LC79H Series
Hardware Design

GNSS Products

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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	**LC79H Series Hardware Design**
Subtitle	GNSS Products
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Revision History

Version	Date	Description
-	2021-05-31	Creation of the document
1.0	2022-03-30	First official release
1.1	2023-03-02	1. Deleted the information of LC79H (BA). 2. Added the voltage of V_BCKP and the number of concurrent GNSS, and updated the weight of LC79H (AL) (*Table 2*). 3. Added the power data, TTFF with EASY and EPO, and updated the accuracy of 1PPS signal and the velocity accuracy (*Table 3*). 4. Added a notch circuit in the block diagram (*Figure 1*). 5. Added a software command to output the geofence status (*Chapter 1.9*). 6. Added the DC Characteristics of all pins, and updated supported messages for I2C interface (*Table 6*). 7. Updated the supported messages and baud rate for UART (*Table 6* and *Chapter 4.1.1.1*). 8. Added the reference power supply circuit with 3.7 V lithium battery and a note that it is not recommended to use a non-rechargeable battery to power V_BCKP in Continuous mode (*Chapter 3.2.2*). 9. Added the optional SAW filter circuit to active and passive antenna reference designs, as well as the corresponding description (*Chapter 5.2*).

Version	Date	Description
		10. Updated the maximum input power at RF_IN (*Table 9*). 11. Added the high-level input voltage range of RESET_N and maximum output current of VDD_RF. 12. Added the module mounting direction (*Chapter 8.1.3*). 13. Added the sizes of pizza box and carton (*Chapter 8.1.4*). 14. Updated the recommended ramp-to-soak, ramp-up and cool-down slopes (*Figure 24* and *Table 13*).
1.2	2023-04-26	Added the maximum update rate for NMEA message and supported update rate for RTCM message (*Table 3*).
1.3	2023-05-18	Updated the recommended SAW filter model (*Chapter 5.2*).
1.4	2025-08-15	1. Added the applicable module LC79H (EL). 2. Added NavIC support for LC79H (AL) (*Chapter 1.1*, *1.2*, *1.5*). 3. Updated the storage temperature range (*Table 2*, *Table 9*). 4. Updated the tolerances of module length and width (*Table 2*, *Figure 18*). 5. Updated module performance of LC79H (AL) (*Table 3*): ● Updated the test condition for power consumption, sensitivity, TTFF (without AGNSS), accuracy of 1PPS signal, velocity accuracy and dynamic performance; ● Added TTFF (with AGNSS) and vertical position accuracy; ● Updated the update rate and accuracy of 1PPS signal (RMS); ● Deleted the TTFF (EASY), TTFF (with EPO), accuracy of 1PPS signal (3σ) and acceleration accuracy. 6. Deleted the information on EASY function (*Chapter 1.7*). 7. Added the information on EPOC function (*Chapter 1.7.1*). 8. Added a note about module operating voltage range (*Chapter 2*). 9. Deleted the note about non-rechargeable battery (*Chapter 3.2.2*). 10. Updated baud rates supported by the UART interface (*Chapter 4.1.1.1*). 11. Moved information related to antenna selection guide and coexistence with cellular systems to Quectel_GNSS_Antenna_Application_Note. 12. Added the out-of-band rejection for active antenna and updated the active antenna noise figure of LC79H (AL) (*Table 8*). 13. Deleted the chapter of recommended operating conditions (*Chapter 6*). 14. Added the note on the measured power consumption values and updated the test condition (*Chapter 6.2*). 15. Updated the module coplanarity requirement (*Chapter 7.1*). 16. Updated the pre-baking time to 24 h (*Chapter 8.2*). 17. 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;

Version	Date	Description
		● 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 LC79H series module includes two variants: LC79H (AL) and LC79H (EL). The module supports multiple constellations, such as GPS, GLONASS, Galileo, BDS, QZSS and NavIC, and SBAS (including WAAS, EGNOS, MSAS and GAGAN) and AGNSS functions as well. The module is powered by 1.8 V.

Key features:

- Dual-band, multi-constellation GNSS module features a high-performance, high reliability positioning engine facilitating fast and precise GNSS positioning.
- Supported serial communication interfaces: UART and I2C [1].
- LC79H (EL) integrates an RTK position engine to provide centimeter-level positioning accuracy in an open-sky environment.
- Embedded flash memory provides the capacity for storing not only user-specific configurations, but also future firmware upgrades.

Quectel LC79H series is a 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, including 18 LCC pins and 10 LGA pins.

The module is fully compliant with the EU RoHS Directive.

1.1.1. Special Marks

Table 1: Special Marks

Mark	Definition
*	Unless otherwise specified, an asterisk (*) after a function, feature, interface, pin name, command, argument, and so on indicates that it is under development and currently not supported; and the asterisk (*) after a model indicates that the model sample is currently unavailable.
●	The symbol indicates that a function or technology is supported by the module(s).

[1] The I2C interface is under development for LC79H (EL).

1.2. Features

Table 2: Product Features

Features		LC79H (AL)	LC79H (EL)
Grade	Industrial	●	●
	Automotive	-	-
Category	Standard Precision GNSS	●	-
	High Precision GNSS	-	●
	DR	-	-
	RTK	-	●
	Timing	-	-
VCC Voltage	1.75–1.98 V, typ. 1.8 V	●	●
V_BCKP Voltage	1.62–1.98 V, typ. 1.8 V	●	●
I/O Voltage	Following VCC	●	●
Communication Interfaces	UART	●	●
	SPI	-	-
	I2C [2]	●	●
	CAN	-	-
	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

[2] The I2C interface is under development for LC79H (EL).

Features			LC79H (AL)	LC79H (EL)
	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 +95 °C		
Physical Characteristics		Size: (10.1 +0.30/-0.15) mm × (9.7 +0.30/-0.15) mm × (2.4 ±0.20) mm Weight: Approx. 0.5 g		

NOTE

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

1.3. Performance

Table 3: Product Performance

Parameter	Specification	LC79H (AL)	LC79H (EL)
Power Consumption [3] (GPS + GLONASS + Galileo + BDS + QZSS)	Acquisition	33 mA (59.4 mW)	41 mA (73.8 mW)
	Tracking	33 mA (59.4 mW)	41 mA (73.8 mW)
	Backup mode	20 μA (36 μW)	28 uA (50.4 uW)
Sensitivity [3] (GPS + GLONASS + Galileo + BDS + QZSS)	Acquisition	-148 dBm	-148 dBm
	Reacquisition	-159 dBm	-158 dBm
	Tracking	-166 dBm	-165 dBm
TTFF [3] (Without AGNSS)	Cold Start	26 s	26 s
	Warm Start	18 s	18 s
	Hot Start	1 s	1 s
TTFF [4] (with AGNSS)	Cold Start	12 s	12 s
	Warm Start	2 s	2 s
	Hot Start	1 s	1 s
Horizontal Position Accuracy	Autonomous [5]	1 m	1 m
	RTK [6]	-	1 cm + 1 ppm
Vertical Position Accuracy	Autonomous [5]	2 m	2 m
	RTK [6]	-	2.5 cm + 1 ppm
Convergence Time	RTK [6]	-	< 10 s
Update Rate	PVT	GNSS: 1–10 Hz	RTK: 1–10 Hz
	Raw Data	GNSS: 1 Hz	GNSS: 1/2/5 Hz
Accuracy of 1PPS Signal [3]	RMS	20 ns	20 ns

[3] Tested at room temperature, with typical operating voltage, and satellite signal of -130 dBm configured by the instrument.
[4] Open-sky, active high-precision GNSS antenna.
[5] CEP 50 %, 24 hours static, -130 dBm, more than 6 SVs.
[6] CEP 50 %, with active high-precision antennas in an open-sky environment and within 1 km from the base station.

Parameter	Specification	LC79H (AL)	LC79H (EL)
Velocity Accuracy [3]	Without Aid	0.03 m/s	0.03 m/s
Dynamic Performance [3]	Maximum Altitude	10000 m	10000 m
	Maximum Velocity	500 m/s	500 m/s
	Maximum Acceleration	4g	4g

1.4. Block Diagram

A block diagram of the module is presented below, which includes a front-end section with a notch circuit, an additional LNA and a diplexer, a TCXO, an XTAL, and a GNSS IC with a PMU. The diplexer integrates two band-pass filters, which can improve the out-of-band rejection.

