L26-LB Hardware Design

GNSS Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2020-03-18	Ronnie HU/ Phil GAO	Initial

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1 Introduction

This document provides information on the interface specifications, electrical and mechanical details, as well as other related information of Quectel L26-LB GNSS module. To facilitate application designs, it also includes some reference designs for customers' reference. This document, coupled with application notes and user guides, makes it easy to design applications with L26-LB module.

1.1. Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal incorporating Quectel L26-LB module. Manufacturers of the terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, Quectel assumes no liability for customers' failure to comply with these precautions.

	Ensure the use of the product conforms to the local safety and environment regulations, and is allowed in the country and the environment required.
	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 application that incorporates the module to avoid ESD damages.

2 Product Concept

L26-LB module supports multiple positioning and navigation systems including GPS, GLONASS, BeiDou, SBAS (including WAAS, EGNOS, MSAS and GAGAN) and QZSS, and it also supports AGNSS functions. Designed with an embedded LNA, the module realizes high sensitivity, high accuracy, fast GNSS signal acquisition and tracking.

Key features of L26-LB:

- The embedded flash memory provides capacity for storing user-specific configurations and allows for future updates.
- Support multiple power-saving modes such as Periodic, Standby and Backup, and the embedded low-power algorithms suitable for different application scenarios.
- EASY™ autonomous AGNSS technology is supported, which can collect and process all internal auxiliary information including GNSS time, calendar, the latest position and so on, so that the module can achieve fast first fix in hot/warm start.
- Support active antenna detection and short-circuit protection. The antenna status is reported in the NMEA message, so the host can query the antenna status timely and conveniently.

L26-LB module is an SMD type module with a compact profile of 12.2 mm × 16.0 mm × 2.3 mm. It can be embedded in customers' applications through the 24 LCC pins. It provides necessary hardware interfaces for connection with the main PCB.

The module is fully compliant with EU RoHS directive.

2.1. Key Features

Table 1: Key Features

Features	Details
GNSS Constellation Configuration	• Default configuration [1]: GPS + GLONASS or GPS + BeiDou • For more details about the GNSS constellation configuration, please refer to ***document [1]***.
Receiver Type	• GPS L1 C/A (1574.397–1576.443 MHz) • GLONASS L1 (1598.0625–1605.375 MHz)

	● BeiDou B1I (1559.052–1563.144 MHz)			
Power Supply	● Supply voltage: 2.8–4.3 V ● Typical: 3.3 V			
Power Consumption [2] (-130 dBm, VCC = 3.3 V)		**GPS**	**GPS+GLONASS**	**GPS+BeiDou**
	Acquisition (mA)	24	31	31
	Tracking (mA)	22	29	29
	Standby (mA)	0.9	0.9	0.9
	Backup (μA)	8	8	8
	The module's peak current may rush up to 45 mA (typ.)			
Sensitivity (dBm)		**GPS**	**GPS+GLONASS**	**GPS+BeiDou**
	Acquisition	-149	-149	-149
	Reacquisition	-161	-161	-161
	Tracking	-167	-167	-167
Time-to-First-Fix (without AGNSS) (s)		**GPS**	**GPS+GLONASS**	**GPS+BeiDou**
	Cold Start	41	25	34
	Warm Start	34	20	32
	Hot Start	2	1	2
Time-to-First-Fix (EASY Enabled) (s)		**GPS**	**GPS+GLONASS**	**GPS+BeiDou**
	Cold Start	16	13	14
	Warm Start	7	11	9
	Hot Start	1	1	1
Time-to-First-Fix (EPO Enabled) (s)		**GPS**	**GPS+GLONASS**	**GPS+BeiDou**
	Cold Start	5	4	4
	Warm Start	2	3	2
	Hot Start	1	1	1
Horizontal Position Accuracy (Autonomous) [3]	● < 2.5 m			
Update Rate	● 1 Hz by default, maximum up to 10 Hz			
Accuracy of 1PPS Signal	● Typical accuracy < 100 ns			

	● Time pulse width: 100 ms
Velocity Accuracy	● Without aid: < 0.1 m/s
Acceleration Accuracy	● Without aid: < 0.1 m/s²
Dynamic Performance	● Maximum Altitude: 18000 m ● Maximum Velocity: 515 m/s ● Acceleration: 4G
UART Interface	● UART port: UART_TX and UART_RX ● Baud rate: 9600 bps to 921600 bps, 9600 bps by default ● Used for NMEA sentences output, PMTK/PQ commands input and firmware upgrade
I2C Interface [4)]	● Support fast mode, with bit rate up to 400 kbps ● Support 7-bit address ● Operate in slave mode ● Output NMEA data by default, and it can also receive PMTK/PQ commands by I2C bus
Temperature Range	● Operation 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. 1.0 g

NOTES

1. [1)] For more specific information on the default GNSS constellation and the corresponding firmware version, please contact Quectel Technical Support.
2. [2)] The power consumption data are tested when QZSS and SBAS are disabled.
   - The power supply of the integrated LNA inside L26-LB will be cut off automatically once the module enters standby or backup mode.
   - The current consumption of VCC_RF is not reckoned in the values above.
   - Test conditions for the current consumption in tracking mode:
     In cold start: 15 minutes after the first fix.
     In hot start: 15 seconds after the first fix.
3. [3)] CEP, 50%, 2 hours static, -130 dBm, > 6 SVs.
4. [4)] I2C interface is supported only on firmware versions ended with “SC”. In other firmware versions, I2C_SDA and I2C_SCL pins are used for RTCM data input. When I2C interface is supported, NEMA data should be outputted via I2C interface rather than UART interface, otherwise there maybe NEMA data loss.

2.2. Block Diagram

The following figure shows a block diagram of L26-LB module. It consists of a single-chip GNSS IC (RF/Baseband parts included), an LNA, a SAW filter, a TCXO, a crystal oscillator as well as an active antenna protection and short-circuit detection circuit.

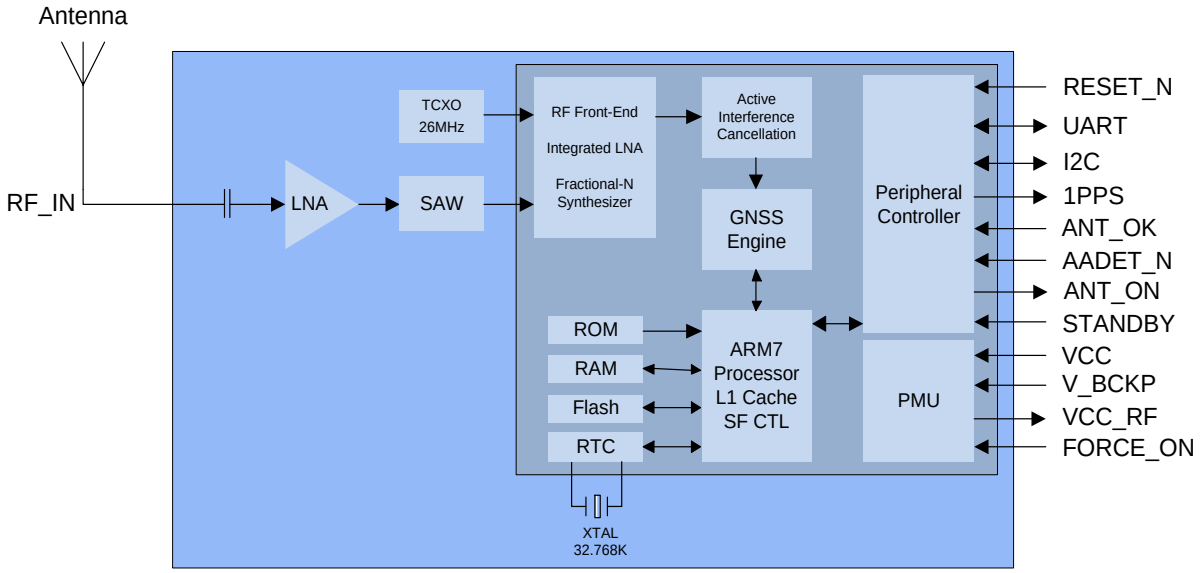

Figure 1: Block Diagram

2.3. Supported Protocols

Table 2: Supported Protocols

Protocol	Description
NMEA	ASCII, 0183, 4.10
PMTK	MTK proprietary protocol
PQ	Quectel proprietary protocol

NOTES

1. Please refer to ***document [1]*** for details of supported protocols.
2. Please refer to ***document [5]*** for details of Quectel proprietary protocol.

2.4. Evaluation Board

In order to facilitate application design with L26-LB module, Quectel supplies the evaluation board (L26-LB EVB), micro-USB cable, active antenna and other peripherals to test the module.
For more details, please refer to ***document [2]***.

3 Application Interfaces

L26-LB is equipped with 24 LCC pins through which the module can be mounted to the motherboard of any terminal.

