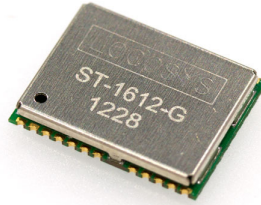


Product name	Description	Version
ST-1612-G	Datasheet of ST-1612-G multiple GNSS module	1.1



## 1 Introduction

LOCOSYS ST-1612-G module can simultaneously acquire and track multiple satellite constellations that include GPS, GLONASS, GALILEO and QZSS. It features high sensitivity, low power and ultra small form factor. This multiple GNSS module is powered by ST, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment.

## 2 Features

- ST high sensitivity solution
- Support GPS, GLONASS, GALILEO and QZSS
- Capable of SBAS (WAAS, EGNOS, MSAS)
- 32 tracking channels and 2 fast acquisition channels
- Low power consumption
- Fast TTFF at low signal level
- Support interface of UART, USB and CAN bus
- Small form factor 16 x 12.2 x 2.2 mm
- SMD type with stamp holes; RoHS compliant

## 3 Application

- Personal positioning and navigation
- Automotive navigation
- Marine navigation

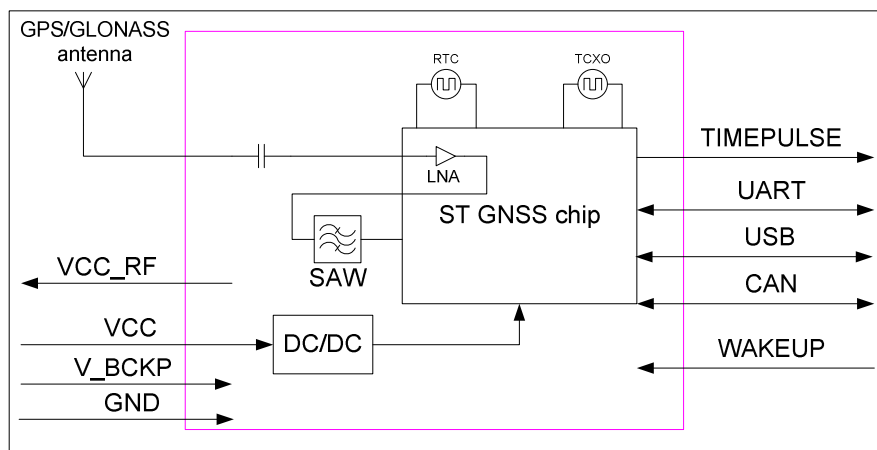


Fig 3-1 System block diagram.

