POXA1328-002

GPS Standalone Module
Data Sheet

The POXA1328-002 is a 4th generation stand-alone GPS module with lightning fast TTFF, ultra high sensitivity (-165dBm), and exceptional low power consumption in a small form factor (9*12.7*2.1mm)

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1. Functional Description

1.1 Overview

The POXA1328-002 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.

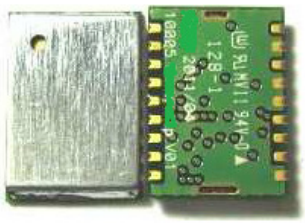
With built-in LNA to reach total NF to 0.7dB customers can relax antenna requirement and don't need for external LNA. Power management design makes POXA1328-002 easily integrated into your system without extra voltage regulator.POXA1328-002 allows direct battery connection, no need any external LDO and 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, POXA1328-002 supports various location and navigation applications, including autonomous GPS, SBAS ranging (WAAS, EGNO, GAGAN, and MSAS), and AGPS.

POXA1328-002 is excellent low power consumption characteristic (acquisition 63mW, tracking 49mW), power sensitive devices, especially portable applications, need not worry about operating time anymore and user can get more fun. Combined with many advanced features including AlwaysLocate™, EASY™, 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

√ 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.adv anceprogrambooklet_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)

√ Consumption current(@3.3V):
- Acquisition: 19 mA Typical
- Tracking: 15 mA Typical

