LC79D (A) Hardware Design

GNSS Module Series

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The following safety precautions must be observed during all phases of operation, such as usage, service, or repair of any terminal or mobile incorporating the module. Manufacturers of the terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all product manuals. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.

	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
-	2019-11-14	Creation of the document
1.0	2019-11-14	First official release
1.1	2022-05-09	1. Numerous changes were made to this document. It should be read in its entirety. 2. Deleted the applicable variant: LC79D (B). 3. Deleted the I2C interface for LC79D (A) and information related to SPI. 4. Updated the Pin Assignment (Chapter 2): Updated the pin 2 from TXD/SPI_CLK to TXD; Updated the pin 3 from RXD/SPI_CS to RXD; Updated the pin 14 from VCC_RF to VDD_RF; Reserved the pin 16 (I2C_SDA); Reserved the pin 17 (I2C_SCL); Reserved the pin 18 (INT); Reserved the pin 20 (RDY); Updated the pin 22 from RTS/SPI_MISO to RTS; Updated the pin 23 from CTS/SPI_MOSI to CTS. 5. Added the table of Product Features (Table 1). 6. Updated the data and test conditions for power consumption, sensitivity and TTFF and updated the test condition for horizontal position accuracy

	(Table 2). 7. Added the content of GNSS Constellations, AGNSS and Firmware Upgrade (Chapter 1.5, 1.6 and 1.7). 8. Reorganize the structure related to Power Supply and added new contents (Chapter 3.1, 3.2 and 3.3). 9. Added the content of Power-Up and Power-Down Sequences (Chapter 3.4 and 3.5). 10. Updated the L1 frequency range for passive and active antenna (Chapter 5.1.1). 11. Added the content of Coexistence with Cellular Systems (Chapter 5.2). 12. Added the content of Supply Current Requirement (Chapter 6.3). 13. Updated the dimensional tolerances and the figure of Top, Side and Bottom View Dimensions and Top and Bottom Views of the Module (Chapter 7). 14. Added the content of Product Handing (Chapter 8). 15. Added the content of Labelling Information (Chapter 9).

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1 Product Description

1.1. Overview

The Quectel LC79D (A) module supports multiple global positioning and navigation systems: GPS, GLONASS, Galileo, BDS, QZSS and IRNSS. The module also supports AGNSS function.

Key features:

- The LC79D (A) module is a dual-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 interface UART.
- The embedded flash memory provides the capacity for storing user-specific configurations and future firmware updates.

The Quectel LC79D (A) module is an SMD type module with a compact form factor of 10.1 mm × 9.7 mm × 2.4 mm. It can be embedded in your applications through the 28 pins (18 LCC and 10 LGA).

The module is fully compliant with the EU RoHS Directive.

1.2. Features

Table 1: Product Features

Features		LC79D (A)
Grade	Industrial	●
	Automotive	-
Category	Standard Precision GNSS	●
	High Precision GNSS	-

	DR		-
	RTK		-
	Timing		-
Supply Voltage	1.7-1.9 V, Typ. 1.8 V		●
IO Voltage	Typ. 1.8 V		●
Communication Interfaces	UART		●
	SPI		-
	I2C		-
	CAN		-
Integrated Features	Additional LNA		●
	Additional SAW		●
	RTC Crystal		●
	TCXO Oscillator		●
	6-axis IMU		-
Constellations	GPS	L1 C/A	●
		L5	●
	GLONASS	L1	●
	Galileo	E1	●
		E5a	●
	BDS	B1I	●
		B2a	-
	QZSS	L1 C/A	●
		L5	●
	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: (10.1 ±0.15) mm × (9.7 ±0.15) mm × (2.4 ±0.20) mm Weight: Approx. 0.42 g

NOTE

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

1.3. Performance

Table 2: Product Performance

Parameter	**Specification**	**LC79D (A)**
Power Consumption [1] (G3 [2] + BDS + QZSS)	Acquisition	49 mA
	Tracking	48 mA
	Sleep Mode	350 µA
	Standby Mode	91 µA
Sensitivity (G3 [2] + BDS + QZSS)	Acquisition	-147 dBm
	Reacquisition	-158 dBm
	Tracking	-163 dBm
TTFF [1] (without AGNSS)	Cold Start	34 s
	Warm Start	30 s
	Hot Start	2 s
TTFF [3] (with AGNSS)	Cold Start	5 s
Horizontal Position Accuracy [4]		1.2 m
Update Rate		1 Hz
Accuracy of 1PPS Signal [1]	Typ. 100 ns	

[1] Room temperature, all satellites at -130 dBm.
[2] G3 is GPS + GLONASS + Galileo.
[3] Open-sky, active high precision GNSS antenna.
[4] CEP, 50%, 24 hours static, -130 dBm, more than 6 SVs.

Velocity Accuracy [1]	Without Aid: 0.1 m/s
Acceleration Accuracy [1]	Without Aid: 0.1 m/s²
Dynamic Performance [1]	Maximum Altitude: 18000 m Maximum Velocity: 515 m/s Acceleration: 4g

1.4. Block Diagram

A block diagram of the LC79D (A) module which includes a GNSS IC, two additional LNAs, two additional SAWs, a diplexer, flash memory, a TCXO and a XTAL is presented below. The diplexer integrates two band-pass filters, which can improve the out-of-band rejection. Consequently, the LNAs will have less chance to produce in-band interference in challenging environments, which ensures enhanced performance in a jamming environment.

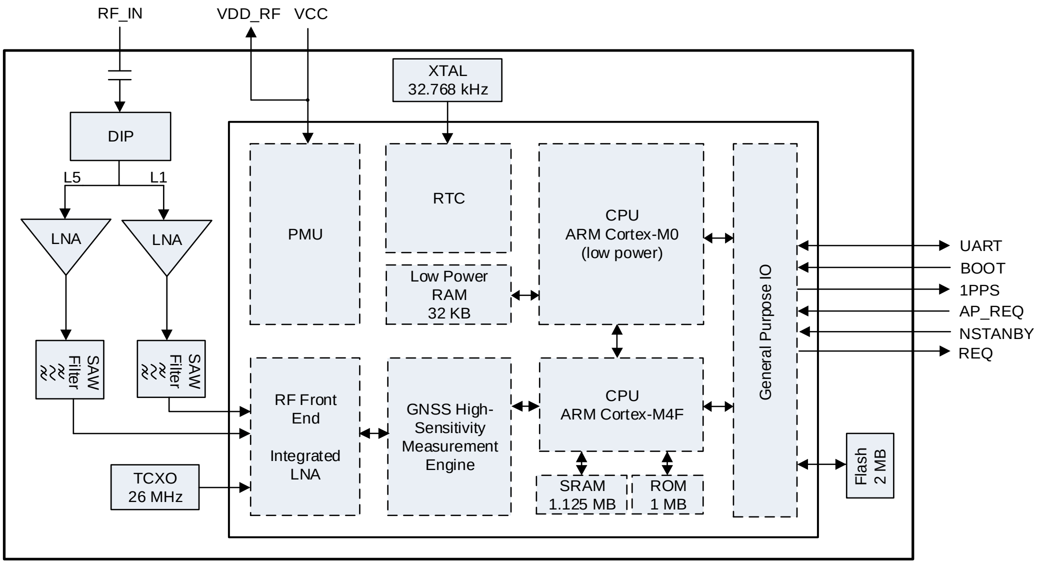


Figure 1: Block Diagram

1.5. GNSS Constellations

The Quectel LC79D (A) module is a dual-band GNSS receiver that can receive and track GPS, GLONASS, Galileo, BDS, QZSS and IRNSS signals.

