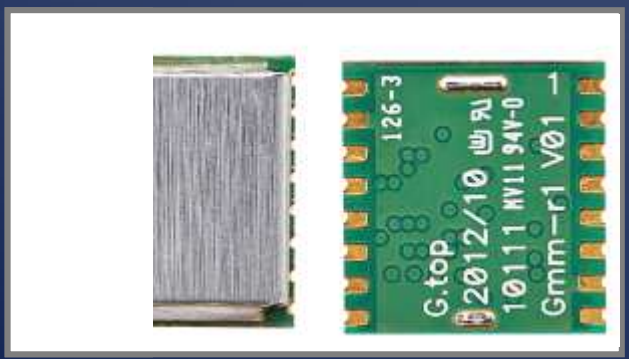
Data Sheet

GlobalTop Technology Inc.

Ivory-2
GPS Standalone Module
Data Sheet(Tape Reel)

Part Number: Gmm-r1

Revision: V0F



Ivory-2 is a ROM stand-alone GPS module with fast TTFF, ultra high sensitivity (-165dBm), and exceptional low power consumption in a small form factor (9.7*10*2.1mm)

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Version History

Title:	GlobalTop Ivory-2 Datasheet		
Subtitle:	**GPS Module**		
Doc Type:	**Datasheet**		
Revision	**Date**	**Author**	**Description**
V0A	2012-12-05	Delano	Preliminary Datasheet
V0B	2012-12-19	Dylan	Modify→2.4 Pin Assignment
V0C	2015-05-20	Benson	1. Add EASY , PPS sync NMEA 2. 2.6 Specification List , update TTFF specific
V0D	2015-07-30	MaxNi	1. Update power consumption 2. Update Tape reel quantity 3. Remove SBAS function
V0E	2015-09-22	Yingjie	1. Modify Fig. 5.1 Reel Dimension
V0F	2015-12-10	Archie Lin	Changed product weight from <1g to 0.60g (pg 14)

Table of Contents

1. Functional Description

1.1 Overview

Ivory-2 is built based on the MediaTek ROM GPS Chipset –MT3337 with capability of achieving the industry's highest level of sensitivity (-165dBm) and instant Time-to-First Fix (TTFF). It is designed for lowest power consumption in a small footprint package.

Ivory-2 has an in-built LNA with a noise figure (NF) of 0.7dB. It allows customer to develop his products without the need of external LNA. The design of power management allows Ivory-2 to be integrated easily into any system without extra voltage regulator. For flexible circuit design, Ivory-2 allows direct battery connection while no external LDO is needed.

Ivory-2 supports up to 210 PRN channels with 66 search channels and 22 simultaneous tracking channels. With QZSS and AGPS, Ivory-2 can provide even more accurate positioning. The ISSCC2011 awarded **12-Multi-Tone Active Interference Canceller** is capable of removing 12 active noise sources and with that it enables customer to have more flexibility in system design.

Ivory-2 is excellent in low power consumption (acquisition 63mW, tracking 49mW). It is suitable for power sensitive devices especially portable applications. It is integrated along with power managements and many advanced features including EASY™, Host Aiding EPO™, and PPS sync NMEA function.

Applications:

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

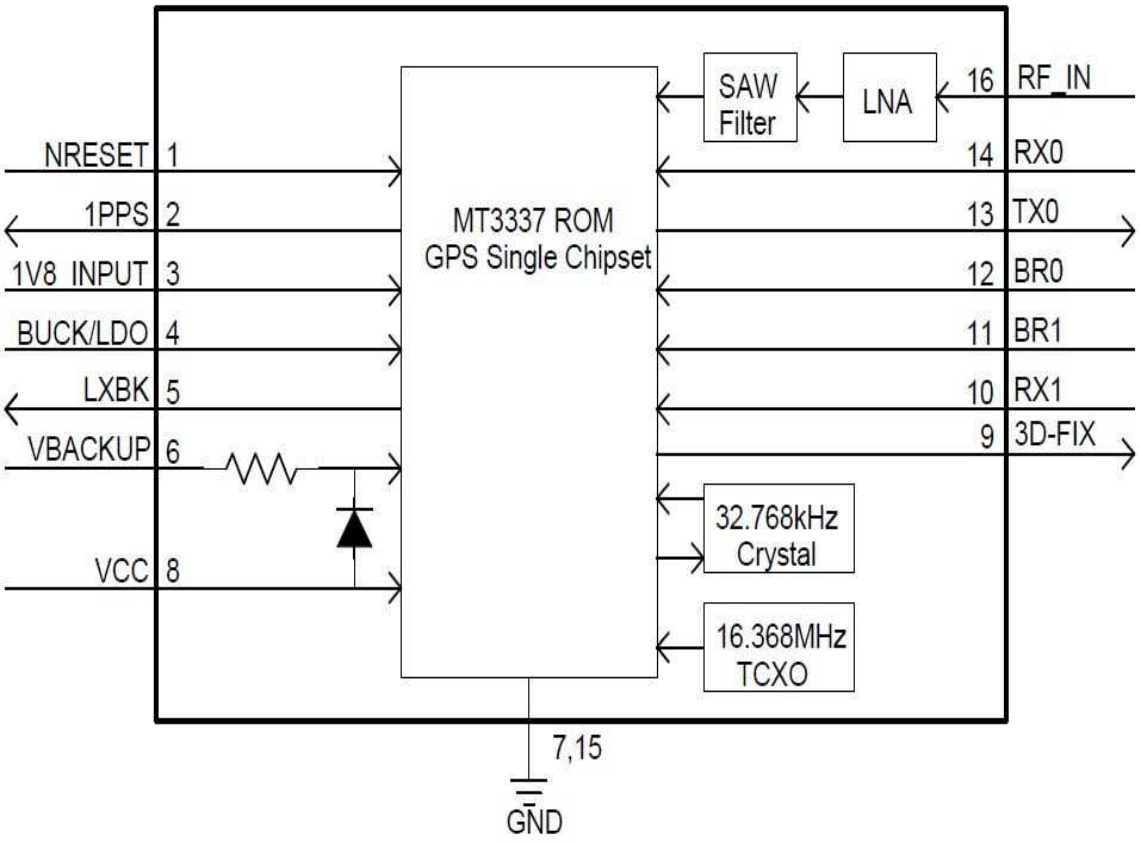
1.2 Highlights and Features

- Support QZSS satellites (Japan)
- Ultra-High Sensitivity: -165dBm
- 12 multi-tone active interference canceller [ISSCC 2011 Award -Section 26.5] (http://isscc.org/doc/2011/isscc2011.advanceprogrambooklet_abstracts.pdf)
- High 1-PPS timing accuracy for Timing Applications (±10ns RMS jitter)
- Adjustable duty cycle of 1PPS
- AGPS Support for Fast TTFF (Host Aiding EPO™)(Note1)
- EASY™(Note2): Self-Generated Orbit Prediction for instant positioning fix
- PPS sync NMEA
- Selectable Baud rates via HW configuration (4800,9600,38400,and 115200bps)
- Power scheme, a 1.8V volts BUCK and LDO mode are selectable
- Current consumption (BUCK mode VCC@3.3V):
  - Acquisition: 21 mA Typical
  - Tracking: 17 mA Typical
- E911, RoHS, REACH compliant
- CE, FCC Certification

Note1: Please refer to "GTop Host Aiding EPO Application Note"

Note2: Some features need special firmware or command programmed by customer. Please refer to "PMTK command List" and "Firmware check list_C37(E)".