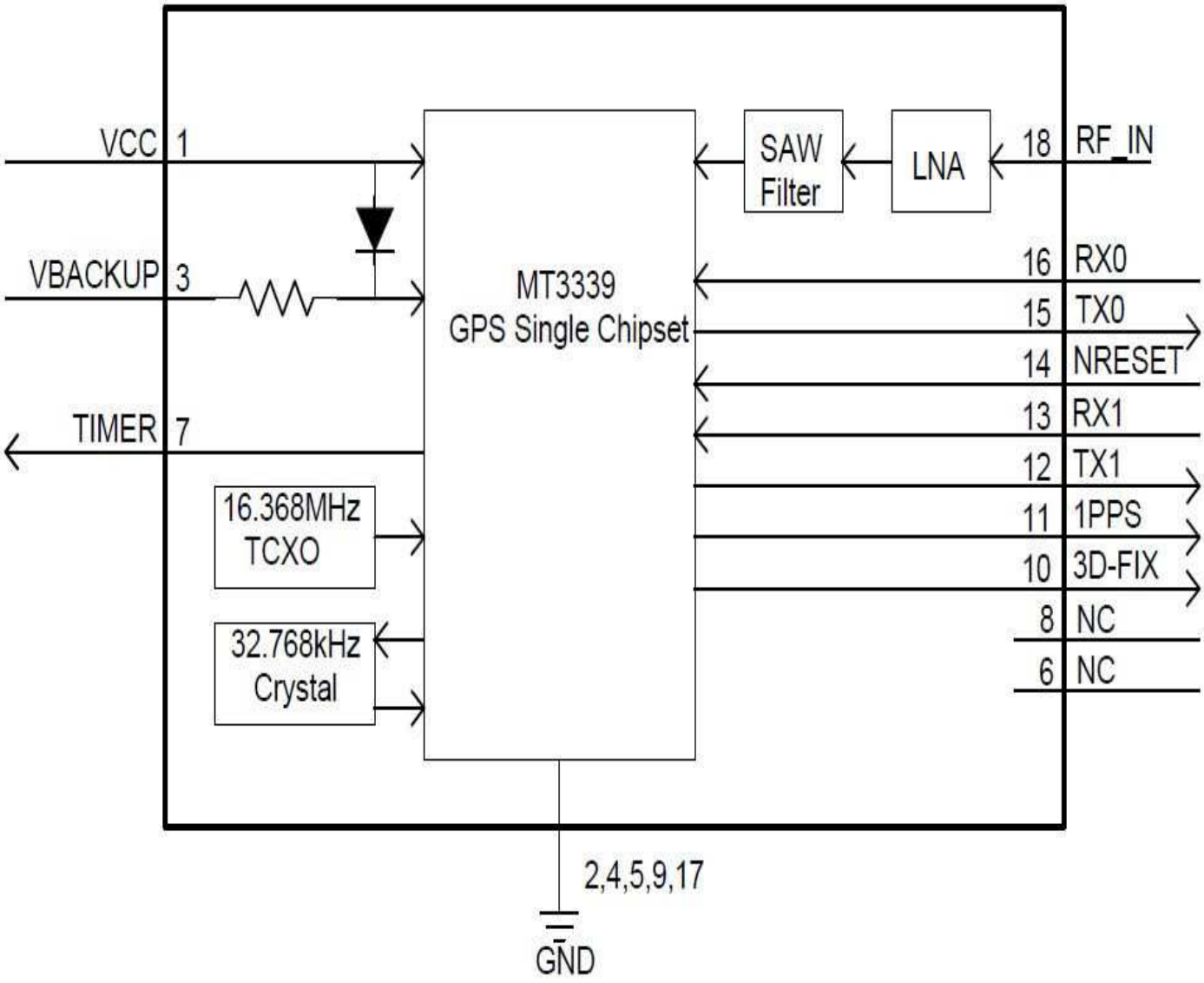
√ E911, RoHS, REACH compliant

√ 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 documents “PMTK command List” and “Firmware check list_C39”.

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 .POXA1328-002 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:

POXA1328-002 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 Timer Function for device on/off control

The timer function support a time tick generation of 31.25ms resolution, the period of timer can be from 31.25ms to 524287s, the pin outputs signal during the timer period and becomes a input pin after time out, the system can use the pin to connect an external LDO controller and pull high circuit to enable other device for specified operation (ex: wake up GSM/GPRS processor to transmit location data of asset during one period, then enter power saving mode after finish its job)

1.7 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.

1.8 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, the Backup power (VBACKUP) is necessary .

