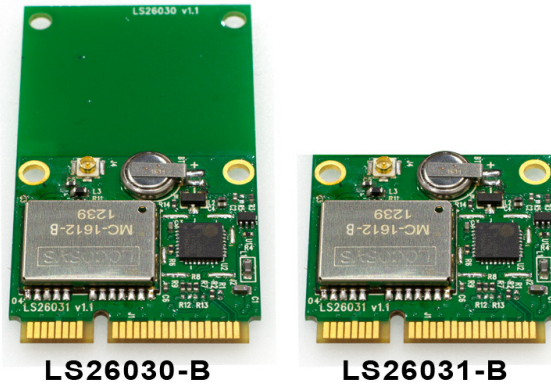


Product name	Description	Version
LS26030-B	GNSS module of PCIe Full-Mini card	1.0
LS26031-B	GNSS module of PCIe Half-Mini card	



1 Introduction

LOCOSYS LS26030-B and LS26031-B are GNSS modules incorporated into the PCIe Full-Mini card or PCIe Half-Mini card. These GNSS modules are powered by MediaTek, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment. Besides, the USB interface makes these modules easy to integrate into the laptop.

These modules support hybrid ephemeris prediction to achieve faster cold start. One is self-generated ephemeris prediction 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 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

- USB interface
- MediaTek high sensitivity solution
- Support GPS, BEIDOU, 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
- Up to 10 Hz update rate
- ±11ns high accuracy time pulse (1PPS)
- Indoor and outdoor multi-path detection and compensation
- Built-in LNA and SAW filter
- Built-in micro battery to reserve system data for rapid satellite acquisition

3 Application

- Laptop with GNSS function
- IPC with GNSS function

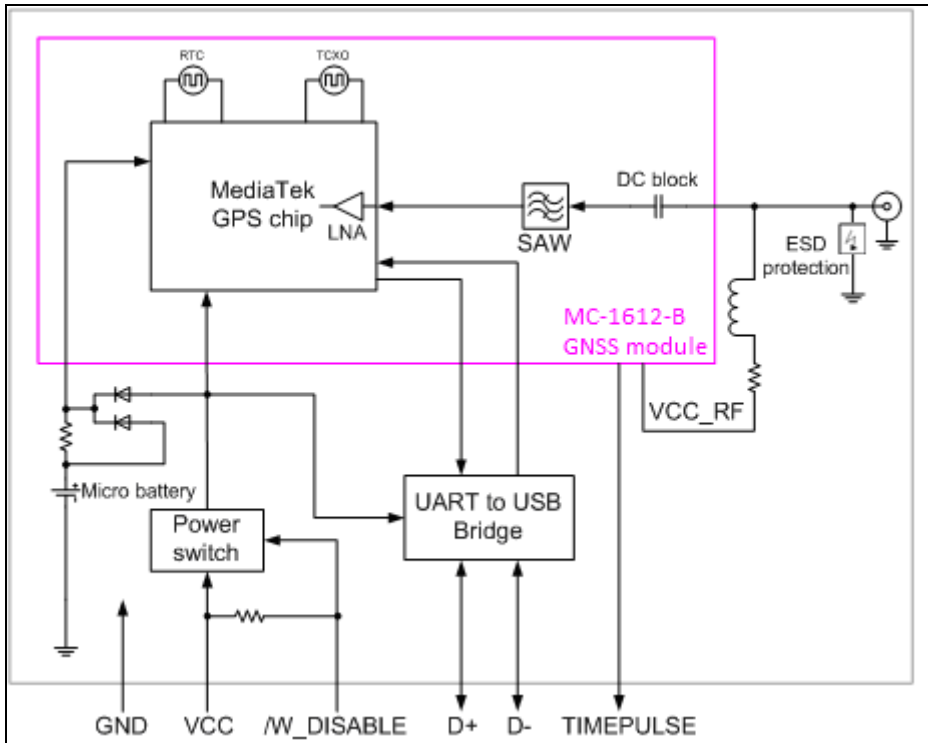


Fig 3-1 System block diagram.

