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Data Sheet

GlobalTop Technology Inc.

FGPMMOPA6H
GPS Standalone Module
Data Sheet

Revision: V0A

The FGPMMOPA6H is a 4th generation stand-alone GPS module with lightning fast TTFF, ultra high sensitivity (-165dBm), and low power consumption in a small form factor (16*16*4.7mm)

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Version History

Title:	**GlobalTop FGPMMOPA6H Datasheet**
Subtitle:	**GPS Module**
Doc Type:	**Datasheet**

Revision	Date	Author	Description
V0A	2012-1-31	Delano	Preliminary

Table of Contents

1. Functional Description

1.1 Overview

The FGPMMOPA6H utilizes the MediaTek new generation GPS Chipset MT3339 that achieves the industry's highest level of sensitivity (-165dBm) and instant Time-to-First Fix (TTFF) with lowest power consumption for precise GPS signal processing to give the ultra-precise positioning under low receptive, high velocity conditions.

The module a revision of POT (Patch On Top) GPS Module with an extra embedded function for external antenna I/O and comes with **automatic antenna switching function** and short circuit protection, also features a antenna system called "Antenna Advisor" that helps with the detections and notifications of different antenna statuses, including active antenna connection, antenna open circuit and antenna shortage.

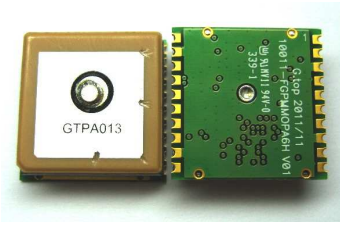
Up to 12 multi-tone active interference canceller (ISSCC2011 award), customer can have more flexibility in system design. Supports up to 210 PRN channels with 66 search channels and 22 simultaneous tracking channels, Module supports various location and navigation applications, including autonomous GPS,QZSS,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

FGPMMOPA6H is excellent low power consumption characteristic (acquisition 82mW, tracking 66mW), power sensitive devices, especially portable applications, need not worry about operating time anymore and user can get more fun.

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

Application:

