



Product Technical Specification

AirPrime XA1100



SIERRA
WIRELESS®

41111209
Rev 1

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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.

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Revision History

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

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>> 1: Function Description

Overview

The XA1100 is a GPS module with an integrated patch antenna. It comes with an external antenna interface with automatic antenna detection. It is one of the smallest GPS Antenna modules in the world with an ultra-compact size of 12.5 x 12.5 x 6.8 mm in a QFN Package. This ultra-compact module provides a UART interface and its unique design of SMPS is capable of reducing power consumption to a great extent.

The XA1100 is based on Chipset MT3337(E). It supports up to 210 PRN channels with 66 search channels and 22 simultaneous tracking channels. With support of QZSS and AGPS, The XA1100 can provide even more accurate positioning. Its *Tone Active Interference Canceller* is capable of removing 12 active noise sources and such feature enables more flexibility in system design.

The XA1100 is integrated along with power managements and many advanced features, including EASY™, EPO™, PPS sync NMEA, and logger. It is ideally suitable for power-sensitive devices especially for portable applications.

Potential 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: up to 10Hz
- 12 multi-tone active interference canceller
- High accuracy 1-PPS timing (± 20 ns 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 NMEA²
- Consumption current (@3.3V):
- Acquisition: 20mA / 21mA / 22mA (min / typical / max)
- Tracking: 19mA / 20mA / 25mA (min / typical / max)
- RoHS compliant

System Block Diagram

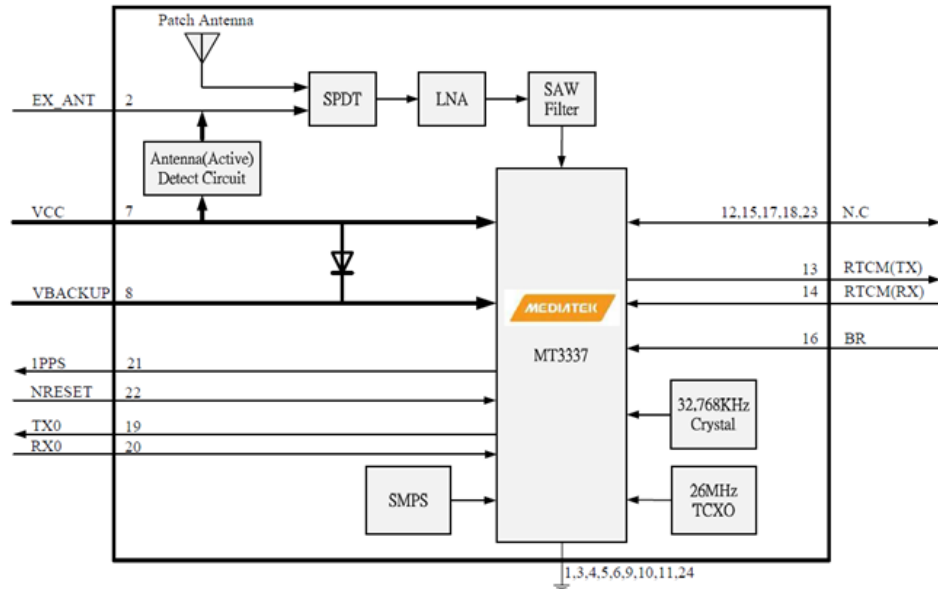


Figure 1-2: System Block Diagram

Multi-tone Active Interference Canceller

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 XA1100 cancels up to 12 independent channels continuous interference wave.

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 the accuracy of $\pm 20\text{ns}$ 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 user-defined PMTK command setting.

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 adopt 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 is able to calculate and predict a single ephemeris automatically up to three days when the power is on. It then saves the predicted information into 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 positioning even under weak signal conditions (e.g. in dense urban areas). Backup power (VBACKUP) is required for this feature.