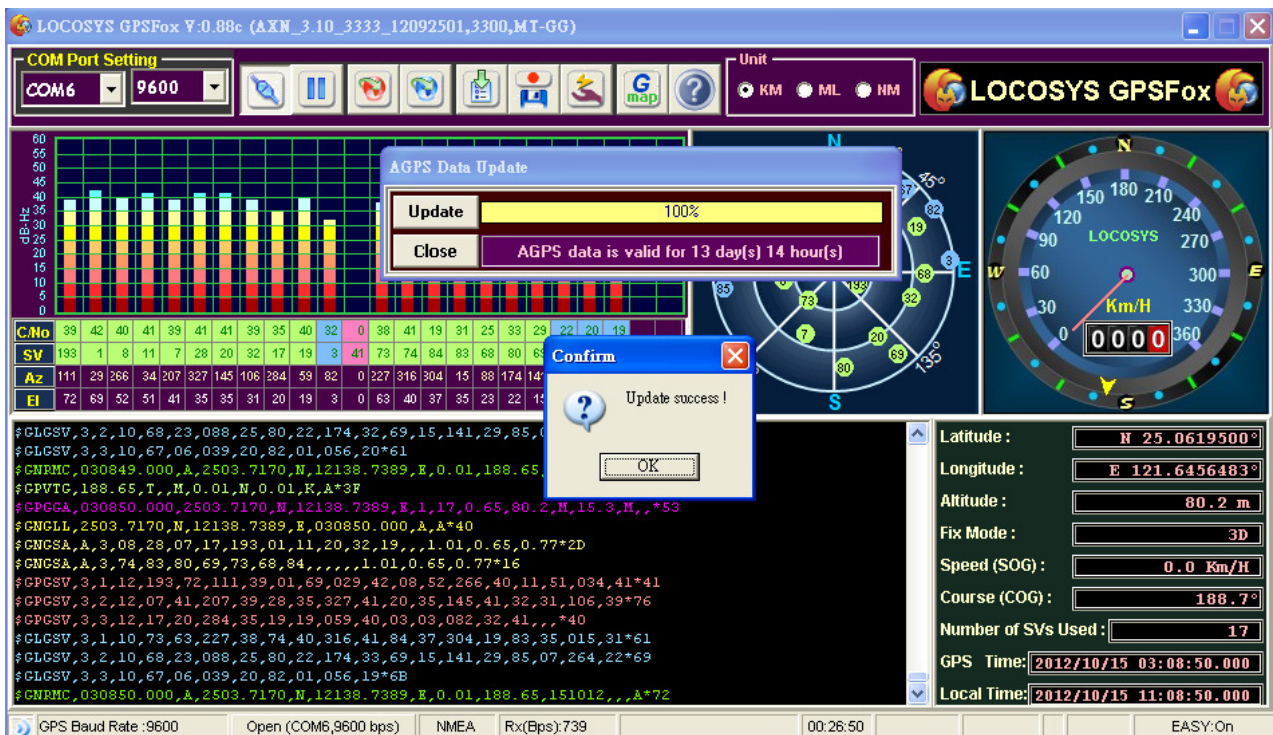


Fig 3-2 Download free up-to-14-day AGPS data from LOCOSYS' server to get faster time to fix.

4 GNSS receiver

Chip	MediaTek MT3333	
Frequency	GPS, GALILEO, QZSS: L1 1575.42MHz, C/A code BEIDOU: B1 1561.098MHz, C code	
Channels	Support 99 channels (33 Tracking, 99 Acquisition)	
Update rate	1Hz default, up to 10Hz	
Sensitivity	Tracking	Up to -165dBm (with external LNA)
	Cold start	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	9600 bps ⁽¹⁾ , 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,025633.000,2503.7148,N,12138.7462,E,2,19,0.74,116.8,M,15.3,M,0000,0000*6C

Table 5.1-2 GGA Data Format

Name	Example	Units	Description
------	---------	-------	-------------

Message ID	\$GPGGA		GGA protocol header
UTC Time	025633.000		hhmmss.sss
Latitude	2503.7148		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7462		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 33
HDOP	0.74		Horizontal Dilution of Precision
MSL Altitude	116.8	mters	
Units	M	mters	
Geoid Separation	15.3	mters	
Units	M	mters	
Age of Diff. Corr.	0000	second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
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:

\$GNGLL,2503.7148,N,12138.7462,E,025633.000,A,D*43

Table 5.1-4 GLL Data Format

Name	Example	Units	Description
Message ID	\$GNGLL		GLL protocol header (GP GLL or GN GLL)
Latitude	2503.7148		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7462		dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	025633.000		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	*43		
<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,3,06,23,16,03,31,19,27,14,32,,,,,1.03,0.74,0.73*11

\$BDGSA,A,3,09,08,07,06,05,10,01,02,03,04,,,,,1.03,0.74,0.73*16

Table 5.1-5 GSA Data Format

Name	Example	Units	Description
Message ID	\$GNGSA		GSA protocol header (GP GSA or GNG SAA or BD GSA)
Mode 1	A		See Table 5.1-6
Mode 2	3		See Table 5.1-7
ID of satellite used	06		Sv on Channel 1
ID of satellite used	23		Sv on Channel 2
....		
ID of satellite used			Sv on Channel 12
PDOP	1.03		Position Dilution of Precision
HDOP	0.74		Horizontal Dilution of Precision
VDOP	0.73		Vertical Dilution of Precision
Checksum	*11		
<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:

\$GPGSV,4,1,15,06,64,183,48,16,58,316,48,42,54,141,40,27,51,189,45*7F

\$GPGSV,4,2,15,03,44,206,46,31,44,077,48,23,30,314,45,19,19,199,46*76

\$GPGSV,4,3,15,32,18,236,43,14,14,154,41,21,12,090,,20,09,262,*73

\$GPGSV,4,4,15,13,06,324,,29,03,036,38,193,,,*41

\$BDGSV,3,1,10,07,69,034,44,08,66,200,44,03,60,206,45,01,56,140,40*6D

\$BDGSV,3,2,10,10,53,337,45,04,39,117,41,02,36,245,37,05,16,259,34*6E

\$BDGSV,3,3,10,09,11,215,42,06,05,188,37*66

Table 5.1-8 GSV Data Format

Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header (G PGSV and B DGSV)
Total number of messages ¹	4		Range 1 to 6
Message number ¹	1		Range 1 to 6
Satellites in view	15		
Satellite ID	06		Channel 1 (Range 01 to 196)
Elevation	64	degrees	Channel 1 (Range 00 to 90)
Azimuth	183	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	27		Channel 4 (Range 01 to 196)
Elevation	51	degrees	Channel 4 (Range 00 to 90)
Azimuth	189	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	45	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*7F		
<CR> <LF>			End of message termination