3.1. Pin Assignment

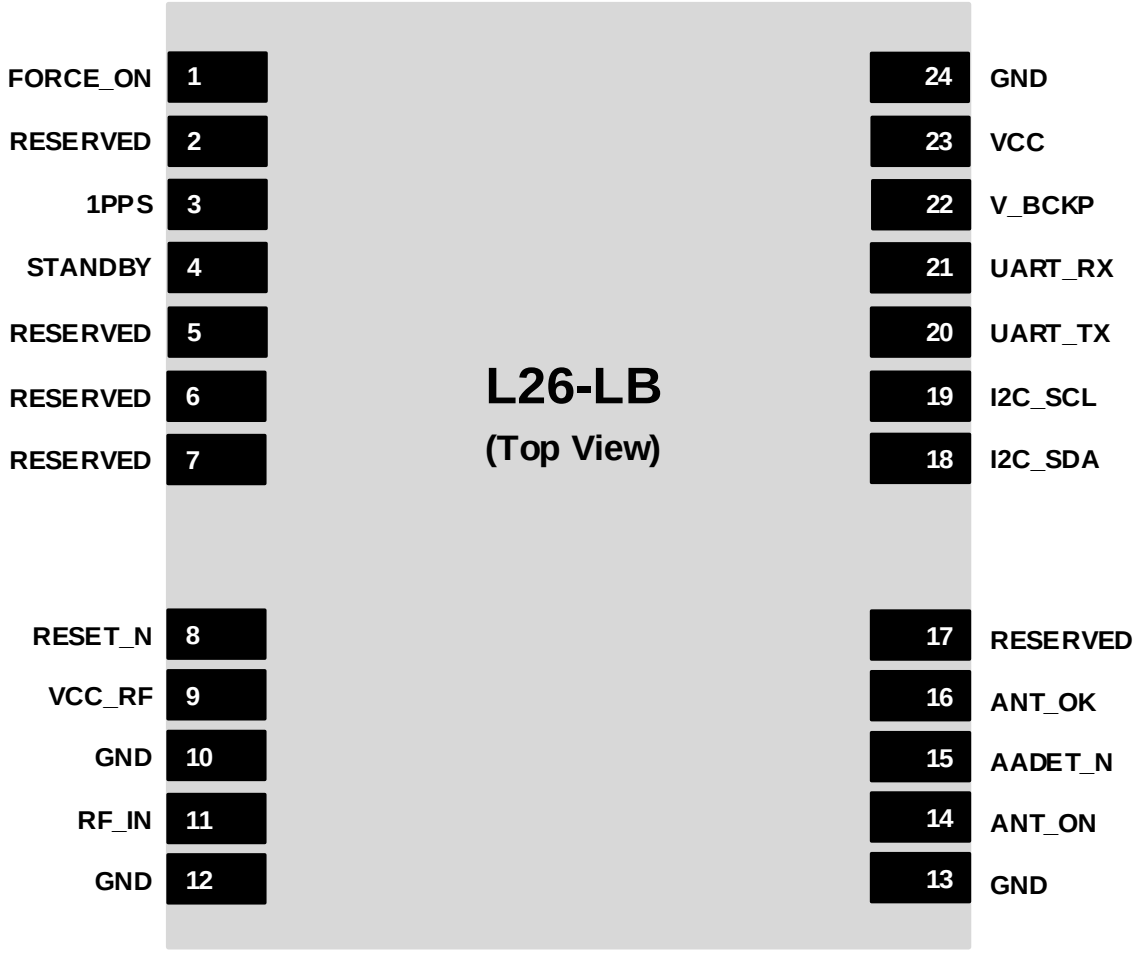

Figure 2: Pin Assignment

3.2. Pin Description

Table 3: I/O Parameters Definition

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

Table 4: Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VCC	23	PI	Main power supply	Vmax = 4.3 V Vmin = 2.8 V Vnom = 3.3 V	Assure the maximum current capability of power supply no less than 100 mA.
V_BCKP	22	PI	Backup power supply for RTC	Vmax = 4.5 V Vmin = 1.5 V Vnom = 3.3 V I_{V_BCKP} ≈ 8 μA @ Backup mode	Supply power for RTC domain when VCC is powered off.
Reset					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RESET_N	8	DI	Reset the module	V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	Active low. If unused, keep this pin open.

UART Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
UART_TX	20	DO	Transmit data	V_{OL}max = 0.42 V V_{OH}min = 2.38 V V_{OH}nom = 2.8 V	The UART interface is used for NMEA sentences output, PMTK/PQ commands input and firmware upgrade. Please do not use UART for NMEA sentences output if I2C is supported.
UART_RX	21	DI	Receive data	V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	
I2C Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
I2C_SDA	18	IO	I2C serial data	V_{OL}max = 0.42 V V_{OH}min = 2.38 V V_{OH}nom = 2.8 V V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	The I2C interface is used for NMEA sentences output by default, and the module also supports receiving PMTK/PQ commands by I2C bus. The pins can also be used for RTCM data input then I2C function is not supported. I2C interface is supported only on firmware versions ended with “SC”. In other firmware versions, I2C_SDA and I2C_SCL pins are used for RTCM data input. If unused, keep these pins open.
I2C_SCL	19	IO	I2C serial clock		
RF Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VCC_RF	9	PO	Power supply for external RF components	VCC_RF≈VCC Vmax = 4.3 V Vmin = 2.8 V Vnom = 3.3 V	Typically used to supply power for an external active antenna.
RF_IN	11	AI	RF signal input		50 Ω characteristic impedance.

ANT_ON	14	DO	Active antenna power control	V_{OL}max = 0.42 V V_{OH}min = 2.38 V V_{OH}nom = 2.8 V	If unused, keep this pin open.
AADET_N	15	DI	Active antenna open-circuit detection	V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	If unused, keep this pin open.
ANT_OK	16	DI	Active antenna short-circuit detection	V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	If unused, keep this pin open.
Other Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
FORCE_ON	1	DI	Logic high will wake up the module from backup mode	V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	Keep this pin open or pulled low before entering backup mode. It belongs to RTC domain. If unused, keep this pin open.
1PPS	3	DO	One pulse per second	V_{OL}max = 0.42 V V_{OH}min = 2.38 V V_{OH}nom = 2.8 V	Synchronized at rising edge. Pulse width: 100 ms. If unused, keep this pin open.
STANDBY	4	DI	Used to enter or exit standby mode	V_{IL}min = -0.3 V V_{IL}max = 0.7 V V_{IH}min = 2.1 V V_{IH}max = 3.1 V V_{IH}nom = 2.8 V	It is pulled up internally. It is edge-triggered. If unused, keep this pin open.
GND	10, 12, 13, 24		Ground		
RESERVED	2, 5, 6, 7, 17				Please keep these pins open.

NOTE

Please keep all reserved and unused pins open.

3.3. Power Supply

VCC supplies power for BB, RF and RTC domains. The load current of VCC pin varies according to the VCC voltage level, processor load and satellite acquisition. The typical VCC peak current is 45 mA during GNSS acquisition after power-up, so it is important to supply sufficient current and make sure the power clean and stable. It is recommended to choose an LDO with a minimum output current of 100 mA as the power supply, and add a 10 μF and a 100 nF decoupling capacitor combination as well as a TVS near the VCC pin.

The V_BCKP pin supplies power for RTC domain. A cell battery with the combination of a 4.7 μF and a 100 nF capacitor is recommended to be placed nearby V_BCKP pin. The voltage of RTC domain ranges from 1.5 V to 4.5 V. In order to achieve better Time to First Fix (TTFF), RTC domain should be valid all the time so as to supply power for SRAM memory which contains all the necessary GNSS information for quick start-up and a small amount of user configuration variables.

3.3.1. Internal Power-System Construction

The module's internal power-system construction is shown as below.

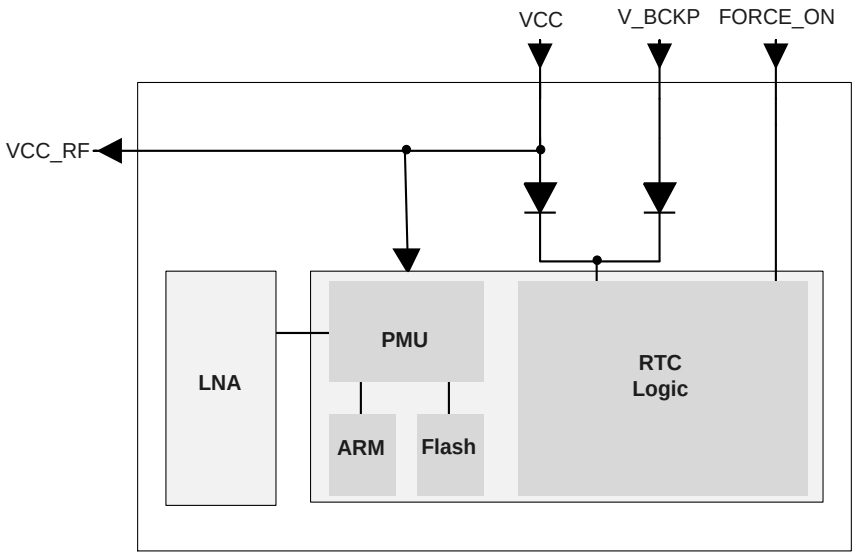

Figure 3: Internal Power-System Construction

- VCC supplies power not only for PMU but also for VCC_RF and RTC domains, while V_BCKP supplies power for RTC domain only.
- The two diodes in the above figure form an OR gate to supply power for RTC domain. The FORCE_ON pin belongs to RTC domain.
- The PMU is designed with an integrated switch which is used to control the PMU power supply status.

3.4. Operation Modes

The table below briefly illustrates the supported features/functions of the module in different modes, and the switching between the modes.

