ST310A

GNSS Module Specification

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Contents

1 Overview

1.1 Description

ST310Ais a GNSS Module build-in high sensitivity chip on board. Featuring AIROHA single-frequency high performance and low power consumption positioning engine, ST310Aprovides excellent sensitivity and short TTFF with no host interaction needed. ST310Ais suitable for vehicle or position devices requiring for high sensitivity and need fast TTFF in weak signal environments. ST310Aprovides maximum sensitivity while maintaining low system power.

1.2 GNSS Features

- AIROHA Ultra high sensitivity -165dBm
- Supports up to 210 PRN channels
- 47 tracking/66 acquisition-channels
- Supports GPS/QZSS、SBAS、GLONASS、BDS **GAlileo**
- Supports AGPS
- Integrated TCXO,RTC
- Up to 10Hz update rate
- Standard 10*10mm 18 PINs stamp holes
- RoHS Compliant (lead-free)

1.3 Product Applications

- DVR
- PND (Portable Navigation Device)
- Vehicle navigation system
- Tracker

2 Technical Information

2.1 Supported GNSS Constellations

ST310Aare GNSS Modules and can receive/track GPS (including SBAS and QZSS), BDS / GLONASS Galileo signals. QZSS and SBAS signals (by default) can be received concurrently with GPS signals.

2.2 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 .

2.3 AlwaysLocate™

AlwaysLocate™ is an intelligent controller of periodic mode. Depending on the environment and motion conditions, GNSS module can adaptively adjust working/standby time to achieve balance of positioning accuracy and power consumption. In this mode, the host CPU does not need to control GNSS module until the host CPU needs the GPS position data. The following flow chart is an example to make GNSS module go into AlwaysLocate™ mode and then back to normal operation mode.

2.4 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 .

2.5 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 .

2.6 AIC_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 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 .ST310Acan cancel up to 12 independent channel interference continuous wave.

2.7 Augmentation Systems

2.7.1 Satellite-Based Augmentation System (SBAS)

The modules support reception of SBAS broadcast signals. These systems supplement GNSS data with additional regional or wide area GPS augmentation data. The system broadcasts range correction and integrity information via satellite which can be used by GNSS Modules to improve resulting precision. SBAS satellites can be used as additional satellites for ranging (navigation, further enhancing availability. The following SBAS types are supported: GAGAN, WAAS, EGNOS and MSAS.

2.7.2 QZSS

The Quasi-Zenith Satellite System (QZSS) is a navigation satellite overlay system for the Pacific region covering Japan and Australia which transmits additional GPS L1C/A signals. ST310Apositioning modules are able to receive and to track these signals simultaneously with GPS, resulting in better availability, especially under bad signal conditions e.g. in urban canyons.

2.8 Protocols and interfaces

Protocol	Type
NMEA 0183	Input/output, ASCII, 0183, 2.3 (compatible to 3.0)
RTCM	Input message, 1, 2, 3, 9

Table : Available Protocols

2.9 Clock generation

2.9.1 Oscillators

ST310AGNSS modules use TCXO versions which allows accelerated weak signal acquisition, enabling faster start and re-acquisition times rather than crystal versions.

Oscillators used on ST310Amodules are carefully selected and screened for stability and against frequency perturbations across the full operating range (–40° to +85°C. The careful selection and qualification of critical parts, such as GNSS oscillators, has resulted in GNSS modules being the most reliable positioning modules in the industry, particularly in challenging conditions.

2.9.2 Real-Time Clock (RTC

The RTC is driven by a 32 kHz oscillator using an RTC crystal. If the main supply voltage fails, parts of the receiver switch off, but the RTC still runs providing a timing reference for the receiver. This operating mode is called Hardware Backup Mode, which enables all relevant data to be saved in the backup RAM to allow a hot or warm start later. A “battery” is integrated in ST310Ato support the function as backup power supply.

2.10 Power management

ST310Aoffers a power-optimized architecture with built-in autonomous power saving functions to minimize power consumption at any given time. Furthermore, the receiver can be used in two operating modes: Continuous mode for best performance or Power Save Mode for optimized power consumption respectively.

