# POXA1328-007

## GPS Standalone Module

## Data Sheet


**The POXA1328-007 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*6.2mm)**

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# 1. Functional Description

## 1.1 Overview

The POXA1328-007 is an ultra-compact POT (Patch On Top) GPS Module, The module 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.

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, FGPMMOPA6C supports various location and navigation applications, including autonomous GPS, SBAS(note) ranging (WAAS, EGNO, GAGAN, MSAS), AGPS.

POXA1328-007 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

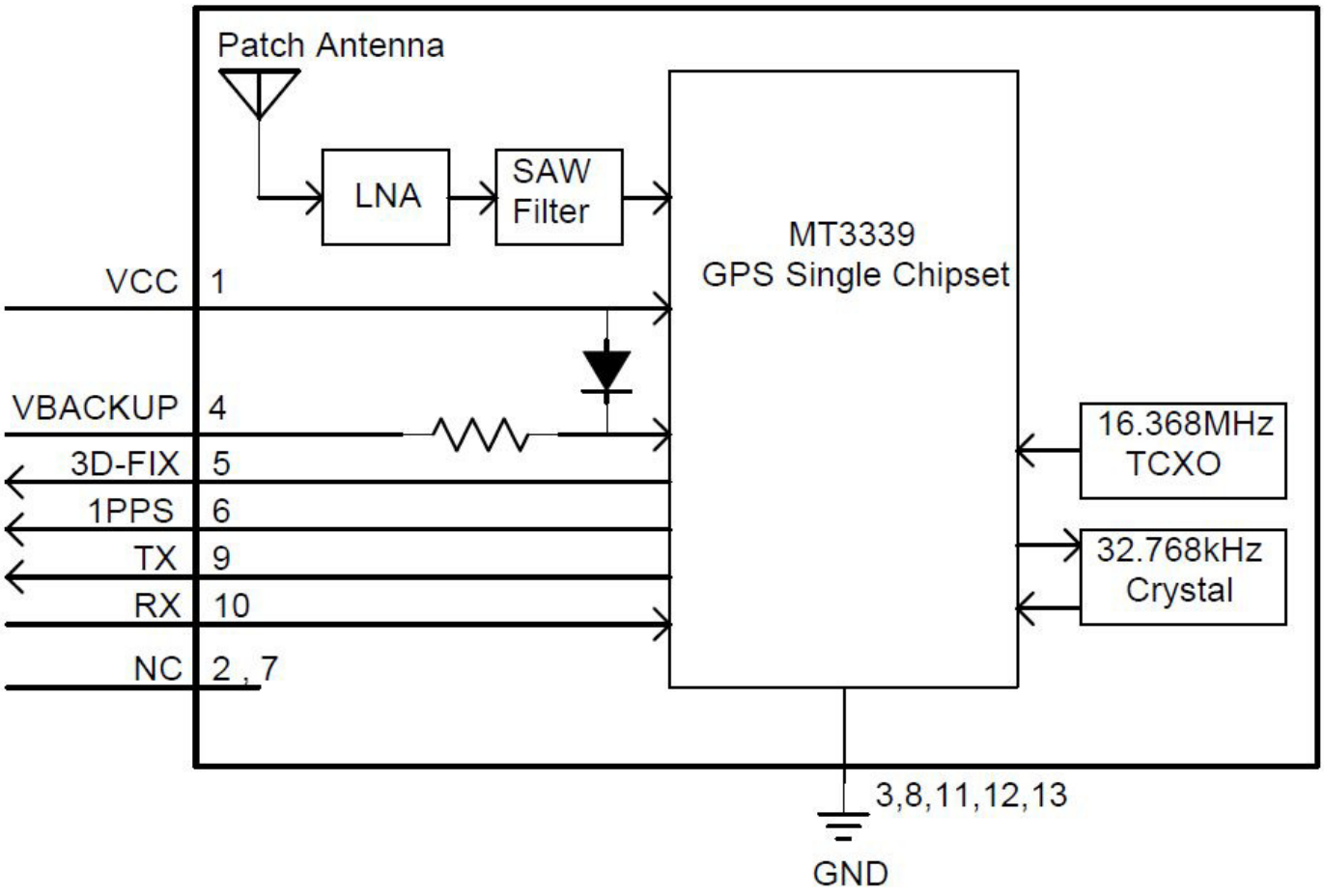
- √ Built-in 15X15X4mm ceramic patch antenna on the top of module
- √ Ultra-High Sensitivity: -165dBm (w/o patch antenna), up to 45dB C/N of SVs in open sky reception.
- √ High Update Rate: up to 10Hz(note1)
- √ 12 multi-tone active interference canceller(note2)[ISSCC 2011 Award -Section 26.5]