1.3 System Block Diagram



1.4 Multi-tone active interference canceller

Navigation system often integrated with variant applications that are not limited to Wi-Fi, GSM/GPRS, 3G/4G, Bluetooth. Such system, as often seen, generates RF harmonics which would influence the GPS reception and performance. The embedded multi-tone active interference canceller (MTAIC) is capable of rejecting unwanted RF harmonics of the nearby on-board active components. MTAIC improves the capacity of GPS reception leaving hardware integration engineering without the need of hardware changes. Ivory-2 cancels up to 12 independent channels continuous interference wave.

1.5 1PPS

Ivory-2 generates a_pulse_per_second signal (1 PPS). It is an electrical signal which precisely indicates the start of a second with the accuracy of ±10ns RMS .The PPS signal is provided through designated output pin for many external applications. The pulse is not only limited to being active every second but also allowed to set up the required duration, frequency and active high/low by programming user-defined setting.

1.6 AGPS Support for Fast TTFF (HOST EPO™)

The AGPS (HOST EPO™) supplies the predicated Extended Prediction Orbit data to speed TTFF. Users can download EPO data to GPS engine from the FTP server via internet or wireless network. The GPS engine of the module will adopt EPO data to assist position calculation when navigation information from satellites is insufficient because of weak signal. For more details on EPO, please visit our website.

1.7 EASY™

Embedded Assist System (EASY™) is embedded within the receiver module to assist for quick positioning when information received is insufficient from the satellites. With EASY™ technology, the GPS engine is able to calculate and predict single ephemeris automatically up to 3 days when power is on. It then saves the predicted information onto the memory. So the GPS engine can use this information for positioning later if information received from the satellites is insufficient. This function will be helpful for TTFF improvement to allow positioning even under weak signal condition (e.g. dense urban area). Backup power (VBACKUP) is required for this feature.

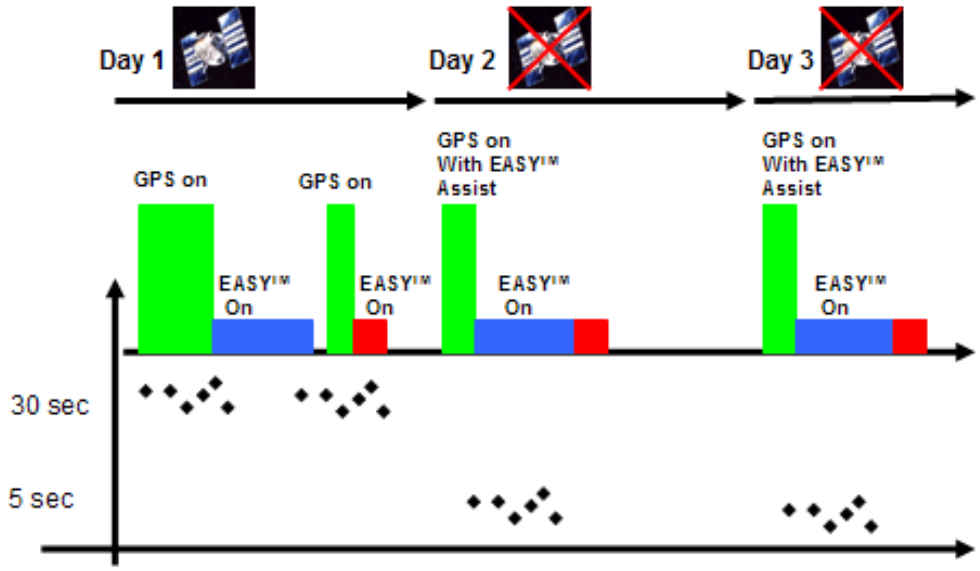


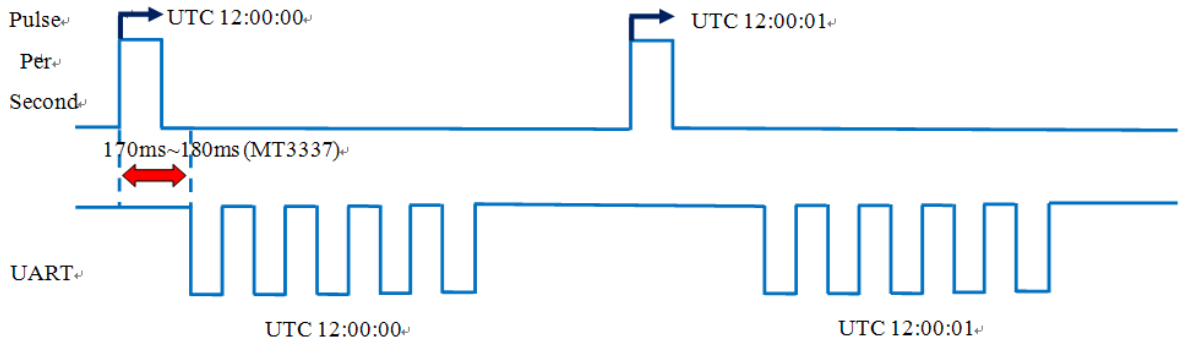
Figure: EASY™ System operation

The figure above shows that when the GPS device obtains information from GPS satellites, the GPS engine would start to pre-calculate automatically in order to predict orbits for 3 extended days.

1.8 PPS sync NMEA

Pulse Per Second (PPS) VS. NMEA can be used in time service. The latency range of the beginning of **UART Tx** is between 170ms~180ms at MT3337 platform and behind the rising edge of PPS.