2.10.1 DC/DC converter

The ST310Amodules integrate a DC/DC converter in the chip, allowing reduced power consumption

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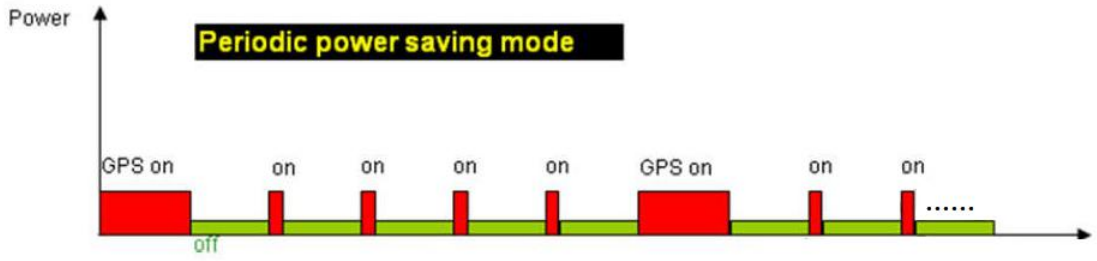
2.10.2 Standby Mode

User can issue software command to make GNSS module go into standby mode that consumes less than 200uA current. GNSS module will be awaked when receiving any byte. The following flow chart is an example to make GNSS module go into standby mode and then wake up.

2.10.3 Periodic Mode

When GNSS module is commanded to periodic mode, it will be in operation and standby periodically. Its status of power consumption is as below chart



2.10.4 Continuous Mode

Continuous Mode uses the acquisition engine at full performance resulting in the shortest possible TTFF and the highest sensitivity. It searches for all possible satellites until the Almanac is completely downloaded. The receiver then switches to the tracking engine to lower power consumption.

Thus, a lower tracking current consumption level will be achieved when:

- A valid GNSS position is obtained
- The entire Almanac has been downloaded
- The Ephemeris for each satellite in view is valid

3 GNSS Performance

Parameter	Specification
Receiver type	■GPS L1 C/A ■BDS B1C ■GLONASS L1OF ■G3+BDS
Sensitivity	Tracking & Navigation: -165dBm Reacquisition: -163dBm Cold Start: -148dBm
Time-To-First-Fix[1]	Cold Start 35s Warm Start 25s Hot Start 1 s
Horizontal Position accuracy[2]	Autonomous 3 m SBAS 2.5 m
Accuracy of time pulse signal	RMS 10ns
Velocity accuracy	0.1 m/s
Operational limits[3]	Dynamics ≤ 4 g Altitude 18000m Velocity 515 m/s
Frequency of time pulse signal	1Hz
Baud Rate	92,1600 bps （Default）
Max navigation update rate	10 Hz （Default 1Hz）

[1] All satellites at -130 dBm
[2] CEP, 50%, 24 hours static, -130 dBm, > 6 SVs
[4] Assuming Airborne < 4 g platform

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

Parameter	Symbol	Module	Condition	Min	Max	Units
Power supply voltage	VCC	All		-0.5	3.6	V
Backup battery voltage	V_BCKP	All		-0.5	3.6	V
Input pin voltage	Vin	All		-0.5	3.6	V
DC current trough any digital I/O pin (except supplies)	Ipin				10	mA
VCC_RF output current	ICC_RF	All			100	mA
Input power at RF_IN	Prfin	All	source impedance = 50 Ω, continuous wave		13	dBm
Storage temperature	Tstg	All		-40	85	°C

Stressing the device beyond the “Absolute Maximum Ratings” may cause permanent damage.

These are stress ratings only. The product is not protected against over-voltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

4.2 Electrical characteristics

Parameter	Symbol	Min	Typ	Max	Units
Power supply voltage	VCC	2.8	3.3	3.6	V
Average supply current	Acquisition	10@3.3V	12@3.3V	14@3.3V	mA
	Tracking	10@3.3V	12@3.3V	14@3.3V	mA
Backup battery voltage	V_BCKP	2.8	3.3	3.6	V
Backup battery current	I_BCKP		200@3.3V		nA
Digital IO voltage	Div	1.8		3.3	V
Storage temperature	Tstg	-40		85	°C
Operating temperature	Topr	-40		85	°C
Humidity				95	%

All specifications are at an ambient temperature of 25°C. Extreme operating temperatures can significantly impact specification values. Applications operating near the temperature limits should be should be tested to ensure the specification.

Values in Table are provided for customer information only as an example of typical power requirements. Values are characterized on samples, actual power requirements can vary depending on FW version used, external circuitry, number of SVs tracked, signal strength, type of start as well as time, duration and conditions of test.