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



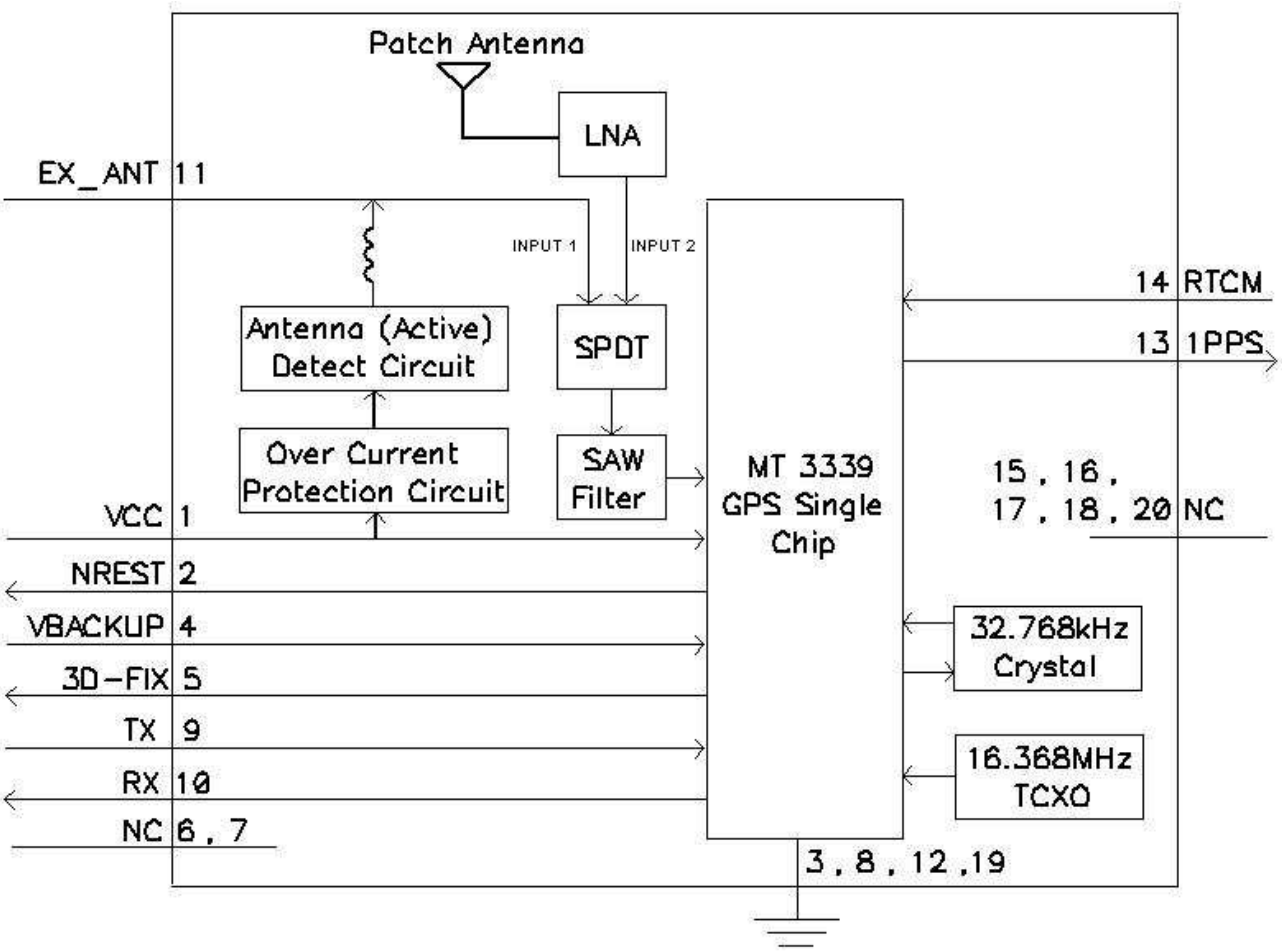
1.2Highlights and Features

- Built-in 15X15X2.5mm ceramic patch antenna on the top of module
- Ultra-High Sensitivity: -165dBm (w/o patch antenna), up to 45dB C/N of SVs in open sky reception.
- High Update Rate: up to 10Hz(note1)
- 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)
- AGPS Support for Fast TTFF (EPO™ Enable 7 days/14 days)
- EASY™(note2): Self-Generated Orbit Prediction for instant positioning fix
- AlwaysLocate™(note2) Intelligent Algorithm (Advance Power Periodic Mode) for power saving
- Logger function Embedded(note2)
- Automatic antenna switching function
- Antenna Advisor function
- Gtop Firmware Customization Services
- Consumption current(@3.3V):
  - Acquisition: 25mA Typical
  - Tracking: 20mA Typical
- E911, RoHS, REACH compliant

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 G-top “GPS command List”

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. PA6H can cancel up to 12 independent channels 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 typical 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:

PA6H supply the high accurate 1PPS timing to synchronize to GPS time after 3D-Fix.
A power-on output 1pps is also available for customization firmware settings.

1.6 AGPS Support for Fast TTFF (EPO™)

The AGPS (EPO™) supply the predicated Extended Prediction Orbit data to speed TTFF ,users can download the EPO data to GPS engine from the FTP server by internet or wireless network ,the GPS engine will use the EPO data to assist position calculation when the navigation information of satellites are not enough or weak signal zone . About the detail, please link Gtop website .

1.7 EASY™

The EASY™ is embedded assist system for quick positioning, the GPS engine will calculate and predict automatically the single emperies (Max. up to 3 days)when power on ,and save the predict information into the memory , GPS engine will use these information for positioning if no enough information from satellites, so the function will be helpful for positioning and TTFF improvement under indoor or urban condition.

