L26-P&L26-T

Hardware Design

GNSS Module Series

Version: 1.2

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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	
Title	**L26-P&L26-T Hardware Design**
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Revision History

Version	Date	Description
-	2019-11-09	Creation of the document
1.0	2019-11-09	First official release
1.1	2022-05-25	1. Completely reorganized the structure of the document, including but not limited to the adding of chapters 1.5, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2.2, 3.3, 3.4, 3.5, 4.1.4, 4.2.1, 5.1.2, 5.2, 6.3, and 9. 2. Selected pin names have been updated to agree with a common naming convention across Quectel GNSS modules. The pins have the same physical hardware but with updated names. Pin 1: from WAKE_UP to WAKEUP Pin 3: from TIMEPULSE to 1PPS Pin 9: from VCC_RF to VDD_RF Pin 16: from ANT2 to ANT_DET2 Pin 17: from ANT1 to ANT_DET1 Pin 20: from UART_TX to TXD Pin 21: from UART_RX to RXD 3. Updated the product features of L26-P/L26-T (Table 1). 4. Updated the product performance of L26-P/L26-T (Table 2). 5. Updated pin assignment and pin description (Chapter 2). 6. Updated descriptions of the UART interface (Chapter 4.1.1).

Version	Date	Description
		7. Added a note to WI (Chapter 4.1.2). 8. Updated descriptions of RESET_N (Chapter 4.2.2). 9. Updated descriptions of BOOT (Chapter 4.2.3). 10. Updated recommended antenna specifications (Chapter 5.1.1). 11. Updated reference designs for active and passive antennas (Chapter 5.1.3). 12. Changed the maximum supply voltage of VCC and V_BCKP from 4.8 V to 3.6 V and added the minimum and maximum storage temperature (Table 9). 13. Updated the recommended operating conditions (Table 10). 14. Updated information on ESD protection (Chapter 6.4). 15. Updated dimensional tolerances to ±0.20 mm (Chapter 7). 16. Updated the module packaging, storage requirements, the recommended reflow soldering thermal profile and relevant parameters, and added notes on conformal coating, ultrasonic technology, and the SMT process (Chapter 8).
1.2	2023-08-24	1. Added the number of concurrent GNSS (*Table 2*). 2. The updates of product performance are listed below (*Table 3*): Added the power data for power consumption for L26-P and L26-T; Updated the power consumption, the sensitivity of acquisition and reacquisition, the TTFF (without AGNSS) of cold start and warm start, the TTFF (with AGNSS), the maximum update rate, timing accuracy and added the 1PPS jitter for L26-T; Updated the power consumption of tracking, the TTFF (with AGNSS) and accuracy of 1PPS signal for L26-P. 3. Deleted the DR information for L26-P. 4. Added the DC characteristics of all pins (*Table 6*). 5. Deleted the rechargeable battery circuit and added the 3.7 V lithium battery reference circuit (*Chapter 3.2.2*). 6. Specificed the software commands for entering/exiting Standby mode (*Chapter 3.3.3*). 7. Specificed the software commands for entering/exiting Backup mode and added the time requirement for entering the Backup mode (*Chapter 3.3.4*). 8. Added the chapter of avoiding current leakage on I/O pins (*Chapter 4.3*). 9. Updated the active antenna total gain (*Table 9*). 10. Added the optional notch circuit and SAW filter circuit to active and passive antenna reference designs, as well as corresponding description (*Chapter 5.2*). 11. Updated the maximum input power at RF_IN (*Table 11*). 12. Added high-level input voltage range of RESET_N pin and the typical output current of VDD_RF (*Table 12*).

Version	Date	Description
		13. Updated the supply current at VCC in tracking mode for L26-P (*Table 13*). 14. Updated the typical supply current at VCC in acquisition mode, tracking mode, the typical supply current at V_BCKP in Backup mode and the supply current at in Standby mode for L26-T (*Table 14*). 15. Added the module mounting direction (*Chapter 8.1.3*). 16. Added the size of pizza box and carton (*Figure 30*). 17. Updated the recommended ramp-to-soak, ramp-up and cool-down slopes (*Figure 31* and *Table 17*).

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1 Product Description

1.1. Overview

Quectel L26-P/L26-T module supports multiple global positioning constellations, such as GPS, GLONASS, Galileo, BDS, and QZSS. The modules also support SBAS (including WAAS, EGNOS, MSAS, and GAGAN) and AGNSS functions.

Key features:

- Single-band, multi-constellation GNSS modules, featuring a high-performance, highly reliable positioning engine, which facilitates fast and precise GNSS positioning.
- L26-P module integrates a 6-axis IMU and can output GNSS raw data concurrently with the sensor raw data. Combined with external DR (dead reckoning) algorithm, the module can provide outstanding positioning accuracy under the open sky.
- L26-T module features high precision timing in demanding applications worldwide.
- L26-T module supports the output of GNSS raw data.
- Supported serial communication interface: UART.
- Built-in LNA ensures better performance in weak signal areas.

The L26-P/L26-T module is an SMD type module with a compact form factor of 12.2 mm × 16.0 mm × 2.3 mm, which can be embedded in your applications through 24 LCC pins.

The module is fully compliant with the EU RoHS Directive.

NOTE

Where applicable, this document will use the words module/modules when referring to common attributes, and “L26-P” or “L26-T” when referring to attributes associated with a particular subset of module.

1.1.1. Special Mark

Table 1: Special Mark

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

1.2. Features

Table 2: Product Features

Features		L26-T	L26-P
Grade	Industrial	●	●
	Automotive	-	-
Category	Standard Precision GNSS	●	●
	High Precision GNSS	-	-
	DR [1]	-	-
	RTK	-	-
	Timing	●	-
VCC Voltage	3.0–3.6 V, Typ. 3.3 V	●	●
V_BCKP Voltage	2.0–3.6 V, Typ. 3.3 V	●	●
I/O Voltage	Following VCC	●	●
Communication Interfaces	UART	●	●
	SPI	-	-
	I2C	-	-
	CAN	-	-
	USB	-	-

[1] DR function can be implemented by using an external application processor algorithm, while L26-P provides the raw data only.

Features			L26-T	L26-P
Integrated Features	Additional LNA		●	●
	Additional Filter		●	●
	RTC Crystal		●	●
	TCXO Oscillator		●	●
	6-axis IMU		-	●
Constellations and Frequency Bands	Number of Concurrent GNSS		3 + QZSS	4 + QZSS
	GPS	L1 C/A	●	●
		L5	-	-
	GLONASS	L1	●	●
	Galileo	E1	●	●
		E5a	-	-
	BDS	B1I	●	●
		B2a	-	-
	QZSS	L1 C/A	●	●
		L5	-	-
	NavIC	L5	-	-
SBAS		L1	●	●
Temperature Range	Operating temperature range: -40 °C to +85 °C Storage temperature range: -40 °C to +90 °C			
Physical Characteristics	Size: (12.2 ±0.15) mm × (16.0 ±0.15) mm × (2.3 ±0.20) mm Weight: Approx. 0.9 g			

NOTE

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

1.3. Performance

Table 3: Product Performance

Parameter	Specification	L26-T	L26-P
Power Consumption [2]		GPS + GLONASS + Galileo	GPS + BDS
	Acquisition	76 mA (250.8 mW)	73 mA (240.9 mW)
	Tracking	73 mA (240.9 mW)	68 mA (204.6 mW)
	Standby mode	12 μA (39.6 μW)	1.7 mA (5.61 mW)
	Backup mode [3]	7 μA (23.1 μW)	8 μA (26.4 μW)
Sensitivity	Acquisition	-145 dBm	-147 dBm
	Reacquisition	-153 dBm	-154 dBm
	Tracking	-162 dBm	-162 dBm
TTFF [2] (Without AGNSS)	Cold Start	35 s	32 s
	Warm Start	30 s	25 s
	Hot Start	2 s	2 s
TTFF [4] (with AGNSS)	Warm Start	2 s	2 s
Horizontal Position Accuracy [5]		1.5 m	1.5 m
Update Rate		1 Hz (Max. 5 Hz)	1 Hz
1PPS Signal Accuracy [2]	RMS	-	50 ns
1PPS Timing Accuracy [2]		< 13.6 (±6.8 ns) @ 1σ	-
1PPS Jitter [2]		±6.5 ns	-
Velocity Accuracy [2]		Without Aid: 0.1 m/s	

[2] Room temperature, all satellites at -130 dBm.
[3] To enter the Backup mode, you must strictly follow the steps referred to in *Chapter 3.3.4 Backup Mode*, otherwise the power consumption may reach mA level.
[4] Open-sky, active high precision GNSS antenna.
[5] CEP, 50 %, 24 hours static, -130 dBm, more than 6 SVs.

Parameter	Specification	L26-T	L26-P
Acceleration Accuracy [2]		Without Aid: 0.1 m/s²	
Dynamic Performance [2]		Maximum Altitude: 18000 m Maximum Velocity: 515 m/s Maximum Acceleration: 4g	

1.4. Block Diagram

A block diagram of the modules is presented below. It includes a front-end section with an additional LNA, and SAW filter, a TCXO, and an XTAL, a 6-axis IMU (only supported by L26-P) and a GNSS IC with an PMU.

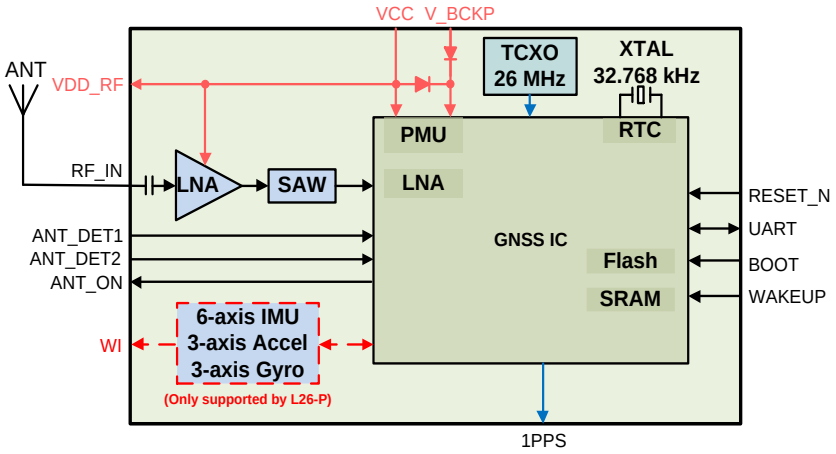


Figure 1: Block Diagram

1.5. GNSS Constellations and Frequency Bands

The modules are single-band concurrent GNSS receivers that can receive and track multiple GNSS signals. Owing to their RF front-end architecture, they can track the following GNSS constellations: GPS, GLONASS, Galileo, BDS, and QZSS, plus SBAS satellites. If low power consumption is a key factor, the modules can be configured to track only a specific 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 modules can detect and track QZSS L1 C/A signal concurrently with GPS signals, leading to better availability especially under challenging conditions, e.g., in urban canyons.

Table 4: GNSS Constellations and Frequency Bands

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

1.6. Augmentation System

1.6.1. SBAS

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

1.8. Firmware Upgrade

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

2 Pin Assignment

The modules feature 24 LCC pins by which they can be mounted on your PCB.