1.5.1. GPS

The module is designed to receive and track GPS L1 C/A and L5 signals centered on 1575.42 MHz and 1176.45 MHz.

1.5.2. GLONASS

The module is designed to receive and track GLONASS L1 signals in the frequency ranging from 1598.0625 MHz to 1605.375 MHz.

1.5.3. Galileo

The module is designed to receive and track Galileo E1 and E5a signals centered on 1575.42 MHz and 1176.45 MHz.

1.5.4. BDS

The module is designed to receive and track BDS B1I signals centered on 1561.098 MHz. The ability to receive and track BDS signals in conjunction with GPS results in higher coverage, improved reliability, and better accuracy.

1.5.5. QZSS

The Quasi-Zenith Satellite System (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 LC79D (A) module can detect and track QZSS L1 C/A and L5 signals concurrently with GPS signals, leading to better availability especially under challenging conditions, e.g, in urban canyons.

1.5.6. IRNSS

The Indian Regional Navigation Satellite System (IRNSS) or NavIC is a regional navigation satellite system that transmits additional L5 signals for complying with the requirements of an independent accurate positioning system for users in India. The Quectel LC79D (A) module is designed to receive and track IRNSS L5 signals from IRNSS satellites centered on 1176.45 MHz.

1.6. AGNSS

The LC79D (A) module supports AGNSS feature that significantly reduces 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, rough position, and LTO data. For more information, see document ***[2]***.

1.7. Firmware Upgrade

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

2 Pin Assignment

The Quectel LC79D (A) module is equipped with 28 pins (18 LCC and 10 LGA) by which the module can be mounted on your PCB.

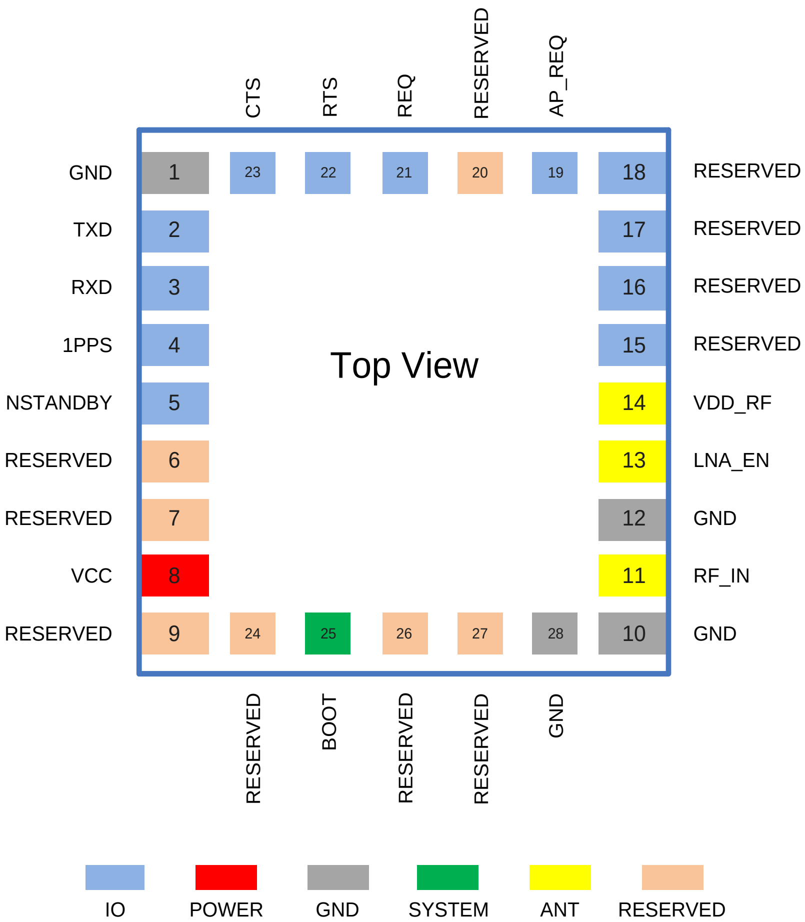


Figure 2: Pin Assignment

Table 3: I/O Parameter Definition

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

Table 4: Pin Description

Function	Name	No.	I/O	Description	Remarks
Power	VCC	8	PI	Main power supply	Provides clean and steady voltage.
IO	TXD	2	DO	Transmits data	For data transmission and firmware upgrade in Normal operating mode, the module only requires a two-wire UART (TXD and RXD). However, a four-wire UART (TXD, RXD, CTS and RTS) is needed for firmware bootloader upgrade in Boot download mode.
	RXD	3	DI	Receives data	
	CTS	23	DO	Clear to send	
	RTS	22	DI	Request to send	
	REQ	21	DO	Indicates if there are data available for reading	High level: There are data available for reading. Low level: No data are available for reading. If unused, leave the pin N/C.
	AP_REQ	19	DI	AP request to send	High level: Notify the module that the AP has data to be sent. Low level: Data transfer has been completed. If unused, leave the pin N/C.
	1PPS	4	DO	One pulse per second	Synchronized on rising edge. If unused, leave the pin N/C.
	NSTANDBY	5	DI	Controls the module to enter or exit Standby mode	The pin is pulled up internally by default.

					If the pin is pulled down after the module's startup, the module will enter Standby mode..
ANT	RF_IN	11	AI	GNSS antenna interface	50 Ω characteristic impedance.
	LNA_EN	13	DO	Power control for active antenna	If unused, leave the pin N/C.
	VDD_RF	14	PO	Power supply for external RF components	VDD_RF = VCC, the output current capacity depends on VCC. Typically used to supply power for an external active antenna or LNA. If unused, leave the pin N/C.
System	BOOT	25	DI	Controls module startup mode	Pulled down internally by default. While the pin is kept floating during startup, the module will enter Normal operating mode. While the pin is kept at high level for about 50 ms during startup, the module will enter Boot download mode.
GND	GND	1, 10, 12, 28	-	Ground	Assures a good GND connection to all GND pins of the module, preferably with a large ground plane.
RESERVED	RESERVED	6, 7, 9, 15-18, 20, 24, 26, 27	-	Reserved	These pins must be left floating and cannot be connected to power or GND.

NOTE

Leave RESERVED and unused pins N/C (not connected).

3 Power Management

The Quectel LC79D (A) 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 three operating modes: Sleep mode and Standby 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 power for the PMU which in turn supplies power for 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.

VDD_RF is an output pin, equal in voltage to the VCC input. VDD_RF supplies power for the external active antenna or the LNA.