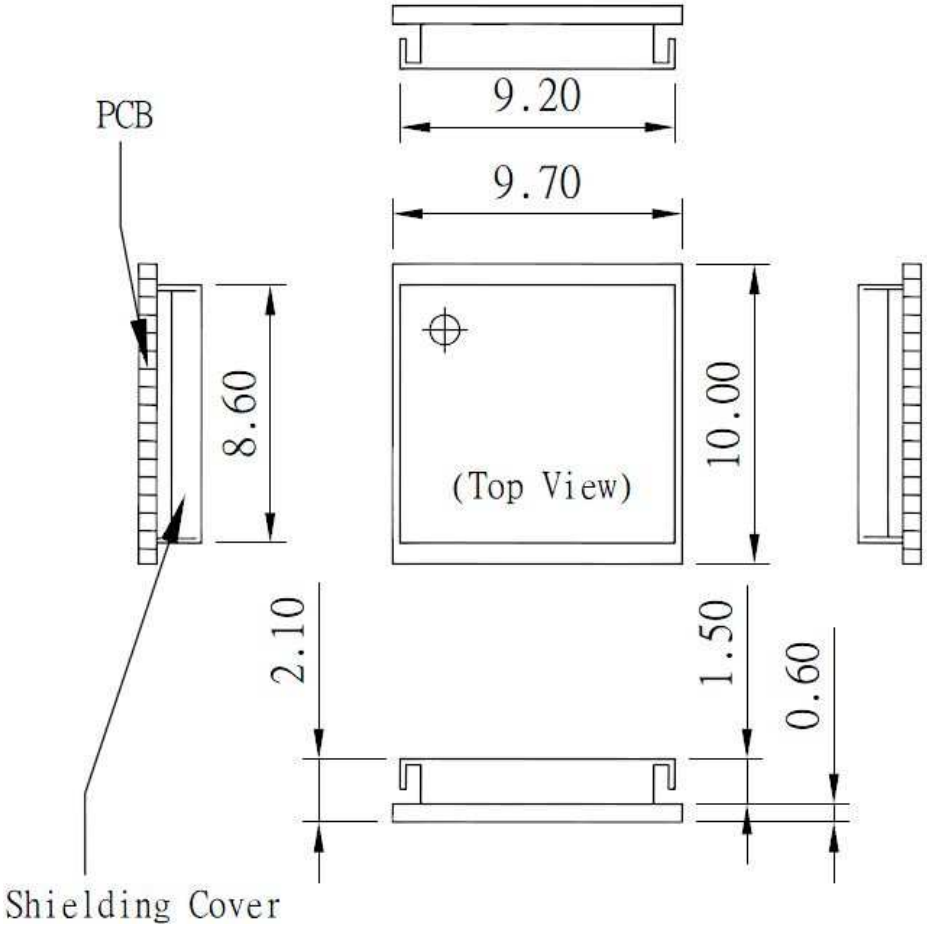
The PPS sync NMEA only supports 1Hz NMEA output and baud rate at 115200~14400. For baud rate at 9600 and 4800, only RMC NMEA sentence is supported. If NMEA sentence outputs are supported even at the low baud rate, per-second transmission may exceed the threshold of one second.



2. Specifications

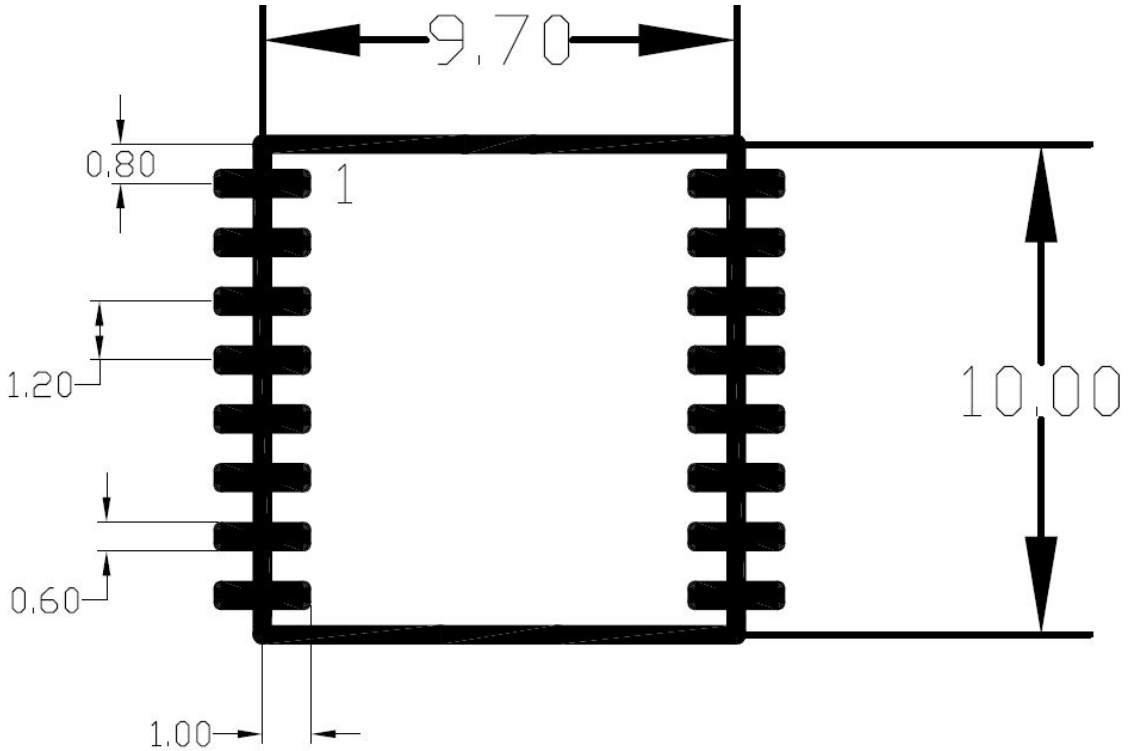
2.1 Mechanical Dimension

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



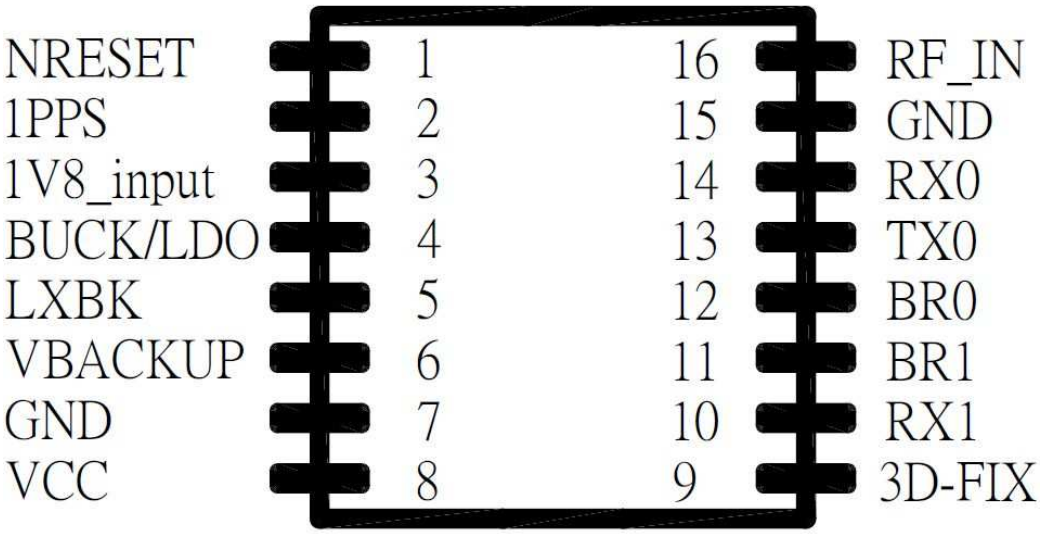
2.2 Recommended PCB pad Layout

(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. (Keep this
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

Active on Low; it causes the module to reset. If not used, keep floating.

NRESET Level	Min(V)	Typ(V)	Max(V)
Low	0	0	1.5
High	2	2.8	3.3

1PPS, Pin2

This pin provides one pulse-per-second signal output which synchronizes to the precise GPS time clock. If not used, keep it floating.