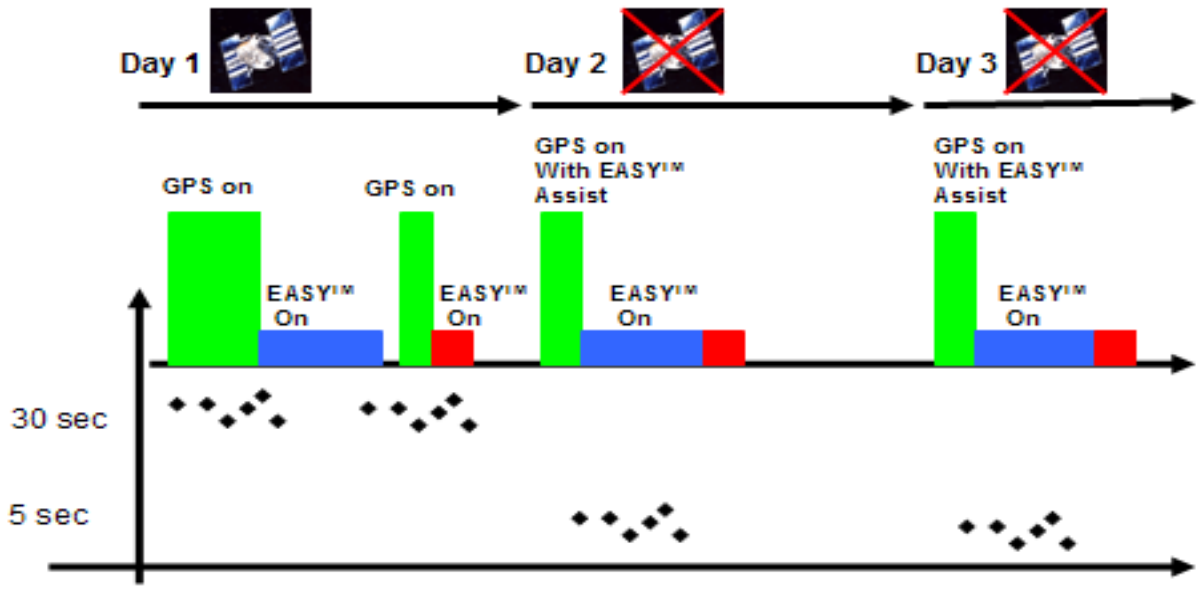


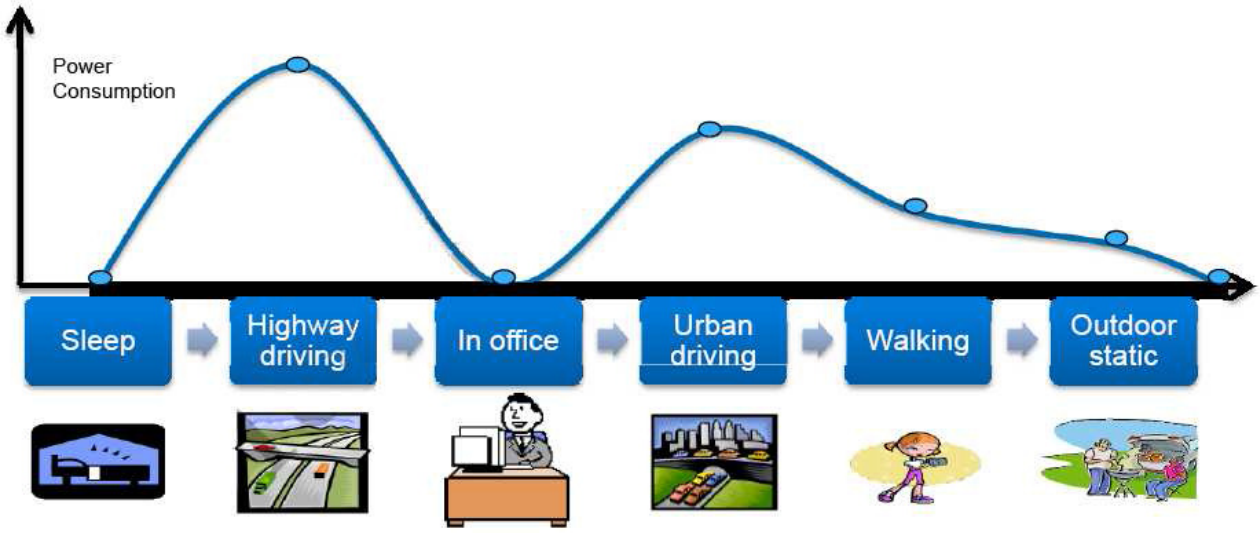
Figure 1.12-1 EASY System operation

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.

1.9 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)