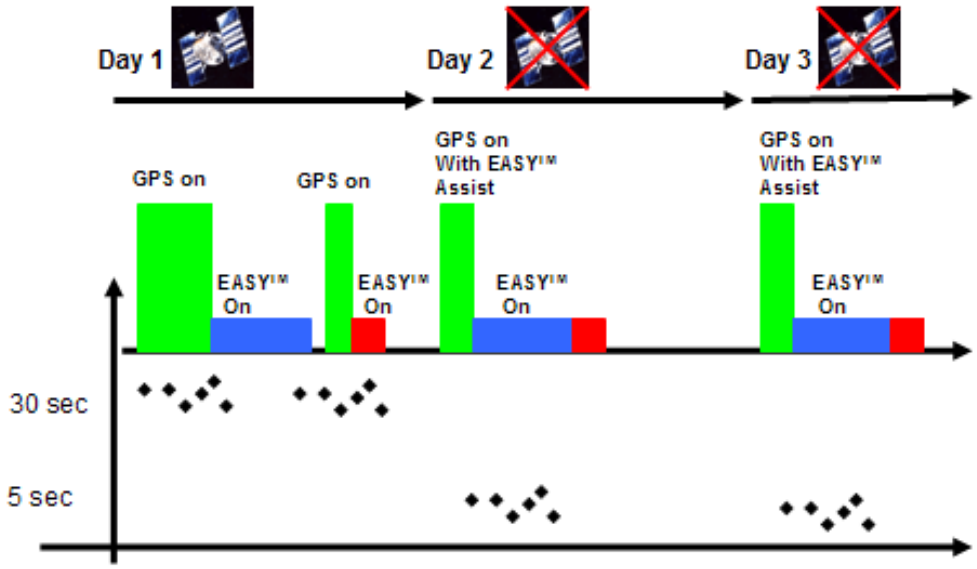


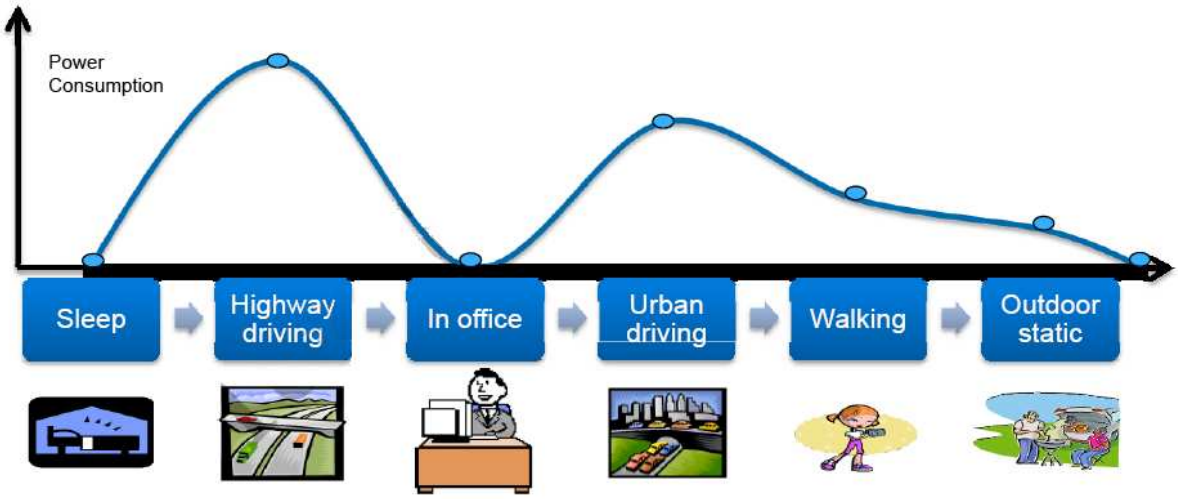
Figure 1.12-1 EASY System operation

Please refer to the Fig 1.12-1, When GPS device great the satellite information from GPS satellites, the GPS engine automatically pre-calculate the predict orbit information for 3 days

The GPS device still can quickly do the positioning with EASY™ function under weak GPS signal.