1V8_input, Pin3

For RF and Digital block input pin. It is powered by LXBK(Pin5) of the module itself. BUCK mode power efficiency will be better than that of the internal LDO mode.
The voltage must be kept between 1.62V and 1.98V (Typical: 1.8V).
The ripple must be limited under 50mVpp.
For BUCK mode, connect LXBK(Pin5) with L/C to **1V8_input (Pin3).**
For LDO mode, connect LXBK(Pin5) with C to **1V8_input (Pin3).**

BUCK/LDO, Pin4

BUCK and LDO mode options and BUCK feedback pin.
For BUCK mode, connect LXBK (Pin5) with L/C for feedback.
For LDO mode, connect VCC (Pin1).
Please see the reference design circuit in chapter 4.

LXBK, Pin5

A built-in switching BUCK mode power supply provides 1.8V power for the 1V8_INPUT (Pin3). The default of current output 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

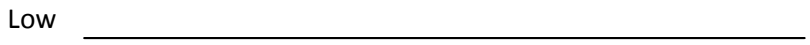
This connects to the backup power of the GPS module. Power source (such as battery) connected to this pin will help the GPS chipset in keeping its internal RTC running when the main power source is turned off. The voltage must be kept between 2.0V~4.3V.
Typical: 3.0V.
IF VBACKUP power were not reserved, the GPS module will perform a lengthy cold start each time when it is powered-on as previous satellite information is not retained and needs to be re-transmitted.
If not used, keep it floating.

GND, Pin7, Pin15
Ground

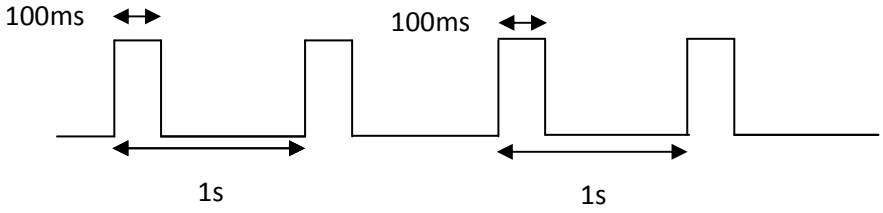
VCC, Pin8
The main DC power supply of the module. The voltage needs to be kept between 3.0V and 4.3V (Typical: 3.3V). **The ripple must be limited under 50mVpp**.

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 it floating.

- Before 2D Fix
  The pin must continuously output low signal



- After 2D or 3D Fix
  The pin must continuously output one second period signal with a 100ms high.



RX1, Pin10
Keep this pin floating.

BR1, Pin11
Baud Rate selection is configurable through BR1 & BR0 with combination of NC and a grounded 10K ohm resistor.

Table: UART Baud rate selection

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

BR0, Pin12
This pin is used in combination with BR1 for Baud Rate selection. Please refer to **BR1 (Pin11)**.

TX0, Pin13
This is the UART transmitter of the module. It outputs the 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 to connect a passive antenna or an active antenna.

2.6 Specification List

	Description
GPS Solution	MTK MT3337
Frequency	L1, 1575.42MHz
Sensitivity	Acquisition -148dBm, cold start Reacquisition -163dBm, Hot start Tracking -165dBm
Channel	66 channels
TTFF	Hot start: 1 second typical Warm start: 24 seconds typical Cold start: 28 seconds typical (No. of SVs>4, C/N>40dB, PDop<1.5)
Position Accuracy	Without aid:3.0m (50% CEP)
Velocity Accuracy	Without aid : 0.1m/s
Timing Accuracy (1PPS Output)	Default: ±10ns RMS within 100ms in one pulse (pulse width/duration can be customized)
Altitude	Maximum 18,000m (60,000 feet)
Velocity	Maximum 515m/s (1000 knots)
Acceleration	Maximum 4G
Update Rate	1Hz (default), maximum 5Hz
Baud Rate	9600 bps (default),4800,38400,115200
Power Supply	VCC: 3.0V to 4.3V；VBACKUP: 2.0V to 4.3V； 1V8_INPUT 1: 1.62V to 1.89V
Current Consumption @ 3.3V (Include 1.8V Consumption)	BUCK Mode: Acquisition : 16mA(min)/ 18mA(typical) /20mA(max) Tracking: 15mA(min)/ 20mA(typical) /26mA(max) LDO Mode: Acquisition : 24mA(min)/ 25mA(typical) /27mA(max) Tracking: 20mA(min)/ 26mA(typical) /32mA)max)
Backup Power Consumption@ 3V	7uA
Power Saving (Periodic)	Standby mode：180uA
NRESET Current @ 3.3V	7mA
Working Temperature	-40 °C to +85 °C
Dimension	9.7 x 10x 2.1mm, SMD
Weight	0.60g

2.7 Absolute Maximum Ratings

The voltage applied for VCC must not exceed 4.3VDC.

	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
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**

2.9 GPS External Antenna Specification (Recommended)

The following is the specification of an external antenna which user will need when selecting the correct external antenna.

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		
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,4,1,15,29,36,029,42,21,46,314,43,26,44,020,43,15,21,321,39*7D
$GPGSV,4,2,15,18,26,314,40,09,57,170,44,06,20,229,37,10,26,084,37*77
$GPGSV,4,3,15,07,,,26*73

Table-7: GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages	4		*(Depending on the number of satellites tracked, multiple messages of GSV data may be required.)* (Note 4)
Message Number	1		
Satellites in View	15		
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	dB-Hz	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	dB-Hz	Range 0 to 99, (null when not tracking)
Checksum	*7D		
<CR> <LF>			End of message termination

Note4: Each GSV sentence can process information from and up to 4 SVs.

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	*37		
<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>