1.10 Embedded Logger function

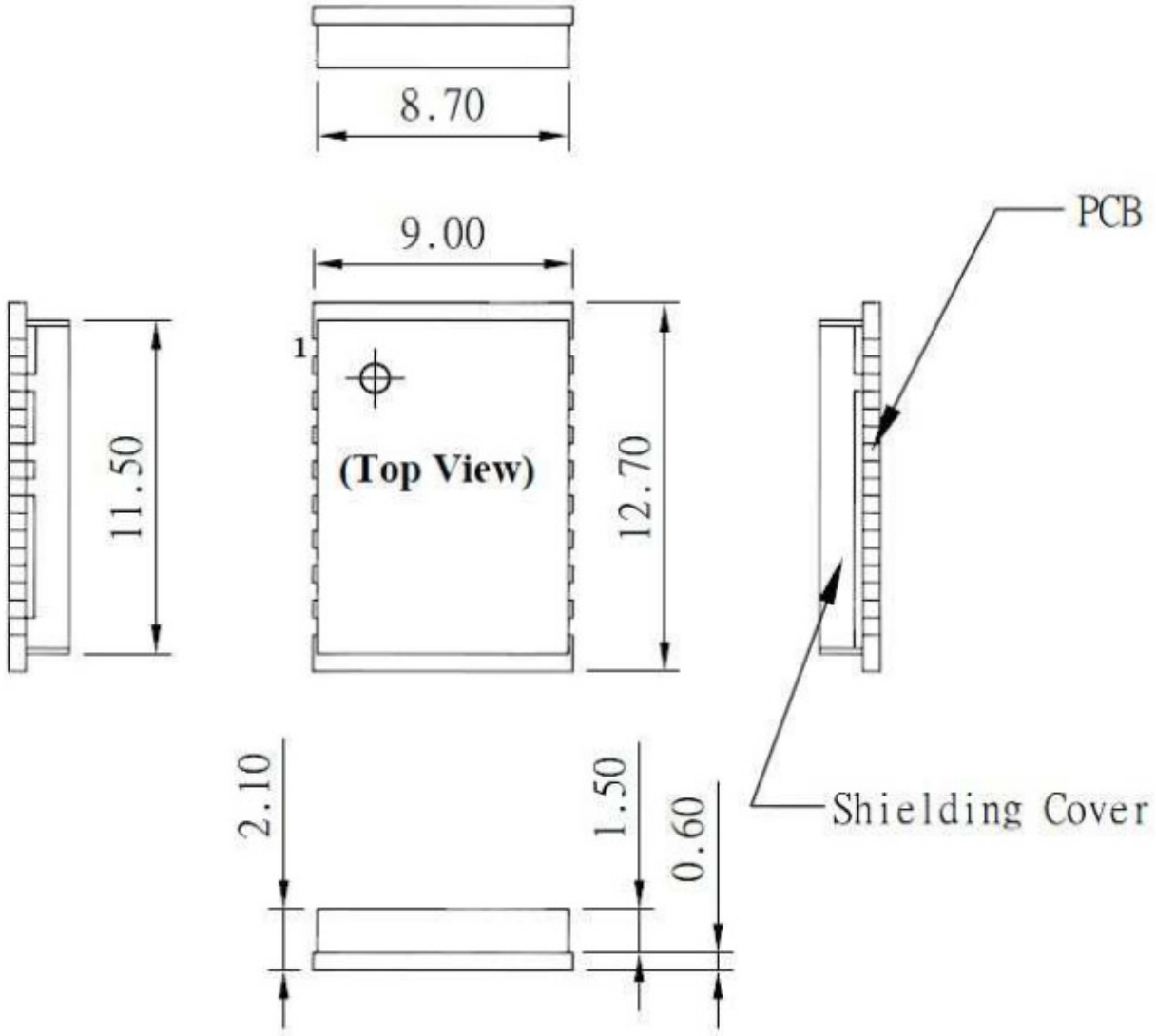
The Embedded Logger function don't need host CPU (MCU) and external flash to handle the operation , GPS Engine will use internal flash (embedded in GPS chipset) to log the GPS data (Data format : UTC, Latitude , longitude, Valid ,Checksum), the max log days can up to 2 days under AlwaysLocate™ condition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