Table 5: Feature Comparison in Different Operation Modes

Features	Full on	Standby	Backup	Periodic	GLP
Antenna Detection	●	●	/	o	●
1PPS	●	/	/	o	●
RF	●	/	/	o	●
NMEA from UART	●	(Support PMTK command)	/	o	●
Acquisition & Tracking	●	/	/	o	●
Power consumption	High	Low	Low	Medium	Medium
Position accuracy	High	/	/	Low	Medium

NOTES

● = supported
o = supported in full on periodic mode

Table 6: Module Mode Switching

Current Mode	Next Mode				
	Backup	Standby	Full on	Periodic	GLP
Backup	/	N/A	Refer to ***Chapter 3.4.3***	N/A	N/A
Standby	N/A	/	Pull STANDBY high, or send any data via UART	N/A	N/A

Full on	Refer to ***Chapter 3.4.3***	Pull STANDBY low or send PMTK161 command	/	Send PMTK225 command	Refer to ***Chapter 3.4.5***
Periodic	N/A	N/A	Refer to ***Chapter 3.4.4***	/	N/A
GLP	N/A	N/A	Refer to ***Chapter 3.4.5***	N/A	/

3.4.1. Full on Mode

Full on mode comprises tracking mode and acquisition mode. In acquisition mode, the module starts to search satellites, and to determine the visible satellites, coarse carrier frequency as well as code phase of satellite signals. When the acquisition is completed, it will automatically switch to tracking mode. In tracking mode, the module tracks satellites and demodulates the navigation data from specific satellites.

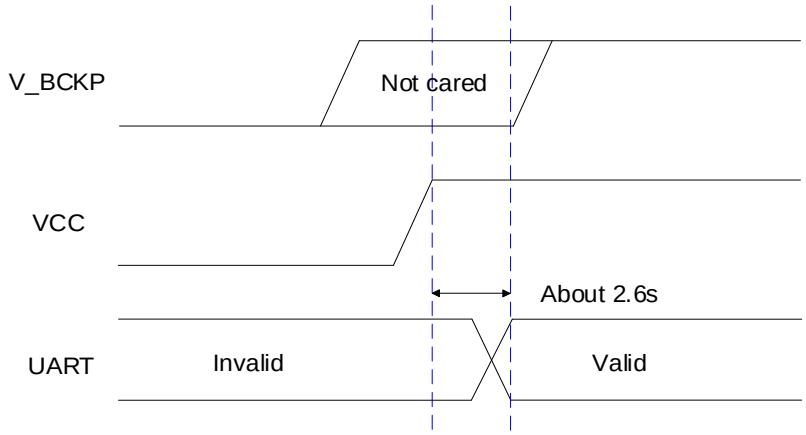

Figure 4: Full on Mode Timing

As long as VCC power supply is valid, the module will enter full on mode automatically and follow the default configurations as below. For better comprehension, please refer to ***Chapter 3.3*** for more details about the internal power supply system construction of the module.

Table 7: Default Configurations

Item	Configuration	Comment
GNSS	GPS + GLONASS or GPS + BeiDou	The following PMTK commands can be used to switch among multiple positioning systems: ● **$PMTK353,1,0,0,0,0*2A**: GPS satellites only ● **$PMTK353,1,1,0,0,0*2B**: GPS and GLONASS satellites ● **$PMTK353,1,0,0,0,1*2B**: GPS and BeiDou satellites
Baud Rate	9600 bps	/
Protocol	NMEA	RMC, VTG, GGA, GSA, GSV, GLL and TXT
Update Rate	1 Hz	/
SBAS	Enabled	/
AIC	Enabled	/
LOCUS	Disabled	/
EASY Technology	Enabled	When update rate exceeds 1 Hz, EASY will be disabled automatically.
I2C	Disabled	The pins can be used for RTCM data input.

After power-up, the module's peak current may rush up to 45 mA (VCC = 3.3 V) and last for a few seconds, and then the current consumption will be reduced to the average values provided in ***Table 1***.

The module will remain in acquisition mode for several minutes after which it will switch to tracking mode automatically. The current consumption in tracking mode is lower, and please refer to ***Table 1*** for more details.

NOTE

RMC, VTG, GGA, GSA, GSV, GLL and TXT are the output types of NMEA messages supported by L26-LB:

- RMC: Recommended Minimum Specific GNSS Data
- VTG: Course Over Ground and Ground Speed
- GGA: Global Positioning System Fix Data
- GSA: GNSS DOP and Active Satellites
- GSV: GNSS Satellites in View
- GLL: Geographic Position - Latitude and Longitude
- TXT: Text Transmission

For more details, please refer to ***document [1]***.

3.4.2. Standby Mode

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

There are two ways to enter/exit standby mode.

- **Through STANDBY pin**:

  Pulling STANDBY low forces the module enter standby mode and pulling it high makes the module return to full on mode again. Please note that pulling low STANDBY pin to ground will cause an extra current consumption of about 0.1 mA @ VCC = 3.3 V.

- **Through PMTK command**:

  The module will enter standby mode after sending PMTK command **$PMTK161,0*28**. Sending any data via UART will make the module exit standby mode. When the module exits standby mode, it will use all internal aiding information such as GNSS time, ephemeris and last position to ensure the fastest possible TTFF in hot/warm start.

In standby mode, the module consumes a current of about 0.9 mA @ VCC = 3.3 V.

NOTES

1. STANDBY is an edge-triggered pin. It is recommended to configure the host GPIO for STANDBY control into input before power on, so as to avoid entering standby mode unexpectedly when starting the module. After the module is powered on, the GPIO can be reset into output.
2. If STANDBY is unused, keep it open.

3.4.3. Backup Mode

The power consumption in backup mode is lower than that in standby mode. In backup mode, the module stops acquiring and tracking satellites. UART is not accessible. But the SRAM memory in RTC domain which contains all the necessary GNSS information for quick start-up and a small amount of user configuration variables is active. Due to the SRAM memory, EASY technology is available. The current consumption in this mode is about 8 μA @ VCC = 3.3 V.

There are two ways to enter/exit backup mode.

- Sending **$PMTK225,4*2F** command makes the module enter backup mode. In such a case, the only way to wake up the module is by pulling FORCE_ON high.
- Cutting off the power supply of VCC while keeping V_BCKP powered, the module will enter backup mode. As soon as the VCC power supply is restored, the module enters full on mode immediately.

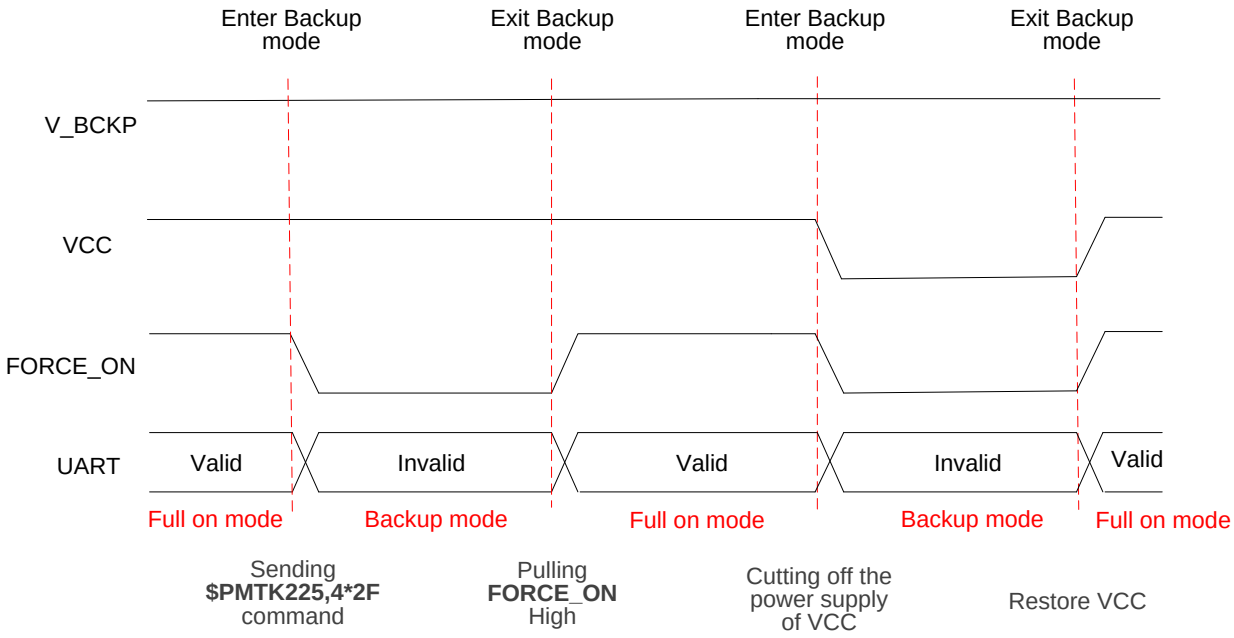

Figure 5: Timing of Entering/Exiting Backup Mode

NOTE

Before entering backup mode, please keep FORCE_ON open or low, otherwise the backup mode will be unavailable.

For details about internal power-system construction, please refer to ***Chapter 3.3.1***. The power can be supplied through V_BCKP pin with external capacitors and a rechargeable or non-chargeable battery. A reference design of RTC backup power supply is illustrated below.