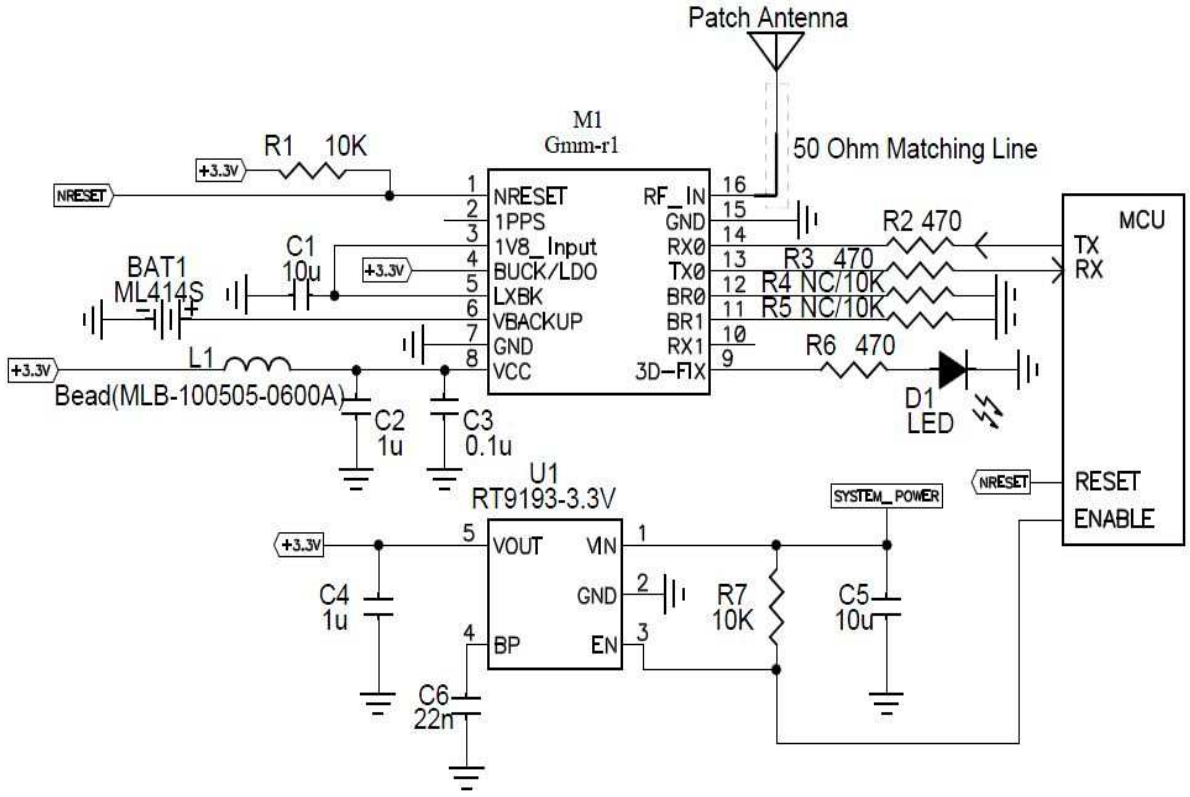
Note: Please contact us for PMTK command document for details in the PMTK command.

4. Reference Design

This section introduces the schematic design as a reference for best performance. Additional tips and cautions on design are well documented in the 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.



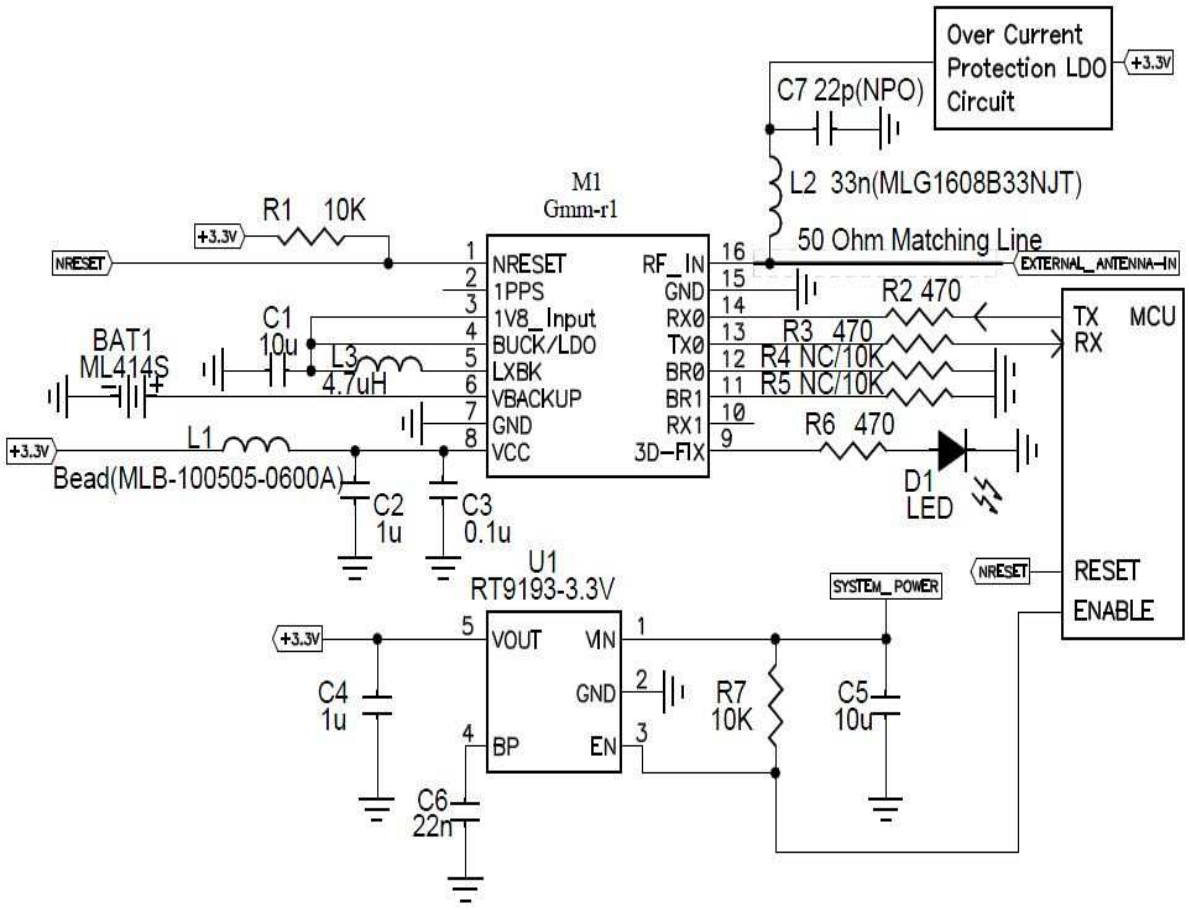
LDO mode

Note:

1. Ferrite bead L1 is added for power noise reduction. User may use one equivalent impedance 600Ω at 100MHz, IDC 200mA max.
2. C1, C2, C3 bypass capacitors must be placed in proximity to the module. The C1 range from 1uF to 10uF is reasonable. For C4, the value chosen depends on the amount of system noise, and the range from 1uF to 100uF is reasonable.
3. Damping resistors R2 and R3 can be modified based on system application for EMI.
4. R4 and R5 are for Baud rate settings.
5. If you need more support and information on antenna implementation, please contact us at sales@gtop-tech.com .

4.2 Active Antenna and BUCK Mode

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



BUCK mode

Note:

1. Ferrite bead L1 is added for power noise reduction. User may use one equivalent impedance 600Ω at 100MHz, IDC 200mA max.
2. C2 and C3 bypass capacitors must be placed in proximity to the module.
   For C4, the value chosen depends on the amount of system noise, ranging from 1uF to 100uF is reasonable.
3. Damping resistors R2 and R3 can be modified based on system application for EMI.
4. L2 choke inductor must be placed in proximity to the Pin16, while C7 RF bypass capacitor must be placed in proximity to L2.
6. L3 of 4.7uH (Murata-LQM2MPN4R7NG0L) and C1 is a filter of BUCK mode. L3 inductor must be placed in proximity to Pin5, while C1 ceramic capacitor must be placed in proximity to L3. Use L3 having the equivalent inductance of 4.7uH ±30% (DCR 0.14ohm±25%)
7. R4 and R5 are for Baud rate settings.
8. If over current protection circuit is required, please contact us at **sales@gtop-tech.com** .

