Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Product Technical Specification

AirPrime XA1110

SIERRA WIRELESS®

41111069
Rev 1

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate the Sierra Wireless modem in areas where blasting is in progress, where explosive atmospheres may be present, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. The Sierra Wireless modem can transmit signals that could interfere with this equipment.

Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE POWERED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

Limitation of Liability

The information in this manual is subject to change without notice and does not represent a commitment on the part of Sierra Wireless. SIERRA WIRELESS AND ITS AFFILIATES SPECIFICALLY DISCLAIM LIABILITY FOR ANY AND ALL DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE OR ANTICIPATED PROFITS OR REVENUE ARISING OUT OF THE USE OR INABILITY TO USE ANY SIERRA WIRELESS PRODUCT, EVEN IF SIERRA WIRELESS AND/OR ITS AFFILIATES HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

Notwithstanding the foregoing, in no event shall Sierra Wireless and/or its affiliates aggregate liability arising under or in connection with the Sierra Wireless product, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Sierra Wireless product.

Patents

This product may contain technology developed by or for Sierra Wireless Inc. This product includes technology licensed from QUALCOMM®. This product is manufactured or sold by Sierra Wireless Inc. or its affiliates under one or more patents licensed from InterDigital Group and MMP Portfolio Licensing.

Copyright

Trademarks

Sierra Wireless®, AirPrime®, AirLink®, AirVantage® and the Sierra Wireless logo are registered trademarks of Sierra Wireless.

Windows® and Windows Vista® are registered trademarks of Microsoft Corporation.

Macintosh® and Mac OS X® are registered trademarks of Apple Inc., registered in the U.S. and other countries.

QUALCOMM® is a registered trademark of QUALCOMM Incorporated. Used under license.

Other trademarks are the property of their respective owners.

Contact Information

Sales information and technical support, including warranty and returns	Web: sierrawireless.com/company/contact-us/ Global toll-free number: 1-877-687-7795 6:00 am to 6:00 pm PST
Corporate and product information	Web: sierrawireless.com

Revision History

Revision number	Release date	Changes
1	June 23, 2017	Initial revision in SWI template.

Contents

1: Function Description

Overview

The XA1110 is a POT (Patch On Top) GNSS module with an extra embedded function for external antenna I/O. It comes with an automatic antenna switching function and also features an antenna system called “Antenna Advisor” that helps with the detection and notification of different antenna statuses, including active antenna connection; it is one of the smallest MediaTek-based modules in the world, for it has an ultra-compact size of 12.5 x 12.5 x 6.8 mm in a QFN Package. This ultra-compact module provides multiple interfaces such as SPI, and UART, and its unique design of SMPS is capable of reducing power consumption to a great extent.

The XA1110 is built based on MediaTek’s new generation of GNSS Chipset MT3333. It supports up to 210 PRN channels with 99 search channels and 33 simultaneous tracking channels. With support of QZSS, SBAS (WAAS, EGNOS, MSAS), QZSS and AGPS, the XA1110 can provide even more accurate positioning. Its *Tone Active Interference Canceller* is capable of removing 12 active noise sources which provides more flexibility in system design.

The XA1110 is integrated along with power management and many advanced features, including AlwaysLocate™, EASY™, EPO™, PPS sync NMEA and LOCUS™ (internal logger). It is suitable for power sensitive devices especially for portable applications.

Potential Applications

- Handheld Devices
- M2M applications
- Asset management
- Surveillance systems
- Wearable products

Figure 1-1: XA1110

Product Highlights and Features

- 33 tracking/ 99 acquisition-channel GPS +GLONASS receiver
- Supports QZSS & SBAS(WAAS, EGNOS, MSAS, GAGAN)[1]
- Sensitivity: -165dBm
- Update Rate: up to 10Hz[2]
- 12 multi-tone active interference canceller[2]
- High accuracy 1-PPS timing (±20ns RMS) and the pulse width is 100ms
- AGPS Support for Fast TTFF (EPO in flash™; choose from 7, 14 or 30 days)
- EASY™: Self-Generated Orbit Prediction for instant positioning fix[3]
- AlwaysLocate™ Intelligent Algorithm (Advance Power Periodic Mode) for power saving[3]
- PPS sync NMEA[3]
- LOCUS (Embedded Logger Function)
- Automatic antenna switching function
- Antenna Advisor function
- Support interface types: I2C/ SPI/ UART (configuration)
- Consumption current(@3.3V):
- For GPS+GLONASS
  - Acquisition: 24mA/ 27mA /30mA (min / typical / max)
  - Full Power Tracking: 21mA / 23mA /28mA (min / typical / max)
- RoHS compliant

1. GAGAN will be supported upon its starting date of service.
2. SBAS can only be enabled when update rate is equal or less than to 5Hz.
3. The features need customized firmware or command programming handled by the customer. Please refer to our “PMTK Command List”.