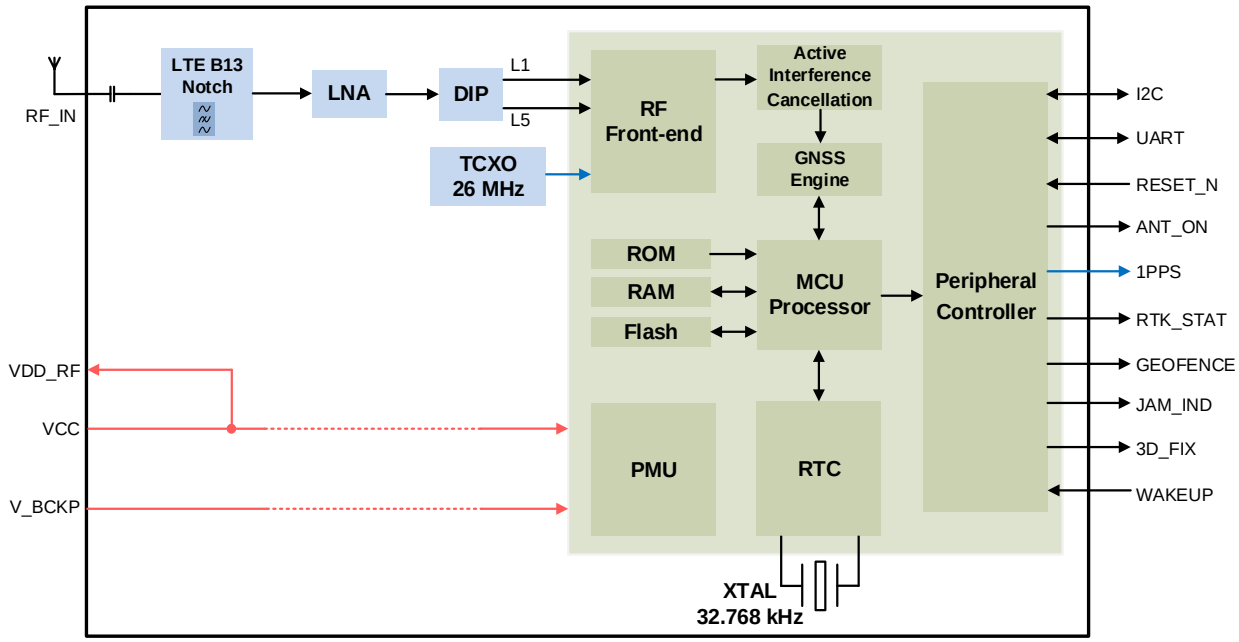


Figure 1: Block Diagram

NOTE

1. The I2C interface is under development for LC79H (EL).
2. RTK_STAT is supported only on LC79H (EL).

1.5. GNSS Constellations

The module is a dual-band concurrent GNSS receiver that can receive and track multiple GNSS constellations. Due to its RF front-end architecture, it can track the following GNSS constellations: GPS, GLONASS, Galileo, BDS, QZSS and NavIC, plus SBAS satellites. If low power consumption is a key factor, then the module can be configured for a subset of 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 and L5 signals concurrently with GPS signals, leading to better availability especially under challenging conditions, e.g., in urban canyons.

NavIC is a regional satellite navigation system that transmits additional L5 signals for complying with the requirements of an independent accurate positioning system for users in India. The module is designed to receive and track NavIC L5 signal centered on 1176.45 MHz.

Table 4: GNSS Constellations and Frequency Bands

System	Signal
GPS	L1 C/A: 1575.42 MHz L5: 1176.45 MHz
GLONASS	L1: 1602 MHz + K × 562.5 kHz, K= (-7 to +6, integer)
Galileo	E1: 1575.42 MHz E5a: 1176.45 MHz
BDS	B1I: 1561.098 MHz B2a: 1176.45 MHz
QZSS	L1 C/A: 1575.42 MHz L5: 1176.45 MHz
NavIC	L5: 1176.45 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: 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 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. EPOC

The module supports the EPOC technology. EPOC is an internal module application designed to improve the TTFF performance by predicting GNSS constellation orbits using the received broadcast ephemeris data. EPOC aiding data serves as an alternative AGNSS method aimed at speeding up TTFF when the loss of EPO aiding data is caused by unavailability of external network connectivity.

The operational mechanism of EPOC: On day 1, TTFF is approximately 30 s without EPOC aiding data. Once the broadcast ephemerides are received, EPOC automatically activates the 3-day satellite orbit prediction process. Over the subsequent 72 hours, EPOC accelerates TTFF and ensures precise positioning. After completing the orbit prediction process for all available broadcast ephemerides, EPOC transitions to standby state until new broadcast ephemeris data becomes available.

For more information about EPOC, see *document [2] AGNSS application note*.

1.7.2. EPO

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

1.8. Multi-Tone AIC

The module features a function called multi-tone active interference cancellation (AIC) to decrease 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 can be demodulated from the jammed signal, which can ensure better navigation quality.

The AIC function is enabled by default, and it can be disabled with **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 the current location of each region is within that region or not and signals its status via the GEOFENCE pin or **PQTMGEOFENCESTATUS**.

The evaluation is activated whenever one or more geofences are configured. For more information about geofencing configuration, see *document [1] protocol specification*.

1.10. RTK

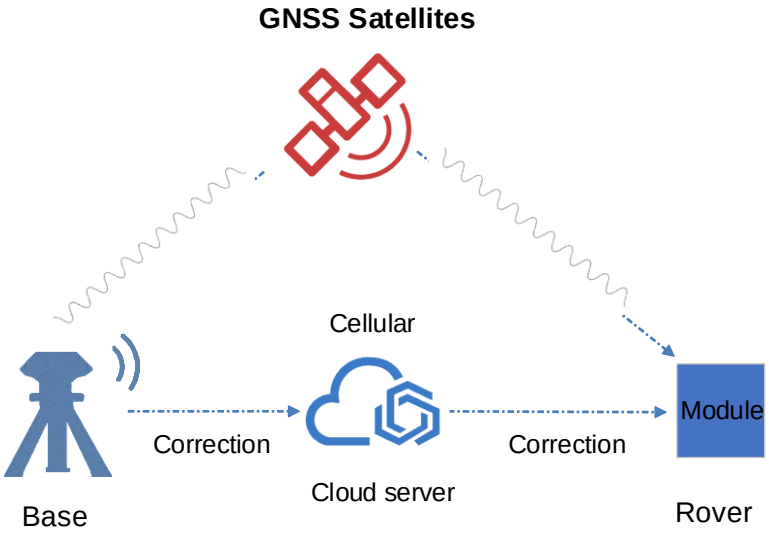


Figure 2: RTK Operation Process

1.10.1. RTK Rover

The LC79H (EL) supports RTK functionality as a rover.

Before implementing the RTK navigation technique, the module needs to receive the RTK differential data via its UART port. RTK differential data can be delivered either using a cellular module or other terrestrial network technologies. When set to the default configuration, the module will attempt to achieve the best positioning accuracy based on the received correction data. Once the differential correction data is validated to be used by the position engine, the module will enter differential mode or RTK float mode. Once the module internal position engine decodes the carrier phase ambiguities, it will achieve the RTK fixed mode. In RTK fixed mode, the positioning accuracy can reach sub-meter or centimeter level.

The convergence time refers to the interval as the module internal position engine switching from RTK float mode to RTK fixed mode. It typically takes less than 60 s to fix the carrier phase ambiguities. For more information, see *document [3] DR&RTK application note*.

1.11. 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 [4] firmware upgrade guide*.

2 Pin Assignment

The module matches industry convention and are equipped with 28 pins. Specifically, there are 18 LCC pins (pins 1–18) on each side by which the module can be mounted onto legacy designs, and 10 LGA pins (pins 19–28) under the top and bottom of the module which can provide access to additional advanced functionality.