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

● RMC---Recommended Minimum Specific GNSS Data

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

\$GNRMC,025633.000,A,2503.7148,N,12138.7462,E,0.04,149.71,150713,,,D*7B

Table 5.1-9 RMC Data Format

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header (G P R MC or G N R MC)
UTC Time	025633.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.7148		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.7462		dddmm.mmmm

E/W Indicator	E		E=east or W=west
Speed over ground	0.04	knots	True
Course over ground	149.71	degrees	
Date	150713		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	*7B		
<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,149.71,T,,M,0.04,N,0.08,K,D*3E

Table 5.1-10 VTG Data Format

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Course over ground	149.71	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.04	knots	Measured speed
Units	N		Knots
Speed over ground	0.08	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	*3E		
<CR> <LF>			End of message termination

5.2 Proprietary NMEA input/output message

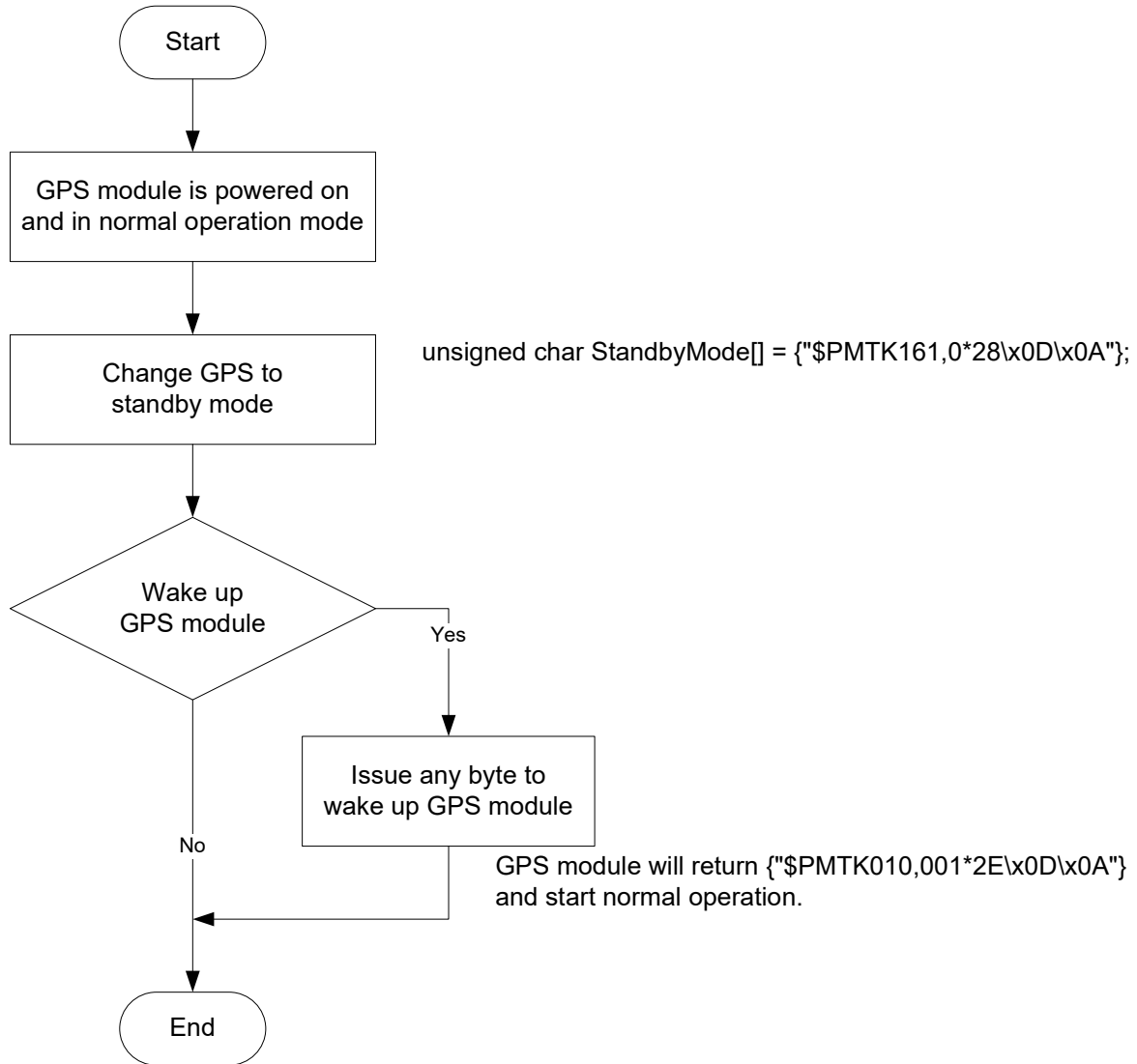
Please refer to MTK proprietary message.