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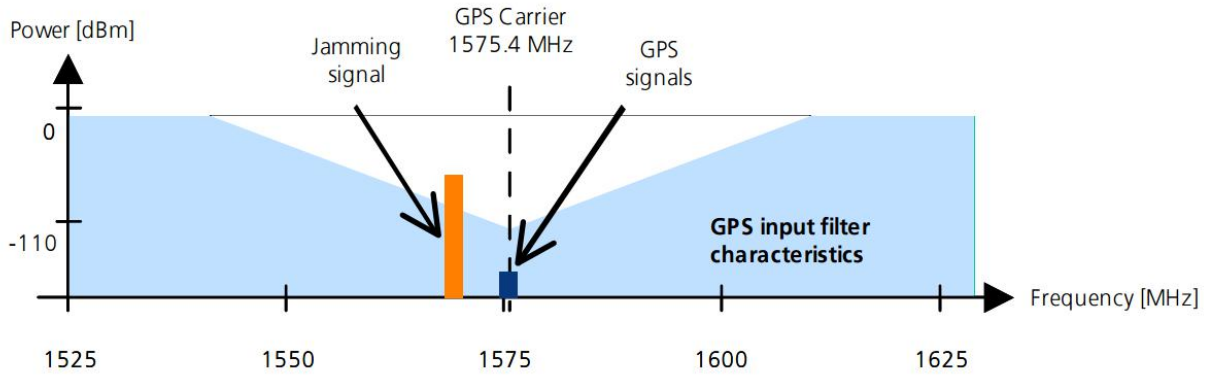
5 EMI/EMC Handling

5.1 In-band jamming

With in-band jamming the signal frequency is very close to the GPS frequency of 1575 MHz. Such jamming signals are typically caused by harmonics from displays, micro-controller, bus systems, etc.

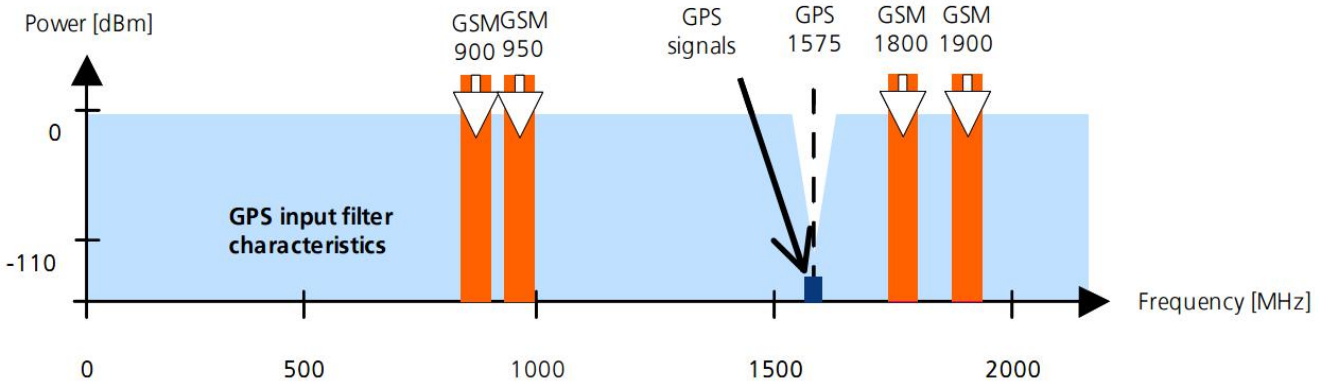


Measures against in-band jamming include:

- Shielding
- Layout optimization
- Filtering
- Placement of the GPS antenna
- Adding a CDMA, GSM, WCDMA band-pass filter before handset antenna

5.2 Out-band jamming

Out-band jamming is typically caused by signal frequencies that are different from the GPS carrier. The sources are usually wireless communication systems such as GSM, CDMA, WCDMA, WiFi, BT, etc..



ST310Aconfigured SAW to reduce the out-band jamming by adding SAW filter.

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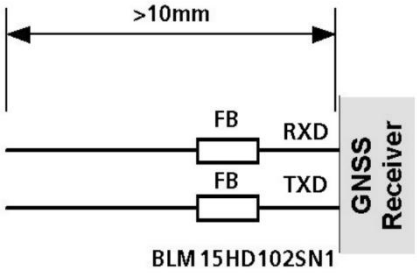
5.3 Electromagnetic interference on I/O lines

Any I/O signal line with a length greater than approximately 3 mm can act as an antenna and may pick up arbitrary RF signals transferring them as noise into the GNSS Module. This specifically applies to unshielded lines, in which the corresponding GND layer is remote or missing entirely, and lines close to the edges of the printed circuit board.