System Block Diagram

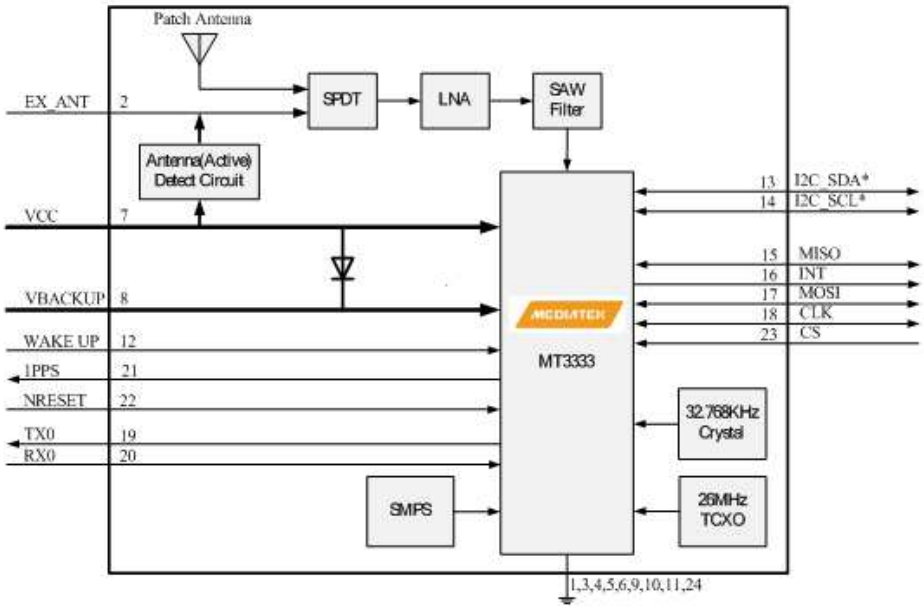

*Figure 1-2: System Block Diagram. *I2C Disable in XA1110 by Default,Keep pin floating.*

Multi-tone Active Interference Canceller

Navigation systems often integrate with variant applications that are not limited to Wi-Fi, GSM/GPRS, 3G/4G, Bluetooth. Such systems often generate RF harmonics which would influence the GPS reception and performance.

The embedded Multi-tone Active Interference Canceller (MTAIC) can reject unwanted RF harmonics of the nearby on-board active components. MTAIC improves the capacity of GPS reception, eliminating the need for hardware integration engineering to make hardware changes. The XA1110 cancels up to 12 independent channels continuous interference wave.

1PPS

The XA1110 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 ±20ns RMS(Root Mean Square). The PPS signal is provided through a designated output pin for many external applications. The pulse is not only limited to being active every second but is also allowed to set up the required duration, frequency, and active high/low through a programmable user-defined setting.

AGPS for faster TTFF (EPO in flash™)

The AGPS (EPO in flash™) provides predicated EPO (Extended Prediction Orbit) data to speed up TTFF (Time To First Fix). This feature is useful when a satellite signal is weak. AGPS can be downloaded from an FTP server via the Internet or through a wireless network. The GPS engine in the module will apply EPO data to assist with position calculation when navigation information from satellites is insufficient. For more details on EPO, please contact us.

EASY™

EASY™ (Embedded Assist System) is for quick positioning/TTFF when information received from the satellites is insufficient (weak signal). When EASY™ is enabled, the GPS engine will automatically calculate and then predict single ephemeris up to three days. The predicted information will be saved into the memory and the GPS engine will then use the saved information for later positioning. Backup power (VBACKUP) is required for EASY™.

