AirPrime XA1100

Product Technical Specification

SIERRA WIRELESS®

41111209
Rev 6.0

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 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 5:00 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.
2	January 19, 2018	Updates throughout.
3.0	March 09, 2018	Updated: • No connect pins to Left Open • Figure 4-1 on page 24 • Packaging and Handling (Tape Reel) on page 25
3.1	March 13, 2018	Updated Packaging and Handling (Tape Reel) on page 25
4.0	April 24, 2018	Updated: • Pin Assignment on page 14 • Figure 5-4 on page 27
4.1	May 03, 2018	Fixed typo in Drying on page 28
5.0	September 26, 2018	Updated Specifications on page 12
5.1	October 02, 2018	Updated Table 3-4 on page 20

Revision number	Release date	Changes
6.0	February 18, 2019	Updated Figure 2-2 on page 13
		Deleted: • section 5 Packing and Handling • section 6 Reflow Soldering Temperature Profile

Contents

List of Figures

List of Tables

1: Function Description

Overview

The XA1100 is a GPS module with an integrated patch antenna. It also comes with an external antenna interface that supports automatic antenna detection. It is one of the smallest GPS Antenna modules on the market with an ultra-compact size of 12.5 x 12.5 x 6.8 mm that comes in a QFN Package.

The module is integrated with SMPS (switched-mode power supply) which allows for the lowest possible power consumption while offering optimum GNSS sensitivity and performance.

The XA1100 is based on the latest MT3337E chipset and supports all standard GNSS features including QZSS, Anti-Jamming, EASY™, PPS sync NMEA, LOCUS™ and AGPS.

Target Applications

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

Figure 1-1: XA1100

Product Highlights and Features

- 22 tracking/ 66 acquisition-channel GPS receiver
- Supports QZSS
- Sensitivity: -165dBm
- Update Rate: 1Hz (default)
- 12 multi-tone active interference canceller
- High accuracy 1-PPS timing (±20ns RMS) and the pulse width is 100ms
- AGPS Support for Fast TTFF (Host Aiding EPO™)
- EASY™: Self-Generated Orbit Prediction for instant positioning fix
- PPS sync NMEA
- Consumption current (@3.3V):
- Acquisition: 20mA/ 21mA / 22mA (min / typical / max)
- Tracking: 19mA / 20mA / 25mA (min / typical / max)
- RoHS compliant

System Block Diagram

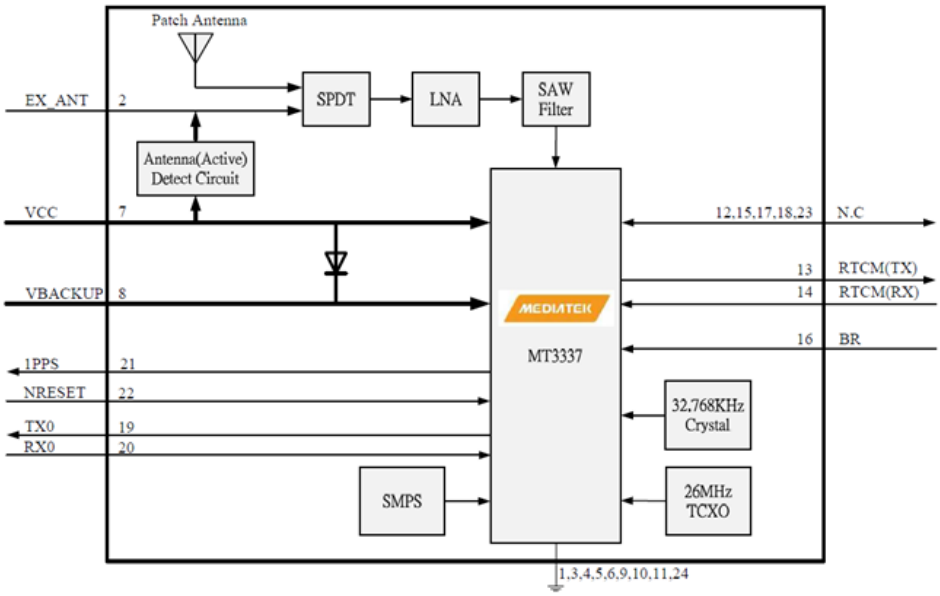

Figure 1-2: System Block Diagram

Multi-tone Active Interference Canceller

Many GNSS systems today also integrate various other RF systems such as Wi-Fi, Cellular and Bluetooth. These other radios can often generate RF harmonics which can influence GPS reception and performance.

