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Product name	Description	Version
MC-1612-G2	Standalone multiple GNSS module	1.4

1 Introduction

LOCOSYS MC-1612-G2 is a complete standalone GNSS module. The module can simultaneously acquire and track multiple satellite constellations that include GPS, GLONASS, GALILEO, QZSS and SBAS. It features low power and small form factor. Besides, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment.

This module supports hybrid ephemeris prediction to achieve faster cold start. One is self-generated ephemeris prediction (called EASY) that is no need of both network assistance and host CPU's intervention. This is valid for up to 3 days and updates automatically from time to time when GNSS module is powered on and satellites are available. The other is server-generated ephemeris prediction (called EPO) that gets from an internet server. This is valid for up to 14 days. Both ephemeris predictions are stored in the on-board flash memory and perform a cold start time less than 15 seconds.

2 Features

- MediaTek high sensitivity solution
- Support GPS, GLONASS, GALILEO and QZSS
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Support 99-channel GNSS
- Low power consumption
- Fast TTFF at low signal level
- Built-in 12 multi-tone active interference canceller
- Free hybrid ephemeris prediction to achieve faster cold start
- Built-in data logger
- Support I2C interface
- Up to 10 Hz update rate
- ±10ns high accuracy time pulse (1PPS)
- Indoor and outdoor multi-path detection and compensation
- Small form factor 16 x 12.2 x 2.2 mm
- SMD type with stamp holes; RoHS compliant
- IATF 16949 quality control

3 Application

- Personal positioning and navigation
- Automotive navigation

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- Marine navigation
- Static timing application
- Surveying and mapping

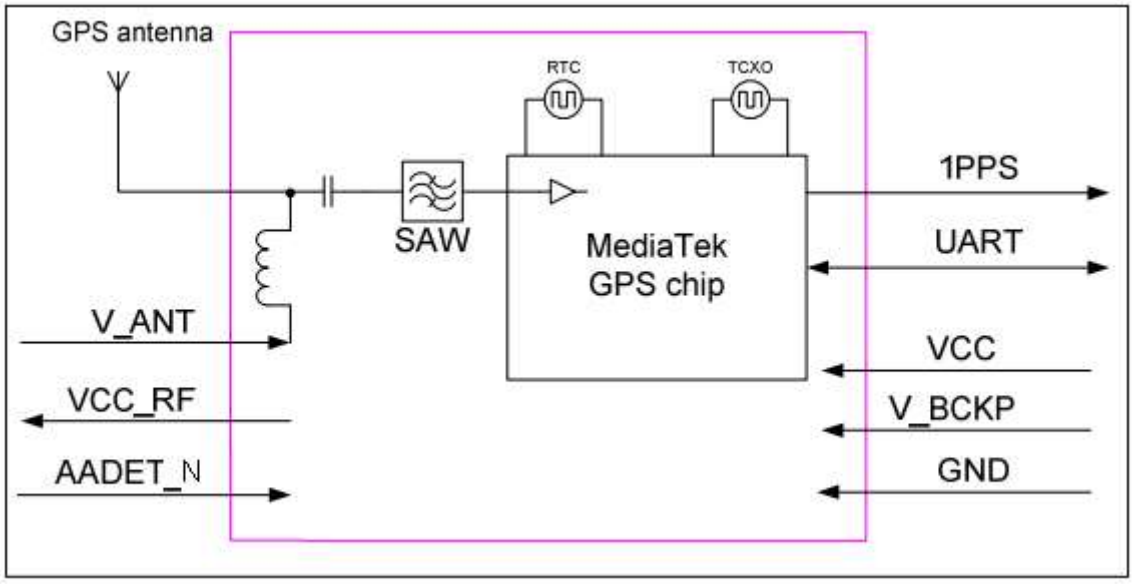

Fig 3-1 System block diagram.

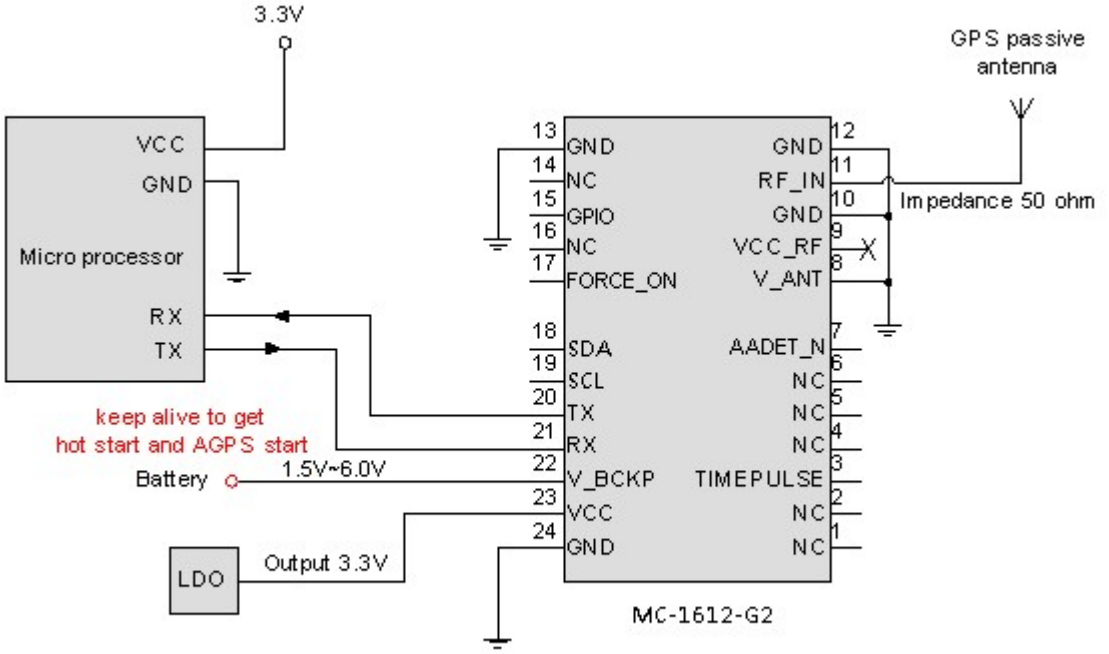

Fig 3-2 Typical application circuit that uses a passive antenna.

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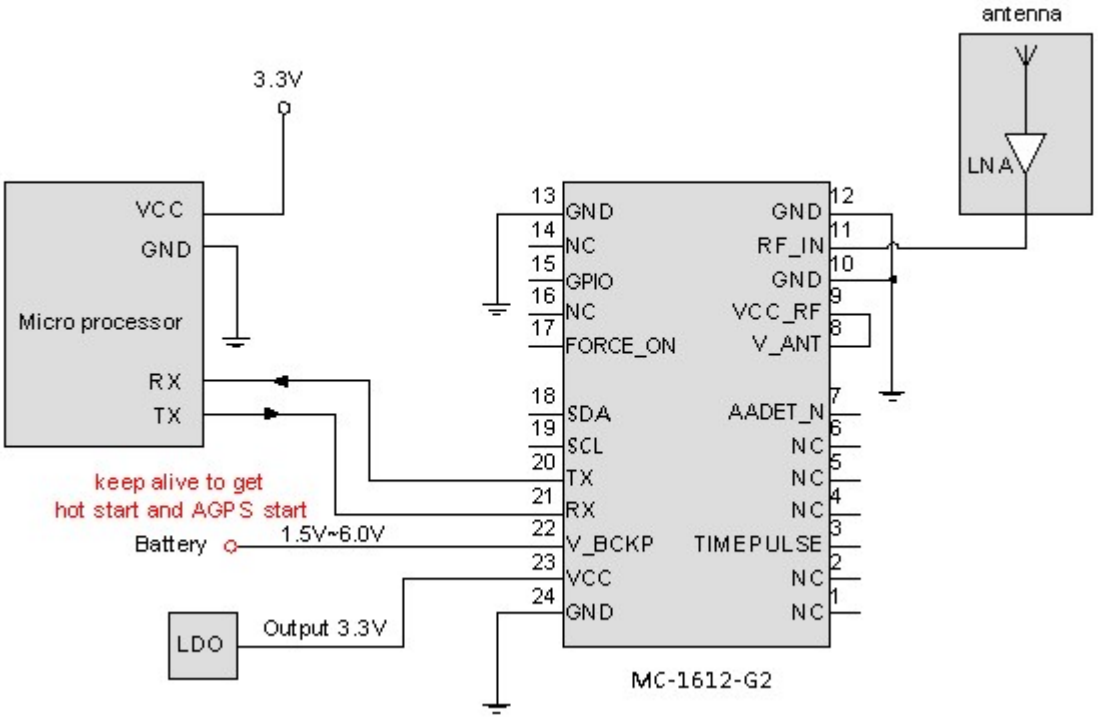
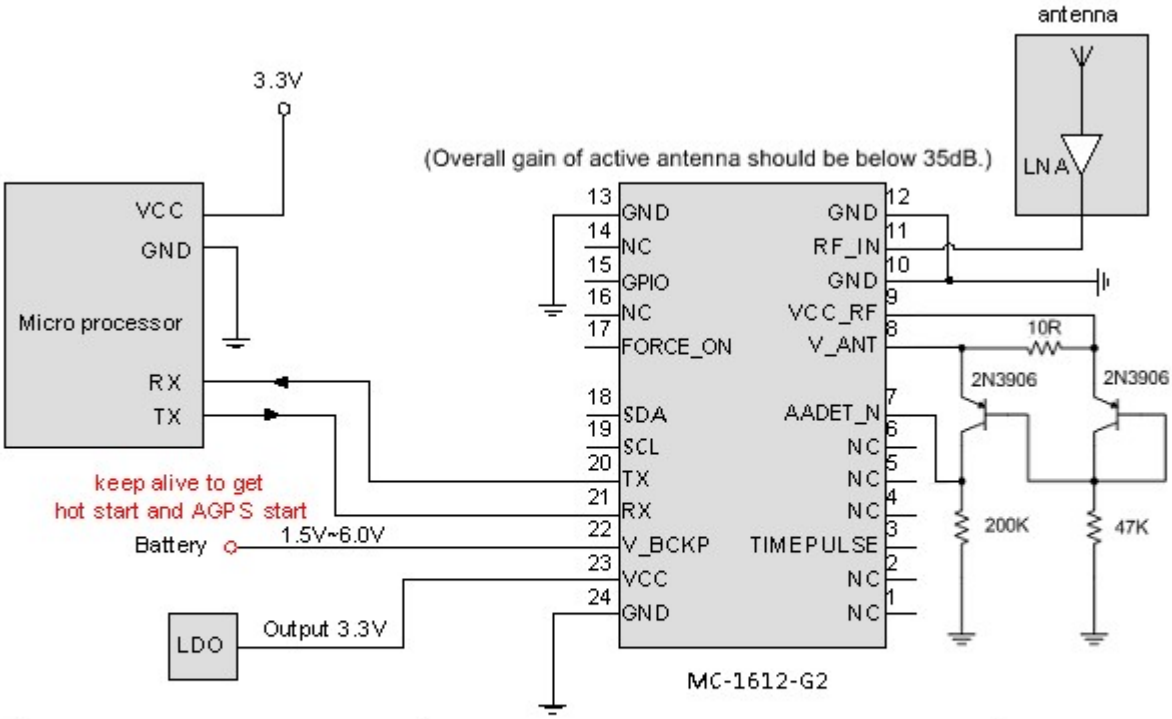


