LG77L Hardware Design

GNSS Module Series

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	Ensure that the product may be used in the country and the required environment, as well as that it conforms to the local safety and environmental regulations.
	Keep away from explosive and flammable materials. The use of electronic products in extreme power supply conditions and locations with potentially explosive atmospheres may cause fire and explosion accidents.
	The product must be powered by a stable voltage source, and the wiring shall conform to security precautions and fire prevention regulations.
	Proper ESD handling procedures must be followed throughout the mounting, handling and operation of any devices and equipment that incorporate the module to avoid ESD damages.

About the Document

Document Information	
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Revision History

Version	Date	Description
-	2020-09-01	Creation of the document
1.0	2021-01-05	First official release
1.1	2021-07-16	1. Completely reorganized the structure of the document. 2. Added LG77L (B) and LG77L (C). 3. Added Chapters 1.5, 1.6, 1.7, 3.4, 3.5, 5.2.2, 5.3 and 9. 4. Updated the power consumption, sensitivity, 1PPS signal accuracy, and maximum altitude values of LG77L (A) (Table 3). 5. Updated the name of pin 13 from FORCE_ON to WAKEUP. 6. Updated the pin 10 from RESERVED to 3D_FIX. 7. Updated the pin 28 from RESERVED to JAM_IND. 8. Updated the description of the 1PPS (Chapter 4.1.4). 9. Updated the reset sequence (Chapter 4.2.2). 10. Optimized the antenna interface reference designs (Chapter 5.2). 11. Updated the recommended total gain of active antenna into 35 dB (Chapter 5.2.1). 12. Updated the recommended operating conditions (Chapter 6.2). 13. Updated the packaging specifications (Table 12). 14. Updated the notes about module storage (Chapter 8.2). 15. Updated the recommended peak reflow temperature and the reflow time in reflow zone (Chapter 8.3).

Contents

Table Index

Figure Index

1 Product Description

1.1. Overview

The Quectel LG77L module includes three versions: LG77L (A), LG77L (B), LG77L (C). Unless otherwise indicated, any information described in this document about LG77L applies to LG77L (A), LG77L (B) and LG77L (C).

The Quectel LG77L module supports multiple global positioning and navigation systems: BeiDou, GPS, Galileo (only for LG77L (C)), GLONASS, QZSS. The module also supports SBAS (including WAAS, EGNOS, MSAS and GAGAN) and AGNSS functions.

Key features:

- The LG77L (A) and LG77L (B) are hosting the same chipset while the LG77L (A) requires an external RTC and the LG77L (B) has an integrated RTC. The LG77L (C) is hosting an upgraded chipset from the same supplier series and it has an integrated RTC.
- The LG77L (A) and LG77L (B) can simultaneously track up to 2 GNSS satellite constellations. The LG77L (C) can simultaneously track up to 3 GNSS satellite constellations.
- The LG77L module is a single-band, multi-constellation GNSS module and features a high-performance, high reliability positioning engine. This module facilitates a fast and precise GNSS positioning capability.
- The module supports serial communication interfaces UART and I2C.
- Multiple power-saving modes are supported, such as Standby, Backup, Periodic and GLP modes.
- The module includes embedded low-power algorithms, suitable for different application scenarios.
- The EASY™ autonomous AGNSS technology is automatically enabled. The EASY™ feature collects and processes all internal auxiliary information including GNSS time, date, the latest position and much more, so that the module can achieve a fast first fixing during hot or warm start.
- There is signalling for active antenna detection and short-circuit protection (when using the suggested peripheral circuits).
- The embedded flash memory provides the capacity for storing user-specific configurations and future firmware updates.

The Quectel LG77L module is an SMD type module with a compact form factor of 7.0 mm × 7.0 mm × 2.0 mm. It can be embedded in your applications through the 43 LGA pins.

The module is fully compliant with the EU RoHS Directive.

1.1.1. Special Mark

Table 1: Special Mark

Mark	Definition
◆	When the symbol ◆ is used after a piece of data, it indicates that the piece of data is preliminary, unless otherwise specified.

1.2. Features

Table 2: Product Features

Features		LG77L (A)	LG77L (B)	LG77L (C)
Grade	Industrial	●	●	●
	Automotive	-	-	-
Category	Standard Precision GNSS	●	●	●
	High Precision GNSS	-	-	-
	DR	-	-	-
	RTK	-	-	-
	Timing	-	-	-
Supply	2.8–4.3 V, Typical: 3.3 V	●	●	●
Interfaces	UART	●	●	●
	SPI	-	-	-
	I2C [1]	●	●	●
	1PPS	●	●	●
Features	Additional LNA	-	-	-
	Additional SAW	●	●	●
	RTC crystal	-	●	●
	TCXO oscillator	●	●	●
	6-axis IMU	-	-	-

[1] The I2C interface is supported only on firmware versions ending with "SC".

Constellations	GPS/QZSS	L1 C/A	●	●	●
		L5	-	-	-
	Galileo	E1	-	-	●
		E5a	-	-	-
	BeiDou	B1I	●	●	●
		B2a	-	-	-
	GLONASS	L1	●	●	●
	IRNSS	L5	-	-	-
	SBAS	L1	●	●	●
Temperature Range	Operating temperature range: -40 °C to +85 °C Storage temperature range: -40 °C to +90 °C				
Physical Characteristics	Size: (7.0 ±0.20) mm × (7.0 ±0.20) mm × (2.0 ±0.20) mm Weight: Approx. 0.20 g				

NOTE

For more information about GNSS constellation configuration, see ***document [1]*** and ***document [2]***.

1.3. Performance

Table 3: Product Performance

Parameter	Specification		LG77L (A)	LG77L (B)	LG77L (C)
Power Consumption [2]	GPS + GLONASS	Acquisition	25 mA	26 mA	24 mA
		Tracking	24 mA	25 mA	23 mA
	GPS + BeiDou	Acquisition	28 mA	28 mA	24 mA
		Tracking	26 mA	26 mA	23 mA
	Standby mode		1 mA	1 mA	0.9 mA
	Backup mode		6 μA	6 μA	6 μA

[2] All satellites at -130 dBm, except Galileo at -122 dBm.

Sensitivity [2]	Acquisition	-147 dBm	-147 dBm	-146 dBm
	Reacquisition	-156 dBm	-156 dBm	-156 dBm
	Tracking	-158 dBm	-158 dBm	-163 dBm
TTFF (with EASY™)	Cold Start	14 s	14 s	17 s
	Warm Start	4 s	4 s	5 s
	Hot Start	2 s	2 s	2 s
TTFF (EPO Enabled)	Cold Start	4 s	4 s	8 s
	Warm Start	3 s	3 s	6 s
	Hot Start	2 s	2 s	2 s
TTFF [2] (without EASY™)	Cold Start	26 s	26 s	25 s
	Warm Start	24 s	24 s	23 s
	Hot Start	2 s	2 s	2 s
Horizontal Position Accuracy [3]		2.5 m	2.5 m	2.5 m
Update Rate	1 Hz (max. 10 Hz)			
Accuracy of 1PPS Signal	Typical accuracy: 50 ns Time pulse width: 100 ms			
Velocity Accuracy [2]	Without aid: 0.1 m/s			
Acceleration Accuracy [2]	Without aid: 0.1 m/s^2			
Dynamic Performance [2]	Maximum Altitude: 10000 m Maximum Velocity: 515 m/s Acceleration: 4g			

1.4. Block Diagram

The following figure shows a block diagram of the module. The module includes a single-chip GNSS IC, an additional SAW filter, a TCXO, as well as active antenna protection and short-circuit detection circuit ports. And there is no 32.768 kHz crystal in LG77L (A). But there is a 32.768 kHz crystal in both LG77L (B) and LG77L (C).

[3] CEP, 50%, 24 hours static, -130 dBm, more than 6 SVs.

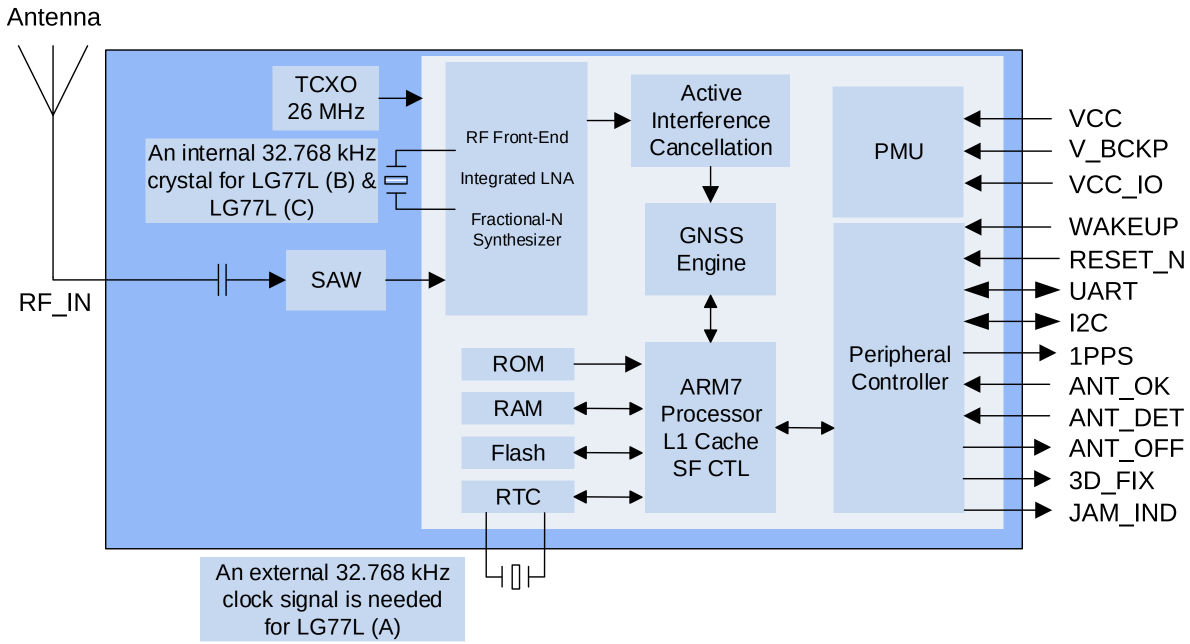

Figure 1: Block Diagram

1.5. GNSS Constellations

The Quectel LG77L module is a single-band GNSS receiver that can receive and track GPS, BeiDou, GLONASS, Galileo (only for LG77L (C)) and QZSS signals. The module supports concurrent reception of GPS, GLONASS (or BeiDou) and QZSS. The default configuration is either GPS + BeiDou or GPS + GLONASS.

1.5.1. GPS

The LG77L module is designed to receive and track GPS L1 C/A signals (1574.397–1576.443 MHz) provided by GPS.

1.5.2. BeiDou

The LG77L module is designed to receive and track BeiDou B1I (1559.052–1563.144 MHz) signals provided by the BeiDou Navigation Satellite System. The ability to receive and track BeiDou signals in conjunction with GPS results in higher coverage, improved reliability, and better accuracy.

1.5.3. GLONASS

The LG77L module is designed to receive and track GLONASS L1 signals (1597.781–1605.656 MHz) provided by GLONASS.

1.5.4. Galileo

The LG77L (C) module is designed to receive and track Galileo E1 (1573.374–1577.466 MHz) signals provided by Galileo.

1.5.5. QZSS

The Quasi-Zenith Satellite System (QZSS) is a regional navigation satellite system that transmits additional GPS L1 C/A signals for the Pacific region covering Japan and Australia. The Quectel LG77L module can detect and track these signals concurrently with GPS signals, resulting in better availability especially under challenging conditions, e.g., in urban canyons.

1.6. Augmentation System

1.6.1. SBAS (Satellite-Based Augmentation System)

The Quectel LG77L module supports SBAS broadcast signal reception, and GPS data are complemented by additional regional or wide area GPS enhancement data. The system enhances the data through satellite broadcasting, and this information can be used in GNSS receivers to improve the accuracy of the results. SBAS satellites can also be used as additional signals for ranging or distance measurement, further improving availability. Supported SBAS systems: WAAS, EGNOS, MSAS and GAGAN.

1.7. AGNSS

The module supports AGNSS feature that significantly reduces the module's TTFF, especially under lower signal conditions. To implement AGNSS feature, the module should get the assistance data including the current time, rough position, and LTO data.