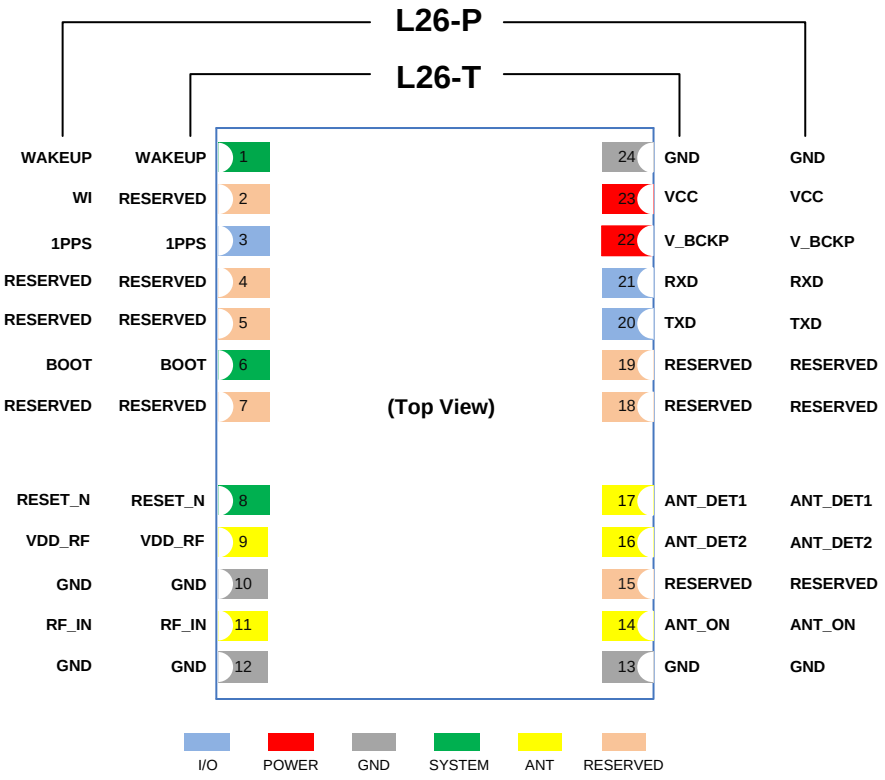


Figure 2: Pin Assignment

Table 5: I/O Parameter Definition

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

Table 6: Pin Description

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
Power	VCC	23	PI	Main power supply	$V_I$min = 3.0 V $V_I$nom = 3.3 V $V_I$max = 3.6 V	Requires clean and steady voltage.
	V_BCKP	22	PI	Backup power supply for backup domain	$V_I$min = 2.0 V $V_I$nom = 3.3 V $V_I$max = 3.6 V	V_BCKP must be connected to power supply for startup, and it should always be powered if hot (warm) start is needed.
I/O	TXD	20	DO	Transmits data	V_{OL}max = 0.4 V V_{OH}min = VCC - 0.4 V	The UART interface supports standard NMEA message, PSTM message and firmware upgrade.
	RXD	21	DI	Receives data	V_{IL}min = -0.3 V V_{IL}max = 0.8 V V_{IH}min = 2.0 V V_{IH}max = VCC + 0.3 V	
	WI	2	DO	Warning indicator	V_{OL}max = 0.4 V V_{OH}min = VCC - 0.4 V	VCC must be valid to ensure the interrupt signal output. If unused, leave the pin N/C. L26-T does not support this feature.
	1PPS	3	DO	One pulse per second	V_{OL}max = 0.4 V V_{OH}min = VCC - 0.4 V	Synchronized on the rising edge. The pin must be kept at low level at startup for normal operation. It is pulled down internally with a 47 kΩ resistor. If unused, leave the pin N/C.
Antenna	VDD_RF	9	PO	Supplies power for external RF components	$V_O$nom = VCC	VDD_RF = VCC, the output current capacity depends on VCC. Typically used to supply power for an external active antenna or LNA. In the Backup mode, VDD_RF is turned off. If unused, leave the pin N/C.
	RF_IN	11	AI	GNSS antenna	-	50 Ω characteristic

Function	Name	No.	I/O	Description	DC Characteristics	Remarks
				interface		impedance.
	ANT_ON	14	DO	Power control for external active antenna with antenna detection or LNA	V_{OL}max = 0.4 V V_{OH}min = VCC - 0.4 V	If unused, leave the pin N/C.
	ANT_DET2	16	AI	External active antenna detection 2	$V_I$min = 0.3 V $V_I$nom = 3.3 V $V_I$max = 4.5 V	If unused, leave the pins N/C (not connected).
	ANT_DET1	17	AI	External active antenna detection 1	$V_I$min = 0.3 V $V_I$nom = 3.3 V $V_I$max = 4.5 V	
System	WAKEUP	1	DI	Wakes up the module from the Standby mode	V_{IH}min = 2.1 V V_{IH}max = VCC	Keep this pin at a low voltage level in the Continuous mode. It is pulled down internally with a 47 kΩ resistor. Drive the pin to a high voltage level for at least 10 ms to exit the Standby mode. If unused, leave the pin N/C.
	RESET_N	8	DI	Resets the module	V_{IL}min = -0.3 V V_{IL}max = 0.35 V V_{IH}min = 0.65 V V_{IH}max = 1.3 V	Active low.
	BOOT	6	DI	Controls module startup mode	V_{IL}min = -0.3 V V_{IL}max = 0.8 V V_{IH}min = 2.0 V V_{IH}max = VCC + 0.3 V	Pulled down internally by default. If the pin is pulled up for about 50 ms during startup, the module enters the Boot download mode.
GND	GND	10, 12, 13, 24	-	Ground	-	Ensure a good GND connection to all GND pins of the modules, preferably with a large ground plane.
RESERVED	RESERVED	2, 4, 5, 7, 15, 18, 19	-	Reserved	-	These pins must be left N/C and must not be connected to power or GND.

NOTE

1. Pin 2 is RESERVED for L26-T and WI for L26-P.
2. Leave RESERVED and unused pins N/C.

3 Power Management

The modules feature a power optimized architecture with built-in autonomous energy saving capabilities to minimize power consumption at any given time. The receivers can be used in three operating modes: Standby and Backup modes for optimum power consumption, and Continuous mode for optimum performance.

3.1. Power Unit

VCC is the module supply voltage pin. 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 SRAM. To achieve quick startup and improve TTFF, the backup domain power supply should be valid at all times during Backup mode. If the VCC is not valid, the V_BCKP supplies the SRAM, which stores all the necessary GNSS data and some user configuration variables.

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

The modules' internal power supply is shown below:

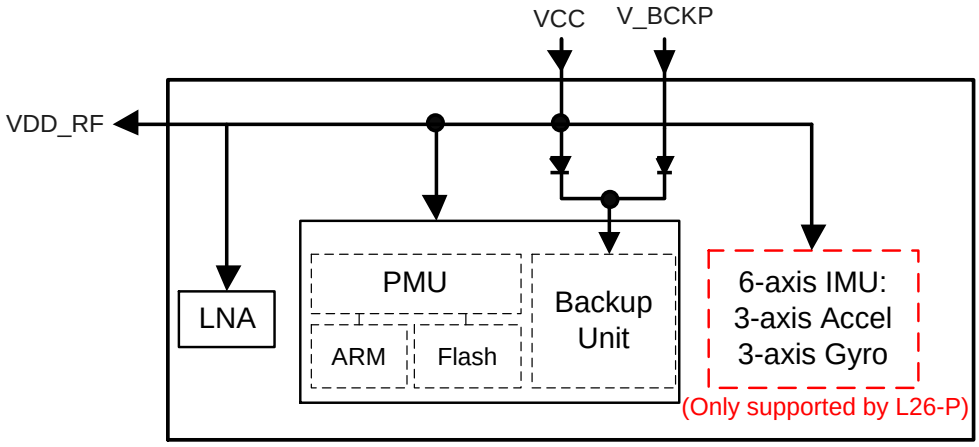


Figure 3: Internal Power Supply

3.2. Power Supply

3.2.1. VCC

VCC is the supply voltage pin that supplies the BB, RF, and 6-axis IMU (only supported by the L26-P module).

Module power consumption may vary by several orders of magnitude, especially when power saving modes are enabled. Therefore, it is important to ensure a power supply that can sustain peak power for short periods without exceeding the rated load current. During module startup or when switching from the Backup mode to the Continuous mode, VCC must charge the internal capacitors in the core domain, which can result in a significant current drain.

For low-power applications using power saving modes, it is important that the LDO at the power supply or module input can provide sufficient current when the module is switched from Backup mode to Continnuous 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.

A fast-discharging LDO voltage regulator is recommended to ensure a quick voltage drop when the VCC power is removed.

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

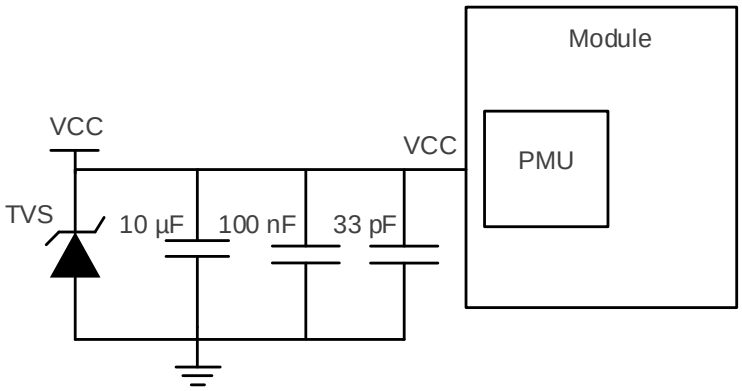


Figure 4: VCC Input Reference Circuit

NOTE

Ensure the module VCC is controlled by MCU to save power, or restart the modules if they enter 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 be always 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.

V_BCKP can be powered by an 3.3 V always-on power supply. It is recommended to place a battery with 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 power supply circuit is illustrated below.