Fig 3-3 Typical application circuit that uses an active antenna.



Active antenna status	Output message per second from GNSS module
Antenna is short	$GPTXT,01,01,02,ANTSTATUS=SHORT*6D
Antenna is well connected.	$GPTXT,01,01,02,ANTSTATUS=OK*3B
Antenna is open, i.e. not connected.	$GPTXT,01,01,02,ANTSTATUS=OPEN*2B

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

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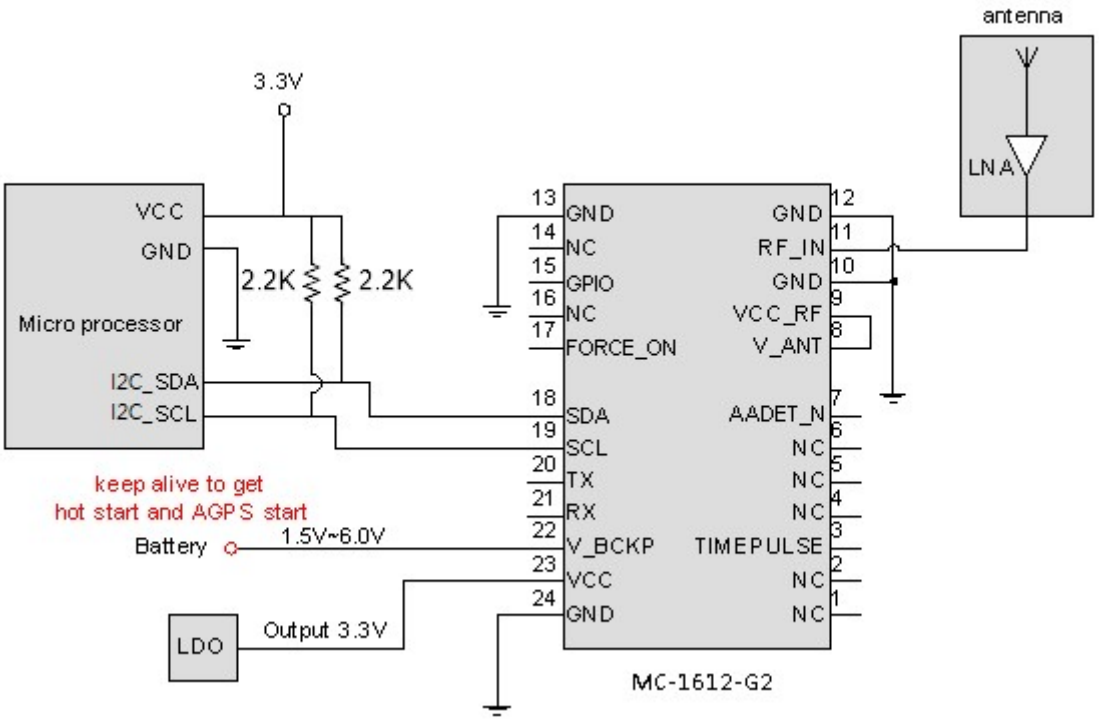

Fig 3-5 Use I2C interface to communicate with MC-1612-G2.

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4 GNSS receiver

Chip	MediaTek MT3333	
Frequency	GPS, GALILEO(1), QZSS: L1 1575.42MHz, C/A code GLONASS: L1 1598.0625MHz ~ 1605.375MHz, C/A code	
Channels	Support 99 channels (33 Tracking, 99 Acquisition)	
Update rate	1Hz default, up to 10Hz	
Sensitivity	Tracking	-161.5dBm, up to -164dBm (with external LNA)
	Cold start	-143.5dBm, up to -148dBm (with external LNA)
Acquisition Time	Hot start (Open Sky)	1s (typical)
	Hot start (Indoor)	< 30s (typical)
	Cold Start (Open Sky)	33s (typical) without AGPS
		< 15s (typical) with AGPS (hybrid ephemeris prediction)
Position Accuracy	Autonomous	2.5m CEP
	SBAS	2.5m (depends on accuracy of correction data).
Max. Altitude	< 18,000 m, up to 50,000m by request	
Max. Velocity	< 515 m/s	
Protocol Support	NMEA 0183 ver 4.00(2)	9600 bps(3), 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG

Note (1): MC-1612-G2 module is default configured for concurrent GPS, GLONASS, QZSS and SBAS reception. Please contact us for different default configuration, such as concurrent GPS, GLONASS, GALILEO, QZSS and SBAS.

Note (2): The default NMEA version is 4.00 and it also can configure to 4.10. If customers want to the product to support 4.10 please contact us in advance.

Note (3): Both baud rate and output message rate are configurable to be factory default.

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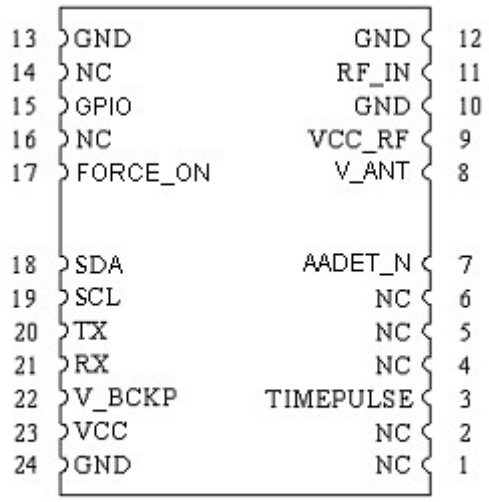
5 Pin assignment and descriptions



Top view

Table 5-1 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 when 3D fix is available)	
4	NC		Not connected	
5	NC		Not connected	
6	NC		Not connected	
7	AADET_N	I	Active antenna detection. Leave open if not used.	
8	V_ANT	I	Antenna bias voltage	
9	VCC_RF	O	Output voltage for active antenna	1
10	GND	P	Ground	
11	RF_IN	I	GNSS RF signal input	
12	GND	P	Ground	
13	GND	P	Ground	
14	NC		Not connected	
15	GPIO	I/O	General purpose I/O (Default status indicator. When GNSS position fix is available, it outputs 50ms high per second, otherwise it outputs low.)	
16	NC		Not connected	
17	FORCE_ON	I	FORCE_ON_PIN is for waking up the module when it is in BACKUP mode stage. For standard firmware, open this node.	

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18	SDA	I/O	I2C Interface data	
19	SCL	I/O	I2C Interface clock	
20	TX	O	Serial output for channel 0 (Default NMEA)	
21	RX	I	Serial input for channel 0 (Default NMEA)	
22	V_BCKP	P	Backup battery supply voltage. This pin is optional.	1, 2
23	VCC	P	DC supply voltage	
24	GND	P	Ground	

<Note>

1. In order to get the advantage of hybrid ephemeris prediction, this pin must be always powered during the period of effective ephemeris prediction.
2. The module doesn't have hot start when this pin is not applied.