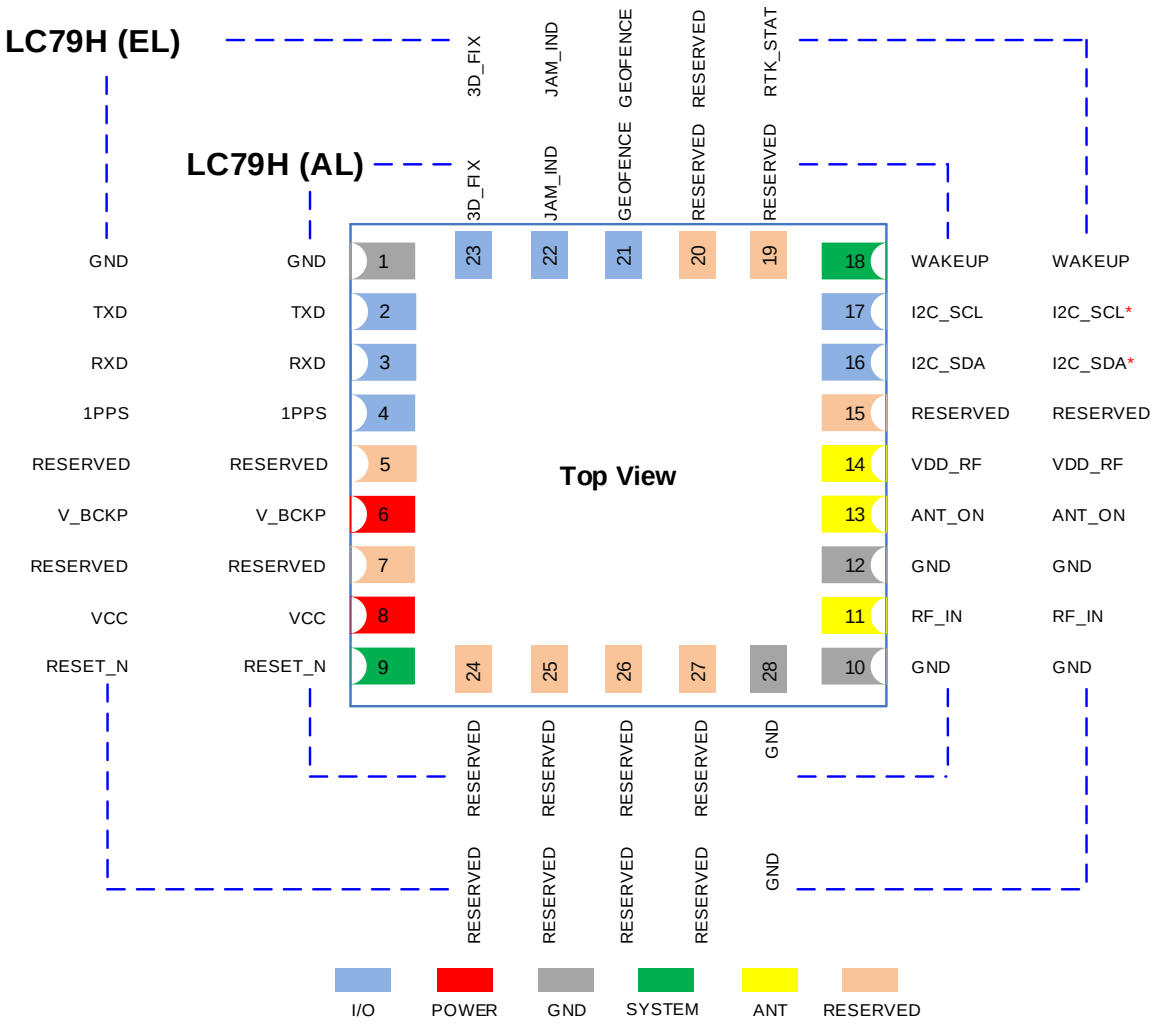


Figure 3: Pin Assignment

Table 5: 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 6: Pin Description

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
Power	VCC	8	PI	Main power supply	$V_I$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	$V_I$min = 1.62 V $V_I$nom = 1.8 V $V_I$max = 1.98 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	V_{OH}min = 0.75 V × VCC V_{OL}max = 0.25 V × VCC	The UART interface supports RTCM and standard NMEA messages, PAIR/PQTM message, binary data and firmware upgrade.
	RXD	3	DI	Receives data	V_{IL}min = -0.3 V V_{IL}max = 0.35 V × VCC V_{IH}min = 0.65 V × VCC V_{IH}max = 1.98 V	
	I2C_SCL(*)	17	DI	I2C serial clock		The I2C interface supports RTCM message, standard NMEA message, PAIR/PQTM message, binary data and firmware upgrade.
	I2C_SDA(*)	16	DIO	I2C serial data	V_{IL}min = -0.3 V V_{IL}max = 0.35 V × VCC V_{IH}min = 0.65 V × VCC V_{IH}max = 1.98 V V_{OL}max = 0.25 V × VCC V_{OH}min = 0.75 V × VCC	
	RTK_STAT	19	DO	Indicates RTK status	V_{OH}min = 0.75 V × VCC V_{OL}max = 0.25 V × VCC	This pin is only supported by

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
						LC79H (EL). If the pin outputs a high level, it indicates that the module enters RTK fixed mode. If the pin outputs a low level, it indicates that the module exits RTK fixed mode. If unused, leave the pin N/C (not connected).
	GEOFENCE	21	DO	Indicates geofence status	V_{OH}min = 0.75 V × VCC V_{OL}max = 0.25 V × VCC	Once the pin is enabled, the receiver continuously compares its current position to the preset geofence area. If unused, leave the pin N/C.
	JAM_IND	22	DO	Jamming indication		If unused, leave the pin N/C.
	3D_FIX	23	DO	3D fix indication		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.
ANT	RF_IN	11	AI	GNSS antenna interface	-	50 Ω characteristic impedance.
	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.
	ANT_ON	13	DO	Power control for external active antenna or LNA	V_{OH}min = 0.75 V × VCC V_{OL}max = 0.25 V × VCC	If unused, leave the pin N/C.
System	RESET_N	9	DI	Resets the module	V_{IL}min = -0.3 V V_{IL}max = 0.1 V	Active low.

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
					V_{IH}min = 1.62 V V_{IH}max = 1.98 V	
	WAKEUP	18	DI	Wakes up the module from the Backup mode	V_{IH}min = 1.62 V V_{IH}nom = 1.8 V V_{IH}max = 1.98 V	It is pulled down internally. Keep the pin low when the module is in the Continuous mode or the Backup mode. Drive the pin high for at least 10 ms to exit the Backup mode. If unused, leave the pin N/C.
GND	GND	1, 10, 12, 28	-	Ground	-	Ensure a good GND connection to all GND pins of the module, preferably with a large ground plane.
RESERVED	RESERVED	5, 7, 15, 19, 20, 24–27	-	Reserved	-	Pin 19 is RTK_STAT for LC79H (EL). These pins must be left floating and cannot be connected to power or GND.

NOTE

1. Leave RESERVED and unused pins N/C.
2. Operation beyond the operating voltage range indicated by DC characteristics is not recommended and extended exposure beyond the operating voltage range may affect device reliability.

3 Power Management

The module features 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 two operating modes: 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, the backup domain power supply should be valid during Backup mode. If the VCC is invalid, the V_BCKP supplies RAM 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 the Continuous mode, VDD_RF supplies for an external active antenna or the LNA. Only if VCC is cut off, VDD_RF is turned off.

The module's internal power supply block diagram is shown below:

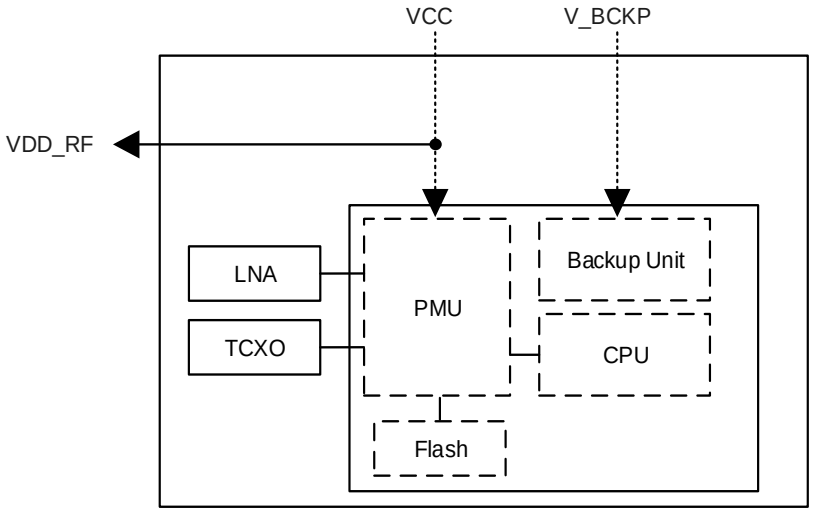


Figure 4: Internal Power Supply Block Diagram

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 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 is able to provide sufficient current when the module is switched from Backup mode to Continuous mode. 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 VCC pin.

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

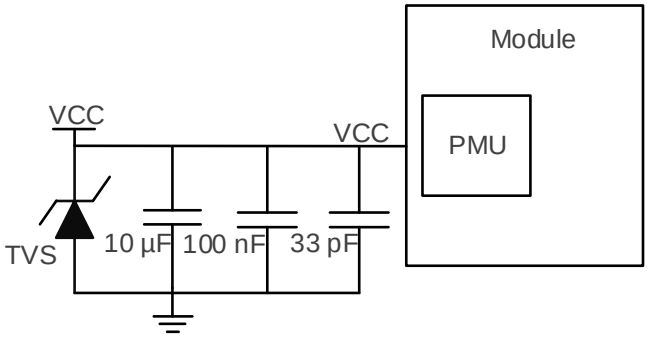


Figure 5: VCC Input Reference Circuit

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 capacitor near the V_BCKP pin. The reference circuit is illustrated below.