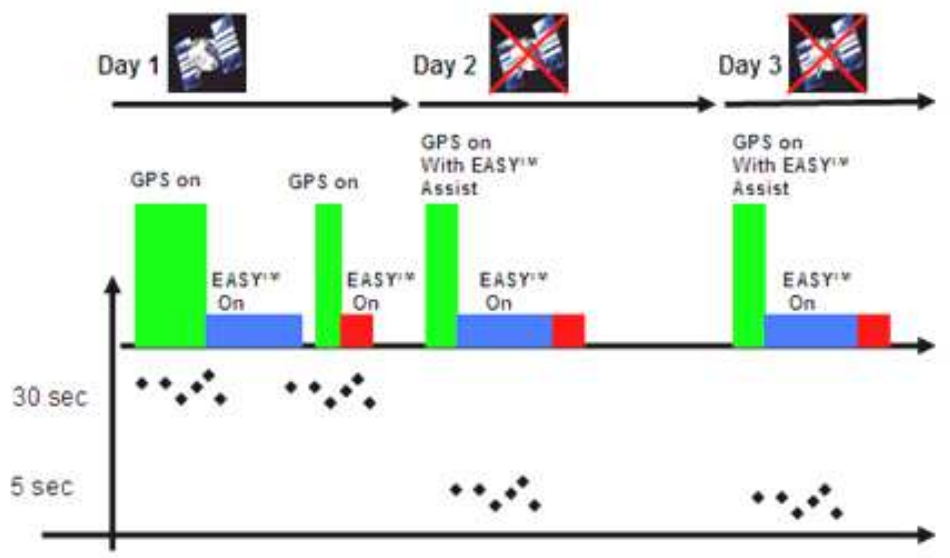

Figure 1-3: Operation of EASY™

When the module obtains information from GPS satellites, the GPS engine will start to pre-calculate and predict orbits automatically for three days.

AlwaysLocate™

In *AlwaysLocate*™ mode, the on/off time can be adjusted adaptively to achieve balance between positioning accuracy and power consumption depending on environmental or motion conditions.

Figure 1-4 gives some insight on power saving in different cases when AlwaysLocate™ mode is enabled. For command detail, please contact Sierra Wireless sales staff.

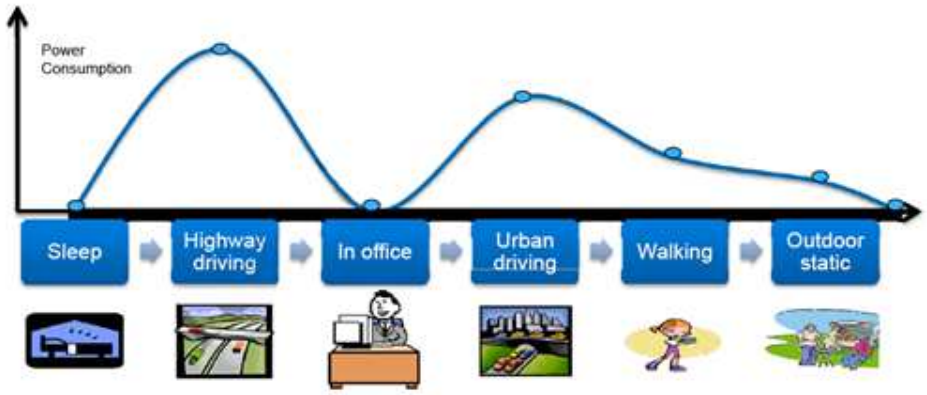

Figure 1-4: AlwaysLocatie

LOCUS

When LOCUS (Embedded Logger Function) is enabled, the receiver module will become a logger-capable device. It does not need any host or external flash data format such as UTC, latitude, longitude, valid or checksum for GPS data logging. The maximum log duration is up to two days under AlwaysLocate™.

PPS sync NMEA

Pulse-Per-Second (PPS) VS. NMEA can be used in the time service. The latency range of the beginning of UART Tx is between 465ms~485 ms at the MT3333 platform and behind the rising edge of PPS.

The PPS sync NMEA only supports 1Hz NMEA output and baud rate at 115200~14400 bps. For baud rates at 9600 bps and 4800 bps, only the 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.