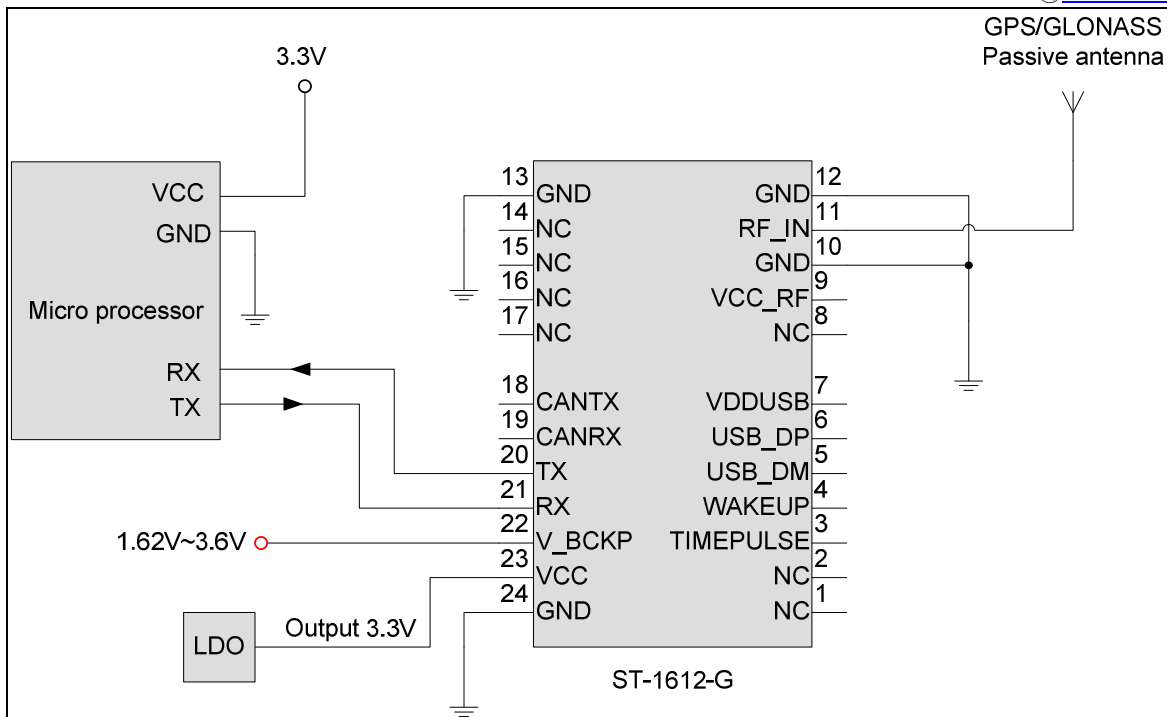


Fig 3-2 Typical application circuit that uses a passive antenna.

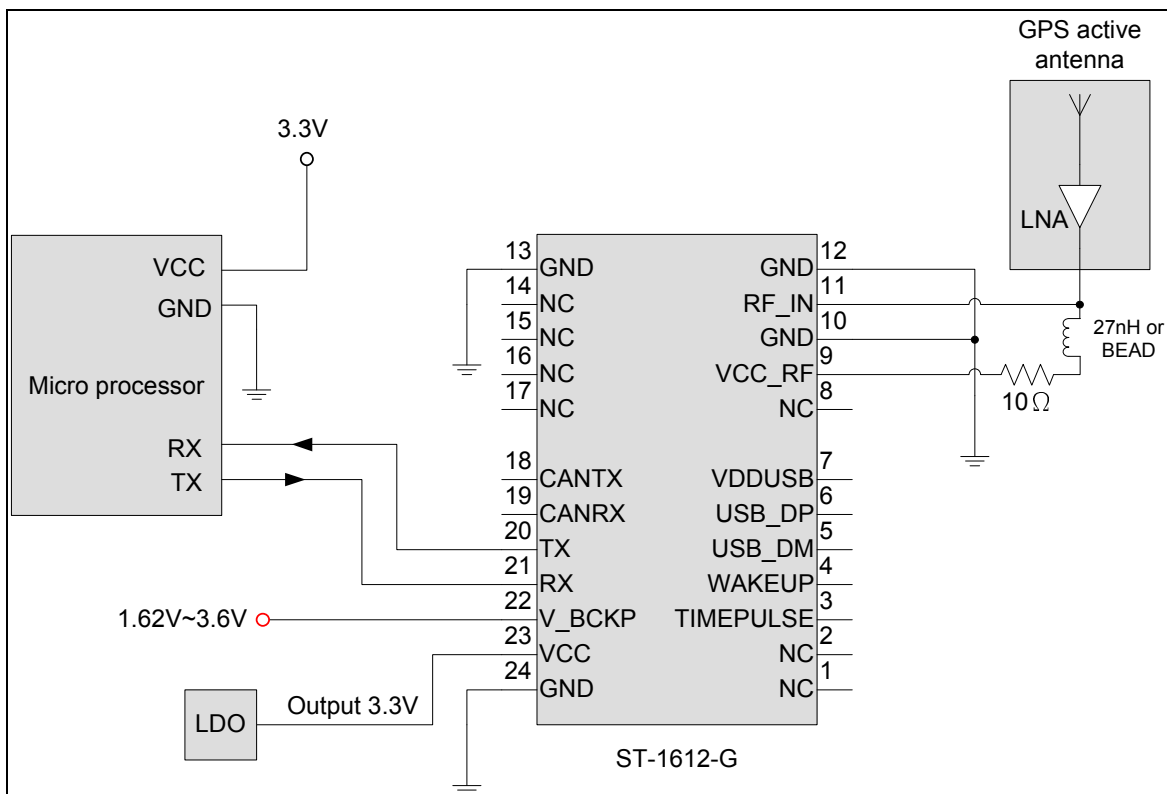


Fig 3-3 Typical application circuit that uses an active antenna.