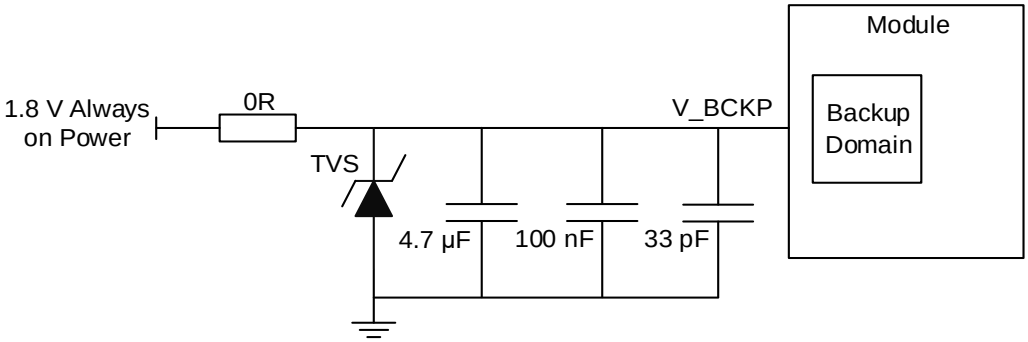


Figure 6: Backup Domain Reference Circuit

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 below.

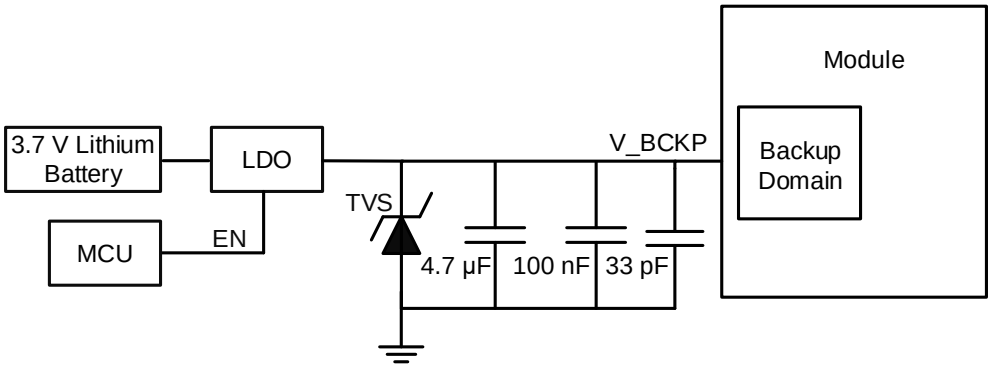


Figure 7: Reference Power Supply Circuit with 3.7 V Lithium Battery

NOTE

1. If V_BCKP is below the minimum value of the recommended operating voltage, the module cannot work normally.
2. 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
NMEA/RTCM from UART	●	-
1PPS	●	-
RF	●	-
Acquisition & Tracking	●	-
Power Consumption	High	Low
Position Accuracy	High	-

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. Once 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. Backup Mode

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

- To enter Backup mode:
  1. Send **PAIR650** command to shut down internal main powers in sequence.
  2. Cut off the power supply of the VCC pin and keep the V_BCKP pin powered.

- To exit Backup mode:
  1. Restore VCC power supply.
  2. Pull the WAKEUP pin high for at least 10 ms.

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

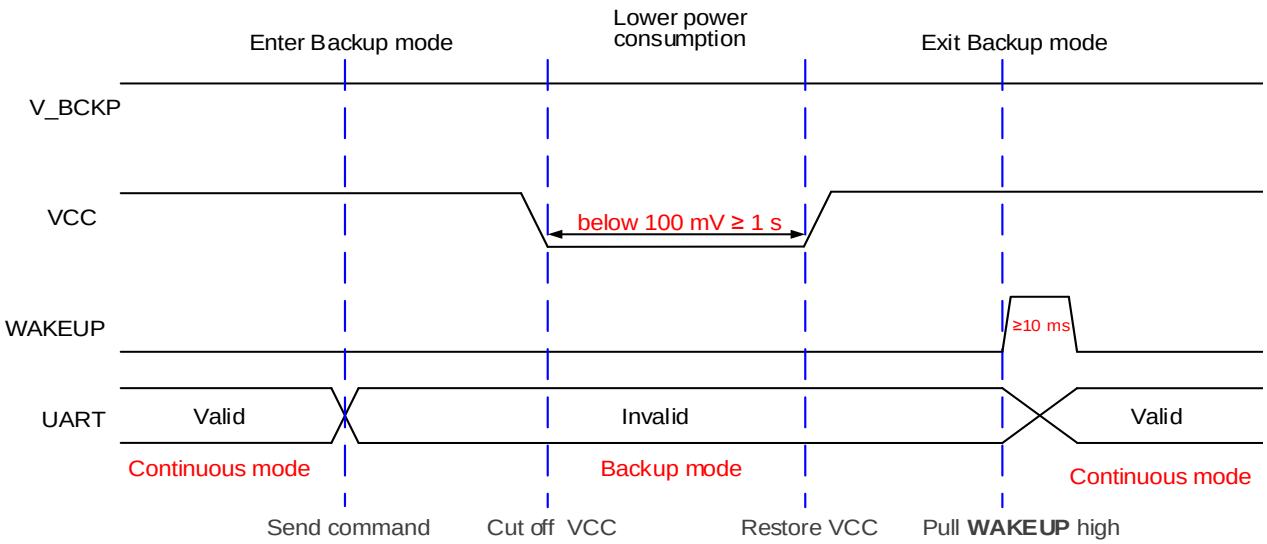


Figure 8: Enter/Exit Backup Mode Sequence

NOTE

1. **PAIR650** must be sent; to ensure a hot (warm) start at the module at the next startup, V_BCKP must be kept powered.
2. If the **PAIR650** is not sent or the VCC is not cut off, the module will not enter the Backup mode entirely, thus causing a higher current consumption than the specified value.
3. Keep the WAKEUP pin low in the Continuous mode and the Backup mode; drive the pin high to wake up the module from the Backup mode.
4. Ensure V_BCKP voltage stable without rush or drop when the VCC is switched on or off.

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. Hence, 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 the rising time, and then keep the voltage stable. The recommended ripple is < 50 mV.

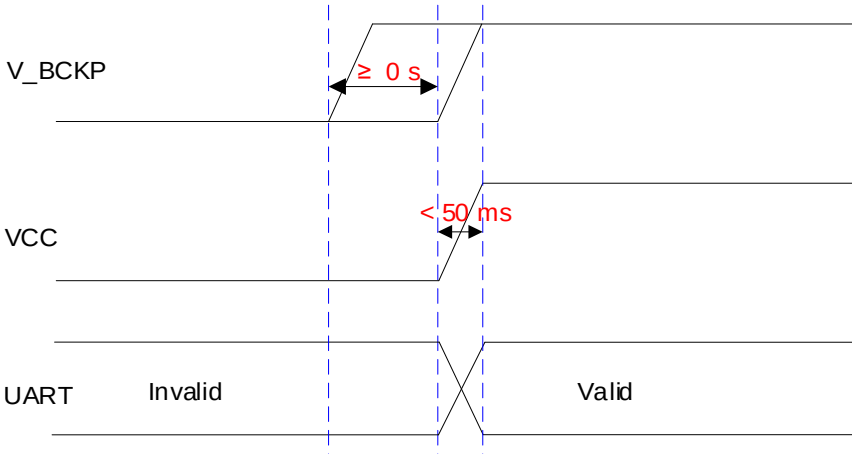


Figure 9: Power-up Sequence

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. It is recommended to use a voltage regulator that supports fast discharging.

To avoid abnormal voltage conditions, 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.