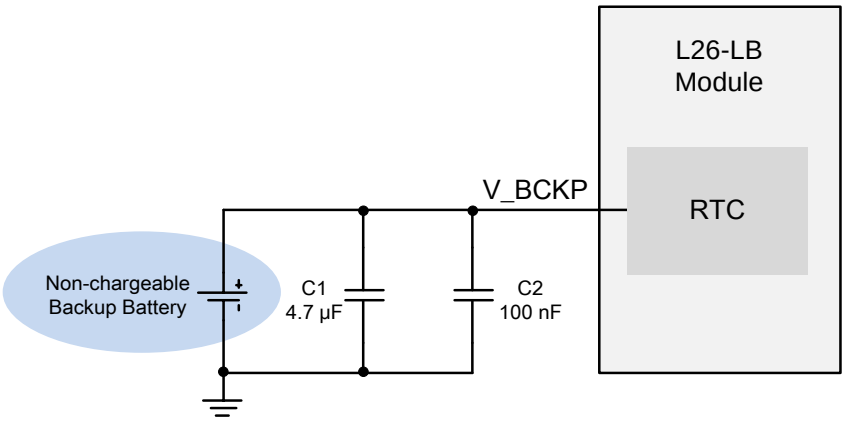

Figure 6: RTC Backup Power Supply (Non-chargeable Battery)

V_BCKP does not support battery charging function, therefore it is necessary to add a charging circuit when a rechargeable battery is applied. A reference circuit is provided below.

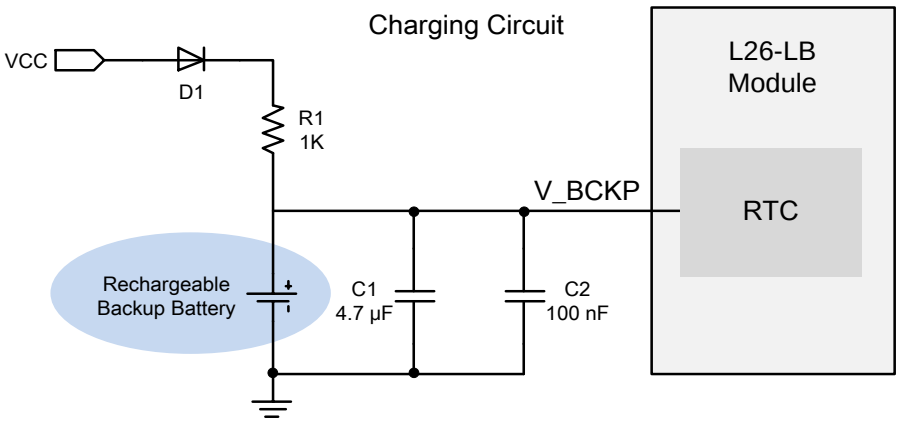

Figure 7: RTC Backup Power Supply (Rechargeable Battery)

Coin-type rechargeable capacitors from Seiko (http://www.sii.co.jp/en/) can be used and Schottky diodes from ON Semiconductor (http://www.onsemi.com/) are recommended due to their low voltage drop.

3.4.4. Periodic Mode

Periodic Mode achieves the balance between positioning accuracy and power consumption, and performance is a sacrifice compared to full on mode. In periodic mode, the module should be always supplied with power and it switches between full on mode and standby/backup mode periodically to reduce power consumption. Periodic Mode contains periodic standby mode and periodic backup mode.

The command illustrated in the table below enables the module to enter periodic mode.

Table 8: PMTK Command Format

Format: **$PMTK225,<Type>,<Run Time>,<Sleep Time>,<Second Run Time>,<Second Sleep Time>*<Checksum><CR><LF>**		
Parameter	**Format**	**Description**
Type	Decimal	**Type = 1** for periodic backup mode **Type = 2** for periodic standby mode
Run Time	Decimal	**Run Time** = Full on mode period (ms)
Sleep Time	Decimal	**Sleep Time** = Standby/Backup mode period (ms)

Second Run Time	Decimal	**Second Run Time** = Full on mode period (ms) for extended acquisition in case the module fails in acquisition during the **Run Time**
Second Sleep Time	Decimal	**Second Sleep Time** = Standby/Backup mode period (ms) for extended sleep in case the module fails in acquisition during the **Run Time**
Checksum	Hexadecimal	Hexadecimal checksum

Example

```
$PMTK225,2,3000,12000,18000,72000*15<CR><LF>
$PMTK225,1,3000,12000,18000,72000*16<CR><LF>
```

In periodic standby mode, sending **$PMTK225,0*2B** at any time will make the module enter full on mode.

In periodic backup mode, pulling FORCE_ON high and sending **$PMTK225,0*2B** immediately will make the module enter full on mode.

In periodic backup mode, sending **$PMTK225,0*2B** in **Run Time** or **Second Run Time** will also make the module enter full on mode. However, this method is not recommended as the exact time to send the command is difficult the control.

NOTES

1. Please keep STANDBY open or at high level before entering periodic standby mode, otherwise, the periodic standby mode will be unavailable.
2. Please keep FORCE_ON open or at low level before entering periodic backup mode, otherwise, the periodic backup mode will be unavailable.

The following figure illustrates the operation of periodic mode. After sending the PMTK command for entering periodic mode, the module enters and remains in full on mode for several minutes, after which it enters periodic mode and operate according to the parameters set in the PMTK command. If the module fails to fix the position in **Run Time**, it will switch to the **Second Run Time** and **Second Sleep Time** automatically. As long as it fixes the position again, it returns to **Run Time** and **Sleep Time**.

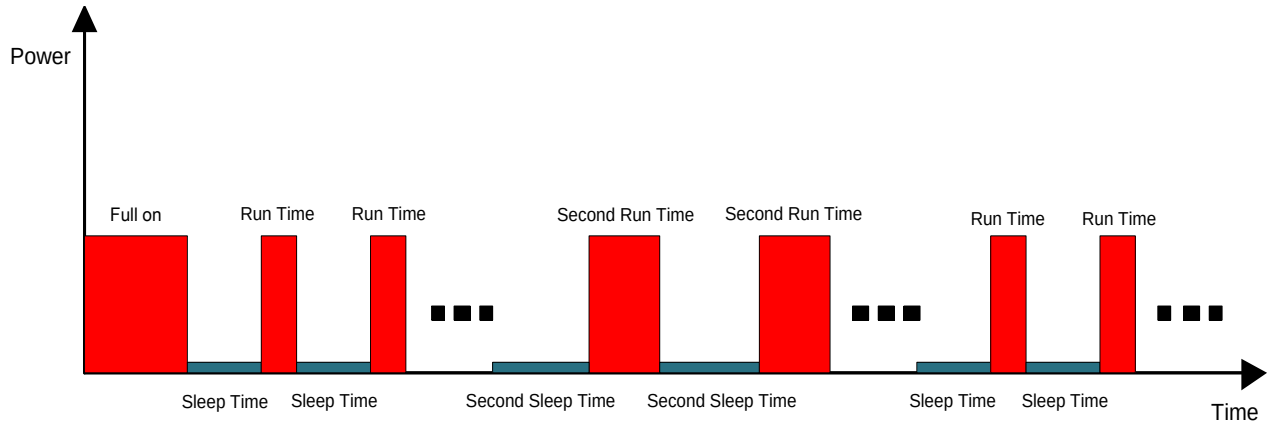

Figure 8: Periodic Mode

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

The average current value can be worked out with the following formula:

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

Example

- **PMTK225,2,3000,12000,18000,72000*15**

Periodic mode with 3 s in tracking mode and 12 s in standby mode based on GPS + GLONASS. The average current consumption is calculated below:
$I_{periodic} = (I_{tracking} \times T1 + I_{standby} \times T2)/(T1+T2) = (29 \times 3 + 0.9 \times 12)/(3 +12) \approx 6.52$ (mA)

- **PMTK225,1,3000,12000,18000,72000*16**

Periodic mode with 3 s in tracking mode and 12 s in backup mode based on GPS + GLONASS. The average current consumption is calculated below:
$I_{periodic} = (I_{tracking} \times T1 + I_{backup} \times T2)/(T1+T2) = (29 \times 3 + 0.008 \times 12)/(3 + 12) \approx 5.81$ (mA)

3.4.5. GLP Mode

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

In GLP mode, the module provides good positioning performance while operating in walking and running scenarios, and supports automatic dynamic duty operation switch for a balance on performance and power consumption. The module will be restored to normal mode in challenging environments to keep

good accuracy, thus realizing maximum performance with the lowest power consumption.

The average current consumption in GLP mode is down to 13.7 mA in static scenario, which is about 50% of that in normal mode. It may increase a little bit in dynamic scenario.

GLP mode entering/exiting:

- **$PQGLP,W,1,1*21**: The command is used to set the module into GLP mode. When **$PQGLP,W,OK*09** is returned, it means the module has entered GLP mode successfully.
- **$PQGLP,W,0,1*20**: The command is used to make the module exit GLP mode. When **$PQGLP,W,OK*09** is returned, it means the module has exited GLP mode successfully

NOTES

1. It is recommended to set all the necessary commands before the module enters GLP mode. If customers need to send commands, please exit from GLP mode first.
2. When the module enters GLP mode, 1PPS function will be disabled.
3. When the GLP mode is enabled, the SBAS will be affected.
4. In high dynamic scenario, the module will slightly decrease positioning accuracy in GLP mode.
5. The modules will automatically return to the normal mode in complex environments to keep good positioning accuracy.
6. It is recommended that 115200 bps baud rate and 1 Hz frequency are set before the module enters low power mode.

3.5. Reset

L26-LB module can be reset by driving RESET_N low for at least 10 ms and then releasing it. Please note that the resetting will force the loss of volatile RAM data, while the data in non-volatile backup RAM will not be cleared so that fast TTFF is still possible. An OC driver circuit shown as below is recommended to control RESET_N.

