

G15B-1612

GPS Module Data Sheet

Revision: 1.0

Date:2022.12

Highlights:

- GPS L1, Beidou B1, Galileo E1, QZSS L1, GLONASS G1
- GPS L5, Beidou B2A, Galileo E5, QZSS L5, IRNSS
- Built in RTK algorithm
- Full mode solution: GPS/GLONASS /Beidou/Galileo
- Embedded FLASH, archiving flexible customization requirements
- Compact module size for easy integration
- 16 x 12 x 2.2 mm

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1 Introduction

The G15B module is a high sensitivity, low power and very compact Surface Mount Device (SMD), and it supports signal processing of L1 and L5 band signals. 120 tracking channels global positioning system (GPS) receiver is designed for a broad spectrum of OEM applications and is based on the fast and deep GPS signal search capabilities. G15B is designed to allow quick and easy integration into GPS-related applications, especially for compact size devices, such as:

- Automotive GNSS navigation
- Fleet Management / Asset Tracking
- AVL and Location-Based Services
- UAV Positioning and Navigation

1.1 Features

Hardware and Software

- Compact module size for easy integration: 16.0x12.0x2.2 mm.
- SMT pads allow for fully automatic assembly processes equipment and reflow soldering
- Built-in LDO, regulators to decrease extra-BOM cost
- Up to 25Hz update rate
- Embedded DC/DC circuitry to prolong battery life
- AGPS supported

Performance

- Cold/ Hot Start Time: 28 / 1 sec.
- RF Metal Shield for best performance in noisy environments
- Enhanced Navigation Performance