  (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/30 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)
- √ Consumption current(@3.3V):
  • Acquisition: 25mA Typical
  • Tracking: 20mA 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 "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. POXA1328-007 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 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:

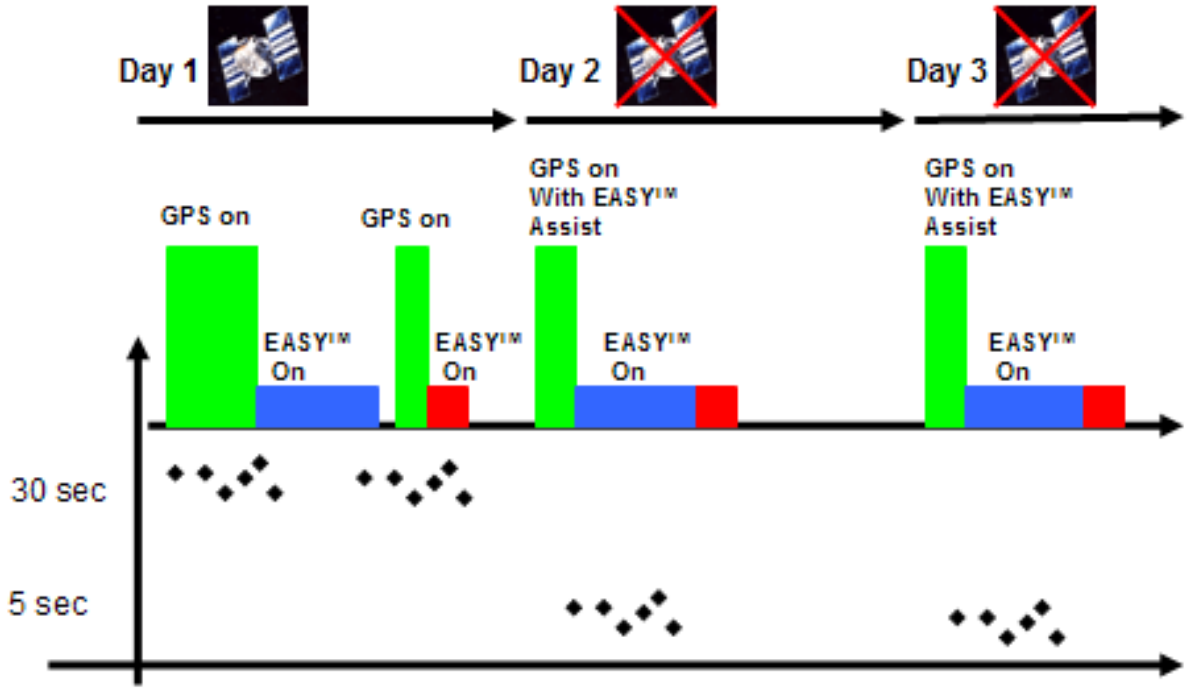
POXA1328-007 supply the high accurate 1PPS timing to synchronize to GPS time after 3D-Fix.
A power-on output 1pps is also available for customization firmware settings.