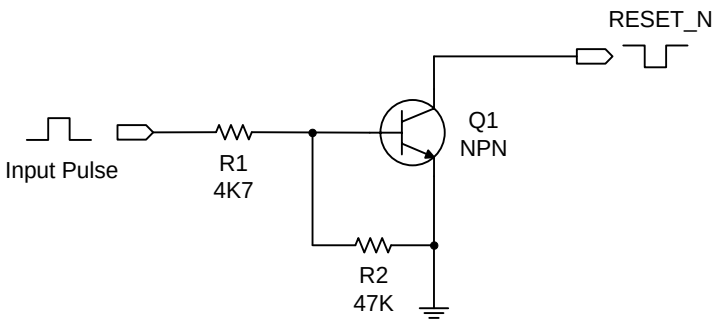

Figure 9: Reference OC Circuit for Module Reset

The following figure shows the reset timing of L26-LB module.

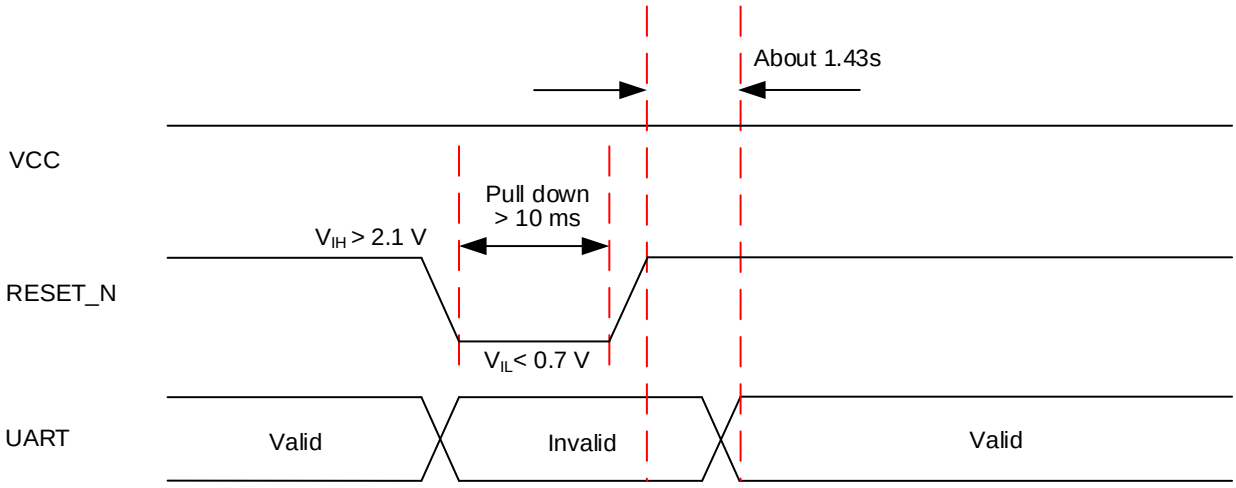

Figure 10: Reset Timing

3.6. UART Interfaces

L26-LB provides one universal asynchronous receiver & transmitter serial port. The UART port has the following features:

- Support NMEA sentences output, PMTK/PQ commands input and firmware upgrade.
- Default output type of NMEA sentences: RMC, VTG, GGA, GSA, GSV, GLL and TXT.
- Supported baud rates: 9600 bps, 14400 bps, 19200 bps, 38400 bps, 57600 bps, 230400 bps, 460800 bps and 921600 bps.
  The default setting is 9600 bps, 8 bits, no parity bit, 1 stop bit.
- Hardware flow control and synchronous operation are not supported.

The module is designed as DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the signals shown in the following figure.

Table 9: Pin Definition of UART Interface

Pin Name	Pin No.	I/O	Description	Comment
UART_TX	20	DO	Transmit data to the RX signal of DTE	The UART port is used for NMEA sentences output, PMTK/PQ commands input and firmware upgrade.
UART_RX	21	DI	Receive data from the TX signal of DTE	

A reference design of 3.3 V level match is shown as below. If the host is a 3.0 V system, please change the 5.6 kΩ resistor to a 10 kΩ one.

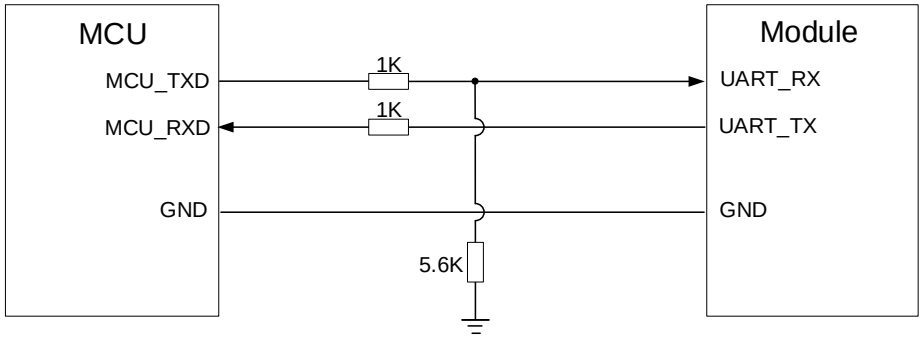

Figure 11: Reference Design of UART Interface

The UART port does not support the RS-232 level but only CMOS level. If the module's UART port is connected to the UART port of a computer, it is necessary to add a level shift circuit between the module and the computer. A reference design is provided below.

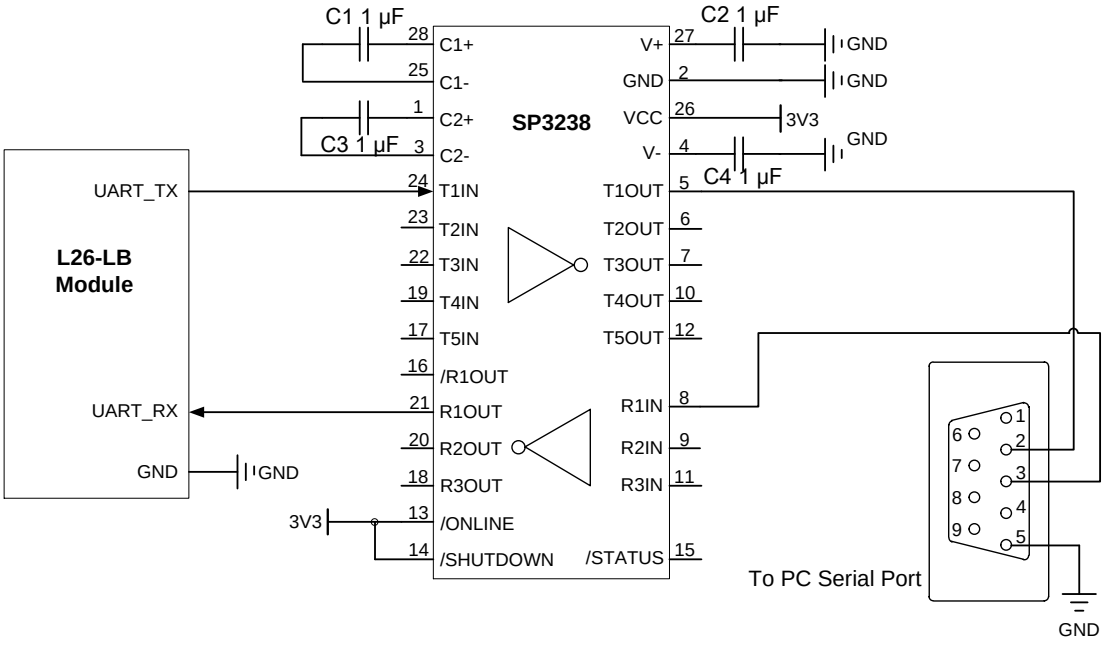

Figure 12: RS-232 Level Shift Circuit

3.7. I2C Interface (Optional)

L26-LB provides an I2C interface with a dedicated firmware version. The interface can be used to output NMEA sentences and receive PMTK/PQ commands.
I2C interface features:

- Support fast mode, with bit rate up to 400 kbps.
- Support 7-bit address.
- Operate in slave mode.
- Default I2C address values are: Write: 0x20, Read: 0x21.

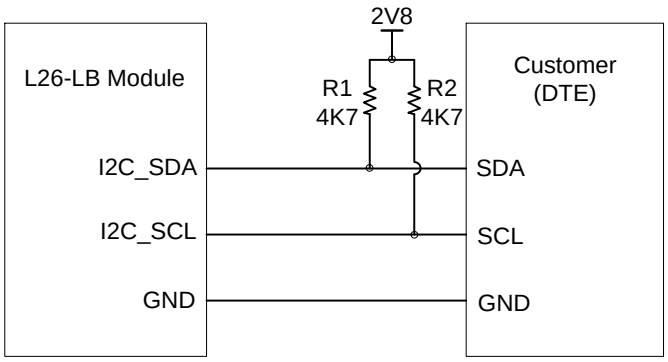

Figure 13: Reference Design of I2C Interface

NOTES

1. The power domain of I2C interface is 2.8V. If the system voltage does not match, a voltage-level shifter circuit must be designed.
2. I2C interface is supported only on firmware versions ended with “SC”. In other firmware versions, I2C_SDA and I2C_SCL pins are used for RTCM data input. When I2C interface is supported, NEMA data should be outputted via I2C interface rather than UART interface, otherwise there maybe NEMA data loss.

3.8. EASY™ Autonomous AGNSS Technology

L26-LB supports EASY™ technology which provides assistant information such as ephemeris, almanac, rough last position, time, and satellite status to improve TTFF and acquisition sensitivity of GNSS modules.

EASY™ technology works as embedded software to accelerate TTFF by predicting satellite navigation

messages from received ephemeris. After receiving the broadcast ephemeris for the first time, the GNSS engine will calculate and predict orbit information up to the subsequent 3 days automatically and save the predicted information into the internal memory. The GNSS engine will use the information for positioning in the case of no enough information from satellites. Therefore, the function improves positioning and TTFF.