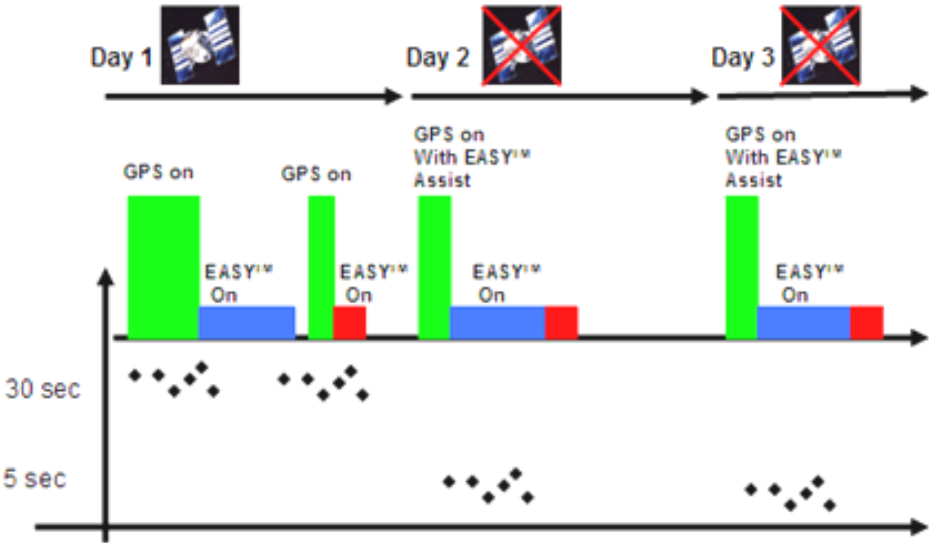


Figure 1-3: Operation of EASY™

Figure 1-3 shows that when the GPS device obtains information from GPS satellites, the GPS engine will start to pre-calculate automatically in order to predict orbits for three extended 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~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 at 115200~14400 bps. For baud rates at 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.

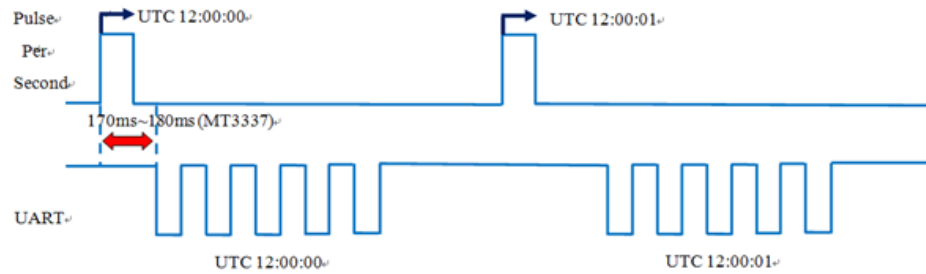


Figure 1-4: PPS sync NMEA

2: Specifications

Mechanical Dimensions

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

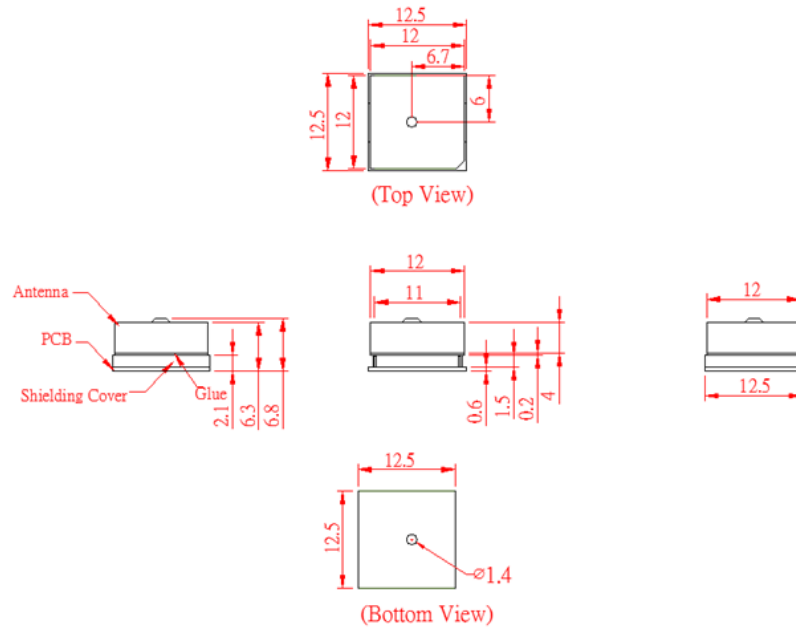


Figure 2-1: Mechanical Dimensions

Recommended PCB Pad Layout

(Unit: mm, Tolerance: 0.1mm)