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6 DC & Temperature characteristics

6.1 Absolute maximum ratings

Parameter	Symbol	Ratings	Units
Input Voltage	VCC	4.3	V
Input Backup Battery Voltage	V_BCKP	4.3	V
Operating Temperature Range	Topr	-40 ~ 85	℃
Storage Temperature Range	Tstg	-40 ~ 85	℃

6.2 DC Electrical characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Voltage	VCC		3.0	3.3	4.3	V
Input Backup Battery Voltage	V_BCKP		1.5		6.0	V
VCC_RF Output Voltage	VCC_RF			VCC		V
Supply Current	Iss	VCC = 3.3V, w/o active antenna, Peak Acquisition Tracking Standby		 31 26(2) 410	130(1)	 mA mA mA uA
Backup Battery Current	Ibat	VCC = 0V		4		uA
High Level Input Voltage	V_{IH}		2.0		3.6	V
Low Level Input Voltage	V_{IL}		-0.3		0.8	V
High Level Input Current	I_{IH}	no pull-up or down	-1		1	uA
Low Level Input Current	I_{IL}	no pull-up or down	-1		1	uA
High Level Output Voltage	V_{OH}		2.4		3.3	V
Low Level Output Voltage	V_{OL}				0.4	V
High Level Output Current	I_{OH}			2		mA
Low Level Output Current	I_{OL}			2		mA

Note (1): This happens when downloading AGPS data to MC-1612-G2.

Note (2): Measured when position fix (1Hz) is available, input voltage is 3.3V and the function of self-generated ephemeris prediction is inactive.

6.3 Temperature characteristics

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

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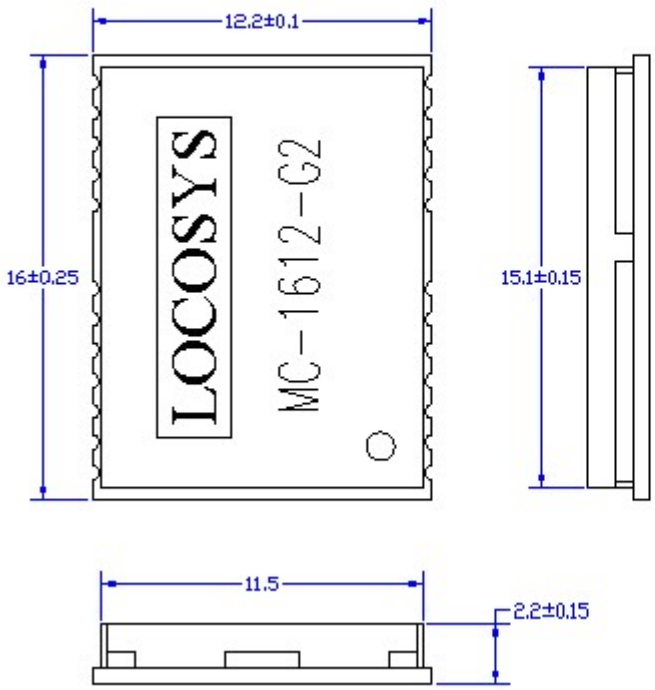
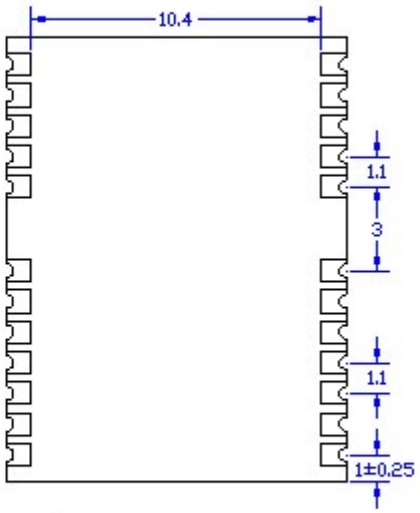
7 Mechanical specification

7.1 Outline dimensions

Top view

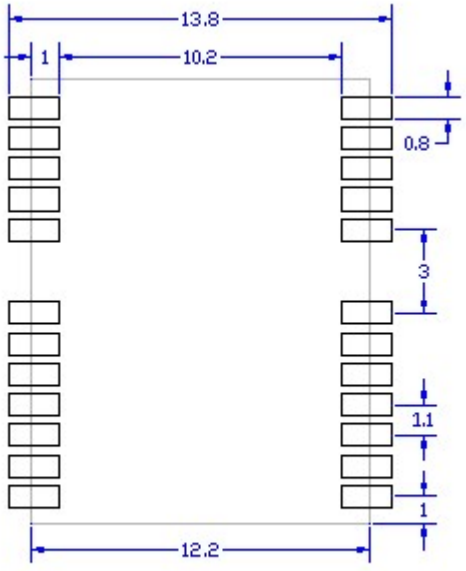


Bottom view



unit: mm
Tolerance: ±0.1
Weight: 0.8g

7.2 Recommended land pattern dimensions



unit: mm

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8 Software interface

8.1 NMEA output message

Table 8.1-1 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 8.1-2 contains the values for the following example:

$GNGGA,183015.000,2503.7123,N,12138.7446,E,2, 16,0.68,123.2,M,15.3,M,,*78

Table 8.1- 2 GGA Data Format

Name	Example	Units	Description
Message ID	$GNGGA		GGA protocol header
UTC Time	183015.000		hhmmss.sss
Latitude	2503.7123		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7446		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		See Table 8.1-3 (2: DGPS(RTCM) or SBAS)
Satellites Used	16		Range 0 to 33
HDOP	0.68		Horizontal Dilution of Precision
MSL Altitude	123.2	meters	
Units	M	meters	
Geoid Separation	15.3	meters	
Units	M	meters	
Age of Diff. Corr.		seconds	Null fields when DGPS is not used
Diff. Ref. Station ID			
Checksum	*78		
<CR> <LF>			End of message termination

Table 8.1-3 Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid

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2	Differential GPS, SPS Mode, fix valid
3-5	Not supported
6	Dead Reckoning Mode, fix valid

● GLL--- Geographic Position – Latitude/Longitude

Table 8.1-4 contains the values for the following example:

$GNGLL,2503.7135,N,12138.7448,E,055757.000,A,D*45

Table 8.1-4 GLL Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GNGLL		GLL protocol header
Latitude	2503.7135		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7448		dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	055757.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Checksum	*45		
<CR> <LF>			End of message termination

● GSA---GNSS DOP and Active Satellites

Table 8.1-5 contains the values for the following example:

NMEA V4.0

$GPGSA,A,3,193,19,06,05,02,17,09,12,13,195,,,1.23,0.92,0.81*01

$GLGSA,A,3,69,,,,,,,,,,,1.23,0.92,0.81*13

$GAGSA,A,3,,,,,,,,,,,,1.23,0.92,0.81*11

NMEA V4.10

$GNGSA,A,3,02,06,17,19,09,05,28,193,195,,,,1.34,1.02,0.87,1*01

$GNGSA,A,3,69,,,,,,,,,,,1.34,1.02,0.87,2*07

$GNGSA,A,3,,,,,,,,,,,,1.34,1.02,0.87,3*09

Table 8.1-5 GSA Data Format

Name	**Example**	**Units**	**Description**

Message ID	$GNGSA		GSA protocol header, GP=GPS/QZSS, GL=GLONASS, GA=GALILEO, BD=BEIDOU (**GN for NMEA Ver 4.10**)
Mode 1	A		See Table 8.1-6
Mode 2	3		See Table 8.1-7
ID of satellite used	02		Sv on Channel 1
ID of satellite used	06		Sv on Channel 2
….			….
ID of satellite used			Sv on Channel N
PDOP	1.34		Position Dilution of Precision
HDOP	1.02		Horizontal Dilution of Precision
VDOP	0.87		Vertical Dilution of Precision
System ID	1		1: GPS, 2:GLONASS, 3:GALILEO, 4:BEIDOU **(NMEA Ver 4.10 support only)**
Checksum	*01		
<CR> <LF>			End of message termination

Table 8.1-6 Mode 1

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

Table 8.1-7 Mode 2

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

● GSV---GNSS Satellites in View

Table 8.1-8 contains the values for the following example:

$GPGSV,3,1,11,18,67,344,48,09,55,031,50,42,54,142,40,193,47,174,45,0*51

$GPGSV,3,2,11,21,44,219,46,27,39,035,48,12,34,131,44,15,30,057,46,0*6A

$GPGSV,3,3,11,22,27,319,47,14,22,285,42,25,19,171,40,0*58

$GLGSV,2,1,07,76,71,201,44,65,57,041,40,75,48,028,39,72,27,108,39,1*75

$GLGSV,2,2,07,66,25,333,43,77,17,207,37,81,02,280,29,1*41

$GAGSV,2,1,05,01,83,026,35,26,53,024,35,21,38,134,30,12,16,233,21,0*70

$GAGSV,2,2,05,18,,,30,0*7B

Table 8.1-8 GSV Data Format

Name	**Example**	**Units**	**Description**

Message ID	$GPGSV		GSV protocol header GP=GPS/QZSS, GL=GLONASS, GA=GALILEO, BD=BEIDOU
Total number of messages(1)	3		Range 1 to 6
Message number(1)	1		Range 1 to 6
Satellites in view	11		
Satellite ID(2)	18		Channel 1 (Range 01 to 196)
Elevation	67	degrees	Channel 1 (Range 00 to 90)
Azimuth	344	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	48	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
Satellite ID	09		Channel 4 (Range 01 to 196)
Elevation	55	degrees	Channel 4 (Range 00 to 90)
Azimuth	031	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	50	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
	…		
Signal ID	0		GPS/QZSS: All signal=0, GLONASS: All signal=0, G1 C/A=1 GALILEO: All signal=0, BEIDOU: All signal=0 **(NMEA Ver 4.10 support only)**
Checksum	*51		
<CR> <LF>			End of message termination