## 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 .

## 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.



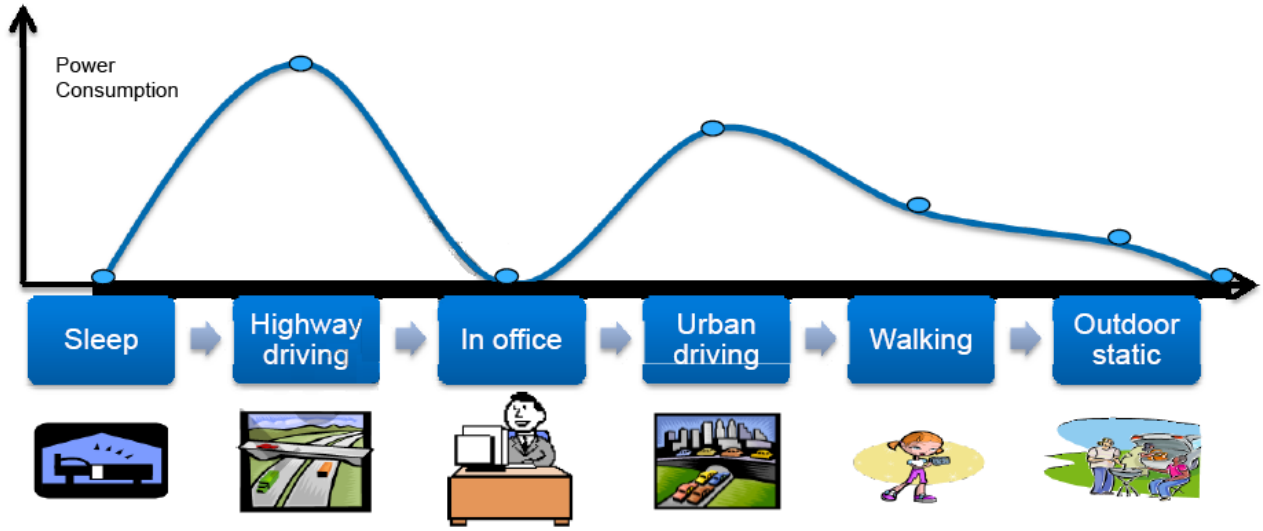

1.12-1 EASY System operation

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

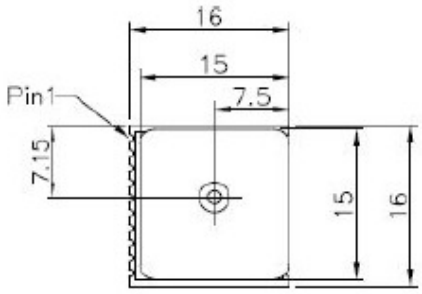
The Embedded Logger function don't need host CPU (MCU ) and external flash to handle the operation , GPS Engine will use internal flash (embedded in GPS chipset ) to log the GPS data (Data format : UTC, Latitude , longitude, Valid ,Checksum ), the max log days can up to 2 days under AlwaysLocate™ condition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

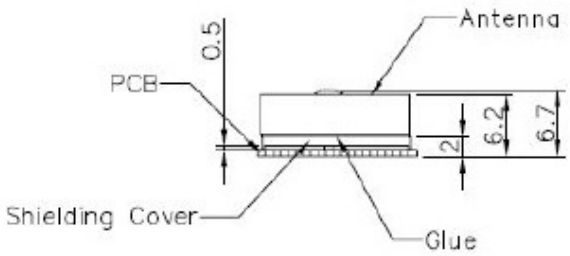
Note: Data size per log was shrunk from 24 bytes to 15 bytes.