1.8 AlwaysLocate™ (Advance Power Periodic Mode)

Embedded need to be executed full y 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)



1.9 Embedded Logger function

The Embedded Logger function don't need host CPU (MCU) and external flash to handle the operation , GPS Engine will use internal flash (embedded in GPS chipset) to log the GPS data (Data format : UTC, Latitude , longitude, Valid ,Checksum), the max log days can up to 2 days under AlwaysLocate™ condition .[Note]

Note: Data size per log was shrunk from 24 bytes to 15 bytes.

2.0 Antenna Advisor

"Antenna Advisor" is a brand new antenna system available exclusively for PA6H. It is designed to detect and notify antenna status using software (through proprietary protocol on **Chapter 3.2**).

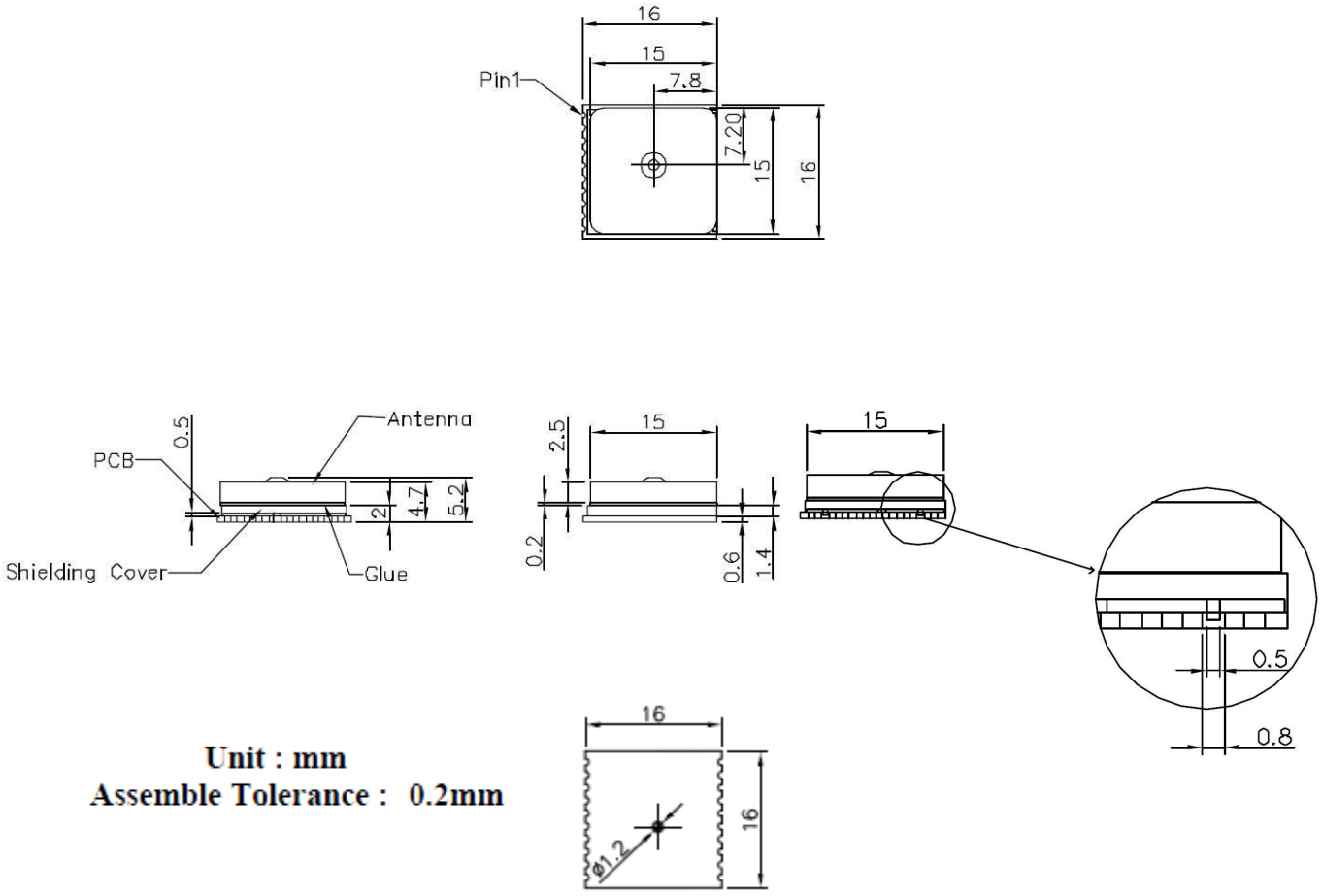
Antenna Advisor can detect and notify the following:

- Active Antenna Shorted
- Using Internal Antenna
- Using Active Antenna

2. Specifications

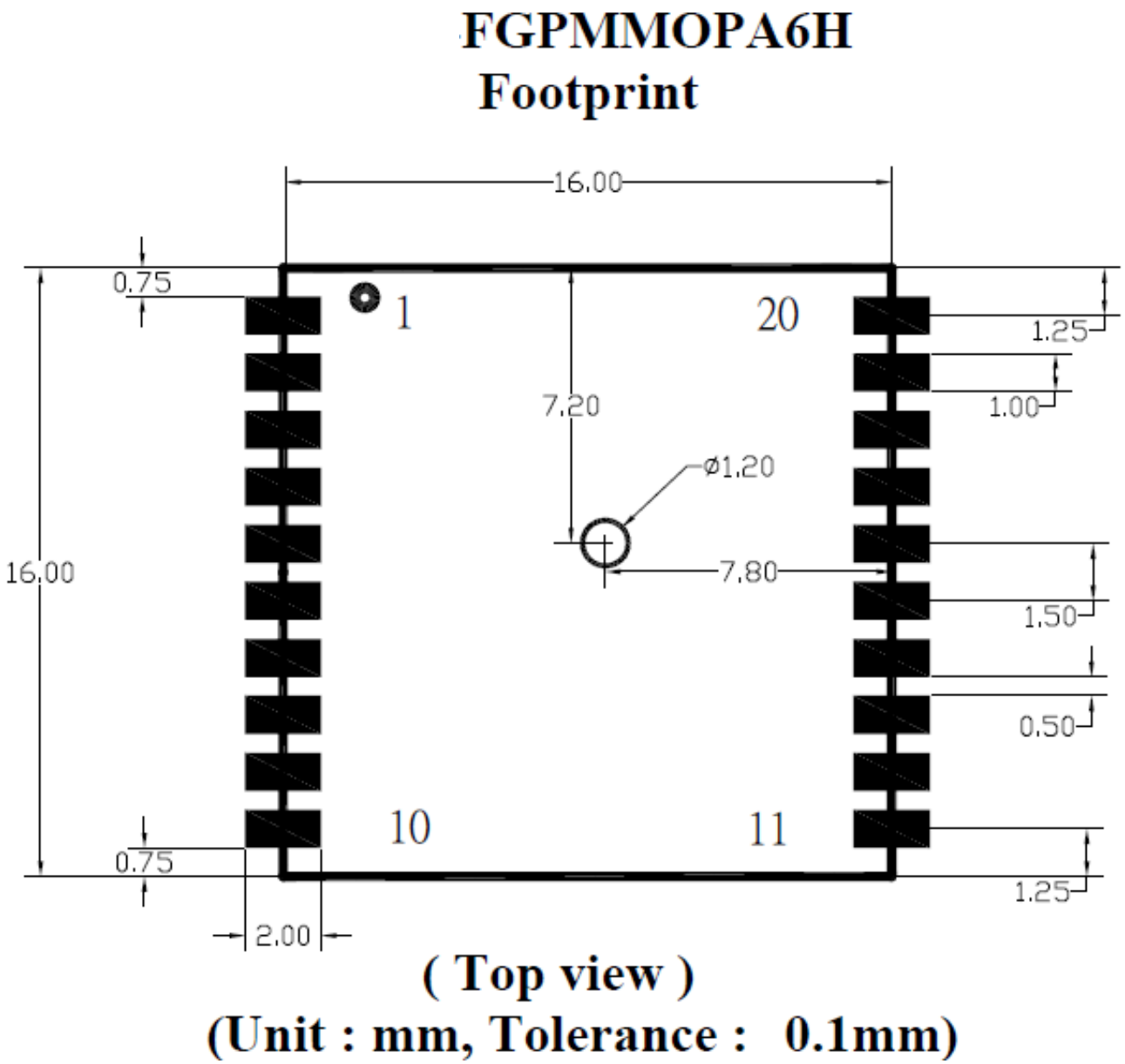
2.1 Mechanical Dimension

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

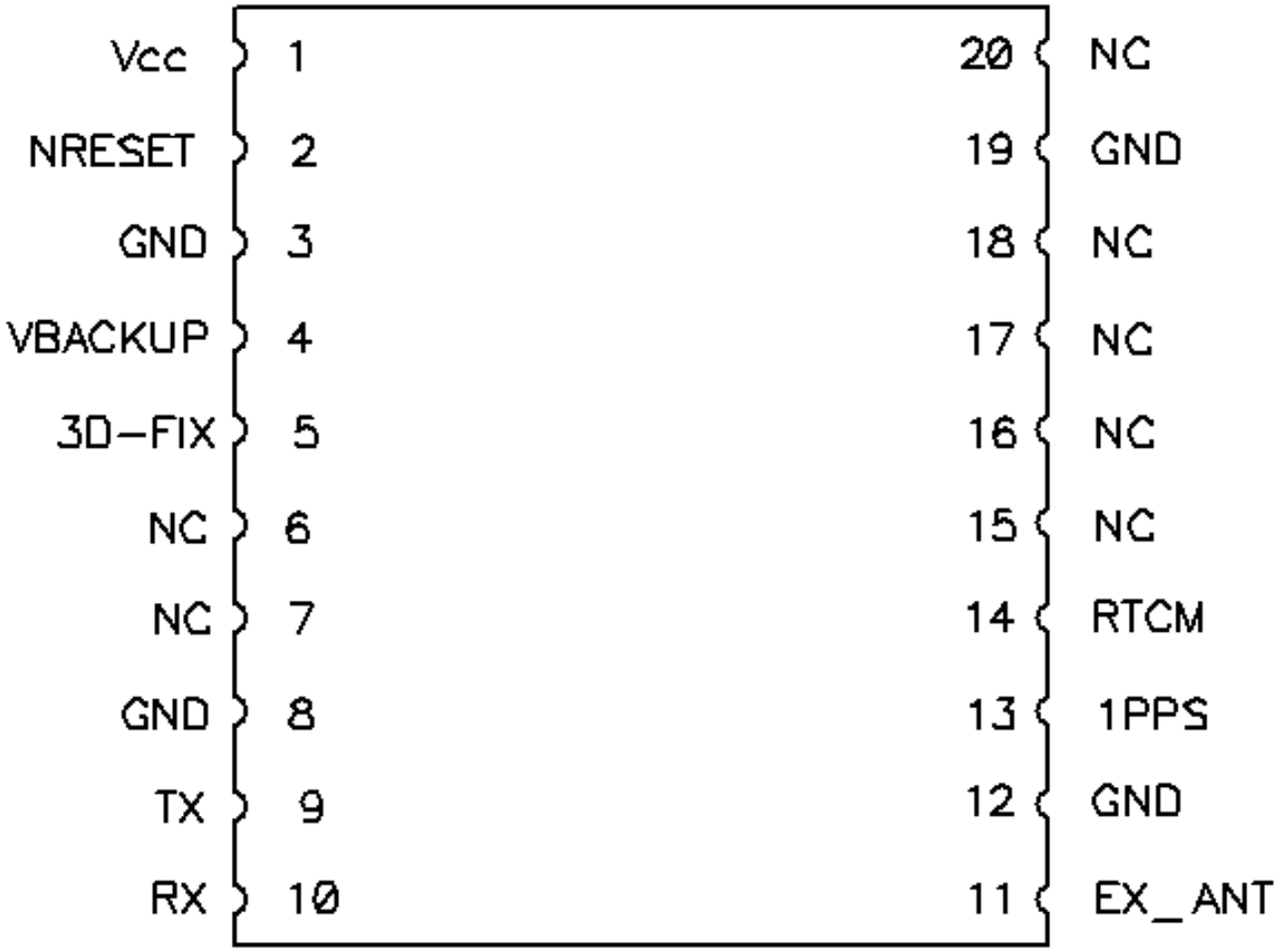


2.2 Recommended PCB pad Layout

(Unit: mm, Tolerance: 0.1mm)



2.3 Pin Configuration



(Top view)

2.4 Pin Assignment

Pin	Name	I/O	Description & Note
1	VCC	PI	Main DC Power Input
2	NRESET	I	Reset Input, Low Active
3	GND	P	Ground
4	VBACKUP	PI	Backup Power Input for RTC & Navigation Data Retention
5	3D-FIX	O	3D-Fix Indicator
6	NC	--	Not Connect
7	NC	--	Not Connect
8	GND	P	Ground
9	TX	O	Serial Data Output for NMEA Output (UART TTL)
10	RX	I	Serial Data Input for Firmware Update (UART TTL)