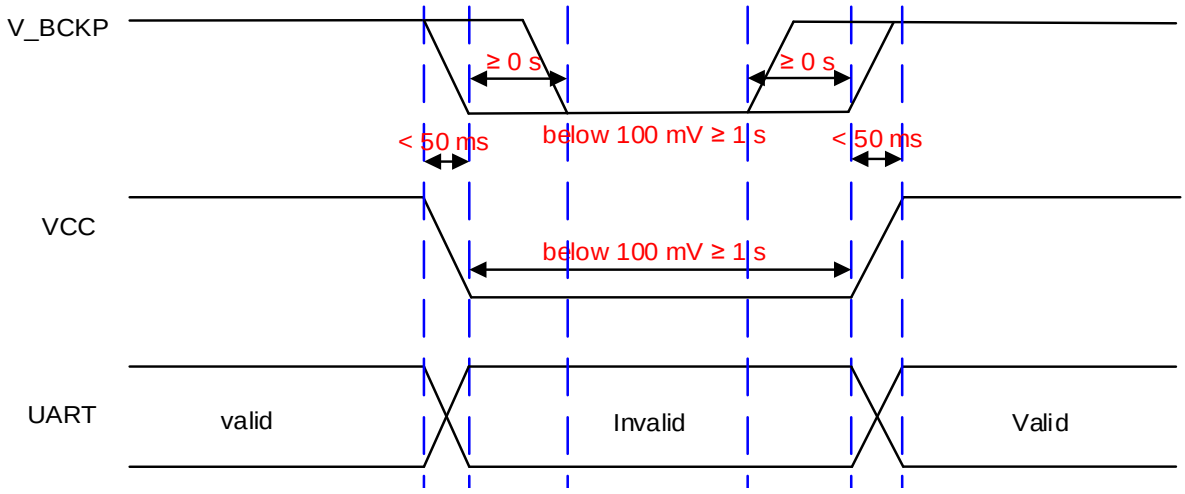


Figure 10: Power-down and Power-on Restart Sequence

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. 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: 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps, 921600 bps and 3000000 bps [7].
- Hardware flow control and synchronous operation are not supported.

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

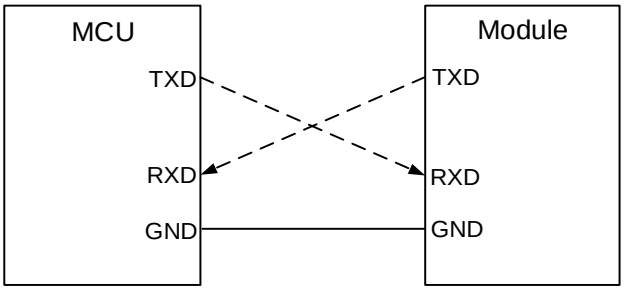


Figure 11: UART Interface Reference Design

A reference design is shown in the figure above. For more information, see *document [6] reference design*.

[7] The UART interface does not support 3000000 bps on LC79H (AL).

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 that of module, a level-shifting circuit must be selected.

4.1.1.2. I2C Interface

The module has one I2C interface with the following features:

- Supports RTCM message, standard NMEA message, PAIR/PQTM message, binary data and firmware upgrade.
- Operates in slave mode.
- Supports 7-bit address.
- Supports the standard mode (100 kbps) and fast mode (400 kbps).

For more information, see *document [6] I2C application note*.

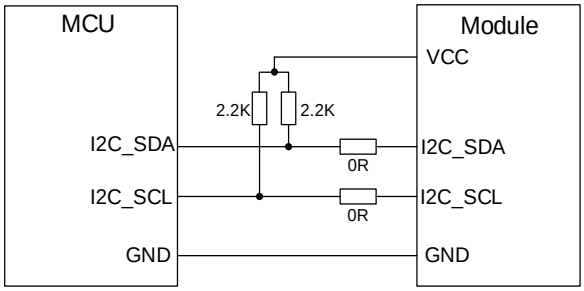


Figure 12: I2C Interface Reference Design

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

NOTE

1. The I2C interface is under development for LC79H (EL).
2. 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. 3D_FIX

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

4.1.3. GEOFENCE

The GEOFENCE pin indicates the current geofence status. Geofence configurations including geofence area(s) can be set using **PQTMCFGGENFENCE** command. The receiver continuously compares its current position to the preset geofence areas(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 that the receiver is inside the geofence area(s). For more information, see *document [1] protocol specification*.

4.1.4. 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.

4.1.5. RTK_STAT

The RTK_STAT pin is used to indicate RTK status. If the pin outputs a high level, it indicates that the module enters the RTK fixed mode. If the pin outputs a low level, it indicates that the module exits the RTK fixed mode. If the pin outputs an alternating level, it indicates that the module receives the correct RTCM data but does not enter the RTK fixed mode. The pin has no output in Backup mode.

4.1.6. 1PPS

The 1PPS output pin can be used for outputting time pulse signals as 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.

The 1PPS signal is output one pulse per second after successful positioning of the module. For more information, see *document [1] protocol specification*.

4.2. System Pins

4.2.1. WAKEUP

The WAKEUP pin can be used to wake up the module from the Backup mode by being driven to a high voltage level for at least 10 ms. It is pulled down internally. Keep this pin at low voltage level in the Continuous mode and the Backup mode.

4.2.2. RESET_N

RESET_N is an input pin. The module can be reset by driving 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.

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

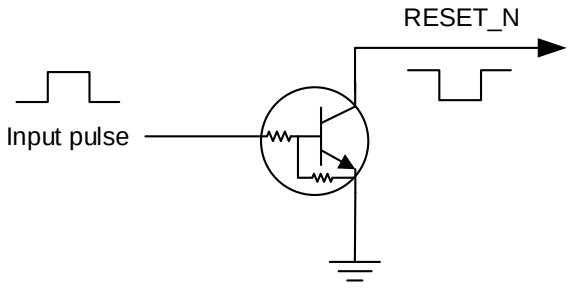


Figure 13: Reference OC Circuit for Module Reset

The following figure shows the reset sequence of the module.

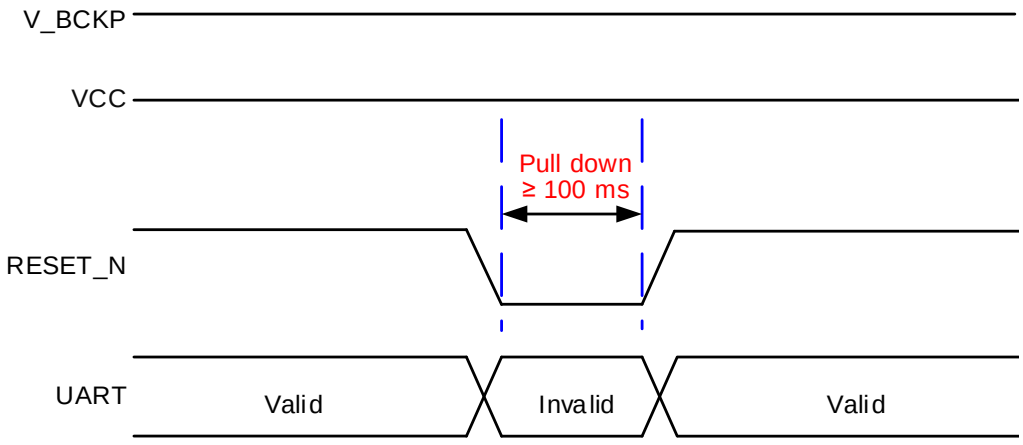


Figure 14: Reset Sequence

NOTE

RESET_N must be connected so that it can be used to reset the module if the module enters an abnormal state.

5 Design

This chapter explains the reference design of RF section and recommended footprint of the module. GNSS receiver could be vulnerable to environmental interference. To learn the details about interference and ensuring interference immunity, see *document [7] GNSS antenna application note*.

5.1. Antenna Specifications

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

Table 8: Recommended Antenna Specifications

Antenna Type	Specifications	
	LC79H (AL)	**LC79H (EL)**
Passive Antenna	Frequency Range: 1164–1189 MHz & 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi	Frequency Range: 1164–1189 MHz & 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi Phase Center Offset: < 20 mm [8] Phase Center Variation: < 20 mm [8] Axial Ratio: < 3 dB [8] -3 dB Beam Width: > 90° [8]
Active Antenna	Frequency Range: 1164–1189 MHz & 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi Active Antenna Noise Figure: ≤ 2.5 dB Active Antenna Total Gain: < 17 dB [9] Out-of-band Rejection: > 30 dB	Frequency Range: 1164–1189 MHz & 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi Active Antenna Noise Figure: ≤ 2.5 dB Active Antenna Total Gain: < 17 dB [9] Phase Center Offset: < 20 mm [8]

[8] When RTK function is used to achieve high-precision positioning, the antenna should meet the specifications recommended above.
[9] The total antenna gain equals the internal LNA gain minus total insertion loss of cables and components inside the antenna.

Antenna Type	Specifications	
	LC79H (AL)	LC79H (EL)
		Phase Center Variation: < 20 mm [8] Axial Ratio: < 3 dB [8] -3 dB Beam Width: > 90° [8] Out-of-band Rejection: > 30 dB

NOTE

For recommended antenna and design, see *document [7] GNSS antenna application note* or contact Quectel Technical Support (support@quectel.com).

5.2. Antenna Reference Design

In a complex electromagnetic environment, a SAW filter circuit must be added to the antenna design to further reduce the impact of out-of-band signals on GNSS module. The SAW filter circuit has a stable suppression effect on all out-of-band signals. 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.

NOTE

For recommended SAW models, contact Quectel Technical Support (support@quectel.com).