Note (1): Depending on the number of satellites tracked multiple messages of GSV data may be required.
Note (2): GPS ID: 01~32, SBAS ID: 33~64, QZSS ID: 193~196, BEIDOU ID: 01~32, GALILEO ID: 01~32

● RMC---Recommended Minimum Specific GNSS Data

Table 8.1-9 contains the values for the following example:

$GNRMC,183015.000,A,2503.7123,N,12138.7446,E,0.01,34.92,270812,,, D,V*39

Table 8.1-9 RMC Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GNRMC		RMC protocol header
UTC Time	183015.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.7123		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.7446		dddmm.mmmm
E/W Indicator	E		E=east or W=west

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Speed over ground	0.01	knots	True
Course over ground	34.92	degrees	
Date	270812		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west (Not shown)
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Navigational status indicator	V		= Safe C = Caution U = Unsafe V = Void **(NMEA Ver 4.10 support only)**
Checksum	*39		
<CR> <LF>			End of message termination

● VTG---Course Over Ground and Ground Speed

Table 8.1-10 contains the values for the following example:

$GNVTG,196.90,T,,M,0.01,N,0.01,K,D*21

Table 8.1-10 VTG Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPVTG		VTG protocol header
Course over ground	196.90	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.01	knots	Measured speed
Units	N		Knots
Speed over ground	0.01	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed

			F = RTK float E = Estimated/Dead reckoning fix
Checksum	*21		
<CR> <LF>			End of message termination

8.2 Proprietary NMEA input/output message

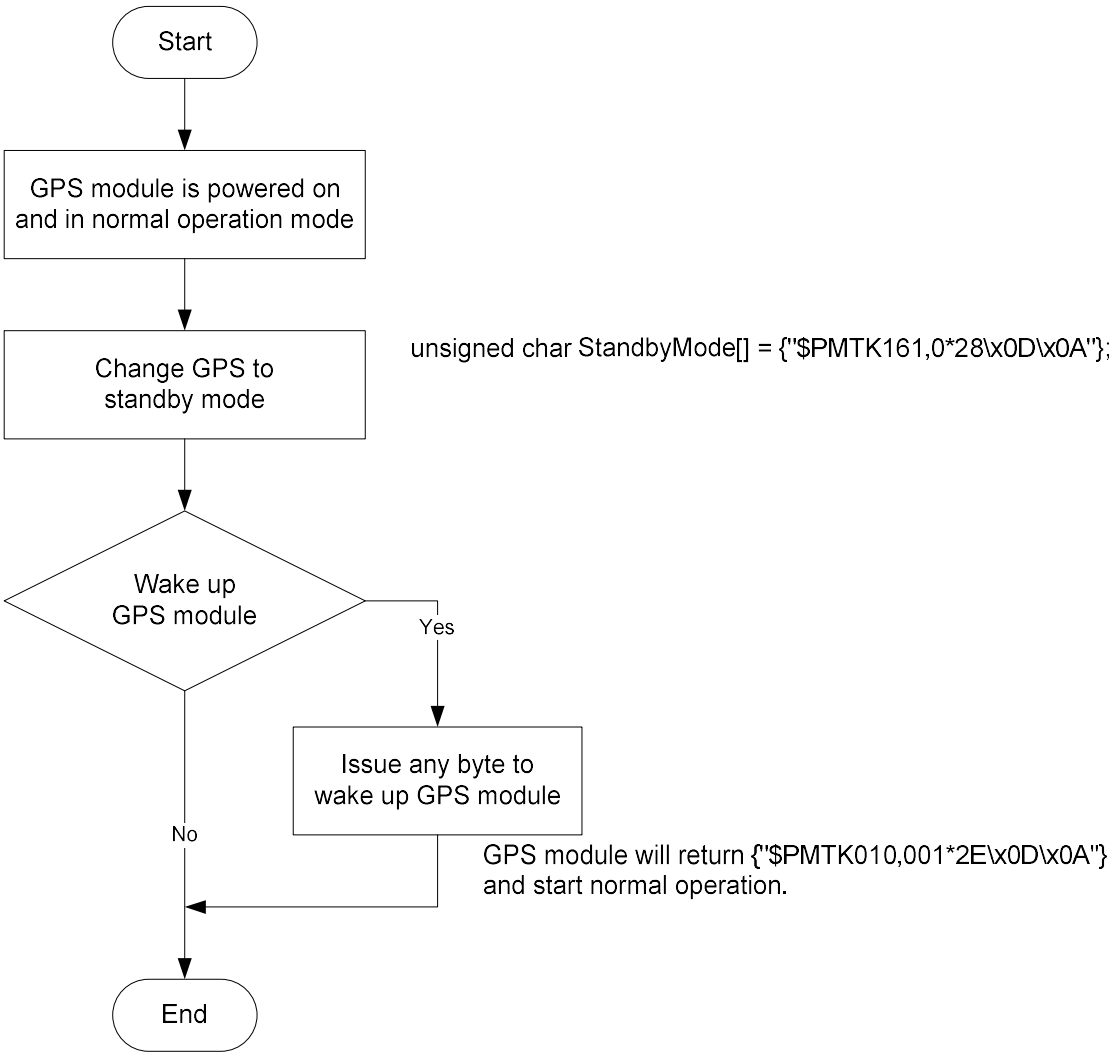
Please refer to MTK proprietary message.

8.3 Examples to configure the power mode of GNSS module

The GNSS module supports different power modes that user can configure by issuing software commands.

8.3.1 Standby mode

User can issue software command to make GNSS module go into standby mode that consumes less than 500uA current. GNSS module will be awaked when receiving any byte. The following flow chart is an example to make GNSS module go into standby mode and then wake up.



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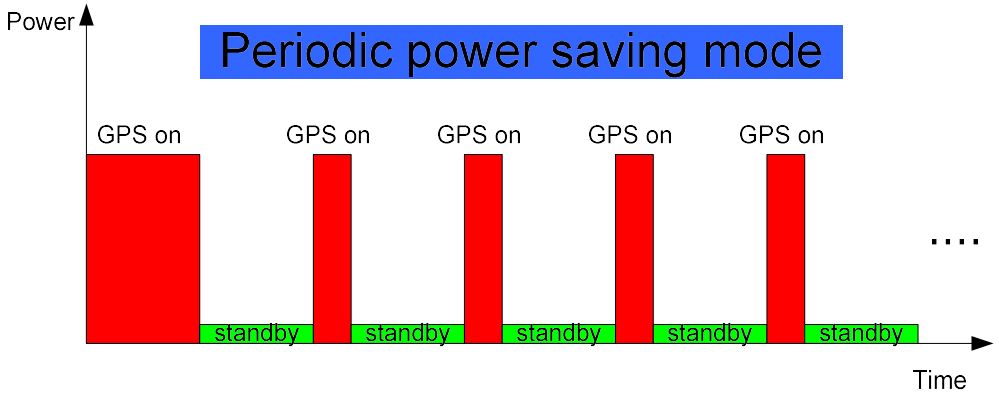
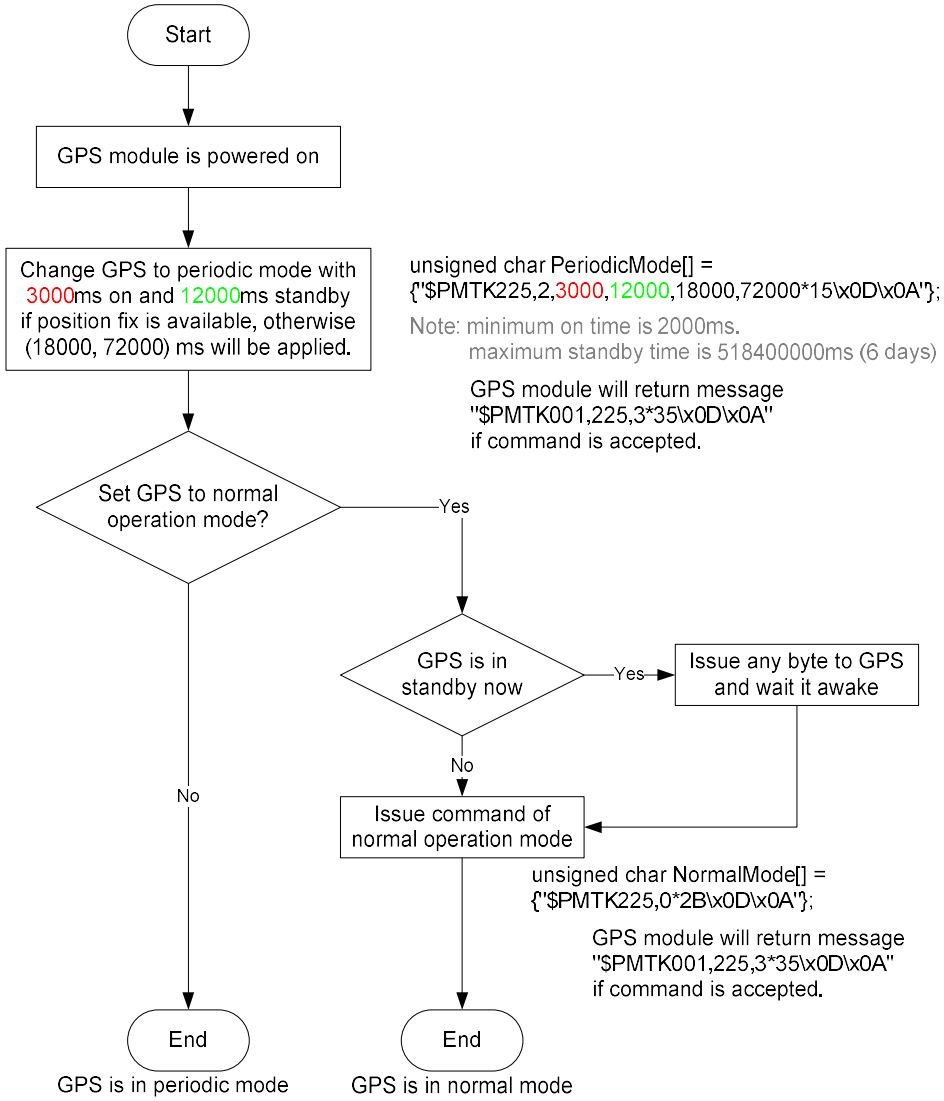
8.3.2 Periodic mode