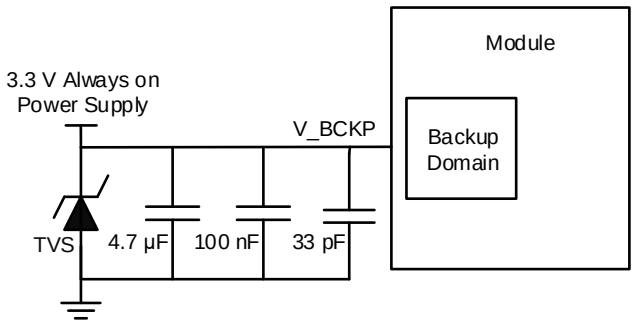


Figure 5: Backup Domain Input Reference Circuit

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

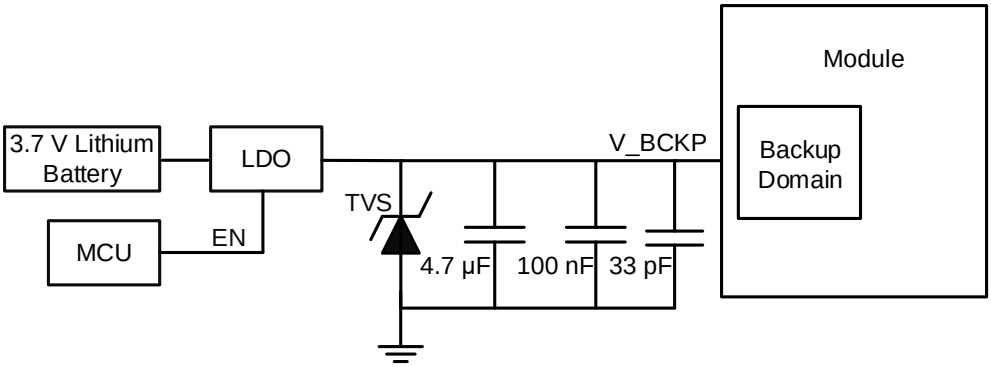


Figure 6: Reference Power Supply Circuit with 3.7 V Lithium Battery

NOTE

1. If V_BCKP is below the minimum recommended operating voltage, the modules cannot work normally.
2. It is recommended to control the module V_BCKP via MCU to restart the modules when they enter 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	Standby	Backup
NMEA from UART	●	-	-
1PPS	●	-	-
RF	●	-	-
Acquisition & Tracking	●	-	-
Power Consumption	High	Low	Low
Position Accuracy	High	-	-

3.3.2. Continuous Mode

If VCC and V_BCKP are powered on, the modules automatically enter the Continuous mode that comprises acquisition mode and tracking mode. In acquisition mode, the modules search and determine visible satellites, coarse frequency, as well as the code phase of satellite signals. Once the acquisition is completed, the modules automatically switch to tracking mode to track satellites and demodulate the navigation data from specific satellites.

3.3.3. Standby Mode

The Standby mode is a power saving mode. In this mode, the internal core, I/O power domain, and RF are powered off. The UART interface is not accessible, and the modules stop acquiring and tracking satellites. However, the 6-axis IMU (only supported by the L26-P module) and backup domain are still

active. When the modules exit the Standby mode, they will use internal ancillary information, such as GPS time, ephemeris, and last position to ensure the fastest possible TTFF during hot or warm start.

There is one way to enter and two ways to exit the Standby mode.

- Enter the Standby mode:
  Send **$PSTMFORCESTANDBY** command.

- Exit the Standby mode:
  - Pull up WAKEUP pin for at least 10 ms; **OR**
  - Wait for the Standby time duration set by **$PSTMFORCESTANDBY** to end.

For details of the related software command, see *document [1] protocol specification*.

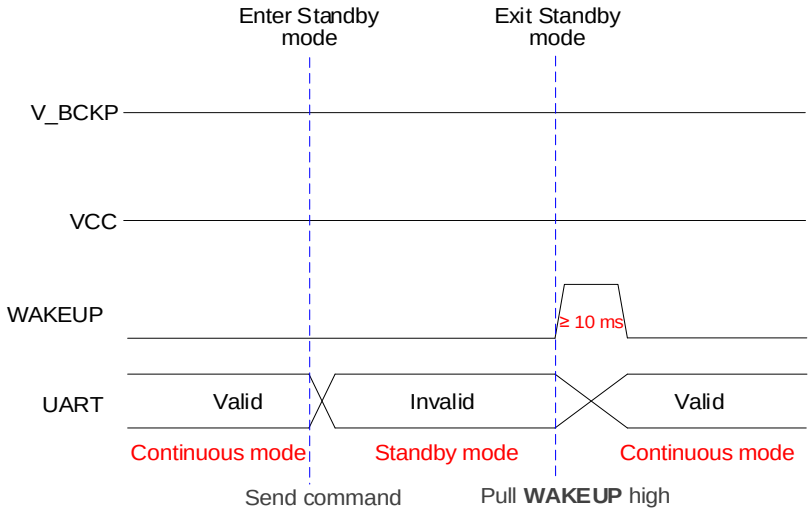


Figure 7: Enter/Exit Standby Mode Sequence

NOTE

Before running **$PSTMFORCESTANDBY** to enter the Standby mode, ensure that the WAKEUP pin is not pulled up, otherwise the module will enter an indeterminate state.

3.3.4. Backup Mode

For power-sensitive applications, the modules support a Backup mode that reduces power consumption. Only the backup domain is active during the Backup mode and it keeps track of time.

- Enter the Backup mode:
  1. Send **$PSTMFORCESTANDBY** to shut down the internal main power supply in sequence.
  2. After 350 ms, cut off the power supply to the VCC pin and keep the V_BCKP powered.

- Exit the Backup mode:
  1. Restore VCC.
  2. Pull up the WAKEUP pin for at least 10 ms.

For details of the related software command, see *document [1] protocol specification*.

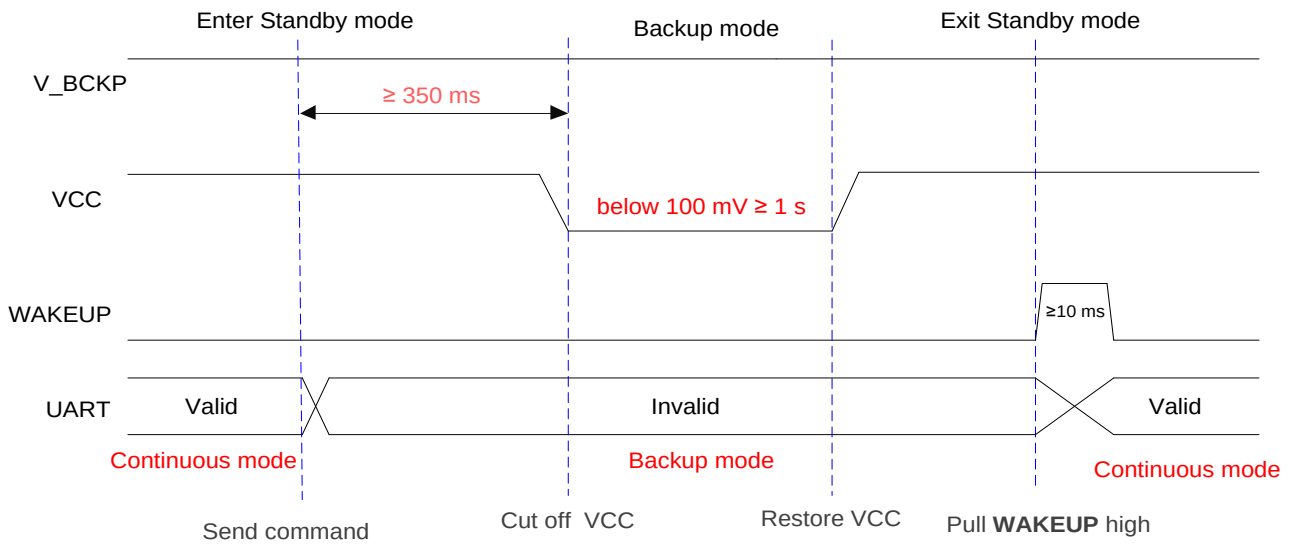


Figure 8: Enter/Exit Backup Mode Sequence

NOTE

1. After restoring VCC, the WAKEUP pin must be pulled up for at least 10 ms to exit the Standby mode. Otherwise, the UART will be inaccessible.
2. Ensure a stable V_BCKP voltage, without rush or drop when the VCC is switched on or off.
3. The **$PSTMFORCESTANDBY** must be sent to shut down the internal main power supply, and the V_BCKP must be kept powered to ensure a hot (warm) start of the module at the next startup.

3.4. Power-up Sequence

Once the VCC and V_BCKP are powered up, the modules start 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 rising time, and keep the voltage stable. The recommended ripple is < 50 mV.

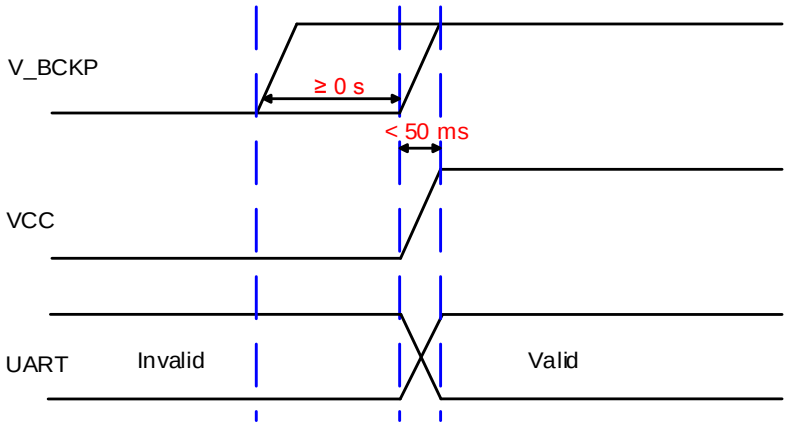


Figure 9: Power-up Sequence

3.5. Power-down Sequence

Once the VCC and V_BCKP are shut down, the modules turn off automatically and the 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 specified minimum value, the system must initiate a power-on restart by reducing VCC and V_BCKP to less than 100 mV for at least 1 s.

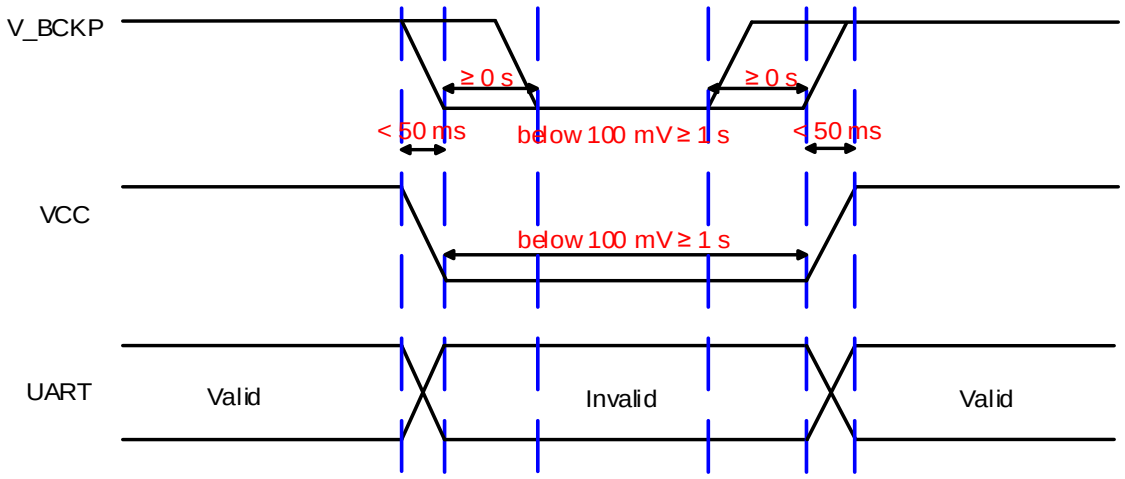


Figure 10: Power-down and Power-on Restart Sequence

4 Application Interfaces

4.1. I/O Pins

4.1.1. Communication Interface

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

4.1.1.1. UART Interface

The modules have one UART interface with the following features:

L26-P:

- Supports standard NMEA message, PSTM message and firmware upgrade.
- Supports raw data output of 6-axis IMU.
- Supported baud rates: 115200, 230400, 460800, and 921600 bps.
- Hardware flow control and synchronous operation are not supported.