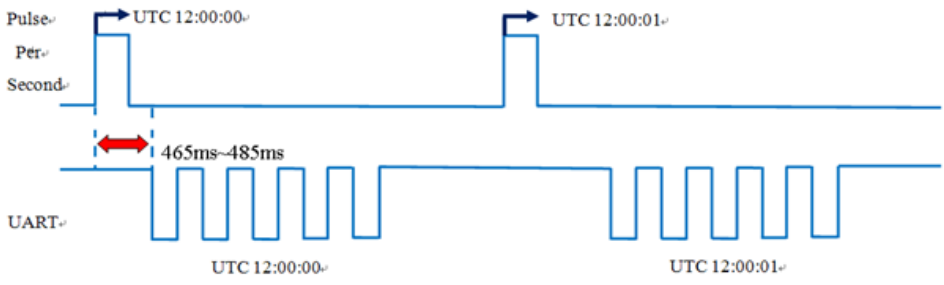

Figure 1-5: PPS sync NMEA

Antenna Advisor

“Antenna Advisor” is a brand new antenna system available exclusively for the XA1110. It is designed to detect and notify antenna status using software (through a proprietary protocol as described below in Antenna Status Protocol (Antenna Advisor)).

Antenna Advisor can detect and notify the following:

- Using Internal Antenna
- Using External Active Antenna

2: Specifications

Mechanical Dimensions

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

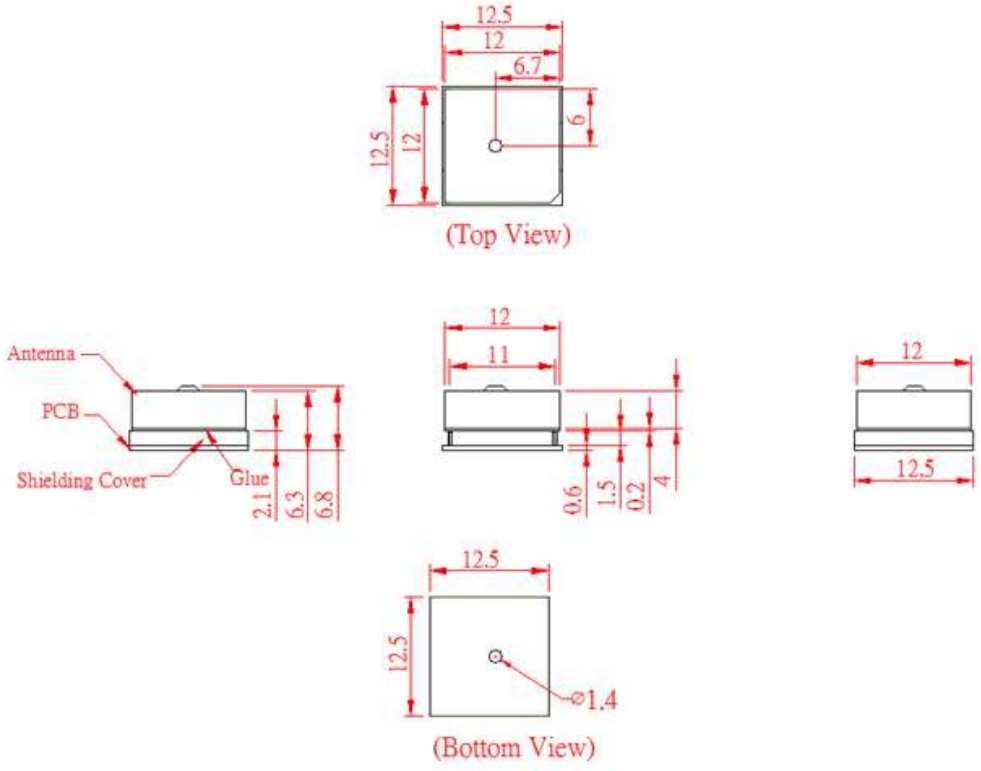

Figure 2-1: Mechanical Dimensions

Recommended PCB Pad Layout

(Unit: mm, Tolerance: 0.1mm)

