with a risk of fire or explosion such as gasoline stations, oil refineries, etc.
- Do not use this product in environments such as hospital or airplane where it might interfere with other electronic equipment.

Please follow the requirements below in application design:

- Do not disassemble the module without permission from Neoway. Otherwise, we are entitled to refuse to provide further warranty.
- Please design your application correctly by referring to the HW design guide document and our review feedback on your PCB design.
- Please avoid touch the pins of the module directly in case of damages caused by ESD.

## A Abbreviation

Abbr	Full Name
AGPS	Assisted GPS
CEP	Circular Error Probable
DGPS	Differential GPS
EASY	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
EMI	Electro Magnetic Interference
ESD	Electronic Static Discharge
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
GGA	GPS Fix Data
GLONASS	Global Navigation Satellite System
GSV	GNSS Satellites in View
I/O	Input/output
LNA	Low Noise Amplifier
MSAS	Multi-Functional Satellite Augmentation System
NMEA	National Marine Electronics Association
PPS	Pulse Per Second
PRN	Pseudo Random Noise Code
QZSS	Quasi-Zenith Satellite System
RHCP	Right Hand Circular Polarization
RMC	Recommended Minimum Specific GNSS Data
SBAS	Satellite-based Augmentation System
SAW	Surface Acoustic Wave
TTFF	Time To First Fix
UART	Universal Asynchronous Receiver & Transmitter