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

2. Specifications

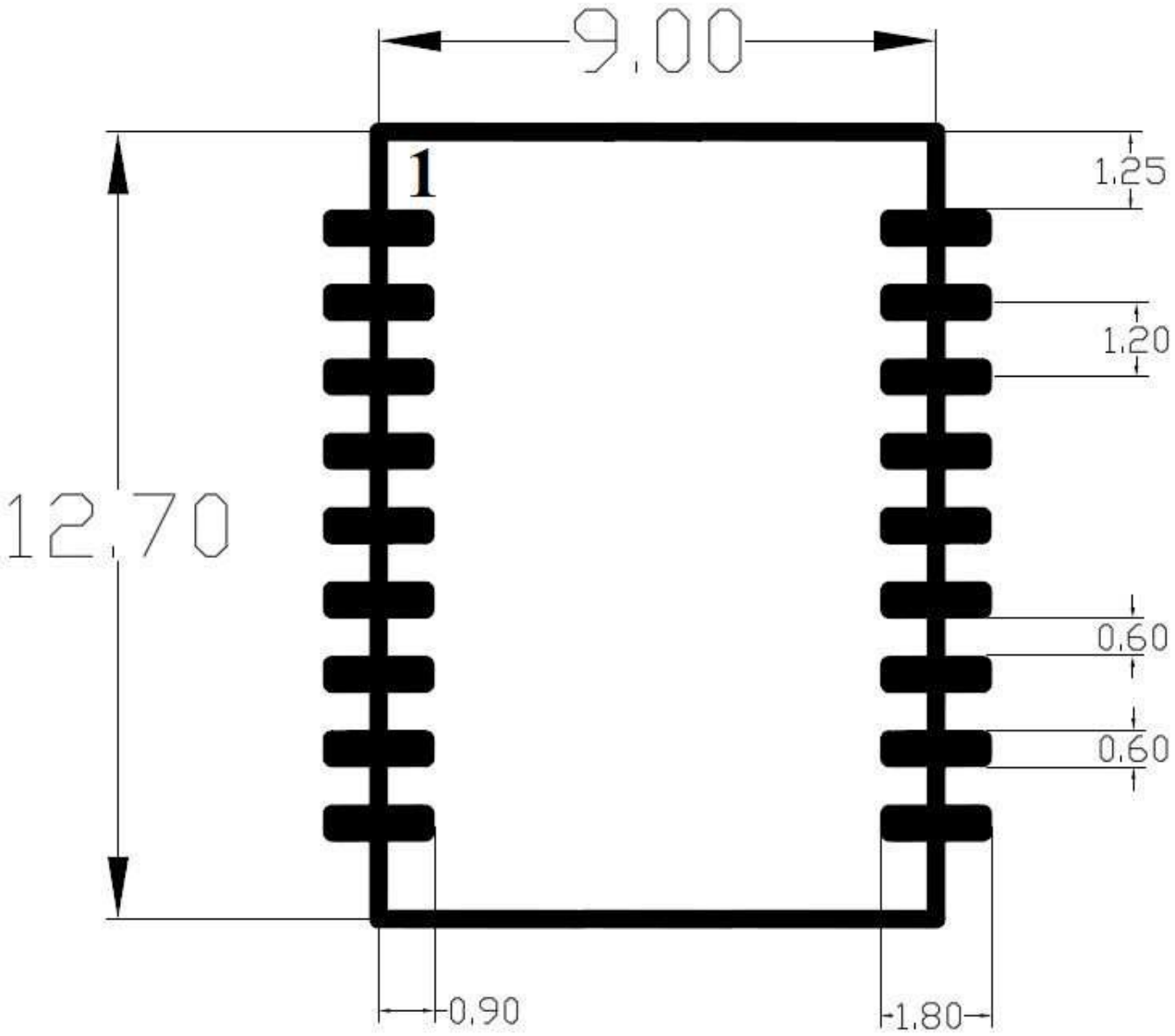
2.1 Mechanical Dimension

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



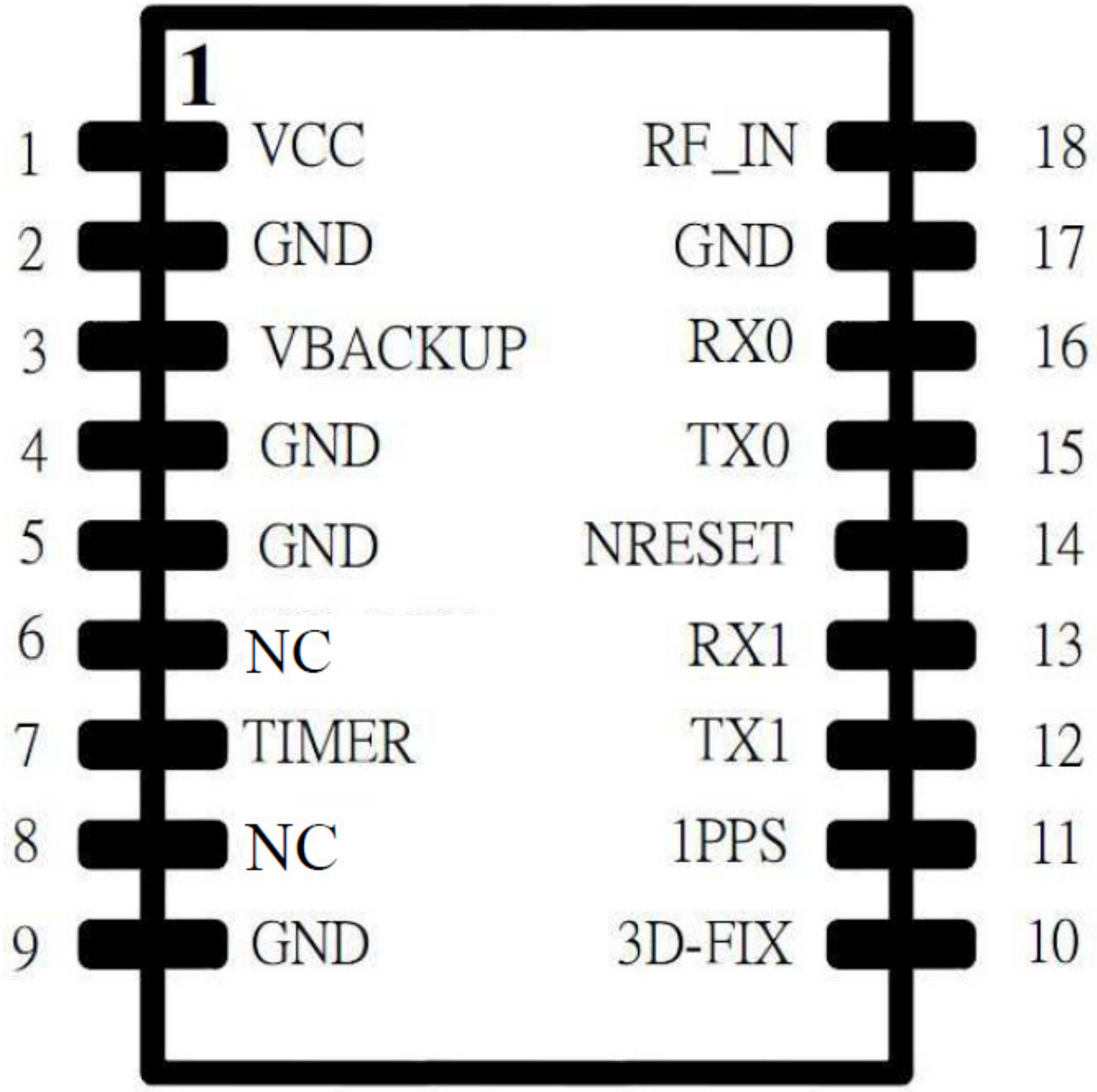
2.2 Recommended PCB pad Layout

(Unit: mm, Tolerance: 0.1mm)



(Top view)

2.3 Pin Configuration



(Top view)

2.4 Pin Assignment

Pin	Name	I/O	Description & Note
1	VCC	PI	Main DC power input
2	GND	p	Ground
3	VBACKUP	PI	Backup power input for RTC & navigation data keep
4	GND	P	Ground
5	GND	P	Ground
6	NC	--	Not Connect
7	TIMER	O	The timer function support a time tick
8	NC	--	Not Connect
9	GND	P	Ground
10	3D-FIX	O	3D-Fix Indicator
11	1PPS	O	1PPS time mark output 2.8V CMOS level
12	TX1	O	Serial Data Output
13	RX1	I	Serial Data Input for DGPS RTCM data streaming
14	NRESET	I	Reset Input, Low Active
15	TX0	O	Serial Data Output for NMEA output (TTL)
16	RX0	I	Serial Data Input for Firmware update (TTL)
17	GND	P	Ground
18	RF_IN	I	GPS RF signal input

2.5 Description of I/O Pin

VCC, Pin1

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).

