LC76G Series
Hardware Design

GNSS Module Series

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Status: Released

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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	
Title	**LC76G Series Hardware Design**
Subtitle	GNSS Module Series
Document Type	Hardware Design
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Revision History

Version	Date	Description
-	2022-05-11	Creation of the document
1.0	2022-07-14	First official release
1.1	2023-02-09	1. Added the applicable variant LC76G (PB). 2. Added I2C function for LC76G (PA). 3. Added the ALP mode (*Chapters 1.1, 1.3* and *3.3*). 4. Added the number of concurrent GNSS (*Table 2*). 5. Updated the power consumption under acquisition and tracking modes, TTFF, 1PPS accuracy signal of LC76G (AB) and LC76G (PA), and the power consumption under Backup mode, horizontal position accuracy and update rate of LC76G (PA), and added the power data (*Table 3*). 6. Added the DC characteristics of all pins (*Table 6*). 7. Reserved the AP_REQ pin (*Figure 1*, *Chapters 2* and *4.1*). 8. Added the supported messages for UART, SPI and I2C interfaces (*Table 6* and *Chapter 4.1*) 9. Added the 3.7 V lithium battery reference circuit (*Figure 7*). 10. Updated or added the description of Backup mode, including: The way to exit Backup mode; Notes of the way to exit Backup mode for LC76G (AB), the way to

Version	Date	Description
		enter Backup mode for LC76G (PA), and modules' approximate power consumption when they are forced into Backup mode without sending a software command (*Chapter 3.3.4*). 11. Updated the supported baud rates of UART interface (*Chapter 4.1.1.2*). 12. Updated the resistance of the pull-up resistors in I2C interface reference design (*Figure 13*). 13. Added the optional notch circuit and band-pass filter circuit to active and passive antenna reference designs, as well as the corresponding description (*Chapter 5.2*). 14. Updated the maximum input power at RF_IN for LC76G (AB) and LC76G (PA) (*Table 10*). 15. Updated the typical high-level input voltage of RESET_N and added the maximum output current of VDD_RF for LC76G (AB) and LC76G (PA) (*Table 12*). 16. Update the supply current for LC76G (PA) (*Chapter 6.3*). 17. Added the module mounting direction (*Chapter 8.1.3*). 18. Added the sizes of pizza box and carton (*Chapter 8.1.4*). 19. Updated the recommended ramp-to-soak, ramp-up and cool-down slopes (*Figure 25:* and *Table 17*).
1.2	2023-05-30	1. Added the power consumption in ALP mode for LC76G (AB) (*Table 3* and *Table 14*). 2. Added the requirement for GEOFENCE and 3D_FIX pins when the module is powered on (*Chapters 2*, *4.1.2* and *4.1.4*). 3. Deleted the notch circuit in antenna reference designs and corresponding description (*Chapter 5.2*).
1.3	2024-11-25	1. Updated product performance (*Table 3*): ● Updated test conditions for power consumption, TTFF (without AGNSS), accuracy of 1PPS signal, velocity accuracy, acceleration accuracy and dynamic performance. ● Updated power consumption in acquisition, tracking and ALP mode 1. ● Deleted the 3σ accuracy of 1PPS signal. ● Updated dynamic performance. 2. Added the ALP mode 2 (*Chapters 1.3* and *3.3*). 3. Updated the description of EASY function (*Chapter 1.7.1*). 4. Updated the software command for configuring geofence function (*Chapters 1.9* and *4.1.2*). 5. Updated D_SEL pin function (*Chapters 2* and *4.1.1.1*). 6. Updated the high-level minimum input voltage for RESET_N of LC76G (AB, PA) (*Chapters 2* and *6.2*). 7. Deleted the rechargeable battery circuit and related notes for the

Version	Date	Description
		V_BCKP pin (*Chapter 3.2.2*). 8. Updated the way and sequence of exiting Backup mode (*Chapter 3.3.4*). 9. Moved information related to antenna selection guide and coexistence with cellular systems to Quectel_GNSS_Antenna_Application_Note. 10. Added the out-of-band rejection of active antenna (*Table 9*). 11. Updated the supply current requirement (*Chapter 6.3*). 12. Updated the module coplanarity requirement (*Chapter 7.1*). 13. Updated manufacturing and soldering related information (*Chapter 8.3*): ● Updated the reference document for recommended module stencil thickness. ● Added the note specifying that mercury-containing materials should be avoided for module processing. ● Added the note prohibiting storage or use of unprotected modules in environments containing corrosive gases.

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1 Product Description

1.1. Overview

Quectel LC76G series module supports multiple global positioning constellations, such as GPS, GLONASS, Galileo, BDS and QZSS. The modules also support SBAS (including WAAS, EGNOS, MSAS and GAGAN) and AGNSS functions. The LC76G series comprises three variants: LC76G (AB), LC76G (PA) and LC76G (PB).

Key features:

- The single-band, multi-constellation GNSS module series features a high-performance, high reliability positioning engine facilitating fast and precise GNSS positioning.
- The LC76G (AB) is designed to meet standard application requirements while operating at 3.3 V, while the LC76G (PA) and the LC76G (PB) are super low power consumption variants operating at 3.3 V and 1.8 V respectively.
- Supported serial communication interfaces: UART, SPI and I2C.
- Supported advanced power saving modes: Backup mode and ALP mode.
- The embedded low-power algorithms make the LC76G series module suitable for different application scenarios.
- EASY technology facilitates achieving a faster Time to First Fix (TTFF) in either hot or warm start.
- The integrated flash memory provides the capacity for storing user-specific configurations and future firmware upgrades.

The LC76G is a series of SMD type modules with a compact form factor of 10.1 mm × 9.7 mm × 2.4 mm. They can be embedded in your applications through 18 LCC pins and 10 LGA pins.

The LC76G series is fully compliant with the EU RoHS Directive.

NOTE

Where applicable, this document will use the words module/modules when referring to common attributes and LC76G (AB), LC76G (PA) and LC76G (PB) when referring to attributes associated with a particular subset of module.

1.1.1. Special Mark

Table 1: Special Mark

Mark	Definition
●	The symbol indicates that a function or technology is supported by the module(s).

1.2. Features

Table 2: Product Features

Features		LC76G (AB)	LC76G (PA)	LC76G (PB)
Grade	Industrial	●	●	●
	Automotive	-	-	-
Category	Standard Precision GNSS	●	●	●
	High Precision GNSS	-	-	-
	DR	-	-	-
	RTK	-	-	-
	Timing	-	-	-
VCC Voltage	2.55–3.6 V, typ. 3.3 V	●	●	-
	1.75–1.98 V, typ. 1.8 V	-	-	●
V_BCKP Voltage	1.65–3.6 V, typ. 3.3 V	●	●	-
	1.65–3.6 V, typ. 1.8 V	-	-	●
I/O Voltage	Following VCC	●	●	●
Communication Interfaces	UART	●	●	●
	SPI	●	●	●
	I2C	●	●	●
	CAN	-	-	-

Features			LC76G (AB)	LC76G (PA)	LC76G (PB)
	USB		-	-	-
Integrated Features	Additional LNA		●	●	●
	Additional Filter		●	●	●
	RTC Crystal		●	●	●
	TCXO Oscillator		●	●	●
	6-axis IMU		-	-	-
Constellations and Frequency Bands	Number of Concurrent GNSS		4 + QZSS	4 + QZSS	4 + QZSS
	GPS	L1 C/A	●	●	●
		L5	-	-	-
		L2C	-	-	-
	GLONASS	L1	●	●	●
		L2	-	-	-
	Galileo	E1	●	●	●
		E5a	-	-	-
		E5b	-	-	-
	BDS	B1I	●	●	●
		B1C	●	●	●
		B2a	-	-	-
		B2I	-	-	-
	QZSS	L1 C/A	●	●	●
		L5	-	-	-
		L2C	-	-	-
	NavIC	L5	-	-	-
	SBAS	L1	●	●	●
Temperature Range			Operating temperature range: -40 °C to +85 °C Storage temperature range: -40 °C to +90 °C		

Features	LC76G (AB)	LC76G (PA)	LC76G (PB)
Physical Characteristics	Size: (10.1 ±0.15) mm × (9.7 ±0.15) mm × (2.4 ±0.20) mm Weight: Approx. 0.5 g		

NOTE

For more information about GNSS constellation configuration, see *document [1] protocol specification*.

1.3. Performance

Table 3: Product Performance

Parameter	Specification	LC76G (AB)	LC76G (PA)	LC76G (PB)
Power Consumption [1] (GPS + GLONASS + Galileo + BDS + QZSS)	Acquisition	33 mA (108.9 mW)	9.7 mA (32.01 mW)	15.6 mA (28.08 mW)
	Tracking	32.9 mA (108.57 mW)	9.7 mA (32.01 mW)	15.6 mA (28.08 mW)
	ALP Mode 1	10.5 mA (34.65 mW)	3.8 mA (12.54 mW)	5.4 mA (9.72 mW)
	ALP Mode 2	24.5 mA (80.85 mW)	7.5 mA (24.75 mW)	11.3 mA (20.34 mW)
	Backup Mode	13 μA (42.9 μW)	13 μA (42.9 μW)	13 μA (23.4 μW)
Sensitivity (GPS + GLONASS + Galileo + BDS + QZSS)	Acquisition	-147 dBm	-147 dBm	-147 dBm
	Reacquisition	-159 dBm	-159 dBm	-159 dBm
	Tracking	-166 dBm	-166 dBm	-166 dBm
TTFF [1] (without AGNSS)	Cold Start	28 s	28 s	28 s
	Warm Start	25 s	25 s	25 s
	Hot Start	1 s	1 s	1 s
TTFF [2] (with EASY)	Cold Start	15 s	15 s	15 s
	Warm Start	2 s	2 s	2 s

[1] Tested at room temperature, with typical operating voltage, and satellites signal of -130 dBm configured by the instrument.
[2] Open-sky, active high-precision GNSS antenna.

Parameter	Specification	LC76G (AB)	LC76G (PA)	LC76G (PB)
	Hot Start	1 s	1 s	1 s
TTFF [2] (with EPO)	Cold Start	5 s	5 s	5 s
Horizontal Position Accuracy [3]	Autonomous	1.5 m	1.5 m	1.5 m
Update Rate		1 Hz (Default); Max. 10 Hz	1 Hz	1 Hz
Accuracy of 1PPS Signal [1]	RMS	30 ns	30 ns	30 ns
Velocity Accuracy [1]	Without Aid	0.1 m/s	0.1 m/s	0.1 m/s
Acceleration Accuracy [1]	Without Aid	0.1 m/s²	0.1 m/s²	0.1 m/s²
Dynamic Performance [1]	Maximum Altitude	10000 m	10000 m	10000 m
	Maximum Velocity	490 m/s	490 m/s	490 m/s
	Maximum Acceleration	4g	4g	4g

1.4. Block Diagram

A block diagram of the module is presented below. It includes a front-end section with an additional LNA and an additional SAW filter. Other parts of the module include a TCXO, an XTAL and a GNSS IC with a PMU.