If, for example, a cellular signal radiates into an unshielded high-impedance line, it is possible to generate noise in the order of volts and not only distort receiver operation but also damage it permanently. On the other hand, noise generated at the I/O pins will emit from unshielded I/O lines. Receiver performance may be degraded when this noise is coupled into the GNSS antenna.

To avoid interference by improperly shielded lines, it is recommended to use resistors (e.g. R>20 W), ferrite beads (e.g. BLM15HD102SN1) or inductors (e.g. LQG15HS47NJ02) on the I/O lines in series. These components should be chosen with care because they will affect also the signal rise times. The below shows an example of EMI protection measures on the RXD/TXD line using a ferrite bead.



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6 Software Protocol

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a $ and with carriage return/line feed.
GPS specific messages all start with $GNxxx where xxx is a three-letter identifier of the message data that follows.
NMEA messages have a checksum, which allows detection of corrupted data transfers. $GPxxx is for GPS.

Table :NMEA-0183 Output Messages

NMEA Record	Description	Default
GNGGA	Global positioning system fixed data	Y
GNGLL	Geographic position—latitude/longitude	Y
GPGSA	GNSS DOP and active satellites for GPS	Y
GLGSA	GNSS DOP and active satellites for GLONASS	Y
BDGSA	Beidou DOP and active satellites for BD	Y
GPGSV	GNSS satellites in view for GPS	Y
GLGSV	GNSS satellites in view for GLONASS	Y
BDGSV	Beidou satellites in view for BD	Y
GNRMC	Recommended minimum specific GNSS data	Y
GNVTG	Course over ground and ground speed	Y
GNZDA	Date and Time	Y

CMD List

Table : CMD List

CMD TYPE	CMD Example:
Hot Restart	$PAIR004*3E<CR><LF>
Warm Restart	$PAIR005*3F<CR><LF>
Cold Restart	$PAIR006*3C<CR><LF>
Full Cold Restart	
Search G3B satellites only	$PAIR066,1,1,1,1,0,0*3B<CR><LF>
Search GPS satellites only	$PAIR066,1,0,0,0,0,0*3B<CR><LF>
Search GPS and GLONASS satellites	$PAIR066,1,1,0,0,0,0*3A<CR><LF>
Search BEIDOU satellites only	
Search GPS and BEIDOU satellites	$PAIR066,1,0,0,1,0*2B<CR><LF>

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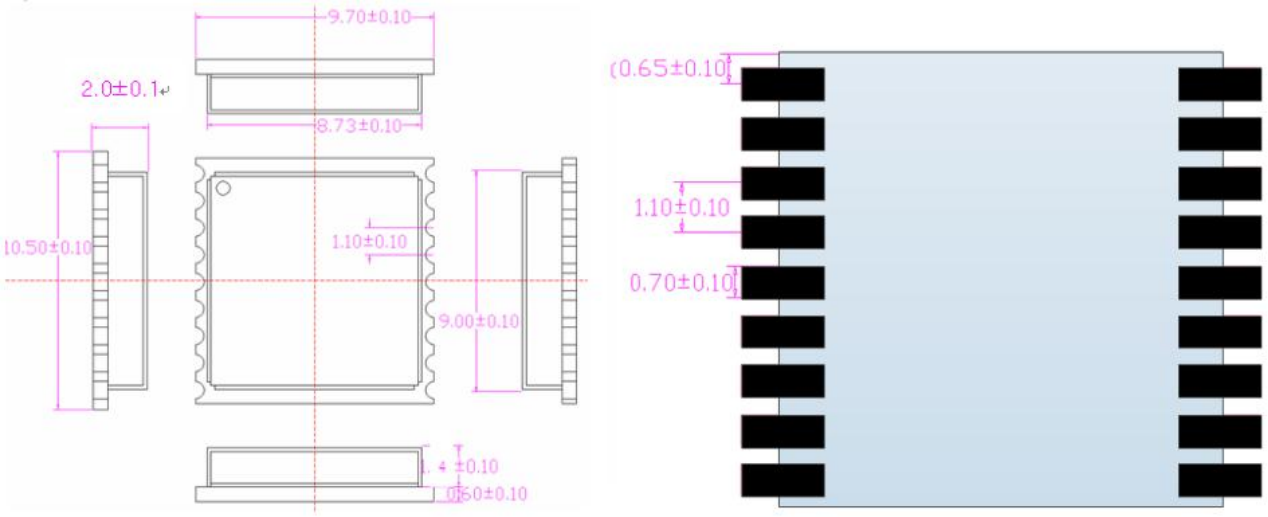
7 Hardware Interface