EASY™ function reduces TTFF to 9 s (average value within 500 tests) in warm start. In this case, the RTC domain should be valid. In order to obtain enough broadcast ephemeris information from GNSS satellites, the GNSS module should receive the information for at least 5 minutes in strong-signal environments after it fixes the position.

EASY™ function is enabled by default. **$PMTK869,1,0*34** command can be used to disable the function. For more details, please refer to the ***document [1].***

3.9. EPO Offline AGNSS Technology

L26-LB features a leading AGNSS technology called EPO (Extended Prediction Orbit). It is a free service provided by Quectel, which can achieve fast TTFF and improve accuracy in weak signal conditions. Customers must know the current UTC time to download the current valid EPO files. Through EPO data downloaded from EPO servers, the function provides up to 30-day's orbit predictions to speed up TTFF.

The following are download URLs of EPO Files:

Table 10: Download URLs of EPO Files

EPO Type	GNSS Type	EPO File URL Example	File Name
Unified QEPO URL	GPS only	http://wpepodownload.mediatek.com /QGPS.DAT?vendorinfo	Single name: QGPS.DAT
Unified QEPO URL	GPS + GLONASS	http://wpepodownload.mediatek.com /QG_R.DAT?vendorinfo	Single name: QG_R.DAT
EPO	GPS only	http://wpepodownload.mediatek.com */EPO_GPS_3_X.DAT?vendorinfo*	X = 1–10 EPO_GPS_3_1.DAT to EPO_GPS_3_10.DAT
EPO	GPS + GLONASS	http://wpepodownload.mediatek.com */EPO_GR_3_X.DAT?vendorinfo*	X = 1–10. EPO_GR_3_1.DAT to EPO_GR_3_10.DAT

The following shows a complete URL sample:
http://wpepodownload.mediatek.com/QGPS.DAT?vendor=AAA&project=BBB&device_id=CCC

- The query string starts with "**?**" and separated by "**&**".
- The values of "**vendor**" and "**project**" (**AAA**, **BBB** in the example) are issued by Quectel. Please contact Quectel Technical Support to get the values.
- The value of "**device_id**" (**CCC** in the example) is assigned by the vendor, and each device must have its own unique ID. For example: if **CCC=XXX_YYY**, please contact Quectel Technical Support to get the value of **XXX**, while **YYY** can be assigned by customers and it must be a unique value, such as IMEI.

NOTE

Slices of 30 days EPO:
3 days for each file and up to 30 days.
_1 for days 1 to 3,
_2 for days 4 to 6,
...
_10 for days 28 to 30.

3.10. Multi-tone AIC

L26-LB features a function called multi-tone AIC (Active Interference Cancellation) to decease harmonic of RF noise from Wi-Fi, Bluetooth, 2G, 3G, 4G and 5G.

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

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

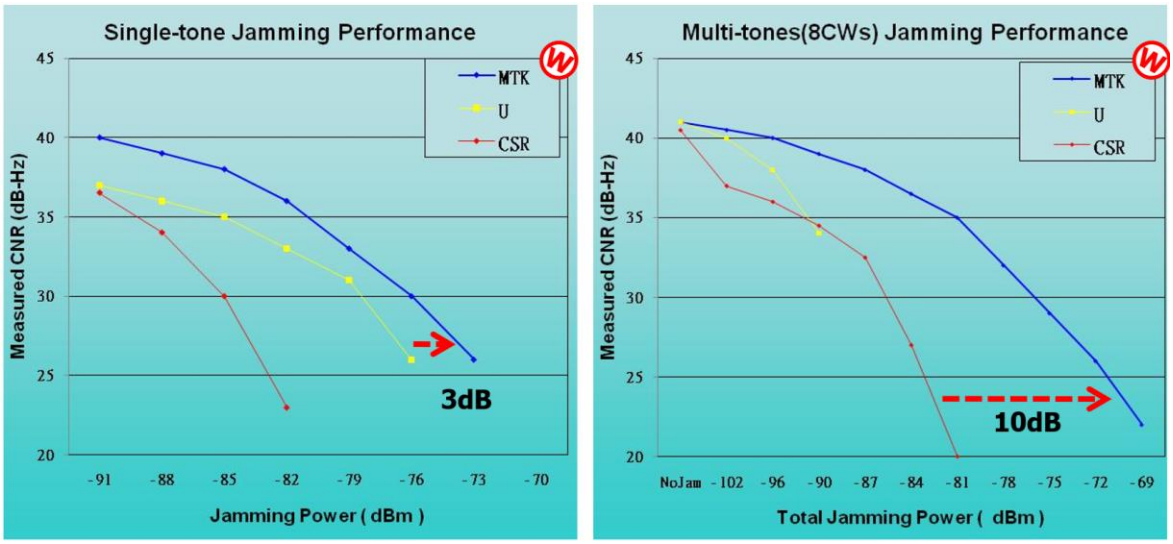

Figure 14: Anti-Jamming Performance by the AIC

AIC function is enabled by default. Enabling AIC function will increase current consumption of about 1 mA @ VCC = 3.3 V. The following commands can be used to set AIC function.

- Enable AIC function: **$PMTK 286,1*23**
- Disable AIC function: **$PMTK 286,0*22**

3.11. LOCUS

L26-LB supports the embedded logger function called LOCUS. It can log position information to the internal flash memory automatically when this function is enabled with **$PMTK185,0*22**. Due to this function, the host can enter sleep mode to save power consumption and does not need to receive the NMEA information all the time. The module provides a log capacity of more than 16 hours. **$PMTK183*38** can be used to query the current state of LOCUS.

The detailed procedures of this function are illustrated below:

- The module fixes the position (only available in 3D fixed scenario).
- Send PMTK command **$PMTK184,1*22** to erase the internal flash.
- Send PMTK command **$PMTK185,0*22** to start logging.
- The module logs the basic information (UTC time, latitude, longitude and height) every 15 seconds to the internal flash memory.
- Stop logging the information by sending **$PMTK185,1*23**.
- Send **$PMTK622,1*29** command via UART to the module to get the data .

The LOCUS log acquired by the host has to be parsed via LOCUS parsing code provided by Quectel. For more details, please contact Quectel Technical Support.

3.12. PPS VS. NMEA

Pulse per Second (PPS) VS. NMEA can be used for time service. The latency range is 465–485 ms between the beginning of UART_TX and the rising edge of PPS.

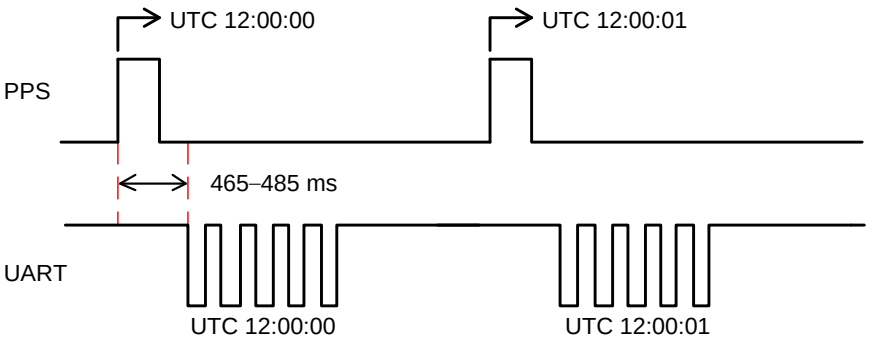

Figure 15: PPS VS. NMEA Timing

The feature only supports 1 Hz NMEA sentences output and baud rates from 14400 to 115200 bps. When the baud rate is 9600 bps, only RMC NMEA sentence output is supported.

- Enable the function: **$PMTK255,1*2D**
- Disabled the function: **$PMTK255,0*2C**

4 Antenna Interfaces

L26-LB supports GPS and GLONASS systems by default. The RF signal is obtained from the RF_IN pin. The impedance of RF trace should be controlled to 50 Ω, and the trace length should be kept as short as possible.

4.1. Recommended Antenna Specifications

L26-LB receives GNSS satellite signals through an external passive or active GNSS antenna. The recommended antenna specifications are given in the following table.

Table 11: Recommended Antenna Specifications

Antenna Type	Specification
Passive Antenna	Frequency Range: 1559–1609 MHz VSWR: < 2 (Typ.) Polarization: RHCP Passive Antenna Gain: > 0 dBi
Active Antenna	Frequency Range: 1559–1609 MHz VSWR: < 2 (Typ.) Polarization: RHCP Passive Antenna Gain: > 0 dBi Active Antenna Noise Figure: < 1.5 dB Active Antenna Total Gain: < 17 dB (Typ.)

NOTE

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

4.2. Antenna Interface Reference Designs

Both active and passive GNSS antennas can be used for L26-LB module.

4.2.1. Active Antenna without Antenna Status Detection

The following figure is a typical reference design of active antenna without antenna status detection. In the design, the antenna is powered by the VCC_RF. The antenna can also be powered by an external power supply (3.3 V typ.).