5.3 Examples to configure the power mode of GNSS module

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

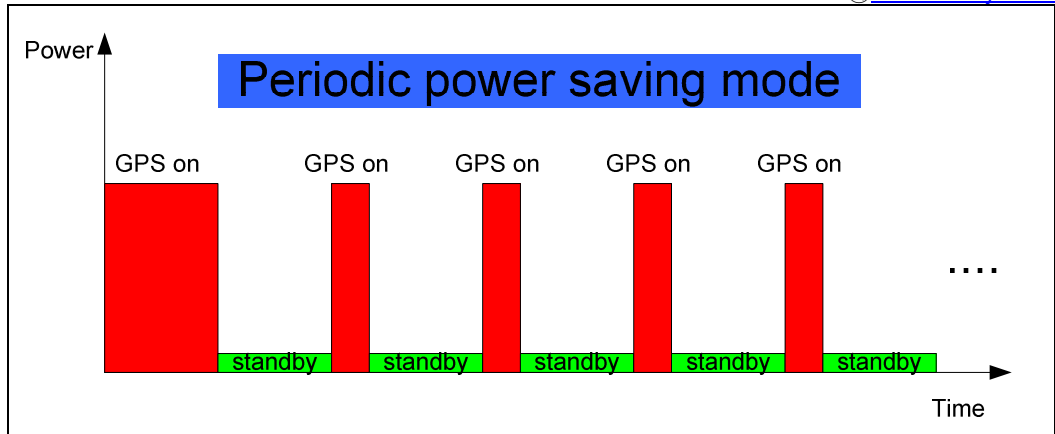
5.3.1 Standby mode

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.

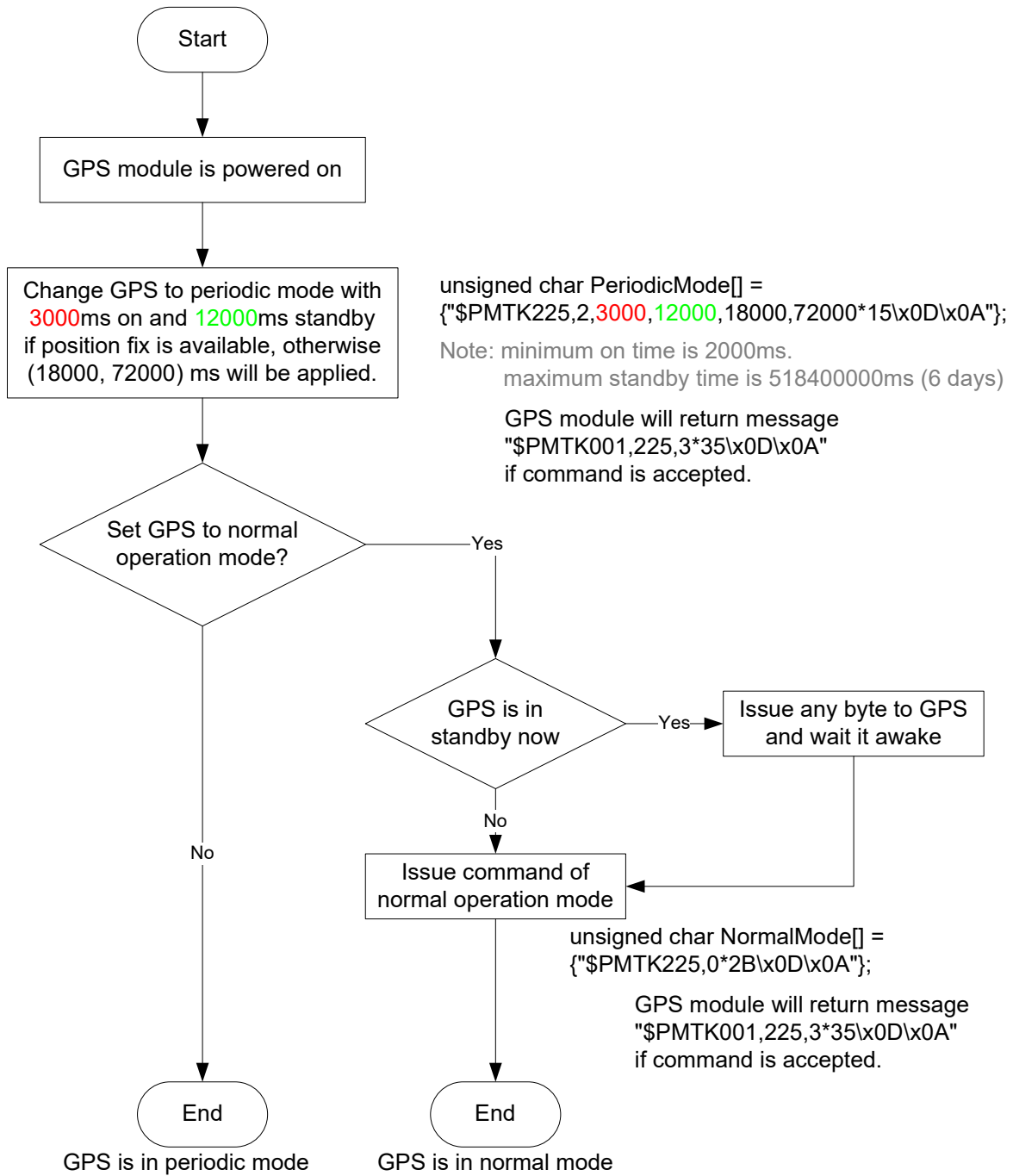


5.3.2 Periodic mode

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.