When GNSS module is commanded to periodic mode, it will be in operation and standby periodically. Its status of power consumption is as below chart.



The following flow chart is an example to make GNSS module go into periodic mode and then back to normal operation mode.



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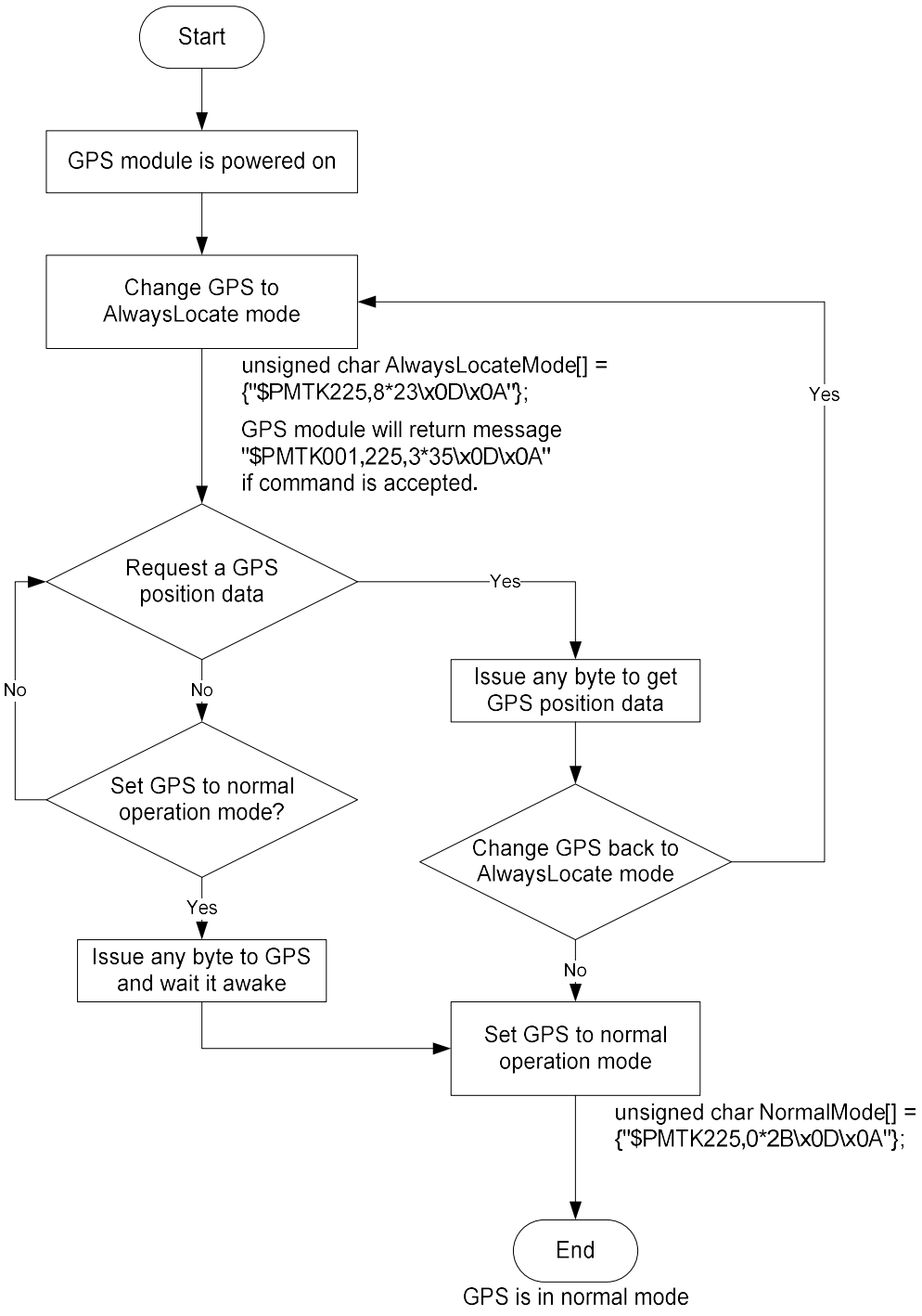
8.3.3 AlwaysLocate™ mode

AlwaysLocate™ is an intelligent controller of periodic mode. Depending on the environment and motion conditions, GNSS module can adaptively adjust working/standby time to achieve balance of positioning accuracy and power consumption. In this mode, the host CPU does not need to control GNSS module until the host CPU needs the GNSS position data. The following flow chart is an example to make GNSS module go into AlwaysLocate™ mode and then back to normal operation mode.

Note: AlwaysLocate™ is a trade mark of MTK.



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8.4 Data logger

The GNSS module has internal flash memory for logging GNSS data. The configurations include time interval, distance, speed, logging mode, and … etc. For more information, please contact us.

8.5 Examples to configure the update rate of GNSS module

The GNSS module supports up to 10Hz update rate that user can configure by issuing software commands. Note that the configurations by software commands are stored in the battery-backed SRAM that is powered through VBACKUP pin. Once it drains out, the default/factory settings will be applied.

Due to the transmitting capacity per second of the current baud rate, GNSS module has to be changed to higher baud rate for high update rate of position fix. The user can use the following software commands to change baud rate.

Baud rate	Software command
Factory default	$PMTK251,0*28<CR><LF>
4800	$PMTK251,4800*14<CR><LF>
9600	$PMTK251,9600*17<CR><LF>
19200	$PMTK251,19200*22<CR><LF>
38400	$PMTK251,38400*27<CR><LF>
57600	$PMTK251,57600*2C<CR><LF>
115200	$PMTK251,115200*1F<CR><LF>

Note: <CR> means Carriage Return, i.e. 0x0D in hexadecimal. <LF> means Line Feed, i.e. 0x0A in hexadecimal.

If the user does not want to change baud rate, you can reduce the output NMEA sentences by the following software commands.

NMEA sentence	Software command
Factory default	$PMTK314,-1*04<CR><LF>
Only GLL at 1Hz	$PMTK314,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only RMC at 1Hz	$PMTK314,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only VTG at 1Hz	$PMTK314,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GGA at 1Hz	$PMTK314,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GSA at 1Hz	$PMTK314,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GSV at 1Hz	$PMTK314,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only ZDA at 1Hz	$PMTK314,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0*29<CR><LF>
RMC, GGA, GSA at 1Hz and GSV at	$PMTK314,0,1,0,1,1,5,0,0,0,0,0,0,0,0,0,0,0,0,0*2C<CR><LF>

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0.2Hz	
If the command is correct and executed, GNSS module will output message $PMTK001,314,3*36<CR><LF>	

After the GNSS module is changed to higher baud rate or reduced NMEA sentence, the user can configure it to high update rate of position fix by the following commands.

Interval of position fix	Software command
Every 100ms (10Hz)(1)	$PMTK220,100*2F<CR><LF>
Every 200ms (5Hz)	$PMTK220,200*2C<CR><LF>
Every 500ms (2Hz)	$PMTK220,500*2B<CR><LF>
Every 1000ms (1Hz)	$PMTK220,1000*1F<CR><LF>
Every 2000ms (0.5Hz)(2)	$PMTK220,2000*1C<CR><LF>
If the command is correct and executed, GNSS module will output message $PMTK001,220,3*30<CR><LF>	

Note 1: The minimum interval of position fix is 100ms, i.e. the maximum update rate is 10Hz.