L26-T:

- Supports standard NMEA message, PSTM message and firmware upgrade.
- Supported baud rates: 9600, 19200, 38400, 57600, 115200, 230400, 460800, and 921600 bps.
- Hardware flow control and synchronous operation are not supported.

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

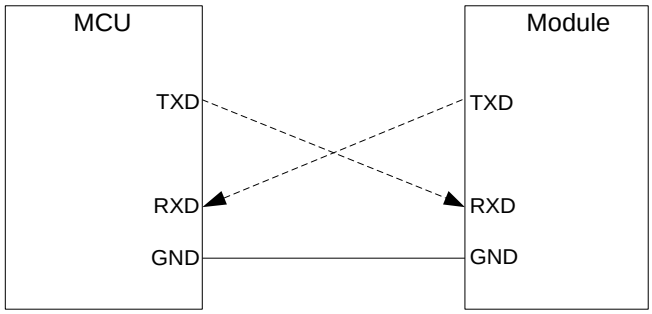


Figure 11: UART Interface Reference Design

A reference design is shown in the figure above. For more information, see *document [4] reference design*.

NOTE

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

4.1.2. WI

WI (only for L26-P module) signal is an interrupt output to wake up the host when the value of the 6-axis IMU is higher than the threshold value. L26-P module cannot determine what causes vehicle tilting. It needs the MCU to judge whether the vehicle is towed or is running normally on an uphill road.

NOTE

To ensure interrupt signal output, the module VCC must not be powered off.

4.1.3. 1PPS

The 1PPS output pin can be used for outputting one pulse per second periodic signal synchronized with the GNSS time grid with intervals. Maintaining high accuracy of 1PPS requires a clear view of satellites in an unobstructed sky and a stable power supply (VCC). See *Table 3: Product Performance* for details about pulse accuracy.

4.2. System Pins

4.2.1. WAKEUP

The WAKEUP pin is pulled down internally with a 47 kΩ resistor. It is used for waking up the modules from the Standby mode by being driven to a high voltage level for at least 10 ms. Keep this pin at low voltage level in the Continuous mode.

4.2.2. RESET_N

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

By default, the RESET_N pin is internally pulled up to 1.0 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.

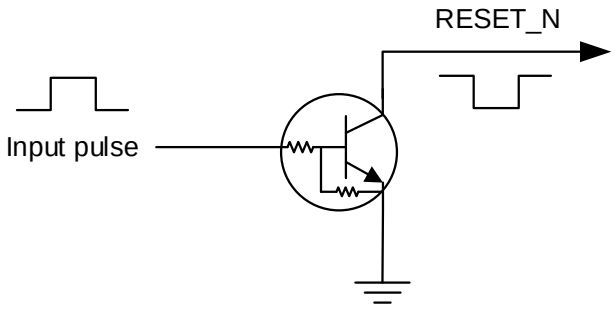


Figure 12: Reference OC Circuit for Module Reset

The following figure shows the reset sequence of the module.

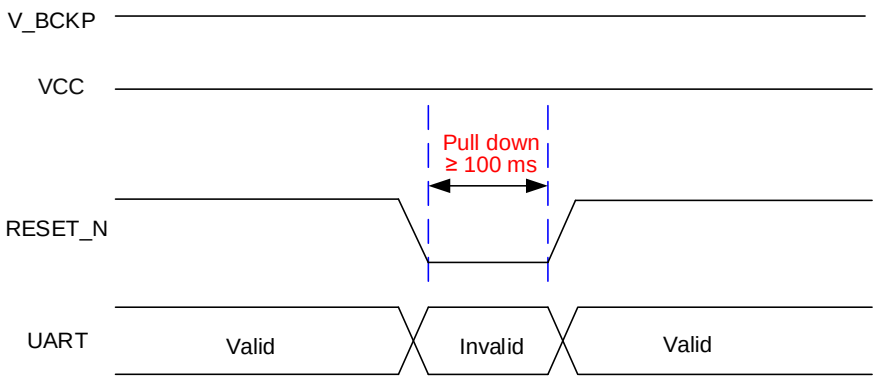


Figure 13: Reset Sequence

NOTE

RESET_N must be connected so that it can be used to reset the modules if they enter an abnormal state.

4.2.3. BOOT

The BOOT pin can be used to set the the modules to the Boot download mode. It is pulled down internally by default. If the pin is kept at a high level for about 50 ms during startup, the modules enter the Boot download mode. For more information about the reference circuit design, see *document [4] reference design*.

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

Table 8: Operating Modes

Voltage Level	Operating Mode	Comment
Low	Normal	BOOT pin is pulled down internally by default.
High	Boot download	If the pin is kept at a high level for about 50 ms during startup, the module enters the Boot download mode.

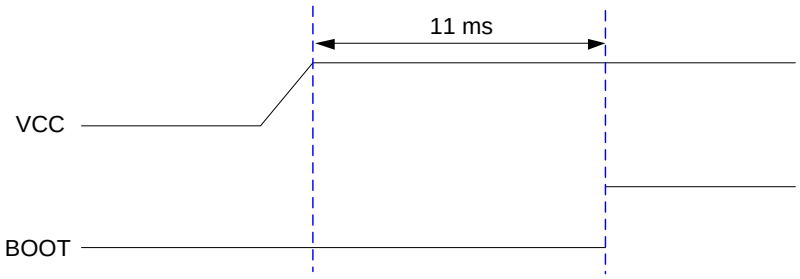


Figure 14: BOOT Pin State (Normal Operating Mode)

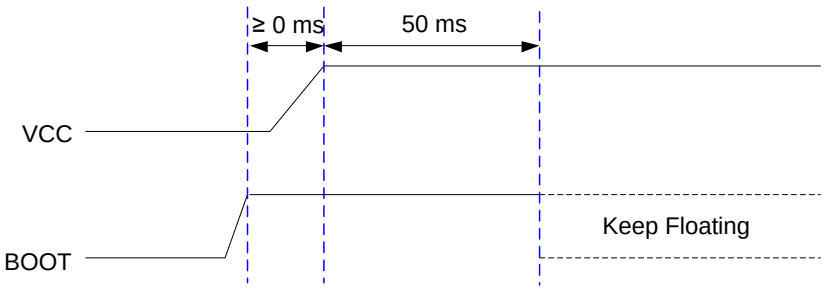


Figure 15: BOOT Pin Control Sequence (Boot Download Mode)

4.3. Avoiding Current Leakage on I/O Pins

This chapter provides important design considerations for the current leakage of the module in Backup mode and the complete power-off power state of the module, which are defined as follows:

- In Backup mode, the module's VCC power pin is disconnected while the V_BCKP pin is still powered.
- In the complete power-off state, all power pins (V_BCKP and VCC) of the module are powered off.

In the above two power states, when there is an external voltage on the module's I/O pins, the power consumption in Backup mode will increase, and there will be residual voltage on VCC pin, whereas the external voltage can cause parasitic leakage current to flow through the module in the completely powered-off state, leading to energy loss. To prevent current leakage or parasitic leakage current, no external voltage is allowed on the module's I/O pins. Two recommended ways to accomplish this are to:

1. Pull down all I/O pins connected to the module when it enters Backup mode or is completely powered off, while the host is still working.

2. Use components that prevent backflow current from passing through when power is turned off, specifically designed for power-off applications. The noninverting buffer with output-enable (OE) control is recommended to play an isolation role. When the OE of the enable pin is low, the output end of the noninverting buffer exhibits a high resistance state. A recommended design of the UART communication between the module and host is as follows:

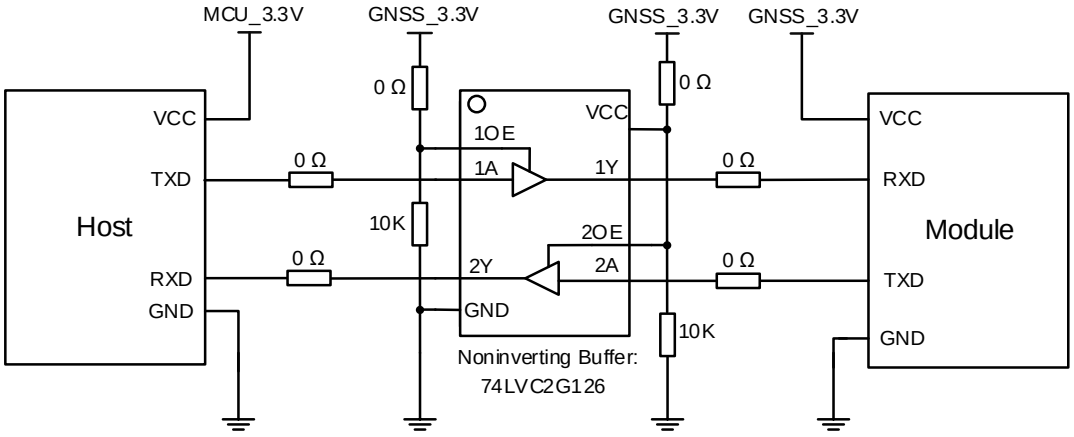


Figure 16: Noninverting Buffer Circuit Between Module and Host

5 Design

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

5.1. Antenna Design

5.1.1. Antenna Specifications

The modules can be connected to a dedicated passive or active single-band GNSS antenna to track the GNSS satellite signals. The recommended antenna specifications are given in the table below.

Table 9: Recommended Antenna Specifications

Antenna Type	Specifications
Passive Antenna	Frequency Range: 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi
Active Antenna	Frequency Range: 1559–1606 MHz Polarization: RHCP VSWR: < 2 (Typ.) Passive Antenna Gain: > 0 dBi Active Antenna Noise Figure: < 2 dB Active Antenna Total Gain: < 17 dB

NOTE

1. For recommended antenna and design, see *document [5] GNSS antenna selection&application guide* or contact Quectel Technical Support (support@quectel.com).
2. The total gain of the whole antenna equals the internal LNA gain minus total insertion loss of cables and components inside the antenna.

5.1.2. Antenna Selection Guide

Both active and passive single-band GNSS antennas can be used with the modules. A passive antenna is recommended if it 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 > 1 dB, since the insertion loss of RF cable can decrease the C/N_0 of GNSS signal. For more information about RF trace layout, see *document [6] RF layout application note*.

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 1 Hz bandwidth. C/N_0 formula:

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

The "Power of GNSS signal" is GNSS signal level. In practical scenarios, the signal level at the Earth's 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:

$$NF = 10 \log F \, (dB)$$

"F" is the noise factor of receiver system:

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

"F1" is the first stage noise factor; "G1" is the first stage gain, etc. This formula indicates that the LNA with sufficient 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 the first stage LNA plus the noise figure of the LNA itself. This explains the need for using an active antenna, if the antenna connection cable is too long.

5.2. Antenna Reference Design

To mitigate the impact of out-of-band signals on the GNSS module in a complex electromagnetic environment, a notch circuit and a SAW filter circuit must be added to the antenna design. The notch circuit, consisting of capacitors and an inductor, is effective at attenuating interference signals close to 787 MHz. However, since the notch bandwidth of the signals close to 787 MHz is narrow, it has little impact on out-of-band signals in other frequency ranges, whereas the SAW filter circuit has a stable suppression effect on all out-of-band signals. In the actual layout, these two circuits should be placed close to RF_IN pin. It is recommended to use SAFFB1G56AC0F7F from Murata or B39162B2618P810 from RF360 in the SAW filter circuit. The specific notch circuit and SAW filter circuit should be selected according to the use case.