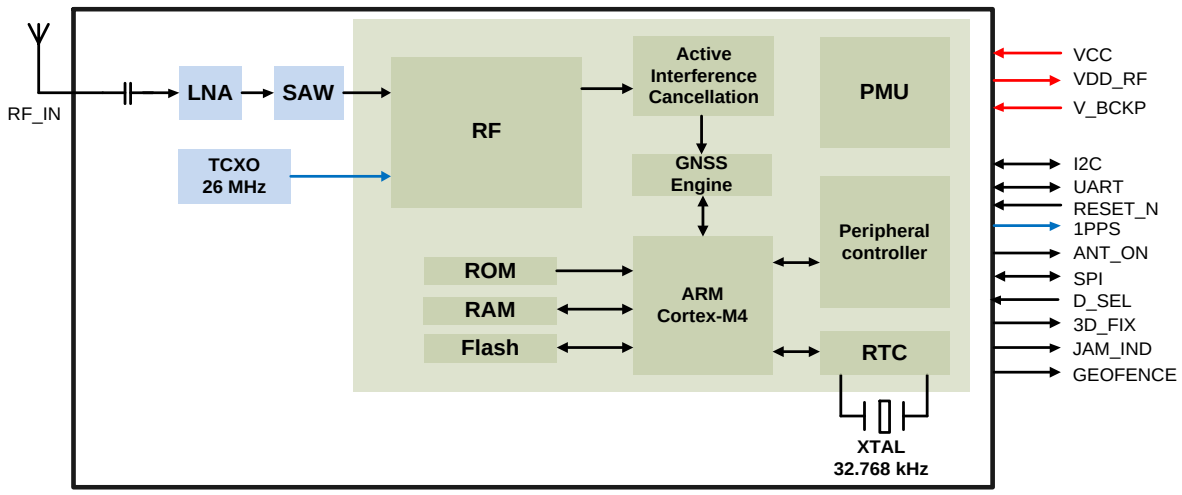


Figure 1: Block Diagram

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

1.5. GNSS Constellations

The module is a single-band GNSS receiver that can concurrently track signals from up to 4 GNSS constellations. Owing to its RF front-end architecture, it can concurrently track the following GNSS constellations: GPS, GLONASS, Galileo, BDS, and QZSS, plus SBAS satellites. If an intense low power consumption is the application's main a key factor, then the module can be configured for a subset of these 4 GNSS constellations.

QZSS is a regional navigation satellite system that transmits signals compatible with the GPS L1 C/A, L1C, L2C and L5 signals for the Pacific region covering Japan and Australia. The module can detect and track QZSS L1 C/A signal concurrently with GPS signals, leading to better availability especially under challenging conditions, e.g., in dense urban canyons.

Table 4: GNSS Constellations and Frequency Bands

System	Signal
GPS	L1 C/A: 1575.42 MHz
GLONASS	L1: 1602 MHz + K × 562.5 kHz, K= (-7 to +6, integer)
Galileo	E1: 1575.42 MHz
BDS	B1I: 1561.098 MHz B1C: 1575.42 MHz
QZSS	L1 C/A: 1575.42 MHz

1.6. Augmentation System

1.6.1. SBAS

The module supports SBAS signal reception. By augmenting primary GNSS constellations with additional satellite-broadcast messages, the system improves the accuracy and reliability of GNSS information by correcting signal measurement errors and providing information about signal accuracy, integrity, continuity and availability. SBAS transmits signals for ranging or distance measurement, thus further improving availability. Supported SBAS systems are WAAS, EGNOS, MSAS and GAGAN.

1.7. AGNSS

The module supports AGNSS feature that significantly improves the module's TTFF, especially under lower signal conditions. To implement the AGNSS feature, the module should get the assistance data including the current time and rough position. For more information, see *document [2] AGNSS application note*.

1.7.1. EASY

The module supports the EASY technology to improve TTFF by providing ancillary information, such as ephemeris and almanac.

The EASY technology works as an embedded software to reduce the TTFF duration 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 for up to 3 subsequent days, and saves the predicted information in the internal memory. The GNSS engine will use the information for positioning if there is not enough information from satellites, resulting in improved positioning and TTFF.

The EASY function can improve the TTFF to 2 s in warm start. In this case, the backup domain should still be valid.

The EASY function is enabled by default and it can be disabled by using the **PAIR490** command. For more information about the command, see *document [1] protocol specification*.

1.7.2. EPO

The module features a leading AGNSS technology called EPO, which assists the receiver to reduce the TTFF, and it's valid for up to 14 days. For more information about EPO, see *document [2] AGNSS application note*.

1.8. Multi-Tone AIC

The module includes a function called multi-tone Active Interference Cancellation (AIC), which is used to reduce the harmonic distortion of RF signals from Wi-Fi, Bluetooth, 2G, 3G, 4G and 5G networks.

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

The AIC function is enabled by default, and it can be disabled by using the **PAIR074** command. For more information, see *document [1] protocol specification*.

1.9. Geofencing

The module supports geofence areas, defined on the Earth's surface using a 2D model. Geofencing is active when at least one geofence area is defined. The current status can be found by polling the receiver. The receiver evaluates whether its current location is within a defined GEOFNECE region or not and signals its status via the GEOFENCE pin. The geofencing feature can be configured using the **PQTMCFGEOFENCE** command. The feature is activated once one or more geofences has been configured.

For more information about geofencing configuration, see *document [1] protocol specification*.

1.10. Firmware Upgrade

The module is delivered with preprogrammed firmware. Quectel may release firmware versions that contain bug fixes or performance optimizations. It is highly important to implement a firmware upgrade mechanism in your system. A firmware upgrade is the process of transferring a binary file image to the receiver and storing it in non-volatile flash. For more information, see *document [3] firmware upgrade guide*.

2 Pin Assignment

The module is equipped with 28 pins (18 LCC pins and 10 LGA pins) by which it can be mounted on your PCB.

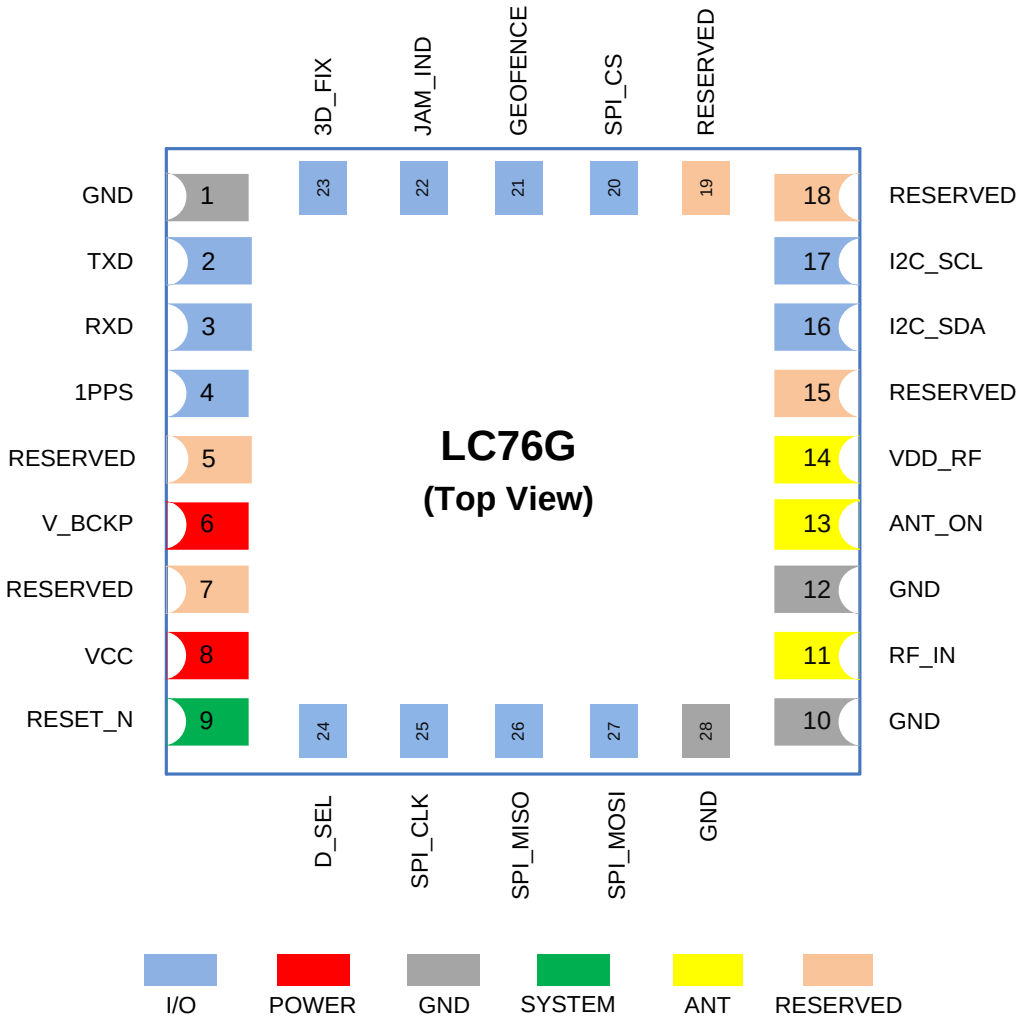


Figure 2: Pin Assignment

Table 5: I/O Parameter Definition

Type	Description
AI	Analog Input
DI	Digital Input
DIO	Digital Input/Output
DO	Digital Output
PI	Power Input
PO	Power Output

Table 6: Pin Description

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
Power	VCC	8	PI	Main power supply	For LC76G (AB, PA): $V_I$min = 2.55 V $V_I$nom = 3.3 V $V_I$max = 3.6 V For LC76G (PB): $V_I$min = 1.75 V $V_I$nom = 1.8 V $V_I$max = 1.98 V	Requires clean and steady voltage.
	V_BCKP	6	PI	Backup power supply for backup domain	For LC76G (AB, PA): $V_I$min = 1.65 V $V_I$nom = 3.3 V $V_I$max = 3.6 V For LC76G (PB): $V_I$min = 1.65 V $V_I$nom = 1.8 V $V_I$max = 3.6 V	V_BCKP must be connected to power supply for startup, and it should always be powered if hot (warm) start is needed.
I/O	TXD	2	DO	Transmits data	For LC76G (AB, PA): V_{OL}max = 0.4 V V_{OH}min = 2.4 V For LC76G (PB): V_{OL}max = 0.27 V V_{OH}min = 1.53 V	UART interface supports RTCM message, standard NMEA message, PAIR/PQTM message, binary data and firmware upgrade.