1.7.1. EASY™ Autonomous AGNSS Technology

The LG77L module supports the EASY™ technology to improve TTFF and acquisition sensitivity of GNSS modules. To achieve that goal, the EASY™ technology provides assistant information, such as the ephemeris, almanac, rough last position, time, and a satellite status.

The EASY™ technology works as an embedded software to accelerate TTFF by predicting satellite navigation messages from the received ephemeris. After receiving the broadcast ephemeris for the first time, the GNSS engine automatically calculates and predicts the orbit information up to the subsequent 3 days, and saves the predicted information into the internal memory. The GNSS engine will use the information for positioning if there is not enough information from satellites. As a result, the positioning and TTFF are improved.

The EASY™ function reduces TTFF to 5 s in warm start. In this case, the RTC domain should still be valid. In order to obtain enough broadcast ephemeris information from GNSS satellites after fixing the position, the GNSS module should keep receiving the information for at least 5 minutes in strong-signal environments.

The EASY™ function is enabled by default, and it can be disabled with software commands. For more information about commands, see ***document [1]*** and ***document [2]***.

1.7.2. EPO™ Offline AGNSS Technology

The LG77L module features a leading AGNSS technology called EPO™ (Extended Prediction Orbit). It is a free service provided by Quectel, which can achieve a fast TTFF and improve accuracy in weak signal conditions. You need to use the EPO file that contains the valid information, which is applicable to the time that you want to operate the receiver. Through EPO data downloaded from EPO servers, the function provides up to 30-days orbit predictions to speed up the TTFF.

For more information about EPO™, see ***document [3]***.

1.8. LOCUS

The Quectel LG77L module supports the embedded logger function called LOCUS. When this function is enabled, it logs position information to the internal flash memory. Additionally, with this function, the host can save power consumption. As a result, the host won’t receive the NMEA information all the time. The module provides more than 16 hours of log capacity (64 KB).

Software commands can be used to query the current state of LOCUS. For more information about commands, see ***document [1]*** and ***document [2]***.

1.9. Multi-tone AIC

The Quectel LG77L module features a function called multi-tone active interference cancellation (AIC) to decrease harmonic distortion of RF signals from Wi-Fi, Bluetooth, 2G, 3G, 4G, and 5G.

Up to 12 AIC tones embedded in the module provide effective narrow-band interference and jamming elimination. That way, the GNSS signal could be demodulated from the jammed signal, which can ensure better navigation quality.

The following figure shows the anti-jamming performance by the AIC:

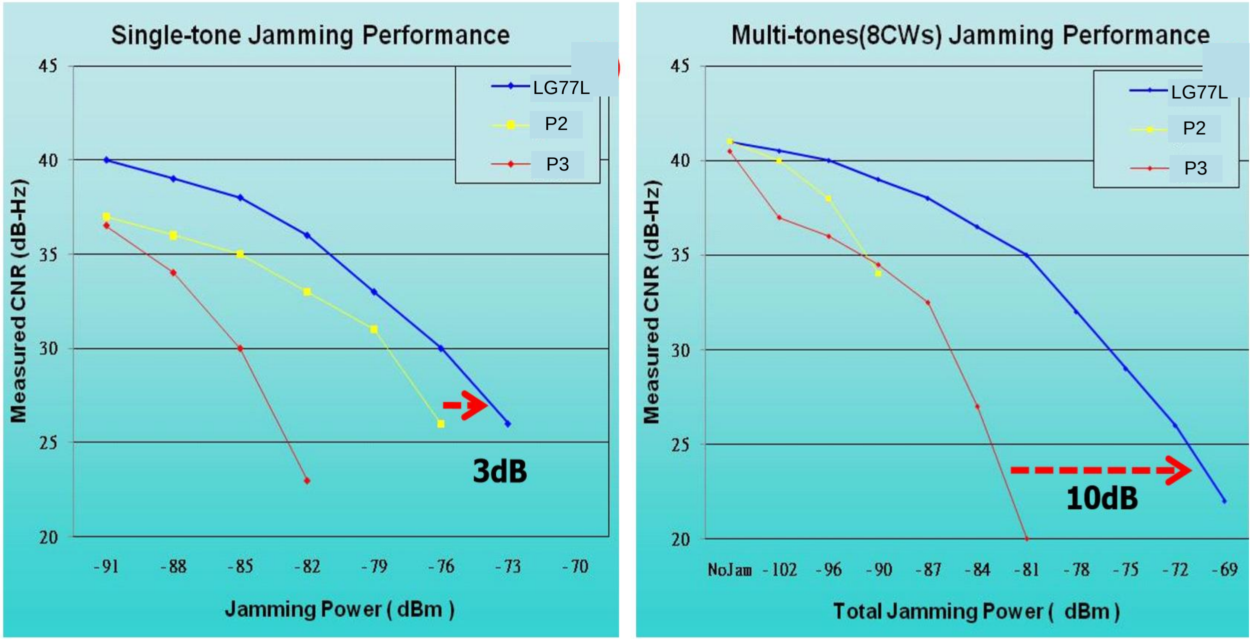

Figure 2: Anti-Jamming Performance by the AIC

The AIC function is enabled by default, and it can be disabled with software commands. For more information about commands, see ***document [1]*** and ***document [2]***.

2 Pin Assignment

The Quectel LG77L module is equipped with 43 LGA pins by which the module can be mounted on the customer's PCB.

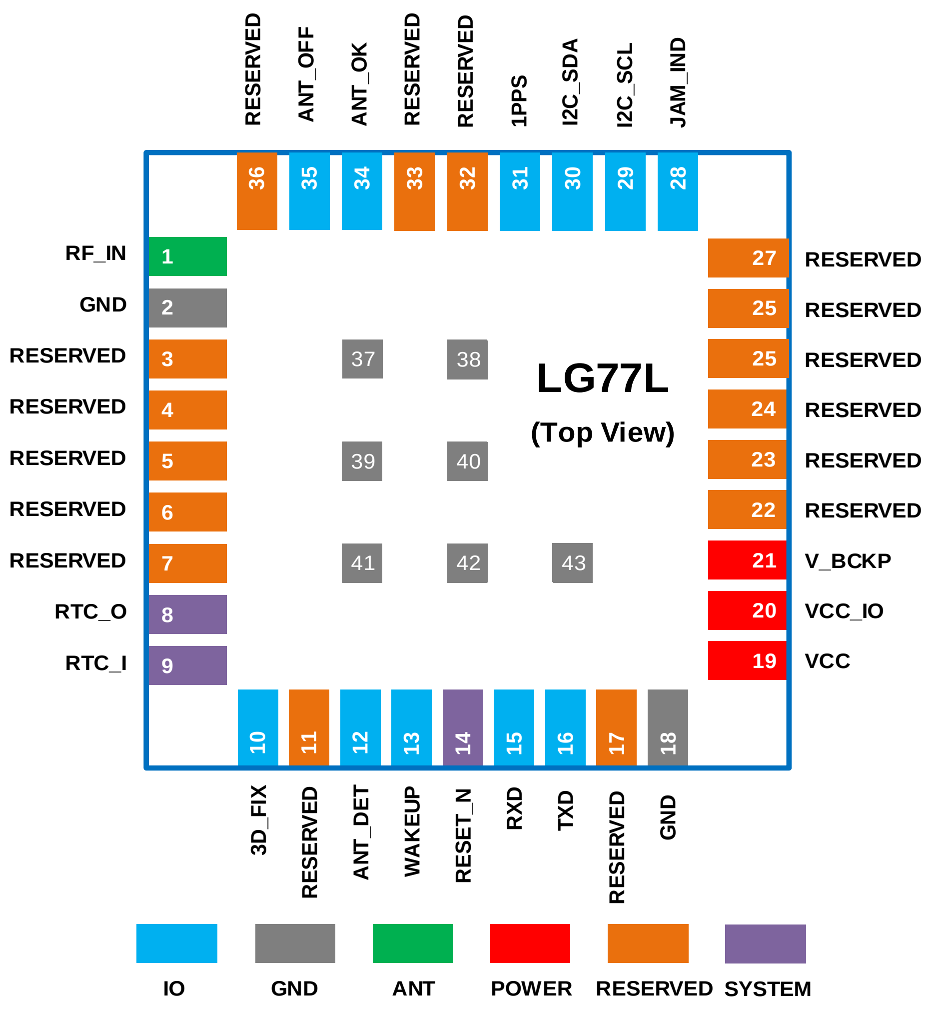

Figure 3: Pin Assignment

Table 4: I/O Parameter Definition

Type	Description
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
OD	Open Drain
PI	Power Input
PO	Power Output

Table 5: Pinout

Function	Name	No.	I/O	Description	Remarks
Power	VCC	19	PI	Main power supply	Provides clean and steady voltage.
	V_BCKP	21	PI	Backup power supply for RTC domain	The V_BCKP pin must be kept in the power supply for the module to start up and work normally. Supplies power to the RTC domain when VCC power supply is disconnected.
	VCC_IO	20	PI	Digital I/O port power supply	Powered by an external power supply. The pin powers I/O pins and determines the power domain of I/O pins.
I/O	TXD	16	DO	Transmits data	The UART interface is used for NMEA messages output, PMTK/PQ messages input/output and firmware upgrade. When the module supports the I2C interface, then the NMEA messages are output from the I2C interface by default.
	RXD	15	DI	Receives data	

	I2C_SCL	29	DIO	I2C serial clock	The I2C interface is used for NMEA messages output by default. The module also supports the receiving of PMTK/PQ messages through the I2C bus. If unused, leave the pins N/C (not connected).
	I2C_SDA	30	DIO	I2C serial data	
	ANT_DET	12	DI	Active antenna open-circuit detection	If unused, leave the pin N/C (not connected).
	ANT_OK	34	DI	Active antenna short-circuit detection	If unused, leave the pin N/C (not connected).
	ANT_OFF	35	DO	Active antenna power control	If unused, leave the pin N/C (not connected).
	3D_FIX	10	DO	3D fix indication	Active high. If unused, leave the pin N/C (not connected).
	WAKEUP	13	DI	Logic high will wake up the module from backup mode	Leave this pin N/C (not connected) or pulled low before entering the backup mode. If unused, leave the pin N/C (not connected).
	JAM_IND	28	DO	Jamming indication	Active low. If unused, leave the pin N/C (not connected).
	1PPS	31	DO	One pulse per second	Synchronized on rising edge, and the pulse width is 100 ms. If unused, leave the pin N/C (not connected).
ANT	RF_IN	1	AI	GNSS antenna interface	50 Ω characteristic impedance.
System	RTC_O	8	AO	32.768 kHz crystal output	An external 32.768 kHz clock signal must be provided for LG77L (A). The two pins are RESERVED for LG77L (B) and LG77L (C).
	RTC_I	9	AI	32.768 kHz crystal input	
	RESET_N	14	DI	Resets the module	Active low.
GND	GND	2, 18, 37–43	-	Ground	Assures a good GND connection to all GND pins of the module, preferably with a large ground plane.

RESERVED	RESERVED	3–7, 11, 17, 22–27, 32, 33, 36	-	Reserved	These pins must be left floating and cannot be connected to power or GND.

NOTE

1. Leave RESERVED and unused pins N/C (not connected).
2. See ***document [1]*** and ***document [2]*** for details of NMEA standard and chipset supplier proprietary protocols.
3. See ***document [6]*** for details of Quectel proprietary protocol.

3 Power Management

The Quectel LG77L module provides a power optimized architecture with built-in autonomous energy saving capabilities to minimize power consumption at any given time. The receiver can be used in five operating modes: standby mode, periodic mode, GLP mode, backup mode for best power consumption, continuous mode for best performance.

3.1. Power Unit

VCC is the supply voltage pin of the module. It supplies power for the PMU which in turn supplies the entire system and RTC domains. The load current of the VCC pin varies according to VCC voltage level, processor load, and satellite acquisition. It is important to supply sufficient current and make sure the power supply is clean and stable.