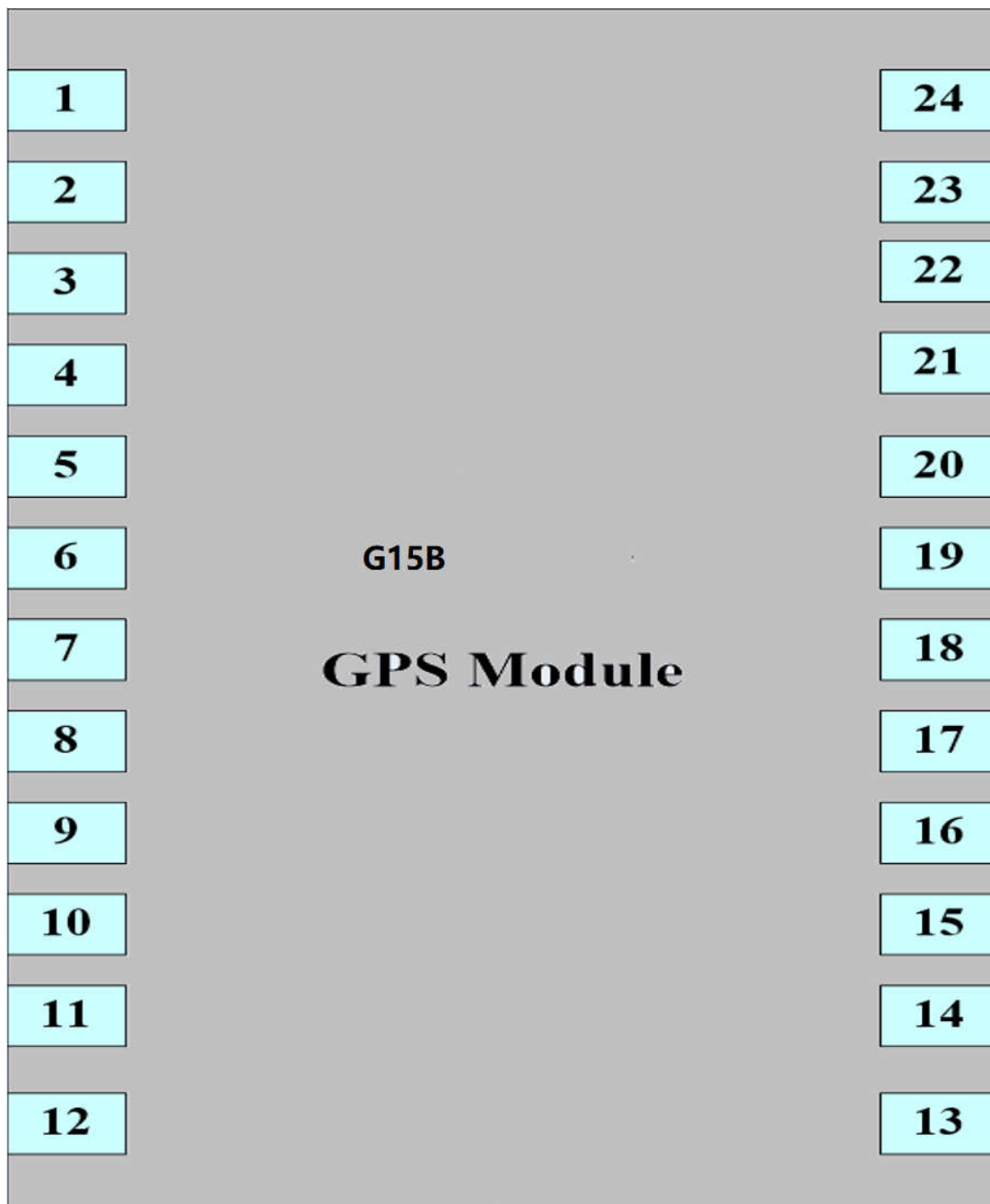
Interface

- TTL level UART interface
- Protocol: NMEA 0183
- Baud Rate: 115200 bps(Default)

Advantages

- Ideal for compact size devices
- Data / Power / RF through surface mount pads
- Flexible and cost effective hardware design for different application requirements
- Secure SMD PCB mounting method

2 Pin Assignment



Pin Numbers	Name	Type	Description	Note
1,2,4,5,6,7,8,1 4,15,16,17	NC		NC	
3	1PPS	O	One pulse per second output	
9	VCC_RF	P	Supply Antenna Bias voltage(V = Vcc)	

11	RF_IN	I	GPS Antenna Input	
10,12,13,24	GND	P	Ground	
18	DDC_SDA	I/O	DDC Serial Data in/out	
19	DDC_SCL	I	DDC Serial Clock Input	
20	UART_TX	O	TTL UART output,0~3.3V	
21	UART_RX	I	TTL UART input	
22	VBAT	P	Backup battery supply voltage	
23	VCC_MAIN	P	Main power supply voltage	

3 Electrical Specification

3.1 Absolute maximum ratings

Parameter	Symbol	Min	Max	Unit
Power Supply Voltage	VCC_MAIN	-0.5	3.6	V
Backup Supply Voltage	VBAT	-0.5	3.6	V

3.2 Operation Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Main Power Supply					
Power Supply Voltage	VCC_MAIN	2.8	3.3	3.6	V
Operating Current		25	28	30	mA
Backup Power Supply					
Backup Supply Voltage	VBAT	1.6	3.3	3.6	V
Operating Current			14		uA
UART/DDC/IO					
Input Low Voltage	Vil	0		0.72	V
Input High Voltage	Vih	2.0		3.6	V
Output Low Voltage	Vol			0.4	V
Output High Voltage	Voh	2.4			V

3.3 Environmental Specification

Item	Description
Operating temperature rang	-40 deg. C to +85 deg. C
Operating temperature rang	-50 deg. C to +105 deg. C

