GMM-R1 GPS standalone module

Data Sheet(v1.1)

AscenKorea

Table of Contents

1. Functional Description 3
1.1 Overview 3
1.2 Highlights and Features 4
1.3 System Block Diagram 5
1.4 Multi-tone active interference canceller 6
1.5 1PPS 6
1.6 AlwaysLocate™ (Advance Power Periodic Mode) 6
2. Specifications 7
2.1 Mechanical Dimension 7
2.2 Recommended PCB pad Layout 8
2.3 Pin Configuration 9
2.4 Pin Assignment 9
2.5 Description of I/O Pin 10
2.6 Specification List 13
2.7 Absolute Maximum Ratings 14
2.8 Operating Conditions 14
2.9 GPS External Antenna Specification (Recommended) 15
3. Protocols 16
3.1 NMEA Output Sentences 16
3.2 MTK NMEA Command Protocols 21
4. Reference Design 22
4.1 Patch (Passive) Antenna and LDO Mode 22
4.2 Active Antenna and BUCK Mode 23
5. Reflow Soldering Temperature Profile 24
5.1 SMT Reflow Soldering Temperature Profile 24
5.2 Manual Soldering 28

1. Functional Description

1.1 Overview

The AscenKorea Gmm-r1 module utilizes the MediaTek ROM GPS Chipset MT3337 that achieves the industry's highest level of sensitivity (-165dBm) and instant Time-to-First Fix (TTFF) with lowest power consumption in a small footprint package.

With built-in LNA to reach total NF to 0.7dB customers can release antenna requirement and don't need an external LNA. Power management design makes Gmm-r1 easily integrated into your system without extra voltage regulator. Gmm-r1 allows direct battery connection, no need any external LDO and gives customers plenty of choices for their application circuit.

Up to 12 multi-tone active interference canceller (ISSCC2011 award), customer can have more flexibility in system design. Supports up to 210 PRN channels with 66 search channels and 22 simultaneous tracking channels, Gmm-r1 supports various location and navigation applications, including autonomous GPS, SBAS ranging (WAAS, EGNO, GAGAN, and MSAS), QZSS and AGPS.

The Gmm-r1 is excellent at low power consumption characteristic (acquisition 63mW, tracking 49mW). It is suitable for power sensitive devices such as portable applications. It is also integrated with many advanced features including AlwaysLocate™, EPO™, and logger function.

Application:

- ✓ Handheld Device
- ✓ Tablet PC/PLB/MID
- ✓ M2M application
- ✓ Asset management
- ✓ Surveillance

1.2 Highlights and Features

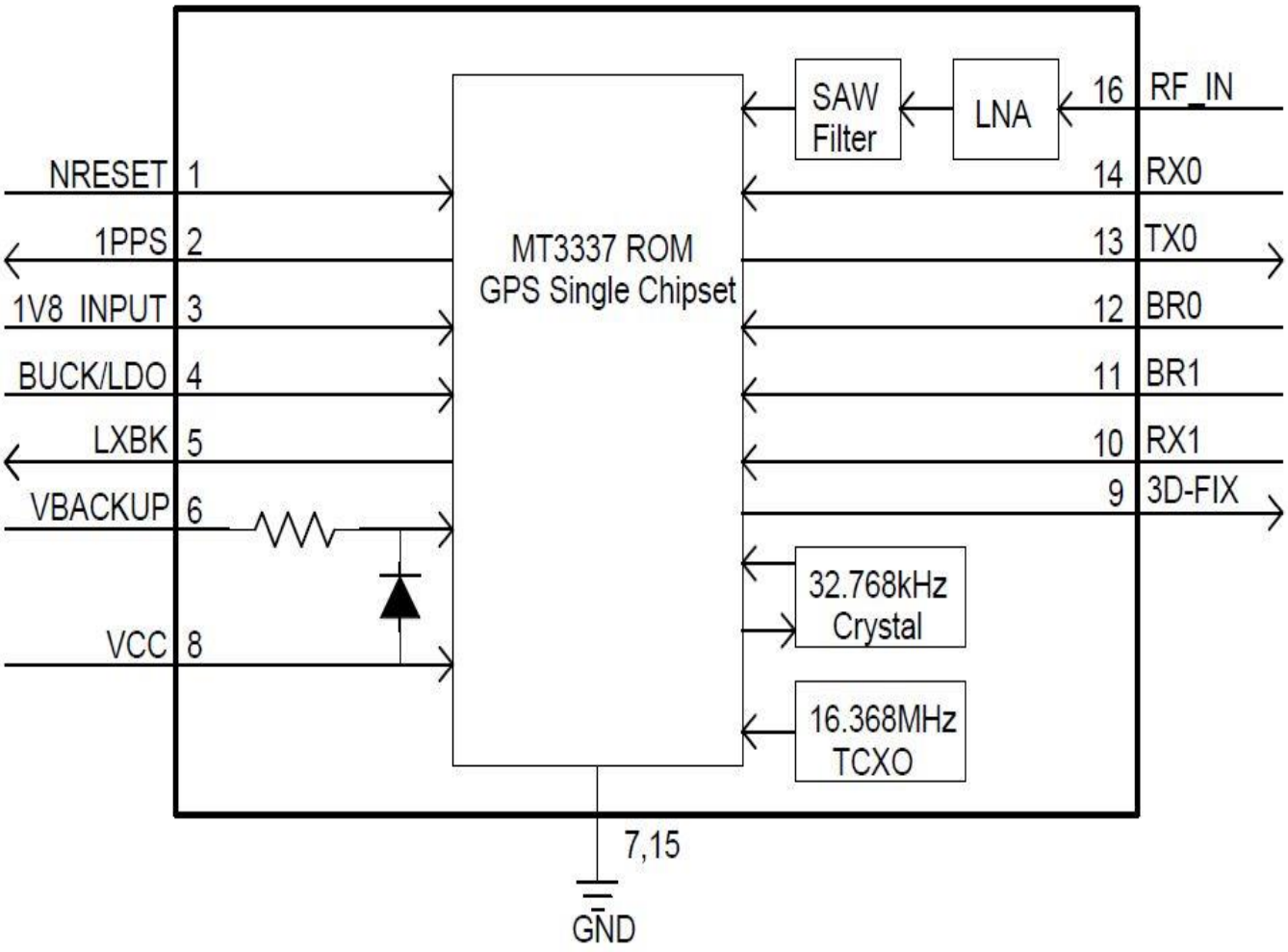
- Support QZSS satellites (Japan)
- Ultra-High Sensitivity: -165dBm
- 12 multi-tone active interference canceller(note2) [ISSCC 2011 Award -Section 26.5]

  (http://isscc.org/doc/2011/isscc2011.advanceprogrambooklet_abstracts.pdf)
- High accuracy 1-PPS timing support for Timing Applications (10ns jitter)
- Adjustable duty cycle of 1PPS
- AGPS Support for Fast TTFF (Hosting EPO™ Enable)
- AlwaysLocate™(note2) Intelligent Algorithm (Advance Power Periodic Mode) for power saving
- Bit rates are selectable from 4800,9600,38400,and 115200bps
- Power scheme a 1.8V volts BUCK and LDO mode are selectable
- Consumption current(BUCK mode VCC@3.3V):
  - Acquisition: 19 mA Typical
  - Tracking: 15 mA Typical
- E911, RoHS, REACH compliant
- CE, FCC Certification

note 1: SBAS can only be enabled when update rate is less than or equal to 5Hz.

note2: Some features need special firmware or command programmed by customer, please refer to AscenKorea documents “PMTK command List” and “Firmware check list_C37”.