The V_BCKP pin supplies power for the RTC domain. If the VCC voltage drops under the acceptable level, the V_BCKP keeps the RTC domain powered. To achieve quick startup and improve Time to First Fix (TTFF), the RTC domain power supply should be valid during the interval the VCC does not have a valid level. SRAM memory also belongs to the RTC domain. If the VCC is not valid, the V_BCKP supplies power for SRAM memory that contains all the necessary GNSS data and some of the user configuration variables.

The module’s internal power supply is shown below:

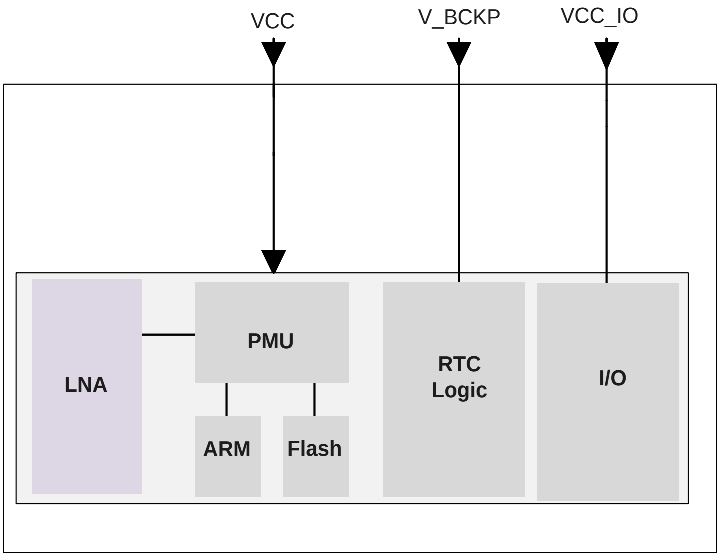

Figure 4: Internal Power Supply

NOTE

The V_BCKP pin must be supplied with power for the module to start up and work normally. Its supply voltage range is 2.0–4.3 V.

3.2. Power Supply

3.2.1. VCC

The VCC pin supplies power for BB and RF parts. VCC pin load current varies according to VCC voltage level, processor load and satellite acquisition state.

Module power consumption may vary by several orders of magnitude, especially when low power mode is enabled. Therefore, it is important that the power supply can sustain peak power for a short time, ensuring that the load current does not exceed the rated value. When the module switches from backup mode to normal operation or startup, it must charge the internal capacitors in the core domain. In some cases, this can lead to a significant current drain.

For low-power applications using power saving and backup modes, it is important that the LDO at the power supply or module input can provide the current/drain. An LDO with a high PSRR should be chosen for good performance. In addition, a TVS diode, and a combination of a 10 μF, 100 nF and a 33 pF decoupling capacitor network should be added near the VCC pin. The lowest value capacitor should be the closest to module pins.

An LDO voltage regulator with a fast discharge is recommended as the power supply. This can ensure a quick voltage drop when the VCC power is cut.

It is not recommended to use a switching DC-DC power supply.

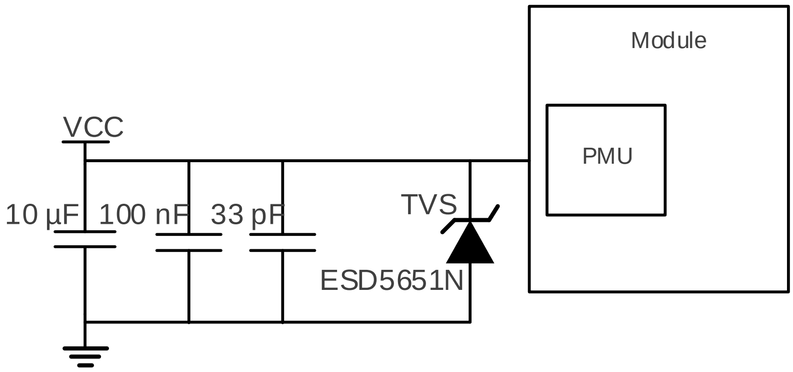

Figure 5: VCC Input Reference Circuit

3.2.2. V_BCKP

The V_BCKP pin supplies power for the RTC domain. If the module power supply fails, the V_BCKP pin supplies the real-time clock (RTC) and RAM. Use of valid time and GNSS orbit data at startup, allows GNSS hot (warm) start. In order to achieve a better Time to First Fix (TTFF), the RTC domain should be valid all the time. If no backup power is connected, the module performs a cold start at power up.

The V_BCKP pin also supplies power for the SRAM (Static Random-Access Memory) that contains user configuration variables and all the necessary GNSS information for quick start-up.

If there is a constant power supply in your system, it can be used to provide a suitable voltage to supply V_BCKP.

V_BCKP can be directly powered by an external battery (rechargeable or non-rechargeable). It is recommended to place a battery with the combination of a 4.7 µF, a 100 nF and a 33 pF capacitor near the V_BCKP pin. The figure below illustrates the reference design for supplying the RTC domain with a non-rechargeable battery.

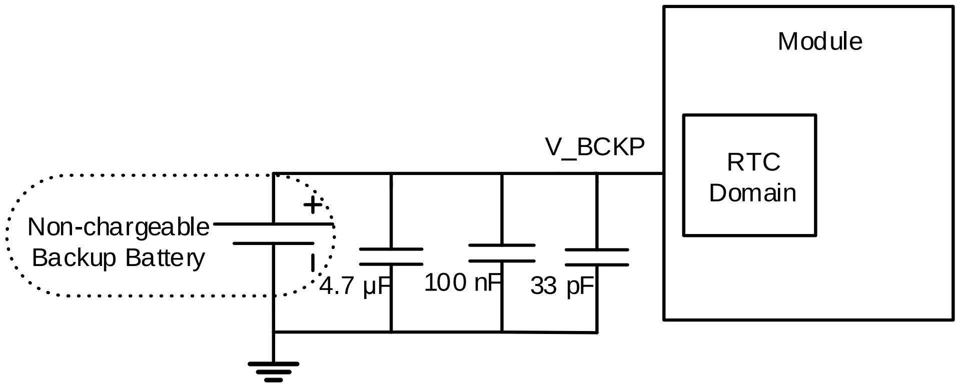

Figure 6: RTC Powered by Non-Rechargeable Battery

If V_BCKP is powered by a rechargeable battery, it is necessary to implement an external charging circuit for the battery. A reference charging circuit is illustrated below.

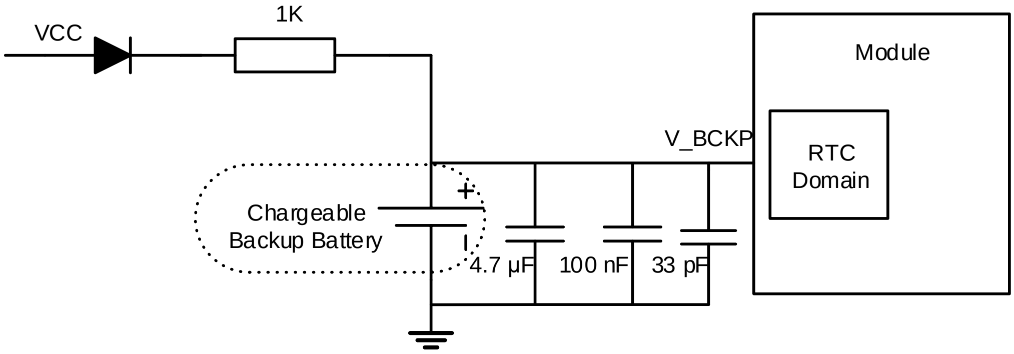

Figure 7: Reference Charging Circuit for a Rechargeable Battery

3.2.3. VCC_IO

The VCC_IO pin can be directly powered by an external power source, or it can be supplied from the VCC after a voltage level conversion. The voltage level conversion circuit using an LDO is shown in the figure below.

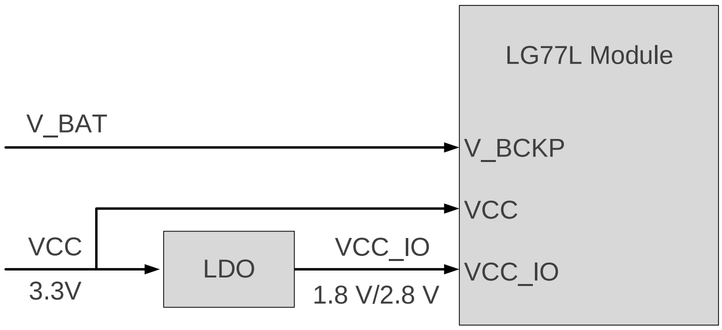

Figure 8: VCC to VCC_IO Reference Circuit Diagram

3.3. Power Mode

3.3.1. Feature Comparison

The table below illustrates the supported features/functions of the module in different modes.

Table 6: Feature Comparison in Different Power Modes

Features	Continuous	Standby	Backup	Periodic	GLP
Antenna Detection	●	-	-	O	●
1PPS	●	-	-	O	●
RF	●	-	-	O	●
NMEA from UART	●	(Enter continuous mode after receiving any command)	-	O	●
Acquisition & Tracking	●	-	-	O	●
Power Consumption	High	Low	Low	Medium	Medium
Position Accuracy	High	-	-	Low	Medium

NOTE

● = supported
O = supported in the continuous periodic mode

3.3.2. Continuous Mode

If VCC is powered on, it automatically enters continuous mode. Continuous mode comprises acquisition mode and tracking mode. In acquisition mode, the module starts to search satellites, and to determine visible satellites, coarse frequency, as well as the code phase of satellite signals. When the acquisition is completed, the module automatically switches to tracking mode. In tracking mode, the module tracks satellites and demodulates the navigation data from specific satellites.

3.3.3. Standby Mode

The standby mode is a low-power consumption mode. In the standby mode, the internal core and the I/O power domain are still active, but the RF is powered off, so the module stops satellite searching and navigation. The UART is still accessible through software commands, but there are no NMEA messages output.

You can send a command (see ***document [1]*** and ***document [2]*** for details about the command) to make the module enter the standby mode. The module can exit the standby mode by sending any data via the UART port. When the module exits the standby mode, it will use all internal aiding information such as GPS time, ephemeris, and last position to ensure the fastest possible TTFF during hot or warm start.

3.3.4. Backup Mode

For power-sensitive applications, the module receiver provides a backup mode to further reduce power consumption. The power consumption in backup mode is lower than in the standby mode.

In the backup mode, the module stops acquiring and tracking satellites. The UART is not accessible. But the SRAM memory in the RTC domain is active, which contains all the necessary GNSS information for a quick start-up, and a small amount of user configuration variables. Due to the SRAM memory, the EASY™ technology is available.

If VCC and VCC_IO are cut off and V_BCKP is powering the RTC domain, the module switches from continuous mode to backup mode. Only RTC domain is active in backup mode and it keeps track of time. As soon as the VCC pin is powered, the module immediately switches to continuous mode.

There are two ways to enter or exit the backup mode:

- **Software Method**: Send a command to set the module into backup mode. For more information about the command, see ***document [1]*** and ***document [2]***. To exit the backup mode, pull the WAKEUP pin high.
- **Hardware Method**: To enter the backup mode, cut off the power supply to the VCC and VCC_IO pin while keeping the V_BCKP powered. As soon as the VCC and VCC_IO power supply is restored, the module exits the backup mode and immediately enters the continuous mode.