The module's internal power supply is shown below:

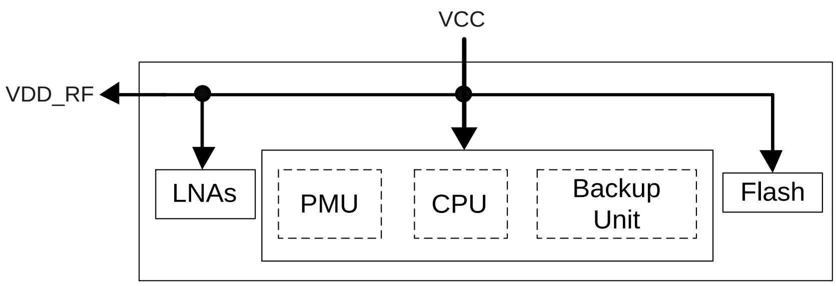


Figure 3: Internal Power Supply

3.2. Power Supply

3.2.1. VCC

The VCC is the supply voltage pin that supplies BB and RF.

Module power consumption may vary by several orders of magnitude, especially when power saving modes 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 power saving modes to Continuous mode 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 in power saving modes, it is important that the LDO at the power supply or module input can provide the current. An LDO with a high PSRR should be chosen for good performance. In addition, a TVS, and a combination of a 10 μF, a 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.

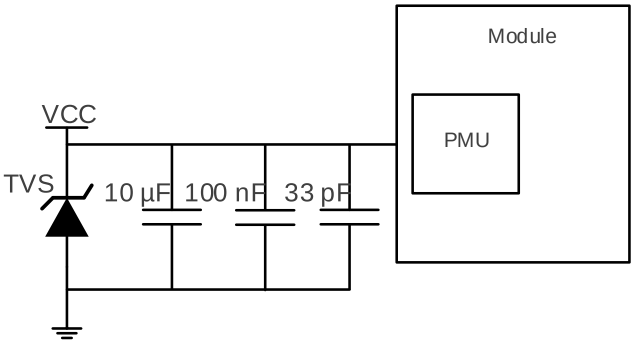


Figure 4: VCC Input Reference Circuit

NOTE

It is recommended to control the VCC of the module via MCU to save power, or restart the module when the module enters an abnormal state.

3.3. Power Mode

3.3.1. Feature Comparison

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

Table 5: Feature Comparison in Different Power Modes

Features	Continuous	Sleep	Standby
NMEA from UART	●	-	-
1PPS	●	-	-
RF	●	-	-
Acquisition & Tracking	●	-	-
Power Consumption	High	Low	Low
Position Accuracy	High	-	-

3.3.2. Continuous Mode

If VCC is powered on, the module automatically enters 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. Sleep Mode

In Sleep mode, the LC79D (A) module stops acquiring and tracking satellites. UART is not accessible. But the flash and the backup domain which contains all the necessary GNSS information for quick start-up and a small amount of user configuration variables keep working. Sleep mode is disabled by default.

Two approaches to enter/exit Sleep mode:

- Enter Sleep mode:
  1. Send a command to enable Sleep mode. For more information about the command, see ***document [1]***.
  2. Pull down AP_REQ pin to make the module enter Sleep mode.

- Exit Sleep mode:
  1. Pull up AP_REQ pin.
     Send a command to make the module exit Sleep mode. For more information about the command, see ***document [1]***.

NOTE

When Sleep mode is used, please keep AP_REQ pin at the low level.

3.3.4. Standby Mode

In Standby mode, only RTC clock is active, and other parts are inactive.

- Enter Standby mode: Pull down NSTANDBY pin to make the module enter Standby mode.
- Exit Standby mode: Keep NSTANDBY pin floating to make the module exit Standby mode.

An OC driver circuit shown as below is recommended to control NSTANDBY.

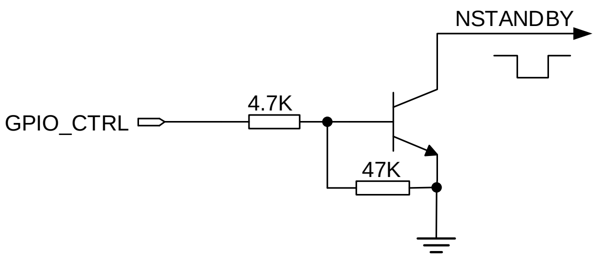


Figure 5: Reference OC Circuit for Standby Mode

NOTE

1. The NSTANDBY pin has to remain high during module startup.
2. The NSTANDBY pin is pulled up internally. Therefore, an external pull-up circuit is not needed.
3. Pulling down NSTANDBY pin for at least 50 ms and then releasing it will reset the module.

3.4. Power-Up Sequence

Once the VCC is powered up, the module starts up automatically and the voltage should rise rapidly within 50 ms.

Ensure that the VCC has no rush or drop during rising time, and then keep the voltage stable. The recommended ripple is less than 50 mV.

3.5. Power-Down Sequence

Once the VCC is shut down, voltage should drop quickly in 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 the minimum specified value, the system must initiate a power-on restart by lowering VCC to less than 100 mV for at least 1 s.

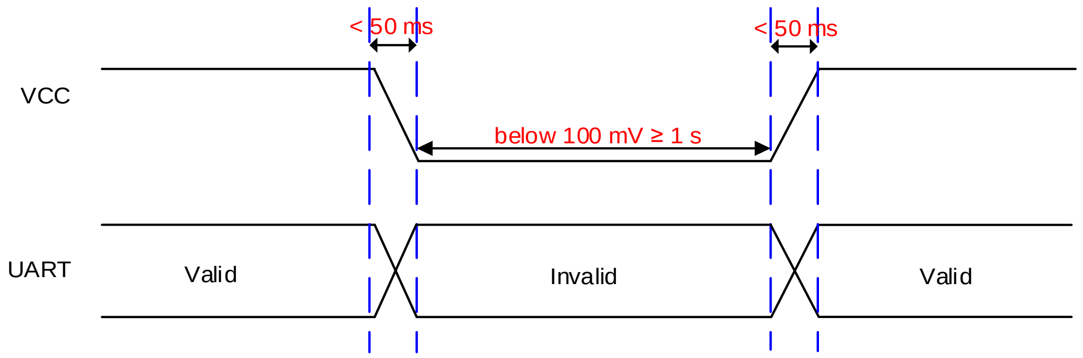


Figure 6: Power-Down and Power-On Restart Sequence

4 Application Interfaces

4.1. IO Pins

4.1.1. Communication Interface

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

4.1.1.1. UART Interface

The LC79D (A) module has one UART interface with following features:

- Supports standard NMEA message output, PQ command input and output, and firmware upgrade.
- Supports baud rates of 115200, 230400, 460800 and 921600 bps.

A reference design is shown in the figure below.