The embedded Multi-tone Active Interference Canceller (MTAIC) also known as Anti-Jamming, can reject such unwanted RF harmonics from nearby on-board active components. Anti-Jamming can improve the capacity of GPS reception, eliminating the need for additional hardware engineering to compensate for these interferences. This built-in feature can cancel up to 12 independent channels of continuous interference waves.

1PPS

The XA1100 generates a-pulse-per-second signal (1 PPS). It is an electrical signal which precisely indicates the start of a second with an accuracy of ±20ns RMS (Root Mean Square). The PPS signal is provided through a designated output pin for external applications.

AGPS for Faster TTFF (HOST

The AGPS (HOST EPO) provides predicated EPO (Extended Prediction Orbit) data to speed up TTFF (Time To First Fix). Users can download EPO data to the GPS engine from an FTP server via the Internet or through a wireless network. The GPS engine of the module will use EPO data to assist with position calculation when navigation information from satellites is insufficient due to a weak signal.

EASY™

EASY™ (Embedded Assist System) is for quick positioning when information received from the satellites is insufficient. With EASY™ technology, the GPS engine can calculate and predict a single ephemeris automatically up to three days when the power is on. It then saves the predicted information into internal memory so the GPS engine can use this information for positioning later if information received from the satellites is insufficient. This function is useful for TTFF improvement to allow better positioning even under weak signal conditions (e.g. in dense urban areas). Backup power (VBACKUP) is required for this feature to work.

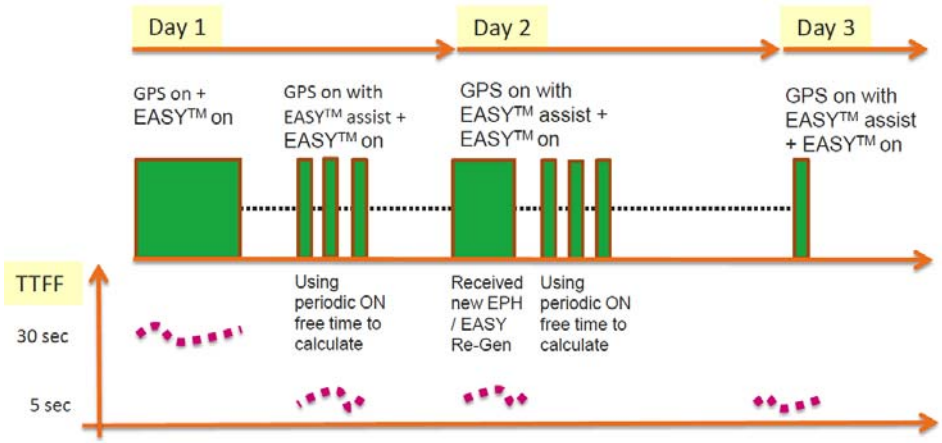

Figure 1-3: Operation of EASY™

Figure 1-3 shows that when the module obtains information from GPS satellites, the GPS engine will start to pre-calculate and predict orbits automatically for the next three days.

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 170ms to 180 ms at the MT3337(E) platform and behind the rising edge of PPS.