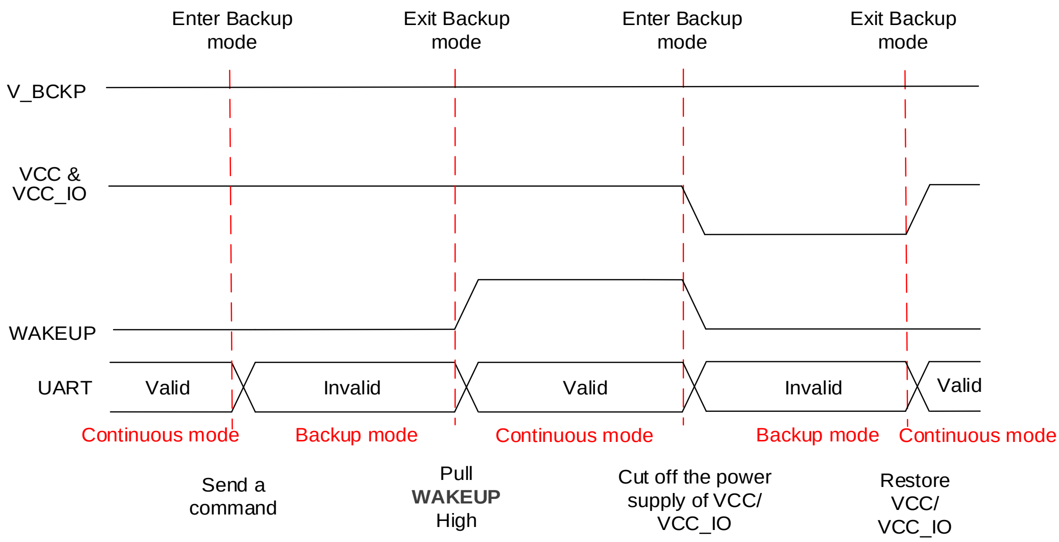

Figure 9: Entering/Exiting Backup Mode Sequence

3.3.5. Periodic Mode

The periodic mode achieves a balance between the positioning accuracy and power consumption, but the performance is lower compared to the continuous mode. In the periodic mode, the module should be always supplied with power. In this mode, the module switches between the continuous mode and the standby/backup mode periodically to reduce power consumption.

Through software commands, the module enters/exits the periodic mode. For more information about the commands, see ***document [1]*** and ***document [2]***.

The following figure illustrates the operation of the periodic mode. After sending the command for entering the periodic mode, the module first goes into the continuous mode and remains in it for several minutes. Afterwards, the module enters the periodic mode and operates according to the parameters set in the command. If the module fails to fix the position in **Run Time**, it switches to the **Second Run Time** and **Second Sleep Time** automatically. As long as it manages to fix the position again, the module will return to **Run Time** and **Sleep Time**.

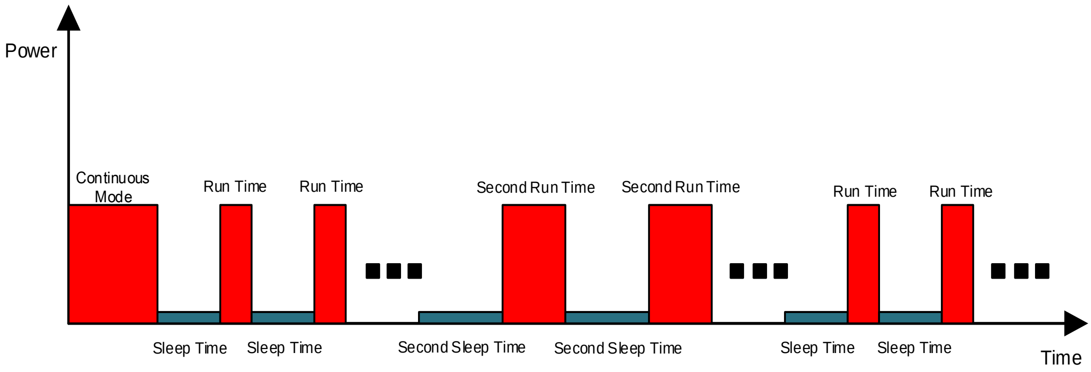

Figure 10: Periodic Mode

The average current value can be calculated with the following formula:

$I_{periodic} = (I_{tracking} \times T1+I_{standby/backup} \times T2) / (T1+T2)$

T1 = Run Time, T2 = Sleep Time.

NOTE

Before entering the periodic mode, make sure the module is in the tracking mode; otherwise, there will be a risk of satellite-tracking failure. If the module operates in weak signal environments, it is recommended to set a longer **Second Run Time** to ensure the success of reacquisition.

3.3.6. GLP Mode

The GLP (GNSS Low Power) mode is an optimized solution for wearable fitness and tracking devices. It reduces power consumption by disabling high accuracy positioning.

In GLP mode, the module provides good positioning performance while walking or running. The module automatically switches to the operation in the continuous mode in challenging environments to keep good accuracy. As a result, the module can still achieve maximum performance with the lowest power consumption.

The average current consumption in GLP mode is down to 18 mA in static scenario, which is about 40 % of that in normal mode. It may increase a little bit in dynamic scenario.

Software commands can set the module into or make the module exist GLP mode. For more information about commands, see ***document [1]*** and ***document [2]***.

NOTE

1. Before the module enters GLP mode, set the baud rate to 115200 bps and the frequency to 1 Hz.
2. When the module enters GLP mode, the 1PPS function is disabled. When GLP mode is enabled, the SBAS function cannot be used.
3. In highly dynamic scenarios, the positioning accuracy of the module in GLP mode is slightly decreased.
4. In complex environments, the module automatically returns to the continuous mode, to keep good positioning accuracy.

3.4. Power-Up Sequence

Once VCC is powered up, the module will start up automatically.

To ensure correct power-up sequence, the RTC logic should start up before the PMU. So, the V_BCKP must be supplied at the same time or before the VCC.

Ensure that the VCC has no rush or drop during rising time, and then keep the voltage stable. The recommended ripple is < 100 mV.

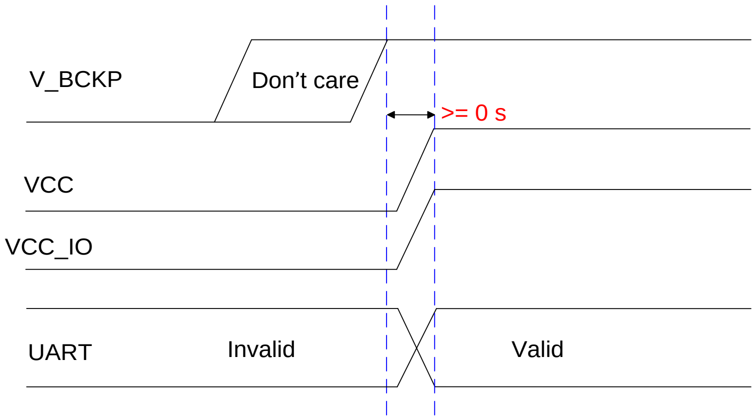

Figure 11: Power-Up Sequence

3.5. Power-Down Sequence

Once VCC is shut down, the voltage should drop within a duration of less than 50 ms. It is recommended to use a voltage regulator that supports fast discharge.

To avoid abnormal voltage condition, if VCC falls below minimum specified value, the system must initiate a power-on reset by lowering VCC to less than 100 mV for at least 100 ms.

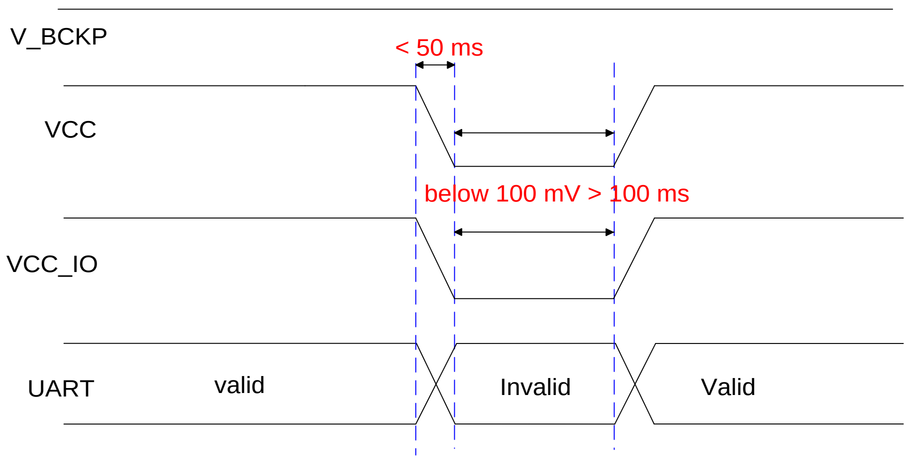

Figure 12: Power-Down Sequence

4 Application Interfaces

4.1. I/O Pins

4.1.1. Communication Interfaces

The following interfaces can be used for data reception and transmission.

4.1.1.1. UART Interface

The module provides one UART interface. The UART port has the following features:

- Support for NMEA data transmission, PMTK/PQ messages input/output, and firmware upgrading.
- Supported baud rates: 9600, 14400, 19200, 38400, 57600, 115200, 230400, 460800, and 921600 bps.
- Default settings: 9600 bps, 8 bits, no parity bit, 1 stop bit.
- Hardware flow control and synchronous operation are not supported.

Tracking 3 satellite constellations concurrently generates too much data, and while using the port baud rate at 9600 bps, there is a high risk of data loss. When using GPS + GLONASS + Galileo, in order to avoid any loss of NMEA data packets, set the port baud rate to at least 19200 bps. Make sure that the MCU port speed is modified as well.

If the UART pins of the MCU and the UART pins of the module have the same voltage, they can be cross-connected. If this is not the case, refer to the reference circuit below. In the figure below, the VCC_IO_MCU and VCC_IO_Module stand for the UART pins' voltage of the MCU and the UART pins' voltage of the module, respectively.

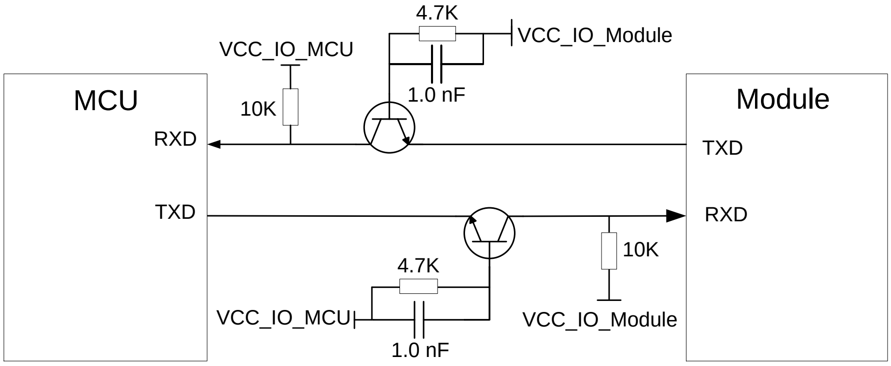

Figure 13: UART Interface Reference Design

By default, the UART port only supports the CMOS level. The RS-232 level is not supported. Therefore, when the module's UART port is connected to the UART port of a computer, it is necessary to add a level shift circuit between the module and the computer. A reference design is provided below.

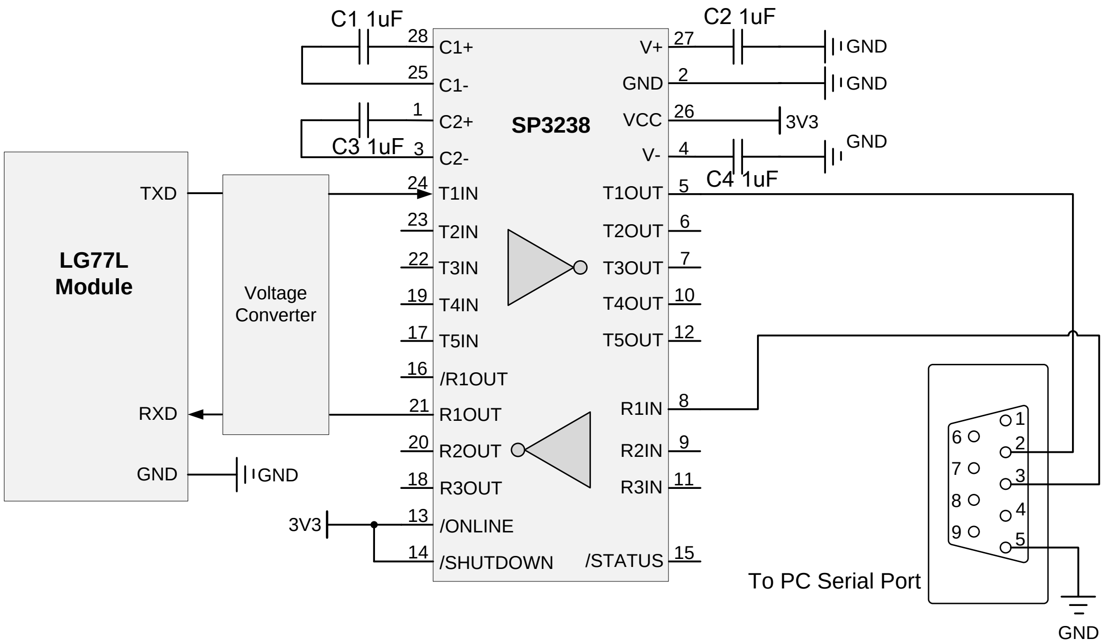

Figure 14: RS-232 Level Shift Circuit

NOTE

If the I/O port voltage level of MCU does not match with that of the module, a level shifter must be selected.