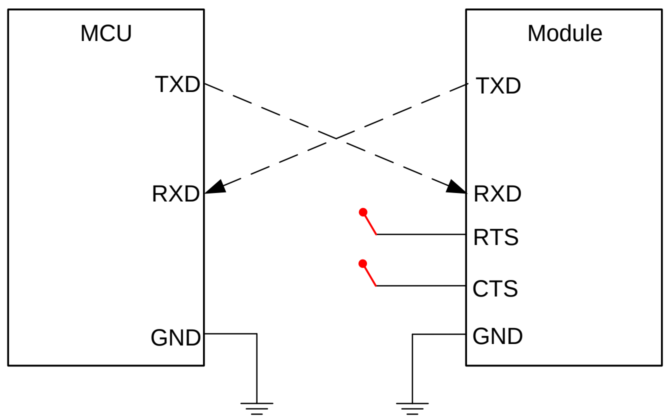


Figure 7: UART Interface Reference Design

NOTE

1. For data transmission and firmware upgrading in Normal operating mode, the module only requires a two-wire UART (TXD and RXD). However, a four-wire UART (TXD, RXD, CTS and RTS) is needed for firmware bootloader upgrade in Boot download mode. These additional pins

should be made accessible in your design.
2. "↘" represents UART interface test points. Place the test points close to the module.
3. If the IO voltage of MCU is not matched with module, a level shifter must be selected.
4. The default settings of the UART interface vary with software versions. Please refer to specific software version for details.

4.1.2. AP_REQ

The AP_REQ pin is used for requesting to send. When the pin is at high level, it notifies the module that the AP has data to be sent. When the pin is at low level, it indicates that data transfer has been completed.

4.1.3. REQ

The REQ pin indicates whether there are data available for reading. When the pin is at high level, it indicates that there are data available for reading. When the pin is at low level, it indicates that no data are available for reading.

4.1.4. 1PPS

The 1PPS output pin generates one pulse per second periodic signal synchronized with a GNSS time grid with intervals. The accuracy is less than 100 ns. Thus, it may be used as a low frequency time synchronization pulse or as a high frequency reference signal. Maintaining high accuracy of 1pps requires visible satellites in an open sky environment and keeping the VCC power.

4.2. System Pin

4.2.1. BOOT

The BOOT pin can be used to set the Quectel LC79D (A) module into Boot download mode. It is pulled down internally by default. If the pin is kept floating during startup, the module enters Normal operating mode. If the pin is kept at high level for about 50 ms during startup, the module enters Boot download mode. For more information about the reference circuit design, see ***document [4]***.

The BOOT pin voltage level is checked to identify its operating mode when the module is powered on.

Table 6: Operating Modes

Voltage Level	Operating Mode	Comment
Low	Normal	If the pin is kept floating during startup, the module enters Normal operating mode.
High	Boot download	If the pin is kept at high level for about 50 ms during startup, the module enters Boot download mode.

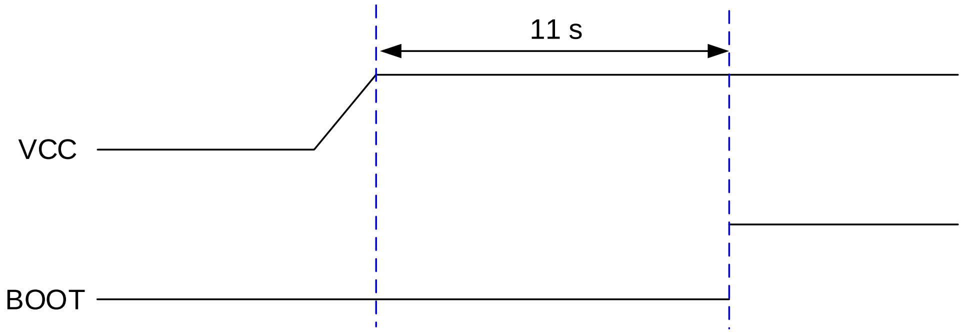


Figure 8: BOOT Pin State (Normal Operating Mode)

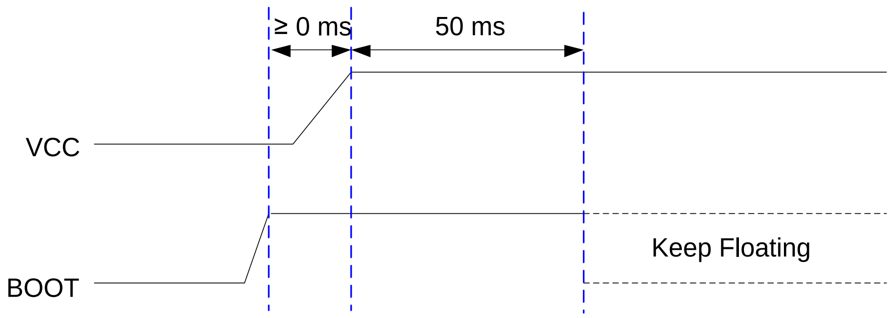


Figure 9: BOOT Pin Control Sequence (Boot Download Mode)

5 Design

This chapter explains the reference design of RF section of the module and recommended footprint.

5.1. Antenna Reference Design

5.1.1. Antenna Specification

The Quectel LC79D (A) module can be connected to a dedicated passive or active dual-band (L1 + L5) GNSS antenna to receive GPS, GLONASS, Galileo, BDS, QZSS, and IRNSS satellite signals. The recommended antenna specifications are given in the table below.

Table 7: Recommended Antenna Specifications

Antenna Type	Specifications
Passive Antenna	Frequency Range: 1164–1189 MHz & 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi
Active Antenna	Frequency Range: 1164–1189 MHz & 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 Proposition of the Quectel Antenna Team: **YB0017AA**

NOTE

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

5.1.2. Antenna Selection Guide

Both active and passive dual-band (L1 + L5) GNSS antennas can be used for the Quectel LC79D (A) 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. It is recommended to switch from a passive antenna to an active antenna once the loss is greater than 1 dB, since the insertion loss of RF cable can decrease the C/N_0 of GNSS signal. For more information about RF layout, see ***document [5]***.

C/N_0 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. C/N_0 formula is as below:

$$C/N_0 = \text{Power of GNSS signal} - \text{Thermal Noise} - \text{System NF(dB-Hz)}$$

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 C/N_0 of GNSS signal, an LNA could be added to reduce “System NF”.

“System NF”, formula:

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

“F” is the noise factor of receiver system:

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

“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.

5.1.3. Active Antenna Reference Design

The following figure is a typical reference design of an active antenna. In this case, the antenna is powered by the VDD_RF. When selecting the active antenna, it is necessary to pay attention to operating voltage range.

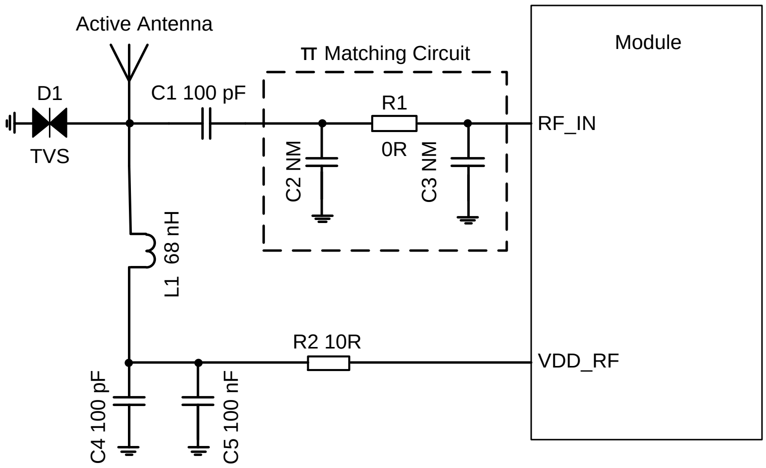


Figure 10: Active Antenna Reference Design

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. The junction capacitance of D1 cannot be more than 0.6 pF and the transient voltage suppressor is recommended.