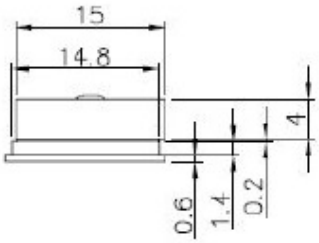
# Specifications

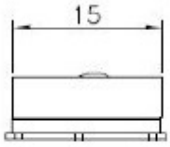
## 2.1 Mechanical Dimension

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

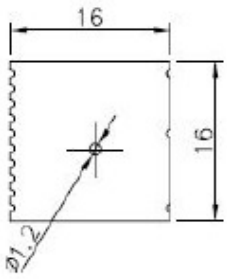


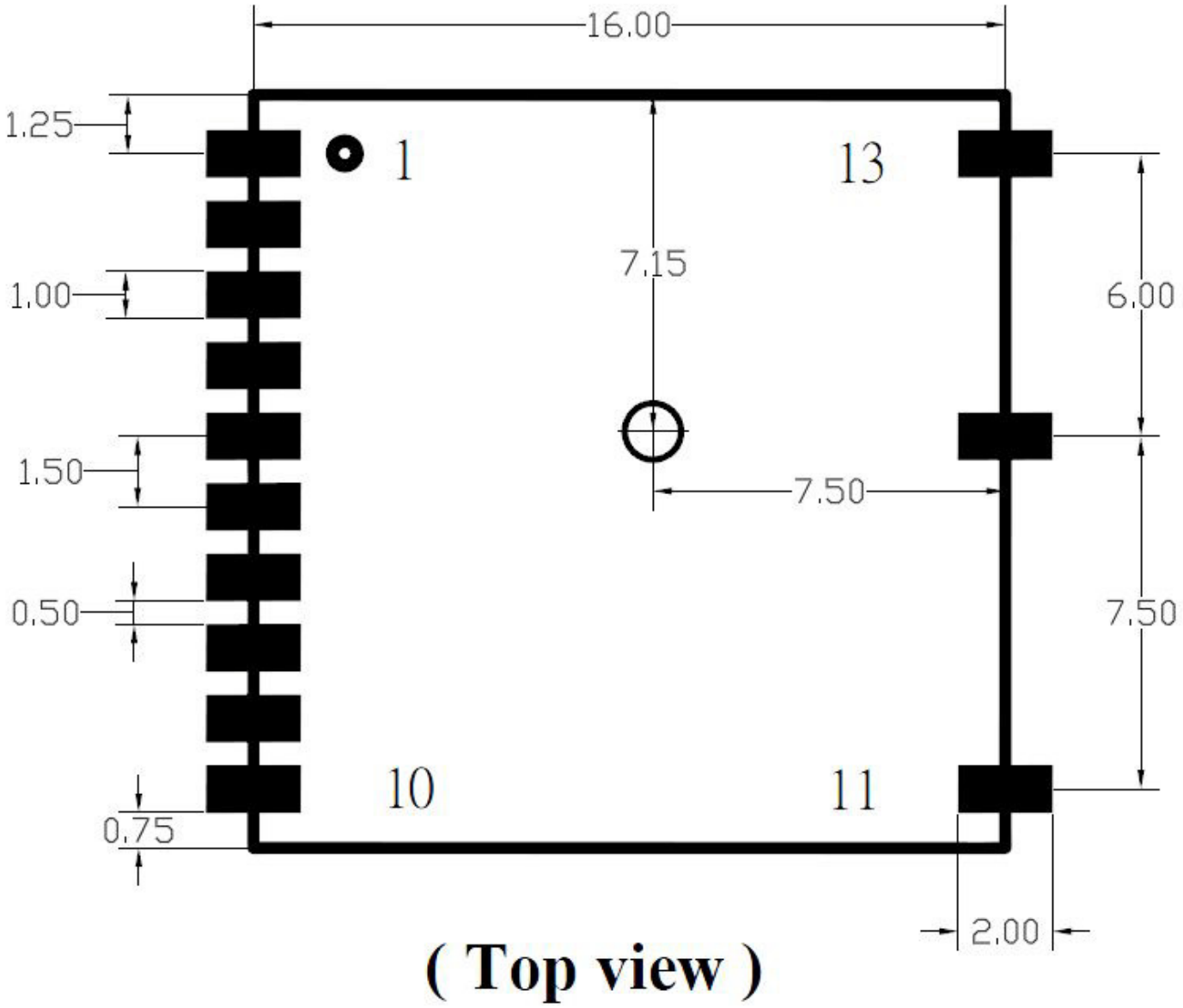




**Unit : mm**
**Assemble Tolerance : 0.2mm**

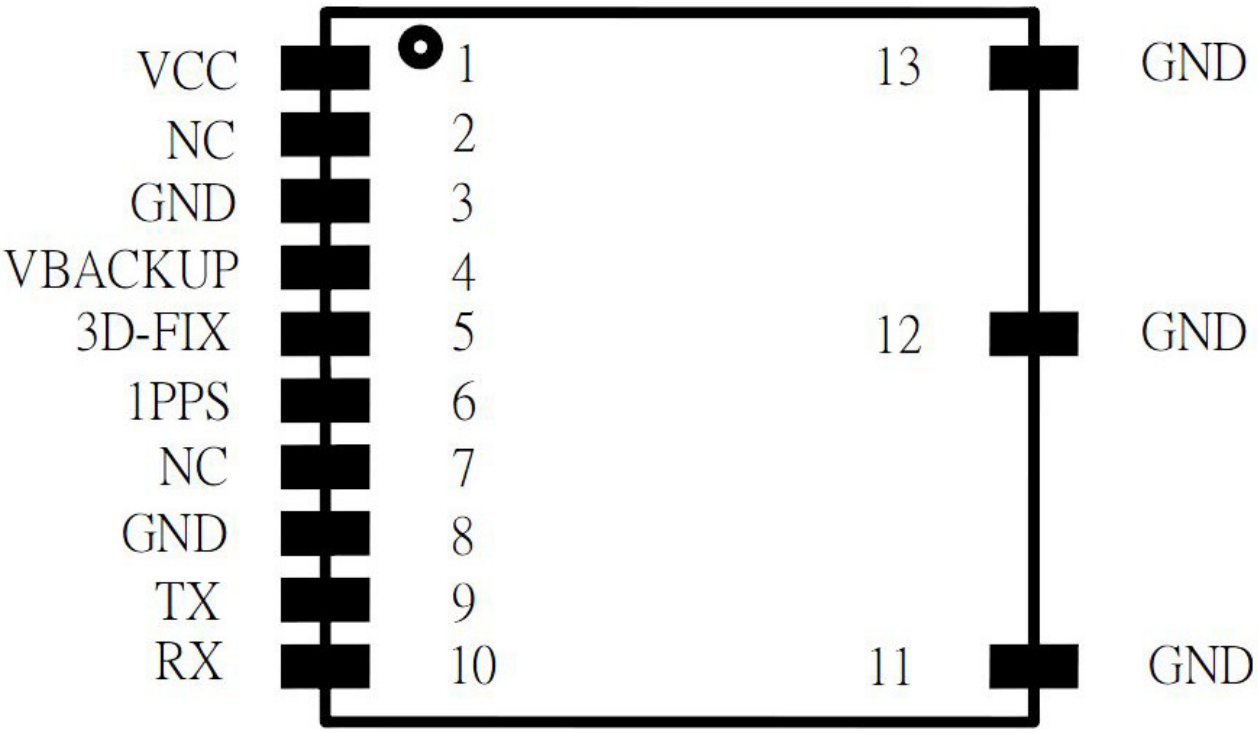


## 2.2 Recommended PCB pad Layout

(Unit: mm, Tolerance: 0.1mm)



## 2.3 Pin Configuration




**(Top view)**

## 2.4 Pin Assignment

| Pin | Name | I/O | Description |
|---|---|---|---|
| 1 | **VCC** | PI | Main DC power input |
| 2 | **NC** | — | Not connected |
| 3 | **GND** | P | Ground |
| 4 | **VBACKUP** | PI | Backup power input |
| 5 | **3D-FIX** | O | 3D-fix indicator |
| 6 | **1PPS** | O | 1PPS Time Mark Output 2.8V CMOS Level |
| 7 | **NC** | — | Not connected |
| 8 | **GND** | P | Ground |
| 9 | **TX** | O | Serial data output of NMEA |
| 10 | **RX** | I | Serial data input for firmware update |
| 11 | **GND** | P | Ground |
| 12 | **GND** | P | Ground |
| 13 | **GND** | P | Ground |

# 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)**

## NC (Pin2 and Pin7)

These are NC pins, they are not connected.

## GND (Pin3 and Pin8)

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.