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
	RXD	3	DI	Receives data		
	D_SEL	24	DI	Selects interfaces for communication and firmware upgrade	For LC76G (AB, PA): V_{IL}min = -0.3 V V_{IL}max = 0.8 V V_{IH}min = 2.0 V V_{IH}max = VCC + 0.3 V For LC76G (PB): V_{IL}min = -0.3 V V_{IL}max = 0.45 V V_{IH}min = 1.35 V V_{IH}max = VCC + 0.3 V	D_SEL is internally pulled down by default. Upon startup, the module automatically detects the pin level to select communication and firmware upgrade interfaces. See *Chapter 4.1.1.1 Interface Selection (D_SEL)* for details.
	SPI_CLK	25	DI	SPI clock		SPI supports RTCM message, standard NMEA message, PAIR/PQTM message and firmware upgrade.
	SPI_CS	20	DI	SPI chip-select		
	SPI_MOSI	27	DI	SPI master out; slave in		
	SPI_MISO	26	DO	SPI master in; slave out	For LC76G (AB, PA): V_{OL}max = 0.4 V V_{OH}min = 2.4 V For LC76G (PB): V_{OL}max = 0.27 V V_{OH}min = 1.53 V	
	I2C_SCL	17	DI	I2C serial clock	For LC76G (AB, PA): V_{IL}min = -0.3 V V_{IL}max = 0.8 V V_{IH}min = 2 V V_{IH}max = VCC + 0.3 V V_{OL}max = 0.4 V V_{OH}min = 2.4 V For LC76G (PB): V_{IL}min = -0.3 V V_{IL}max = 0.45 V V_{IH}min = 1.35 V V_{IH}max = VCC + 0.3 V V_{OL}max = 0.27 V V_{OH}min = 1.53 V	I2C interface supports RTCM message, standard NMEA message and PAIR/PQTM message.
	I2C_SDA	16	DIO	I2C serial data		
	GEOFENCE	21	DO	Indicates geofence status	For LC76G (AB, PA): V_{OL}max = 0.4 V V_{OH}min = 2.4 V	Once the pin is activated, the receiver continuously compares its current

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
					For LC76G (PB): V_{OL}max = 0.27 V V_{OH}min = 1.53 V	position to the preset geofence area. If unused, leave the pin N/C (not connected).
	JAM_IND	22	DO	Jamming indication	For LC76G (AB, PA): V_{OL}max = 0.4 V V_{OH}min = 2.4 V For LC76G (PB): V_{OL}max = 0.27 V V_{OH}min = 1.53 V	If unused, leave the pin N/C.
	1PPS	4	DO	One pulse per second		Synchronized on the rising edge. If unused, leave the pin N/C.
	3D_FIX	23	DO	3D position fix indication		If unused, leave the pin N/C.
ANT	RF_IN	11	AI	GNSS antenna interface	-	50 Ω characteristic impedance.
	ANT_ON	13	DO	Power control for external LNA or active antenna	For LC76G (AB, PA): V_{OL}max = 0.4 V V_{OH}min = 2.4 V For LC76G (PB): V_{OL}max = 0.27 V V_{OH}min = 1.53 V	The pin outputs high-level signal in Continuous and ALP modes, and low-level signal in Backup mode. If unused, leave the pin N/C.
	VDD_RF	14	PO	Supplies power for external RF components	$V_O$nom = VCC	VDD_RF = VCC. The output current capacity depends on VCC. Typically used for powering an external active antenna or LNA. If unused, leave the pin N/C.
System	RESET_N	9	DI	Resets the module	For LC76G (AB, PA): V_{IL}min = -0.3 V V_{IL}max = 0.45 V V_{IH}min = 1.72 V V_{IH}max = 3.6 V For LC76G (PB): V_{IL}min = -0.3 V V_{IL}max = 0.45 V V_{IH}min = 1.72 V V_{IH}max = 2.1 V	Active low.
GND	GND	1, 10, 12, 28	-	Ground	-	Ensure a good GND connection to all module GND pins, preferably with a large ground plane.

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
RESERVED	RESERVED	5, 7, 15, 18, 19	-	Reserved	-	These pins must be left floating and cannot be connected to power or GND.

NOTE

1. To ensure that the module enters the normal operating mode, it is necessary that GEOFENCE and 3D_FIX pins cannot be pulled up within 50 ms after the module is reset or powered on.
2. Leave RESERVED and unused pins N/C.

3 Power Management

The module features a power optimized architecture with a built-in autonomous energy saving capabilities. To minimize power consumption at any given time, the receiver can operate at one of the three operating modes: ALP mode and Backup mode for optimum power consumption, and Continuous mode for optimum performance.

3.1. Power Unit

VCC is the supply voltage pin of the module. It supplies the PMU which in turn supplies the entire system. 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 the backup domain, which includes RTC and RAM. To achieve quick startup and improve TTFF duration, the backup domain power supply should be valid. If the VCC is not valid, the V_BCKP is powering the RAM section that contains all the necessary GNSS data and some of the user configuration variables.

VDD_RF is an output pin equal in voltage to the VCC input. In Continuous mode, VDD_RF supplies for the external active antenna or the LNA. Only if VCC is cut off, VDD_RF is turned off.

The module's internal power supply is shown below:

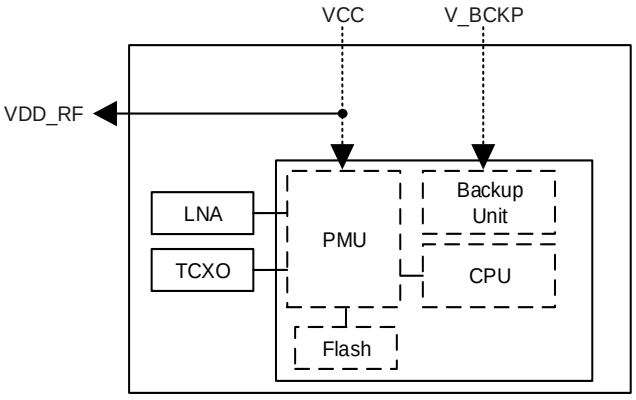


Figure 3: Internal Power Supply

3.2. Power Supply

3.2.1. VCC

The VCC is the supply voltage pin that provides power to the BB and RF sections.

Module power consumption may vary by several orders of magnitude, especially when a power saving mode is enabled. Therefore, it is important that the power supply is able to sustain peak power for a short time, ensuring that the load current does not exceed the rated value. When the module starts up or switches from the Backup mode to the Continuous mode, VCC 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 mode, it is important that the LDO at the power supply or module input can provide the sufficient current. An LDO with a high PSRR should be chosen for optimum performance. In addition, a TVS, and a combination of a 10 µF, a 100 nF and a 33 pF decoupling capacitor should be added near the VCC pin. The lowest value capacitor should be the closest to module pins.

It is not recommended to use a switching DC-DC converter.

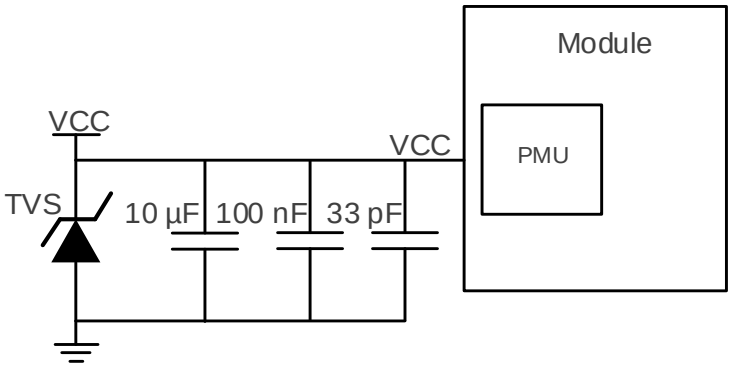


Figure 4: VCC Input Reference Circuit

NOTE

Ensure the module VCC is controlled by MCU to save power, or restart the module when it enters an abnormal state.

3.2.2. V_BCKP

The V_BCKP pin supplies the backup domain. Use of valid time and GNSS orbit data at startup allows GNSS hot (warm) start. V_BCKP must be connected to power supply for startup, and it should always be powered if hot (warm) start is needed.

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

It is recommended to place a TVS and a combination of a 4.7 μF, a 100 nF and a 33 pF decoupling capacitor near the V_BCKP pin. The figures below illustrate the reference design for powering the backup domain.

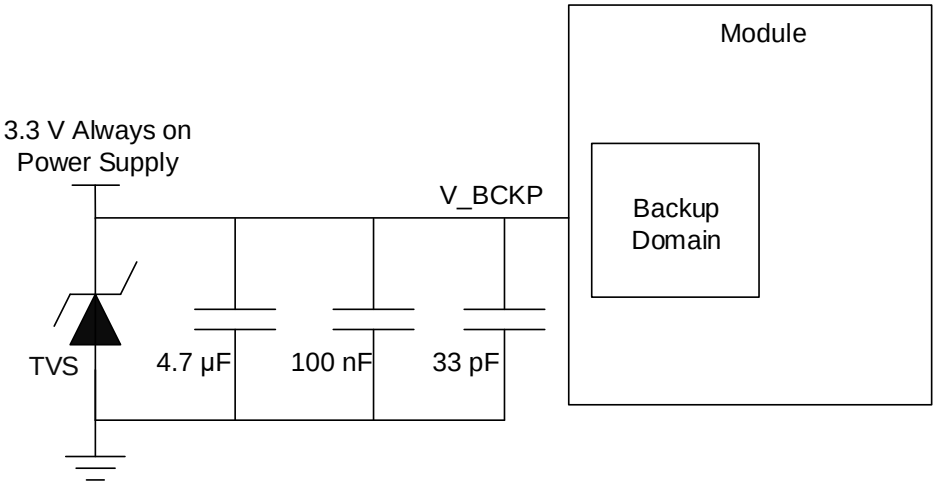


Figure 5: LC76G (AB, PA) Backup Domain Input Reference Circuit

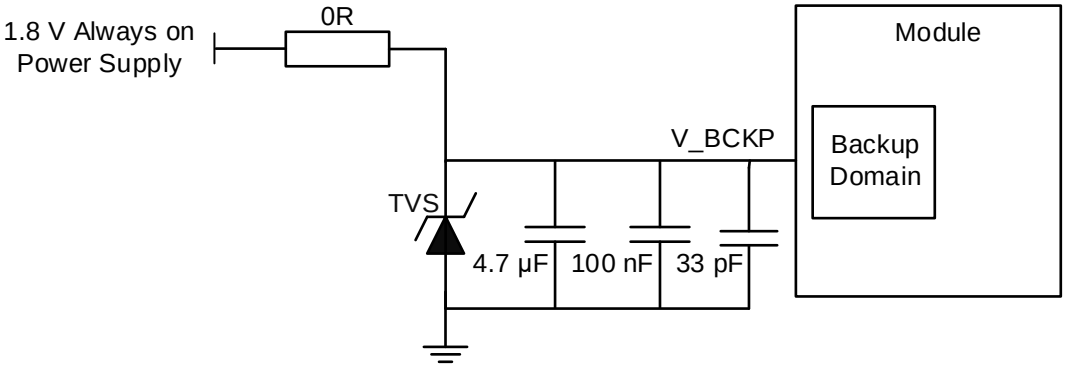


Figure 6: LC76G (PB) Backup Domain Input Reference Circuit

V_BCKP can also be powered by a 3.7 V lithium battery. It is recommended to control the enable pin of LDO via MCU, as shown in the figure below.