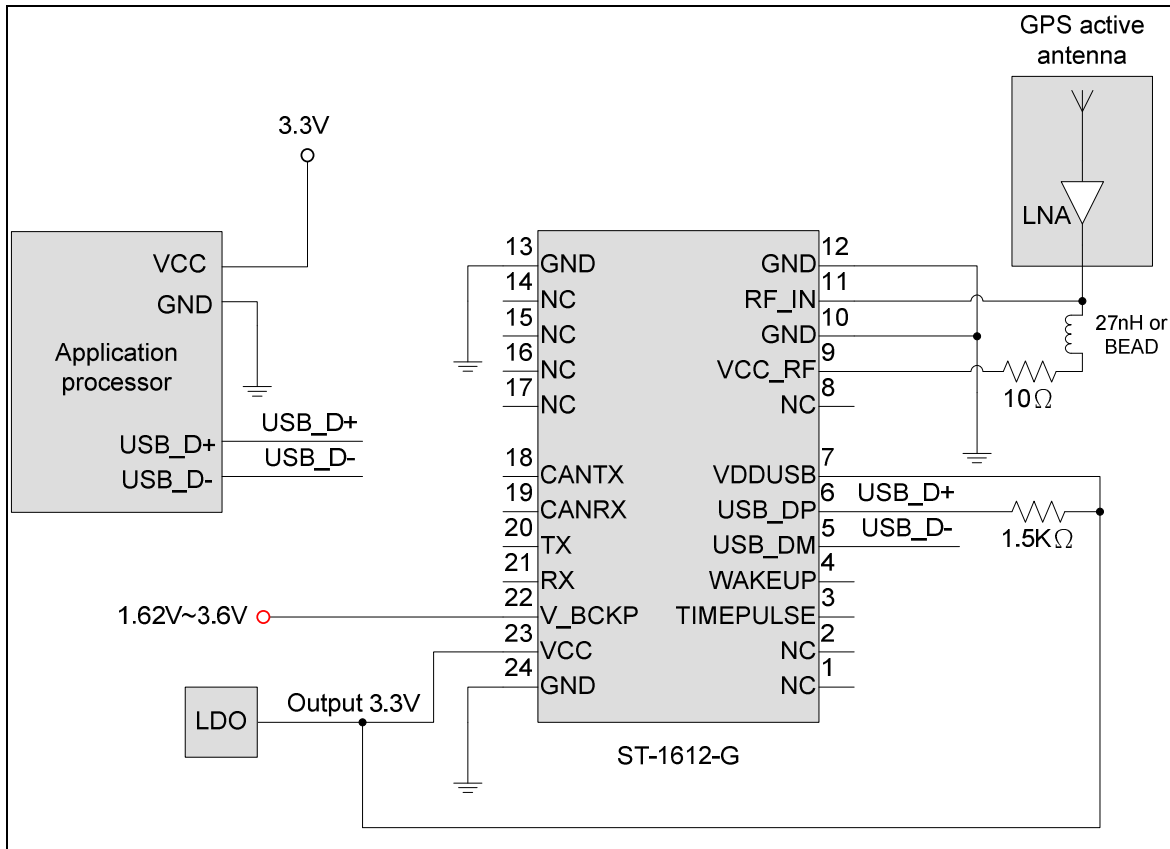
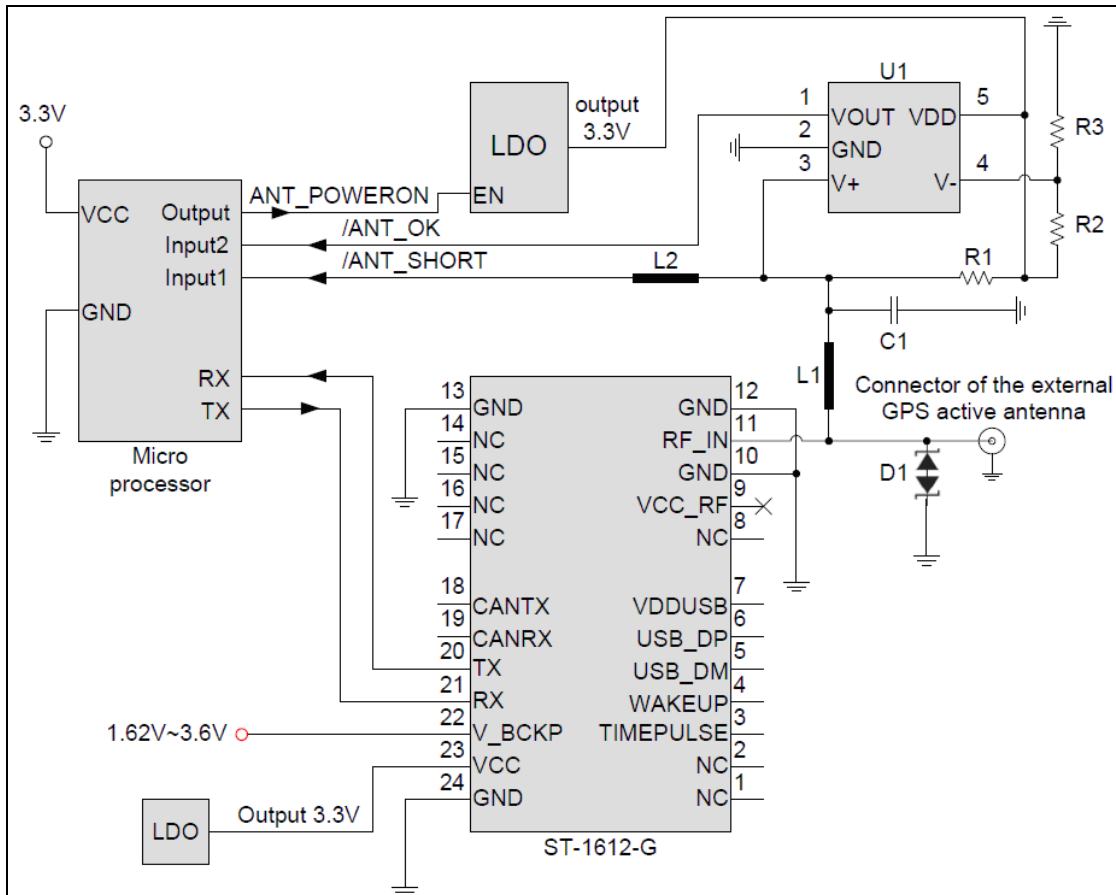