5.2.1. Active Antenna Reference Design

If VDD_RF pin is used to supply the active antenna, it is important to ensure that the operating voltage range of the antenna meets the voltage drop on the external power supply circuit, caused by the resistor (R2) and the inductor (L1). 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 the selected active antenna must meet the circuit design characteristics.

A typical reference design of an active antenna is illustrated in the following figure.

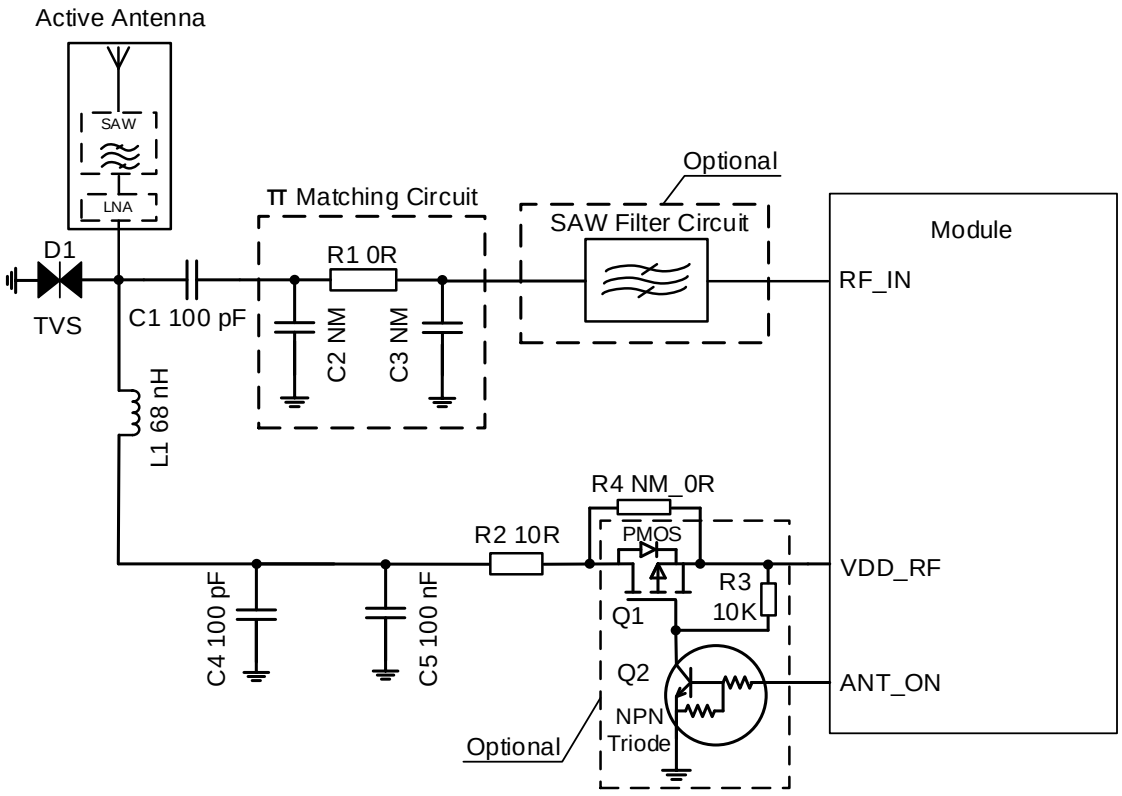


Figure 15: Active Antenna Reference Design

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 RF components inside the module from the damage caused by ESD through the antenna interface. The junction capacitance of D1 cannot be more than 0.6 pF and a transient voltage suppressor is recommended.

L1 inductor is used to prevent the RF signal from leaking into the 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. The impedance of RF trace should be controlled to 50 Ω and trace length should be kept as short as possible. For more information about RF layout, see *document [8] 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 the 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.

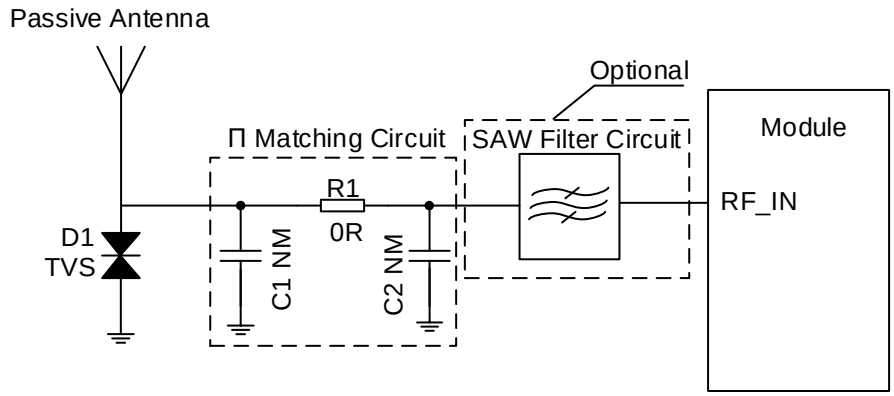


Figure 16: Passive Antenna Reference Design

C1, R1 and C2 are reserved for matching antenna impedance. By default, R1 is 0 Ω, while 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 RF route from the damage caused by ESD. The junction capacitance of D1 cannot be more than 0.6 pF and a transient voltage suppressor is recommended. The impedance of RF trace should be controlled to 50 Ω and trace length should be kept as short as possible.

5.3. Recommended Footprint

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

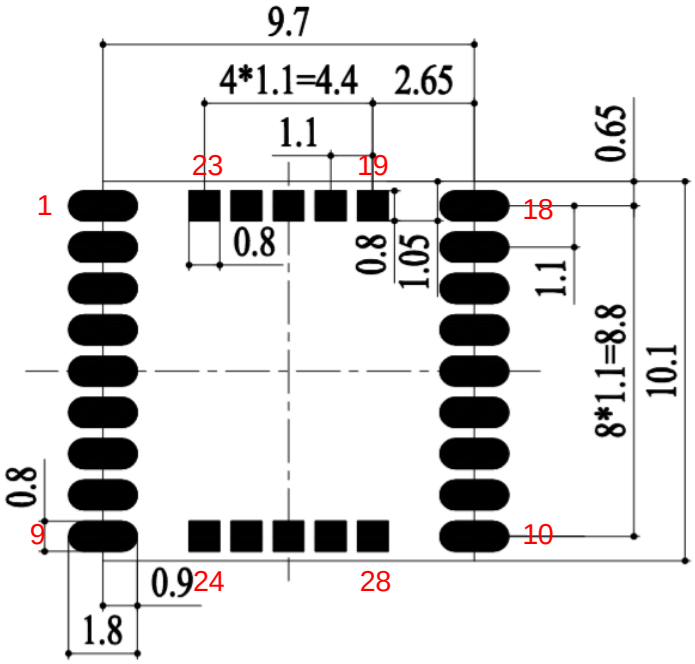


Figure 17: Recommended Footprint

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 9: Absolute Maximum Ratings

Parameter	Description	Min.	Max.	Unit
VCC	Main Power Supply Voltage	-0.3	1.98	V
V_BCKP	Backup Power Supply Voltage	-0.3	1.98	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	95	°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. Power Consumption Requirement

The following table lists the power consumption 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 and test conditions.

Table 10: Power Consumption

Parameter	Description	Condition	LC79H (AL)		LC79H (EL)	
			$I_{Typ.}$ [10]	I_{PEAK} [10]	I_{Typ} [10]	I_{PEAK} [10]
I_{VCC} [11]	Current at VCC	Acquisition	33 mA	53 mA	41 mA	41 mA
		Tracking	33 mA	56 mA	41 mA	41 mA
I_{V_BCKP} [12]	Current at V_BCKP	Continuous mode	74 μA	146 μA	101 μA	220 μA
		Backup mode	20 μA	53 μA	28 μA	55 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.

6.3. 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 protective 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).