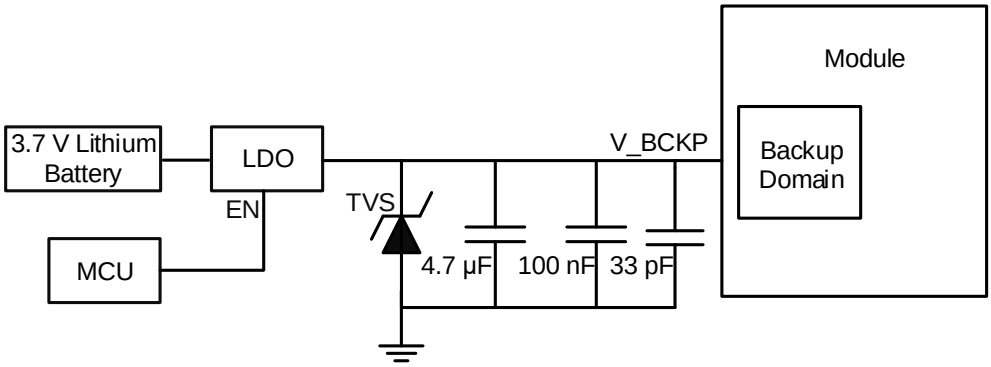


Figure 7: Reference Power Supply Circuit with 3.7 V Lithium Battery

NOTE

1. Connect the V_BCKP pin to VCC when backup supply voltage is unavailable.
2. If V_BCKP is below the minimum recommended operating voltage, the module cannot work normally.
3. It is recommended to control the module V_BCKP via MCU to restart the module when the module enters an abnormal state.

3.3. Power Modes

3.3.1. Feature Comparison

The module features supported in different modes are listed in the table below.

Table 7: Feature Comparison in Different Power Modes

Features	Continuous	Backup	ALP Mode 1	ALP Mode 2
NMEA/RTCM from UART	●	-	●	●
1PPS	●	-	●	●
RF	●	-	●	●
Acquisition & Tracking	●	-	●	●
Power Consumption	High	Low	Relatively low	Moderate
Position Accuracy	High	-	Relatively low	Moderate

3.3.2. Continuous Mode

If VCC and V_BCKP are powered on, the module automatically enters the Continuous mode that 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. ALP Mode (ALP Mode 1 & ALP Mode 2)

The ALP (Adaptive Low Power) mode offers two options that prioritize either power efficiency or positioning performance: ALP mode 1 (power mode) and ALP mode 2 (performance mode). ALP mode 1 consumes less power than ALP mode 2 but has lower positioning accuracy. The ALP mode can only be used when the navigation mode is set to Normal mode.

Enter ALP mode 1 and ALP mode 2:

- ALP mode 1: Send the **$PAIR732,1*21** command.
- ALP mode 2: Send the **$PAIR732,2*22** command.

Exit ALP mode 1 or ALP mode 2:

- Send the **$PAIR732,0*20** command.

For more information, see *document [1] protocol specification* and *document [4] low power mode application note*.

3.3.4. Backup Mode

For power-sensitive applications, the receiver supports Backup mode to reduce power consumption. Only backup domain is active in Backup mode and it keeps track of time.

- Enter Backup mode:

  1. Send the **$PAIR650,0*25** command.
  2. Cut off the power supply of the VCC pin and keep the V_BCKP pin powered.

- Exit Backup mode: Restore VCC power supply. Note that LC76G (PB) must be in Backup mode for at least 10 s.

For more information, see *document [1] protocol specification* and *document [4] low power mode application note*.

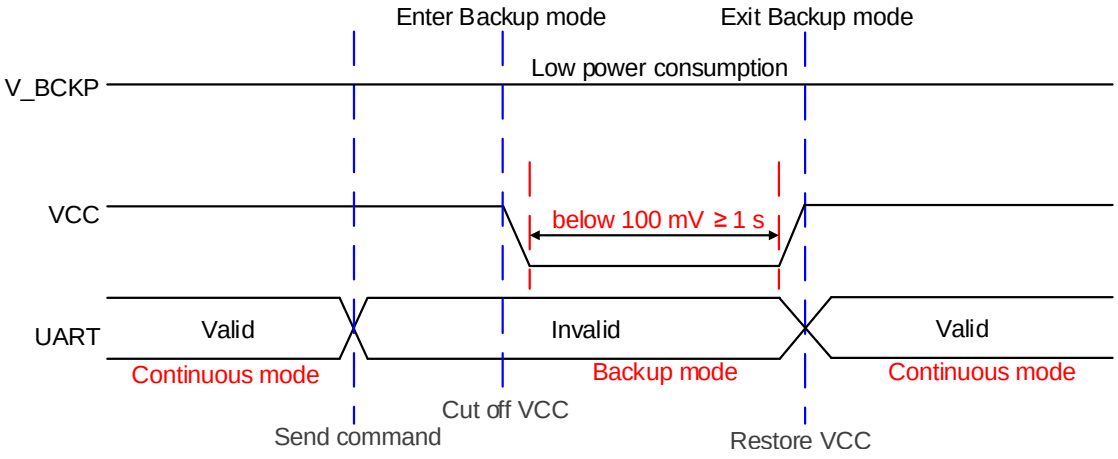


Figure 8: Enter/Exit Backup Mode Sequence

NOTE

1. The **$PAIR650,0*25** command must be sent before the power supply to VCC is disconnected. To ensure hot (warm) start of the module at the next startup, V_BCKP must be kept powered.
2. Ensure a stable V_BCKP voltage without rush or drop when the VCC is switched on or off.
3. For LC76G (PA, PB), the VCC must be cut off to enter Backup mode; otherwise, the power consumption will be at mA level.
4. If you cut off module power supply directly without sending the **$PAIR650,0*25** command first, then the module will not enter the Backup mode normally. In this case, the module will be in an undefined state and the power consumption is going to be higher, about 30 μA.

3.4. Power-up Sequence

Once the VCC and V_BCKP are powered up, the module starts up automatically and the voltage should rise rapidly in less than 50 ms.

To ensure the correct power-up sequence, the backup unit should start up no later than the PMU. Therefore, the V_BCKP must be powered simultaneously with the VCC or before it.

Ensure that the VCC and V_BCKP have no rush or drop during rising time, and then keep them stable. The recommended ripple is < 50 mV.

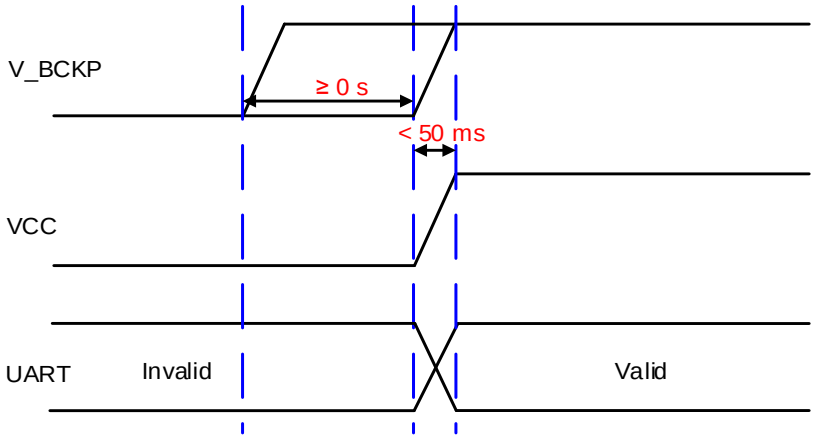


Figure 9: Power-up Sequence

3.5. Power-down Sequence

Once the VCC and V_BCKP are shut down, the module turns off automatically and voltage should drop quickly in less than 50 ms.

To avoid abnormal voltage condition, if VCC and V_BCKP fall below the minimum specified value, the system must initiate a power-on restart by lowering VCC and V_BCKP to less than 100 mV for at least 1 s.

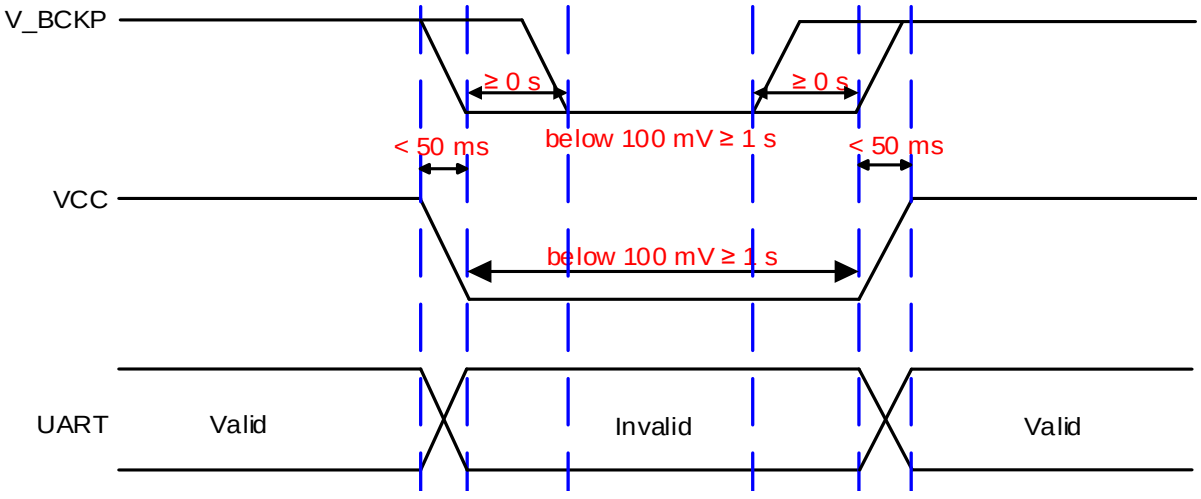


Figure 10: Power-down and Power-on Restart Sequence

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. Interface Selection (D_SEL)

The D_SEL pin is internally pulled down by default. By externally pulling it up with a 10 kΩ resistor, you can switch the interfaces for communication and firmware upgrade. Upon startup, the module automatically detects the pin level to select the communication and firmware upgrade interfaces.

Table 8: Interface Selection by D_SEL

Voltage Level of D_SEL upon Module Startup	Interface		
	UART	I2C	SPI
Low	Can be used for communication and firmware upgrade (in Download mode)	Can be used for communication	-
High	Can be used for communication	-	Can be used for communication and firmware upgrade (in Download mode)

4.1.1.2. UART Interface

The module has one UART interface with the following features:

- Supports RTCM message, standard NMEA message, PAIR/PQTM message, binary data and firmware upgrade.

- Supported baud rates: 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps and 921600 bps.
- Hardware flow control and synchronous operation are not supported.

For more information, see *document [1] protocol specification*.

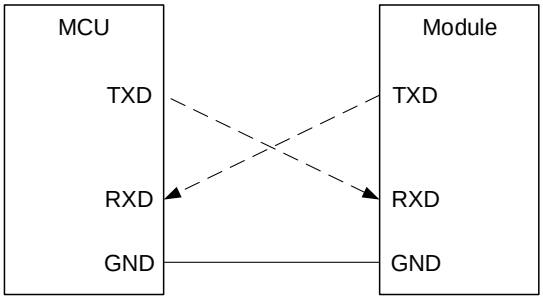


Figure 11: UART Interface Reference Design

A reference design is shown in the figure above. For more information, see *document [5] reference design*.

NOTE

1. UART interface default settings may vary depending on software version. See the relevant software versions for details.
2. If the I/O voltage of MCU is not matched with the module, a level-shifting circuit must be selected.