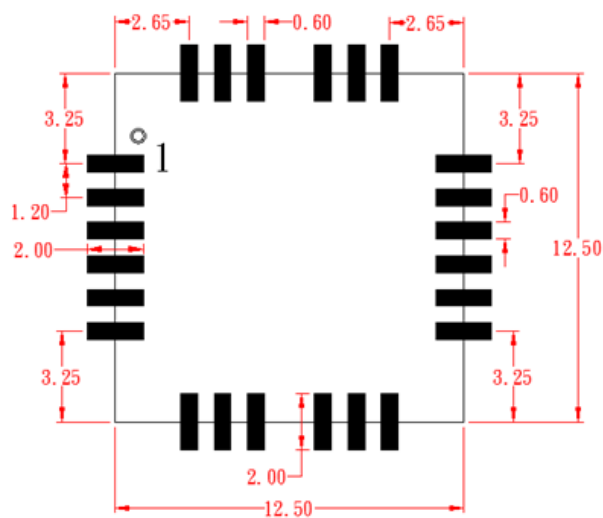


Figure 2-2: PCB Layout

Pin Configuration

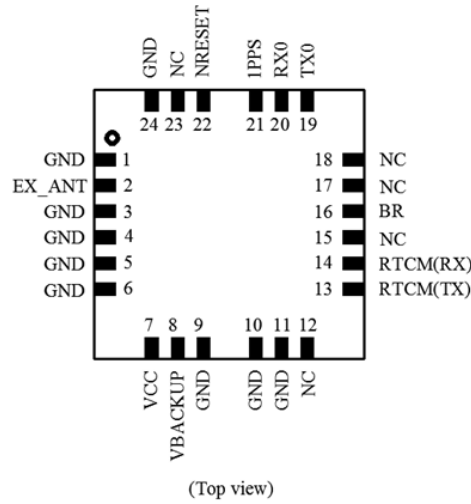


Figure 2-3: Pin Configuration

Pin Assignment

Table 2-1: Pin Assignment

Pin	Name	I/O	Description and Note
1	GND	P	Ground
2	EX_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 and navigation data keep
9	GND	P	Ground
10	GND	P	Ground
11	GND	P	Ground
12	NC	--	None Connect
13	RTCM(TX)	O	Serial Data Input (TTL) for RTCM data ACK (Acknowledge Character)
14	RTCM(RX)	I	Serial Data Input (TTL) for RTCM data streaming
15	NC	--	None Connect

Table 2-1: Pin Assignment

Pin	Name	I/O	Description and Note
16	BR	I	Baud Rate selection need to matchup BR
17	NC	--	None Connect
18	NC	--	None Connect
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 (PPS setting can be configure by PMTK command) ^a
22	NRESET	I	Reset Input, Low Active
23	NC	--	None Connect
24	GND	P	Ground

a. Please refer to PMTK Command 285.

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. 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 and will be provided for thte 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~4.3V (typical: 3.0V).
 - 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, keeps this pin floating.
- **Pin9:** GND (Ground).
- **Pin10:** GND (Ground).
- **Pin11:** GND (Ground).
- **Pin12:** NC (None Connect).

- **Pin13:** RTCM (TX). Can ack for the RTCM message by pin connecting. If not used, keep it floating.
- **Pin14:** RTCM (RX). Can ack for the RTCM function by pin connecting. If not used, keep it floating.
- **Pin15:** NC (None Connect)
- **Pin16:** BR (Baud Rate selection is configurable through BR with combination a grounded 10K ohm resistor).

Table 2-2: Baud Rate

Baud Rate	BR (Pin16)
9600	No Connect
115200	10K Ohm

- **Pin17:** NC (None Connect).
- **Pin18:** NC (None Connect).
- **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

NRESET Level	Min(V)	Typ(V)	Max(V)
Low	0	0	1.5
High	2	3.8	3.3

- **Pin23:** NC (None Connect).
- **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
TTF (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
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) ^a
Acceleration	Maximum 4G
Update Rate	1Hz (default), maximum 10Hz
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) ^b
NRESET Current @ 3.3V	9mA (TYP)
Working Temperature	-40 °C to +85 °C
Dimension	12.5 x 12.5 x 6.8 mm, SMD
Weight	4g

- a. The number was simulated from lab test
b. Please refer to PMTK Command 161

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	-	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	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	064951.00 0		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N->North or S->South
Longitude	12016.443 8		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

Table 3-2: GGA Data Format

Name	Example	Units	Description
MSL Altitude	39.9	meter	Antenna Altitude above/below mean-sea-level
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	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 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,4,1,15,29,36,029,42,21,46,314,43,26,44,020,43,15,21,321,39*7D
```

```
$GPGSV,4,2,15,18,26,314,40,09,57,170,44,06,20,229,37,10,26,084,37*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)
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 4 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 PMTK command document for details.

4: Reference Design

This section introduces the reference schematic design for best performance. Additional tips and cautions on design are well documented in the related Application Note that is available upon request.

Reference Schematic Design for Using the Active Antenna

Connect the external antenna to RF_IN (Pin2):