5.2.1. Active Antenna Reference Design

The modules provide analog input pins ANT_DET1 and ANT_DET2 for detecting external active antenna status. Through an antenna detection circuit, the state of the antenna (normal/open/short) can be judged by ANT_DET1 and ANT_DET2. See *Chapter 5.2.1.2 Active Antenna Reference Design with Antenna Detection Function* for details.

The typical reference designs of an active antenna are illustrated in the following figures. In this case, the antenna is powered by VDD_RF. To mitigate the impact of out-of-band signals on GNSS module performance in a complex electromagnetic environment around the module, you must choose the active antenna whose SAW filter is placed in front of the LNA in the internal framework.

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

5.2.1.1. Active Antenna Reference Design Without Antenna Detection Function

A typical reference design of an active antenna without antenna detection function is presented below.

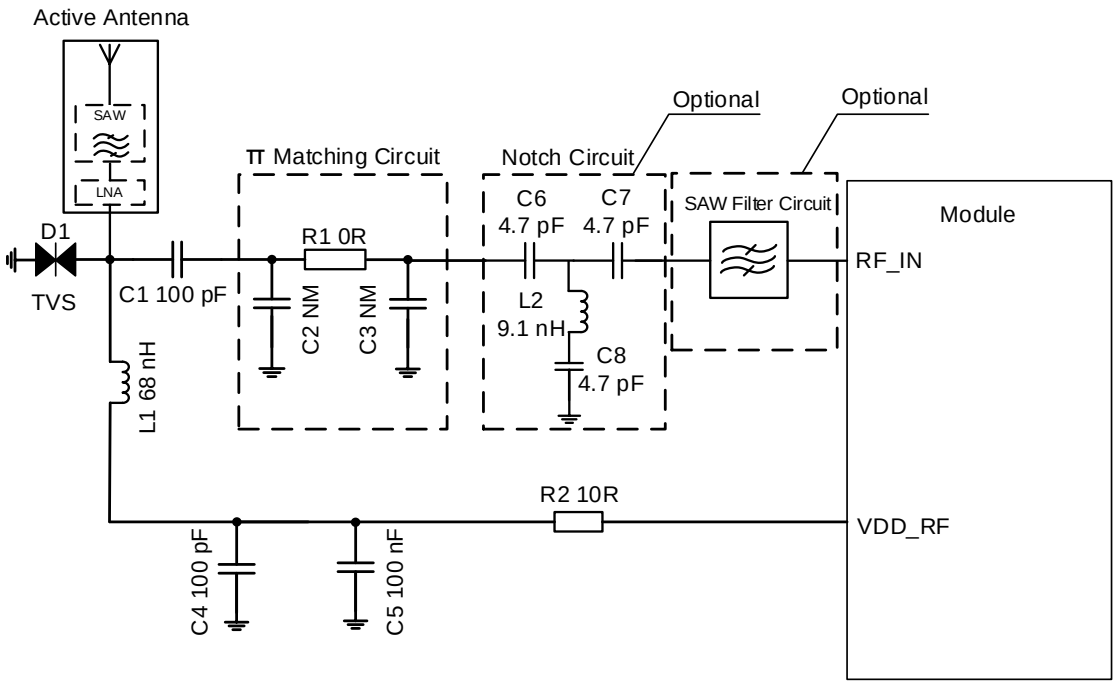


Figure 17: Active Antenna Reference Design Without Antenna Detection

C1 is a DC-blocking capacitor used for blocking the DC current from VDD_RF. C2, R1, and C3 are components 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 component for protecting the RF signal input from the potential damage caused by ESD. The junction capacitance of D1 cannot exceed 0.6 pF and a transient voltage suppressor is recommended.

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. 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. The resistor R2 is used to protect the module in case the active antenna is short-circuited to the ground plane.

5.2.1.2. Active Antenna Reference Design with Antenna Detection Function

A typical reference design of an active antenna with antenna detection function is presented below.

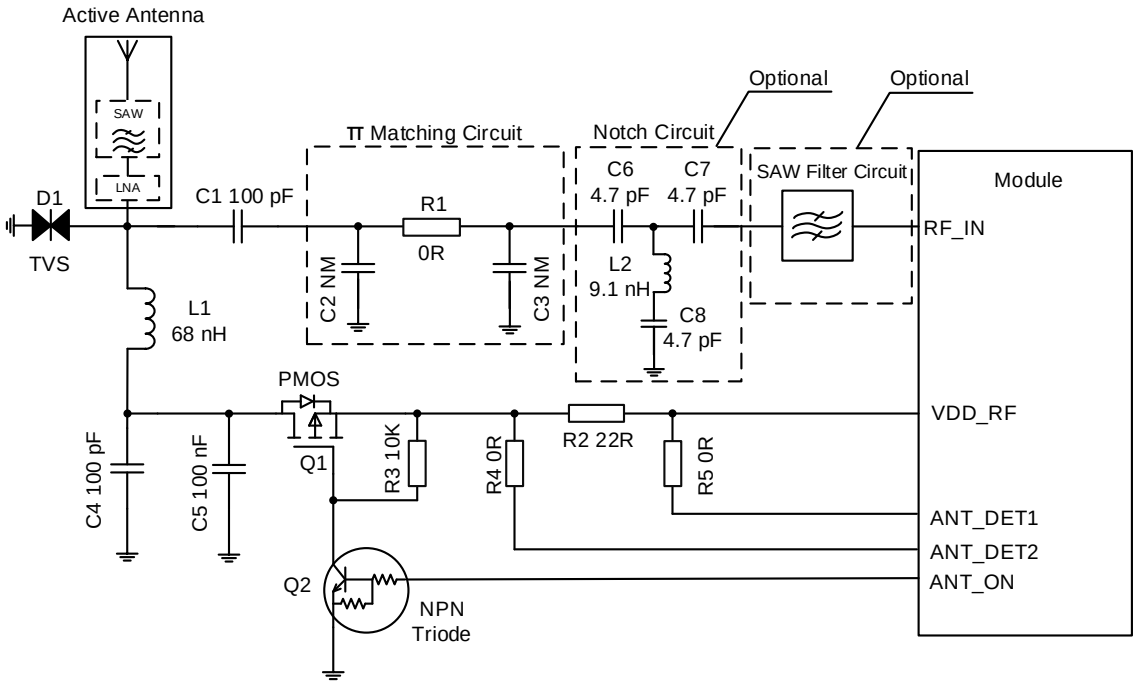


Figure 18: Active Antenna Reference Design with Antenna Detection

The modules read the state of the antenna (normal/open/short) through the antenna detection circuit. The circuit uses two analog inputs, ANT_DET1 and ANT_DET2 pins, to compare the voltages at both ends of the R2 resistor (22 Ω recommended).

The ANT_ON pin controls the power supply for the active antenna with antenna detection function. When ANT_ON is at high level, both transistors Q1 and Q2 will be switched on and the external antenna will be powered by VDD_RF. When ANT_ON is at low level, both Q1 and Q2 will be switched off, thus disabling the external antenna. VDD_RF will be powered off automatically only in the Backup mode.

Ensure that the antenna power consumption falls within the 7–30 mA range, otherwise the active antenna may not work. The status of the antenna detection circuit will be reported in an NMEA message at start-up and on each change. For more information about the NMEA message, see *document [1] protocol specification*.

5.2.2. Passive Antenna Reference Design

A typical reference design of a passive antenna is presented in the following figure.

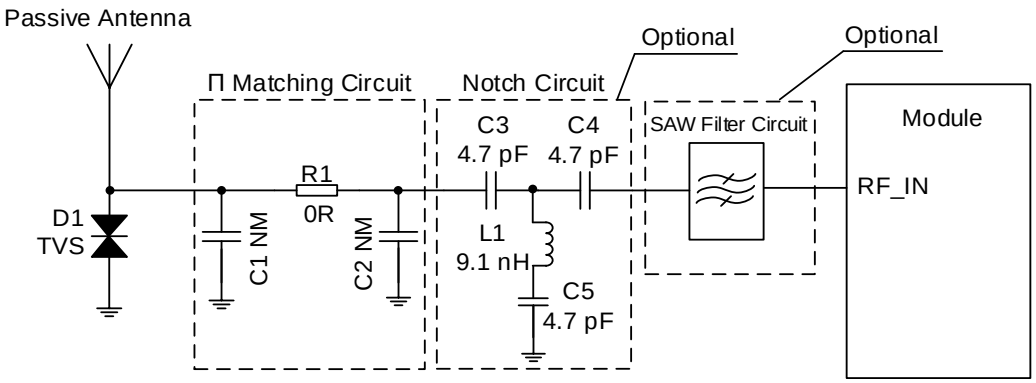


Figure 19: Passive Antenna Reference Design

C1, R1, and C2 are reserved for matching antenna impedance. By default, R1 is 0 Ω, while C1 and C2 are not mounted. D1 is an electrostatic discharge (ESD) protection device for protecting the RF signal input 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. RF trace impedance should be controlled to 50 Ω and the trace length should be kept as short as possible.

5.3. Coexistence with Cellular Systems

Since GNSS signals are usually very weak, a GNSS receiver may be vulnerable to environmental interference. According to 3GPP specifications, a cellular terminal should transmit a signal up to 33 dBm at GSM bands, or of about 24 dBm at WCDMA and LTE bands, or of about at 26 dBm at 5G bands. Therefore, coexistence with cellular systems must be optimized to avoid significant deterioration of the GNSS performance.

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

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

5.3.1. In-band Interference

In-band interference refers to the signal whose frequency is within or near the operating frequency range of a GNSS signal. For example, GPS L1 is centered at 1575.42 MHz with a bandwidth of 2.046 MHz. As shown in the figure below, the frequency of the interfering signal is within the GPS operation band, and its power is higher than the power of the received GPS signal.

See the following figure for more details.

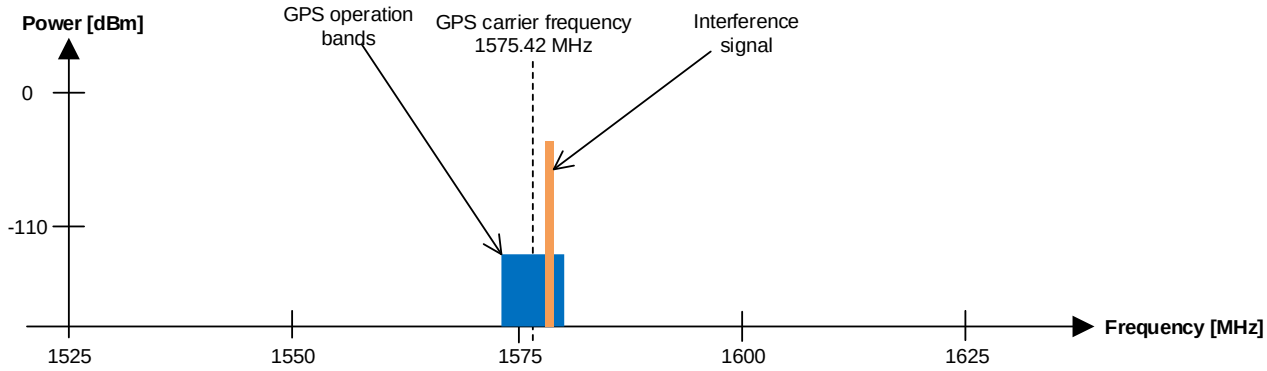


Figure 20: In-band Interference on GPS L1

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 intermodulations or the second harmonic of LTE Band 13.