GND, Pin2, Pin4, Pin5, Pin9, Pin17

Ground

VBACKUP, Pin3

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 retransmitted.

If not used, keep floating.

NC, Pin6

This pin is not connected, keep floating.

TIMER, Pin7

The timer function support a time tick generation of 31.25ms resolution, the period of timer can be from 31.25ms to 524287 s, the pin outputs signal during the timer period and becomes a input pin after time out, the system can use the pin to connect an external LDO controller and pull high circuit to enable other device for specified operation (ex: wake up GSM/GPRS processor to transmit location data of asset during one period, then enter power saving mode after finish its job)

If not used, keep floating.

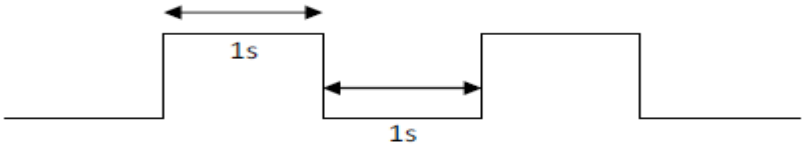
NC, Pin8

This pin is not connected, keep floating.

3D-FIX, Pin10

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, Pin11

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

TX1, Pin12

This is the UART transmitter of the module. It is used for customization by firmware. If not used, keep floating.