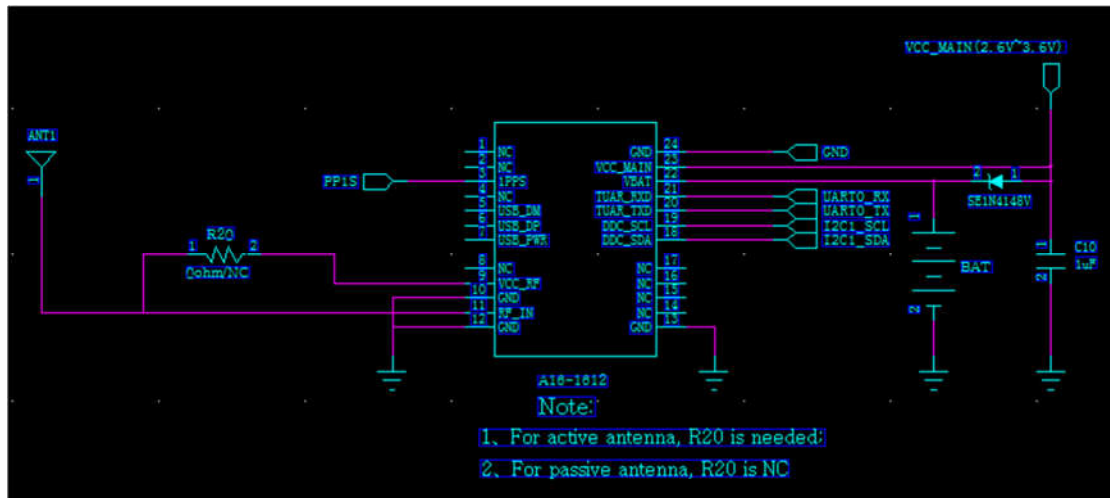


Altitude	50,000 m
Velocity	500 m/s

3.4 Timepulse

After GPS module is synchronized with GPS satellites, Timepulse is output per second, which is usually used for time synchronization to reference time. The accuracy is no more than 20ns. Timepulse's pulse width and TIMING mode can be configured according to the protocol document.

4 Reference Design



Note:

1. Trace impedance between Antenna and Pin11 should be 50 ohm.
2. Trace between Antenna and R20 is recommended to be 5mil line width.

5 Performance Characteristics

Position and Velocity Accuracy

Accuracy	Position	1.0cm+1ppm(H) 3.0cm+1ppm(V)
	Velocity	0.05m/s

Dynamic constrains

Dynamic Conditions	Altitude	50,000m
	Velocity	500 m/s
	Acceleration	<= 4g

Acquisition time TTFF

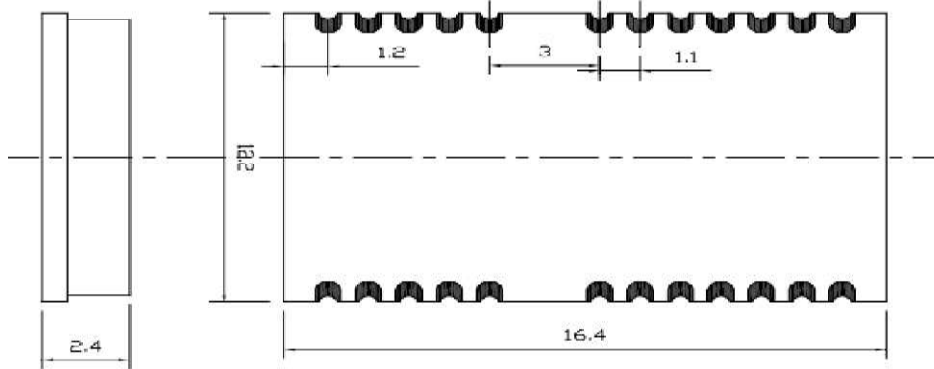
Mode	G15B GPS Module
Hot Start	1s
Cold Start	28s

Sensitivity

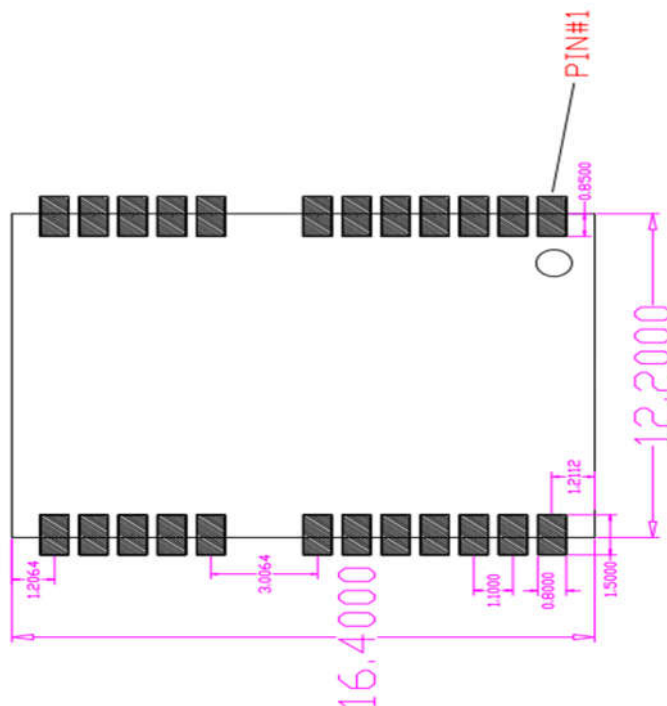
Parameter	Description
Tracking & Navigation	-163 dBm
Acquisition	-148 dBm

6 PCB Layout Recommend

Recommended Layout Pad



Module PAD



PCB LAYOUT PAD

PCB Layout Recommendations

- Do not routing the other signal or power trace under the module board.