11	EX_ANT	I PO	External active antenna RF input. DC power from VCC and provide for external active antenna.
12	GND	P	Ground
13	1PPS	O	1PPS Time Mark Output 2.8V CMOS Level
14	RTCM	I	Serial Data Input for DGPS RTCM Data Streaming
15	NC	--	Not Connect
16	NC	--	Not Connect
17	NC	--	Not Connect
18	NC	--	Not Connect
19	GND	P	Ground
20	NC	--	Not Connect

2.5 Description of I/O Pin

VCC (Pin1)

The main DC power supply of the module, the voltage should be kept between from 3.0V to 4.3V.
The Vcc ripple must be controlled under 50mV$_{pp}$ (Typical: 3.3V)

NRESET (Pin2)

With a low level, it causes the module to reset. If not used, keep floating.

GND (Pin3, Pin8, Pin12, Pin19)

Ground

VBACKUP (Pin4)

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 should be kept between 2.0V~4.3V, Typical 3.0V.

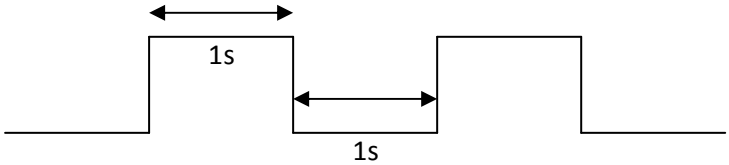
IF VBACKUP power was not reserved, the GPS module will perform a lengthy cold start every time it is powered-on because previous satellite information is not retained and needs to be re-transmitted.

If not used, keep open.

3D-FIX (Pin5)

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 one-second high-level with one-second low-level signal.



- After 2D or 3D Fix
  The pin should continuously output low-level signal.

  Low _____

NC (Pin6, Pin7, Pin15, Pin16, Pin17, Pin18, Pin20)

Not connect.

TX (Pin9)

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

RX (Pin10)

This is the UART receiver of the module. It is used to receive software commands and firmware update.