Note 2: The current consumption is the same with the update rate of 1Hz.

8.6 Configure the static navigation parameter

The output position of GNSS module will keep the same and output speed will be zero if the actual speed is below the threshold of the static navigation parameter. This is useful for different applications. For example, the car stopped at a red light will get stationary GNSS position if the threshold is 1.5m/s. It is better to disable this function by setting threshold to 0 for pedestrian navigation. This function is default disabled.

The format of the software command is as below.

$PMTK386,speed threshold*checksum<CR><LF>

The unit of speed threshold is meter per second. The range of speed threshold is from 0.1m/s to 2.0m/s. Value 0 is to disable the function.

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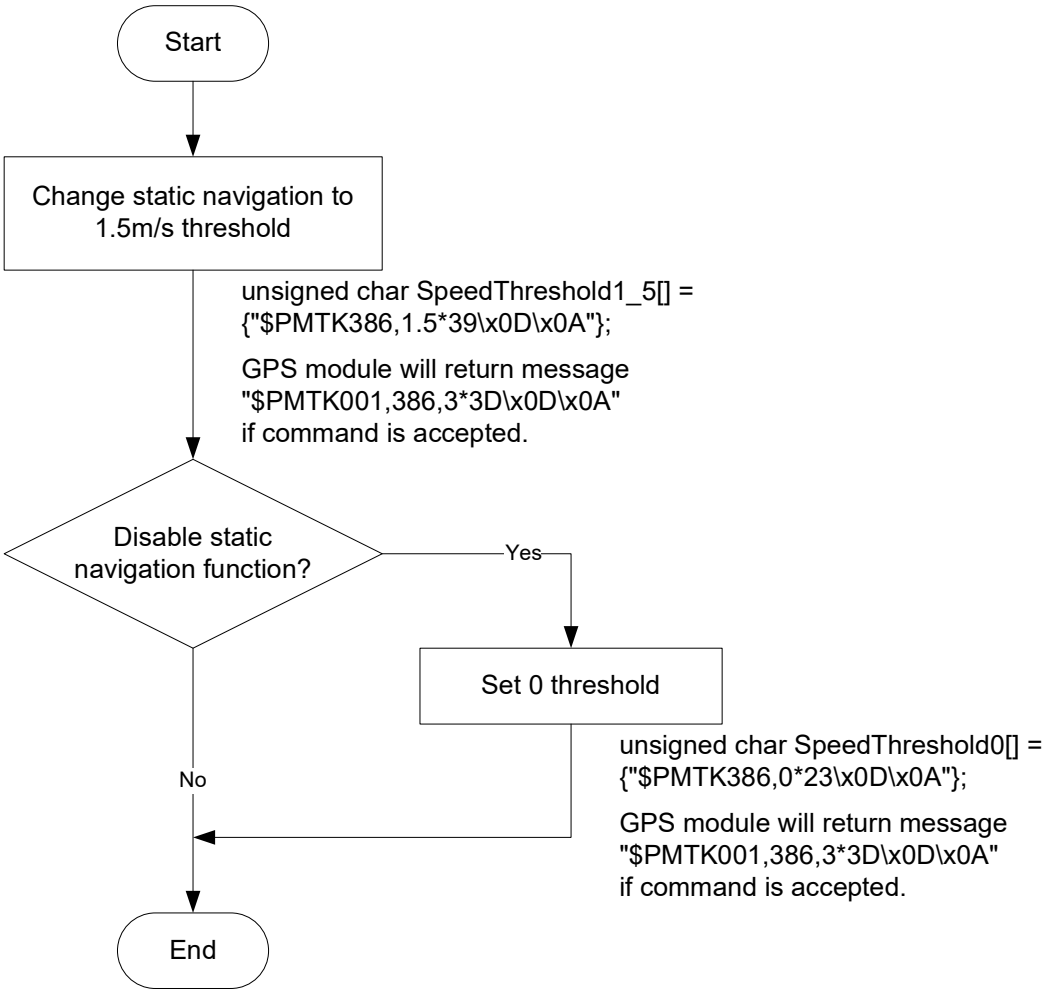

8.7 Receive NMEA data through I2C interface

I2C slave address is 0x10. I2C TX buffer of GNSS module has 255 bytes. Master can read one I2C data packet maximum 255 bytes at a time. In order to read entire NMEA packet of one second, master needs to read several I2C data packets and extract valid NMEA data from them.

After reading one I2C data packet, master needs to sleep 5ms to read next I2C data packet because GNSS module spends 5ms to upload new I2C data into its I2C buffer.

8.7.1 I2C data packet format in slave buffer

I2C data packet in slave buffer has 254 valid NMEA bytes at most and one end character <LF>, so master must read maximum 255 bytes as an I2C data packet at a time. When slave buffer is empty, master will read one I2C data packet with all garbage byte, i.e. <LF>.

Packet format in slave buffer:

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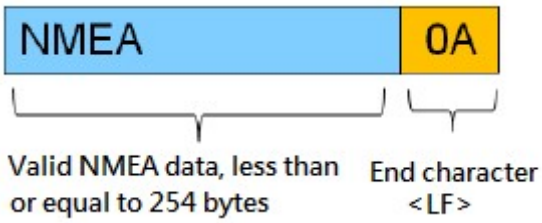
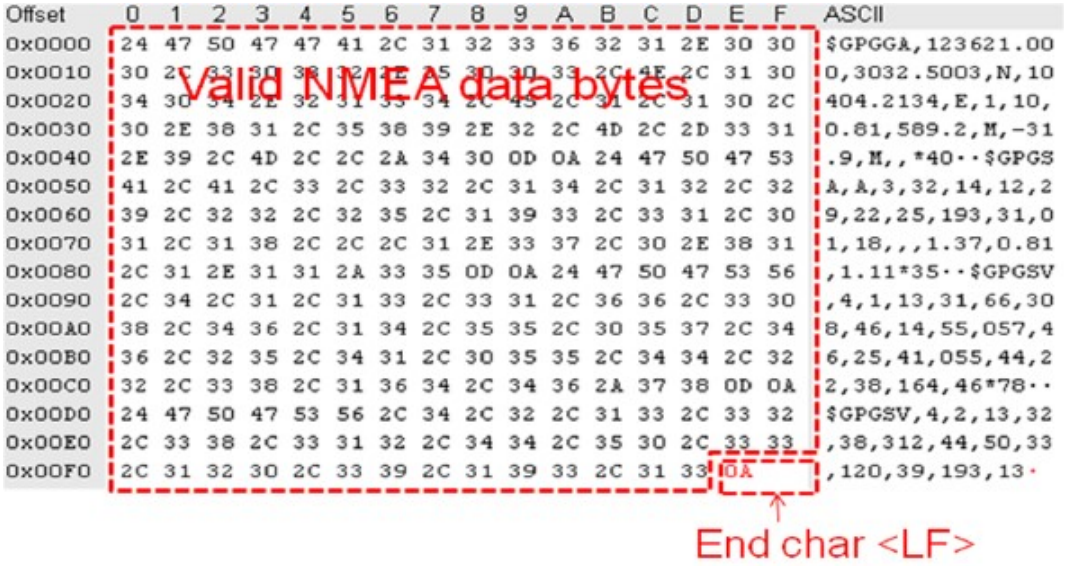


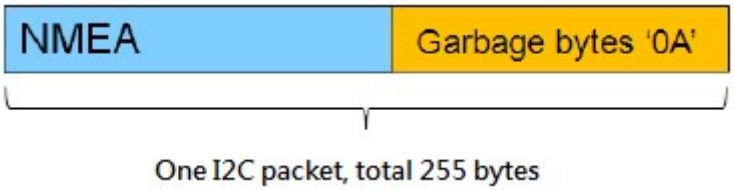
Example:

There are 254 valid NMEA bytes and 1 end character <LF> in I2C slave buffer as follwing figure.



8.7.2 Three types of I2C packet that master may read

I. When slave buffer already has some data, master read one I2C packet (255 bytes). It includes some valid data in the header of packet and some garbage bytes in the end of packet.



Example:

If slave buffer has 202 bytes NMEA data, master reads one I2C packet (255 bytes), the read packet format is as following.