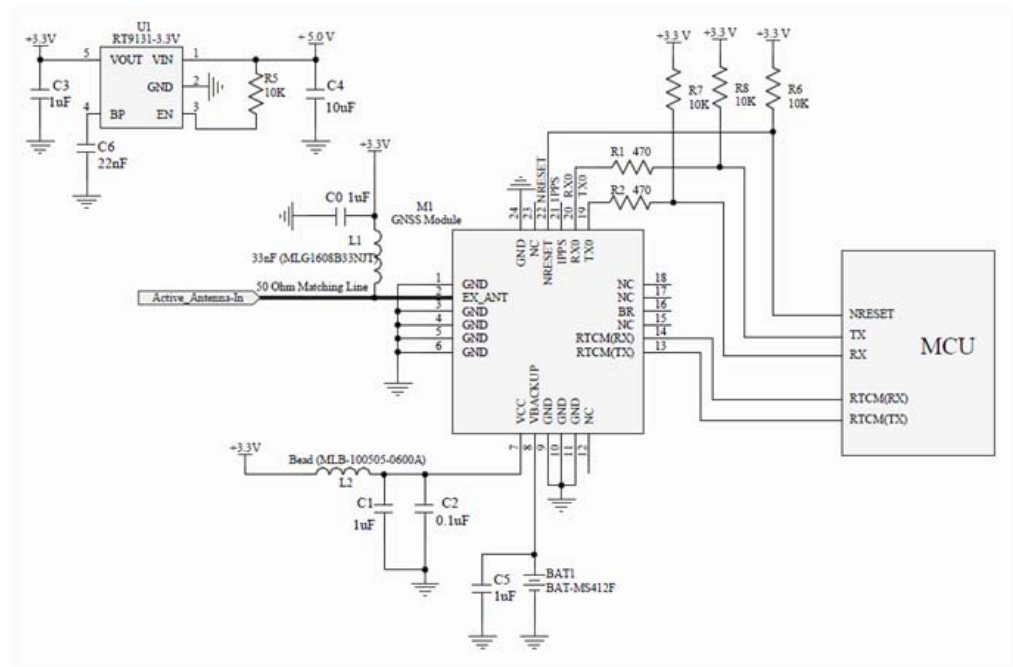


Figure 4-1: Active Antenna Application

Notes:

1. Chock coil L1 is used in electrical circuits to pass direct current and attenuate alternating current.
2. Ferrite bead L2 is added for power noise reduction. Use one with equivalent impedance (600Ω at 100MHz; IDC 200mA).
3. Place C0, C1, C2 and C5 bypass-capacitors as close as possible to the module.
4. Damping resistors R1 and R2 can be modified based on system application for EMI.

5: Packing and Handling

The XA1100, like any other SMD devices, is sensitive to moisture, electrostatic discharge and temperature. By following the standards of storage and handling outlined in this document for GNSS modules, the chances of them being damaged during production setup can be reduced. This section will walk you through the basics on how Sierra Wireless packages the modules, to ensure that the modules arrive at their destination without any damages or deterioration for performance quality. Cautionary steps prior to the surface mount process are also included in the cautionary notes.

Important: Please read the following sections carefully to avoid possible damage.

Important: GPS receiver modules are highly electrostatic-sensitive devices. Without ESD protections or without proper handling may lead to permanent damage to the modules.

Packaging and Handling (Tape Reel)

350pcs/Reel

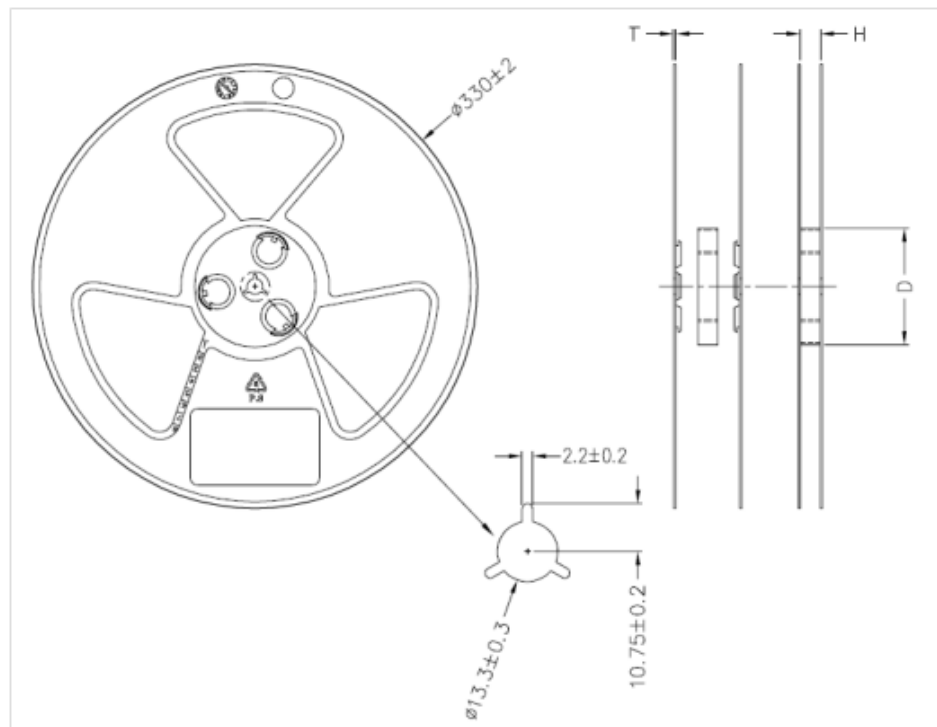


Figure 5-1: Reel Dimensions

Specs:

H: 24.5 ± 1.5 ,

T: 2.2 ± 0.2 ,

D: 99 ± 1.5

Note: 13" Reel;