[10] Tested at room temperature, with typical operating voltage, and satellite signal of -130 dBm configured by the instrument.
[11] Used to determine maximum current capability of power supply.
[12] 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

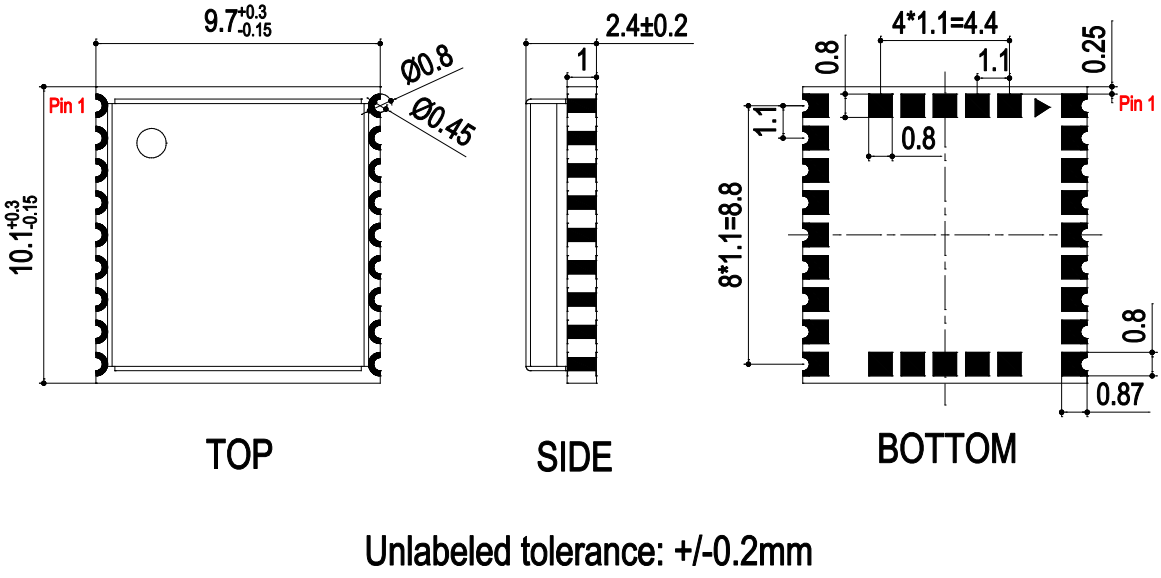


Figure 18: Top, Side and Bottom View Dimensions

NOTE

The module's coplanarity standard: ≤ 0.13 mm.

7.2. Top and Bottom Views

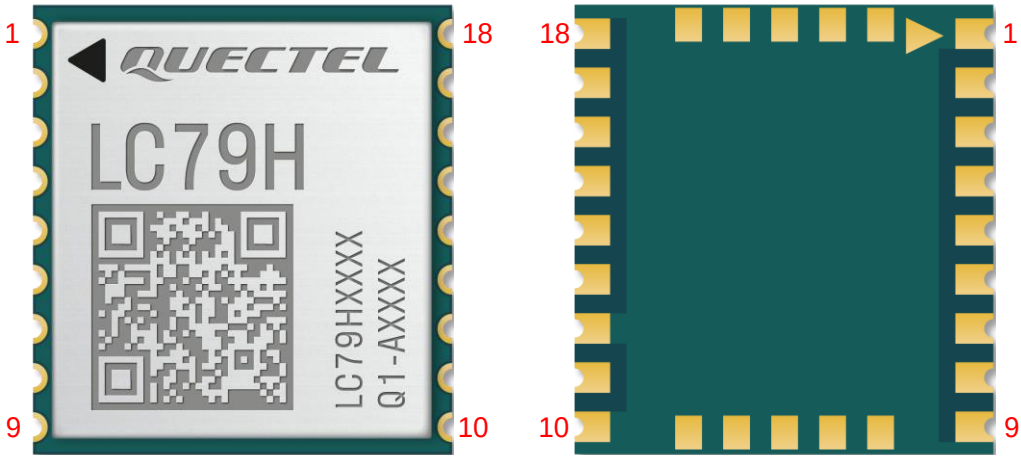


Figure 19: Top and Bottom Views

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 describes only the key parameters and process of packaging. All figures below are for reference only. The appearance and structure of packaging materials are subject to the actual delivery.

The module is packed in carrier tape packaging and the details are as follows.

8.1.1. Carrier Tape

Carrier tape dimensions are detailed below:

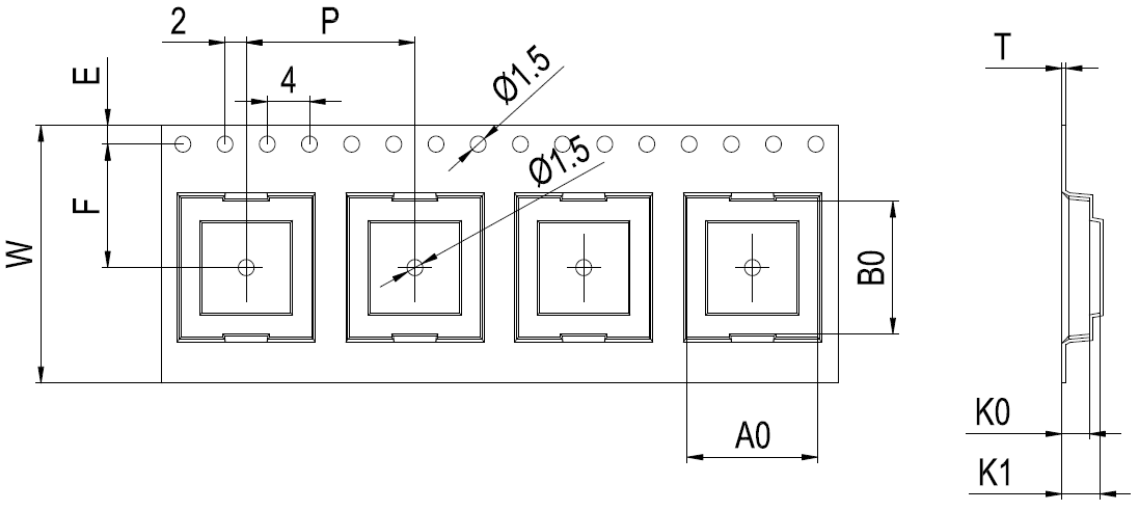


Figure 20: Carrier Tape Dimension Drawing (mm)

Table 11: 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 detailed below:

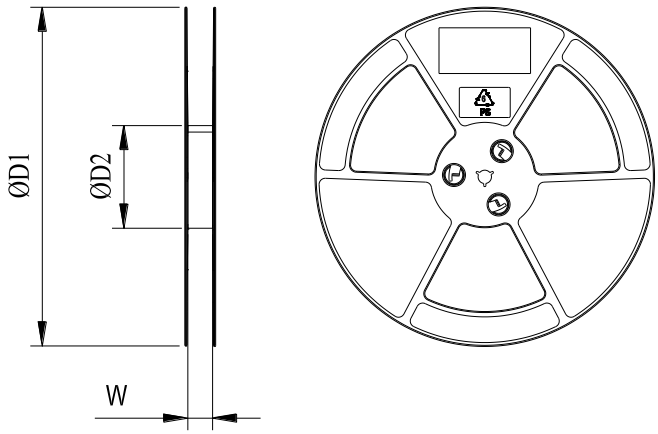


Figure 21: Plastic Reel Dimension Drawing

Table 12: Plastic Reel Dimension Table (Unit: mm)

øD1	øD2	W
330	100	24.5

8.1.3. Mounting Direction

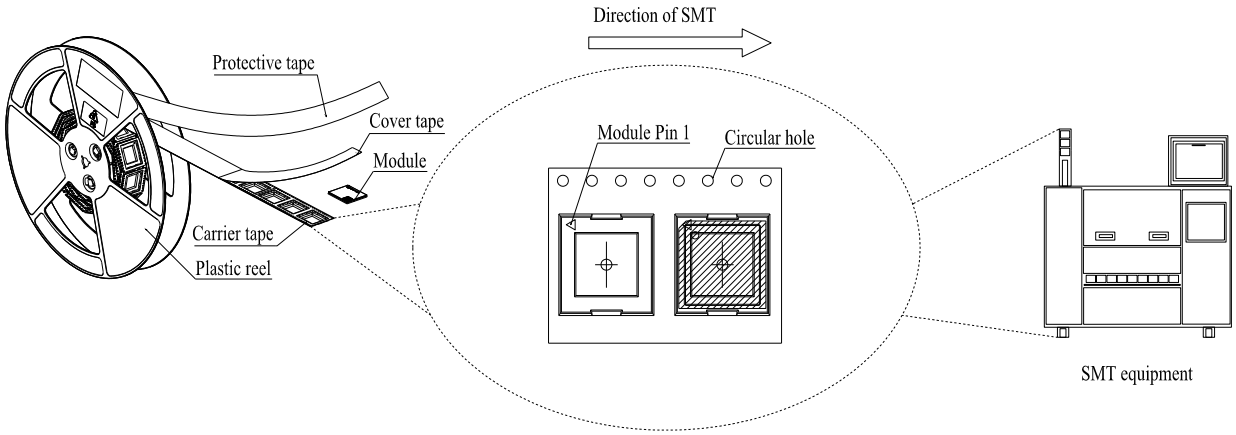
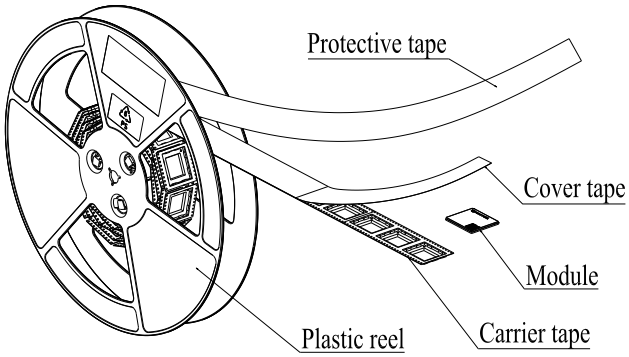