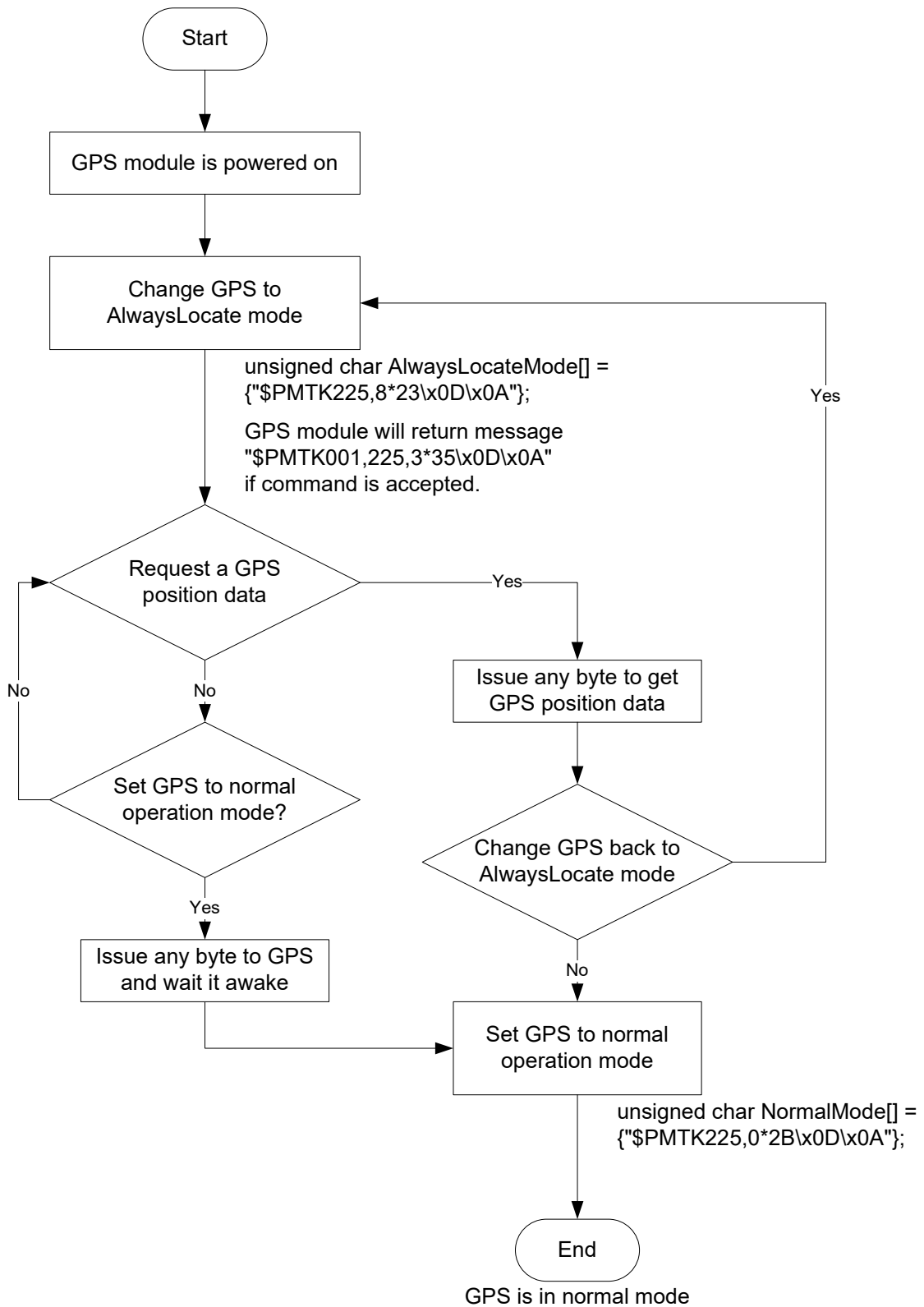
The following flow chart is an example to make GNSS module go into periodic mode and then back to normal operation mode.



5.3.3 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.



5.4 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.

5.5 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*29<CR><LF>
Only RMC at 1Hz	\$PMTK314,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only VTG at 1Hz	\$PMTK314,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GGA at 1Hz	\$PMTK314,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GSA at 1Hz	\$PMTK314,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GSV at 1Hz	\$PMTK314,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only ZDA at 1Hz	\$PMTK314,0,1,0*29<CR><LF>
RMC, GGA, GSA at 1Hz and GSV at 0.2Hz	\$PMTK314,0,1,0,1,1,5,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*2C<CR><LF>
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.