4.1.1.2. I2C Interface (Optional)

The Quectel LG77L module provides an I2C interface with a dedicated firmware version. When the interface is supported, it is used to output NMEA messages by default. The module also supports the receiving of software commands through the I2C bus.

I2C interface features are listed below:

- Supports fast mode, with bit rates up to 400 kbps;
- Supports 7-bit address;
- Operates in slave mode;
- Open-drain output;
- The default I2C address values: Write: 0x20; Read: 0x21.

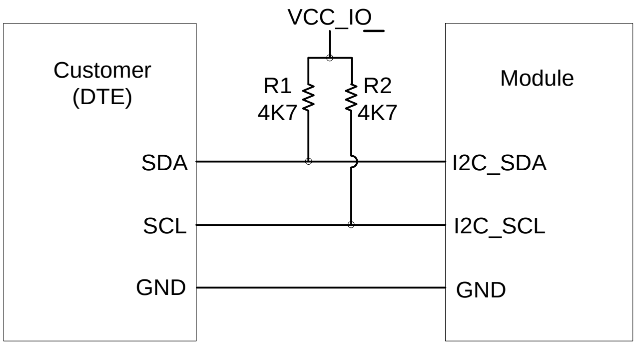

Figure 15: I2C Interface Reference Design

NOTE

1. If the I/O port voltage level of MCU does not match with that of the module, a level shifter must be selected.
2. The I2C interface is supported only on firmware versions ending with “SC”. When the I2C interface is supported, NMEA data should be outputted via an I2C interface rather than the UART interface.

4.1.2. 3D_FIX

The 3D_FIX is assigned as a fix flag output. The pin will output a logic high level voltage to indicate successful positioning.

4.1.3. JAM_IND

The LG77L provides an indicator signal to indicate whether there is any jamming that may impact on the module. If there is any jamming, the JAM_IND pin outputs a logic low level voltage, otherwise it outputs a logic high level voltage.

4.1.4. 1PPS

The 1PPS output generates one pulse per second trains synchronized with a GPS or UTC time grid with intervals configurable over a wide range of frequencies. The accuracy is < 50 ns. Thus, it may be used as a low frequency time synchronization pulse or as a high frequency reference signal.

4.2. System Pins

4.2.1. Clock

4.2.1.1. LG77L (A) Clock

There is no 32.768 kHz clock crystal inside the LG77L (A) module, so a 32.768 kHz crystal or clock signal must be provided externally. Otherwise, the LG77L (A) module will not start up or work properly. To achieve adequate accuracy of the clock signal, at least 20 ppm needs to be assured.

There are two methods to provide a 32.768 kHz clock signal:

- Using a 32.768 kHz crystal.
- From a MCU that sends the 32.768 kHz clock signal.

The two reference designs shown below illustrate each of these methods.

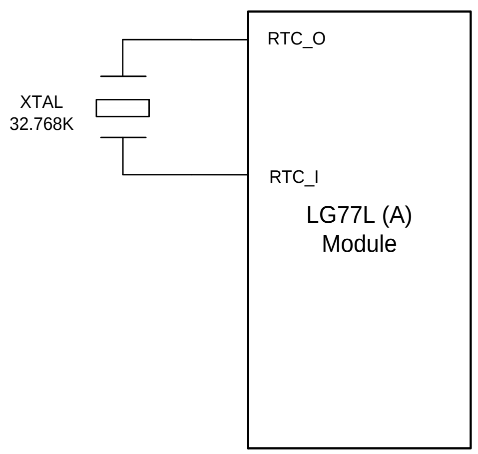

Figure 16: Clock Signal from External Crystal

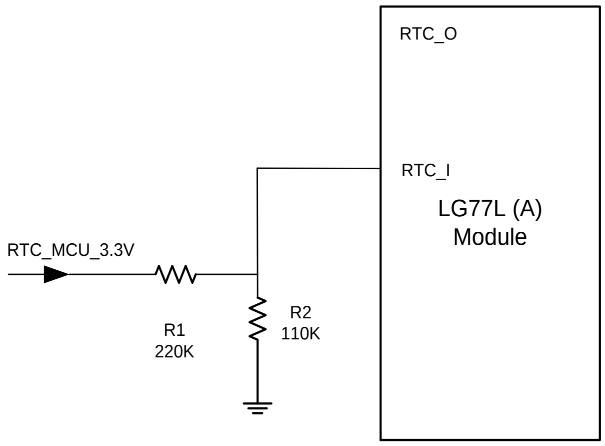

Figure 17: Clock Signal from MCU

In the second method shown in the figure above, the signal amplitude of the MCU is 3.3 V, and the RTC_I pin domain is 1.1 V. If the supply voltage of the MCU is inconsistent, the resistance values of R1 and R2 need to be adjusted. The accuracy of the resistances should be 1 %. If the clock signal sent by the MCU is used, connect the MCU clock signal to the module's RTC_I pin. The RTC_O pin should remain floating. The R1 and R2 resistors should be mounted.

NOTE

1. In order to ensure normal operation of the module, an external 32.768 kHz clock signal must be provided. The resonance capacitors are integrated inside the module.
2. The external TCXO, however, is not needed, as the module has an integrated one.

4.2.1.2. LG77L (B) and LG77L (C) Clock

The LG77L (B) and LG77L (C) have an integrated 32.768 kHz crystal, so they do not need any external crystal.

4.2.2. RESET_N

RESET_N is an input pin. The module can be reset by driving RESET_N low for at least 100 ms and then releasing it.

RESET_N is pulled up internally by default. As the power domain of RESET_N is VCC_IO and the pin has been pulled up inside the module, no external pull-up circuit is allowed for this pin.

An OC driver circuit as shown below is recommended to control the RESET_N pin.

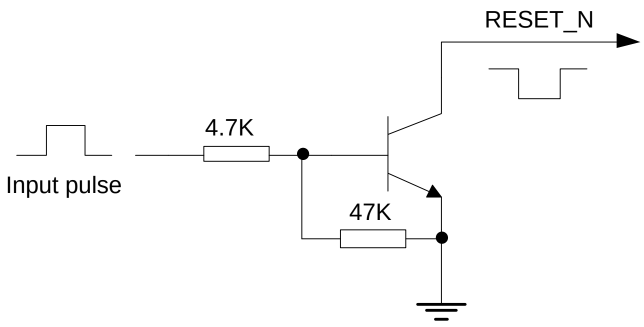

Figure 18: Reference OC Circuit for Module Reset

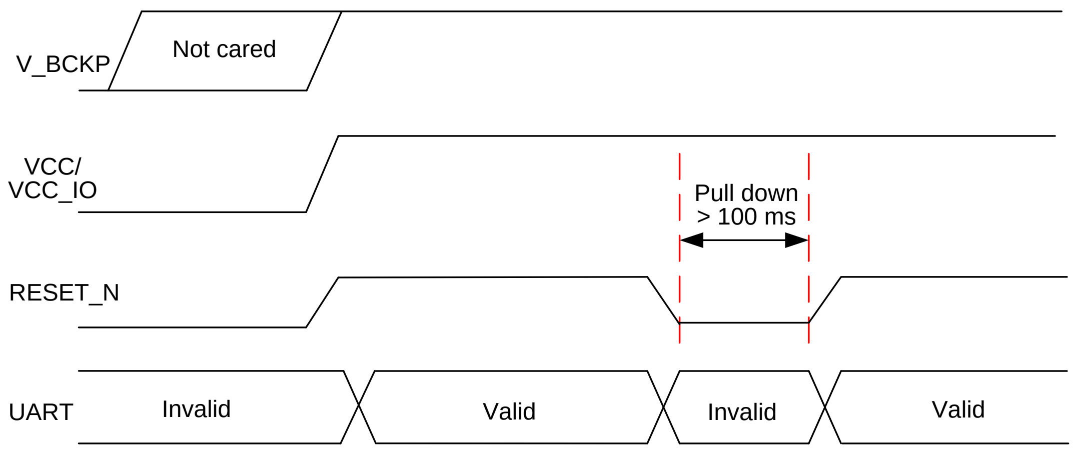

Figure 19: Reset Sequence

NOTE

1. Ensure RESET_N is connected so that it can be used to reset the module if the module enters an abnormal state.
2. Reset will force the loss of volatile RAM data, and the data in the non-volatile backup RAM will not be cleared, so fast TTFF is still possible.

5 Design

5.1. Recommended Footprint

The figure below describes module footprint. These are recommendations, not specifications.

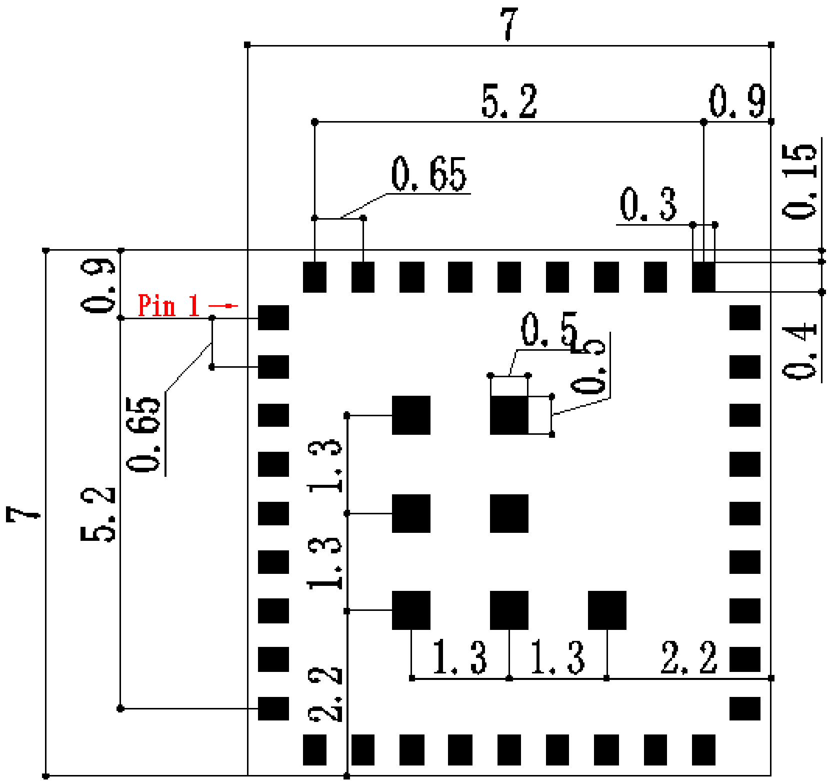

Figure 20: Recommended Footprint

NOTE

For easy maintenance, keep a distance of at least 3 mm between the module and other components on the motherboard.

5.2. Antenna Design

5.2.1. Antenna Specification

The Quectel LG77L module can be connected to a dedicated passive or active single-band GNSS antenna to receive GPS, Galileo (only for LG77L (C)), GLONASS, BeiDou and QZSS satellite signals. The recommended antenna specifications are given in the table below.

Table 7: Recommended Antenna Specifications

Antenna Type	Specifications
Passive Antenna	Frequency Range: 1559–1609 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi
Active Antenna	Frequency Range: 1559–1609 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi Active Antenna Noise Figure: < 1.5 dB Active Antenna Total Gain: < 35 dB

NOTE

The total gain of the whole antenna is the internal LNA gain minus total insertion loss of cables and components inside the antenna.

5.2.2. Antenna Selection Guide

Both active and passive GNSS antennas can be used for the Quectel LG77L module. A passive antenna is recommended if the antenna can be placed close to the module, for instance, when the distance between the module and the antenna is less than 1 m. Otherwise, use an active antenna, since the insertion loss of RF cable can decrease the CNR of GNSS signal.