Fig 3-4 Typical application circuit that uses USB interface.



Logic table			
/ANT_SHORT	/ANT_OK	Status of the external GPS active antenna	Description
LOW	X	Short	Antenna is short.
HIGH	LOW	OK	Antenna is properly connected.
HIGH	HIHG	Open	Antenna is not connected

Reference BOM			
Part	Spec/value	Vendor	Remark
C1	18pF±5%, size 0402/0603		
D1	SUC0402-240E0R05P-LF	SFI	Input capacitance ≤ 0.5pF
L1	BEAD, 300R, size 0603 PBY16080T-301Y-N	YAGEO	Must use 0603 size or larger
L2	BEAD, 300R, size 0402/0603		
R1	10R±5%, size 0603		Must use 0603 size or larger
R2	1K±5%, size 0402/0603		
R3	100K±5%, size 0402/0603		
U1	MCP6001T-IOT	Microchip	
	SGM8541XN5/TR	SG Micro	

Fig 3-4 Typical application circuit that has supervisor of the external active antenna.

## 4 GNSS receiver

### 4.1 GNSS receiver

Chip	STA8088FG series	
Frequency	GPS, GALILEO, QZSS: L1 1575.42MHz, C/A code GLONASS: L1 1598.0625MHz ~ 1605.375MHz, C/A code	
Channels	Support 32 channels	
Update rate	1Hz default, up to 10Hz.	
Sensitivity	Tracking	up to -161dBm (with external LNA)
	Cold start	up to -147dBm (with external LNA)
Acquisition Time	Cold Start (Open Sky)	32s (typical)
Position Accuracy	Autonomous	1.5m CEP
	SBAS	1.5m (depends on accuracy of correction data).
Max. Altitude	< 50,000 m	
Max. Velocity	< 515 m/s	
Protocol Support	NMEA 0183 ver 3.01	9600 bps <sup>(1)</sup> , 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG

Note 1: Both baud rate and output message rate are configurable to be factory default.

## 5 Software interface

### 5.1 NMEA output message

Table 5.1-1 NMEA output message

NMEA record	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

#### ● GGA--- Global Positioning System Fixed Data

Table 5.1-2 contains the values for the following example:

\$GPGGA,021754.000,2503.71314,N,12138.74545,E,2,19,0.5,120.50,M,15.3,M,,\*6C

Table 5.1-2 GGA Data Format

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Time	021754.000		hhmmss.sss
Latitude	2503.71314		ddmm.mmmm

N/S indicator	N		N=north or S=south
Longitude	12138.74545		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		See Table 5.1-3
Satellites Used	19		Range 0 to 12
HDOP	0.5		Horizontal Dilution of Precision
MSL Altitude	120.50	mters	
Units	M	mters	
Geoid Separation	15.3	mters	
Units	M	mters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID			
Checksum	*6C		
<CR> <LF>			End of message termination

Table 5.1-3 Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3-5	Not supported
6	Dead Reckoning Mode, fix valid

## ● GLL--- Geographic Position – Latitude/Longitude

Table 5.1-4 contains the values for the following example:

\$GPGLL,2503.71314,N,12138.74545,E,021754.000,A,D\*53

Table 5.1-4 GLL Data Format

Name	Example	Units	Description
Message ID	\$GPGLL		GLL protocol header
Latitude	2503.71314		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.74545		dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	021754.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	D		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator

Checksum	*53		
<CR> <LF>			End of message termination

## ● GSA---GNSS DOP and Active Satellites

Table 5.1-5 contains the values for the following example:

\$GNGSA,A,3,20,06,16,31,29,23,32,14,21,30,03,,1.1,0.5,1.0\*24

\$GNGSA,A,3,73,80,74,70,71,82,72,,,,,1.1,0.5,1.0\*29

\$GNGSA,A,3,193,,,,,,1.1,0.5,1.0\*13

Table 5.1-5 GSA Data Format

Name	Example	Units	Description
Message ID	\$GNGSA		GSA protocol header
Mode 1	A		See Table 5.1-6
Mode 2	3		See Table 5.1-7
ID of satellite used	20		Sv on Channel 1
ID of satellite used	06		Sv on Channel 2
....			....
ID of satellite used			Sv on Channel 12
PDOP	1.1		Position Dilution of Precision
HDOP	0.5		Horizontal Dilution of Precision
VDOP	1.0		Vertical Dilution of Precision
Checksum	*24		
<CR> <LF>			End of message termination

Table 5.1-6 Mode 1

Value	Description
M	Manual- forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

Table 5.1-7 Mode 2

Value	Description
1	Fix not available
2	2D
3	3D

## ● GSV---GNSS Satellites in View

Table 5.1-8 contains the values for the following example:

\$GNGSV,5,1,20,03,33,200,40,06,47,184,44,14,25,148,40,16,56,284,42\*6B

\$GNGSV,5,2,20,20,14,275,36,21,06,097,36,23,20,320,41,29,10,039,38\*62

\$GNGSV,5,3,20,30,60,344,46,31,48,054,47,32,26,250,36,74,26,325,45\*6E

\$GNGSV,5,4,20,82,09,029,37,73,38,025,46,70,07,191,40,80,13,075,43\*60

\$GNGSV,5,5,20,71,31,238,37,72,24,298,36,50,50,134,37,193,00,000,37\*54

Table 5.1-8 GSV Data Format

Name	Example	Units	Description
Message ID	\$GNGSV		GSV protocol header
Total number of messages <sup>1</sup>	5		Range 1 to 8
Message number <sup>1</sup>	1		Range 1 to 8
Satellites in view	20		
Satellite ID	03		Channel 1 (Range 01 to 196)
Elevation	33	degrees	Channel 1 (Range 00 to 90)
Azimuth	200	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	40	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
Satellite ID	06		Channel 4 (Range 01 to 32)
Elevation	47	degrees	Channel 4 (Range 00 to 90)
Azimuth	184	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	44	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*6B		
<CR> <LF>			End of message termination

1. Depending on the number of satellites tracked multiple messages of GSV data may be required.

## ● RMC---Recommended Minimum Specific GNSS Data

Table 5.1-9 contains the values for the following example:

\$GPRMC,021754.000,A,2503.71314,N,12138.74545,E,0.0,0.0,300712,.,,D\*63

Table 5.1-9 RMC Data Format

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTC Time	021754.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.71314		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.74545		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.0	knots	True
Course over ground	0.0	degrees	
Date	300712		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west (Not shown)



Mode	D		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator
Checksum	*63		
<CR> <LF>			End of message termination

● **VTG---Course Over Ground and Ground Speed**

Table 5.1-10 contains the values for the following example:

\$GPVTG,0.0,T,,M,0.0,N,0.0,K,D\*08

Table 5.1-10 VTG Data Format

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Course over ground	0.0	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.0	knots	Measured speed
Units	N		Knots
Speed over ground	0.0	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	D		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator
Checksum	*08		
<CR> <LF>			End of message termination

## 5.2 Proprietary NMEA input/output message

Please refer to ST proprietary message.