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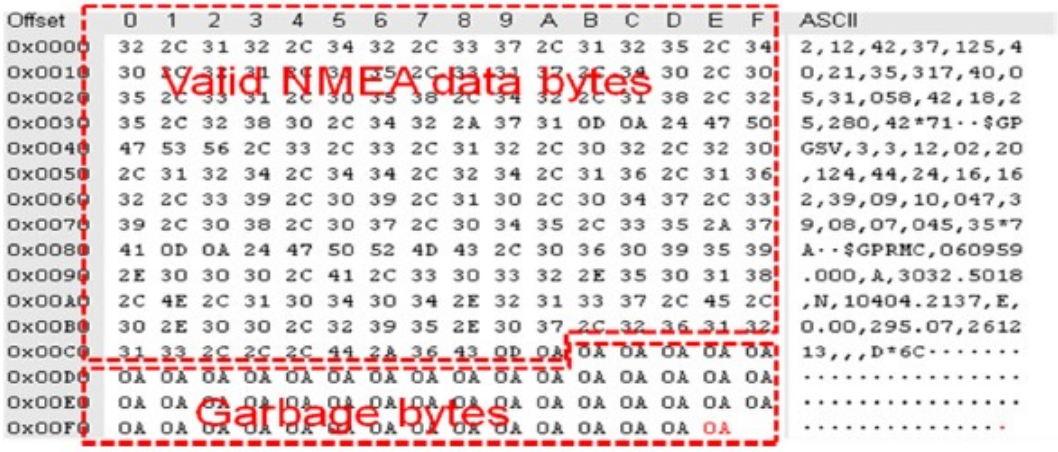
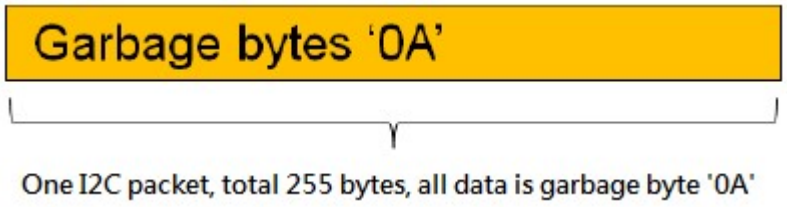


Note: Why garbage byte is '0A'? Because if I2C slave buffer is empty, GNSS module will output last valid byte repeatedly until new data upload into I2C buffer, '0A' is the last valid byte in the last NMEA packet.

II. When slave buffer is empty, master read one I2C packet (255 bytes). All data in packet are garbage bytes.



Example:

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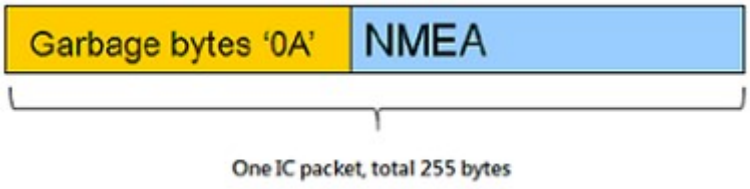
III. If slave buffer is empty, master start to read one I2C packet (will read garbage bytes in the beginning). When this reading procedure is not over, master will read valid N

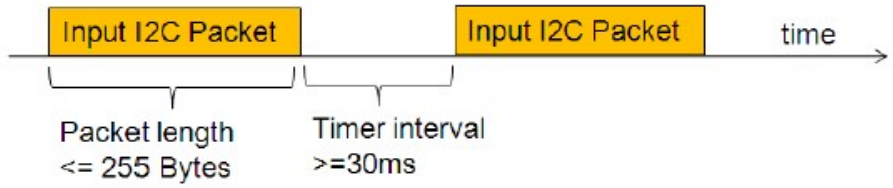


Example:

Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	ASCII
0x0000	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	····
0x0010	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	····
0x0020	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	····
0x0030	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	0A	····
0x0040	0A	0A	0A	0A	0A	0A	0A	0A	24	47	50	47	47	41	2C	30	····$GPGGA,0
0x0050	37	31	34	33	38	2E	30	30	30	2C	33	30	33	32	2E	35	71438.000,3032.5
0x0060	30	31	31	2C	4E	2C	31	30	34	30	34	2E	32	31	31	33	011,N,10404.2113
0x0070	2C	45	2C	32	2C	31	30	2C	30	2E	38	35	2C	35	37	35	,E,2,10,0.85,575
0x0080	2E	34	2C	4D	2C	2D	33	31	2E	39	2C	4D	2C	30	30	30	.4,M,-31.9,M,000
0x0090	30	2C	30	30	30	30	2A	34	38	0D	0A	24	47	50	47	53	0,0000*48··$GPGS
0x00A0	41	2C	41	2C	33	2C	30	36	2C	31	39	33	2C	32	32	2C	A,A,3,06,193,22,
0x00B0	30	35	2C	32	36	2C	31	38	2C	31	35	2C	32	31	2C	32	05,26,18,15,21,2
0x00C0	34	2C	32	39	2C	2C	2C	31	2E	34	37	2C	30	2E	38	35	4,29,,,1.47,0.85
0x00D0	2C	31	2E	31	39	2A	33	42	0D	0A	24	47	50	47	53	56	,1.19*3B··$GPGSV
0x00E0	2C	34	2C	31	2C	31	33	2C	31	35	2C	36	35	2C	30	32	,4,1,13,15,65,02
0x00F0	38	2C	34	36	2C	32	31	2C	36	31	2C	33	31	33	2C		8,46,21,61,313,

8.8 Write command through I2C interface

User can input MTK proprietary message through I2C bus. The maximum input bytes of one I2C packet is 255. The time interval of two input I2C packets can't be less than 30 milliseconds because GNSS module needs 30 milliseconds to process input data.



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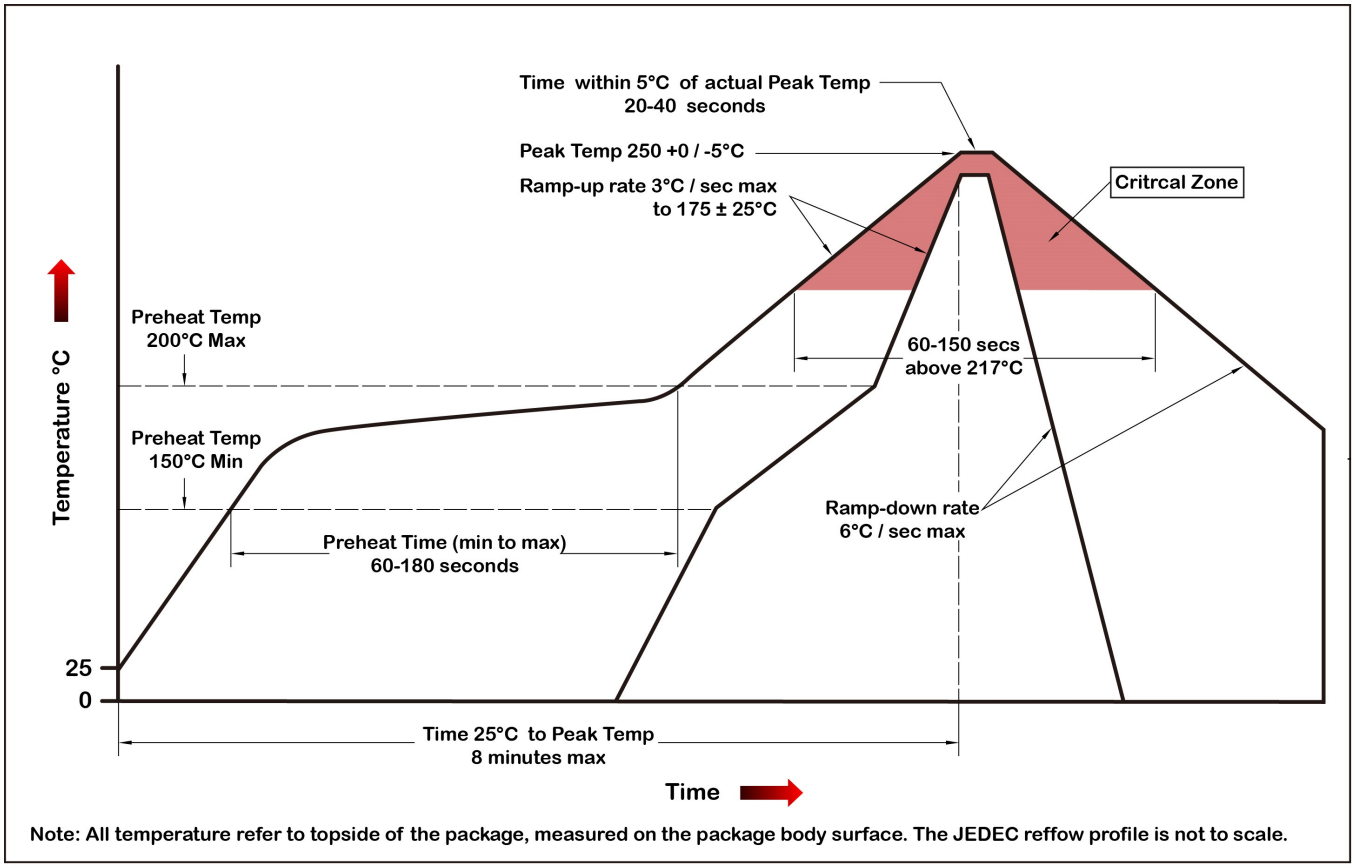
9 Recommended soldering reflow profile

The module belongs to RoHS device. The maximum of reflow temperature, real on top of PCB, is not over 250 Celsius.

Lead-free Processes



Note: All temperature refer to topside of the package, measured on the package body surface. The JEDEC reffow profile is not to scale.

Lead –Free Solder Paste (Sn 96.5-Ag 3.0-Cu 0.5) Cycle Interval: 300 sec

Note:

The MC-1612-G2 module should be soldered on the topside in the soldering process to prevent from falling down.