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

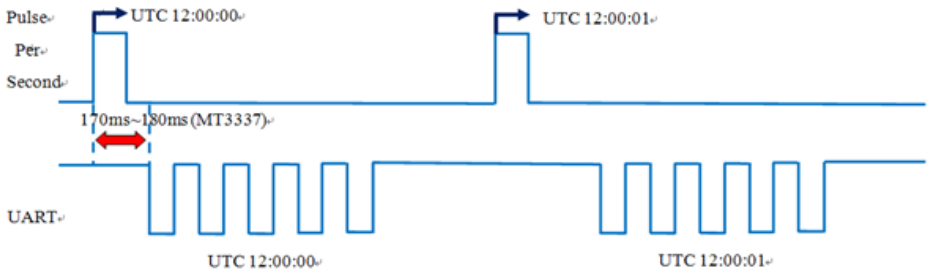

Figure 1-4: PPS sync NMEA

2: Specifications

Mechanical Dimensions

Dimension: (Unit: mm, Maximum height: 6.8 mm)

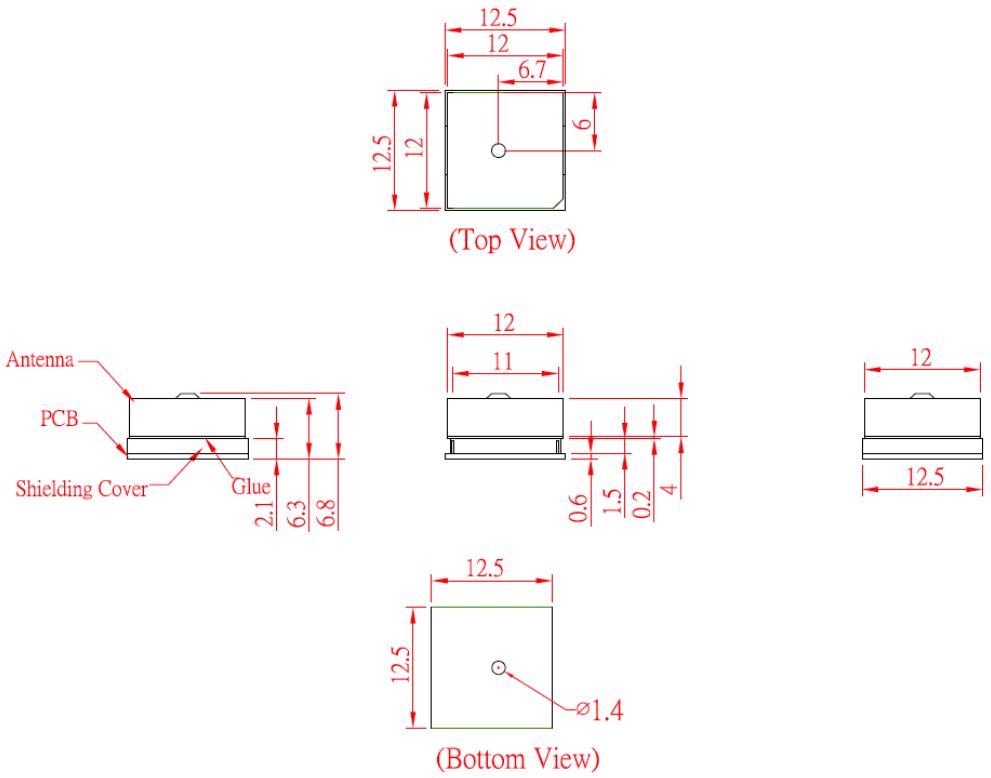

Figure 2-1: Mechanical Dimensions

PCB Copper Pad Definition

(Unit: mm, Tolerance: 0.1mm)