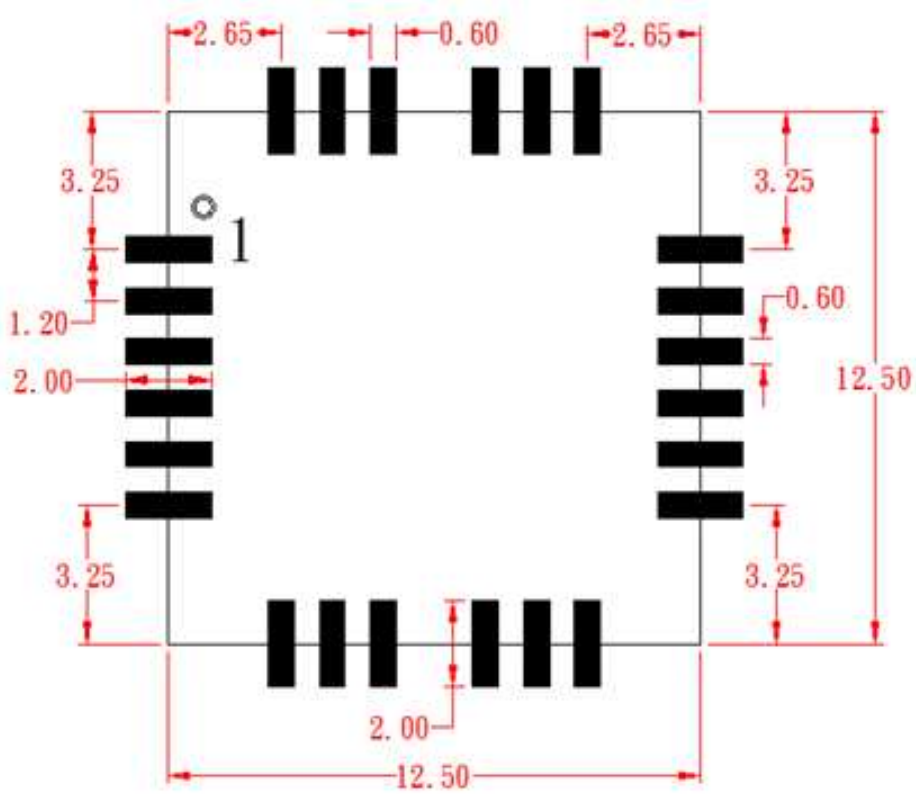

Figure 2-2: PCB Layout

Pin Configuration

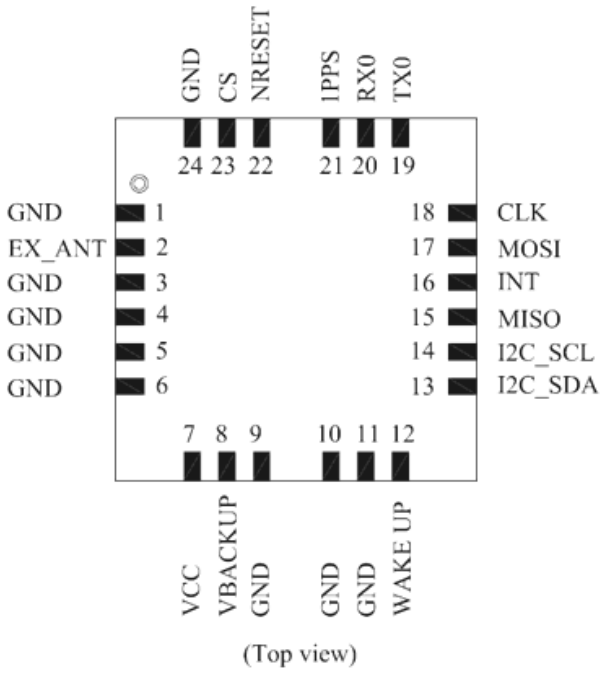

*Figure 2-3: Pin Configuration. *I2C_SCL and I2C_SDA disabled by firmware in XA1110.Keep the pins floating.*

Pin Assignment

Table 2-1: Pin Assignment

Pin	Name	I/O	Description and Note
1	GND	P	Ground
2	EXT_ANT	I PO	External active antenna RF input DC power from VCC and provide for external active antenna
3	GND	P	Ground
4	GND	P	Ground
5	GND	P	Ground
6	GND	P	Ground
7	VCC	PI	Main DC power input
8	VBACKUP	PI	Backup power input for RTC & navigation data keep
9	GND	P	Ground
10	GND	P	Ground

Table 2-1: Pin Assignment

Pin	Name	I/O	Description and Note
11	GND	P	Ground
12	WAKE UP	PI	Wake up from power saving, High Active
13	I2C_SDA[a]	I/O	I2C Serial data (in slave mode)
14	I2C_SCL[a]	I	I2C Serial clock (in slave mode)
15	MISO	O	SPI serial data output (in slave mode)
16	INT	O	Interrupt pin for SPI or I2C
17	MOSI	I	SPI serial data input (in slave mode)
18	CLK	I	SPI serial clock
19	TX0	O	Serial Data Output for NMEA output (TTL)
20	RX0	I	Serial Data Input for Firmware update (TTL)
21	1PPS	O	1PPS Time Mark Output 2.8V CMOS Level (Optional: pulse width can be customized)
22	NRESET	I	Reset Input, Low Active
23	CS	I	SPI serial chip select
24	GND	P	Ground

a. Disabled by default, please keep the pins floating.