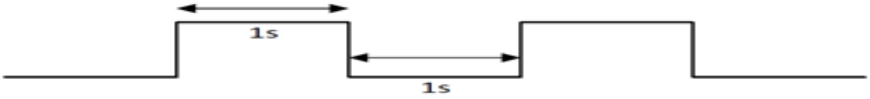
**IF VBACKUP power was not reserved, the GPS module will perform a lengthy cold start every time it is powered-on because previous satellite information is not retained and needs to be re-transmitted.**

If not used, keep open.

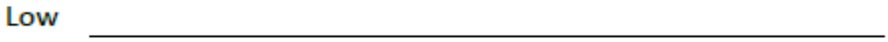
## 3D-FIX (Pin5)

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.




## 1PPS (Pin6)

This pin provides one pulse-per-second output from the module and synchronizes to GPS time.
Keep floating if not used.

## 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.

## 2.6 Specification List

| | Description |
|---|---|
| **GPS Solution** | MTK MT3339 |
| **Frequency** | L1, 1575.42MHz |
| **Sensitivity**[1] | Acquisition: -148dBm, cold start<br>Reacquisition: -163dBm, Hot start<br>Tracking: -165dBm |
| **Channel** | 66 channels |
| **TTFF** | Hot start: 1 second typical<br>Warm start: 33 seconds typical<br>Cold start: 35 seconds typical<br>(No. of SVs>4, C/N>40dB, PDop<1.5) |
| **Position Accuracy** | Without aid:3.0m (50% CEP)<br>DGPS(SBAS(WAAS,EGNOS,MSAS)):2.5m (50% CEP) |
| **Velocity Accuracy** | Without aid : 0.1m/s<br>DGPS(SBAS(WAAS,EGNOS,MSAS,GAGAN)):0.05m/s<br>Without aid:0.1 $m/s^2$ |
| **Acceleration Accuracy** | Without aid:0.1 $m/s^2$<br>DGPS(SBAS(WAAS,EGNOS,MSAS)):0.05$m/s^2$ |
| **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) |
| **DGPS** | SBAS(defult) [QZSS,WAAS, EGNOS, MSAS,GAGAN] |
| **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 6.2mm, SMD |
| **Weight** | **6g** |
| | |

## 2.7 Absolute Maximum Ratings

The voltage applied for VCC should not exceed 6VDC.

| | 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** |

# 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<br>*(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,<br>(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,<br>(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-10: 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 |
| Mode | A | | A= Autonomous mode<br>D= Differential mode<br>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-12: 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<br>D= Differential mode<br>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:**

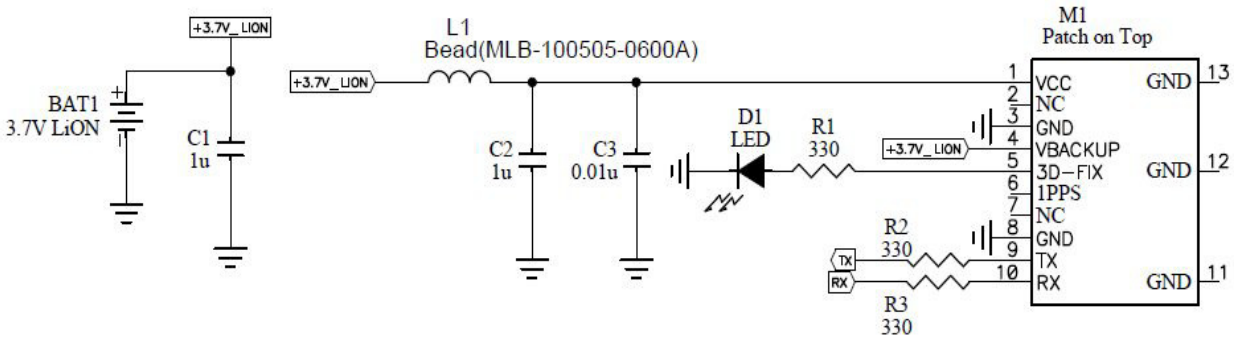
Cold Start：Don’t use Time, Position, Almanacs and Ephemeris data at re-start.

**Example:**

$PMTK103*30<CR><LF>

# 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.




**Note:**

1. Ferrite bead L1 is added for power noise reduction.
2. C2 and C3 bypass should be put near the module.
   For C1, 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.