Material: P.S

Unit: (mm)

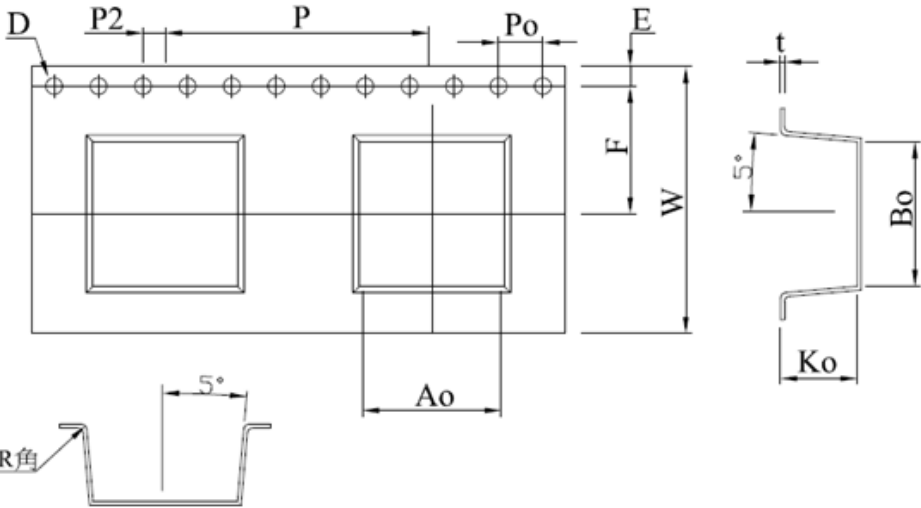


Figure 5-2: Tape Dimensions

Specs:

Ao 13.0 ± 0.10

Bo 13.0 ± 0.10

Ko 6.90 ± 0.10

Unit: (mm)

Storage and Floor Life Guidelines

Moisture Color Coded Card & Caution Label

The moisture color-coded card provides an insight to the relative humidity in percentage (RH). When the GPS modules are taken out, the RH level for the modules would be around or lower than 30%. A caution label is also included with each electrostatic bag.

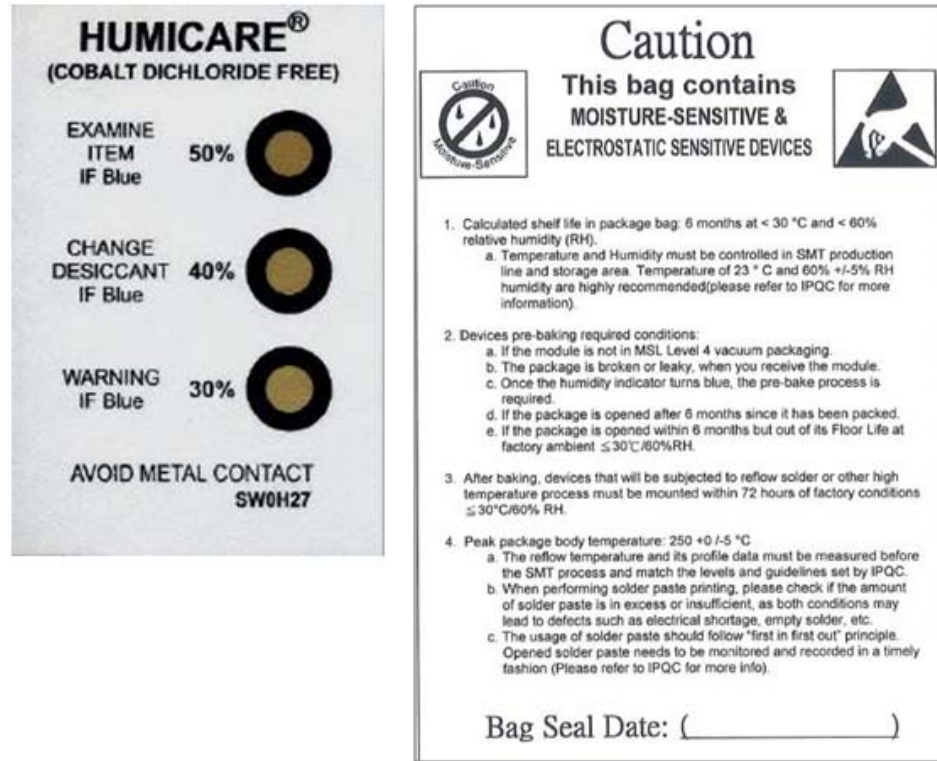


Figure 5-3: Moisture Color Coded Card and Caution Label

Sierra Wireless modules are moisture sensitive. If the package of modules has been stored under the condition of a non-condensing storage environment (<30°C; RH 60%) over 6 months, the modules will need to go through solder-reflow before SMT.

Important: Prior to solder-reflow, pre-baking will be mandatory if the modules meet any of the conditions listed below in "Conditions for Pre-baking".