RX1, Pin13

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

NRESET, Pin14

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

TX0, Pin15

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

RX0, Pin16

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

RF_IN, Pin18

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 MT3339
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 Without aid:0.1 m/s^2
Acceleration Accuracy	Without aid:0.1 m/s^2 DGPS(SBAS(WAAS,EGNOS,MSAS)):0.05m/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	19mA acquisition, 15mA tracking
Working Temperature	-40 °C to +85 °C
Dimension	9 x 12.7x 2.1mm, SMD
Weight	**1g**

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=3.3V	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	Acquisition		19		**mA**
	Tracking		15		**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
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	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-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 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-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 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:

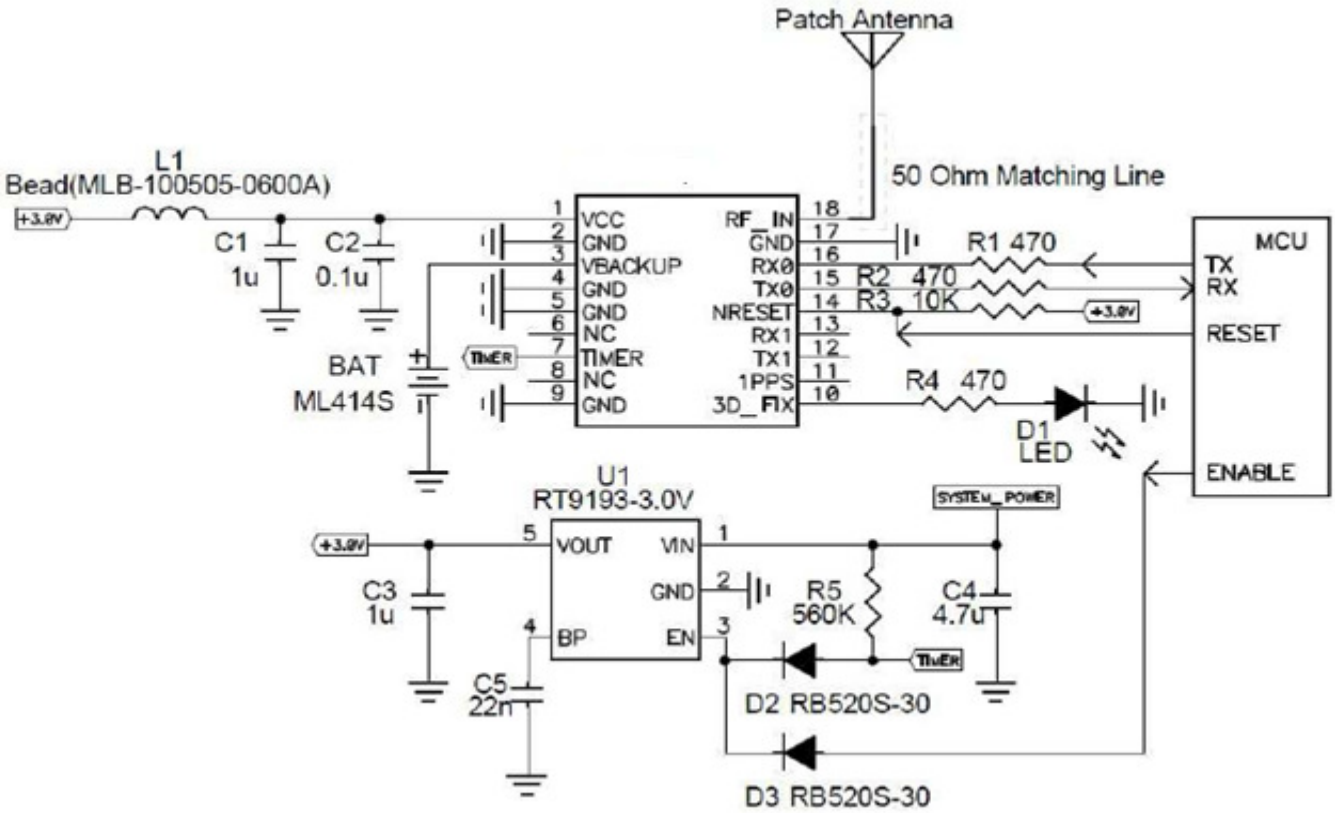
$PMTK103*30<CR><LF>

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

When using a passive antenna, please connect the antenna directly to Pin18, RF_IN.