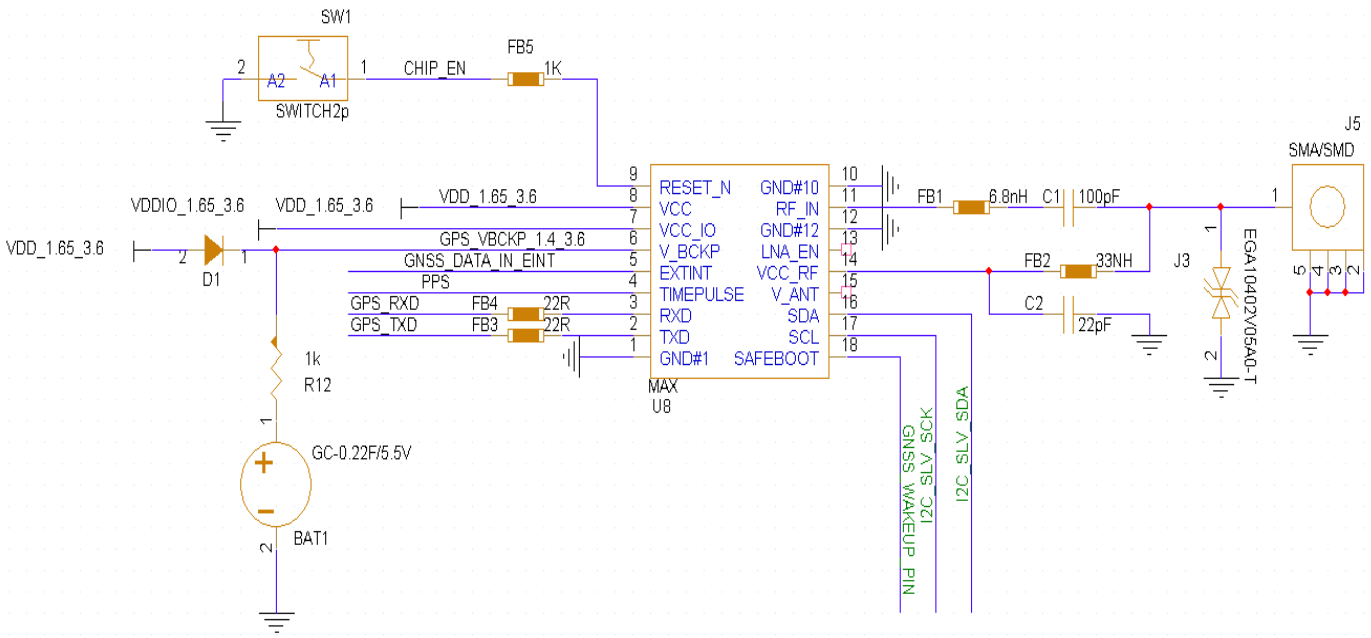
7.1 Pin assignment

NO.	NAME	I/O	Description
1,10,12	GND	G	GROUND
2	TXD	O	TTL output (keep open if not used)
3	RXD	I	TTL Input (keep open if not used)
4	PPS	O	Time Pulse (keep open if not used)
5	EXTINT	I	GNSS_DATA_IN_EINT
6	V_backup	P	Backup voltage supply
7	VCC_IO	P	VCC_IO voltage supply
8	VCC	P	Main Supply
9	RESET	I	RESET_N (Active low, keep open if not used)
11	RF_IN	I	GNSS Signal Input
13,15	NC	NC	NC (keep open if not used)
14	VCC_RF	O	Antenna power supply
16	SDA	I/O	IIC SDA
17	SCL	I/O	IIC SCL
18	SAFEBOOT	I	GNSS_WAKEUP_PIN

7.2 Dimensions



7.3 Recommend Schematics



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8 Product handling & Delivery

8.1 Packaging

ST310Amodules are delivered as hermetically sealed, reeled tapes in order to enable efficient production ,production lot set-up and tear-down. MOQ Package number: 1000 PCS

NO	Part Name	Q,ty / Ctn	Out Size (mm)
1	Box Carton	1/1	360(W)mm×210(D)×370(H)mm
2	Pad Carton	3/1	-
3	REEL	1000/1	-

8.2 Moisture Sensitivity Levels

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required.
For MSL standard see IPC/JEDEC J-STD-020, which can be downloaded from www.jedec.org.