Conditions for Pre-baking

Pre-baking will necessary before the modules go through the solder-reflow process, if any condition listed below is met:

1. The package of the module is broken or leaky when you receive it.
2. When the humidity indicator turns blue.
3. The package is opened six months after the module was packaged.
4. The package is opened within six months but its Floor Life at factory ambient is affected ($\leq 30^{\circ}\text{C}$; RH 60%).
5. When the MSL (Moisture Sensitivity Level) of vacuumed module package is higher than Level 4 (level 1~4 are safe; please refer to the [Figure 5-4](#) below):

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS				
			STANDARD		ACCELERATED EQUIVALENT ¹		
					eV 0.40-0.48	eV 0.30-0.39	CONDITION
TIME	CONDITION	TIME (hours)	CONDITION	TIME (hours)	TIME (hours)	CONDITION	
1	Unlimited	$\leq 30^{\circ}\text{C}/85\%$ RH	168 +5/-0	85 $^{\circ}\text{C}/85\%$ RH	NA	NA	NA
2	1 year	$\leq 30^{\circ}\text{C}/60\%$ RH	168 +5/-0	85 $^{\circ}\text{C}/60\%$ RH	NA	NA	NA
2a	4 weeks	$\leq 30^{\circ}\text{C}/60\%$ RH	696 ² +5/-0	30 $^{\circ}\text{C}/60\%$ RH	120 +1/-0	168 +1/-0	60 $^{\circ}\text{C}/60\%$ RH
3	168 hours	$\leq 30^{\circ}\text{C}/60\%$ RH	192 ² +5/-0	30 $^{\circ}\text{C}/60\%$ RH	40 +1/-0	52 +1/-0	60 $^{\circ}\text{C}/60\%$ RH
4	72 hours	$\leq 30^{\circ}\text{C}/60\%$ RH	96 ² +2/-0	30 $^{\circ}\text{C}/60\%$ RH	20 +0.5/-0	24 +0.5/-0	60 $^{\circ}\text{C}/60\%$ RH
5	48 hours	$\leq 30^{\circ}\text{C}/60\%$ RH	72 ² +2/-0	30 $^{\circ}\text{C}/60\%$ RH	15 +0.5/-0	20 +0.5/-0	60 $^{\circ}\text{C}/60\%$ RH
5a	24 hours	$\leq 30^{\circ}\text{C}/60\%$ RH	48 ² +2/-0	30 $^{\circ}\text{C}/60\%$ RH	10 +0.5/-0	13 +0.5/-0	60 $^{\circ}\text{C}/60\%$ RH
6	Time on Label (TOL)	$\leq 30^{\circ}\text{C}/60\%$ RH	TOL	30 $^{\circ}\text{C}/60\%$ RH	NA	NA	NA

Figure 5-4: Moisture Sensitivity Level Chart

Please note that the modules **must receive solder-reflow 72 hours after pre-baking**. This maximum time is otherwise known as “Floor Life”. If the waiting time exceeds 72 hours, the module may be damaged (cracks / de-lamination, etc.) during the solder-reflow process due to excessive moisture pressure.

Drying

If the modules are exposed to high temperatures in the solder-reflow process, the moisture vapor pressure inside the modules will increase greatly. To prevent delamination, cracking, or “popcorn” effect to the module, it may need to undergo the pre-baking procedure prior to any high-temperature or solder reflow process. The recommended baking time for the Sierra Wireless GPS module is: 50°C for four hours, when humidity condition RF is about 30% ~ 50%.

Once baked, the module’s floor life will “reset”, which means the module will remain in normal factory condition for next 72 hours for solder-reflow process.

Note: the “Popcorn Effect” is when the IC/module “pops” because the moisture inside the package expands in the reflow process.

Important: *Please limit the number of times that GPS modules undergo the baking process. Repeated baking processes will affect performance of wetting on the SMD pad contacts. This applies to all SMT devices.*

Important: *Risk of Oxidation: Baking SMD packages may cause oxidation and/or inter-metallic growth of terminations, which if excessive, can result in problems of solderability during board assembly. The temperature and time for baking SMD packages are therefore limited by solderability considerations. The cumulative bake time at a temperature greater than 90°C and up to 125°C shall not exceed 96 hours. Bake temperatures higher than 125°C are not allowed.*

ESD Handling

Warning: *Please follow the precautions addressed below carefully to prevent severe damage to GPS modules.*

Sierra Wireless modules are sensitive to electrostatic discharges and thus are Electrostatic Sensitive Devices (ESD). Handle the GPS modules particularly to its patch antenna (if included) and RF_IN pin carefully. Please follow the standard ESD safety practices stated below:

- Unless there is a galvanic coupling between the local GND and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- Before working with the RF_IN pin, please make sure the GND is connected.
- When working with the RF_IN pin, do not contact any charged capacitors or materials that can easily develop or store charges such as the patch antenna, coax cable, or soldering iron.
- Please do not touch the mounted patch antenna, to prevent electrostatic discharge from the RF input
- When soldering RF_IN pin, please make sure to use an ESD safe soldering iron tip.