CNR is an important factor for GNSS receivers, and it is defined as the ratio of the received modulated carrier signal power to the received noise power in one Hz bandwidth. CNR formula is as below:

$$\text{CNR} = \text{Power of GNSS signal} - \text{Thermal Noise} - \text{System NF(dB-Hz)}$$

The "Power of GNSS signal" is GNSS signal level. In practical environment, the signal level at the earth surface is about -130 dBm. "Thermal Noise" is -174 dBm/Hz at 290 K. To improve CNR of GNSS signal, a LNA could be added to reduce "System NF".

"System NF", formula:

$$NF = 10 \log F \text{ (dB)}$$

"F" is the noise factor of receiver system:

$$F = F1 + (F2 - 1)/G1 + (F3 - 1)/(G1 \cdot G2) + \cdots$$

"F1" is the first stage noise factor, "G1" is the first stage gain, etc. This formula indicates that LNA with enough gain can compensate for the noise factor behind the LNA. In this case, "System NF" depends mainly on the noise figure of components and traces before first stage LNA plus noise figure of LNA itself. This explains the need for using an active antenna, if the antenna connection cable is too long.

5.2.3. Active Antenna Reference Design

5.2.3.1. Active Antenna without Antenna Status Detection

The following figure is a typical reference design of an active antenna without antenna status detection. In this case, the antenna is powered by a separate 3.3 V power supply. When selecting the active antenna, it is necessary to pay attention to operating voltage range.

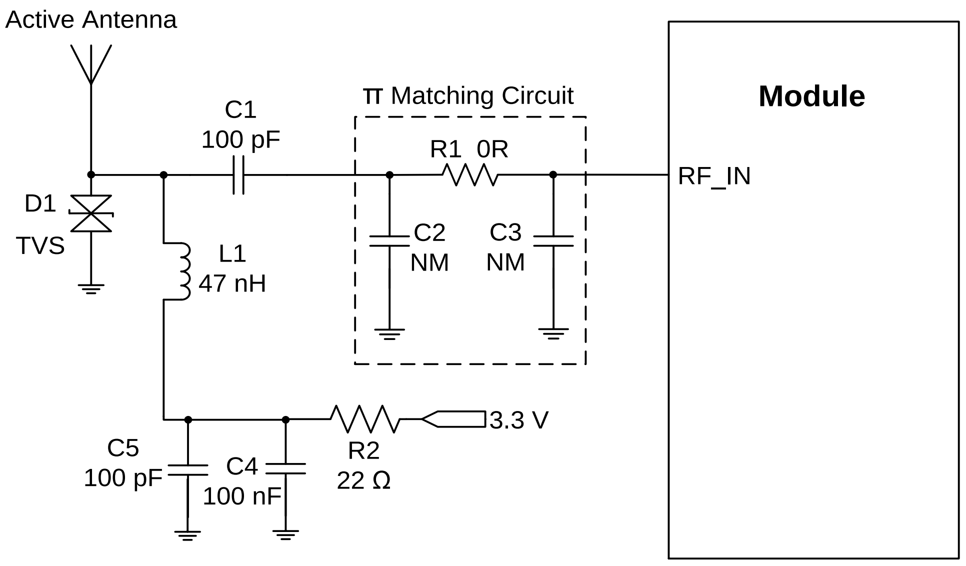

Figure 21: Active Antenna Reference Design without Antenna Status Detection

The components C2, R1 and C3 are reserved for matching antenna impedance. By default, R1 is 0 Ω, while C2 and C3 are not mounted; C1 is 100 pF; D1 is an electrostatic discharge (ESD) protection device to protect the RF signal input from the potential damage caused by ESD.

An active antenna can use the power supply from a separate 3.3 V power supply. In that case, the inductor L1 is used to prevent the RF signal from leaking into the separate power supply and to prevent noise propagation from the separate power supply to the antenna. The L1 inductor routes the bias voltage to the active antenna without losses. The recommended value of L1 is no less than 47 nH. The resistor R2 is used to protect the module in case the active antenna is short-circuited to the ground plane.

The existing footprints in the matching circuit can be used to mount other type of components than the ones presented in the figure above. In that case, you must pay attention to the DC power supply. For example, if an inductor is mounted on the C1 footprint, then the circuit needs a DC-blocking capacitor between L1 and C1 to prevent short-circuiting of the DC power supply through the inductor to the ground. The same applies to the C2 footprint.

5.2.3.2. Active Antenna with Antenna Status Detection

The following figure is a typical reference design of an active antenna with antenna status detection. In this design, short circuit or open circuit of antenna can be detected. When a short circuit is detected, the power supply of the antenna will be turned off immediately.

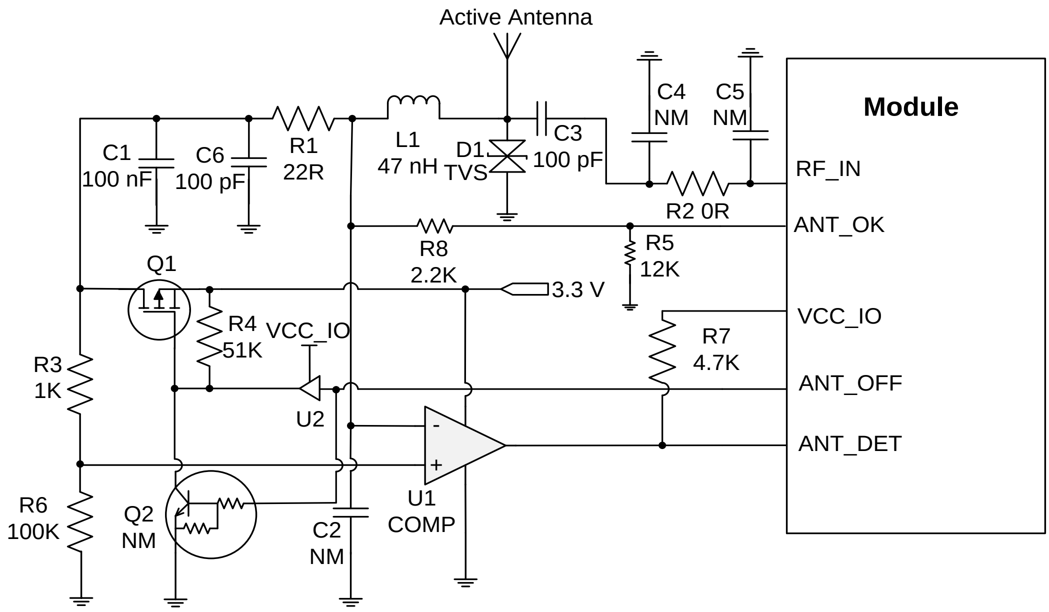

Figure 22: Active Antenna Reference Design with Antenna Status Detection

In the above reference design, the values of resistors R5 and R8 are applicable only when VCC = 3.3 V and VCC_IO = 2.8 V. For different VCC or VCC_IO voltage values, the values of R5 and R8 should be adjusted accordingly to ensure that V_{IH}nom (ANT_OK) = VCC_IO.

- In the current firmware version, the ANT_OFF pin is at a low level when the antenna is connected normally or is open-circuited, and is at a high level when the antenna is short-circuited. In this case,

the circuit needs to mount U2, and the Q2 should not be mounted.
- The Q2 is designed to ensure compatibility and, therefore, is not generally mounted. To allow for possible software version upgrades, it is recommended to reserve Q2 in the circuit design.

NOTE

1. In the above design, the R1 resistor is mandatory; otherwise, the module may become permanently damaged because of the possible short-circuit of the active antenna.
2. The U1 is a universal open-drain output comparator. Quectel recommends ADCMP370 comparator from Analog Devices.
3. The U2 is a buffer, powered by the VCC_IO. The SN74LVC1G07DBV from Texas Instruments is recommended.

The active antenna status detection circuit includes two detection pins and one control pin. The control logic is shown in the table below.

Table 8: Active Antenna Detection Circuit Control Logic

Detection Pins		Control Pin	Antenna Status
ANT_OK	ANT_DET	ANT_OFF	
1	1	0	Normal
1	0	0	Open circuit
0	1	1	Short circuit

5.2.4. Passive Antenna Reference Design

The following figure is a typical reference design of a passive antenna.

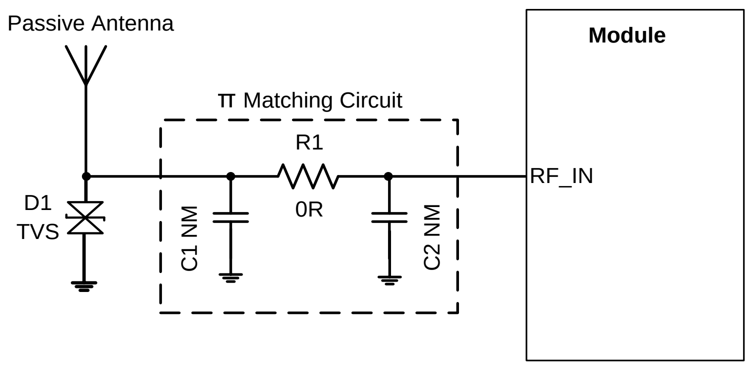

Figure 23: Passive Antenna Reference Design

The components C1, R1 and C2 are reserved for matching antenna impedance. By default, R1 is 0 Ω, while C1 and C2 are not mounted. D1 is an electrostatic discharge (ESD) protection device to protect one signal line from the damage caused by ESD. The impedance of RF trace should be controlled to 50 Ω and the trace length should be kept as short as possible.

5.3. Coexistence with Cellular Systems

Since GNSS signals are usually very weak, a GNSS receiver could be vulnerable to the interference of the surrounding environment. According to 3GPP specifications, a cellular terminal should transmit a signal of up to 33 dBm at GSM bands, or of about 24 dBm at WCDMA and LTE bands. As a result, coexistence with cellular systems must be optimized to avoid significant deterioration of the GNSS performance.

In a complex communication environment, interference signals can come from in-band and out-of-band signals. Therefore, interference can be divided into two types: in-band interference and out-of-band interference, which are both described in this chapter.

In this chapter, you can also find suggestions for decreasing the impact of interference signals that will ensure the interference immunity of a GNSS receiver.

5.3.1. In-Band Interference

In-band interference refers to the signal whose frequency is within or near the operating frequency range of a GNSS signal.

See the following figure for more details.

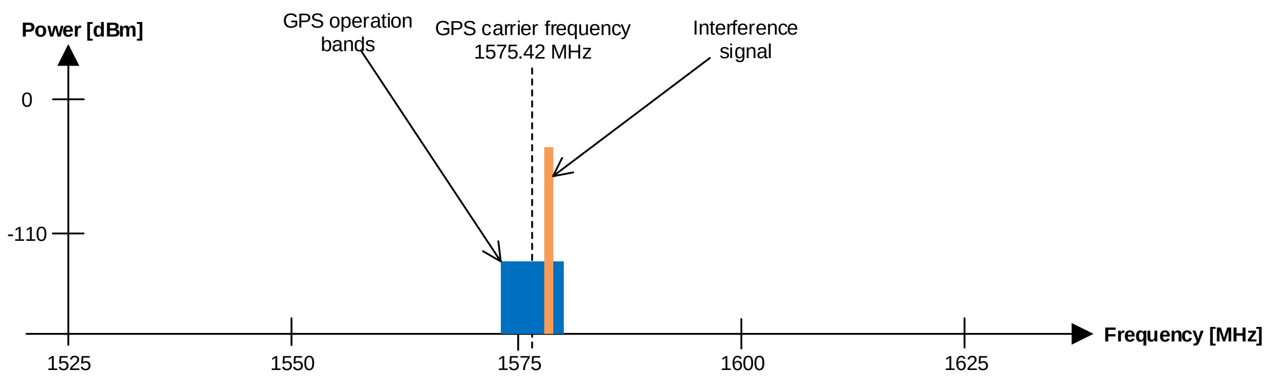

Figure 24: In-Band Interference on GPS L1

The most common in-band interferences usually come from:

- Harmonics, caused by crystals, high-speed signal lines, MCUs, switch-mode power supply etc., or
- Intermodulation from different communication systems.

Common frequency combinations are presented in the table below. The table lists some probable in-band interferences generated by two kinds of out-of-band signal intermodulation, or the second harmonic of LTE B13.