4.1.1.3. SPI

The module has one SPI with the following features:

- Supports RTCM message, standard NMEA message, PAIR/PQTM message and firmware upgrade.
- Operates in slave mode.
- Fixed data frame size of 8 bits.

For more information, see *document [6] SPI application note*.

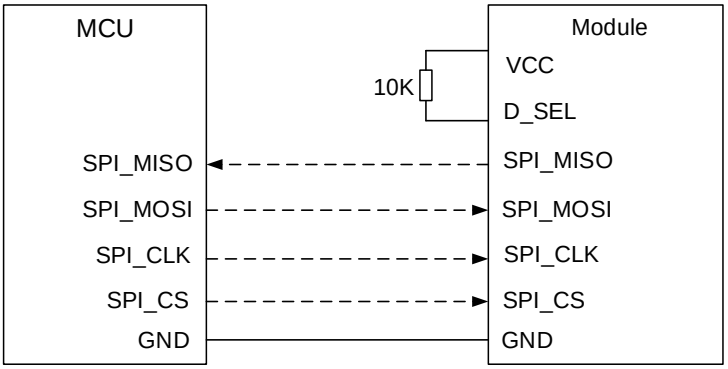


Figure 12: SPI Reference Design

A reference design is shown in the figure above. For more information, see *document [5] reference design*.

NOTE

If the I/O voltage of MCU is not matched with that of the module, a level-shifting circuit must be selected.

4.1.1.4. I2C Interface

The module has one I2C interface with the following features:

- Supports RTCM message, standard NMEA message and PAIR/PQTM message.
- Supports standard mode (100 kbps) and fast mode (400 kbps).
- Operates in slave mode.
- Support 7-bit address.
- Open-drain output.

For more information, see *document [7] I2C application note*.

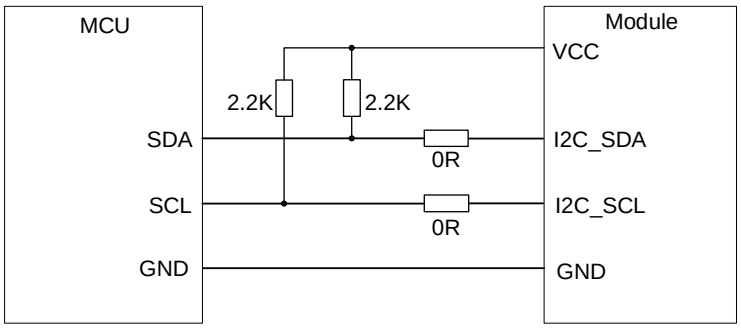


Figure 13: I2C Interface Reference Design

A reference design is shown in the figure above. For more information, see *document [5] reference design*.

NOTE

If the I/O voltage of MCU is not matched with that of the module, a level-shifting circuit must be selected.

4.1.2. GEOFENCE

The GEOFENCE pin indicates the current geofence status. Geofence configurations including geofence area(s) can be set using the **PQTMCFGEOFENCE** command. The receiver continuously compares its current position to the preset geofence area(s) and the pin reflects whether the receiver is inside the active area(s) or not. It outputs a high logic level voltage to indicate the receiver is inside the geofence area(s). For more information, see *document [1] protocol specification*.

NOTE

Once the module is powered on, the level of the pin affects the internal configuration due to the internal mechanism of the module. To ensure that the module enters the normal operating mode, it is necessary that the pin cannot be pulled up within 50 ms of the module being reset or powered on.

4.1.3. JAM_IND

In case of jamming that may interfere with the desired signal(s), the JAM_IND pin outputs a low-level signal; otherwise, it outputs a high-level signal.

4.1.4. 3D_FIX

The 3D_FIX pin is at a low level by default and assigned as a fix flag output. It outputs a high logic level voltage to indicate a successful 3D position fix.

NOTE

Once the module is powered on, the level of the pin will affect the internal configuration due to the internal mechanism of the module. To ensure that the module enters the normal operation mode, it is necessary that the pin cannot be pulled up within 50 ms of the module being reset or powered on.

4.1.5. 1PPS

The 1PPS output pin can be used for time pulse signals, it generates one pulse per second periodic

signal synchronized with a GNSS time grid with intervals. Maintaining high accuracy of 1PPS requires visible satellites in an open sky environment and powered VCC. See *Table 3: Product Performance* for details about pulse accuracy.

4.2. System Pin

4.2.1. RESET_N

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

By default, the RESET_N pin is pulled up internally to 1.8 V with a 10 kΩ resistor, thus no external pull-up circuit is allowed for this pin. The reference circuit shown below is recommended to control the RESET_N pin.

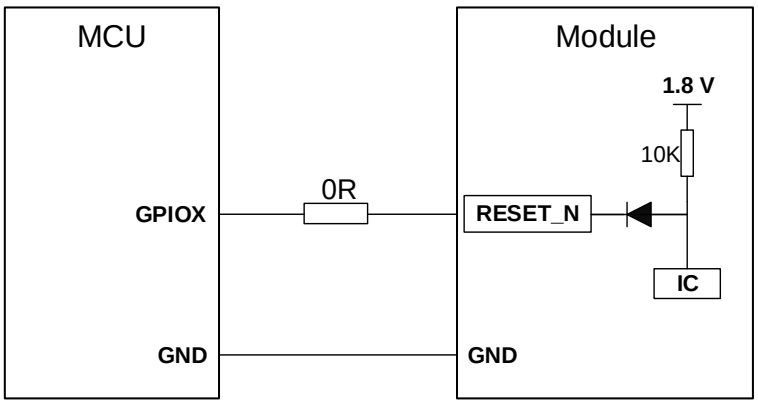


Figure 14: Reference Circuit for Module Reset

The following figure shows the reset sequence of the module.

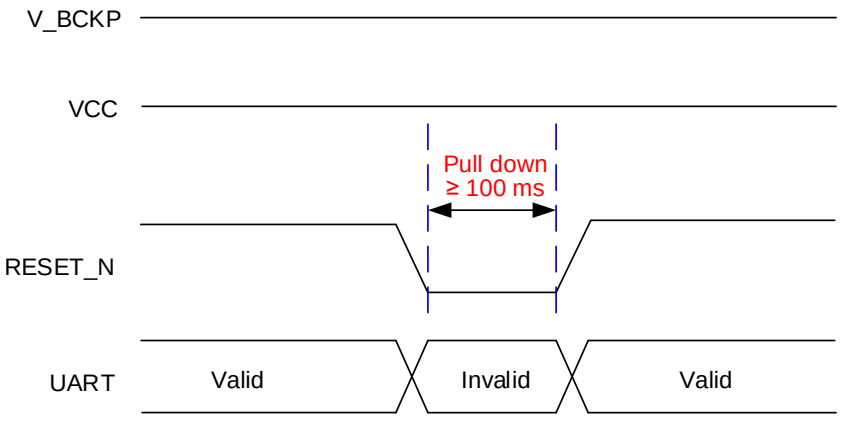


Figure 15: Reset Sequence

NOTE

The module's RESET_N pin must be connected to the MCU so that it can be used to reset the module if it enters an abnormal state.

5 Design

This chapter explains the reference design of RF section and recommended footprint of the module. A GNSS receiver could be vulnerable to environmental interference. To learn the details about interference and ensuring interference immunity, see *document [8] GNSS antenna application note*.

5.1. Antenna Selection

5.1.1. Antenna Specifications

The module can be connected to a dedicated passive or an active single-band GNSS antenna to receive GNSS satellite signals. The recommended antenna specifications are listed in the table below.

Table 9: Recommended Antenna Specifications

Antenna Type	Specifications
Passive Antenna	Frequency Range: 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi
Active Antenna	Frequency Range: 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi Active Antenna Noise Figure: < 1.5 dB Active Antenna Total Gain: < 17 dB [4] Out-of-band Rejection: > 30 dB

NOTE

For recommended antenna and design, see *document [8] GNSS antenna application note* or contact Quectel Technical Support (support@Quectel.com).

[4] The total antenna gain equals the internal LNA gain minus the total insertion loss of cables and components inside the antenna.

5.2. Antenna Reference Design

To mitigate the impact of out-of-band signals on the GNSS module in a complex electromagnetic environment, a SAW filter circuit must be added to the antenna design. The SAW filter circuit has a stable suppression effect on all out-of-band signals. It is recommended to use SAFFB1G56AC0F7F from Murata or B39162B2618P810 from RF360 in the SAW filter circuit. In the actual layout, the circuit should be placed close to RF_IN pin. The SAW filter circuit can be selected according to the use case.

5.2.1. Active Antenna Reference Design

When using VDD_RF pin to supply the active antenna, it is important to pay attention to operating voltage range of the antenna and the voltage drop on the power supply circuit. The voltage drop is caused by the inductor (L1) and the resistor (R2) in the external power supply circuit. To further mitigate the impact of out-of-band signals on GNSS module performance, you must choose the active antenna whose SAW filter is placed in front of the LNA in the internal framework. Do not place the LNA in the front. The minimum operating voltage of selected active antenna needs to meet the circuit design characteristics.

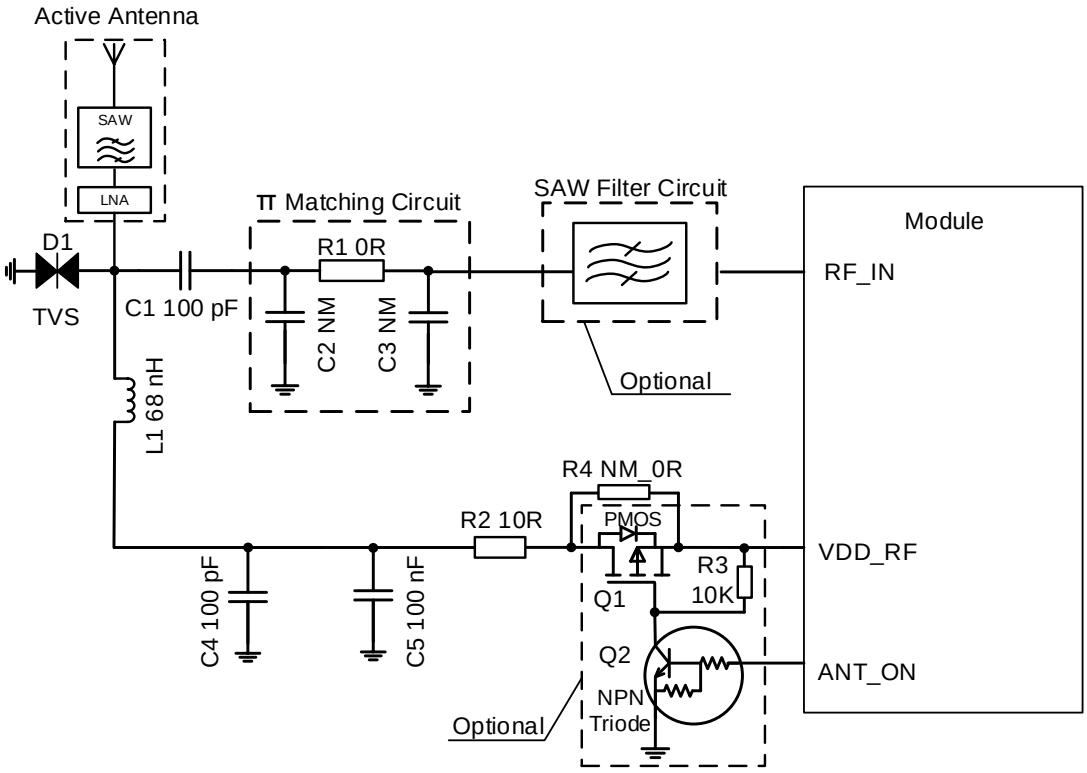


Figure 16: Active Antenna Reference Design

C1 is a DC-blocking capacitor used for blocking the DC current from VDD_RF. The C2, R1, and C3 components are reserved for matching antenna impedance. By default, C1 is 100 pF, R1 is 0 Ω, and C2 and C3 are not mounted. They should be placed near the antenna in the actual layout. D1 is an

electrostatic discharge (ESD) protection device to protect the RF signal input from the potential damage caused by ESD. The junction capacitance of D1 cannot be more than 0.6 pF and a transient voltage suppressor is recommended.