EX_ANT (Pin11)

DC power from VCC and provide for external active antenna (Recommendation: 3.3V).

When a 4mA or higher current is detected, the detect circuit will acknowledge the external antenna as being present and uses external antenna for reception.
In the event of short circuit occurring at external antenna, the module will limit the drawn current to a safe level.
The 3.0V for the GPS external antenna is limited to 25mA.
The 3.3V for the GPS external antenna is limited to 28mA.
The 3.6V for the GPS external antenna is limited to 31mA.

1PPS (Pin13)

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

Keep floating if not used.

RTCM (Pin14)

This pin receive DGPS data of RTCM protocol (TTL level), if not used keep floating'

RTCM is not enabled by default, please consult GlobalTop support to enable this feature.

2.6 Specification List

	Description
GPS Solution	MTK MT3339
Frequency	L1, 1575.42MHz
Sensitivity[1]	Acquisition: -148dBm, cold start Reacquisition: -163dBm, Hot start Tracking: -165dBm
Channel	66 channels
TTFF	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(Typical)
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)
DGPS	SBAS(defult) [WAAS, EGNOS, MSAS,GAGAN]
QZSS	Support(Ranging)
AGPS	Support
Power Supply	VCC：3.0V to 4.3V；VBACKUP：2.0V to 4.3V
Current Consumption	25mA acquisition, 20mA tracking
Working Temperature	-40 °C to +85 °C
Dimension	16 x 16x 4.7mm, SMD
Weight	**4g**

2.7 Absolute Maximum Ratings

The voltage applied for VCC should 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

2.8 Operating Conditions

	Condition	Min.	Typ.	Max.	Unit
Operation supply Ripple Voltage	—	—	—	50	**mVpp**
RX0 TTL H Level	VCC=3.0~4.3V	2.0	—	VCC	**V**
RX0 TTL L Level	VCC=3.0~4.3V	0	—	0.8	**V**
TX0 TTL H Level	VCC=3.0~4.3V	2.4	—	2.8	**V**
TX0 TTL L Level	VCC=3.0~4.3V	0	—	0.4	**V**
Current Consumption @ 3.3V, 1Hz Update Rate	Acquisition	—	25	—	**mA**
	Tracking	—	20	—	**mA**
Backup Power Consumption@ 3V	25°C	—	7	—	**uA**

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 to 3.6V
DC Current	4mA ~ 20mA at 3.3V
Total Gain	>+ 15dBi (Two-stage LNA)
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	meters	Antenna Altitude above/below mean-sea-level
Units	M	meters	Units of antenna altitude
Geoidal Separation	17.8	meters	
Units	M	meters	Units of geoids separation
Age of Diff. Corr.		second	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 Number1	1		Range 1 to 3
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	3.05, W	degrees	E=east or W=west (Need GlobalTop Customization Service)
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		Magnetic (Need GlobalTop Customization Service)
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 Antenna Status Protocol (Antenna Advisor)

The function is for external active antenna only.

PGTOP—Status of antenna

Table-12 contains the values for the following example**:**

$PGTOP,11,3 *6F

Table-12: PGACK Data Format			
Name	**Example**	**Units**	**Description**
Message ID	$PGTOP		Protocol header
Command ID	11		Function Type
Reference	3		Value of antenna status

Example:

$PGTOP,11,value*checksum

Value: 1=>Active Antenna Shorted

2=>Using Internal Antenna

3=>Using Active Antenna

3.3 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>

3.4 Firmware Customization Services

GlobalTop also offers flexible, value-adding GPS firmware customization services that maximizes the over system efficiencies and power consumptions. Latest functions like Binary Mode, 1-Sentence Output, Geo-fencing and Last Position Retention, please see our website at www.gtop-tech.com under Products / GPS Modules / Software Services for more details.

Note: Not all firmware customization services listed below are supported by module. Please contact GlobalTop Sales or Technical Support for more details.