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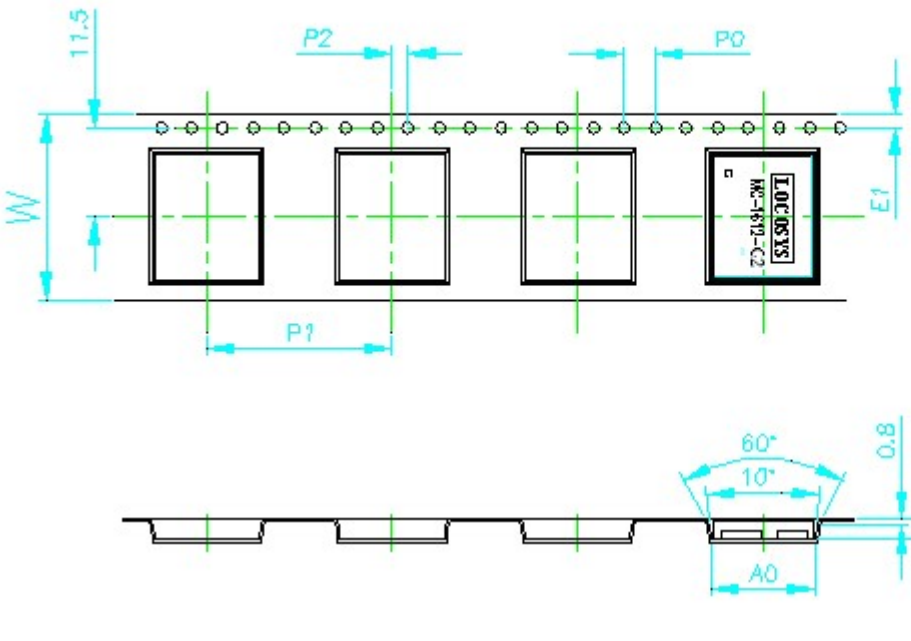
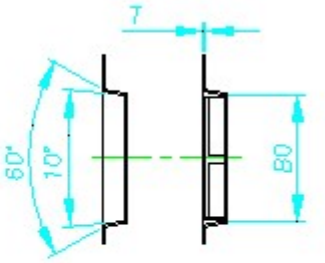
10 Reel Packing information





A0	13.50 ±0.1
B0	16.40 ±0.1
D0	ø1.5
E1	1.75 ±0.1
K0	2.70 ±0.1
P0	4.0 ±0.1
P1	24.00 ±0.1
P2	2.0 ±0.10
T	0.3 ±0.10
W	24.0 ±0.30

1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Camber not to exceed 1mm in 100mm
3. A0 and B0 measured on a plane 0.3mm above the bottom of the pocket
4. K0 measured from a plane on the inside bottom of the pocket to the top surface of the carrier .
5. pocket position relative to sprocket hole measured as true position of pocket,not pocket hole.
6. Component load per 13"reel: 1000 pcs

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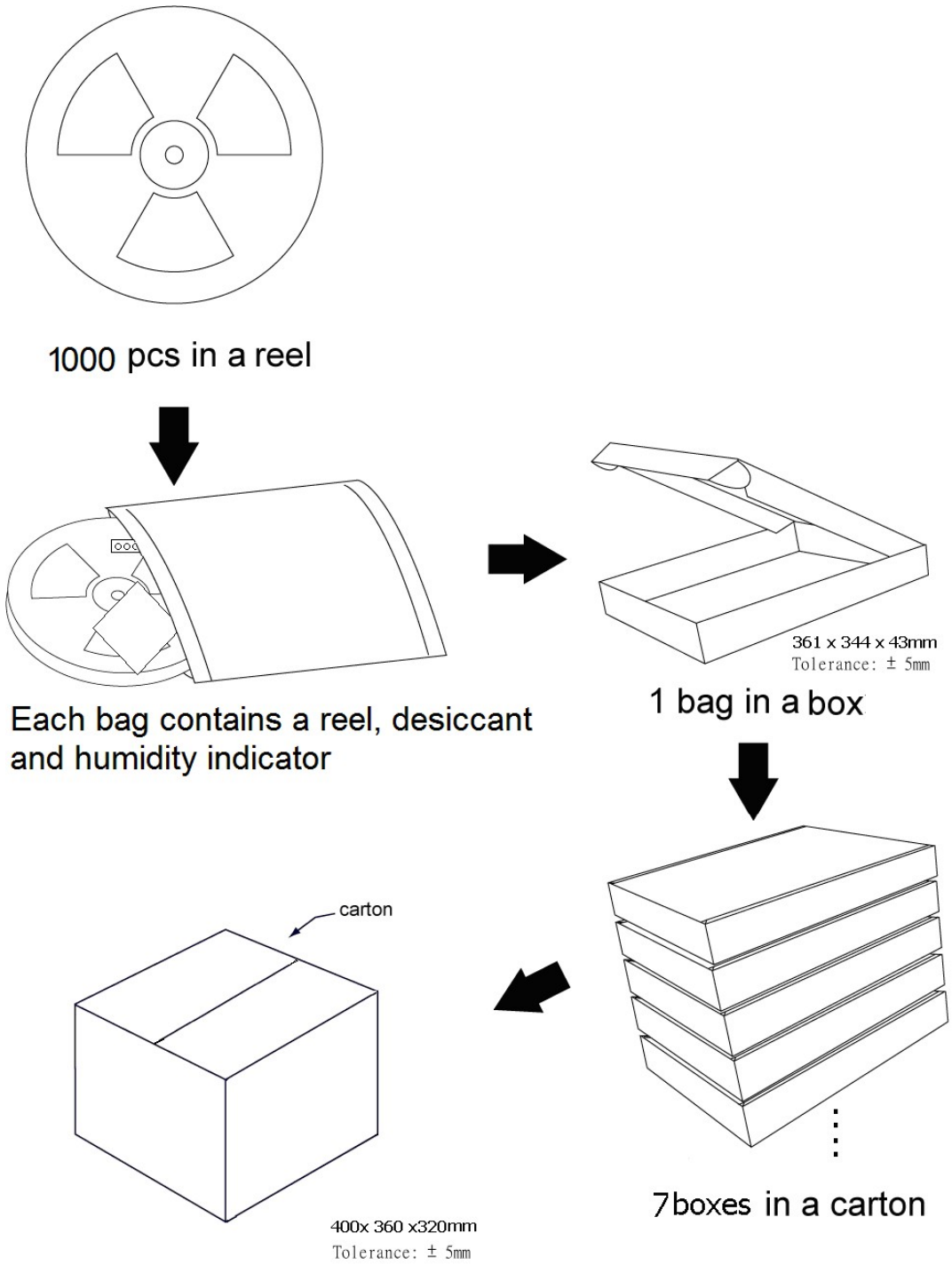
11 Packing and Handling

GNSS modules, like any other SMD devices, are sensitive to moisture, electrostatic discharge, and temperature. By following the description sketched in the document for LOCOSYS GNSS module storage and handling, it is possible to reduce the chances of them being damaged during production.

11.1 Packing



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11.2 Moisture Sensitivity

The module belongs to moisture sensitive device (IPC/JEDEC J-STD-020C Level III). If it is not used by then, we strong recommended storing the GNSS modules in dry places such as dry cabinet. The approximate shelf life for LOCOSYS GNSS modules packages is 6 months from the bag seal date, when store in a non-condensing storage environment (<30°C/60% RH)

11.3 ESD Handling

Please carefully follow the following precautions to prevent severe damage to GNSS modules.

LOCOSYS GNSS modules are sensitive to electrostatic discharges, and thus are Electrostatic Sensitive Devices (ESD). Careful handling of the GNSS modules and in particular RFIN pin must follow the standard ESD safety protections:

- Unless there is a galvanic coupling between the local GND and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- Before working with RFIN pin, please make sure the GND is connected
- When working with RFIN pin, do not contact any charges capacitors or materials that can easily develop or store charges such as patch antenna, coax cable, soldering iron.
- When soldering RFIN pin, please make sure to use an ESD safe soldering iron (tip).

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Document change list

Revision 1.0

- First release on October 08, 2014.

Revision 1.0 to revision 1.1 (April 29, 2020)

- Changed quality control from ISO/TS 16949 to IATF 16949
- Added “Note 1” in the section 4.

Revision 1.1 to revision 1.2 (July 24, 2020)

- Revised protocol support NMEA 0183 version from 4.10 to 4.00 in the section 4.
- Added “Note 2” in the section 4.
- Revised section 8.1 NMEA output message.

Revision 1.2 to revision 1.3 (April 13, 2021)

- Removed support RTCM SC-104 Version-2.x in section 2.
- Added support I2C interface in section 2.
- Revised Fig. 3-2, 3-3, 3-4.
- Added Fig.3-5.
- Removed RTCM SC-104 Version-2.x in section 4.
- Revised Pin assignment in section 5.
- Added section 8.7 and 8.8 for I2C communication.

Revision 1.3 to revision 1.4 (April 22, 2021)

- Revised section 9 Recommended soldering reflow profile.