L1 inductor is used for preventing the RF signal from leaking into VDD_RF and preventing noise propagation from the VDD_RF to the antenna. L1 inductor routes the bias voltage to the active antenna without losses. Place L1, C4 and C5 close to the antenna interface and route the proximal end of L1 pad on the RF trace. The recommended value of L1 should be at least 68 nH. R2 resistor is used to protect the module in case the active antenna is short-circuited to the ground plane. RF trace impedance should be controlled to 50 Ω and trace length should be kept as short as possible. For more information about RF layout, see *document [9] RF layout application note*.

The antenna is always powered when R4 is mounted. When it is not mounted, while Q1, Q2 and R3 are mounted, the antenna power supply can be controlled through ANT_ON pin. When the pin outputs high level, the antenna is powered; otherwise, the antenna is not powered.

5.2.2. Passive Antenna Reference Design

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

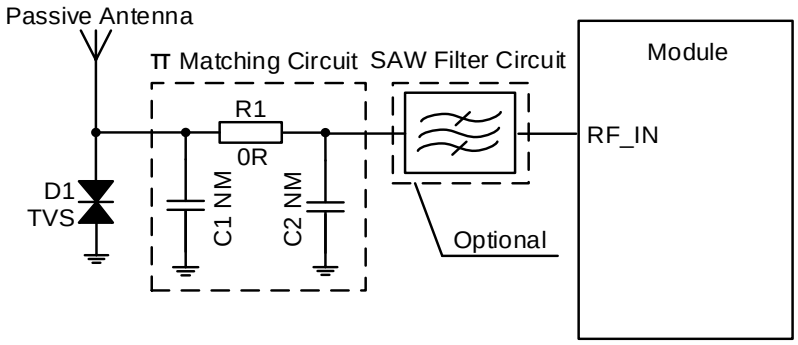


Figure 17: Passive Antenna Reference Design

C1, R1, and C2 are reserved for matching antenna impedance. By default, R1 is 0 Ω, and C1 and C2 are not mounted. They should be placed near the antenna in the actual layout. D1 is an electrostatic discharge (ESD) protection device to protect the RF signal input from the potential damage caused by ESD. The junction capacitance of D1 cannot be more than 0.6 pF and a transient voltage suppressor is recommended. RF trace impedance should be controlled to 50 Ω and trace length should be kept as short as possible.

5.3. Recommended Footprint

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

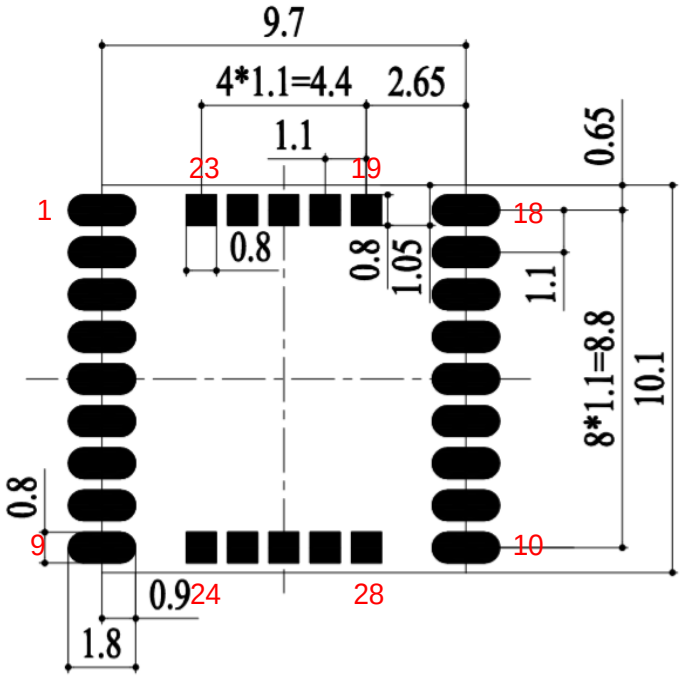


Figure 18: Recommended Footprint

NOTE

Maintain at least 3 mm keepout between the module and other components on the motherboard to improve soldering quality and maintenance convenience.

6 Electrical Specification

6.1. Absolute Maximum Ratings

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

Table 10: Absolute Maximum Ratings for LC76G (AB, PA)

Parameter	Description	Min.	Max.	Unit
VCC	Main Power Supply Voltage	-0.3	3.63	V
V_BCKP	Backup Supply Voltage	0	3.63	V
V_{IN}_IO	Input Voltage at I/O Pins	-0.3	3.63	V
P_{RF_IN}	Input Power at RF_IN	-	0	dBm
T_storage	Storage Temperature	-40	90	°C

Table 11: Absolute Maximum Ratings for LC76G (PB)

Parameter	Description	Min.	Max.	Unit
VCC	Main Power Supply Voltage	-0.3	1.98	V
V_BCKP	Backup Supply Voltage	0	3.63	V
V_{IN}_IO	Input Voltage at I/O Pins	-0.3	1.98	V
P_{RF_IN}	Input Power at RF_IN	-	0	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 specification validity.

Table 12: Recommended Operating Conditions for LC76G (AB, PA)

Parameter	Description	Min.	Typ.	Max.	Unit
VCC	Main Power Supply Voltage	2.55	3.3	3.6	V
V_BCKP	Backup Supply Voltage	1.65	3.3	3.6	V
IO_Domain	Digital I/O Pin Voltage Domain	-	VCC	-	V
V_{IL}	Digital I/O Pin Low-level Input Voltage	-0.3	-	0.8	V
V_{IH}	Digital I/O Pin High-level Input Voltage	2.0	-	VCC + 0.3	V
V_{OL}	Digital I/O Pin Low-level Output Voltage	-	-	0.4	V
V_{OH}	Digital I/O Pin High-level Output Voltage	2.4	-	-	V
RESET_N	Low-level Input Voltage	-0.3	-	0.45	V
	High-level Input Voltage	1.72	-	3.6	V
VDD_RF	VDD_RF Output Voltage	-	VCC	-	V
I_{VDD_RF}	VDD_RF Output Current	-	-	100	mA
T_operating	Operating Temperature	-40	25	+85	°C

Table 13: Recommended Operating Conditions for LC76G (PB)

Parameter	Description	Min.	Typ.	Max.	Unit
VCC	Main Power Supply Voltage	1.75	1.8	1.98	V
V_BCKP	Backup Supply Voltage	1.65	1.8	3.6	V
IO_Domain	Digital I/O Pin Voltage Domain	-	VCC	-	V
V_{IL}	Digital I/O Pin Low-level Input Voltage	-0.3	-	0.45	V
V_{IH}	Digital I/O Pin High-level Input Voltage	1.35	-	VCC + 0.3	V
V_{OL}	Digital I/O Pin Low-level Output Voltage	-	-	0.27	V
V_{OH}	Digital I/O Pin High-level Output Voltage	1.53	-	-	V
RESET_N	Low-level Input Voltage	-0.3	-	0.45	V
	High-level Input Voltage	1.72	-	2.1	V
VDD_RF	VDD_RF Output Voltage	-	VCC	-	V
I_{VDD_RF}	VDD_RF Output Current	-	-	100	mA
T_operating	Operating Temperature	-40	25	+85	°C

NOTE

1. Operation beyond the “Operating Conditions” is not recommended and extended exposure beyond the “Operating Conditions” may affect device reliability.
2. Digital I/O Pin refers to all digital pins specified in *Table 6: Pin Description* except RESET_N.

6.3. Supply Current Requirement

The following table lists the supply current values of the total system that may be applied. Actual power requirements may vary depending on processor load, external circuits, firmware version, the number of tracked satellites, signal strength, startup type, test duration.

Table 14: Supply Current

Parameter		Condition		LC76G (AB)	LC76G (PA)	LC76G (PB)
I_{VCC} [5] (Current at VCC)	$I_{Typ.}$ [6]	GPS + QZSS	Acquisition	28.6 mA	8.4 mA	13.1 mA
			Tracking	23.5 mA	7.2 mA	10.2 mA
			ALP Mode 1	9.3 mA	3.4 mA	4.5 mA
			ALP Mode 2	20.9 mA	6.1 mA	8.6 mA
		GPS + GLONASS + QZSS	Acquisition	30.6 mA	8.9 mA	14.4 mA
			Tracking	27.5 mA	8.7 mA	12.6 mA
			ALP Mode 1	10.2 mA	3.6 mA	4.9 mA
			ALP Mode 2	22.9 mA	6.8 mA	9.7 mA
		GPS + Galileo + QZSS	Acquisition	29.4 mA	8.8 mA	13.8 mA
			Tracking	29.1 mA	8.7 mA	13.5 mA
			ALP Mode 1	10.2 mA	3.8 mA	5.2 mA
			ALP Mode 2	24.1 mA	7.1 mA	10.5 mA
		GPS + BDS + QZSS	Acquisition	29.7 mA	9 mA	14.1 mA
			Tracking	28.3 mA	8.2 mA	13 mA
			ALP Mode 1	10.2 mA	3.8 mA	5.1 mA
			ALP Mode 2	23.9 mA	7.1 mA	10.4 mA
		GPS + Galileo + BDS + QZSS	Acquisition	30.6 mA	9.5 mA	14.7 mA
			Tracking	30.7 mA	9.4 mA	14.7 mA
			ALP Mode 1	10.8 mA	3.9 mA	5.3 mA
			ALP Mode 2	24.4 mA	7.5 mA	10.7 mA
		GPS + GLONASS + Galileo + BDS + QZSS	Acquisition	33 mA	9.7 mA	15.6 mA
			Tracking	32.9 mA	9.7 mA	15.6 mA

[5] Used to determine maximum current capability of power supply.
[6] Tested at room temperature, with typical operating voltage, and satellites signal of -130 dBm configured by the instrument.