1.3 System Block Diagram



1.4 Multi-tone active interference canceller

Because different application (Wi-Fi , GSM/GPRS,3G/4G,Bluetooth)are integrated into navigation system , the harmonic of RF signal will influence the GPS reception , The multi-tone active interference canceller (abbr: MTAIC) can reject external RF interference which come from other active components on the main board , to improve the capacity of GPS reception without any needed HW change in the design . Module can cancel up to 12 independent channel interference continuous wave (CW)

1.5 1PPS

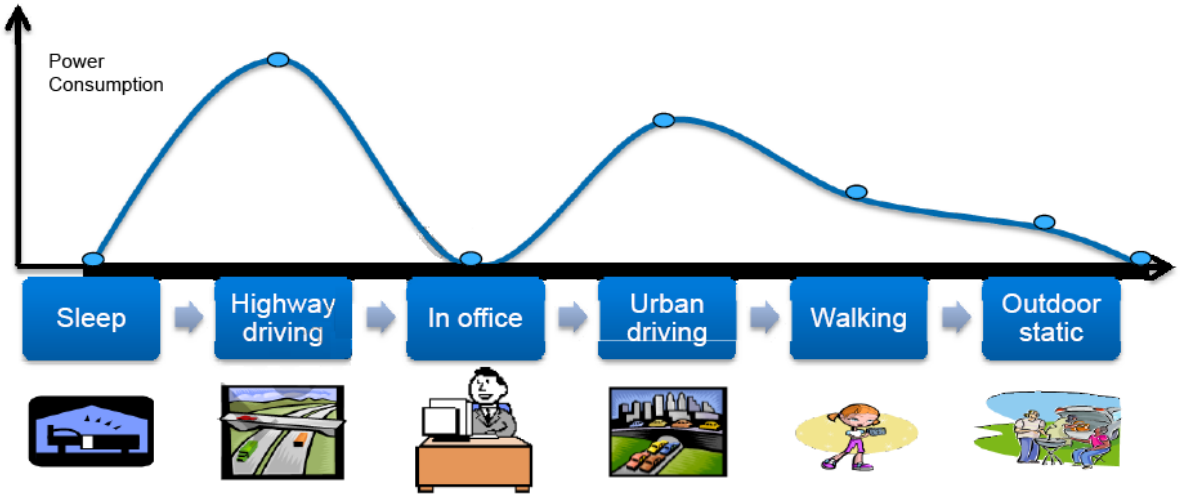
A pulse per second (1 PPS) is an electrical signal that very precisely indicates the start of a second. Depending on the source, properly operating PPS signals have an accuracy ranging ±10ns.

1 PPS signals are used for precise timekeeping and time measurement. One increasingly common use is in computer timekeeping, including the NTP protocol. A common use for the PPS signal is to connect it to a PC using a low-latency, low-jitter wire connection and allow a program to synchronize to it:

Gmm-r1 supply the high accurate 1PPS timing to synchronize to GPS time after 3D-Fix.

1.6 AlwaysLocate™ (Advance Power Periodic Mode)

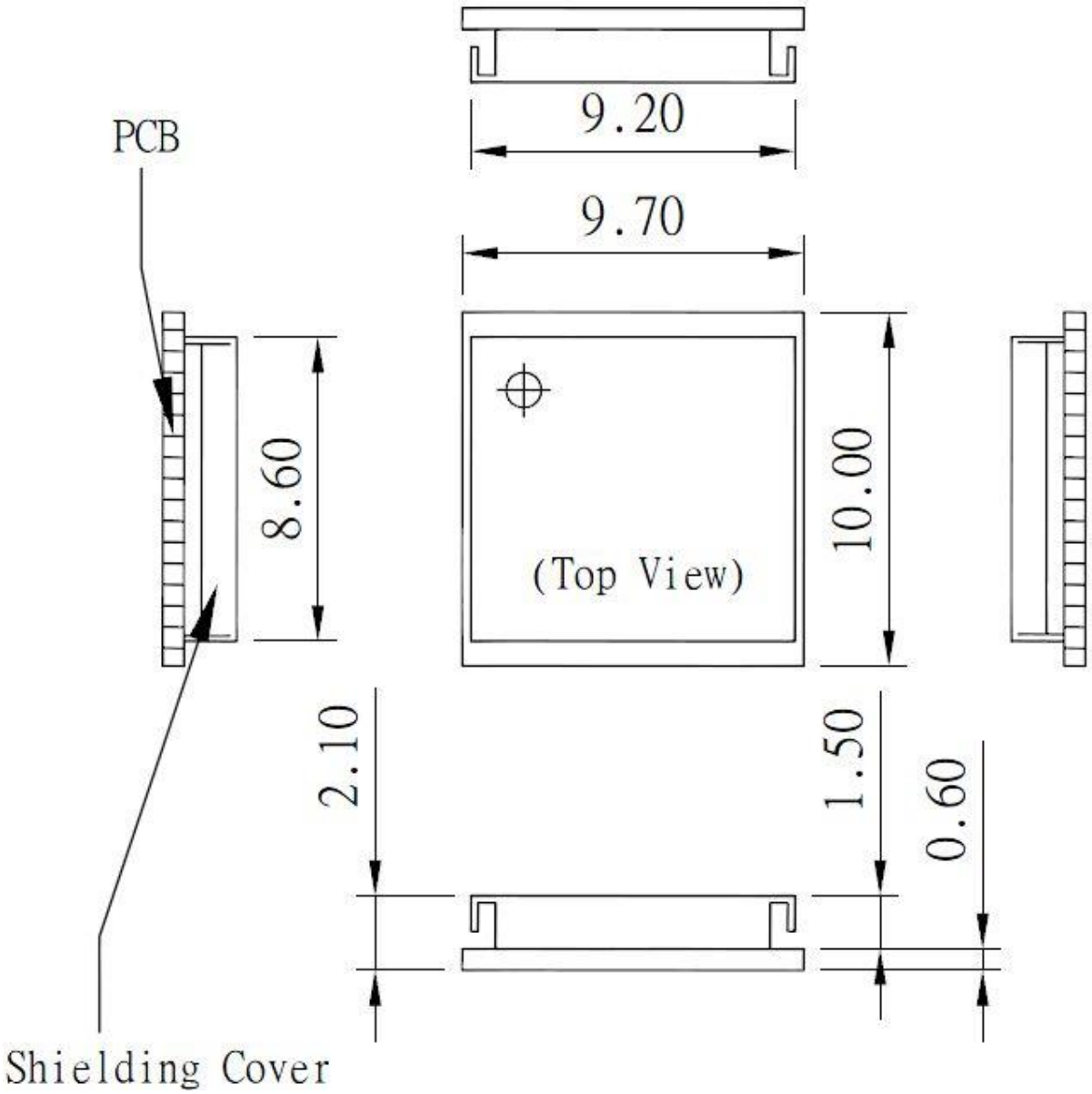
Embedded need to be executed fully all the time , the algorithm can be set by different necessary to decide the operation level of GPS function , reduce power consumption , it will suffer positing accuracy to get the target of power saving and extend the usage time of product . (The positioning accuracy of reporting location < 50m (CEP)) Please contact us for more details.