5. Packing and Handling

Ivory-2, like any other SMD devices, is sensitive to moisture, electrostatic discharge, and temperature. By following the standards outlined in this document for GlobalTop module storage and handling, the chances of them being damaged during production set-up can be reduced. This section will walk you through the basics on how GlobalTop packages its modules to ensure they arrive at their destination without any damages or deterioration for performance quality. It includes cautionary notes prior to the surface mount process.

⚠ **Please read the sections II to V carefully to avoid permanent damages by moisture intake**

⚠ **GPS receiver modules contain highly sensitive electronic circuits and are electronic sensitive devices. Improper handling or without ESD protections may lead to permanent damages to the modules. Please read section VI for more details.**

5.1 Moisture Sensitivity

GlobalTop modules are moisture sensitive, and must be pre-baked before going through the solder reflow process. It is important to know that:

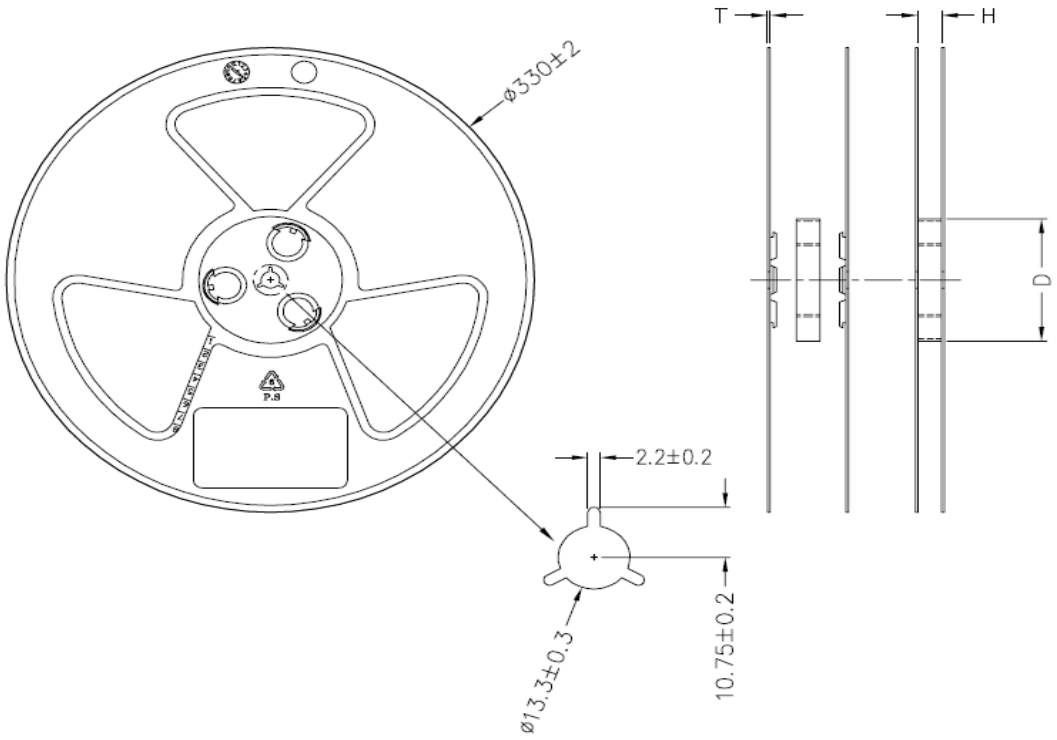
GlobalTop GPS modules must complete solder reflow process in 72 hours after pre-baking.

This maximum time is otherwise known as “Floor Life.”

If the waiting time exceeds 72 hours, it is possible for the modules to suffer damages such as cracks and delamination of the SMD pads during the solder reflow process due to excess moisture pressure.

5.2 Tape Reel Packing Information

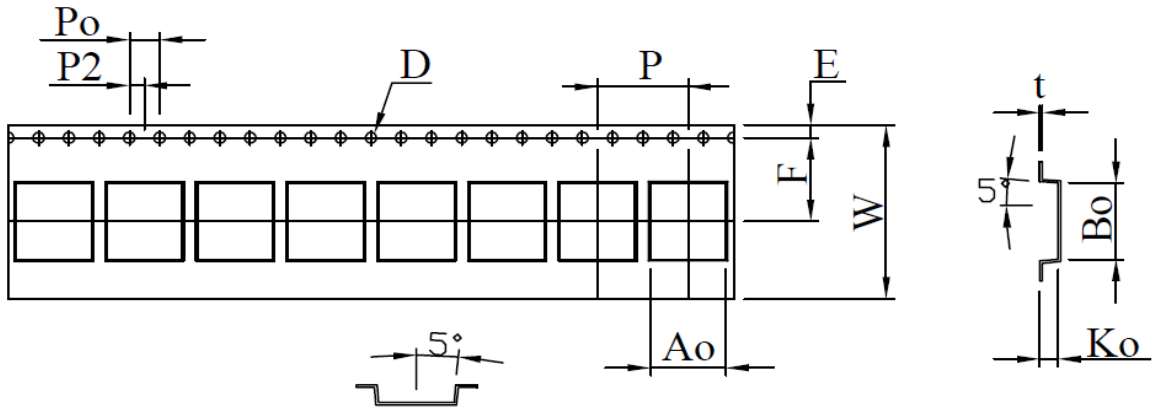
1500pcs/Reel



Spec: H: 24.5±1.5, T: 2.2±0.2, D: 99±1.5

Note: 13”Reel, Material: P.S Unit: (mm)

Fig. 5.1 Reel Dimension



Ao	10±0.10
Bo	10.5±0.10
Ko	2.4±0.10

Unit: (mm)

Fig. 5.2 Tape Dimension

The moisture color coded card provides an insight to the relative humidity in percentage (RH). When the GPS modules are taken out, it must be around or lower than 30% RH level. Outside each electrostatic bag is a caution label for moisture sensitive device.

Figure 3: Example of moisture color coded card and caution label

5.3 Storage and Floor Life Guideline

Since GlobalTop modules must undergo solder-reflow process in 72 hours after them going through pre-baking procedure, it is recommended to store the GPS modules in dry places such as in dry cabinet, if they are not to be used by then.
The approximate shelf life for GlobalTop GPS module packages is 6 months from the bag seal date when storing in a non-condensing storage environment (<30°C/60% RH)

⚠ **It is important to note that it is a required process for GlobalTop GPS modules to undergo pre-baking procedures, regardless of the storage condition.**

5.4 Drying

When GPS modules expose to high temperature during solder reflow, the moisture vapor pressure inside the GPS modules increase greatly. In order to prevent internal delaminating, cracking or the “popcorn” phenomenon happening, undergoing pre-baking procedure becomes necessary prior to any high temperature or solder reflow process.

The recommended baking time for GlobalTop GPS module is as follows:

- ✓ **60°C for 8 to 12 hours**

Once baked, the modules’ floor life will be “reset”, and they will therefore have additional 72 hours in normal factory condition to undergo solder reflow process.