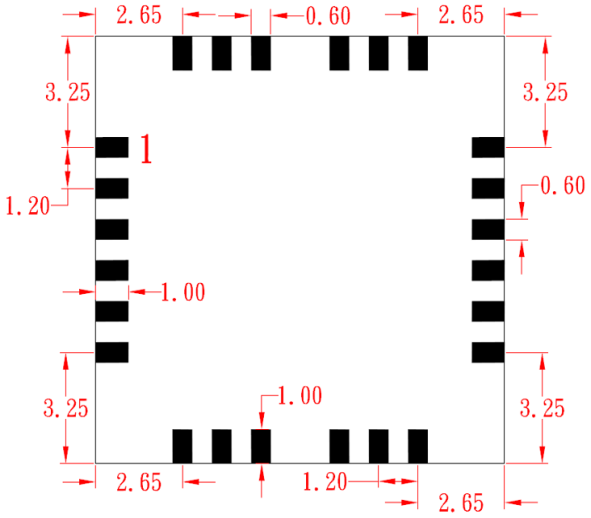

Figure 2-2: PCB Copper Pad

Pin Configuration

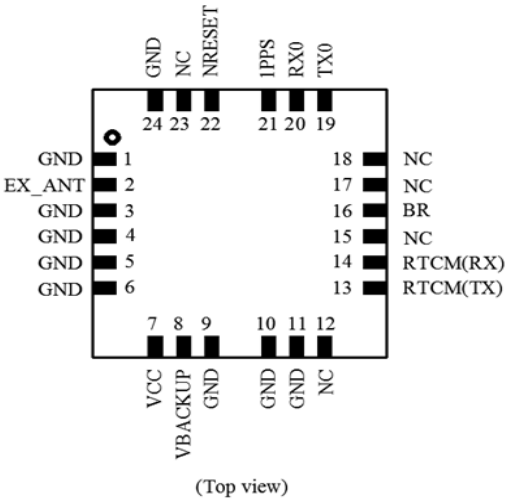

Figure 2-3: Pin Configuration

Pin Assignment

Table 2-1: Pin Assignment

Pin	Name	I/O	Description and Note	Active Low / High	IO Voltage Domain	Reset State[a]	Recommendation for Unused Pad
1	GND	P	Ground		0V		Mandatory connection
2	EX_ANT	I PO	External active antenna RF input DC power from VCC and provide for external active antenna		3.3V		
3	GND	P	Ground		0V		Mandatory connection
4	GND	P	Ground		0V		Mandatory connection
5	GND	P	Ground		0V		Mandatory connection
6	GND	P	Ground		0V		Mandatory connection
7	VCC	PI	Main DC power input		3.3V		Mandatory connection
8	VBACKUP	PI	Backup power input for RTC and navigation data keep		3.0V		Connection to C=1µF
9	GND	P	Ground		0V		Mandatory connection
10	GND	P	Ground		0V		Mandatory connection
11	GND	P	Ground		0V		Mandatory connection
12	NC	--	None connected				Left open
13	RTCM (TX)	O	Serial Data Input (TTL) for RTCM data ACK (Acknowledge Character)		2.8V	O, PU	Left open
14	RTCM (RX)	I	Serial Data Input (TTL) for RTCM data streaming		2.8V	I, PU	Left open
15	NC	--	None connected				Left open
16	BR	I	Baud Rate selection need to matchup BR		2.8V	I, PU	Left open
17	NC	--	None connected				Left open
18	NC	--	None connected				Left open
19	TX0	O	Serial Data Output for NMEA output (TTL)		2.8V	O, PU	Mandatory connection
20	RX0	I	Serial Data Input for Firmware update (TTL)		2.8V	I, PU	Mandatory connection
21	1PPS	O	1PPS Time Mark Output		2.8V	O, PU	Left open
22	NRESET	I	Reset Input	L	2.8V	I, PU	Left open

Table 2-1: Pin Assignment

Pin	Name	I/O	Description and Note	Active Low / High	IO Voltage Domain	Reset State[a]	Recommendation for Unused Pad
23	NC	--	None connected				Left open
24	GND	P	Ground		0V		Mandatory connection

a. I = Input, O = Output, PU = Pull up, PD = Pull Down, H = High, T = High Impedance