## 6 Pin assignment and descriptions

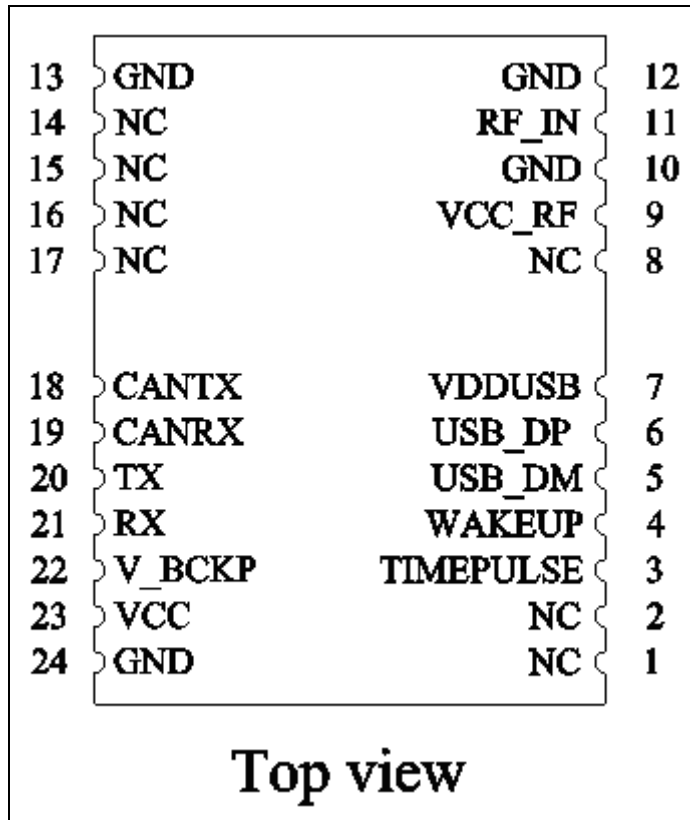


Table 6-1 Pin descriptions

Pin #	Name	Type	Description	Note
1	NC		Not connected	
2	NC		Not connected	
3	TIMEPULSE	O	Time pulse (1PPS, default 100 ms pulse/sec)	
4	WAKEUP	I	Wakeup from standby mode (1.2V I/O voltage). Internal 10K ohm pull-down resistor. If this pin is not used, leave it floating.	
5	USB_DM	I/O	USB data (D-)	
6	USB_DP	I/O	USB data (D+). Connect a 1.5K ohm resistor between USB_DP and VDDUSB.	
7	VDDUSB/ VDDCAN	P	Supply voltage of USB transceiver or CAN bus (3V~3.6V)	1
8	NC		Not connected	
9	VCC_RF	O	Output voltage for active antenna	2
10	GND	P	Ground	
11	RF_IN	I	GPS RF signal input	
12	GND	P	Ground	

13	GND	P	Ground	
14	NC		Not connected	
15	NC		Not connected	
16	NC		Not connected	
17	NC		Not connected	
18	CANTX	O	CAN bus transmit data output	
19	CANRX	I	CAN bus receive data input	
20	TX	O	Serial output (Default NMEA)	
21	RX	I	Serial input (Default NMEA)	
22	V_BCKP	P	Backup battery supply voltage <b>This pin must be powered to enable the module.</b>	
23	VCC	P	DC supply voltage	
24	GND	P	Ground	

<Note>

1. Supply power 3.0 ~ 3.6V to enable USB/CAN or leave open to disable. The firmware for UART, USB and CAN is different, please contact us.
2. VCC\_RF does not have short circuit protection.

## 7 DC & Temperature characteristics

### 7.1 Absolute maximum ratings

Parameter	Symbol	Ratings	Units
Input Voltage	VCC	3.6	V
Input Backup Battery Voltage	V_BCKP	3.6	V
Operating Temperature Range	Topr	-40 ~ 85	°C
Storage Temperature Range	Tstg	-40 ~ 85	°C

### 7.2 DC Electrical characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Voltage	VCC		3.0	3.3	3.6	V
Input Backup Battery Voltage	V_BCKP		1.62		3.6	V
VCC_RF Output Voltage	VCC_RF			VCC		V
Supply Current	I <sub>ss</sub>	VCC = 3.3V, w/o active antenna, Peak Acquisition Tracking		70 50 <sup>(2)</sup>	120	mA mA mA
Backup Battery Current	I <sub>bat</sub>	VCC = 0V		69		uA
High Level Input Voltage	V <sub>IH</sub>		2.0		3.6	V
Low Level Input Voltage	V <sub>IL</sub>		-0.3		0.8	V
High Level Output Voltage	V <sub>OH</sub>		2.6			V
Low Level Output Voltage	V <sub>OL</sub>				0.4	V