An active antenna can use the power supply from the VDD_RF pin. In that case, the inductor L1 is used to prevent the RF signal from leaking into the VDD_RF and to prevent noise propagation from the VDD_RF to the antenna. The L1 inductor routes the bias voltage to the active antenna without losses. When placing parts, L1, C4, and C5 must be placed close to the antenna interface. Among them, the proximal end of L1 pad shall be laid on the RF line. The recommended value of L1 should be at least 68 nH. The resistor R2 is used to protect the module in case the active antenna is short-circuited to the ground plane.

5.1.4. Passive Antenna Reference Design

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

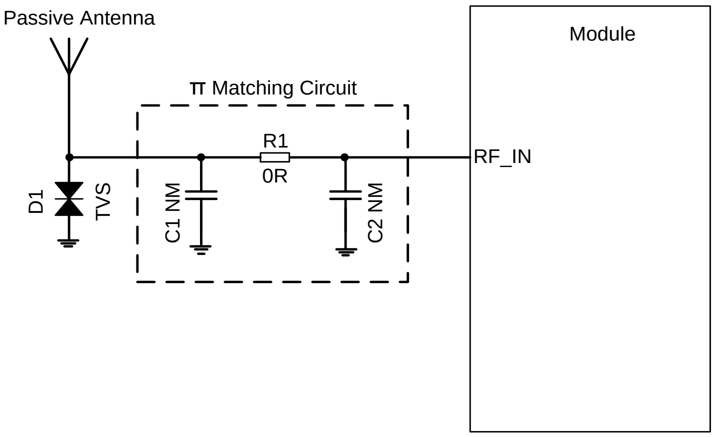


Figure 11: Passive Antenna Reference Design

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 junction capacitance of D1 cannot be more than 0.6 pF and the transient voltage suppressor is recommended. RF trace impedance should be controlled to 50 Ω and the trace length should be kept as short as possible.

5.2. 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.

5.2.1. 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.

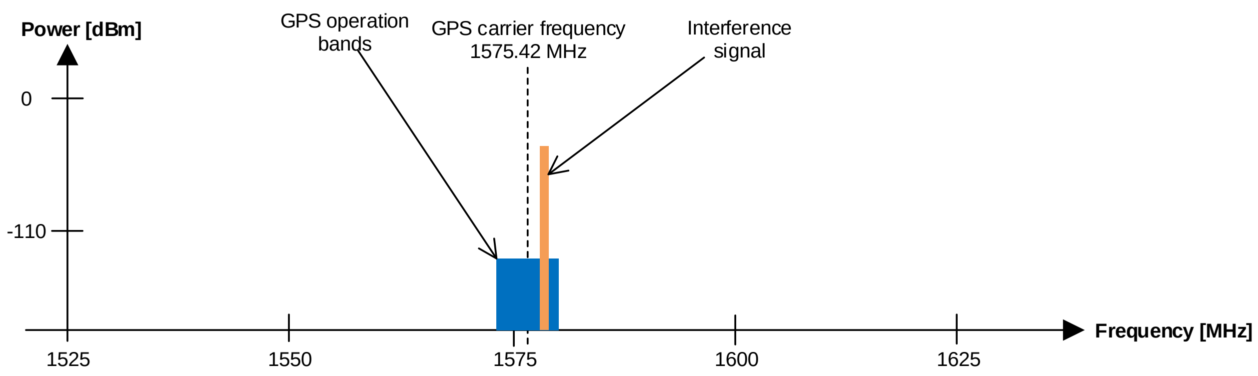


Figure 12: In-Band Interference on GPS L1

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 Band 13.

Table 8: Intermodulation Distortion (IMD) Products

Source F1	Source F2	IM Calculation	IMD Products
GSM850/Band 5	Wi-Fi 2.4 GHz	F2 (2412 MHz) - F1 (837 MHz)	IMD2 = 1575 MHz
DCS1800/Band 3	PCS1900/Band 2	2 × F1 (1712.6 MHz) - F2 (1850.2 MHz)	IMD3 = 1575 MHz
PCS1900/Band 2	Wi-Fi 5 GHz	F2 (5280 MHz) - 2 × F1 (1852 MHz)	IMD3 = 1576 MHz
LTE Band 13	N/A	2 × F1 (786.9 MHz)	IMD2 = 1573.8 MHz

5.2.2. Out-of-Band Interference

Strong signals transmitted by other communication systems can cause a GNSS receiver saturation, thus greatly deteriorating its performance, as illustrated in the following figure.

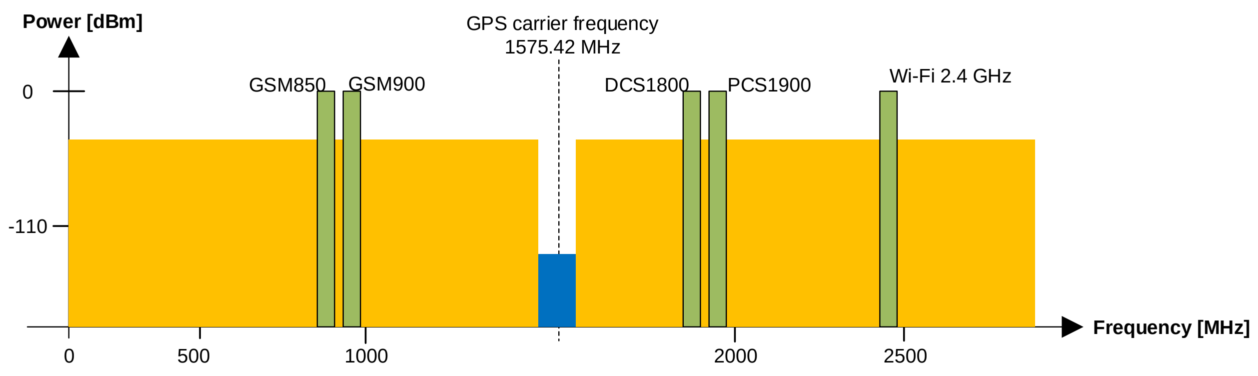


Figure 13: Out-of-Band Interference on GPS L1

5.2.3. 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. A complex communication system usually contains 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.