8.3 Reflow soldering

A convection type-soldering oven is highly recommended over the infrared type radiation oven.
Convection heated ovens allow precise control of the temperature, and all parts will heat up evenly, regardless of material properties, thickness of components and surface color. As a reference, see the “IPC-7530 Guidelines for temperature profiling for mass soldering (reflow and wave) Processes”, published in 2001.

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8.3.1 Preheat phase

During the initial heating of component leads and balls, residual humidity will be dried out. Note that this preheat phase will not replace prior baking procedures.

- Temperature rise rate: max. 3 °C/s. If the temperature rise is too rapid in the preheat phase it may cause excessive Slumping
- Time: 60 – 120 s. If the preheat is insufficient, rather large solder balls tend to be generated. Conversely, if performed excessively, fine balls and large balls will be generated in clusters.
- End Temperature: 150 – 200 °C. If the temperature is too low, non-melting tends to be caused in areas containing large heat capacity.

8.3.2 Heating/ Reflow phase

The temperature rises above the liquidus temperature of 217°C. Avoid a sudden rise in temperature as the slump of the paste could become worse.

- Limit time above 217 °C liquidus temperature: 40 – 60 s
- Peak reflow temperature: 245 °C

8.3.3 Cooling phase

A controlled cooling avoids negative metallurgical effects (solder becomes more brittle) of the solder and possible mechanical tensions in the products. Controlled cooling helps to achieve bright solder fillets with a good shape and low contact angle.

- Temperature fall rate: max 4 °C/s

To avoid falling off, the the module should be placed on the topside of the motherboard during soldering.

The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the base board, etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

The modules must not be soldered with a damp heat process.

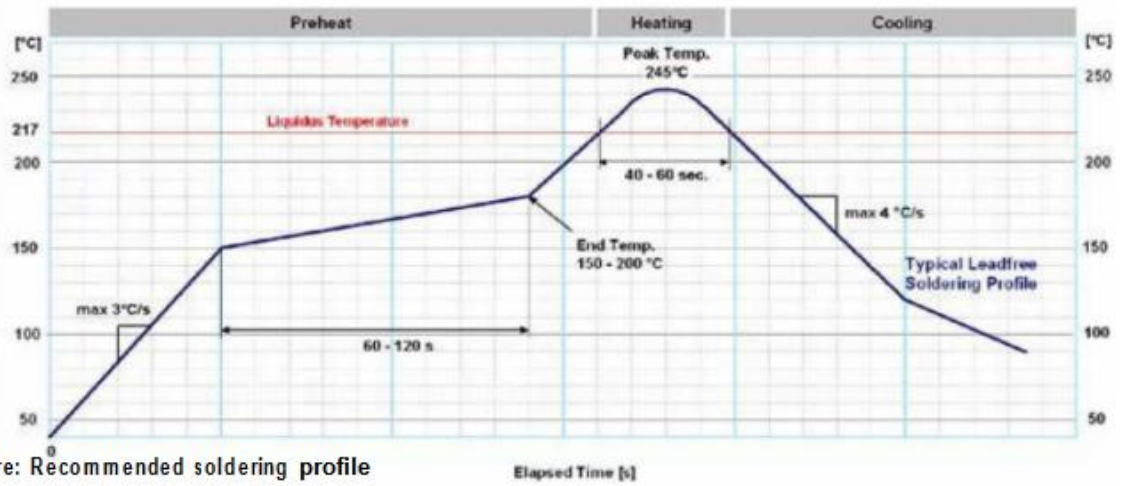

Figure: Recommended soldering profile

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8.4 Notifications

Optical inspection

After soldering the module, consider an optical inspection step to check whether:

- The module is properly aligned and centered over the pads
- All pads are properly soldered
- No excess solder has created contacts to neighboring pads, or possibly to pad stacks and vias nearby

Cleaning

In general, cleaning the populated modules is strongly discouraged. Residues underneath the modules cannot be easily removed with a washing process.