RF:

- This pin receives signal of GPS analog via external active antenna. **Note: It has to be a controlled impedance trace at 50ohm.**
- Do not place the RF traces close to the othersignal path and not routing it on the top layer.
- Keep the RF traces as short as possible.

Antenna:

- Keep the active antenna on the top of your system and confirm the antenna radiation pattern, axial ratio, power gain, noise figure, VSWR are correct when you Setup the antenna in your case.

7 Configuration Management

Configuration settings can be modified with configuration messages. The modified settings remain effective until power-down or reset. If these settings have been stored in battery-backup RAM, then the modified configuration will be retained, as long as the backup battery supply is not interrupted.

Note that: If any new configuration needs to be done, pls refer to module Receiver Description Including Protocol Specification.

8 Software Interface

The output NMEA (0183 v3.01) messages for the receiver are listed as below.

NMEA Command	Description
GGA	Time, position, and fix related data for a GPS receiver.
GLL	Latitude and longitude of present position, time of position fix and status
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
RMC	Time, date, position, course and speed data provided by the GPS receiver.

GGA - Global Positioning System Fixed Data

For example:

\$GPGGA,161229.487,3723.24751,N,12158.34162,W,1,07,1.0,9.0,M,-34.2,M,0000*18

Table 1

Name	Example	Description	Unit
Message ID	\$GPGGA	GGA protocol header	
UTC Time	161229.487	hhmmss.sss	
Latitude	3723.24751	ddmm.mmmmm	
N/S Indicator	N	N=north or S=south	
Longitude	12158.34162	dddmm.mmmmm	
E/W Indicator	W	E=east or W=west	
Position Fix Indicator	1	See Table 1-1	
Satellites Used	07	Range 0 to 12	
HDOP	1.0	Horizontal Dilution of Precision	
MSL Altitude	9.0		meters
Units	M		meters
Geoid Separation	-34.2	Geoid-to-ellipsoid separation. Ellipsoid altitude=MSL Altitude + Geoid Separation	meters
Units	M		meters
Age of Diff. Corr.		Null fields when DGPS is not used	second
Diff. Ref. Station ID	0000		
Checksum	*18		

<CR><LF>		End of message termination	
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Table 1-1

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode , fix valid
3	Not supported
6	Dead Reckoning Mode, fix valid

GLL - Geographic Position-Latitude/Longitude

For example:

\$GPGLL,3723.24755,N,12158.34166,W,161229.487,A,A*41

Table2

Name	Example	Description	Unit
Message ID	\$GPGLL	GLL protocol header	
Latitude	3723.24755	ddmm.mmmmm	
N/S Indicator	N	N=north or S=south	
Longitude	12158.34166	dddmm.mmmmm	
E/W Indicator	W	E=east or W=west	
UTC Position	161229.487	hhmmss.sss	
Status	A	A=data valid or V=data not valid	
Mode	A	A=Autonomous, D=DGPS, E=DR N=Output Data Not Valid R= Coarse Position ¹ S=Simulator	
Checksum	*41		
<CR><LF>		End of message termination	

1.Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

GSA - GNSS DOP and Active Satellites

For example:

\$GPGSA,A,3,07,02,26,27,09,04,15,,,,,1.8,1.0,1.5*33

Table3

Name	Example	Description	Unit
Message ID	\$GPGSA	GSA protocol header	
Mode 1	A	See Table 3-1	
Mode 2	3	See Table 3-2	
Satellite Used ¹	07	Sv on Channel 1	
Satellite Used ¹	02	Sv on Channel 2	
.....			
Satellite Used ¹		Sv on Channel 12	
PDOP ²	1.8	Position dilution of Precision	
HDOP ²	1.0	Horizontal dilution of Precision	
VDOP ²	1.5	Vertical dilution of Precision	
Checksum	*33		
<CR><LF>		End of message termination	

1. Satellite used in solution.
2. Maximum DOP value reported is 50. When 50 is reported, the actual DOP may be much larger.