Description of I/O Pins

- **Pin1**: GND (Ground)
- **Pin2**: EX_ANT
  - When a 4mA or higher current is detected, the detect circuit will acknowledge the external antenna as being present and will use the external antenna for reception. In the event of a short circuit occurring at the external antenna, the module will limit the drawn current to a safe level. DC power from VCC will be provided for the external active antenna (Recommended voltage: 3.3V).
- **Pin3**: GND (Ground)
- **Pin4**: GND (Ground)
- **Pin5**: GND (Ground)
- **Pin6**: GND (Ground)
- **Pin7**: VCC
  - Main DC power supply (3.0V to 4.3V; typical: 3.3V). The ripple must be controlled under 50mVpp.
- **Pin8**: VBACKUP
  - This connects to the backup power of the GNSS module. A power source (such as a battery) connected to this pin will help the GNSS chipset in keeping its internal RTC running when the main power source is turned off. The voltage ranges from 2.0V~4.3V (typical: 3.0V).

- If VBACKUP power is not reserved, the GNSS module will perform a lengthy cold start each time whenever it is powered on, as previous satellite information is not retained and needs to be re-transmitted.
- If not used, keeps this pin floating.

- **Pin9**: GND (Ground)
- **Pin10**: GND (Ground)
- **Pin11**: GND (Ground)
- **Pin12**: WAKE UP.
  - Active on High will wake up the module from backup (power-saving) mode.

Table 2-2: WAKE UP

Symbol	Min(V)	Typ(V)	Max(V)
Low	--	0	--
High	1.2	2.8	3.4

The command is recommended with the PMTK225 command for power saving. Please refer to our “PMTK Command List”.

- **Pin13**: I^2C_SDA[1] (I^2C; outputs GPS information/RTCM_TX)
- **Pin14**: I^2C_SCL[1] (RTCM_RX)
  - This pin can be modified through firmware customization.
  - The *default* of this pin is defined to I^2C_SCL[1]. It will receive the clock for I^2C application.
  - If the pin is customized to RTCM, it will receive DGPS/RTCM (TTL level).
  - If not used, keep this pin floating.
- **Pin15**: MISO (SPI; outputs GPS information)
- **Pin16**: INT
  - This is the interrupt sync. It is used to determine whether NMEA is stored in SPI/ I^2C buffer.
  - If NMEA data is ready and stored in SPI/ I^2C[1] buffer, the pin will pull low.
  - After entire NMEA packet of one second is read, the pin will pull high.
- **Pin17**: MOSI (SPI; to receive commands from system)
- **Pin18**: CLK (SPI; to receive clock time from system)
- **Pin19**: TX0 (UART 0 transmitter; outputs GPS information for application)
- **Pin20**: RX0 (UART 0 receiver; to receive commands from system)
- **Pin21**: 1PPS
  - This pin provides one pulse-per-second signal output. If not used, keeps this pin floating.
- **Pin22**: NRESET
  - **Active** on Low for the module to reset. If not used, keep this pin floating.

Table 2-3: NRESET

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

1. Disabled by default, please keep the pins floating.

- **Pin23**: CS (SPI; to select chip for system)
  - Active on Low to enable SPI
- **Pin24**: GND (Ground)