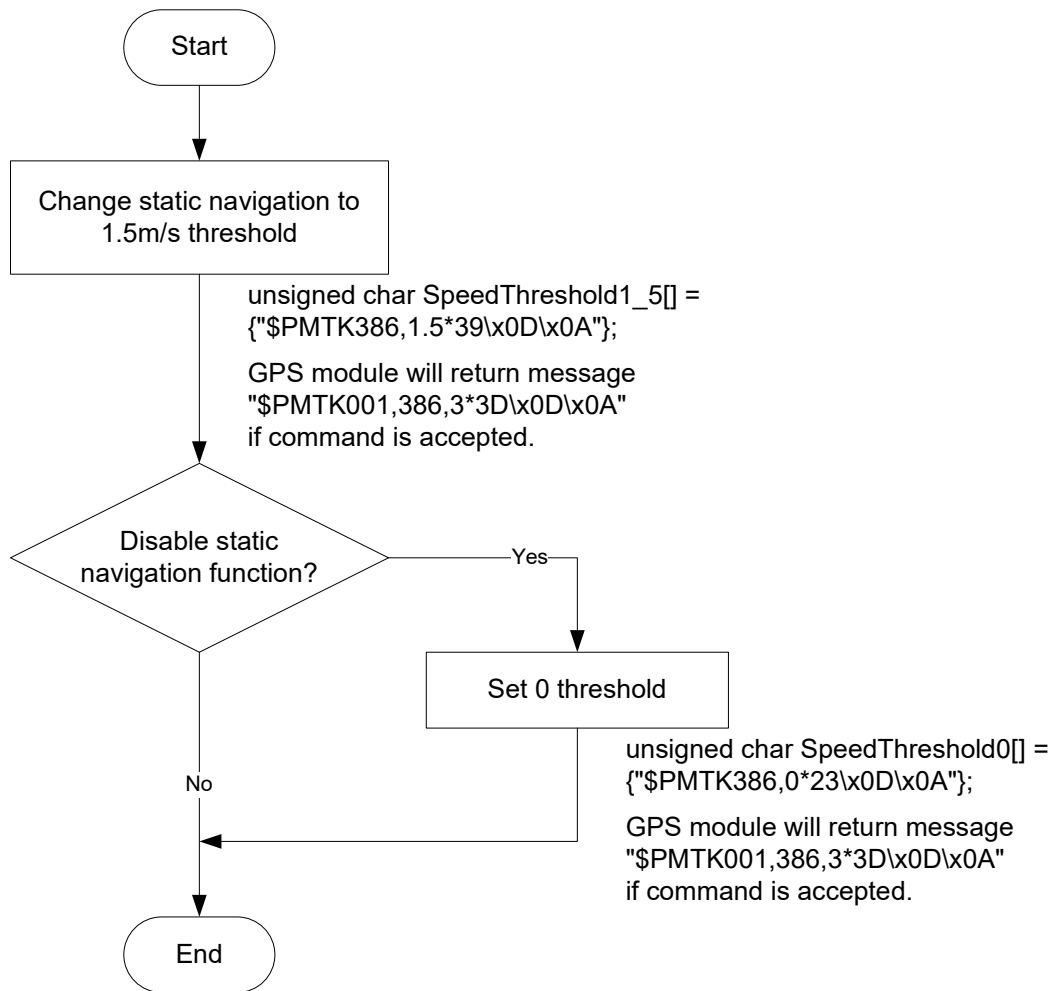
5.6 Configure the static navigation parameter

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.

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.



6 Pin assignment and descriptions

Table 6-1 Pin descriptions of PCIe Mini card

Pin #	Name	Type	Description	Note
1	NC			
2	NC			
3	NC			
4	GND	P	Ground	
5	NC			
6	NC			
7	NC			
8	NC			
9	GND	P	Ground	
10	NC			
11	NC			

12	NC		
13	NC		
14	NC		
15	GND	P	Ground
16	NC		
17	NC		
18	GND	P	Ground
19	NC		
20	/W_DISABLE	I	Power control input pin. Internal pull-up resistor. High: power on; Low: power off
21	GND	P	Ground
22	NC		
23	NC		
24	NC		
25	NC		
26	GND	P	Ground
27	GND	P	Ground
28	NC		
29	GND	P	Ground
30	NC		
31	NC		
32	NC		
33	NC		
34	GND	P	Ground
35	GND	P	Ground
36	USB_D-		USB D- line
37	GND	P	Ground
38	USB_D+		USB D+ line
39	NC		
40	GND	P	Ground
41	NC		
42	NC		
43	GND	P	Ground
44	NC		
45	NC		
46	NC		
47	NC		

48	NC		
49	TIMEMARK	O	Time pulse (1PPS, default 100 ms pulse/sec when 3D position fix is available)
50	GND	P	Ground
51	NC		
52	VCC	P	Power input

7 DC & Temperature characteristics

7.1 DC Electrical characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Voltage	VCC		3.0		3.6	V
Supply Current	I _{ss}	VCC = 3.3V, Peak		51	165	mA
		Acquisition		40 ⁽¹⁾		mA
		Tracking		17		mA
		Standby		<1 ⁽²⁾		uA
		Power off				
High Level Input Voltage	V _{IH}	/W_DISABLE pin	1.3		VCC	V
Low Level Input Voltage	V _{IL}	/W_DISABLE pin			0.25	V
High Level Input Current	I _{IH}	/W_DISABLE pin	-5		1	uA
Low Level Input Current	I _{IL}	/W_DISABLE pin	-5		1	uA

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

(2) Measured when /W_DISABLE pin is at low level.