Table 9: Intermodulation Distortion (IMD) Products

Source F1	Source F2	IM Calculation	IMD Products
GSM850/B5	Wi-Fi 2.4 GHz	F2 (2412 MHz) - F1 (837 MHz)	IMD2 = 1575 MHz
DCS1800/B3	PCS1900/B2	2 × F1 (1712.6 MHz) - F2 (1850.2 MHz)	IMD3 = 1575 MHz
PCS1900/B2	Wi-Fi 5 GHz	F2 (5280 MHz) - 2 × F1 (1852 MHz)	IMD3 = 1576 MHz
LTE B13	N/A	2 × F1 (786.9 MHz)	IMD2 = 1573.8 MHz

5.3.2. Out-of-Band Interference

Strong signals transmitted by other communication systems can cause a GNSS receiver to become saturated, so that its performance is greatly deteriorated, as illustrated in the following figure.

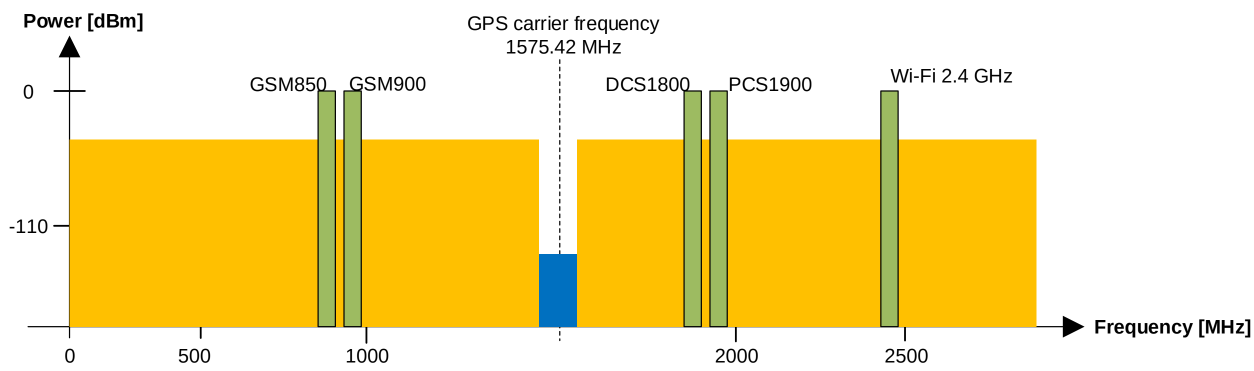

Figure 25: Out-of-Band Interference on GPS L1

5.3.3. Ensuring Interference Immunity

There are several things you can do to decrease the impact of interference signals and thus ensure the interference immunity of a GNSS receiver:

- Keep the GNSS antenna away from interference sources;
- Add a band-pass filter in front of the GNSS module;
- Use shielding and multi-layer PCB and ensure adequate grounding;
- Optimize layout and component placement of the PCB and the whole device.

The following figure illustrates the interference source and its possible interference path. In a complex communication system, there are usually RF power amplifiers, MCUs, crystals, etc. These devices should be far away from a GNSS receiver, or a GNSS module. In particular, shielding should be used to prevent strong signal interference for power amplifiers. The cellular antenna should be placed away from a GNSS receiving antenna to ensure enough isolation. Usually, a good design should provide at least a 20 dB isolation between two antennas. Take DCS1800, for example, the maximum transmitted power of DCS1800 is around 30 dBm. After a 20 dB attenuation, the signal received by the GNSS antenna will be around 10 dBm, which is still too high for a GNSS module. With a GNSS band-pass filter with around 40 dB rejection in front of the GNSS module, the out-of-band signal will be attenuated to -30 dBm.

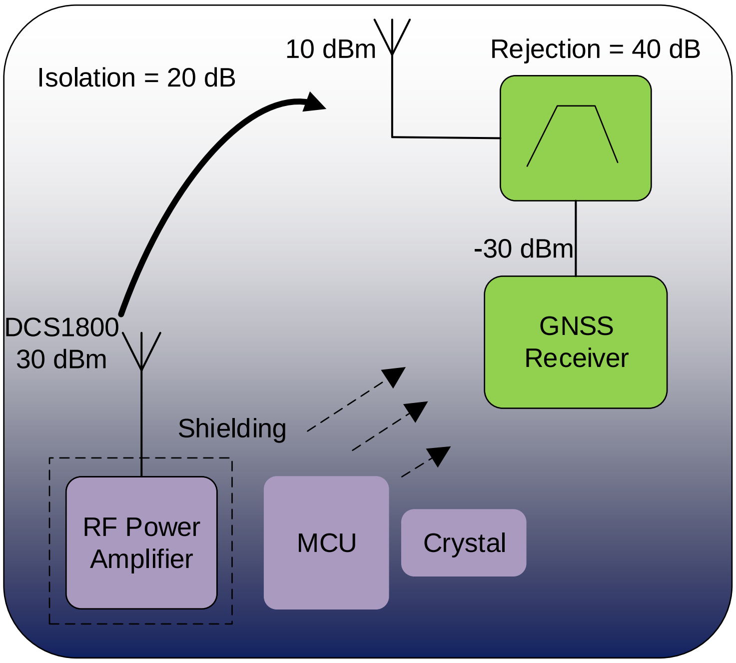

Figure 26: Interference Source and Its Path

6 Electrical Specification

6.1. Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital pins of the Quectel LG77L module are listed in table below.

Table 10: Absolute Maximum Ratings

Parameter	Description	Min.	Max.	Unit
VCC	Main Power Supply Voltage	-0.3	4.3	V
V_BCKP	Backup Supply Voltage	-0.3	4.5	V
V_{IN}_IO	Input Voltage at I/O Pins	-0.2	3.1	V
P_{RF_IN}	Input Power at RF_IN	-	15	dBm
T_storage	Storage Temperature	-40	90	°C

NOTE

Stressing the device beyond the “Absolute Maximum Ratings” may cause permanent damage. The product is not protected against over-voltage or reversed voltage. Therefore, it is necessary to use appropriate protection diodes to keep voltage spikes within the parameters given in the table above.

6.2. Recommended Operating Conditions

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

Table 11: Recommended Operating Conditions

<table>
<tr><th>Parameter</th><th colspan="2">Description</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>VCC</td><td colspan="2">Main Power Supply Voltage</td><td>2.8</td><td>3.3</td><td>4.3</td><td>V</td></tr>
<tr><td>V_BCKP</td><td colspan="2">Backup Supply Voltage</td><td>2.0</td><td>3.3</td><td>4.3</td><td>V</td></tr>
<tr><td rowspan="2">VCC_IO</td><td rowspan="2">Domain Voltage at Digital I/O Pins</td><td>1.8 V domain</td><td>1.62</td><td>1.8</td><td>1.98</td><td rowspan="2">V</td></tr>
<tr><td>2.8 V domain</td><td>2.52</td><td>2.8</td><td>3.08</td></tr>
<tr><td>V_{IL}</td><td colspan="2">Digital I/O Pin Low-Level Input Voltage</td><td>-0.3</td><td>-</td><td>0.25 × VCC_IO</td><td>V</td></tr>
<tr><td>V_{IH}</td><td colspan="2">Digital I/O Pin High-Level Input Voltage</td><td>0.7 × VCC_IO</td><td>VCC_IO</td><td>VCC_IO + 0.3</td><td>V</td></tr>
<tr><td>V_{OL}</td><td colspan="2">Digital I/O Pin Low-Level Output Voltage</td><td>-0.3</td><td>-</td><td>0.15 × VCC_IO</td><td>V</td></tr>
<tr><td>V_{OH}</td><td colspan="2">Digital I/O Pin High-Level Output Voltage</td><td>0.85 × VCC_IO</td><td>VCC_IO</td><td>3.6</td><td>V</td></tr>
<tr><td>RESET_N</td><td colspan="2">Low-Level Voltage</td><td>-0.3</td><td>-</td><td>0.25 × VCC_IO</td><td>V</td></tr>
<tr><td>T_operating</td><td colspan="2">Operating Temperature</td><td>-40</td><td>25</td><td>+85</td><td>°C</td></tr>
</table>

NOTE

Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

6.3. ESD Protection

The Quectel LG77L module is an ESD sensitive device. Therefore, proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the module.

The following measures ensure ESD protection when the module is handled:

- When mounting the module onto a motherboard, make sure to connect the GND first, and then the RF_IN pad.
- When handling the RF_IN pad, do not come into contact with any charged capacitors or materials that may easily generate or store charges (such as patch antenna, coaxial cable, soldering iron, etc.).
- When soldering the RF_IN pin, make sure to use an ESD safe soldering iron (tip).

7 Mechanical Dimensions

This chapter describes the mechanical dimensions of the module. All dimensions are in millimeters (mm). The dimensional tolerances are ±0.20 mm, unless otherwise specified.

7.1. Top, Side and Bottom View Dimensions

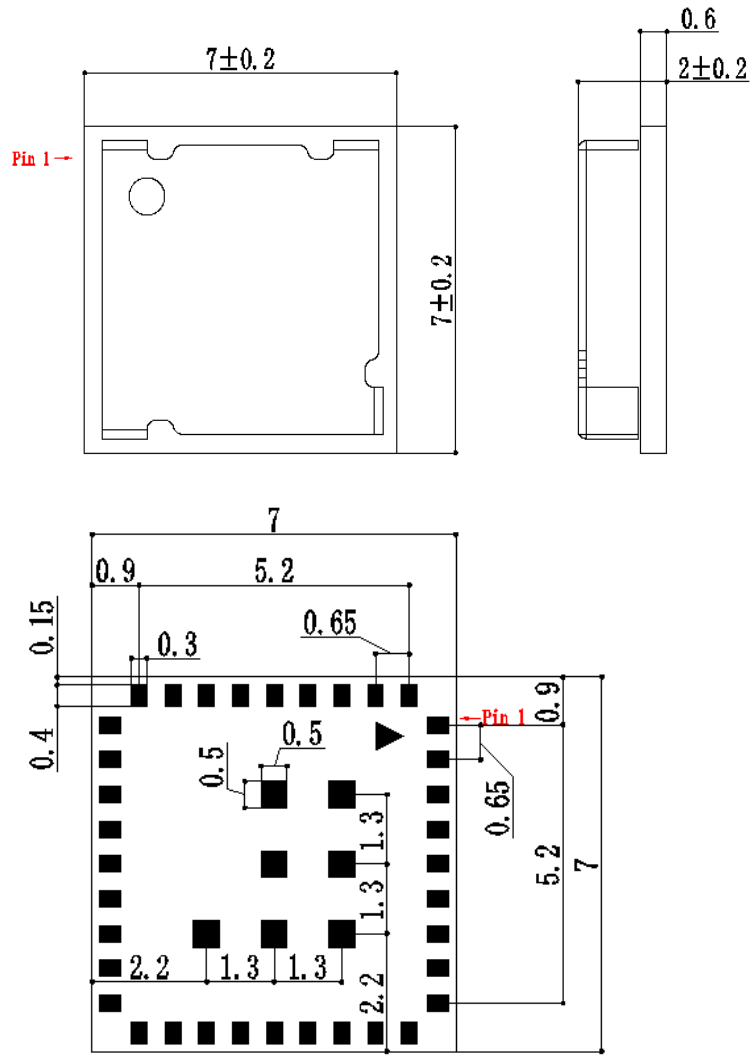

Figure 27: Top, Side and Bottom View Dimensions

NOTE

The package warpage level of the module conforms to the *JEITA ED-7306* standard.

7.2. Top and Bottom Views

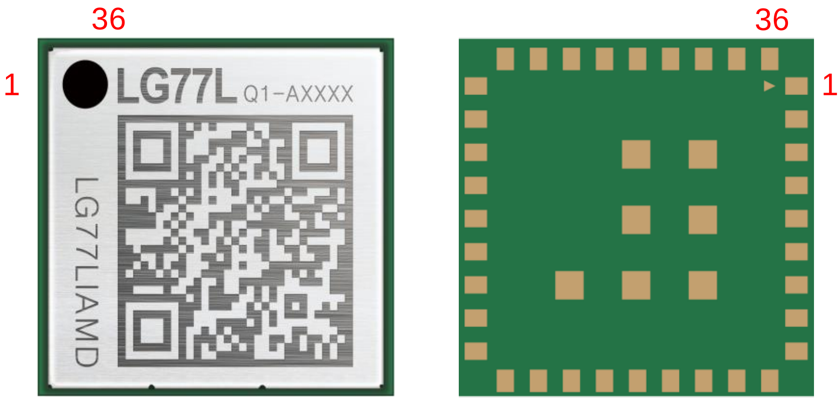

Figure 28: Top and Bottom Views of the Module

NOTE

The images above are for illustrative purposes only and may differ from the actual module. For authentic appearance and label, see the module received from Quectel.