⚠ **Please limit the number of times the GPS modules undergoing baking processes as repeated baking process has an effect of reducing the wetting effectiveness of the SMD pad contacts. This applies to all SMT devices.**

⚠ **Risk of Oxidation: Baking SMD packages with excessive time may cause oxidation and/or intermetallic growth of the terminations, which can result solderability problems during board assembly. The temperature and time for baking SMD packages are therefore limited by solderability considerations. The cumulative bake time at a temperature greater than 90°C and up to 125°C shall not exceed 96 hours. Bake temperature higher than 125°C is not allowed.**

5.5 ESD Handling

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

GlobalTop GPS modules are sensitive to electrostatic discharges, and thus are Electrostatic Sensitive Devices (ESD). Careful handling of the GPS modules particularly to the patch antenna (if included) and RF_IN pin. Please follow the standard ESD safety practices stated below:

- ✓ 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 RF_IN pin, please make sure the GND is connected
- ✓ When working with RF_IN pin, do not contact any charged capacitors or materials that can easily develop or store charges such as patch antenna, coax cable, soldering iron.
- ✓ Please do not touch the mounted patch antenna to prevent electrostatic discharge from the RF input
- ✓ When soldering RF_IN pin, please make sure to use an ESD safe soldering iron tip.

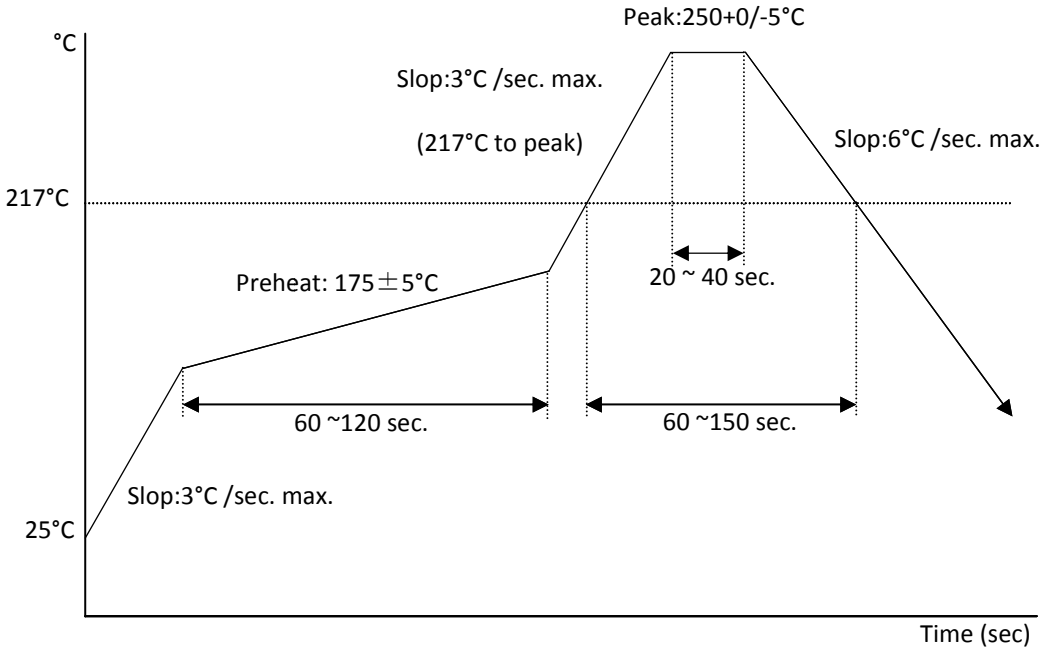
6. Reflow Soldering Temperature Profile

The following reflow temperature profile was evaluated by GlobalTop 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.

6.1 SMT Reflow Soldering Temperature Profile

(For 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 welding or pseudo(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 welding or pseudo (false) welding.**
3	Special attentions are needed for PCBA board during reflow-soldering to see if there is damage (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 damage (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 going through the reflow-soldering process, the production operators must check by eyesight to see if there is positional offset to the module, otherwise it would be difficult to readjust when the module is in the middle process of reflow-soldering.	The operators must check by eyesight and readjust the position before reflow-soldering process.	**When 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	PCBA must be cooled to 35°C or below before they going 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 sufficient space between each patch antennas, in order to avoid patch antennas contacting 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 excessive 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 must follow "First-in-First out" principle. Opened solder paste needs to be monitored and recorded in a timely manner (refer to IPQC standards for related documentation and examples).
3. Temperature and humidity must be controlled within SMT production line and storage area. Temperature of 23°C, 60±5% RH humidity is recommended. (please refer to IPQC standards for related documentation and examples)
4. When performing solder paste printing, please notice if the amount of solder paste is excessive 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 going through the reflow-soldering process, the operators need to check with his/her own eyes to see if there is positional offset to the module.
7. The reflow temperature and its profile data must be measured before the SMT process The measured data must 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 GlobalTop beforehand if you must process GPS module during the 1st pass of double-side process.

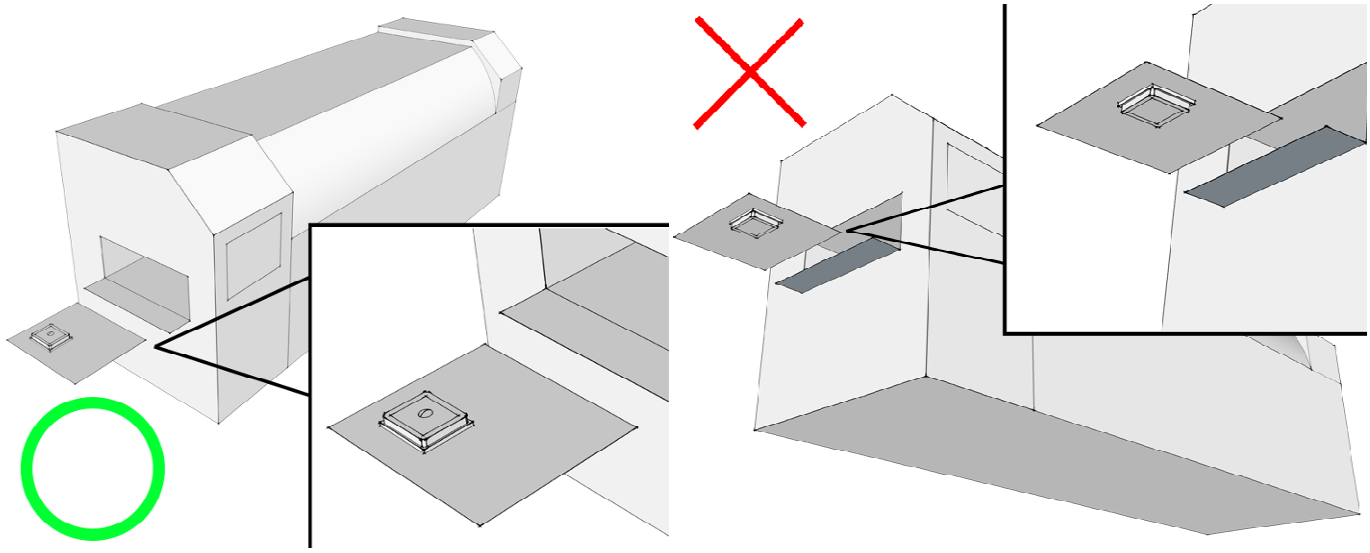


Figure 4: Place GPS module right-side up when running reflow-solder process. Do not invert.