2. Specifications

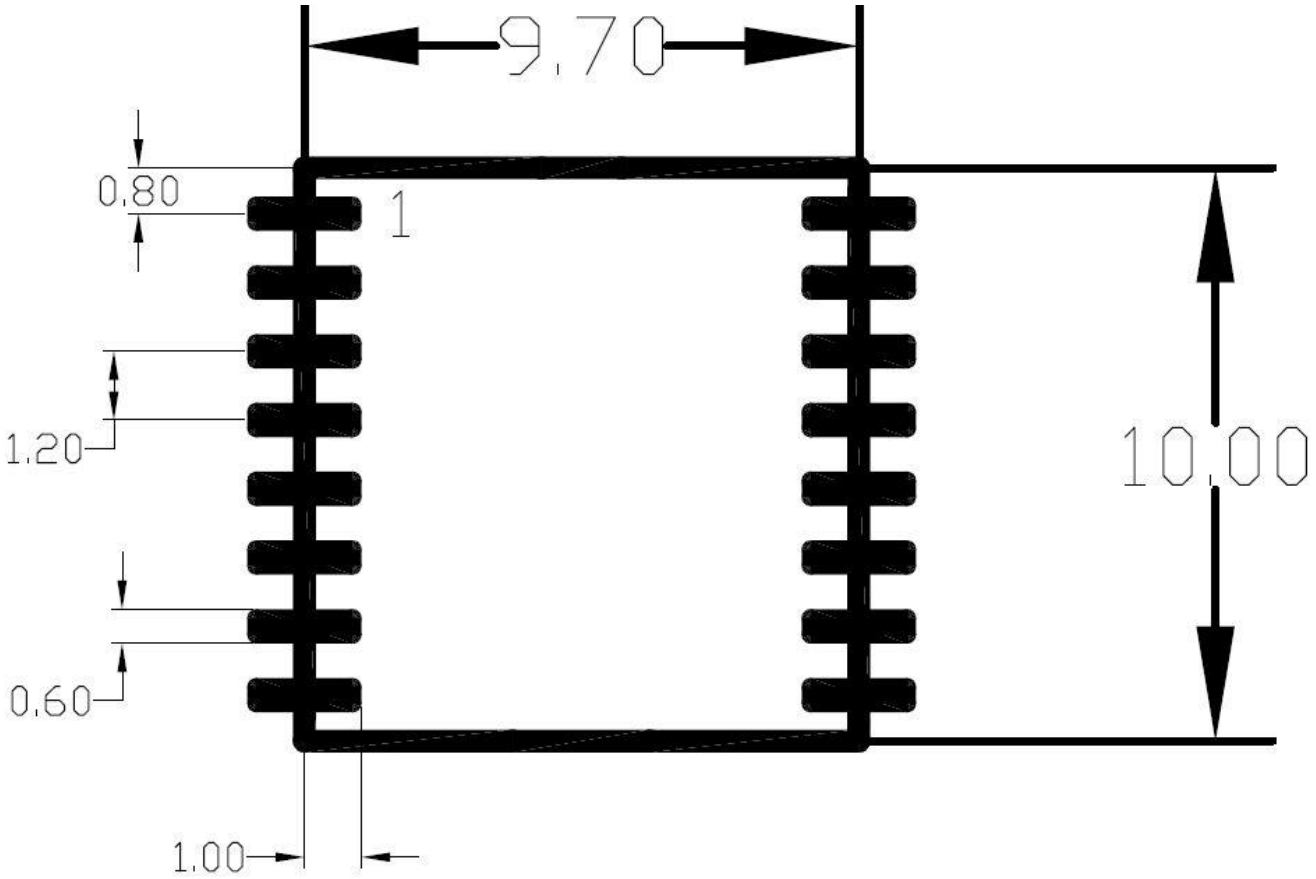
2.1 Mechanical Dimension

Dimension: (Unit: mm, Tolerance: +/- 0.2mm)



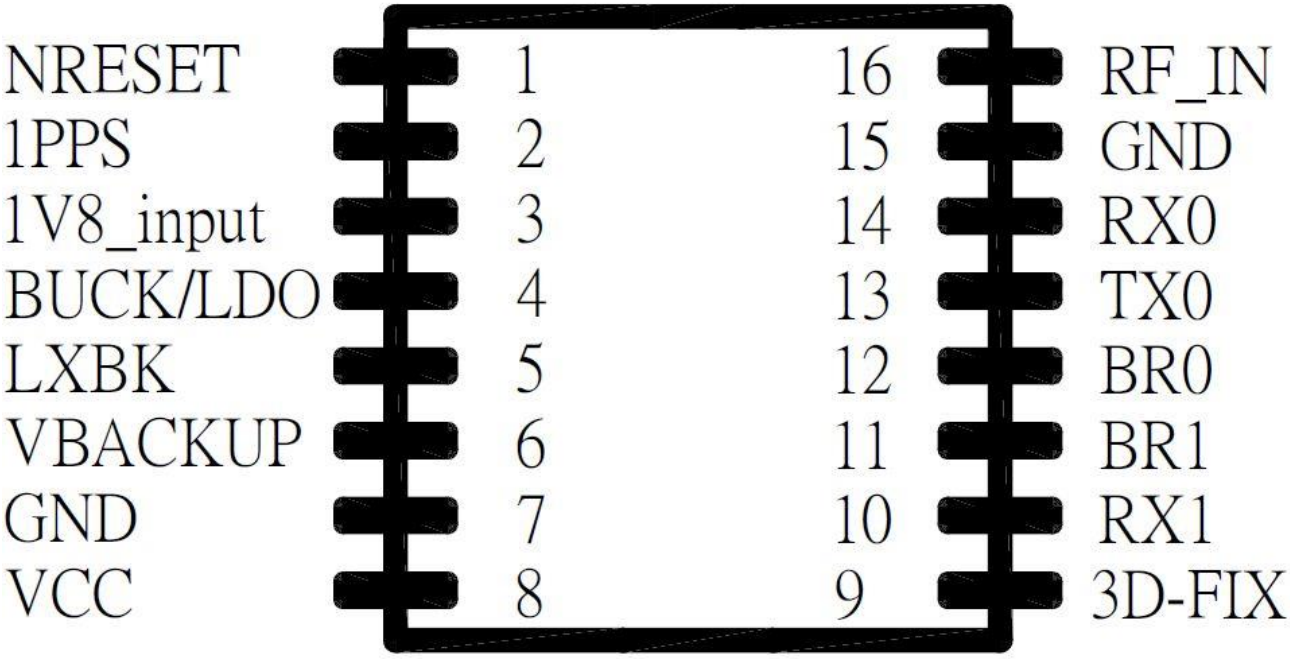
2.2 Recommended PCB pad Layout

(Unit: mm, Tolerance: 0.1mm)