Table3-1

Value	Description
M	Manual-forced to operate in 2D or 3D mode
A	Automatically switch in 2D or 3D mode

Table3-2

Value	Description
1	Fix Not Available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

GSV - GNSS Satellites in View

For example:

\$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71

\$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41

Table4



Name	Example	Description	Unit
Message ID	\$GPGSV	GSV protocol header	
Number of Messages ¹	2	Range 1 to 3	
Message Number ¹	1	Range 1 to 3	
Satellites in View ¹	07		
Satellite ID	07	Channel 1(Range 1 to 32)	
Elevation	79	Channel 1(Maximum90)	degrees
Azimuth	048	Channel1(True, Range 0 to 359)	degrees
SNR(C/No)	42	Range 0 to 99,null when not tracking	dBHz
.....		
Satellite ID	27	Channel 4 (Range 1 to 32)	
Elevation	27	Channel 4(Maximum90)	degrees
Azimuth	138	Channel4(True, Range 0 to 359)	degrees
SNR(C/No)	42	Range 0 to 99,null when not tracking	dBHz
Checksum	*71		
<CR><LF>		End of message termination	

1. Depending on the number of satellites tracked, multiple messages of GSV data may be required. In some software versions, the maximum number of satellites reported as visible is limited to 12, even though more may be visible.

RMC - Recommended Minimum Specific GNSS Data

For example:

\$GPRMC,161229.487,A,3723.24755,N,12158.34166,W,0.13,309.62,120598,,A*10

Table5

Name	Example	Description	Unit
Message ID	\$GPRMC	RMC protocol header	
UTC Time	161229.487	hhmmss.sss	
Status ¹	A	A=data valid or V=data not valid	
Latitude	3723.24755	ddmm.mmmmm	
N/S Indicator	N	N=north or S=south	
Longitude	12158.34166	dddmm.mmmmm	
E/W Indicator	W	E=east or W=west	
Speed Over Ground	0.13		knots
Course Over Ground	309.62	True	degrees
Date	120598	ddmmyy	
Magnetic Variation ²		E=east or W=west	degrees



East/West Indicator ²	E	E=east	
Mode	A	A=Autonomous, D=DGPS, E=DR N=Output Data Not Valid R= Coarse Position ³ S=Simulator	
Checksum	*10		
<CR><LF>		End of message termination	

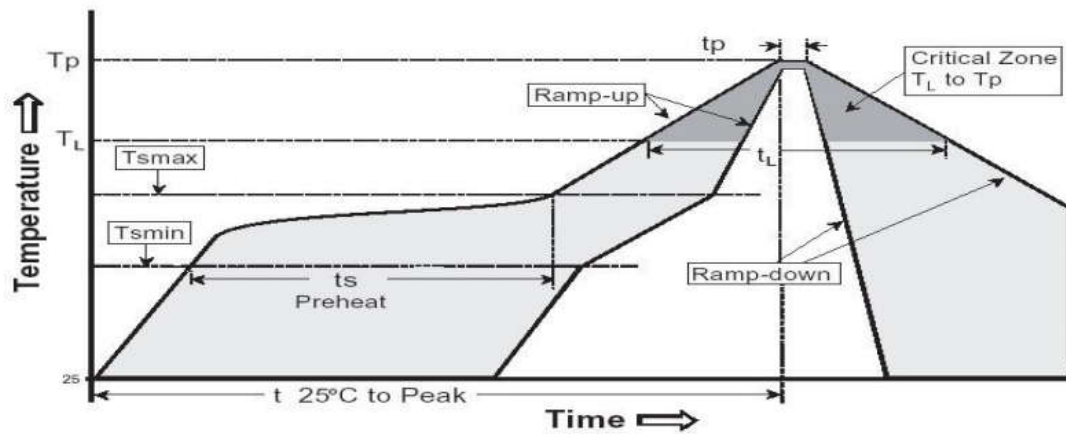
1. A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met the solution will be marked as invalid.

2. All “course over ground” data are geodetic WGS84 directions relative to true North.

3. Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

9 Recommended Reflow Profile

High quality, low defect soldering requires identifying the optimum temperature profile for reflowing the solder paste. To have the correct profile assures components, boards, and solder joints are not damaged and reliable solder connection is achievable. Profiles are essential for establishing and maintaining processes. You must be able to repeat the profile to achieve process consistency. The heating and cooling rise rates must be compatible with the solder paste and components. The amount of time that the assembly is exposed to certain temperatures must first be defined and then maintained.