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 external the antenna for reception. 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 GPS module. A power source (such as a 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 ranges from 2.0V to 4.3V (typical: 3.0V).
  - This pin is also available when VCC is connected to a power supply.
  - VBACKUP functions with a shottky diode and limited-current resistor.
  - If VBACKUP power is not reserved, the GPS 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, keep this pin floating.
- **Pin9**: GND (Ground)
- **Pin10**: GND (Ground)
- **Pin11**: GND (Ground)
- **Pin12**: NC (Left open)
- **Pin13**: RTCM (TX). Can acknowledge the RTCM message when connected. If not used, keep this pin floating.
- **Pin14**: RTCM (RX). Can acknowledge the RTCM function when connected. If not used, keep this pin floating.
- **Pin15**: NC (Left open)

- **Pin16**: BR (Baud Rate selection is configurable and should be combined with a grounded 10KΩ resistor)

Table 2-2: Baud Rate

Baud Rate	BR (Pin16)
9600	No Connect
115200	10KΩ

- **Pin17**: NC (Left open)
- **Pin18**: NC (Left open)
- **Pin19**: TX0 (UART 0 transmitter; outputs GPS information for the application)
- **Pin20**: RX0 (UART 0 receiver; to receive commands from the system)
- **Pin21**: 1PPS
  - This pin provides one pulse-per-second signal output.
  - If not used, keep this pin floating.
- **Pin22**: NRESET
  - Active on Low will allow the module to reset.
  - If not used, keep floating.

Table 2-3: NRESET

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

- **Pin23**: NC (Left open)
- **Pin24**: GND (Ground)

Specifications

Table 2-4: Specification Data

Description	
GPS Solution	MTK MT3337(E)
Frequency	GPS L1, 1575.42MHz
Sensitivity	Acquisition: -148dBm, cold start Reacquisition: -163dBm, Hot start Tracking: -165dBm
SV Number	#1~32
TTFF (GPS, No. of SVs>4, C/N>40dB, PDOP<1.5)	Hot start: 1 second typical Warm start: 24 seconds typical Cold start: 28 seconds typical, 60 seconds Max
Position Accuracy	3m (50% CEP)
Velocity Accuracy	0.1m/s

Table 2-4: Specification Data (Continued)

Description	
Timing Accuracy (1PPS Output)	±20ns RMS within 100ms in one pulse
Altitude	10,000m maximum (Normal mode: Car/ Pedestrian/ Aviation) 80,000m maximum (Balloon mode)
Velocity	Maximum 515m/s (1000 knots)
Acceleration	Maximum 4G
Update Rate	1Hz (default)
Baud Rate	9600 bps (default), 115200 bps
Power Supply	VCC: 3V to 4.3V; VBACKUP: 2.0V to 4.3V
Current Consumption @ 3.3V,1Hz Update Rate	Acquisition: 20mA (min) / 21mA (typical) / 22mA (max) Tracking: 19mA (min) / 20mA (typical) / 25mA (max)
Power Saving (Periodic)	Standby mode: 1.6mA (TYP)
NRESET Current @ 3.3V	9mA (TYP)
Backup Power Consumption @ 3.3V	7μA (TYP)
Working Temperature	-40 °C to +85 °C
Dimension	12.5 x 12.5 x 6.8 mm, SMD
Weight	4g

Absolute Maximum Ratings

The maximum power supply voltage is 4.3 VDC.

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	-	3.3	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	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. The recommended minimum navigation information.
VTG	Course and speed information relative to the ground.

GGA—Time, Position and Related data of Navigation Fix

Table 3-2 explains the sentence below:

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

Table 3-2: 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 3-3
Satellites Used	8		
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meter	Antenna Altitude above/below mean-sea-level

Table 3-2: GGA Data Format (Continued)

Name	Example	Units	Description
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 3-3: Position Fix Indicator

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

GSA—GPS DOP and Active Satellites

Table 3-4 explains the example NMEA sentence below:

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

Table 3-4: GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 3-5
Mode 2	3		See Table 3-6
Satellite Used[a]	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

a. GPS SV No. #01~#32

Table 3-5: 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 3-6: Mode 2

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

GSV— Satellites in View

Table 3-7 explains the example NMEA sentence below:

```
$GPGSV,4,1,15,29,36,029,42,21,46,314,43,26,44,020,43,15,21,3
21,39*7D
```

```
$GPGSV,4,2,15,18,26,314,40,09,57,170,44,06,20,229,37,10,26,0
84,37*77
```

```
$GPGSV,4,3,15,07,,,26*73
```