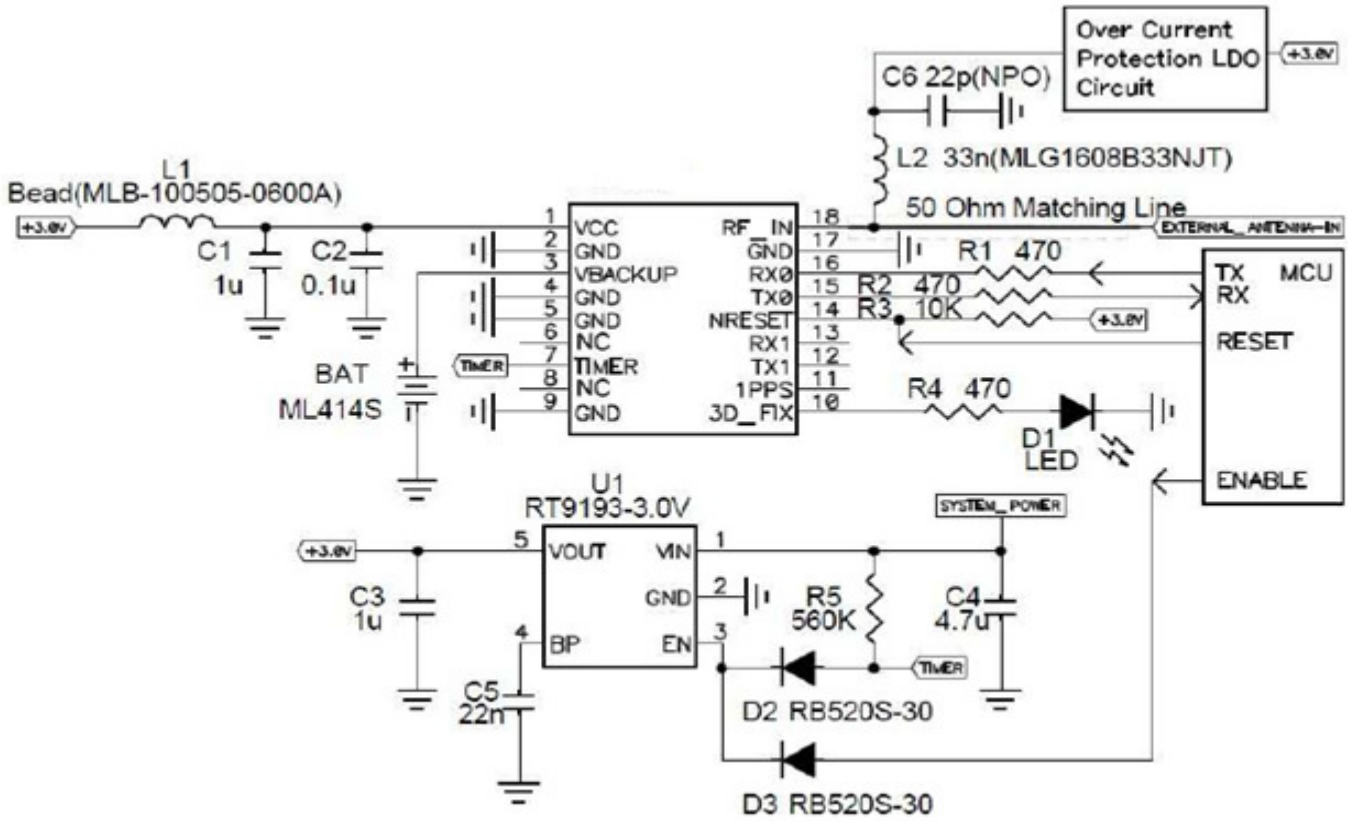


Note:

1. Ferrite bead L1 is added for power noise reduction.
2. C1 and C2 bypass should be put near the module.
   For C3, the value chosen depends on the amount of system noise, the range from 1uF to 100uF is reasonable.
3. Damping resistors R1 and R2 could be modified based on system application for EMI.

4.2 Active Antenna

When using an active antenna, please connect the antenna directly to Pin18, RF_IN.



Note:

1. Ferrite bead L1 is added for power noise reduction.
2. C1 and C2 bypass capacitor should be put near the module.
   For C3, the value chosen depends on the amount of system noise, the range from 1uF to 100uF is reasonable.
3. Damping resistors R1 and R2 could be modified based on system application for EMI.
4. L2 choke inductor should be put near the Pin18 and C6 RF bypass capacitor should be put near the L2.