(Top view)

2.3 Pin Configuration



(Top view)

2.4 Pin Assignment

Pin	Name	I/O	Description & Note
1	NRESET	I	Reset Input, Low Active
2	1PPS	O	1PPS time mark output 2.8V CMOS level
3	1V8_input	I	1.8V input for RF and Digital block
4	BUCK/LDO	I	BUCK and LDO mode option and BUCK feedback pin
5	LXBK	O	BUCK output pin
6	VBACKUP	PI	Backup power input for RTC & navigation data keep
7	GND	P	Ground
8	VCC	PI	Main DC power input
9	3D-FIX	O	3D-Fix Indicator
10	RX1	I	This is the UART receive of the module, It is used for aiding,
11	BR1	I	Baud Rate selection need to matchup BR0
12	BR0	I	Baud Rate selection need to matchup BR1
13	TX0	O	Serial Data Output for NMEA output (TTL)
14	RX0	I	Serial Data Input for receive command (TTL)
15	GND	P	Ground
16	RF_IN	I	GPS RF signal input

2.5 Description of I/O Pin

NRESET, Pin1

Low active, it causes the module to reset. If not used, keep floating.

1PPS, Pin2

This pin provides one pulse-per-second output from the module and synchronizes to GPS time.

If not used, keep floating.

1V8_input, Pin3

For RF and Digital block input pin. Always be powered by BUCK/LDO(Pin4) of module. BUCK mode power efficiency will be better than that internal LDO mode.

The voltage should be kept between from 1.62V to 1.98V(Typical: 1.8V). The ripple must be limited under 50mVpp.

BUCK/LDO, Pin4

BUCK and LDO mode option and BUCK feedback pin.

For BUCK mode, please connect LXBK(Pin5) with L/C for feedback.

For LDO mode, please connect VCC(Pin1) .

Please see reference design circuit of chapter 4.

LXBK, Pin5

A built-in switching BUCK mode power supply provides 1.8V power for the 1V8_INPUT (Pin3). The current output typical is 20mA. During active mode, the LXBK pin is operated in PWM mode and with L/C filter for DC output. The recommended L/C value is 4.7uH/10uF.

VBACKUP, Pin6

This connects to the backup power of the GPS module. Power source (such as battery) connected to this pin will help the GPS chipset in keeping its internal RTC running when the main power source is removed. The voltage should be kept between 2.0V~4.3V, Typical 3.0V.

IF VBACKUP power was not reserved, the GPS module will perform a lengthy cold start every time it is powered-on because previous satellite information is not retained and needs to be re-transmitted.

If not used, keep floating.

GND, Pin7, Pin15

Ground

VCC, Pin8

The main DC power supply for the module. The voltage should be kept between from 3.0V to 4.3V. The ripple must be limited under 50mVpp (Typical: 3.3V).

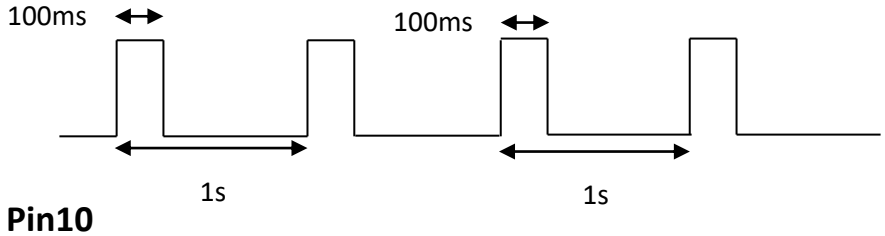
3D-FIX, Pin9

The 3D-FIX is assigned as a fix flag output. The timing behavior of this pin can be configured by custom firmware for different applications (Example: waking up host MCU). If not used, keep floating.

- Before 2D Fix
  The pin should continuously output low-level signal

Low _____

- After 2D or 3D Fix
  The pin should continuously output a 100ms high-level in a second.



RX1, Pin10

This is the UART receive of the module, It is used for aiding, if not used keep floating

BR1, Pin11

Baud Rate selection depend on with NC or 10K ohm to GND and need to matchup BR0.

UART baud rate selection as below:

Baud Rate	BR0(Pin11)	BR1(Pin12)
9600	No Connect	No Connect
115200	10K Ohm	No Connect
4800	No Connect	10K Ohm
38400	10K Ohm	10K Ohm

BR0, Pin12

Baud Rate selection depend on with NC or 10K ohm to GND and need to matchup BR1,

TX0, Pin13

This is the UART transmitter of the module. It outputs GPS information for application.

RX0, Pin14

This is the UART receiver of the module. It is used to receive commands from system.

RF_IN, Pin16

This is the GPS RF signal input pin, which can be connected to a passive antenna or an active antenna.

2.6 Specification List

	Description
GPS Solution	MTK MT3337
Frequency	L1, 1575.42MHz
Sensitivity[1]	Acquisition -148dBm, cold start Reacquisition -163dBm,Hot start Tracking -165dBm
Channel	66 channels
TTFF[1]	Hot start: 1 second typical Warm start: 33 seconds typical Cold start: 35 seconds typical (No. of SVs>4, C/N>40dB, PDop<1.5)
Position Accuracy	Without aid:3.0m (50% CEP) DGPS(SBAS(WAAS,EGNOS,MSAS)):2.5m (50% CEP)
Velocity Accuracy	Without aid : 0.1m/s DGPS(SBAS(WAAS,EGNOS,MSAS,GAGAN)):0.05m/s
Timing Accuracy (1PPS Output)	±10 ns RMS
Altitude	Maximum 18,000m (60,000 feet)
Velocity	Maximum 515m/s (1000 knots)
Acceleration	Maximum 4G
Update Rate	1Hz (default), maximum 10Hz
Baud Rate	9600 bps (default),4800,38400,115200
DGPS	SBAS(defult) [QZSS,WAAS, EGNOS, MSAS,GAGAN]
AGPS	Support
Power Supply	VCC：3.0V to 4.3V；VBACKUP：2.0V to 4.3V； 1V8_INPUT 1：1.62V to 1.89V
Current Consumption	BUCK Mode: 19mA acquisition, 15mA tracking LDO Mode: 25mA acquisition, 20mA tracking
Working Temperature	-40 °C to +85 °C
Dimension	9.7 x 10x 2.1mm, SMD
Weight	**<1g**

2.7 Absolute Maximum Ratings

The voltage applied for VCC should not exceed maximum.