8 Product Handling

8.1. Packaging

The Quectel LG77L module is delivered as a reeled tape, which enables efficient production, set-up and dismantling of production batches. It is shipped in a vacuum-sealed packaging to prevent moisture intake and electrostatic discharge.

8.1.1. Tapes

The following figure shows the position of the Quectel LG77L module when delivered in tape and the dimensions of the tape.

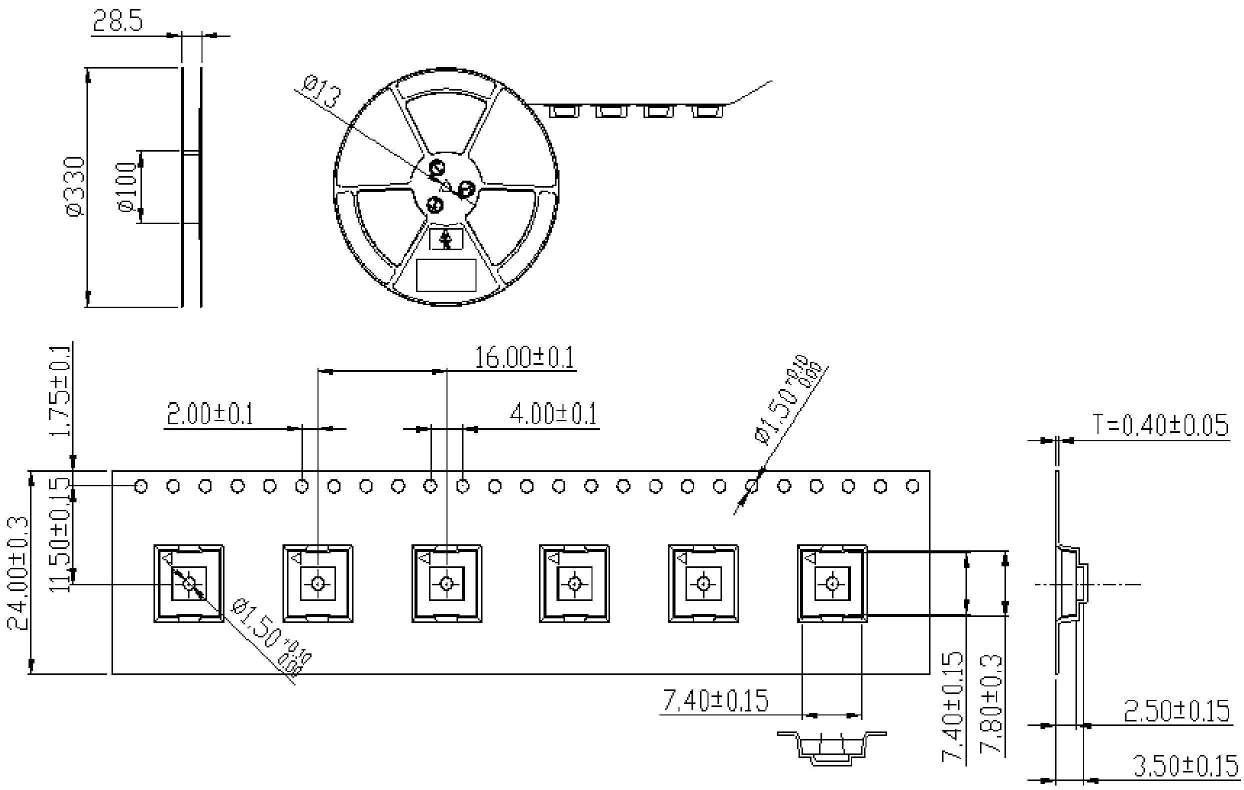

Figure 29: Tape and Reel Specifications

8.1.2. Reels

Each reel contains 500 Quectel GNSS modules. See the figure above.

Table 12: Packaging Specifications

Model Name	MOQ	Minimum Package (MP): 500 pcs	Minimum Package x 4 = 2000 pcs
LG77L	500 pcs	Size: 363 mm × 343 mm × 41 mm N.W: 0.1 kg G.W: 0.75 kg	Size: 380 mm × 190 mm × 365 mm N.W: 0.4 kg G.W: 3.46 kg

8.2. Storage

The module is provided in the vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are listed below.

1. Recommended storage conditions: The temperature should be 23 ±5 °C and the relative humidity should be 35–60 %.

2. The storage life (in vacuum-sealed packaging) is 12 months in Recommended Storage Condition.

3. The floor life of the module is 168 hours [4] in a plant where the temperature is 23 ±5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g., a drying cabinet).

4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:

   - The module is not stored under Recommended Storage Condition;
   - Violation of the third requirement above occurs;
   - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
   - Before module repairing.

5. If needed, the pre-baking should follow the requirements below:
   - The module should be baked for 8 hours at 120 ±5 °C;

[4] This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. And do not remove the packages of tremendous modules if they are not ready for soldering.

- All modules must be soldered to the PCB within 24 hours after the baking, otherwise they should be put in a dry environment such as a drying oven.

NOTE

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. All modules must be soldered to PCB within 24 hours after the baking, otherwise put them in the drying oven. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

8.3. Manufacturing and Soldering

Push the squeegee to apply solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. For more information about the stencil thickness for the module, see ***document [5]***.

The peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid module damage caused by repeated heating, it is strongly recommended that the module should be mounted to the PCB only after reflow soldering of the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown in the figure and table below.

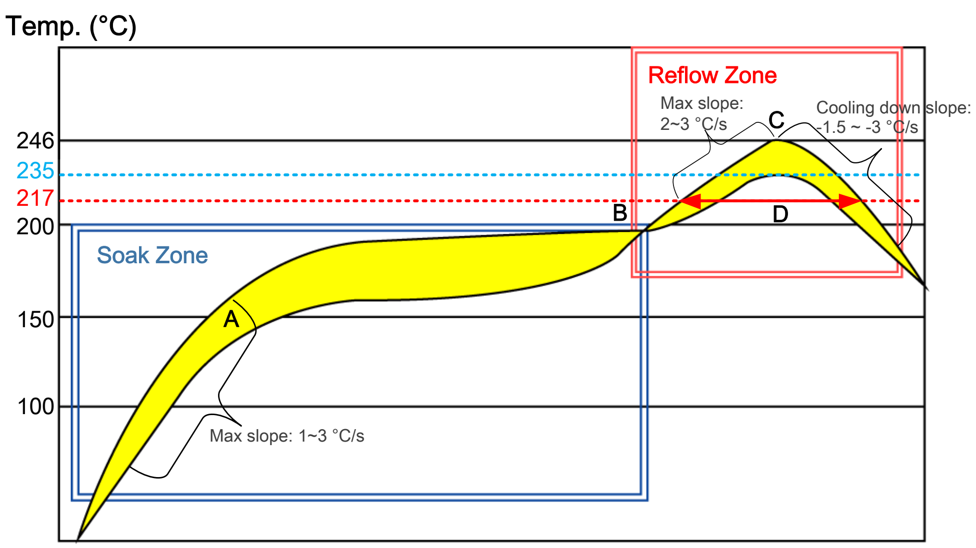

Figure 30: Recommended Reflow Soldering Thermal Profile

Table 13: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Max slope	1–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Max slope	2–3 °C/s
Reflow time (D: over 217 °C)	40–70 s
Max temperature	235 °C to 246 °C
Cooling down slope	-1.5 to -3 °C/s
Reflow Cycle	
Max. reflow cycle	1

NOTE

1. During manufacturing and soldering, or any other processes that may require direct contact with the module, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusty.
2. The module shielding can be made of cupronickel base material. The Neutral Salt Spray Test has shown that after 12 hours the laser-engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
3. If a conformal coating is necessary for the module, **DO NOT** use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.

9 Labelling Information

The label of the Quectel GNSS modules contains important product information. The location of the product type number is shown in figure below.

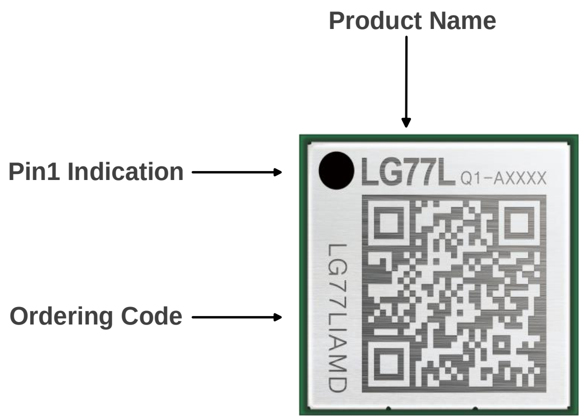

Figure 31: Labelling Information

The image above is for illustrative purposes only and may differ from the actual module. For authentic appearance and label, see the module received from Quectel.

10 Appendix A References

Table 14: Related Documents

Document Name
[1] Quectel_L76-LB&L26-LB&LC86L&LG77L(A)&LG77L(B)_GNSS_Protocol_Specification
[2] Quectel_L26&LG77L(C)_GNSS_Protocol_Specification
[3] Quectel_GNSS_Flash_EPO_Application_Note
[4] Quectel_LG77L_Reference_Design
[5] Quectel_Module_Secondary_SMT_Application_Note
[6] Quectel_GNSS_SDK_Commands_Manual

Table 15: Terms and Abbreviations

Abbreviation	Description
AGNSS	Assisted Global Positioning System
AIC	Active Interference Cancellation
bps	bits per second
CMOS	Complementary Metal-Oxide-Semiconductor
CNR	Carrier-to-noise Ratio
DCS1800	Digital Cellular System at 1800 MHz
DTE	Data Terminal Equipment
EASY™	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit

ESD	Electrostatic Discharge
GAGAN	GPS Aided Geo Augmented Navigation
Galileo	Galileo Satellite Navigation System (EU)
GLONASS	Global Navigation Satellite System (Russian)
GLP	GNSS Low Power
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
G.W	Gross Weight
I/O	Input /Output
I2C	Inter-Integrated Circuit
IC	Integrated Circuit
IM	Intermodulation
IMD	Intermodulation Distortion
kbps	kilobits per second
LDO	Low-dropout Regulator
LGA	Land Grid Array
LNA	Low-Noise Amplifier
LTE	Long Term Evolution
LTO	Long-term Orbit
MCU	Microcontroller Unit/Microprogrammed Control Unit
MOQ	Minimum Order Quantity
MP	Mass Production
MSAS	Multi-functional Satellite Augmentation System (Japan)
MSL	Moisture Sensitivity Levels
N.W	Net Weight

NMEA	National Marine Electronics Association
OC	Open Connector
PCB	Printed Circuit Board
PMU	Power Management Unit
ppm	parts per million
1PPS	One Pulse Per Second
PQ	Quectel Proprietary Protocol
PSRR	Power Supply Rejection Ratio
QR (code)	Quick Response (Code)
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RHCP	Right Hand Circular Polarization
RMC	Recommended Minimum Specific GNSS Data
RoHS	Restriction of Hazardous Substances
ROM	Read Only Memory
RTC	Real-Time Clock
RTCM	Radio Technical Commission for Maritime Services
RTK	Real-Time Kinematic
RXD	Receive Data
3GPP	3rd Generation Partnership Project
SAW	Surface Acoustic Wave
SBAS	Satellite-Based Augmentation System
SCL	Serial Clock
SMD	Surface Mount Device
SMT	Surface Mount Technology
SN	Serial Number

SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
TBD	To Be Determined
TCXO	Temperature Compensated Crystal Oscillator
TTFF	Time to First Fix
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver/Transmitter
UTC	Coordinated Universal Time
VSWR	Voltage Standing Wave Ratio
VTG	Course Over Ground & Ground Speed
WAAS	Wide Area Augmentation System
WCDMA	Wideband Code Division Multiple Access