Table 3-7: 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)[a]
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)

Table 3-7: GSV Data Format (Continued)

Name	Example	Units	Description
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

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

RMC—Recommended Minimum Navigation Information

Table 3-8 explains the example sentence below:

```
$GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406,3.05,W,A*2C
```

Table 3-8: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	064951.000		hhmmss.sss
Status	A		A: data valid V: data not valid
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N: North S: South
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E: East 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 Relating to the Ground

Table 3-9 explains the example sentence below:

`$GPVTG,165.48,T,,M,0.03,N,0.06,K,A*37`

Table 3-9: 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 Variation (By Customization)
Speed	0.03	Knots/hr	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

MTK NMEA Command Protocols

Packet Type: 103 PMTK_CMD_COLD_START

Packet Meaning: Cold Start --- Discarding the data of Time, Position, Almanacs and Ephemeris at re-start.

Example: $PMTK103*30<CR><LF>

Note: Please refer to the XM_XA Software User Guide document for more details.

4: Reference Design

This section introduces the reference schematic design for best performance. For additional design guidelines please refer to the Hardware Design Guide document for specific model.

Reference Schematic Design for Using the Active Antenna

Connect the external antenna to EX_ANT (Pin2):

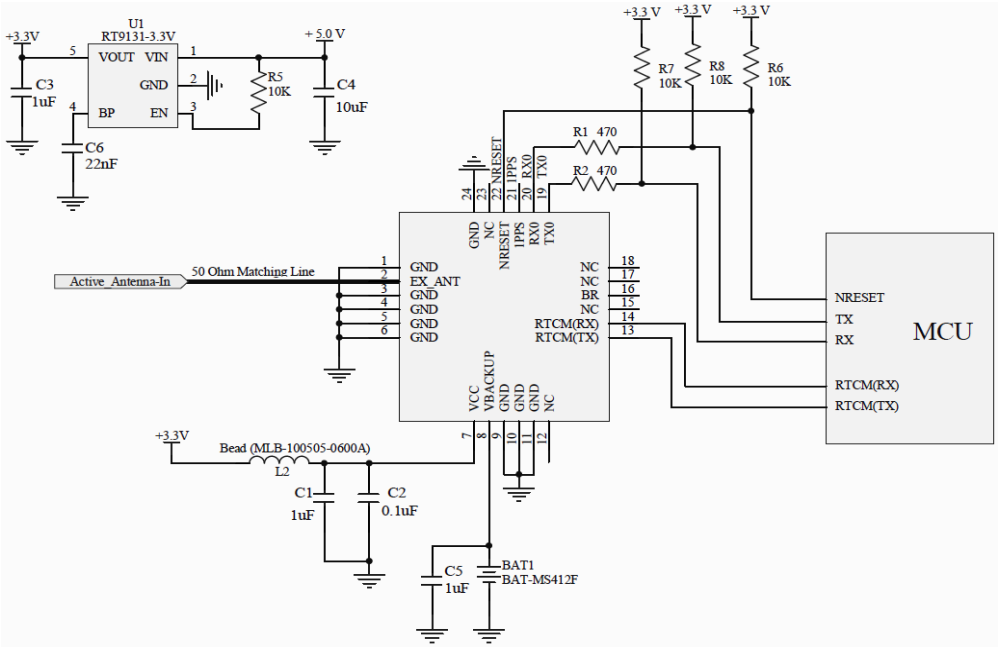

Figure 4-1: Active Antenna Application

Notes:

1. Ferrite bead L2 is added for power noise reduction. Use one with equivalent impedance (600Ω at 100MHz; IDC 200mA).
2. Place C1, C2 and C5 bypass-capacitors as close as possible to the module.
3. Damping resistors R1 and R2 can be modified based on system application for EMI.