Specifications

Table 2-4: Specification Data

Description	
GNSS Solution	MTK MT3333[a]
Frequency	GPS L1, 1575.42MHz GLONASS L1, 1598.0625~1605.375MHz
Sensitivity (GPS portion)	Acquisition: -148dBm, cold start Reacquisition: -163dBm, Hot start Tracking: -165dBm
SV Number GPS GLONASS	#1~32 #65~96 (see Chapter 3 for details)
TTFF (GPS, No. of SVs>4, C/ N>40dB, PDop<1.5)	Hot start: 1 second typical Warm start: 33 seconds typical Cold start: 35 seconds typical, 60 seconds Max
Position Accuracy	Without aid:3m (50% CEP) DGPS(SBAS(WAAS,EGNOS,MSAS, GAGAN [b])):2.5m (50% CEP)
Velocity Accuracy	Without aid: 0.1m/s DGPS(SBAS(WAAS,EGNOS,MSAS, GAGAN [b])):0.05m/s
Timing Accuracy (1PPS Output)	Default: ±20ns RMS within 100ms in one pulse (pulse width/duration can be customized)
Altitude	10,000m maximum (Normal mode: car/pedestrian/ aviation) 80,000m maximum (Balloon mode)
Velocity	Maximum 515m/s (1000 knots) [c]
Acceleration	Maximum 4G
Update Rate	1Hz (default), maximum 10Hz
Baud Rate	9600 bps (default)
DGPS	SBAS (default) [WAAS, EGNOS, MSAS, GAGAN [b]]
Power Supply	VCC: 3V to 4.3V; VBACKUP: 2.0V to 4.3V
Current Consumption @ 3.3V,1Hz Update Rate	GPS+GLONASS Acquisition: 24mA/ 27mA /30mA (min / typical / max) Full Power Tracking: 21mA / 23mA / 28mA (min / typical / max) GLP (GNSS Low-power) Tracking : 7mA / 16mA / 32mA (min / typical / max)
Backup Power Consumption@ 3V	15uA (TYP)
Power Saving (Periodic)	Backup mode: 1.2mA (TYP) [d] Standby mode: 1.5mA (TYP) [d]
NRESET Current @ 3.3V	8mA (TYP)
Working Temperature	-40 °C to +85 °C

Table 2-4: Specification Data

Description	
Dimension	12.5x12.5 x 6.8 mm, SMD
Weight	4g

a. RTCM disabled by default on XA1110
b. GAGAN will be supported
c. The number was simulated from lab test
d. Please refer to PMTK 161 / 225

Absolute Maximum Ranges

The maximum power supply voltage is 4.3.

Table 2-5: Maximum Ranges

	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

Operating Conditions

Table 2-6: Operating Conditions

	Condition	Min.	Typ.	Max.	Unit
Operation Supply Ripple Voltage	-	-	-	50	mVpp
RX0 TTL H Level	-	2.0	-	3.3	V
RX0 TTL L Level	-	0	-	0.8	V
TX0 TTL H Level	-	2.4	-	2.8	V
TX0 TTL L Level	-	0	-	0.4	V

3: Protocols

NMEA Output Sentences

Table 3-1 lists all NMEA output sentences specifically developed and defined by MTK for MTK's products.

Table 3-1: Position Fix Indicator

Option	Description
GGA	Time, position and fix type data.
GSA	GNSS 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. The recommended minimum navigation information.
VTG	Course and speed information relative to the ground.

Table 3-2 lists NMEA output sentences used in GPS system and GLONASS system

Table 3-2: NMEA Output Sentence for GPS and GNSS

System	GGA	GSA	GSV	RMC	VTG
GPS	GPGGA	GPGSA	GPGSV	GPRMC	GPVTG
GNSS (GPS+GLONASS)	GNGGA	GPGSA GLGSA	GPGSV GLGSV[a]	GNRMC	GNVTG

a. In Talker ID, GP is a short term of "GPS"; GL is "GLONASS" and GN is "GPS +GLONASS"

GGA—Time, Position and Related Data of Navigation Fix

Table 3-3 explains the NMEA sentence below:

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

Table 3-3: GGA Data Format

Name	Example	Units	Description
Message ID	$GNGGA		GGA protocol header
UTC Time	064951.000		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm

Table 3-3: GGA Data Format

Name	Example	Units	Description
N/S Indicator	N		N North or S South
Longitude	12016.4448		dddmm.mmmm
E/W Indicator	E		E East or W West
Position Fix Indicator	1		See Table 3-4
Satellites Used	8		
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 3-4: Position Fix Indicator

Value	Description
0	Fix not available
1	GPS Fix
2	Differential GPS Fix

*Note: when inputting the command $PMTK353,0,1,0,0,0*2A, $GNGGA will change to $GLGGA (For GLONASS). When inputting the command $PMTK353,1,0,0,0,0*2A, $GNGGA will change to $GPGGA (For GPS).*

GSA—GNSS DOP and Active Satellites, Including GPS(GPGSA) and GLONASS(GLGSA)

Table 3-5 explains the example NMEA sentence below:

GPS satellite system:

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

GPS+GLONASS satellite system:

```
$GPGSA,A,3,08,28,20,04,32,17,11,,,,,,1.00,0.63,0.77*1B (GPS
satellite)
$GLGSA,A,3,77,76,86,78,65,88,87,71,72,,,,1.00,0.63,0.77*17
(GLONASS satellite)
```