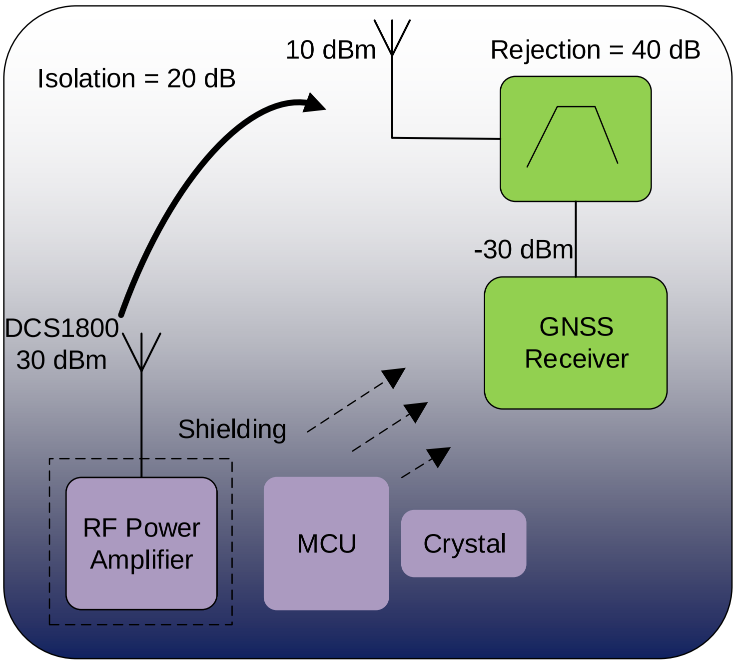


Figure 14: Interference Source and Its Path

5.3. Recommended Footprint

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

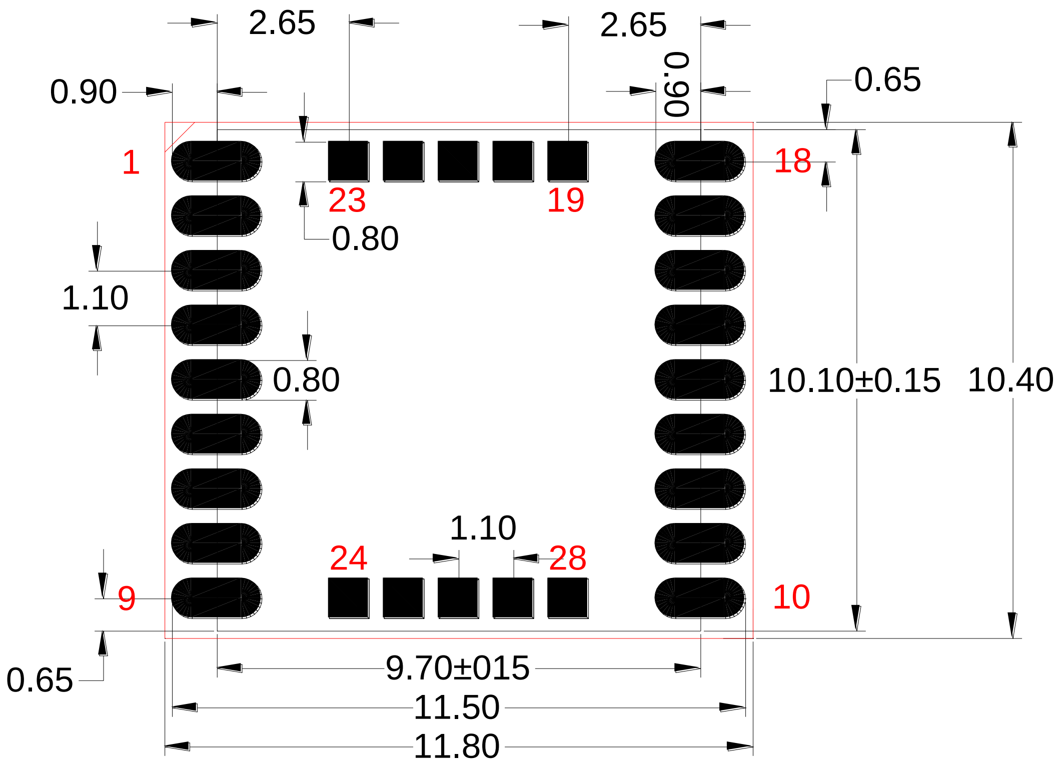


Figure 15: Recommended Footprint

NOTE

Keep at least 3 mm 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 Quectel LC79D (A) module are listed in table below.

Table 9: Absolute Maximum Ratings

Parameter	Description	Min.	Max.	Unit
VCC	Main Power Supply Voltage	-0.2	2.07	V
V_{IN}_IO	Input Voltage at IO Pins	-0.3	VCC + 0.3	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 10: Recommended Operating Conditions

Parameter	Description	Min.	Typ.	Max.	Unit
VCC	Main Power Supply Voltage	1.7	1.8	1.9	V
IO_Domain	Digital IO Pin Domain Voltage	-	1.8	-	V
V_{IL}	Digital IO Pin Low-Level Input Voltage	-0.3	-	0.35 × VCC	V
V_{IH}	Digital IO Pin High-Level Input Voltage	0.65 × VCC	-	VCC + 0.3	V
V_{OL}	Digital IO Pin Low-Level Output Voltage	-	-	0.4	V
V_{OH}	Digital IO Pin High-Level Output Voltage	VCC - 0.45	-	-	V
VDD_RF	VDD_RF Voltage	1.7	1.8	1.9	V
LNA_EN	Low-Level Output Voltage	-	-	0.4	V
	High-Level Output Voltage	VCC - 0.45	1.8	-	V
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. IO_Domain specifically refers to the IO pins in ***Chapter 2***.

6.3. Supply Current Requirement

Table 11: Supply Current

Parameter	Description	Condition	$I_{Typ.}$ [5]	I_{PEAK} [5]
I_{VCC} [6]	Current at VCC	Acquisition	49 mA	80 mA
		Tracking	48 mA	80 mA
		Sleep mode	350 µA	500 µA

[5] Room temperature, measurements are taken with typical voltage.
[6] Used to determine maximum current capability of power supply.

	Standby mode	91 µA	138 µA

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.

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 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, 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