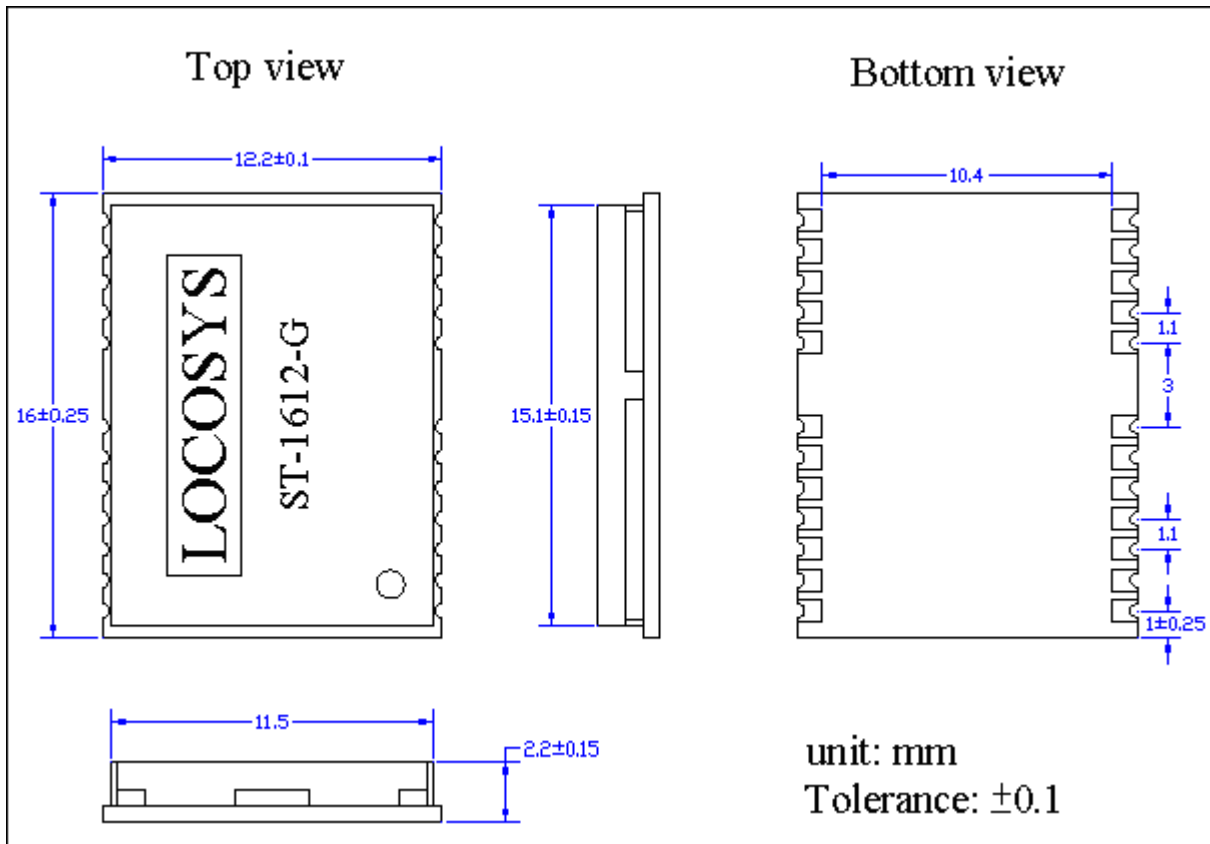
Note 1. Measured when position fix (1Hz) is available and input voltage is 3.3V with UART interface.

### 7.3 Temperature characteristics

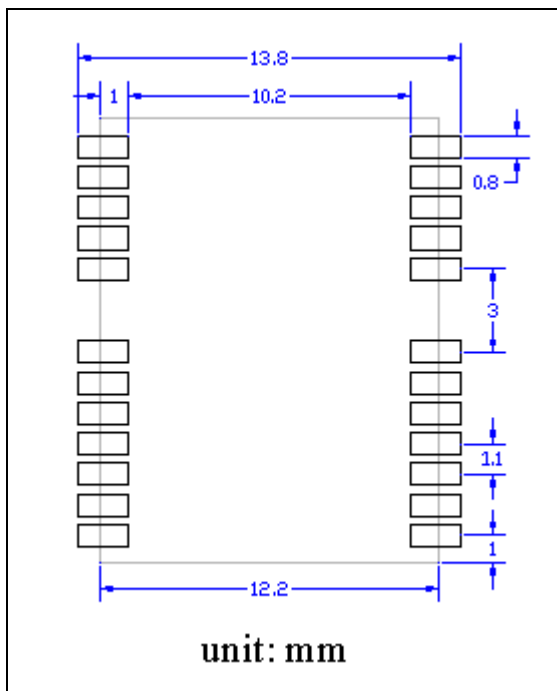
Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	Topr	-40	-	85	°C
Storage Temperature	Tstg	-40	25	85	°C