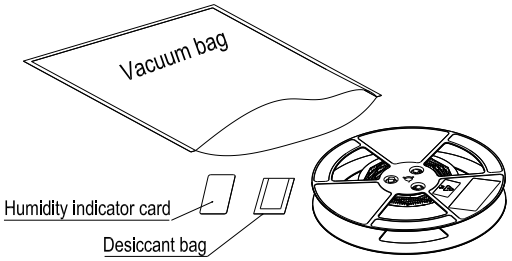
Figure 22: Mounting Direction

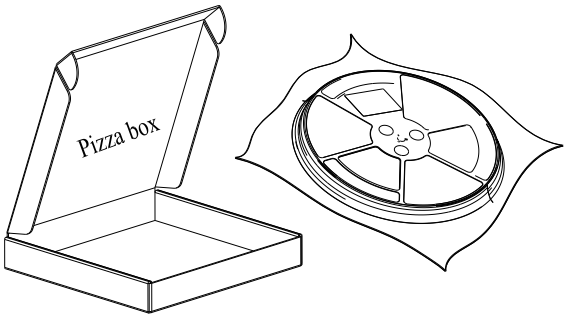
8.1.4. Packaging Process



Place the module onto the carrier tape cavity and cover it 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.

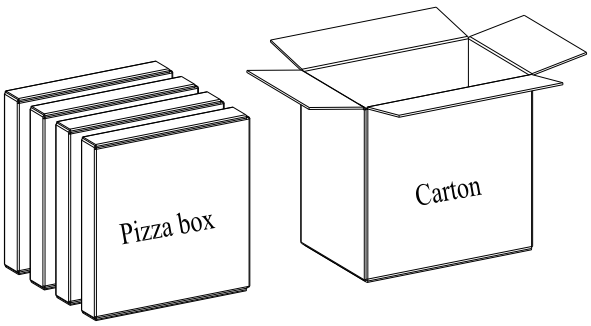
Place the packaged plastic reel, humidity indicator card and desiccant bag into a vacuum bag, and vacuumize it.





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 23: Packaging Process

8.2. Storage

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

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

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

3. Floor life: 168 hours [13] 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 under 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 follow the requirements below:

   - The module should be baked for 24 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 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 the module out of 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.

[13] 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 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 [9] 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.

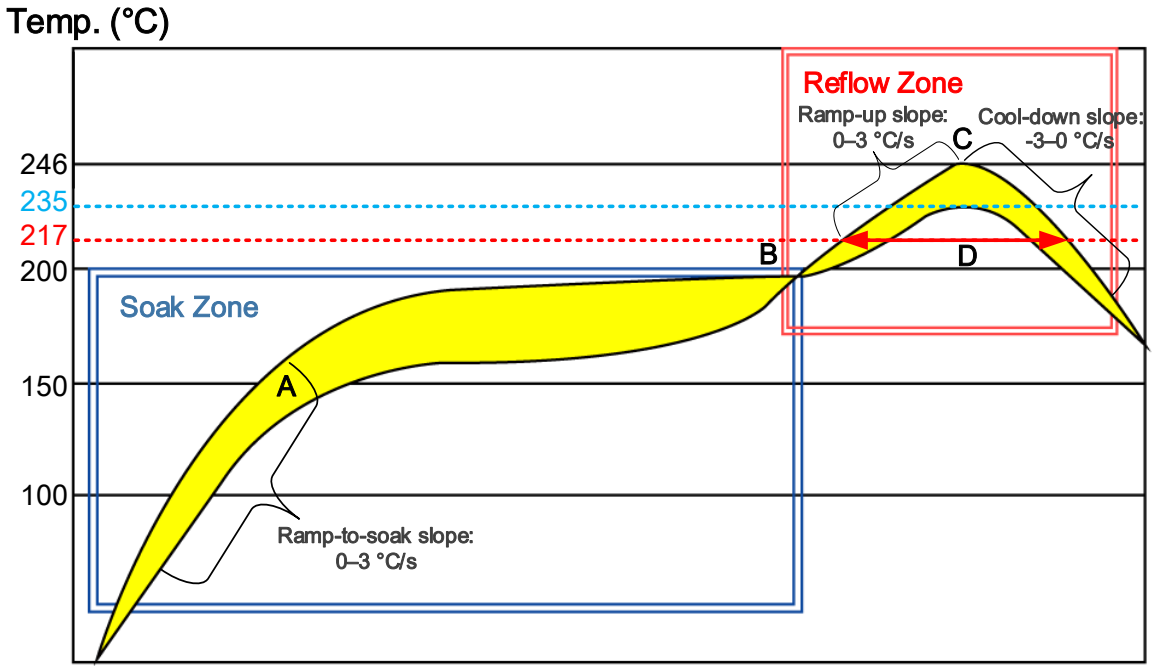


Figure 24: Recommended Reflow Soldering Thermal Profile

Table 13: 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

Factor	Recommendation Value
Reflow Zone	
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 module shielding can is 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.
4. If a conformal coating is necessary for the module, **DO NOT** use any coating material that may 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 [10] 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 figure below.

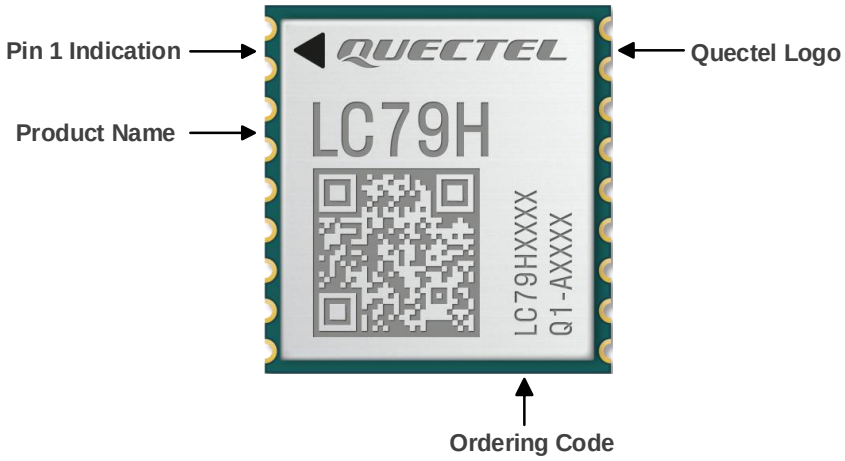


Figure 25: Labelling Information

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 14: Related Documents

Document Name
[1] Quectel_LC29H&LC79H_Series_GNSS_Protocol_Specification
[2] Quectel_L89_R2.0&LC02H&LC29H&LC79H_Series_AGNSS_Application_Note
[3] Quectel_LC29H(BA,CA,DA,EA)&LC79H(EL)_DR&RTK_Application_Note
[4] Quectel_L89_R2.0&LC29H&LC79H_Series_Firmware_Upgrade_Guide
[5] Quectel_LC79H_Series_Reference_Design
[6] Quectel_L89_R2.0&LC29H&LC79H_Series_I2C_Application_Note
[7] Quectel_GNSS_Antenna_Application_Note
[8] Quectel_RF_Layout_Application_Note
[9] Quectel_Module_Stencil_Design_Requirements
[10] Quectel_Module_SMT_Application_Note

Table 15: Terms and Abbreviations

Abbreviation	Description
AGNSS	Assisted GNSS (Global Navigation Satellite System)
AIC	Active Interference Cancellation
BDS	BeiDou Navigation Satellite System
bps	bit(s) per second
CEP	Circular Error Probable
DR	Dead Reckoning

Abbreviation	Description
EGNOS	European Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
EPOC	Enhanced Prediction Orbit on Chip
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
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
MSAS	Multi-functional Satellite Augmentation System (Japan)
MSL	Moisture Sensitivity Levels
NavIC	Indian Regional Navigation Satellite System
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
OC	Open Connector

Abbreviation	Description
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
RTC	Real-time Clock
RTCM	Radio Technical Commission for Maritime Services
RTK	Real-time Kinematic
SAW	Surface Acoustic Wave
SBAS	Satellite-based Augmentation System
SMD	Surface Mount Device
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
UART	Universal Asynchronous Receiver/Transmitter

Abbreviation	Description
USB	Universal Serial Bus
$V_I$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