	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	VCC	3.0	3.3	4.3	V
Backup battery Voltage	VBACKUP	2.0	3.0	4.3	V
1.8V Supply Voltage	1V8_INPUT	1.62	1.8	1.98	V

2.8 Operating Conditions

	Condition	Min.	Typ.	Max.	Unit
Operation supply Ripple Voltage	–	–	–	50	**mVpp**
RX0 TTL H Level	VCC=3.3V	2.0	–	VCC	**V**
RX0 TTL L Level	VCC=3.3V	0	–	0.8	**V**
TX0 TTL H Level	VCC=3.3V	2.4	–	2.8	**V**
TX0 TTL L Level	VCC=3.3V	0	–	0.4	**V**
Current Consumption @ 3.3V (Include 1.8V Consumption)	BUCK Mode Acquisition	–	19	–	**mA**
	BUCK Mode Tracking	–	15	–	**mA**
	LDO Mode Acquisition	–	25	–	**mA**
	LDO Mode Tracking	–	20	–	**mA**
Backup Power Consumption@ 3V	25°C	–	7	–	**uA**
1V8_INPUT Current Consumption	1.8V	–	18	–	**mA**

2.9 GPS External Antenna Specification (Recommended)

It is important that the antenna gets a clear view of the sky and is positioned on a surface level to the horizon for best results. The following specification has to meet for the use reference design.

Characteristic	**Specification**
Polarization	Right-hand circular polarized
Frequency Received	1.57542GHz +/- 1.023MHz
Power Supply	3V
DC Current	3mA < IDC < 30mA at 3.3V
Total Gain	+ 25dBi
Output VSWR	< 2.5
Impedance	50ohm
Noise Figure	< 1.5dB

3. Protocols

3.1 NMEA Output Sentences

Table-1 lists each of the NMEA output sentences specifically developed and defined by MTK for use within MTK products

Table-1: NMEA Output Sentence	
Option	**Description**
GGA	Time, position and fix type data.
GSA	GPS receiver operating mode, active 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. Recommended Minimum Navigation Information.
VTG	Course and speed information relative to the ground.

GGA—Global Positioning System Fixed Data. Time, Position and fix related data

Table-2 contains the values for the following example：

$GPGGA,064951.000,2307.1256,N,12016.4438,E,1,8,0.95,39.9,M,17.8,M,,*65

Table-2: GGA Data Format			
Name	**Example**	**Units**	**Description**
Message ID	$GPGGA		GGA protocol header
UTC Time	064951.000		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N➔North or S➔South
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E➔East or W➔West
Position Fix Indicator	1		See **Table-3**
Satellites Used	8		Range 0 to 14
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meter	Antenna Altitude above/below mean-sea-level
Units	M	meter	Units of antenna altitude
Geoidal Separation	17.8	meter	
Units	M	meter	Units of geoids separation
Age of Diff. Corr.			Null fields when DGPS is not used
Checksum	*65		
<CR> <LF>			End of message termination

Table-3: Position Fix Indicator	
Value	**Description**
0	Fix not available
1	GPS fix
2	Differential GPS fix

GSA—GNSS DOP and Active Satellites

Table-4 contains the values for the following example：

$GPGSA,A,3,29,21,26,15,18,09,06,10,,,,,2.32,0.95,2.11*00

Table-4: GSA Data Format			
Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See **Table-5**
Mode 2	3		See **Table-6**
Satellite Used	29		SV on Channel 1
Satellite Used	21		SV on Channel 2
....	….	….	....
Satellite Used			SV on Channel 12
PDOP	2.32		Position Dilution of Precision
HDOP	0.95		Horizontal Dilution of Precision
VDOP	2.11		Vertical Dilution of Precision
Checksum	*00		
<CR> <LF>			End of message termination

Table-5: Mode 1	
Value	**Description**
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

Table-6: Mode 2	
Value	**Description**
1	Fix not available
2	2D (＜4 SVs used)
3	3D (≧4 SVs used)

GSV—GNSS Satellites in View

Table-7 contains the values for the following example：

$GPGSV,3,1,09,29,36,029,42,21,46,314,43,26,44,020,43,15,21,321,39*7D

$GPGSV,3,2,09,18,26,314,40,09,57,170,44,06,20,229,37,10,26,084,37*77
$GPGSV,3,3,09,07,,,26*73

Table-7: GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages	3		Range 1 to 3 *(Depending on the number of satellites tracked, multiple messages of GSV data may be required.)*
Message Number	1		
Satellites in View	09		
Satellite ID	29		Channel 1 (Range 1 to 32)
Elevation	36	degrees	Channel 1 (Maximum 90)
Azimuth	029	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, (null when not tracking)
....	….	….	....
Satellite ID	15		Channel 4 (Range 1 to 32)
Elevation	21	degrees	Channel 4 (Maximum 90)
Azimuth	321	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	39	dBHz	Range 0 to 99, (null when not tracking)
Checksum	*7D		
<CR> <LF>			End of message termination

RMC—Recommended Minimum Navigation Information

Table-8 contains the values for the following example：

$GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406,3.05,W,A*2C

Table-8: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	064951.000		hhmmss.sss
Status	A		A➔data valid or V➔data not valid
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N➔North or S➔South
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E➔East or W➔West
Speed over Ground	0.03	knots	
Course over Ground	165.48	degrees	True
Date	260406		ddmmyy
Magnetic Variation			
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*2C		
<CR> <LF>			End of message termination

VTG—Course and speed information relative to the ground

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

$GPVTG,165.48,T,,M,0.03,N,0.06,K,A*37

Table-9: VTG Data Format			
Name	**Example**	**Units**	**Description**
Message ID	$GPVTG		VTG protocol header
Course	165.48	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		
Speed	0.03	knots	Measured horizontal speed
Units	N		Knots
Speed	0.06	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*06		
<CR> <LF>			End of message termination

3.2 MTK NMEA Command Protocols

Packet Type:

103 PMTK_CMD_COLD_START

Packet Meaning:

Cold Start：Don’t use Time, Position, Almanacs and Ephemeris data at re-start.