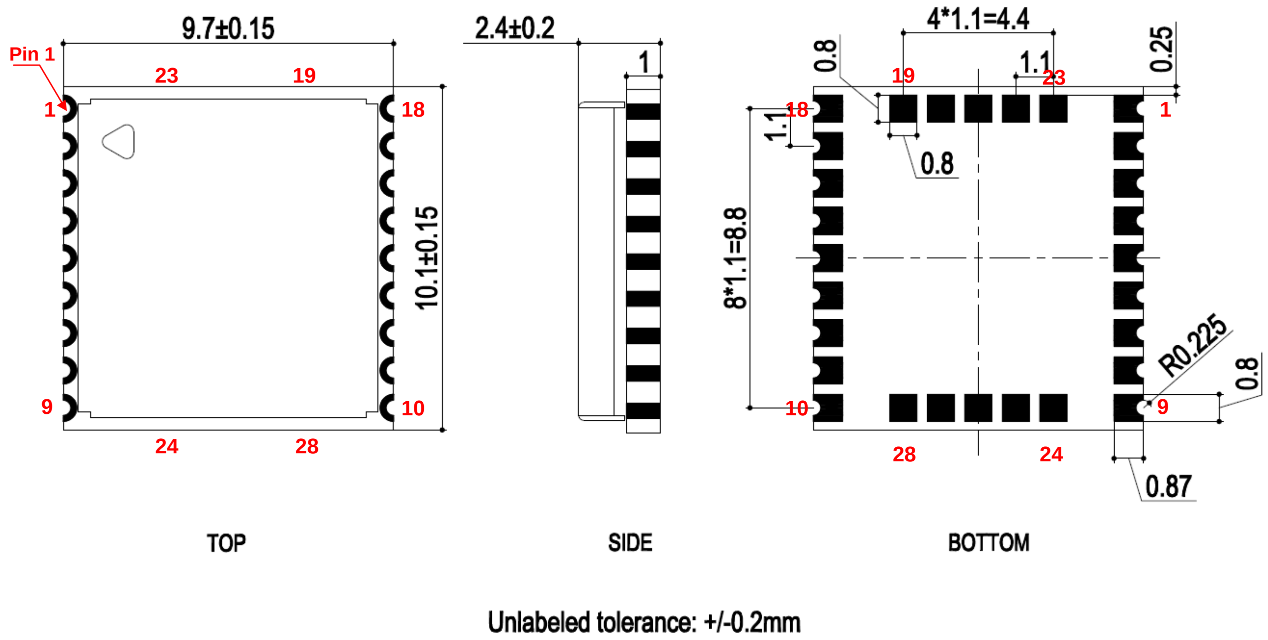


Figure 16: Top, Side and Bottom View Dimensions

NOTE

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

7.2. Top and Bottom Views

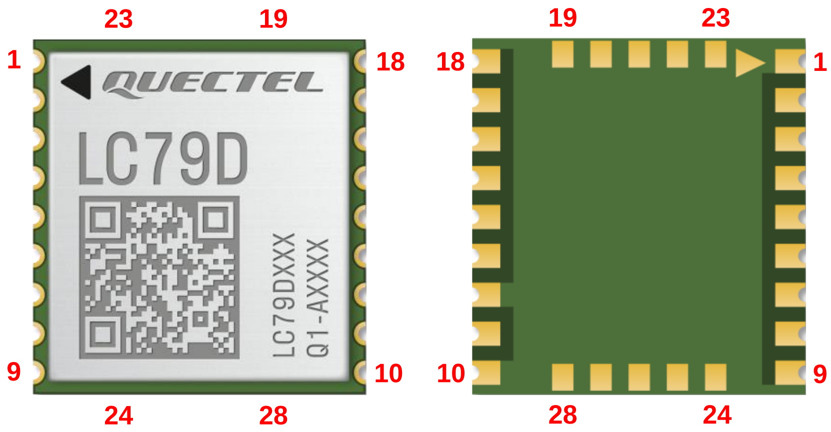


Figure 17: Top and Bottom Views of the Module

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 LC79D (A) module is delivered in a tape carrier package, 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. Carrier Tape

Dimension details are as follow:

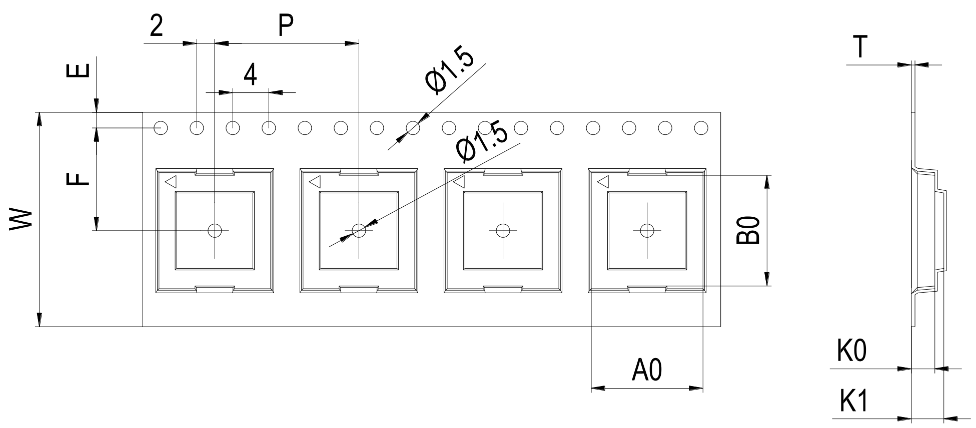


Figure 18: Carrier Tape Dimension Drawing

Table 12: 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

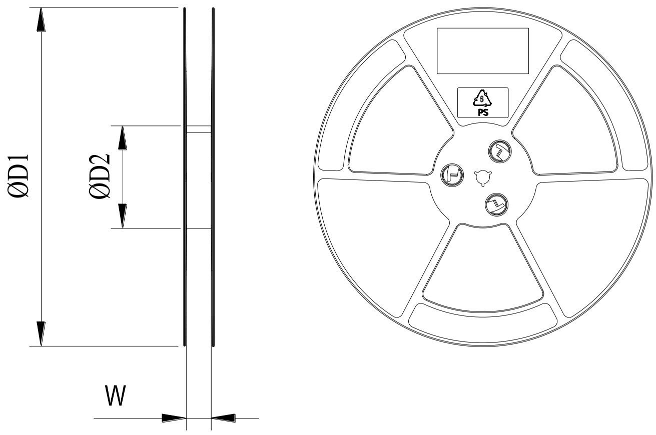
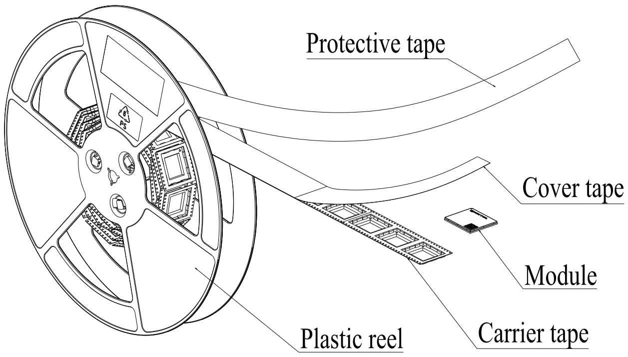


Figure 19: Plastic Reel Dimension Drawing

Table 13: Plastic Reel Dimension Table (Unit: mm)

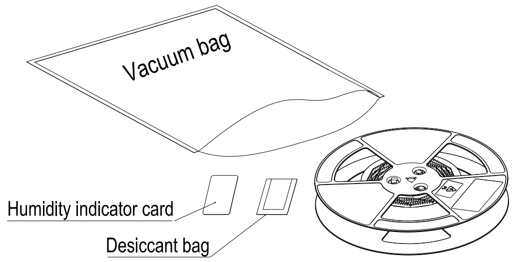
øD1	øD2	W
330	100	24.5

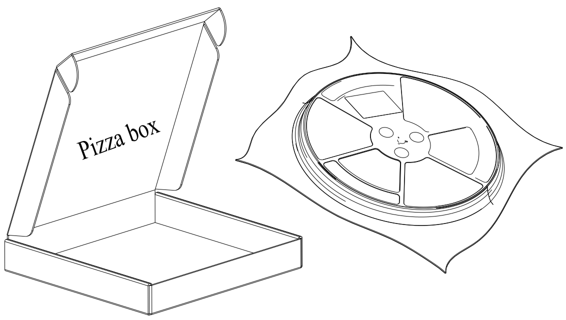
8.1.3. Packaging Process



Place the module into the carrier tape and use the cover tape to cover it then wind the heat-sealed carrier tape on the plastic reel and use the protective tape for protection. One plastic reel can load 500 modules.