## 8 Mechanical specification

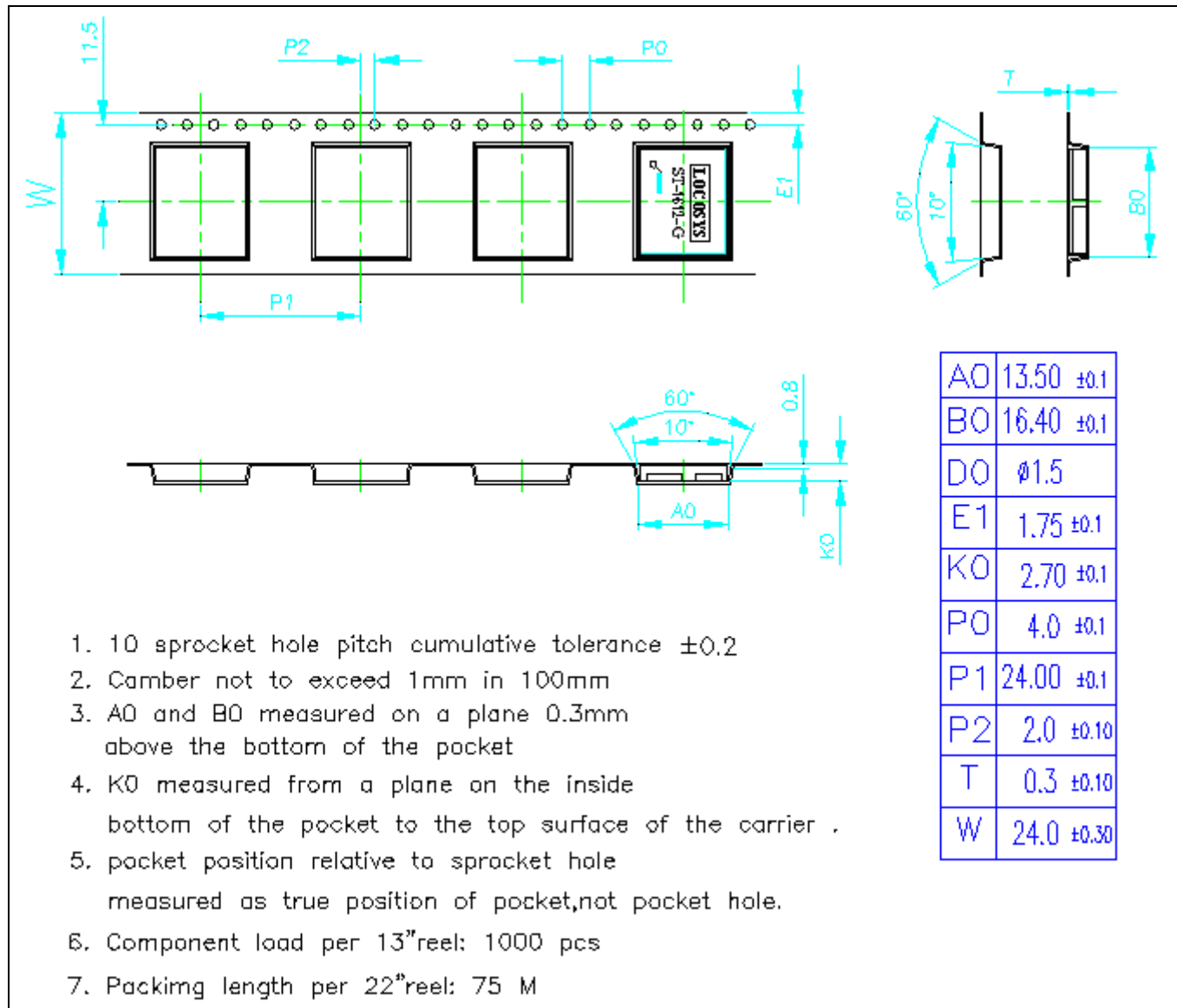
### 8.1 Outline dimensions



### 8.2 Recommended land pattern dimensions



## 9 Reel Packing information



## Document change list

### Revision 1.0

- First release on Sep. 24, 2012.

### Revision 1.1 (October 30, 2012)

- Changed the position accuracy from 2.5m CEP to 1.5m CEP on page 5
- Revised the tolerance of the pin to board edge from 0.1mm to 0.25mm in the section 8.1