Example:

$PMTK103*30<CR><LF>

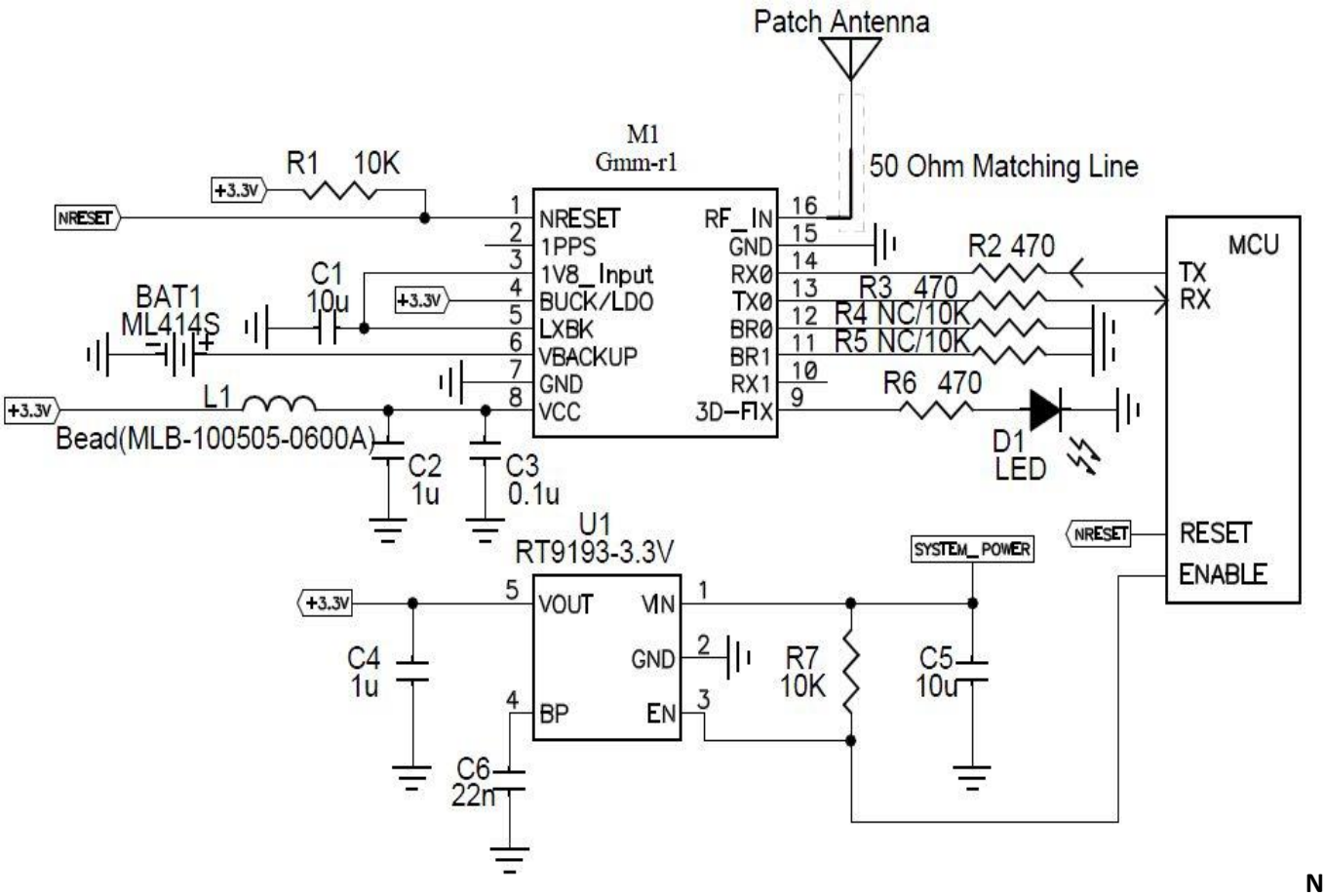
Note: Please contact us for PMTK command document. It has more detail of PMTK command.

4. Reference Design

This chapter introduces the reference schematic design for the best performance. Additional tips and cautions on design are well documented on Application Note, which is available upon request.

4.1 Patch (Passive) Antenna and LDO Mode

When using a passive antenna, please connect the antenna directly to Pin16, RF_IN.



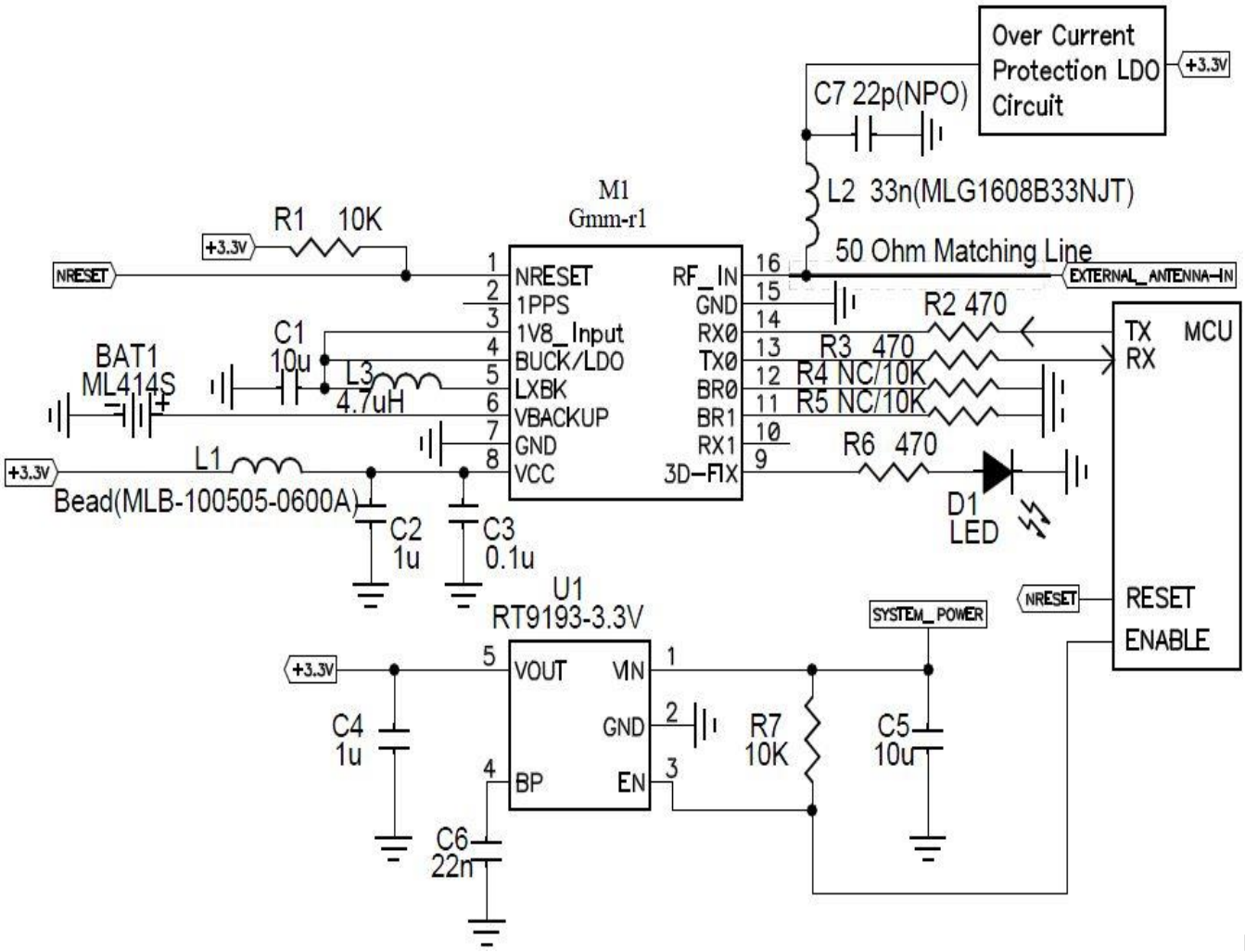
Not

e:

1. Ferrite bead L1 is added for power noise reduction. You can do change to be equal component for Impedance 600Ω at 100 MHz, IDC Max. 200mA.
2. C1, C2, C3 bypass are necessary should be put near the module.
   For C4, the value chosen depends on the amount of system noise, the range from 1uF to 100uF is reasonable.
3. Damping resistors R2 and R3 could be modified based on system application for EMI.
4. R4 and R5 for baud rate selection option.
5. If you need more support and information on antenna implementation, please directly contact us at sales@AscenKorea.com for further services.

4.2 Active Antenna and BUCK Mode

When using an active antenna, please connect the antenna directly to Pin16, RF_IN.



Note:

1. Ferrite bead L1 is added for power noise reduction. You can do change to be equal component for Impedance 600Ω at 100 MHz, IDC Max. 200mA.
2. C2 and C3 bypass capacitor should be put near the module.
   For C4, the value chosen depends on the amount of system noise, the range from 1uF to 100uF is reasonable.
3. Damping resistors R2 and R3 could be modified based on system application for EMI.
4. L2 choke inductor should be put near the Pin16 and C7 RF bypass capacitor should be put near the L2.
6. L3 4.7uH(Murata-LQM2MPN4R7NG0L) and C1 is filter of BUCK mode. L3 inductor should be put near the Pin5 and C1 ceramic capacitor should be put near the L3.You can do change L3 to be equal component 4.7uH ±30% DCR 0.14ohm±25%.
7. R4 and R5 for baud rate selection option.
8. If need use over current protection circuit, please directly contact us at sales@AscenKorea.com for further services.

5. Reflow Soldering Temperature Profile

The following reflow temperature profile was evaluated by AscenKorea and has been proven to be reliable qualitatively. Please contact us beforehand if you plan to solder this component using a deviated temperature profile as it may cause significant damage to our module and your device.

All the information in this sheet can only be used only for Pb-free manufacturing process.

5.1 SMT Reflow Soldering Temperature Profile

(Reference Only)

Average ramp-up rate (25 ~ 150°C): 3°C/sec. max.

Average ramp-up rate (270°C to peak): 3°C/sec. max.

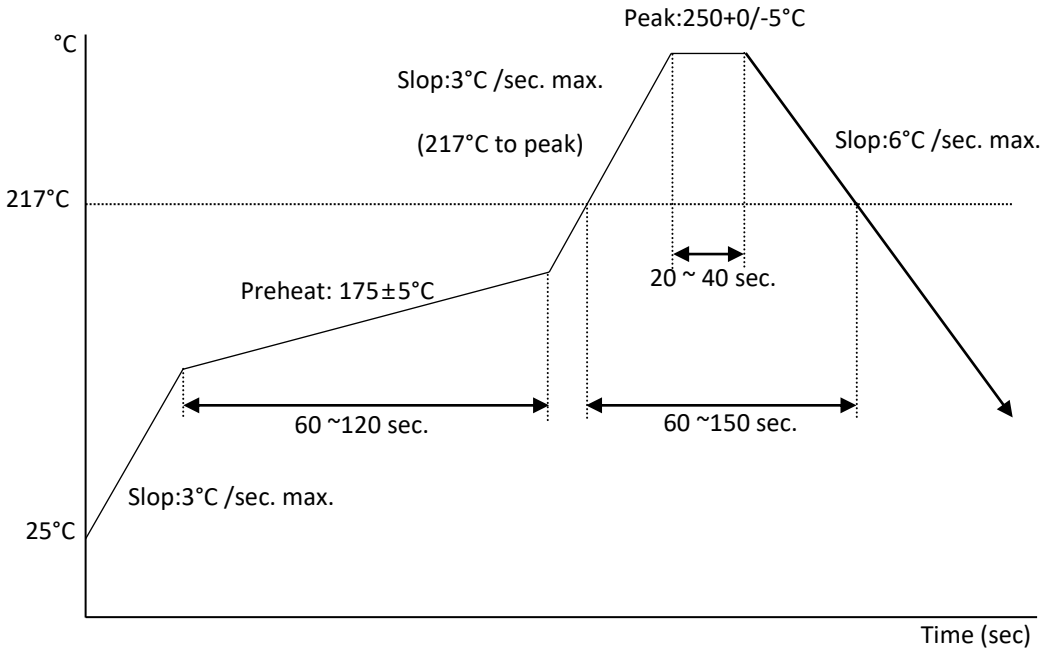
Preheat: 175 ± 25°C, 60 ~ 120 seconds

Temperature maintained above 217°C: 60~150 seconds

Peak temperature: 250 +0/-5°C, 20~40 seconds

Ramp-down rate: 6°C/sec. max.

Time 25°C to peak temperature: 8 minutes max.



	Details	Suggestions	Notes
1	Before proceeding with the reflow-soldering process, the GPS module must be pre-baked.	Pre-bake Time: 6 Hours @ 60°±5°C or 4 Hours @ 70°±5°C	**The maximum tolerated temperature for the tray is 100°C.** **After the pre-baking process, please make sure the temperature is sufficiently cooled down to 35°C or below in order to prevent any tray deformation.**
2	Because PCBA (along with the patch antenna) is highly endothermic during the reflow-soldering process, extra care must be paid to the GPS module's solder joint to see if there are any signs of cold weld(ing) or false welding.	The parameters of the reflow temperature must be set accordingly to module's reflow-soldering temperature profile.	**Double check to see if the surrounding components around the GPS module are displaying symptoms of cold weld(ing) or false welding.**
3	Special attentions are needed for PCBA board during reflow-soldering to see if there are any symptoms of bending or deformation to the PCBA board, possibility due to the weight of the module. If so, this will cause concerns at the latter half of the production process.	A loading carrier fixture must be used with PCBA if the reflow soldering process is using rail conveyors for the production.	**If there is any bending or deformation to the PCBA board, this might causes the PCBA to collide into one another during the unloading process.**
4	Before the PCBA is going through the reflow-soldering process, the production operators must check by eyesight to see if there are positional offset to the module, because it will be difficult to readjust after the module has gone through reflow-soldering process.	The operators must check by eyesight and readjust the position before reflow-soldering process.	**If the operator is planning to readjust the module position, please do not touch the patch antenna while the module is hot in order to prevent rotational offset between the patch antenna and module**

Note: References to patch antenna is referred to GPS modules with integrated Patch-on-top antennas (PA/Gms Module Series), and may not be applicable to all GPS modules.