7.2 Temperature characteristics

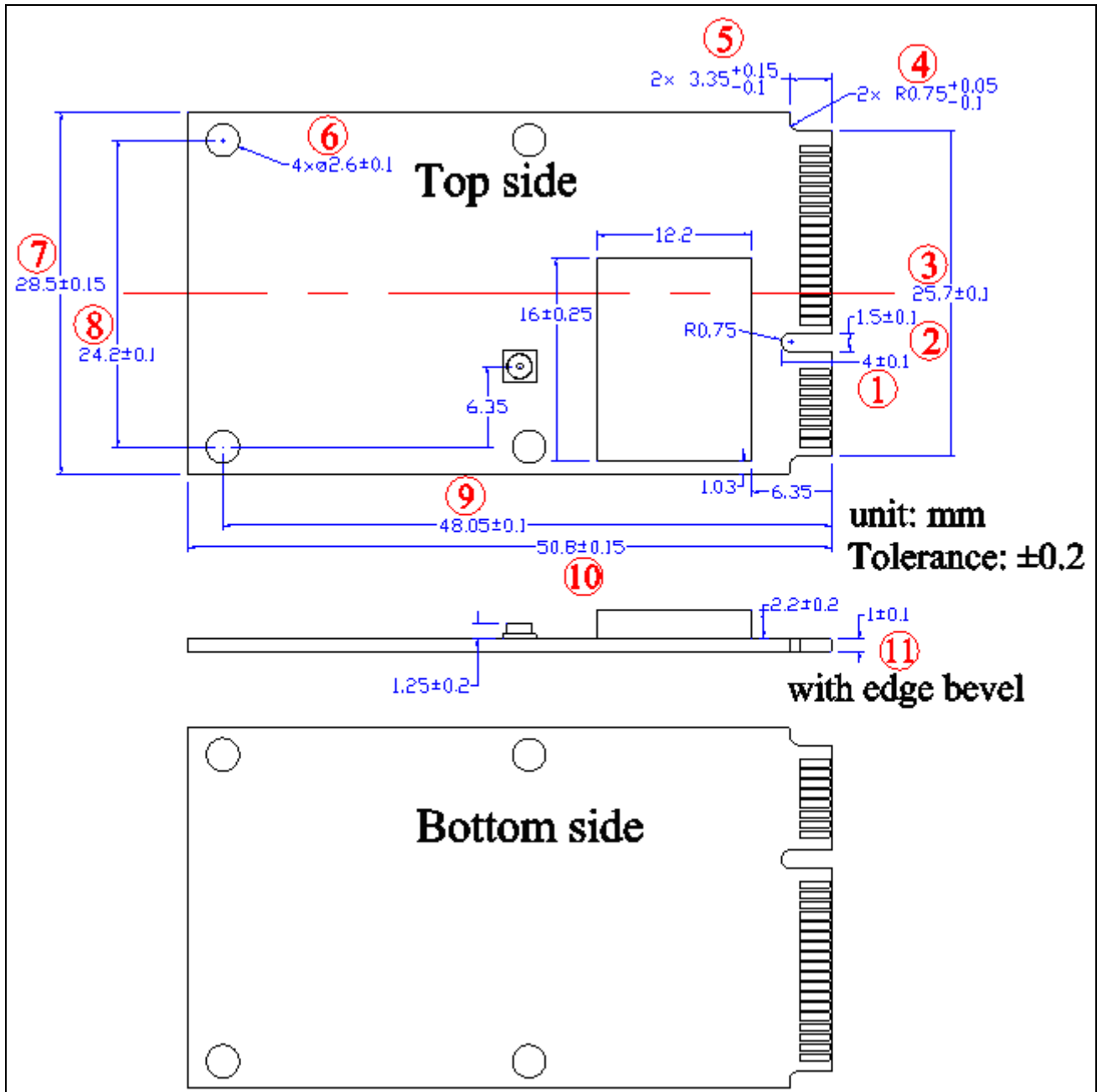
Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	Topr	-40	-	85	°C
Storage Temperature	Tstg	-40	25	85	°C

Note: The operating and storage temperature of the built-in micro battery are -20 ~ +60 °C and -40 ~ +60 °C respectively. GNSS module will still work even the battery is broken or short due to temperature or other issues.