- Cleaning with water will lead to capillary effects where water is absorbed in the gap between the baseboard and the module. The combination of residues of soldering flux and encapsulated water leads to short circuits or resistor-like interconnections between neighboring pads.
- Cleaning with alcohol or other organic solvents can result in soldering flux residues flooding into the two housings, areas that are not accessible for post-wash inspections. The solvent will also damage the sticker and the ink-jet printed text.
- Ultrasonic cleaning will permanently damage the module, in particular the quartz oscillators.

The best approach is to use a “no clean” soldering paste and eliminate the cleaning step after the soldering.

Repeated reflow soldering

Only single reflow soldering processes are recommended for boards populated with the modules. the modules should not be submitted to two reflow cycles on a board populated with components on both sides in order to avoid upside down orientation during the second reflow cycle. In this case, the module should always be placed on that side of the board, which is submitted into the last reflow cycle. The reason for this (besides others) is the risk of the module falling off due to the significantly higher weight in relation to other components.

Two reflow cycles can be considered by excluding the above described upside down scenario and taking into account the rework conditions described in section Product handling. Repeated reflow soldering processes and soldering the module upside down are not recommended.

Wave soldering

Base boards with combined through-hole technology (THT) components and surface-mount technology (SMT) devices require wave soldering to solder the THT components. Only a single wave soldering process is encouraged for boards

populated with the modules.

Hand soldering

Hand soldering is allowed. Use a soldering iron temperature setting equivalent to 350 °C. Place the module precisely on

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the pads. Start with a cross-diagonal fixture soldering (e.g. pins 1 and 15), and then continue from left to right

Rework

The the module can be unsoldered from the baseboard using a hot air gun. When using a hot air gun for unsoldering the module, a maximum of one reflow cycle is allowed. In general, we do not recommend using a hot air gun because this is an uncontrolled process and might damage the module.

⚠ Attention: use of a hot air gun can lead to overheating and severely damage the module. Always avoid overheating the module.

After the module is removed, clean the pads before placing and hand soldering a new module.

⚠ Never attempt a rework on the module itself, e.g. replacing individual components. Such actions immediately terminate the warranty.

In addition to the two reflow cycles, manual rework on particular pins by using a soldering iron is allowed. Manual rework steps on the module can be done several times.

Conformal coating

Certain applications employ a conformal coating of the PCB using HumiSeal® or other related coating products. These materials affect the HF properties of the GNSS module and it is important to prevent them from flowing into the module. The RF shields do not provide 100% protection for the module from coating liquids with low viscosity; therefore, care is required in applying the coating. Conformal Coating of the module will void the warranty.

Casting

If casting is required, use viscose or another type of silicon pottant. The OEM is strongly advised to qualify such processes in combination with the the module before implementing this in the production. Casting will void the warranty.

Grounding metal covers

Attempts to improve grounding by soldering ground cables, wick or other forms of metal strips directly onto the EMI covers is done at the customer's own risk. The numerous ground pins should be sufficient to provide optimum immunity to interferences and noise. Simple makes no warranty for damages to the modules caused by soldering metal cables or any other forms of metal strips directly onto the EMI covers.

Use of ultrasonic processes

Some components on the modules are sensitive to Ultrasonic Waves. Use of any Ultrasonic Processes (cleaning, welding etc.) may cause damage to the GNSS Module. Simple offers no warranty against damages to the modules caused by any Ultrasonic Proces

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8.5 ESD handling precautions

ST310A **modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling !Failure to observe these precautions can result in severe damage to the GNSS Module!**

GNSS Modules are Electrostatic Sensitive Devices (ESD and require special precautions when handling. Particular care must be exercised when handling patch antennas, due to the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the receiver:

Unless there is a galvanic coupling between the local GND (i.e. the work table) and the PCB GND, then the first point of contact when handling the PCB must always be between the local GND and PCB GND.

Before mounting an antenna patch, connect ground of the device

When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10 pF, coax cable ~50-80 pF/m, soldering iron,)

To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.

When soldering RF connectors and patch antennas to the receiver's RF pin, make sure to use an ESD safe soldering iron

9 Ordering Information

9.1 Ordering Information

Ordering No.	Description	Frequency	PIN	Size
ST310A	GNSS Module	G3/BDS/QZSS	LGA18	10.1*9.7*2.0mm