	Details	Suggestions	Notes
5	Before handling the PCBA, they must be cooled to 35°C or below after they have gone through the reflow-soldering process, in order to prevent positional shift that might occur when the module is still hot.	1. Can use electric fans behind the Reflow machine to cool them down. 2. Cooling the PCBA can prevent the module from shifting due to fluid effect.	**It is very easy to cause positional offset to the module and its patch antenna when handling the PCBA under high temperature.**
6	1. When separating the PCBA panel into individual pieces using the V-Cut process, special attentions are needed to ensure there are sufficient gap between patch antennas so the patch antennas are not in contact with one another. 2. If V-Cut process is not available and the pieces must be separated manually, please make sure the operators are not using excess force which may cause rotational offset to the patch antennas.	1. The blade and the patch antenna must have a distance gap greater than 0.6mm. 2. Do not use patch antenna as the leverage point when separating the panels by hand.	**1. Test must be performed first to determine if V-Cut process is going to be used. There must be enough space to ensure the blade and patch antenna do not touch one another.** **2. An uneven amount of manual force applied to the separation will likely to cause positional shift in patch antenna and module.**
7	When separating panel into individual pieces during latter half of the production process, special attentions are needed to ensure the patch antennas do not come in contact with one another in order to prevent chipped corners or positional shifts.	Use tray to separate individual pieces.	**It is possible to chip corner and/or cause a shift in position if patch antennas come in contact with each other.**

Note: References to patch antenna is referred to GPS modules with integrated Patch-on-top antennas (PA/Gms Module Series), and may not be applicable to all GPS modules.

Other Cautionary Notes on Reflow-Soldering Process:

1. Module must be pre-baked **before** going through SMT solder reflow process.
2. The usage of solder paste should follow “first in first out” principle. Opened solder paste needs to be monitored and recorded in a timely fashion (can refer to IPQC for related documentation and examples).
3. Temperature and humidity must be controlled in SMT production line and storage area. Temperature of 23°C, 60±5% RH humidity is recommended. (please refer to IPQC for related documentation and examples)
4. When performing solder paste printing, please notice if the amount of solder paste is in excess or insufficient, as both conditions may lead to defects such as electrical shortage, empty solder and etc.
5. Make sure the vacuum mouthpiece is able to bear the weight of the GPS module to prevent positional shift during the loading process.
6. Before the PCBA is going through the reflow-soldering process, the operators should check by eyesight to see if there are positional offset to the module.
7. The reflow temperature and its profile data must be measured before the SMT process and match the levels and guidelines set by IPQC.
8. If SMT protection line is running a double-sided process for PCBA, please process GPS module during the second pass only to avoid repeated reflow exposures of the GPS module. Please contact AscenKorea beforehand if you must process GPS module during the 1st pass of double-side process.

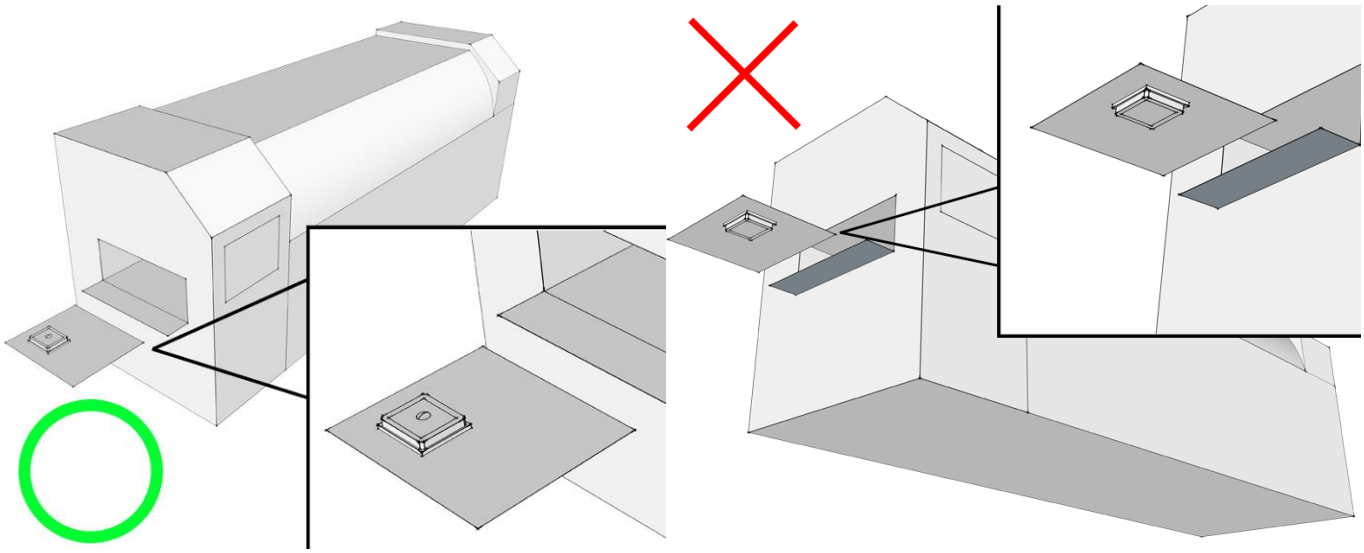


Figure 6.2: Place GPS module right-side up when running reflow-solder process, do not invert.

9. Module must be pre-baked **before** going through SMT solder reflow process.
10. The usage of solder paste should follow “first in first out” principle. Opened solder paste needs to be monitored and recorded in a timely fashion (can refer to IPQC for related documentation and examples).
11. Temperature and humidity must be controlled in SMT production line and storage area. Temperature of 23°C, 60±5% RH humidity is recommended. (please refer to IPQC for related documentation and examples)
12. When performing solder paste printing, please notice if the amount of solder paste is in excess or insufficient, as both conditions may lead to defects such as electrical shortage, empty solder and etc.
13. The reflow temperature and its profile data must be measured before the SMT process and match the levels and guidelines set by IPQC.

5.2 Manual Soldering

Soldering iron:

Bit Temperature: Under 380°C Time: Under 3 sec.

Notes:

1. Please do not directly touch the soldering pads on the surface of the PCB board, in order to prevent further oxidation
2. The solder paste must be defrosted to room temperature before use so it can return to its optimal working temperature. The time required for this procedure is unique and dependent on the properties of the solder paste used.
3. The steel plate must be properly assessed before and after use, so its measurement stays strictly within the specification set by SOP.
4. Please watch out for the spacing between soldering joint, as excess solder may cause electrical shortage
5. Please exercise with caution and do not use extensive amount of flux due to possible siphon effects on neighboring components, which may lead to electrical shortage.
6. Please do not use the heat gun for long periods of time when removing the shielding or inner components of the GPS module, as it is very likely to cause a shift to the inner components and will leads to electrical shortage.