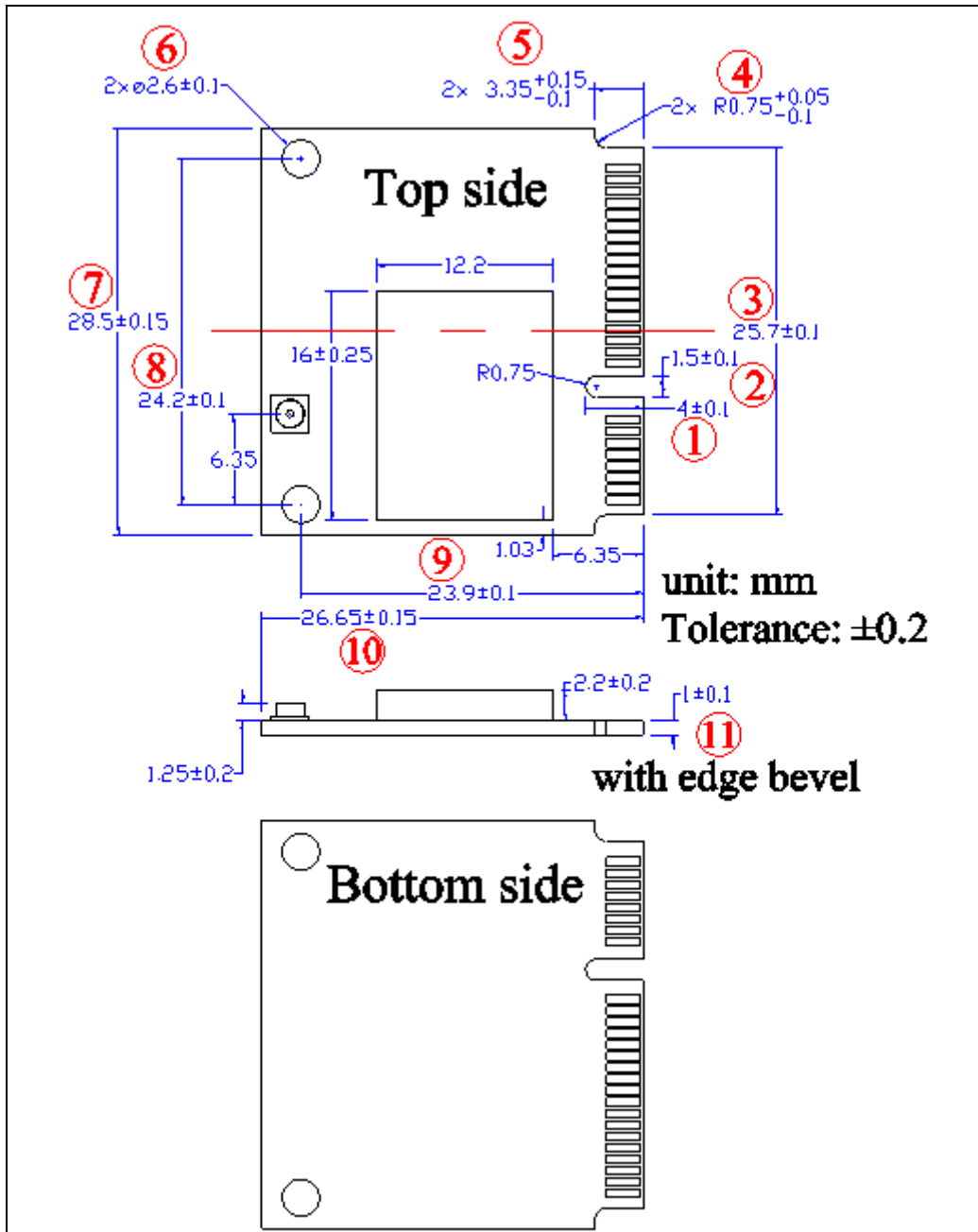
8 Mechanical specification

The dimension and pin definition are compliant with PCI Express Mini Card Revision 1.2.

8.1 Outline dimensions of LS26030-B

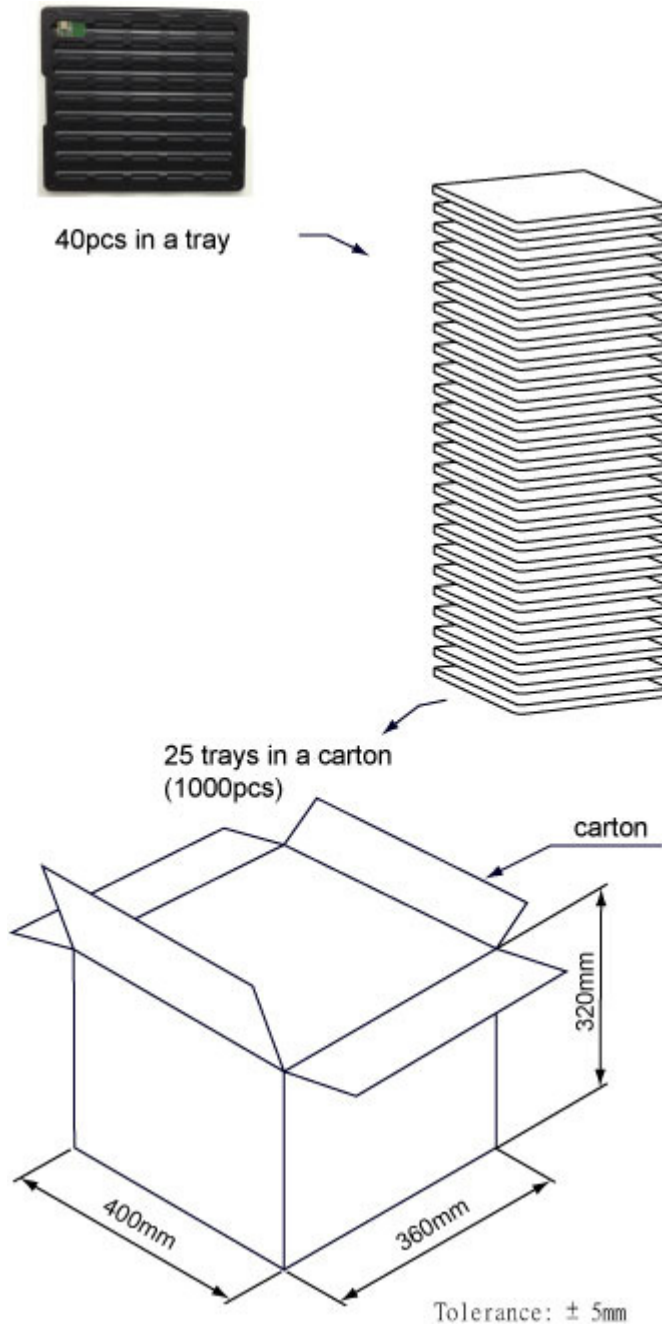


8.2 Outline dimensions of LS26031-B



9 Packing information

Both LS26030-B and LS26031-B use the same package.



Document change list

Revision 1.0

- First release on Oct. 16th, 2013.