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





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

Place 4 pizza boxes inside 1 carton and seal it. One carton can pack 2000 modules.

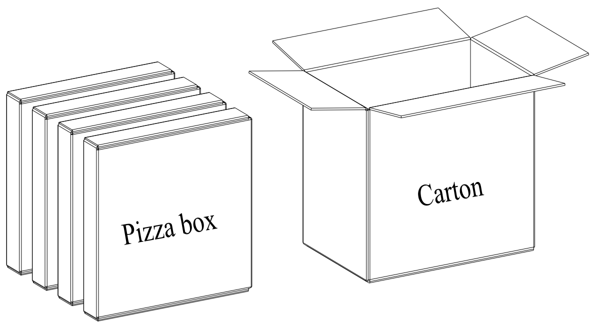


Figure 20: Packaging Process

8.2. Storage

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 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 [7] 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 mentioned 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 follow 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 modules.

[7] 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.

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 [6]***.

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.

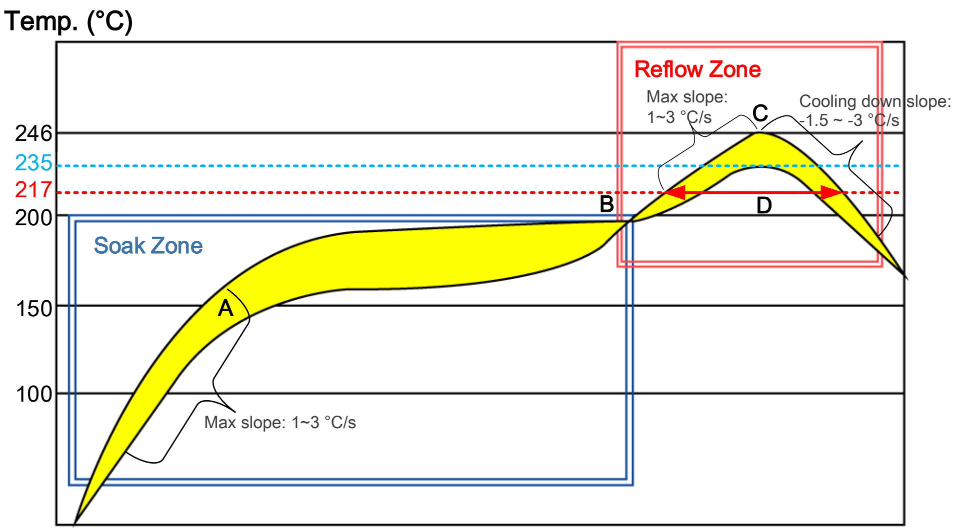


Figure 21: Recommended Reflow Soldering Thermal Profile

Table 14: 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	1–3 °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 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 entering the module shield.
4. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
5. Due to the complexity of the SMT process, please contact Quectel Technical Supports in advance for any situation that you are not sure about, or any process (e.g. selective soldering, ultrasonic soldering) that is not mentioned in ***document [6]***.

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.

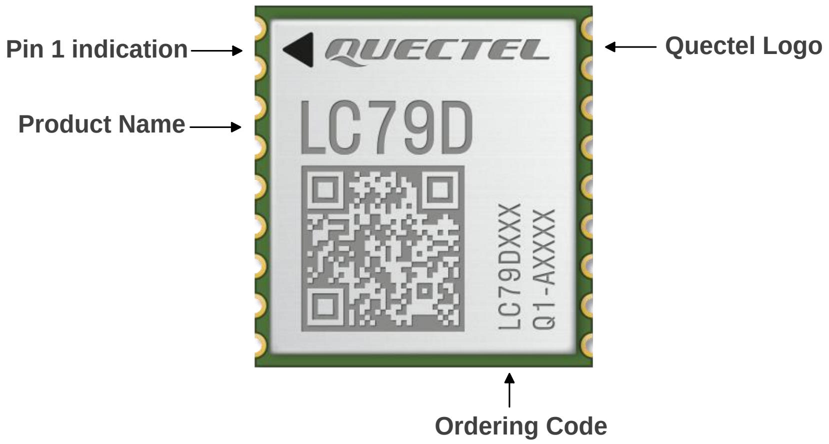


Figure 22: Labelling Information

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 15: Related Documents

Document Name	
[1]	Quectel_LC79D(A)_GNSS_Protocol_Specification
[2]	Quectel_LC79D(A)_AGNSS_Application_Note
[3]	Quectel_LC79D(A)_Firmware_Upgrade_Guide
[4]	Quectel_LC79D(A)_Reference_Design
[5]	Quectel_RF_Layout_Application_Note
[6]	Quectel_Module_Secondary_SMT_Application_Note

Table 16: Terms and Abbreviations

Abbreviation	Description
AGNSS	Assisted Global Positioning System
AP	Application
ARM	Advanced RISC Machine
BDS	BeiDou Navigation Satellite System
CEP	Circular Error Probable
C/N_0	Carrier-to-noise Ratio
CTS	Clear to Send
DCS1800	Digital Cellular System at 1800MHz
DR	Dead Reckoning
EGNOS	European Geostationary Navigation Overlay Service

ESD	Electrostatic Discharge
GAGAN	GPS Aided Geo Augmented Navigation
Galileo	Galileo Satellite Navigation System (EU)
GLONASS	Global Navigation Satellite System (Russian)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
I/O	Input /Output
I2C	Inter-Integrated Circuit
IC	Integrated Circuit
IMU	Inertial Measurement Unit
$I_{Typ.}$	Typical Current
I_{PEAK}	Peak Current
IRNSS/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
LTE	Long Term Evolution
LTO	Long-term Orbit
Mbps	Megabits per second
MCU	Microcontroller Unit/Microprogrammed Control Unit
MSAS	Multi-functional Satellite Augmentation System (Japan)
MSL	Moisture Sensitivity Levels
NF	Noise Factor

NMEA	National Marine Electronics Association
OC	Open Connector
PCB	Printed Circuit Board
PMU	Power Management Unit
1PPS	One Pulse Per Second
PSRR	Power Supply Rejection Ratio
QR (code)	Quick Response (Code)
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RHCP	Right Hand Circular Polarization
RoHS	Restriction of Hazardous Substances
ROM	Read Only Memory
RTC	Real-Time Clock
RTK	Real-Time Kinematic
RTS	Ready to Send/Request to Send
RXD	Receive Data
3GPP	3rd Generation Partnership Project
SAW	Surface Acoustic Wave
SBAS	Satellite-Based Augmentation System
SMD	Surface Mount Device
SMT	Surface Mount Technology
SNR	Signal-to-Noise Ratio
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
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
WAAS	Wide Area Augmentation System
WCDMA	Wideband Code Division Multiple Access
XTAL	External Crystal Oscillator