6: Reflow Soldering Temperature Profile

The following reflow temperature profile was evaluated by Sierra Wireless and has been proven to be reliable qualitatively. Please contact us beforehand if you plan to solder this component using a deviated temperature profile as it may cause significant damage to our module and your device.

All the information in this datasheet can only be used for a Pb-free manufacturing process.

SMT Reflow Soldering Temperature Profile (For Reference Only)

Average ramp-up rate (25 ~ 150°C): 3°C/sec. max.

Average ramp-up rate (270°C to peak): 3°C/sec. max.

Preheat: 175 ± 25°C, 60 ~ 120 seconds

Temperature maintained above 217°C: 60~150 seconds

Peak temperature: 250 +0/-5°C, 20~40 seconds

Ramp-down rate: 6°C/sec. max.

Time 25°C to peak temperature: 8 minutes max.

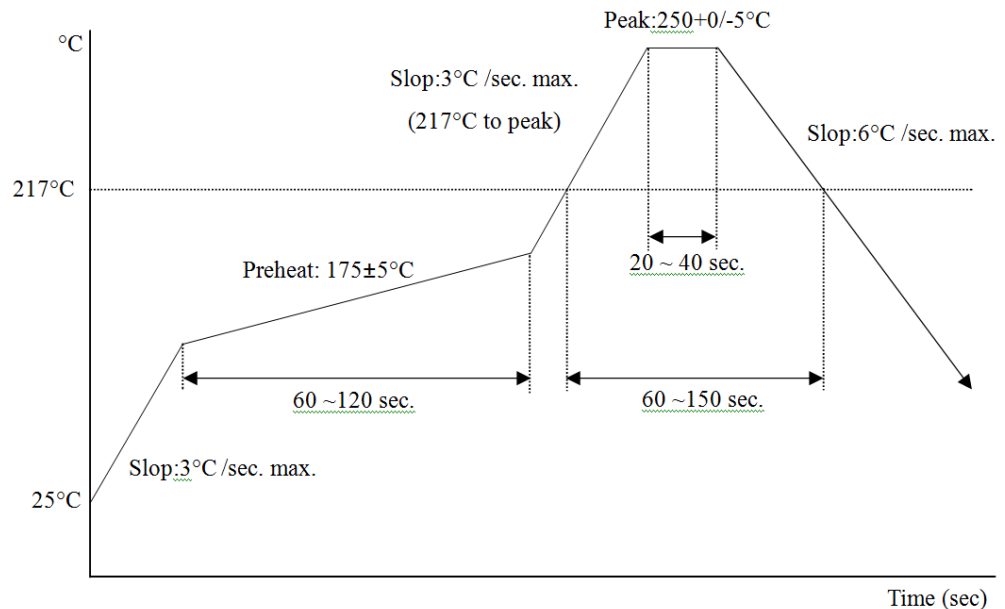


Figure 6-1: SMT Reflow Profile

Table 6-1: Procedures

	Description	Suggestions	Notes
1	Before proceeding with the reflow-soldering process, the GPS modules might need to be pre-baked. Please refer Conditions for Pre-baking .	Pre-bake Time: 4 Hours @ 50°C to 60°C.	The maximum tolerated temperature for the tray is 100°C. After pre-baking, make sure the temperature is cooled down to 35°C or below, to prevent tape and reel deformation.
2	PCBA (along with the patch antenna) is highly endothermic during the reflow-soldering process. Extra care must be paid to the GPS module's solder joints if any signs of cold welding or false welding.	The parameters of the reflow temperature must be set accordingly to module's reflow-soldering temperature profile.	Double check to see if the surrounding components around the GPS module are displaying symptoms of cold weld(ing) or false welding.
3	Special attentions to PCBA board are needed during the reflow-soldering process. See if the PCBA board is bended or deformed, possibly due to the weight of the module. If so, this will cause concerns at the latter half of the production process.	A loading carrier fixture must be used with PCBA if the reflow soldering process applies rail conveyors for the production.	If the PCBA board is bent or deformed, it may collide into one another during the unloading process.
4	Before the PCBA reflow-soldering process, the operator must check with their own eyes to see if there is a positional offset to the module, as it would be difficult to readjust after the module has gone through reflow-soldering process.	The operator must check with their own eyes and readjust the position before reflow-soldering process.	If the operator plans to readjust the module position, please do not touch the patch antenna while the module is hot in order to prevent a rotational offset between the patch antenna and module.
5	Before handling the PCBA, it must be cooled to 35°C or below after it has undergone a reflow-soldering process, in order to prevent a positional shift which may occur when the module is still hot.	1. One may use electric fans behind the reflow machine to cool them down. 2. Cooling the PCBA can prevent the module from shifting due to fluid effect.	It is very easy to cause a positional offset to the module and its patch antenna when handling the PCBA under high temperatures.