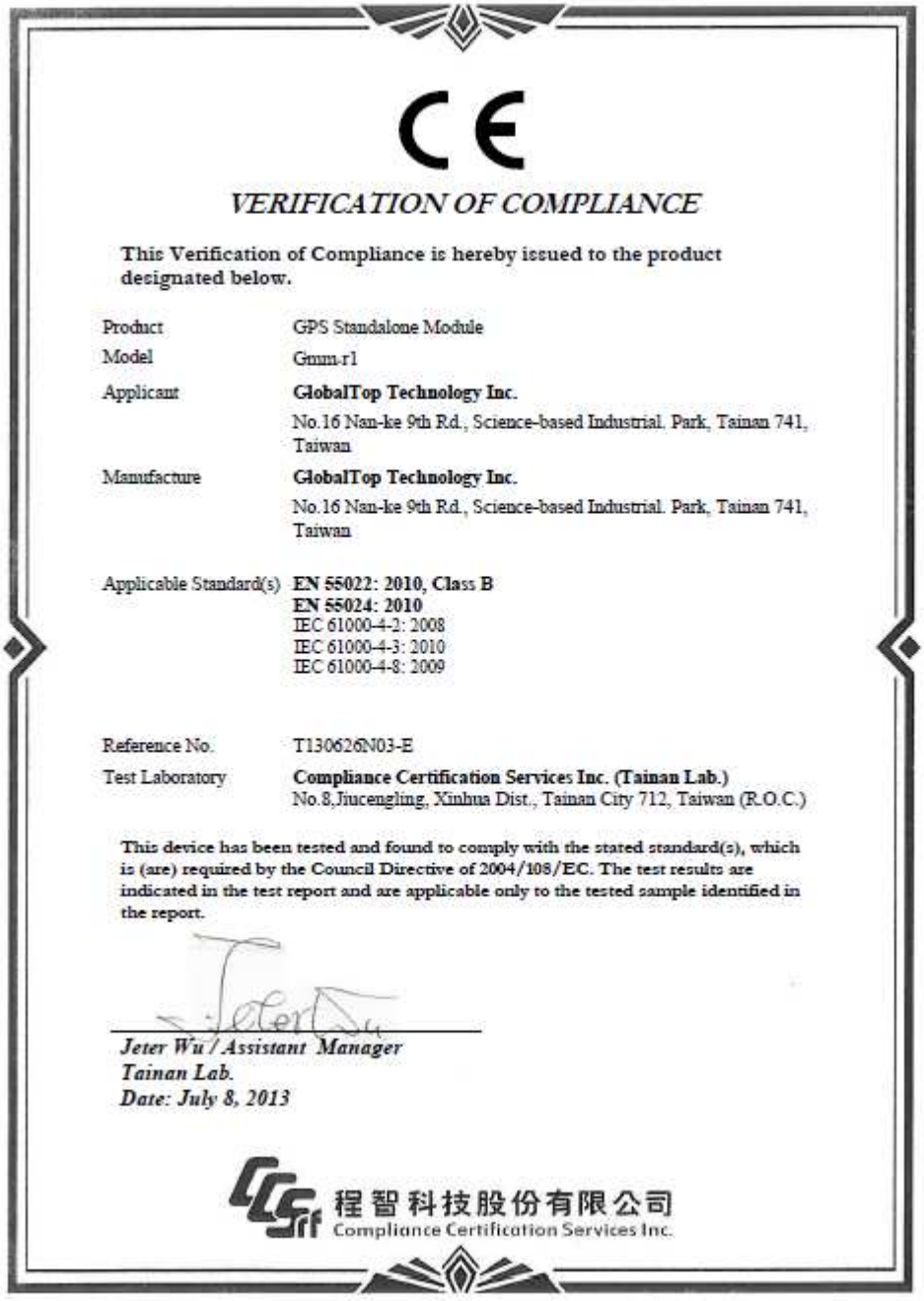
6.2 Manual Soldering

Soldering iron:
Heat temperature: under 380°C | Time: Under 3 sec.
Notes:

1. Please do not touch the soldering pads on the surface of the PCB board directly 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 joints, 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.

7. CE, FCC Certification

7.1 CE



CE

VERIFICATION OF COMPLIANCE

This Verification of Compliance is hereby issued to the product designated below.

Product	GPS Standalone Module
Model	Gmm-r1
Applicant	**GlobalTop Technology Inc.** No.16 Nan-ke 9th Rd., Science-based Industrial. Park, Tainan 741, Taiwan
Manufacture	**GlobalTop Technology Inc.** No.16 Nan-ke 9th Rd., Science-based Industrial. Park, Tainan 741, Taiwan
Applicable Standard(s)	**EN 55022: 2010, Class B** **EN 55024: 2010** IEC 61000-4-2: 2008 IEC 61000-4-3: 2010 IEC 61000-4-8: 2009
Reference No.	T130626N03-E
Test Laboratory	**Compliance Certification Services Inc. (Tainan Lab.)** No.8,Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)

This device has been tested and found to comply with the stated standard(s), which is (are) required by the Council Directive of 2004/108/EC. The test results are indicated in the test report and are applicable only to the tested sample identified in the report.

Jeter Wu / Assistant Manager
Tainan Lab.
Date: July 8, 2013

程智科技股份有限公司
Compliance Certification Services Inc.

7.2 FCC

FC

VERIFICATION OF COMPLIANCE

This Verification of Compliance is hereby issued to the below named company. The test results of this report relate only to the tested sample identified in this report.

Technical Standard: **FCC 47 CFR PART 15 SUBPART B AND ANSI C63.4 (2009)**
IC ICES-003

General Information

Applicant: **GlobalTop Technology Inc.**
No.16 Nan-ke 9th Rd., Science-based Industrial. Park, Tainan 741, Taiwan

Manufacturer: **GlobalTop Technology Inc.**
No.16 Nan-ke 9th Rd., Science-based Industrial. Park, Tainan 741, Taiwan

Product Description

EUT Description : GPS Standalone Module

Model Number : Gmm-r1

Laboratory Name: *Compliance Certification Services Inc. (Tainan Lab.)*
No.8,Jiucongling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)
Tel: +886-6-5802201 / Fax: +886-6-5802202

This device has been shown to be in compliance with and was tested in accordance with the measurement procedures specified in the Standards & Specifications listed above and as indicated in the measurement report number: TL30626N03-D

Jeter Wu / Assistant Manager
Tainan Lab.
Date: July 8, 2013

程智科技股份有限公司
Compliance Certification Services Inc.

8. Contact Information

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