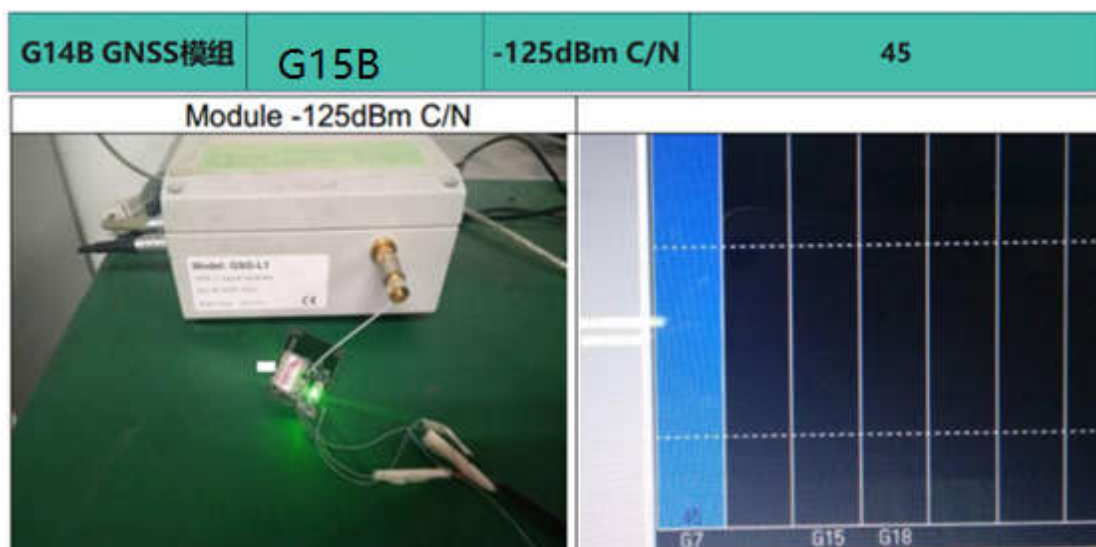
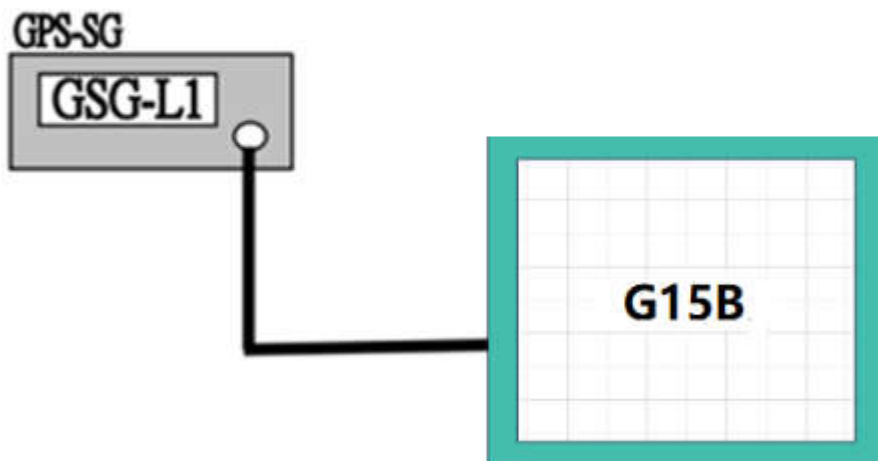


Average ramp-up rate	3°C/second max.
Preheat (T_{smax} – T_{smin}, t_s)	150~200°C ; 60~180seconds
Time maintained above (T_L, t_L)	217°C ; 60~150seconds
Peak Temperature (T_p)	255~260°C ; 10~20seconds
Ramp-down rate	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.
Maximum number of reflow cycles	≤ 3

10 Test Result

10.1 Conduction Test

Block Diagram.



Revision History

Revision	Date	Name	Status/Comments
R1.4	28-Oct-2022	EddieX	1.Add timepulse description
R1.3	28-Aug-2022	EddieX	1.Add conduction test report
R1.2	23-Aug-2022	EddieX	1.Application circuit updated
R1.0	7-July-2022	EddieX	Initial Release