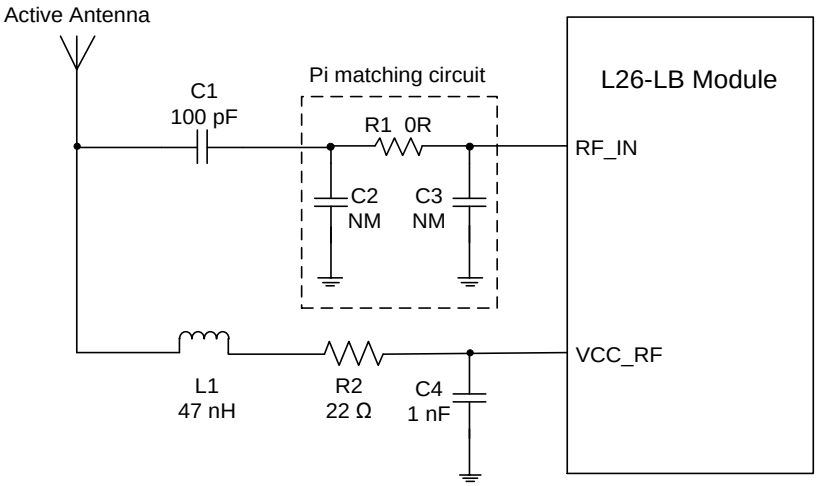

Figure 16: Reference Design of Active Antenna (Without Antenna Status Detection)

NOTE

R2 in the above design is a must, otherwise the module may be damaged permanently because of the possible short-circuit of the active antenna.

4.2.2. Active Antenna with Antenna Status Detection

The following figure is a typical reference design of active antenna with antenna status detection. In this design, antenna short-circuit can be detected. Upon detection of short-circuit, the antenna power supply will be immediately shut down.

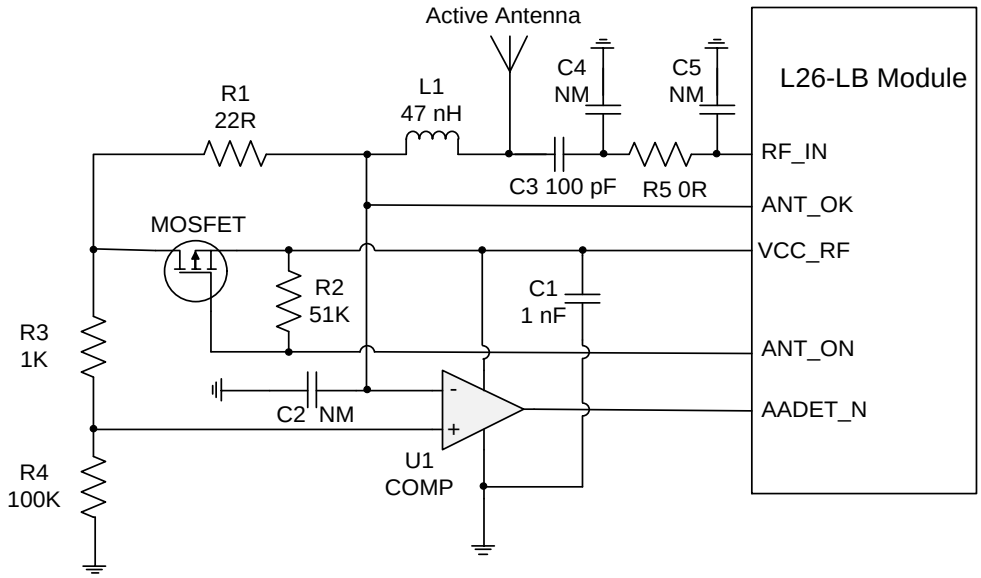

Figure 17: Reference Design of Active Antenna (With Antenna Status Detection)

NOTES

1. R1 in the above design is a must, otherwise the module may be damaged permanently because of the possible short-circuit of the active antenna.
2. U1 is a universal open-drain output comparator, and ADCMP370 of Analog Devices is recommended. More details can be found at https://www.analog.com/cn/products/adcmp370.html.

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

Table 12: Active Antenna Detection Circuit Control Logic

Detection Pin		Control Pin	Antenna Status
ANT_OK	AADET_N	ANT_ON	
1	1	0	Normal
1	0	0	Open-circuit
0	/	1	Short-circuit

The ANT_ON pin can cut off the power supply to the external antenna whenever it is not needed. This feature helps reduce power consumption in power saving mode.

4.2.3. Passive Antenna

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

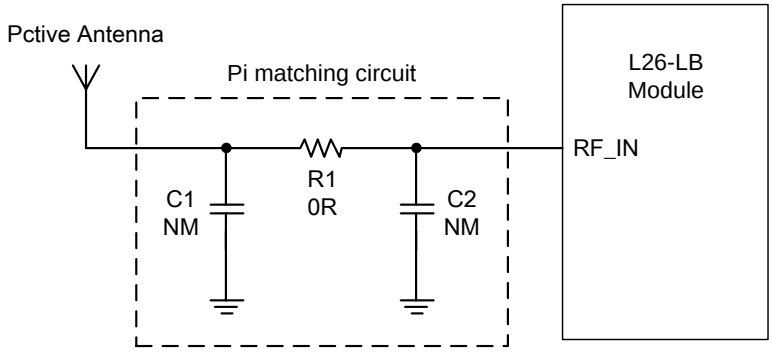

Figure 18: Reference Design of Passive Antenna

C1, C2 and R1 are reserved matching circuit for antenna impedance modification. By default, R1 is 0 Ω, while C1 and C2 are not mounted. The impedance of RF trace should be controlled to 50 Ω and the trace length should be kept as short as possible.

5 Electrical, Reliability and Radio Characteristics

5.1. Absolute Maximum Ratings

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

Table 13: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
Power Supply Voltage (VCC)	-0.3	4.3	V
Backup Battery Voltage (V_BCKP)	-0.3	4.5	V
Input Voltage at Digital Pins	-0.2	3.1	V
Input Power at RF_IN (P_{RF_IN})		15	dBm
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 utilize appropriate protection diodes to keep voltage spikes within the parameters given in the table above.

5.2. Operation Conditions

Table 14: Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VCC	Supply voltage	The actual input voltages must be kept between the minimum and maximum values.	2.8	3.3	4.3	V
I_{VCCP}	Peak supply current	VCC = 3.3 V			100	mA
V_BCKP	Backup voltage supply		1.5	3.3	4.5	V
T_{OPR}	Full on mode operation temperature		-40	+25	+85	°C

NOTES

1. The values above can be used to determine the maximum current capability of power supply.
2. Operation beyond the "Operation Conditions" is not recommended and extended exposure beyond the "Operation Conditions" may affect device reliability.

5.3. ESD Protection

L26-LB is an ESD sensitive device. ESD protection precautions should be emphasized. Proper ESD handling and packaging procedures must be applied throughout processing, handling and operation of any application that incorporates the module.

Please note that the following measures are beneficial to ESD protection when L26-LB is handled.

- The first contact point shall always be between the local GND and PCB GND when handling the PCB, unless there is a galvanic coupling between the local GND and the PCB GND.
- While mounting the module onto a motherboard, please make sure the GND is connected first and then the RF_IN pad.
- Do not contact any charged capacitors or materials which may easily generate or store charges (such as patch antenna, coaxial cable, soldering iron, etc.) when handling the RF_IN pad.
- To prevent electrostatic discharge from the RF input, please do not touch any exposed area of the mounted patch antenna.
- Be sure to use an ESD safe soldering iron (tip) when soldering the RF_IN pin.

6 Mechanical Dimensions

This chapter describes the mechanical dimensions of L26-LB module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.05 mm unless otherwise specified.