Table 10: 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
Band 1	n78	F2 (3500 MHz) - F1 (1925 MHz)	IMD2 = 1575 MHz
DCS1800/Band 3	PCS1900/Band 2	2 × F1 (1712.6 MHz) - F2 (1850.2 MHz)	IMD3 = 1575 MHz

Source F1	Source F2	IM Calculation	IMD Products
PCS1900/Band 2	Wi-Fi 5 GHz	F2 (5280 MHz) - 2 × F1 (1852 MHz)	IMD3 = 1576 MHz
LTE Band 13	-	2 × F1 (786.9 MHz)	IMD2 = 1573.8 MHz

5.3.2. Out-of-band Interference

Strong signals transmitted by other communication systems can cause GNSS receiver saturation, thus greatly deteriorating its performance, as illustrated in the following figure. In practical applications, common strong interference signals originate from wireless communication modules, such as GSM, 3G, LTE, 5G, Wi-Fi and Bluetooth.

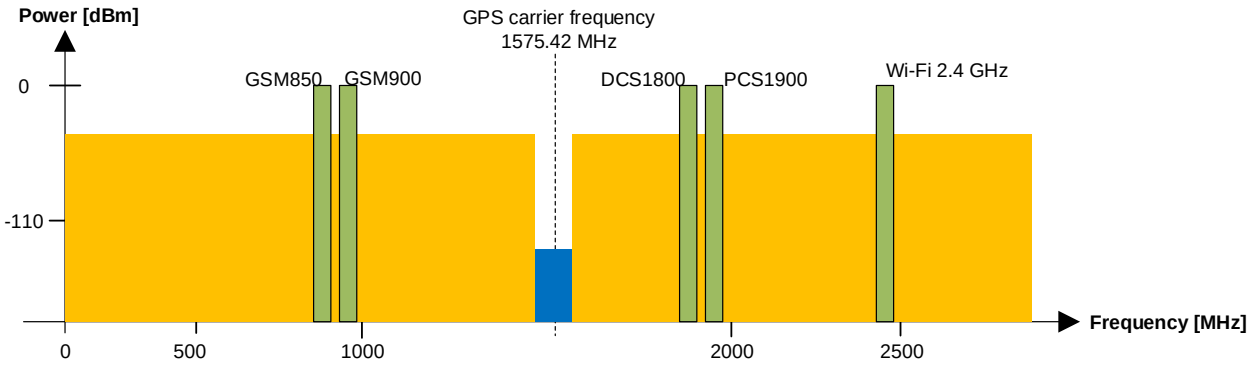


Figure 21: Out-of-band Interference on GPS L1

5.3.3. Ensuring Interference Immunity

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

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

The following figure illustrates the interference source and its potential 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.

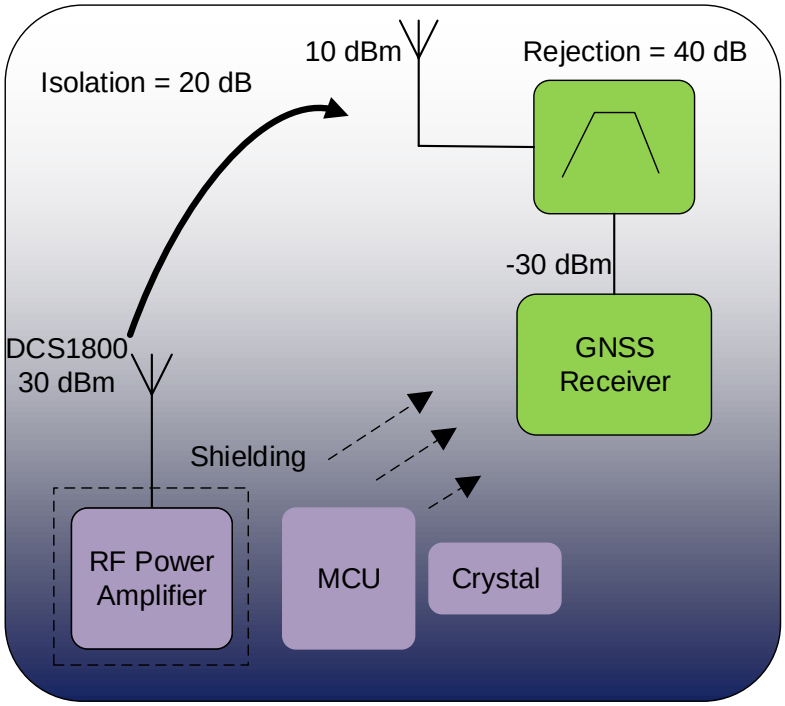


Figure 22: Interference Source and Its Path

5.4. Recommended Footprint

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

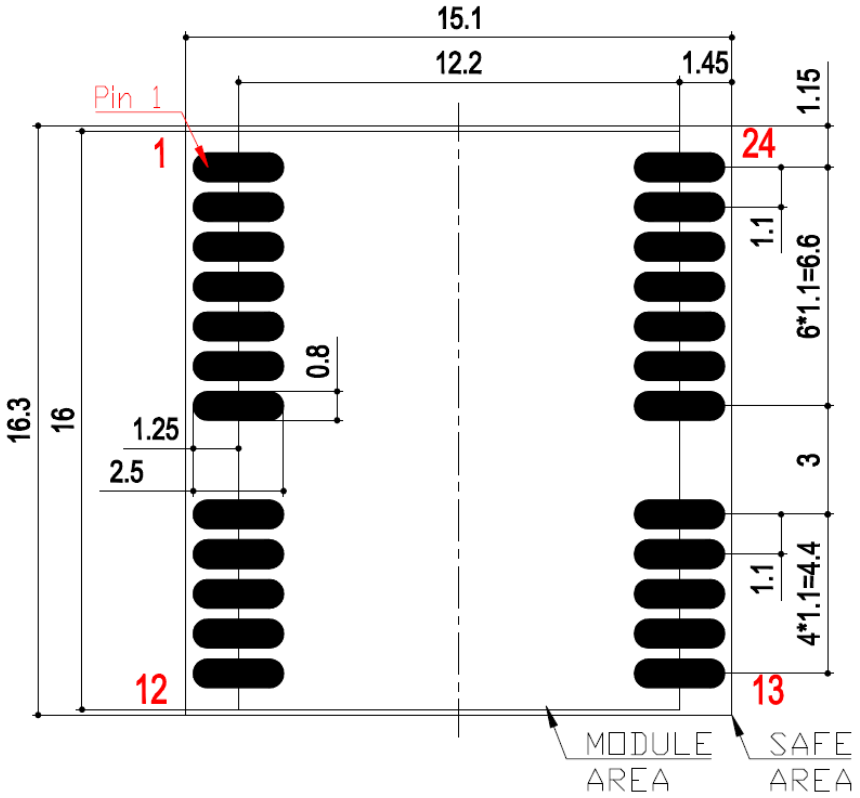


Figure 23: Recommended Footprint

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 modules are listed in the table below.

Table 11: Absolute Maximum Ratings

Parameter	Description	Min.	Max.	Unit
VCC	Main Power Supply Voltage	-0.3	3.6	V
V_BCKP	Backup Supply Voltage	-0.3	3.6	V
V_{IN}_IO	Input Voltage at IO Pins	-0.2	VCC + 0.3	V
P_{RF_IN}	Input Power at RF_IN	-	0	dBm
T_storage	Storage Temperature	-40	90	°C

NOTE

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

6.2. Recommended Operating Conditions

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

Table 12: Recommended Operating Conditions

Parameter	Description	Min.	Typ.	Max.	Unit
VCC	Main Power Supply Voltage	3.0	3.3	3.6	V
V_BCKP	Backup Power Supply Voltage	2.0	3.3	3.6	V
IO_Domain	Digital I/O Pin Domain Voltage	-	VCC	-	V
V_{IL}	Digital I/O Pin Low-level Input Voltage	-0.3	-	0.8	V
V_{IH}	Digital I/O Pin High-level Input Voltage	2.0	-	VCC + 0.3	V
V_{OL}	Digital I/O pin Low-level Output Voltage	-	-	0.4	V
V_{OH}	Digital I/O Pin High-level Output Voltage	VCC - 0.4	-	-	V
RESET_N	Low-level Input Voltage	-0.3	-	0.35	V
	High-level Input Voltage	0.65	-	1.3	V
WAKEUP	High-level Input Voltage	2.1	-	VCC	V
VDD_RF	VDD_RF Output Voltage	-	VCC	-	V
I_{VDD_RF}	VDD_RF Output Current	-	100	-	mA
T_operating	Operating Temperature	-40	25	+85	°C

NOTE

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

6.3. Supply Current Requirements

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

Table 13: Supply Current for L26-P

Parameter	Description	Condition	$I_{Typ.}$ [6]	I_{PEAK} [6]
I_{VCC} [7]	Current at VCC	Acquisition mode	73 mA	120 mA
		Tracking mode	68 mA	108 mA
		Standby mode	1.7 mA	2.4 mA
I_{V_BCKP} [8]	Current at V_BCKP	Continuous mode	120 μA	150 μA
		Standby mode	8 μA	43 μA
		Backup mode	8 μA	43 μA

Table 14: Supply Current for L26-T

Parameter	Description	Condition	$I_{Typ.}$ [6]	I_{PEAK} [6]
I_{VCC} [7]	Current at VCC	Acquisition mode	76 mA	112 mA
		Tracking mode	73 mA	112 mA
		Standby mode	7 μA	29 μA
I_{V_BCKP} [8]	Current at V_BCKP	Continuous mode	78 μA	111 μA
		Standby mode	5 μA	25 μA
		Backup mode	7 μA	43 μA

[6] Room temperature, measurements are taken with typical voltage.
[7] Used to determine the maximum current capability of power supply.
[8] Used to determine the required battery current capability.

6.4. ESD Protection

Static electricity occurs naturally and it may damage the modules. 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).