Table 6-1: Procedures

	Description	Suggestions	Notes
6	<p>1. When separating the PCBA panel into individual pieces using the V-Cut process, special attention is needed to ensure that there are sufficient gap between patch antennas.</p> <p>2. If V-Cut/cutting must be done manually, please make sure the operators are not using excessive force as that may cause a rotational offset to the patch antennas.</p>	<p>1. The blade and the patch antenna must have a distance gap greater than 0.6mm.</p> <p>2. Do not use the patch antenna as a leverage point when separating the panels by hand.</p>	<p>1. A test must first be performed to determine if the V-Cut process is going to be used. Ensure that there is enough space between the blade and the patch antenna so that they do not touch one another.</p> <p>2. An uneven amount of manual force applied to the separation will likely to cause a positional shift in the patch antenna and module.</p>
7	<p>When separating a panel into individual pieces during the latter half of the production process, special attention is needed to ensure the patch antennas do not come in contact with one another in order to prevent chipped corners or positional shifts.</p>	<p>Use a tray to separate the individual pieces.</p>	<p>It is possible to chip a corner and/or cause a shift in position if patch antennas come in contact with each other.</p>

Note: references to patch antenna are meant for GPS modules with integrated Patch antennas and may not be applicable to all GPS modules.

Other Cautionary Notes on the Reflow-Soldering Process:

1. The module may need pre-baking before going through the SMT solder reflow process. Please refer to [Conditions for Pre-baking](#).
2. The usage of solder paste should follow the “FIFO (First-in-First-out)” principle. Opened solder paste needs to be monitored and recorded in a timely manner (please refer to IPQC standards for related documentation and examples).
3. Temperature and humidity must be controlled within an SMT production line and storage area. A temperature of 23°C, 60±5% RH humidity is recommended (please refer to IPQC standards for related documentation and examples).
4. When performing solder paste printing, please notice if the amount of solder paste is excessive or insufficient, as both conditions may lead to defects such as electrical shortage, empty solder, and etc.
5. Make sure the vacuum mouthpiece is able to bear the weight of the GPS module to prevent positional shift during the loading process.
6. Before the PCBA goes through the reflow-soldering process, the operator must visually check if there is a positional offset to the module.
7. The reflow temperature and its profile data must be measured before the SMT process and match the levels and guidelines set by IPQC.
8. If the SMT protection line is running a double-sided process for PCBA, please process the GPS module during the second pass only to avoid repeated

reflow exposures of the GPS module. Please contact Sierra Wireless beforehand if you must process the GPS module during the first pass of a double-side process.

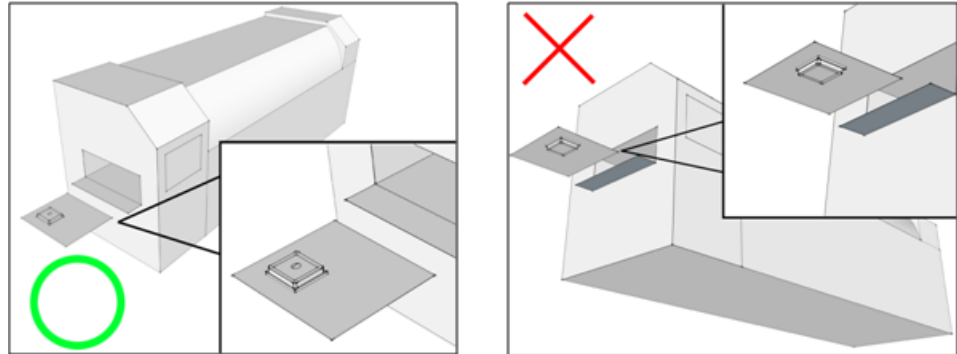


Figure 6-2: Place the GPS module top side up when running the reflow-solder process. Do not invert.

Manual Soldering

Soldering iron:

Heat temperature: under 380°C | Time: under three seconds.

Notes:

1. To prevent further oxidation, do not touch the soldering pads on the surface of the PCB board directly.
2. The solder paste must be defrosted to room temperature before use so it can return to its optimal working temperature. The time required for this procedure is unique and dependent on the properties of the solder paste used.
3. The steel plate must be properly assessed before and after use, so its measurement stays strictly within the specification set by the SOP.
4. Be cautious to the spacing between soldering joints, as excessive soldering may cause electrical shortages.
5. To avoid possible siphon effects on neighboring components which may lead to electrical shortage, do not use an extensive amount of flux.
6. Do not use the heat gun for long periods of time when removing the shielding or inner components of the GPS module, as it is very likely to cause a shift to the inner components and will lead to electrical shortages.