Parameter		Condition		LC76G (AB)	LC76G (PA)	LC76G (PB)
I_{VCC} [5] (Current at VCC)	$I_{Typ.}$ [6]		ALP Mode 1	10.5 mA	3.8 mA	5.4 mA
			ALP Mode 2	24.5 mA	7.5 mA	11.3 mA
	I_{PEAK} [6]	-		58 mA	24 mA	36 mA
I_{V_BCKP} [7] (Current at V_BCKP)	$I_{Typ.}$ [6]	Acquisition/Tracking/ALP Mode 1/ ALP Mode 2		130 µA	127 µA	122 µA
		Backup Mode		13 µA	13 µA	13 µA

NOTE

The above power consumption values are measured within the respective modes, excluding transient pulse currents that occur during power-up and mode transition.

6.4. ESD Protection

Static electricity occurs naturally and it may damage the module. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly, and testing of the module; add ESD protection components to the ESD sensitive interfaces and points in the product design.

Measures to ensure protection against ESD damage when handling the module:

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

[7] Used to determine required battery current capability.

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

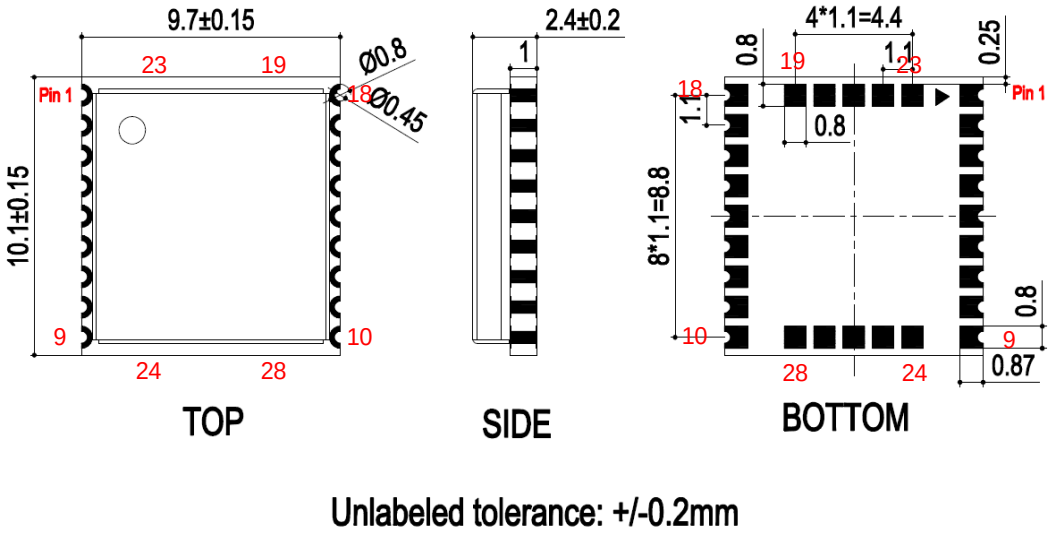


Figure 19: Top, Side and Bottom View Dimensions

NOTE

The module's coplanarity standard: ≤ 0.13 mm.

7.2. Top and Bottom Views

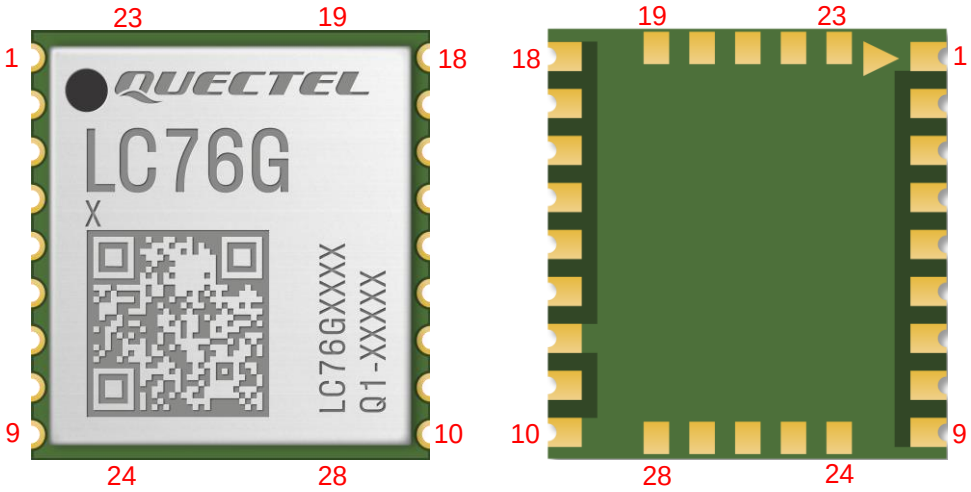


Figure 20: Top and Bottom Module Views

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 Specification

This chapter outlines the key packaging parameters and processes. All figures below are for reference purposes only, as the actual appearance and structure of packaging materials may vary in delivery.

The modules are packed in a tape and reel packaging as specified in the sub-chapters below.

8.1.1. Carrier Tape

Carrier tape dimensions are illustrated in the following figure and table:

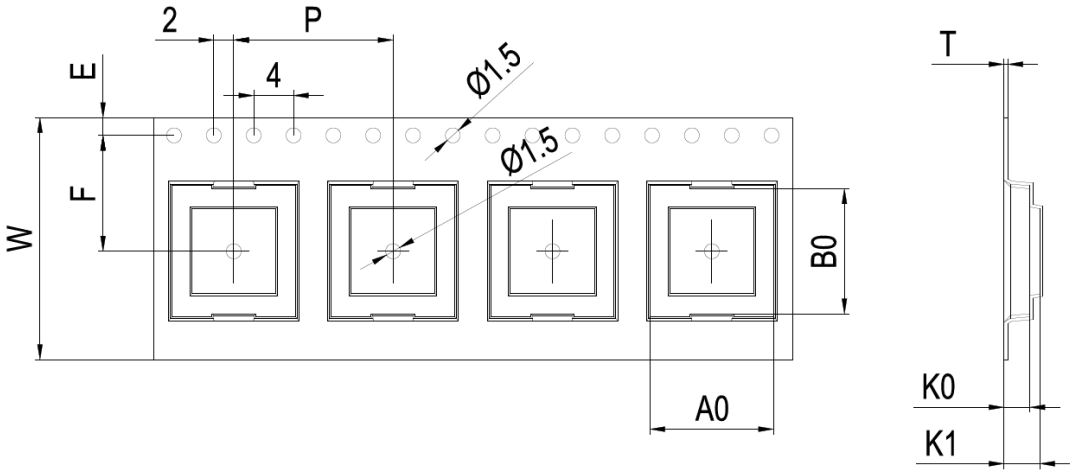


Figure 21: Carrier Tape Dimension Drawing (Unit: mm)

Table 15: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
24	16	0.3	10.1	10.5	2.8	3.3	11.5	1.75

8.1.2. Plastic Reel

Plastic reel dimensions are illustrated in the following figure and table:

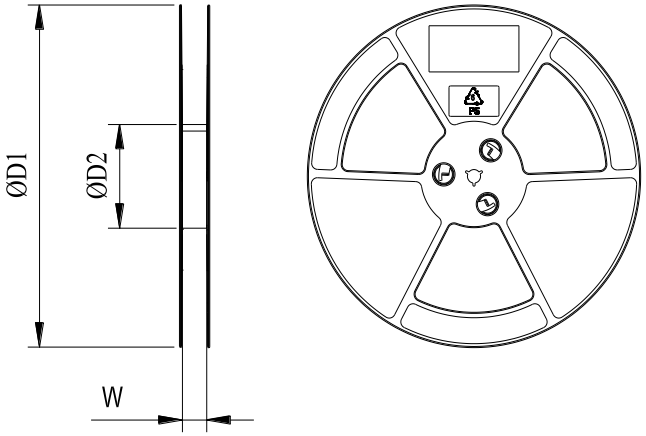


Figure 22: Plastic Reel Dimension Drawing

Table 16: Plastic Reel Dimension Table (Unit: mm)

øD1	øD2	W
330	100	24.5

8.1.3. Mounting Direction

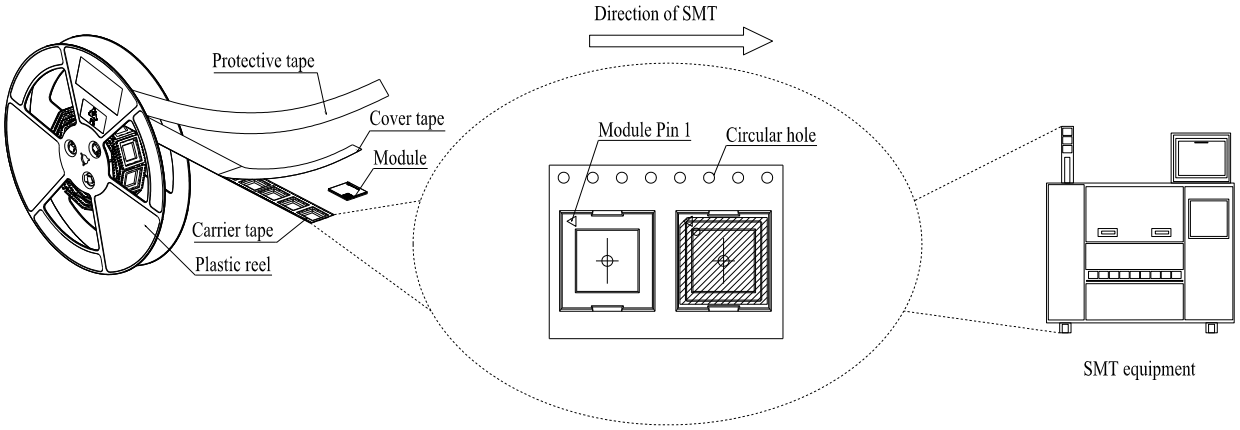
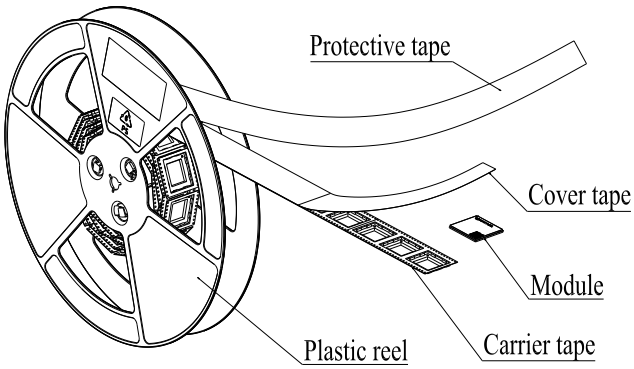


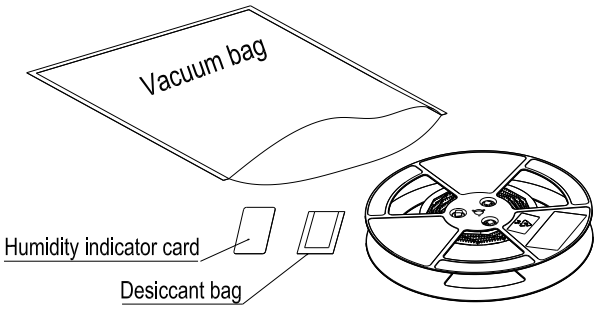
Figure 23: Mounting Direction

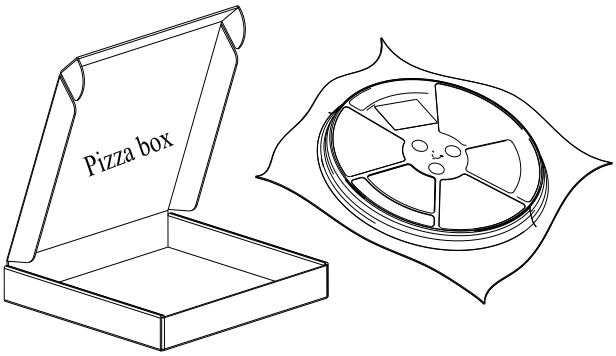
8.1.4. Packaging Process



Place the modules onto the carrier tape cavity and cover them securely with cover tape. Wind the heat-sealed carrier tape onto a plastic reel and apply a protective tape for additional protection. 1 plastic reel can pack 500 modules.