7 Mechanical Dimensions

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

7.1. Top, Side, and Bottom View Dimensions

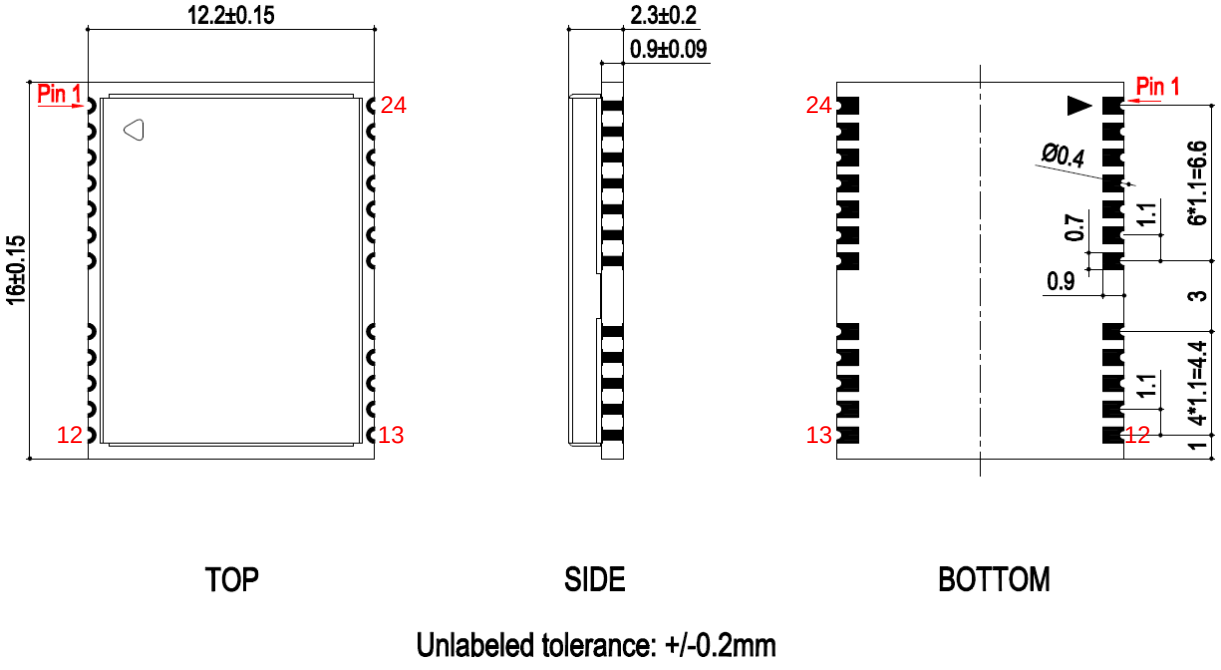


Figure 24: Top, Side, and Bottom View Dimensions

NOTE

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

7.2. Top and Bottom Views

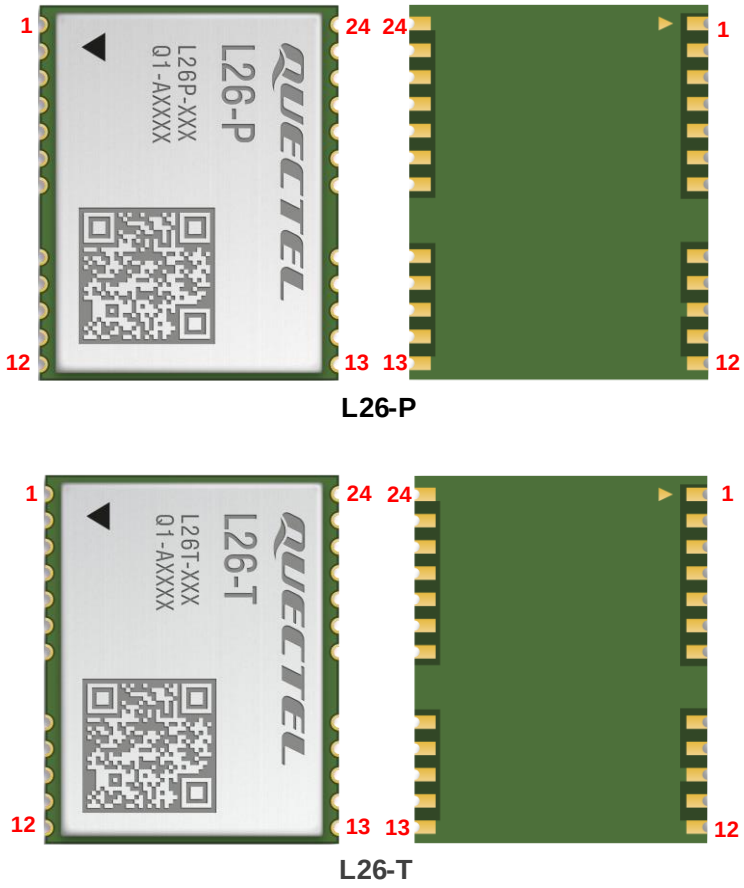


Figure 25: Top and Bottom Views

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.

7.3. Recommended Mounting

The following is the three-axis direction of the IMU accelerometer for the L26-P module. Please refer to the algorithm requirements for specific installation angle and direction restrictions.

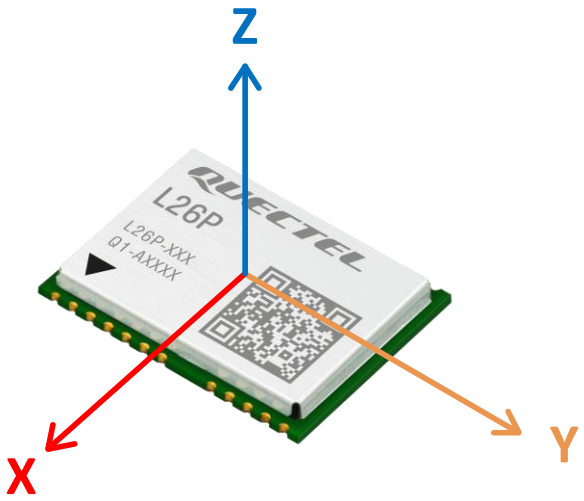


Figure 26: Axes of L26-P Module

To ensure its performance, the L26-P module must be fixed tightly on the vehicle without movement or shaking during positioning.

8 Product Handling

8.1. Packaging

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

The modules adopt carrier tape packaging and details are as follows.

8.1.1. Carrier Tape

Carrier tape dimensions are presented in the figure below:

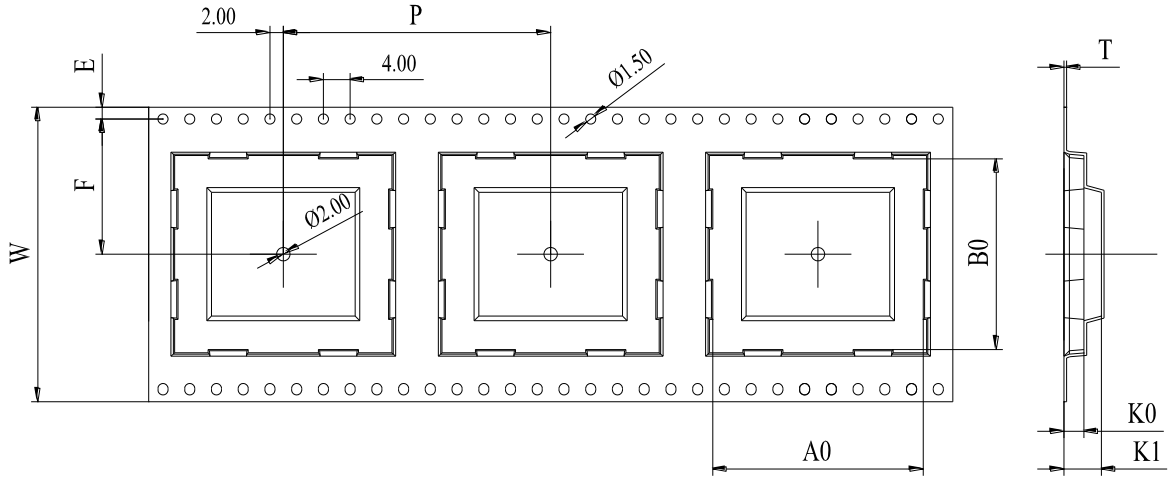


Figure 27: Carrier Tape Dimension Drawing

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

W	P	T	A0	B0	K0	K1	F	E
32	24	0.4	12.7	16.4	2.9	7.4	14.2	1.75

8.1.2. Plastic Reel

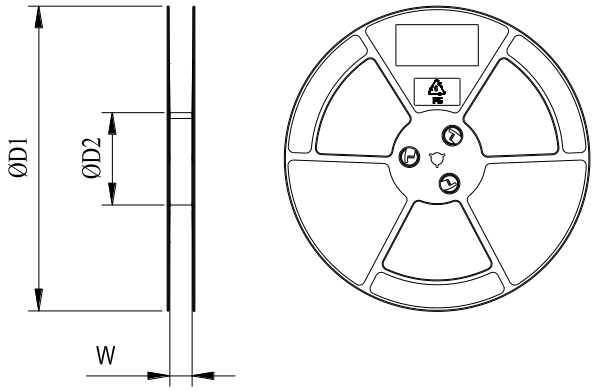


Figure 28: Plastic Reel Dimension Drawing

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

øD1	øD2	W
330	100	32.5

8.1.3. Mounting Direction

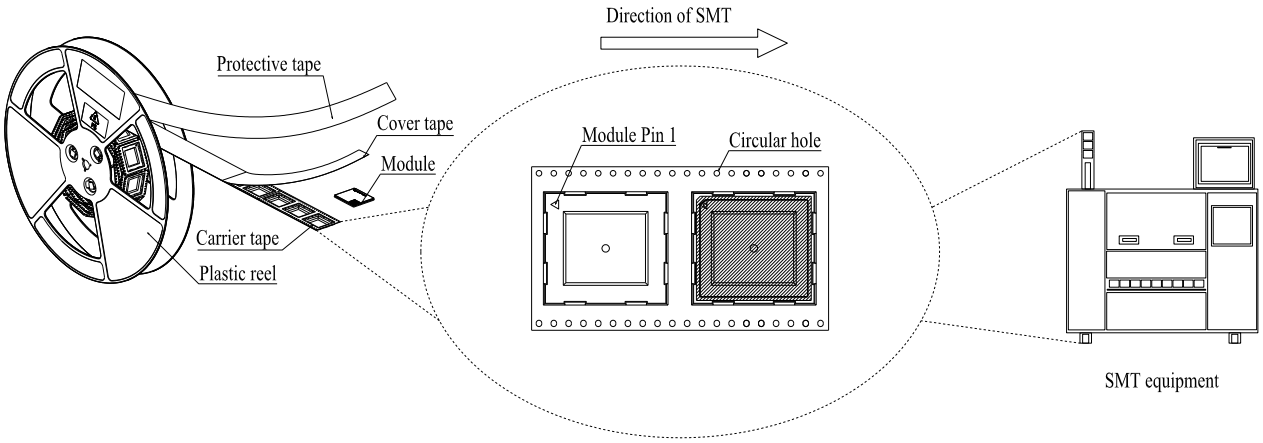
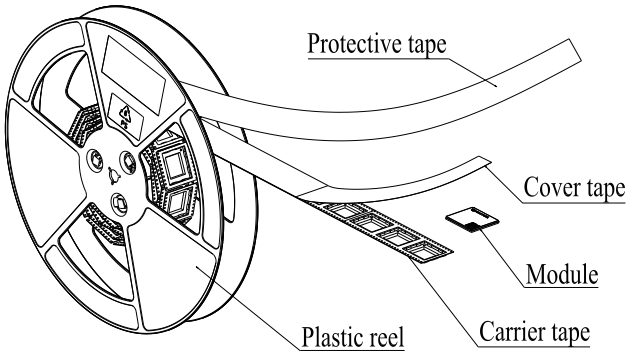


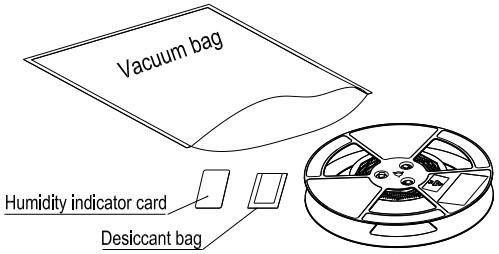
Figure 29: Mounting Direction

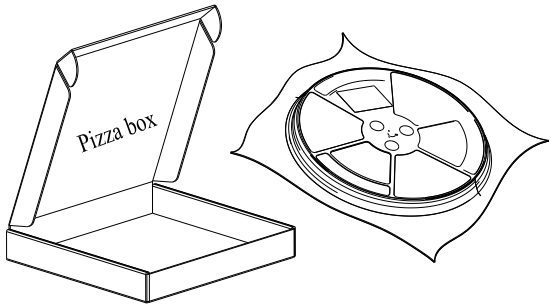
8.1.4. Packaging Process



Place the modules onto the carrier tape and use the cover tape to cover them; then wind the heat-sealed carrier tape on the plastic reel and use the protective tape for protection. One plastic reel can load 250 modules.