Table 3-5: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGSA, or $GLGSA		GSA protocol header
Mode 1	A		See Table 3-6
Mode 2	3		See Table 3-7
Satellite Used [a]	8		SV on Channel 1
Satellite Used	28		SV on Channel 2
....	….	….	....
Satellite Used			SV on Channel 12
PDOP	1		Position Dilution of Precision
HDOP	0.63		Horizontal Dilution of Precision
VDOP	0.77		Vertical Dilution of Precision
Checksum	*1B		
<CR> <LF>			End of message termination

a. GPS SV No. #01~#32
GLONASS SV No. #65~#96

Table 3-6: Mode 1

Value	Description
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowing to switch to 2D/3D mode automatically

Table 3-7: Mode 2

Value	Description
1	Fix not available
2	2D (<4 SVs used)
3	3D (>=4 SVs used)

GSV— Satellites in View, Including GPS(GPGSV) and GLONASS(GLGSV)

Table 3-8 explains the example NMEA sentences below:

```
$GPGSV,4,1,14,28,75,321,44,42,54,137,39,20,53,080,44,17,40,330,44*77
```

```
$GPGSV,4,2,14,04,33,253,43,32,28,055,41,08,26,212,40,11,14,055,33*7F
```

```
$GPGSV,4,3,14,10,12,198,,07,06,179,38,23,04,125,44,27,02,314,*7E
```

```
$GPGSV,4,4,14,193,,,42,01,,,36*45
```

Table 3-8: GPGSV 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) [a]
Message Number	1		
Satellites in View	14		
Satellite ID	28		Channel 1 (Range 1 to 32)
Elevation	75	degrees	Channel 1 (Maximum 90)
Azimuth	321	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	44	dB-Hz	Range 0 to 99, (null when not tracking)
....	….	….	....
Satellite ID	17		Channel 4 (Range 1 to 32)
Elevation	40	degrees	Channel 4 (Maximum 90)
Azimuth	330	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	44	dB-Hz	Range 0 to 99, (null when not tracking)

Table 3-8: GPGSV Data Format

Name	Example	Units	Description
Checksum	*77		
<CR> <LF>			End of message termination

a. One GSV sentence can only receive up to 4 SVs

Table 3-9 explains the example NMEA sentences below:

```
$GLGSV,4,1,15,72,45,084,40,77,39,246,44,87,36,014,44,65,33,1
57,36*62
```

```
$GLGSV,4,2,15,78,26,306,41,88,23,315,42,76,15,192,38,86,13,0
67,38*64
```

```
$GLGSV,4,3,15,71,12,035,38*54
```

Table 3-9: GLGSV Data Format

Name	Example	Units	Description
Message ID	$GLGSV		GSV protocol header
Number of Messages	4		(Depending on the number of satellites tracked, multiple messages of GSV data may be required)[a]
Message Number	1		
Satellites in View	15		
Satellite ID	72		Channel 1 (Range 1 to 32)
Elevation	45	degrees	Channel 1 (Maximum 90)
Azimuth	84	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	40	dB-Hz	Range 0 to 99, (null when not tracking)
....	….	….	....
Satellite ID	44		Channel 4 (Range 1 to 32)
Elevation	65	degrees	Channel 4 (Maximum 90)
Azimuth	157	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	36	dB-Hz	Range 0 to 99, (null when not tracking)
Checksum	*62		
<CR> <LF>			End of message termination

a. One GSV sentence can only receive up to 4 SVs

RMC—Recommended Minimum Navigation Information

Table 3-10 explains the example NMEA sentence below:

```
$GNRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260
406,3.05,W,A*2C
```

Table 3-10: RMC Data Format

Name	Example	Units	Description
Message ID	$GNRMC		RMC protocol header
UTC Time	064951.000		hhmmss.sss
Status	A		A: data valid V: data not valid
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N: North S: South
Longitude	12016.44		dddmm.mmmm
E/W Indicator	E		E: East W: West
Speed over Ground	0.03	Knots/hr	
Course over Ground	165.48	degrees	TRUE
Date	260406		ddmmyy
Magnetic Variation	3.05, W	degrees	E: East W: West (By Customization)
Mode	A		A: Autonomous mode D: Differential mode E: Estimated mode
Checksum	*2C		
<CR> <LF>			End of message termination
Message ID	$GNRMC		RMC protocol header