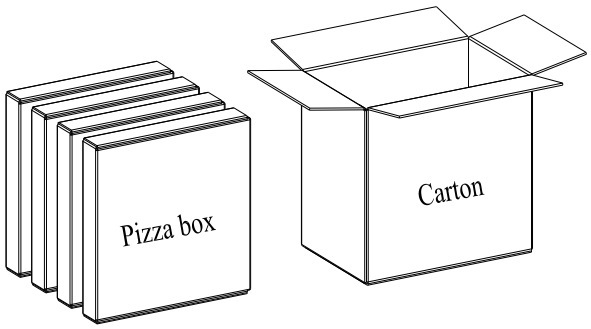
Place the packaged plastic reel, humidity indicator card and desiccant bag into a vacuum bag, and vacuumize it.





Place the vacuum-packed plastic reel into a pizza box.

Place the 4 packaged pizza boxes into 1 carton and seal it. 1 carton can pack 2000 modules.



Pizza Box Size (mm): 363 × 343 × 41
Carton Size (mm): 380 × 190 × 365

Figure 24: Packaging Process

8.2. Storage

The module is provided in a vacuum-sealed packaging. MSL of the module is rated at 3. The storage requirements are shown below.

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

2. Shelf life (in a vacuum-sealed packaging): 12 months in Recommended Storage Condition.

3. Floor life: 168 hours [8] in a factory 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 dry 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 in Recommended Storage Condition;
   - Violation of the third requirement above;
   - 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 meet the requirements below:

   - The module should be baked for 8 hours at 120 ±5 °C;
   - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a dry cabinet.

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. 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 module.

[8] 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*. Do not unpack the modules in large quantities until they are ready for soldering.

8.3. Manufacturing and Soldering

Push the squeegee to apply solder paste on the stencil surface, 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 of the module, see *document [10] module stencil design requirements*.

The recommended 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 recommended to mount the module only after reflow soldering the other side of the PCB. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown in the figure and table below.

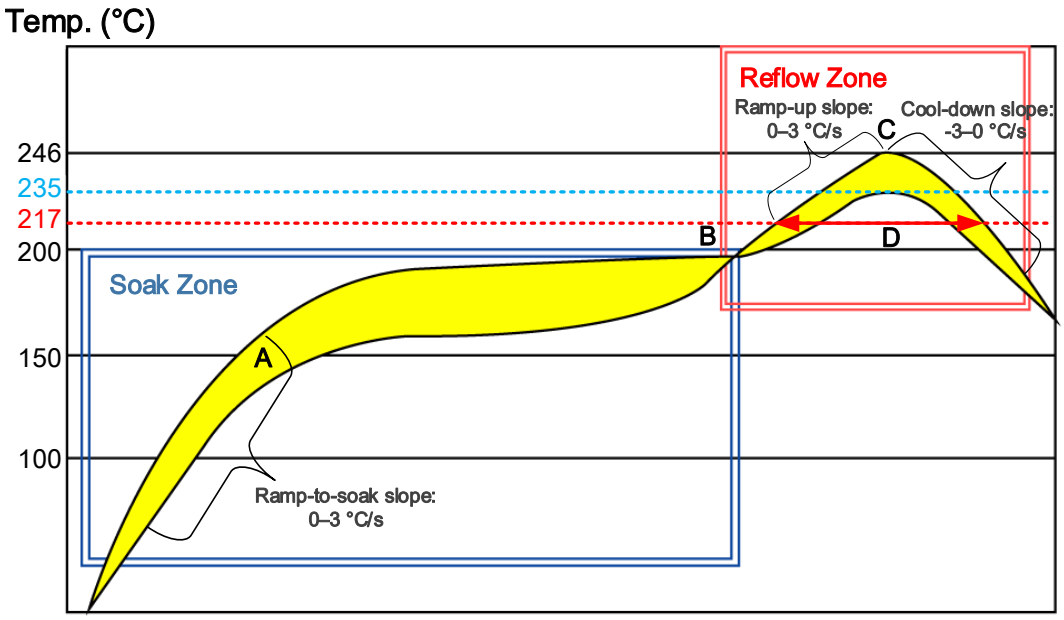


Figure 25: Recommended Reflow Soldering Thermal Profile

Table 17: Recommended Thermal Profile Parameters

Factor	Recommendation Value
Soak Zone	
Ramp-to-soak Slope	0–3 °C/s
Soak Time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	

Factor	Recommendation Value
Ramp-up Slope	0–3 °C/s
Reflow Time (D: over 217 °C)	40–70 s
Max. Temperature	235–246 °C
Cool-down Slope	-3–0 °C/s
Reflow Cycle	
Max. Reflow Cycle	1

NOTE

1. The above profile parameter requirements are for the measured temperature of the solder joints. Both the hottest and coldest spots of solder joints on the PCB should meet the above requirements.
2. During manufacturing and soldering, or any other processes that may require direct contact with the module, **NEVER** wipe the module shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, and trichloroethylene. Otherwise, the shielding can may become rusty.
3. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, 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.
4. 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. Prevent the coating material from penetrating the module shield.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. Avoid using materials that contain mercury (Hg), such as adhesives, for module processing, even if the materials are RoHS compliant and their mercury content is below 1000 ppm (0.1 %).
7. Corrosive gases may corrode the electronic components inside the module, affecting their reliability and performance, and potentially leading to a shortened service life that fails to meet the designed lifespan. Therefore, do not store or use unprotected modules in environments containing corrosive gases such as hydrogen sulfide, sulfur dioxide, chlorine, and ammonia.
8. Due to SMT process complexity, contact Quectel Technical Support in advance regarding any ambiguous situation, or any process (e.g., selective soldering, ultrasonic soldering) that is not addressed in *document [11] module SMT application note*.

9 Labelling Information

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

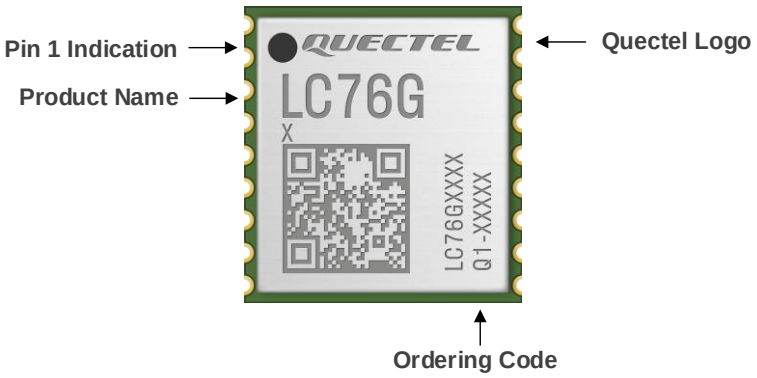


Figure 26: Labelling Information

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 References

Table 18: Related Documents

Document Name
[1] Quectel_LC26G&LC26G-T&LC76G&LC86G_Series_GNSS_Protocol_Specification
[2] Quectel_LC26G&LC26G-T&LC76G&LC86G_Series_AGNSS_Application_Note
[3] Quectel_LC26G&LC26G-T&LC76G&LC86G_Series_Firmware_Upgrade_Guide
[4] Quectel_LC26G&LC76G&LC86G_Series_Low_Power_Mode_Application_Note
[5] Quectel_LC76G_Series_Reference_Design
[6] Quectel_LC76G(AB)_SPI_Application_Note
[7] Quectel_LC26G(AB)&LC26G-T(AA)&LC76G_Series_I2C_Application_Note
[8] Quectel_GNSS_Antenna_Application_Note
[9] Quectel_RF_Layout_Application_Note
[10] Quectel_Module_Stencil_Design_Requirements
[11] Quectel_Module_SMT_Application_Note

Table 19: Terms and Abbreviations

Abbreviation	Description
1PPS	1 Pulse Per Second
AGNSS	Assisted GNSS (Global Navigation Satellite System)
AIC	Active Interference Cancellation
ALP	Adaptive Low Power
ARM	Advanced RISC Machine

Abbreviation	Description
BDS	BeiDou Satellite Navigation System
bps	bit(s) per second
CEP	Circular Error Probable
C/N_0	Carrier-to-noise Ratio
DR	Dead Reckoning
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 (Russia)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
I/O	Input/Output
I2C	Inter-Integrated Circuit
IC	Integrated Circuit
IMU	Inertial Measurement Unit
I_{PEAK}	Peak Current
NavIC	Indian Regional Navigation Satellite System
kbps	kilobits per second
LCC	Leadless Chip Carrier (package)
LDO	Low-dropout Regulator
LGA	Land Grid Array
LNA	Low-noise Amplifier
MCU	Microcontroller Unit/Microprogrammed Control Unit

Abbreviation	Description
MISO	Master In Slave Out
MOSI	Master Out Slave In
MSAS	Multi-functional Satellite Augmentation System (Japan)
MSL	Moisture Sensitivity Levels
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
OC	Open Connector
PAIR	Proprietary Protocol of Airoha
PCB	Printed Circuit Board
PI	Power Input
PMU	Power Management Unit
PQTM	Quectel Proprietary Protocol
PSRR	Power Supply Rejection Ratio
QR (Code)	Quick Response (Code)
QZSS	Quasi-zenith Satellite System
RAM	Random Access Memory
RF	Radio Frequency
RHCP	Right Hand Circular Polarization
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 (Pin)
SAW	Surface Acoustic Wave
SBAS	Satellite-based Augmentation System
SMD	Surface Mount Device

Abbreviation	Description
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
TCXO	Temperature Compensated Crystal Oscillator
T_operating	Operating Temperature
TTFF	Time to First Fix
TVS	Transient Voltage Suppressor
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
VCC	Supply Voltage
$V_I$max	Maximum Input Voltage
$V_I$min	Minimum Input Voltage
$V_I$nom	Normal Input Voltage
V_{IH}max	High-level Maximum Input Voltage
V_{IH}min	High-level Minimum Input Voltage
V_{IH}nom	High-level Normal Input Voltage
V_{IL}max	Low-level Maximum Input Voltage
V_{IL}min	Low-level Minimum Input Voltage
$V_O$nom	Normal Output Voltage
V_{OL}max	Low-level Maximum Output Voltage
V_{OH}min	High-level Minimum Output Voltage
VSWR	Voltage Standing Wave Ratio
WAAS	Wide Area Augmentation System
XTAL	External Crystal Oscillator