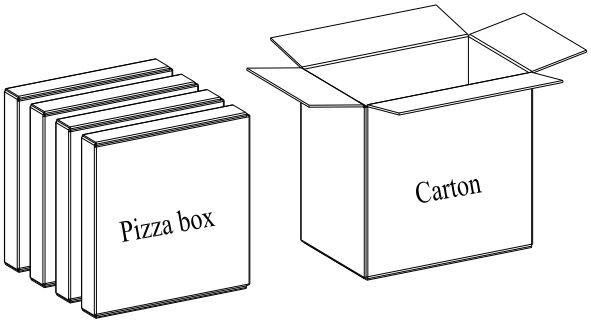
Place the packaged plastic reel, humidity indicator card and desiccant bag inside a vacuum bag, and vacuumize it.





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

Place 4 pizza boxes inside 1 carton and seal it. One carton can hold 1000 modules.



Pizza box size (mm): 363 × 343 × 55
Carton size (mm): 380 × 250 × 365

Figure 30: Packaging Process

8.2. Storage

The modules are provided in the vacuum-sealed packaging. MSL of the modules 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 [9] in a factory where the temperature is 23 ±5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the modules must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the modules should be stored in an environment where the relative humidity is less than 10 % (e.g., a dry cabinet).

4. The modules 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 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 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 packaging 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.

[9] 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 of removing the package if the temperature and moisture do not conform, or if it is not certain that they conform to *IPC/JEDEC J-STD-033*. Do not unpack the modules in large quantities until they are ready for soldering.

8.3. Manufacturing and Soldering

Push the squeegee to apply solder paste on the stencil surface, and ensure the paste fills the stencil openings and penetrates 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 [7] module SMT application note*.

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 (for lead-free reflow soldering) and related parameters are shown in the figure and table below.

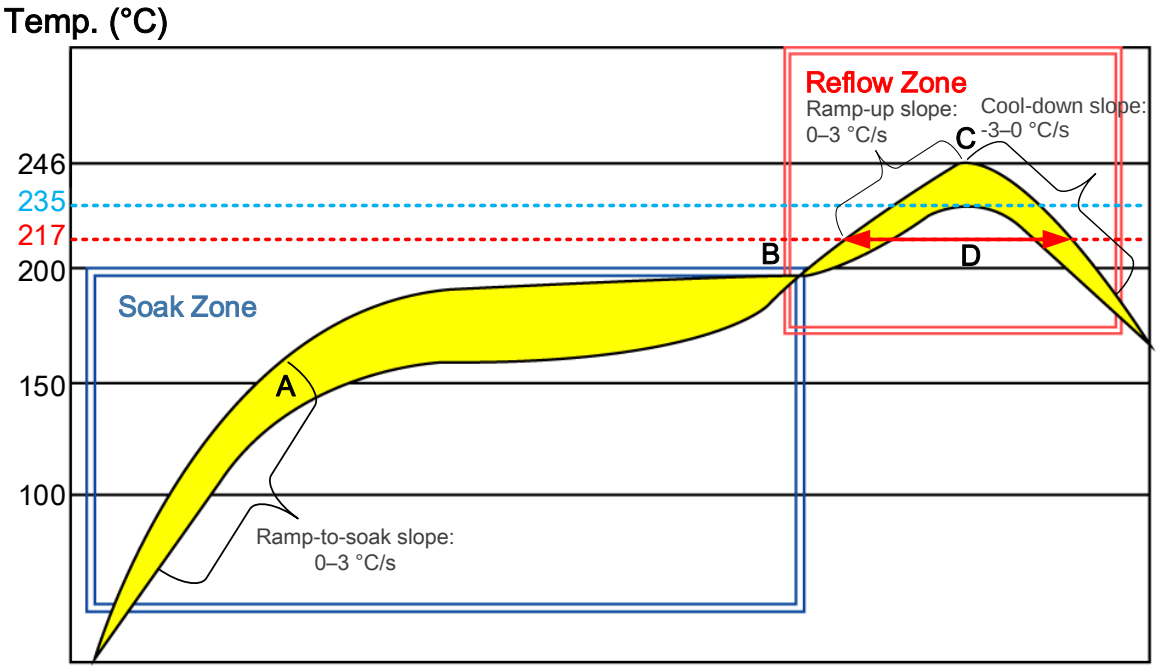


Figure 31: Recommended Reflow Soldering Thermal Profile

Table 17: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Ramp-to-soak Slope	0–3 °C/s
Soak Time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Ramp-up Slope	0–3 °C/s
Reflow Time (D: over 217 °C)	40–70 s
Max. Temperature	235–246 °C
Cooling 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 the module requires conformal coating, **DO NOT** use any coating material that may react with the PCB or shielding cover. Prevent the coating material from entering the module shield.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. 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 [7] module SMT application note*.

9 Labelling Information

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

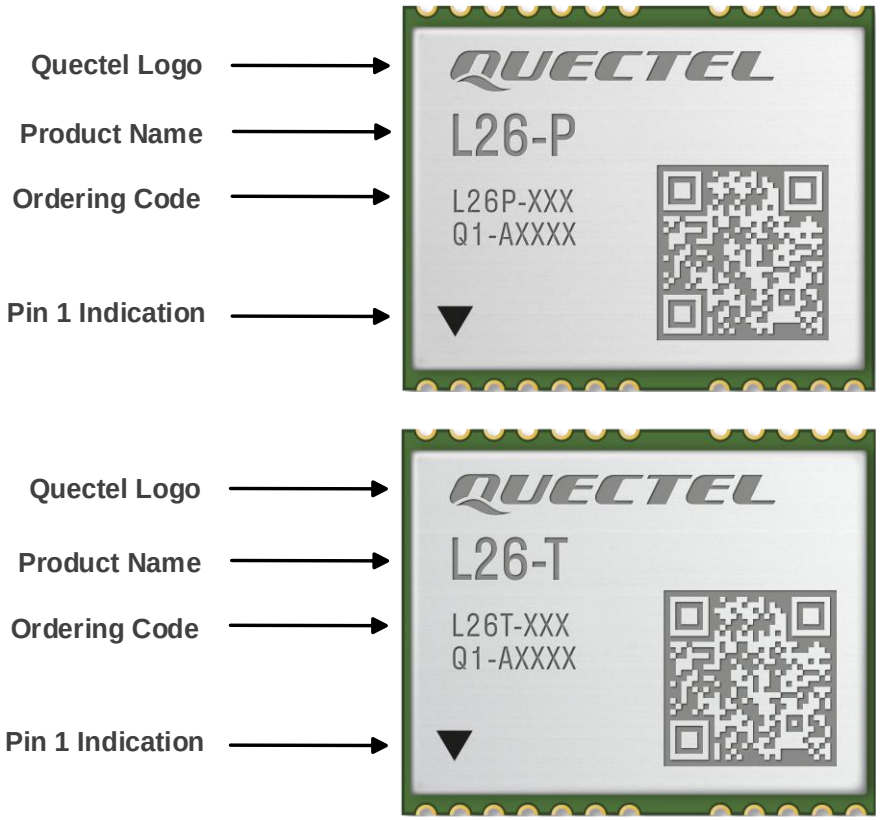


Figure 32: Labelling Information

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

10 Appendix References

Table 18: Related Documents

Document Name
[1] Quectel_L26-DR_Series&L26-P&L26-T&LC98S_GNSS_Protocol_Specification
[2] Quectel_L89&L26-DR&L26-P&L26-T_AGNSS_Application_Note
[3] Quectel_L26-DR&L26-P&L26-T&L89&LC98S_Firmware_Upgrade_Guide
[4] Quectel_L26-T&L26-P_Reference_Design
[5] Quectel_GNSS_Antenna_Selection_Guidance
[6] Quectel_RF_Layout_Application_Note
[7] Quectel_Module_SMT_Application_Note

Table 19: Terms and Abbreviations

Abbreviation	Description
1PPS	One Pulse Per Second
3GPP	3rd Generation Partnership Project
AGNSS	Assisted GNSS (Global Navigation Satellite System)
BB	Baseband
BDS	BeiDou Navigation Satellite System
bps	bit(s) per second
CAN	Controller Area Network
CEP	Circular Error Probable
C/N_0	Carrier-to-noise-density Ratio

Abbreviation	Description
DCS1800	Digital Cellular System at 1800 MHz
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 (Russia)
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_{PEAK}	Peak Current
LCC	Leadless Chip Carrier (package)
LDO	Low-dropout Regulator
LNA	Low-Noise Amplifier
LTE	Long-Term Evolution
MCU	Microcontroller Unit/Microprogrammed Control UnitSRA
MSAS	Multi-functional Satellite Augmentation System (Japan)
MSL	Moisture Sensitivity Levels
NavIC	Indian Regional Navigation Satellite System
NF	Noise Figure
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard

Abbreviation	Description
OC	Ordering Code/Open Connector
OE	Output Enable
PCB	Printed Circuit Board
PI	Power Input
PMU	Power Management Unit
PSRR	Power Supply Rejection Ratio
QR (Code)	Quick Response (Code)
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RHCP	Right Hand Circular Polarization
RMS	Root-mean-square Value
RoHS	Restriction of Hazardous Substances
RTC	Real-Time Clock
RTK	Real-Time Kinematic
RXD	Receive Data (Pin)
SAW	Surface Acoustic Wave
SBAS	Satellite-Based Augmentation System
SMD	Surface Mount Device
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
SV	Satellite Vehicle
TCXO	Temperature Compensated Crystal Oscillator
T_operating	Operating Temperature
TTFF	Time to First Fix

Abbreviation	Description
TVS	Transient Voltage Suppressor
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
VCC	Supply Voltage
$V_I$max	Maximum Input Voltage
$V_I$min	Minimum Input Voltage
$V_I$nom	Normal Input Voltage
V_{IH}max	High-level Maximum Input Voltage
V_{IH}min	High-level Minimum Input Voltage
V_{IH}nom	High-level Normal Input Voltage
V_{IL}max	Low-level Maximum Input Voltage
V_{IL}min	Low-level Minimum Input Voltage
$V_O$nom	Normal Output Voltage
V_{OL}max	Low-level Maximum Output Voltage
V_{OH}min	High-level Minimum Output Voltage
VSWR	Voltage Standing Wave Ratio
WAAS	Wide Area Augmentation System
WCDMA	Wideband Code Division Multiple Access
XTAL	External Crystal Oscillator