6.1. Mechanical Dimensions

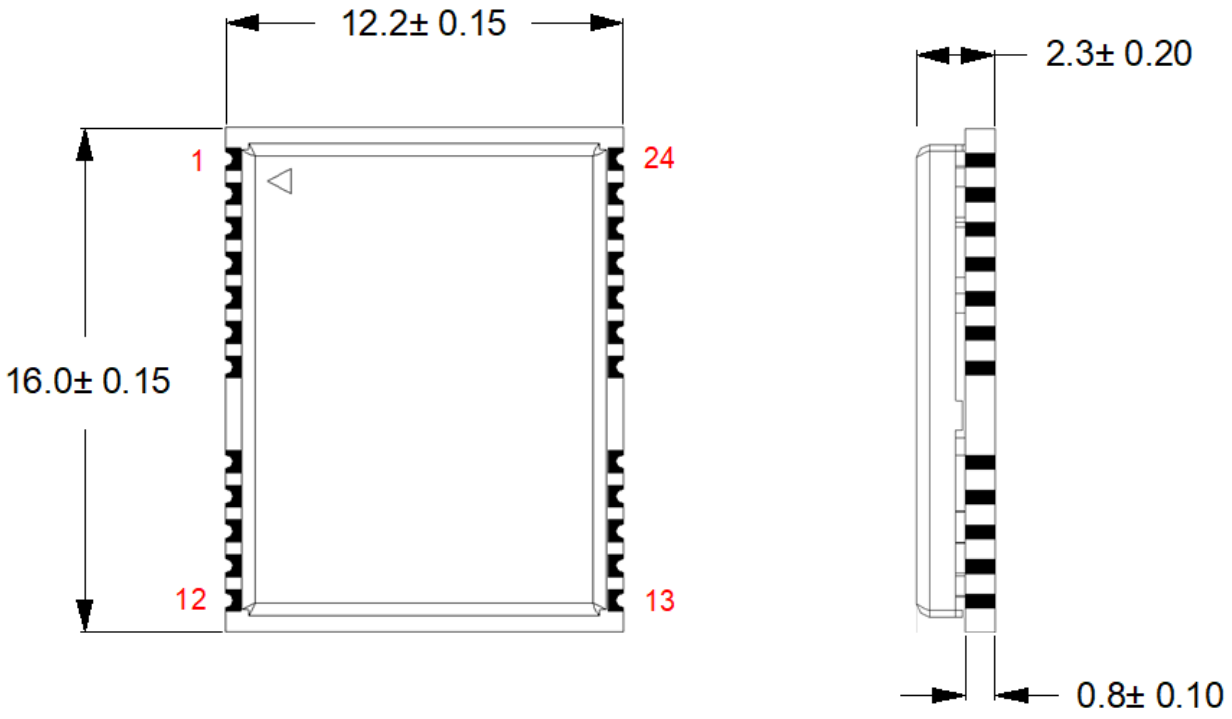

Figure 19: Top and Side Dimensions

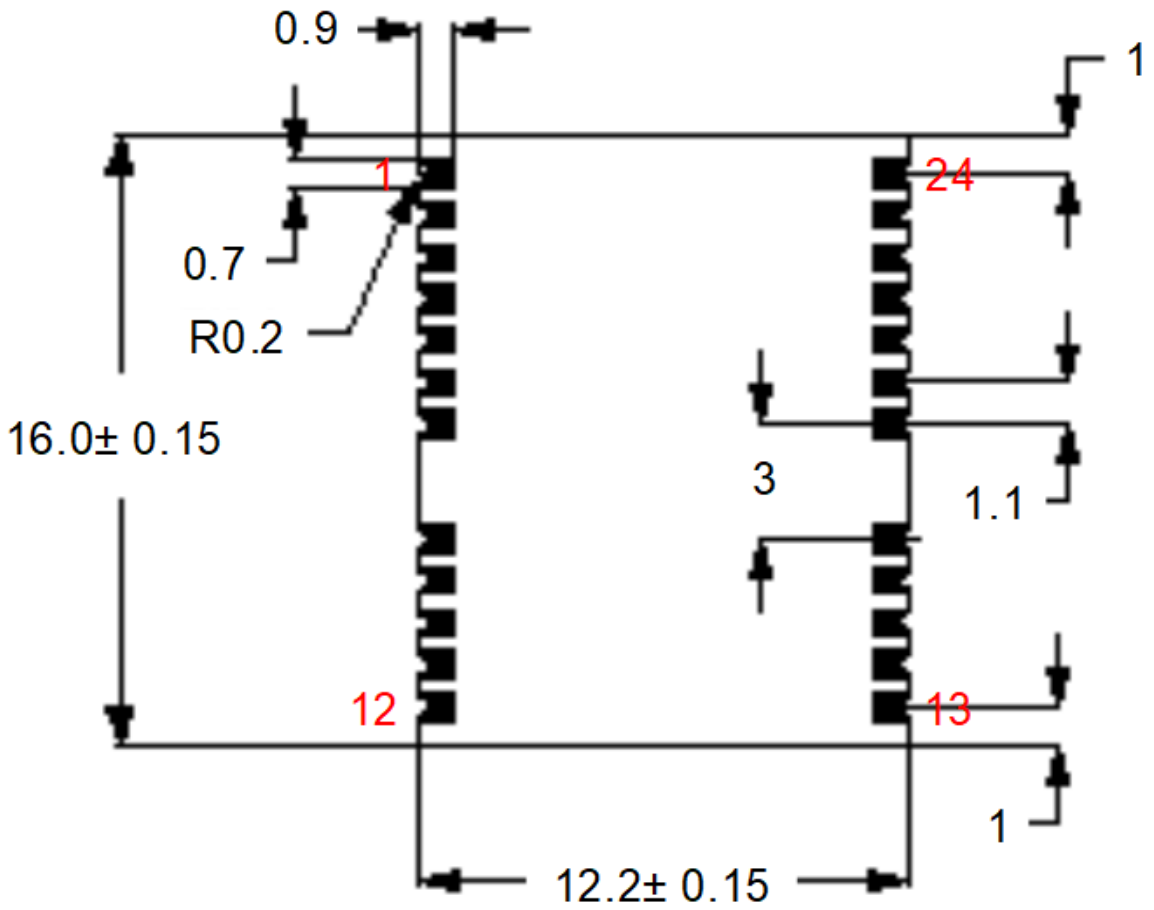

Figure 20: Bottom Dimensions

NOTE

The package warpage level of L26-LB module conforms to JEITA ED-7306 standard.

6.2. Recommended Footprint

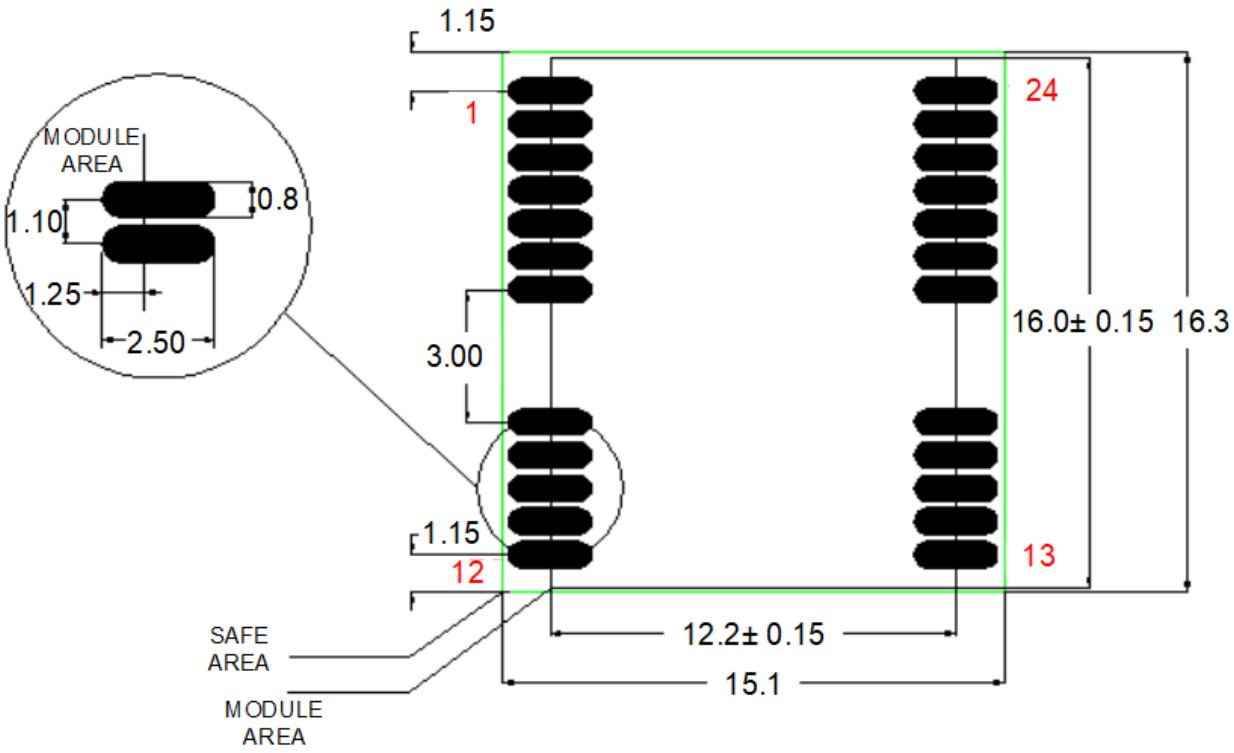

Figure 21: Recommended Footprint

NOTE

For easy maintenance of this module, it is recommended to keep a distance of no less than 3 mm between the module and other components on the motherboard.

6.3. Top and Bottom Views

Figure 22: Top View of the Module

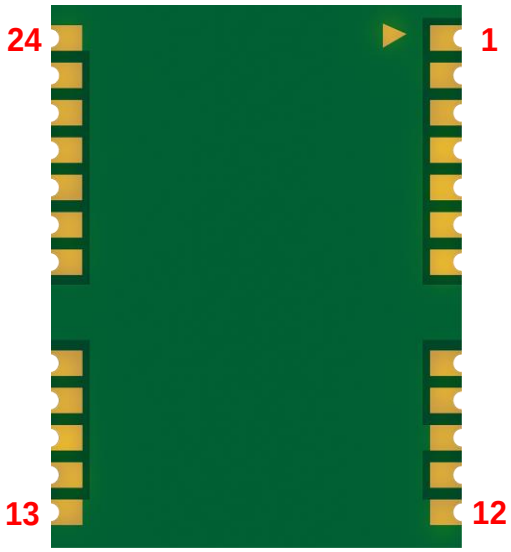

Figure 23: Bottom View of the Module

NOTE

These are renderings of L26-LB module. For authentic appearance, please refer to the module received from Quectel.

7 Storage, Manufacturing and Packaging

7.1. Storage

L26-LB is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

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

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

3. The floor life of the module is 24 hours in a plant where the temperature is 23 ±5 °C and relative humidity is below 60%. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 24 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10% (e.g. a drying cabinet).

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

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

5. If needed, the pre-baking should follow the requirements below:

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

NOTE

Please take the module out of the packaging and put it on high-temperature resistant fixtures before the baking. If shorter baking time is desired, please refer to *IPC/JEDEC J-STD-033* for baking procedure.

7.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. The force on the squeegee should be adjusted properly so as to produce a clean stencil surface on a single pass. To ensure the module soldering quality, the thickness of stencil for the module is recommended to be 0.15–0.18 mm. For more details, please refer to ***document [4]***.

It is suggested that the peak reflow temperature is 238–246 ºC, and the absolute maximum reflow temperature is 246 ºC. To avoid damage to the module caused by repeated heating, it is strongly recommended that the module should be mounted after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

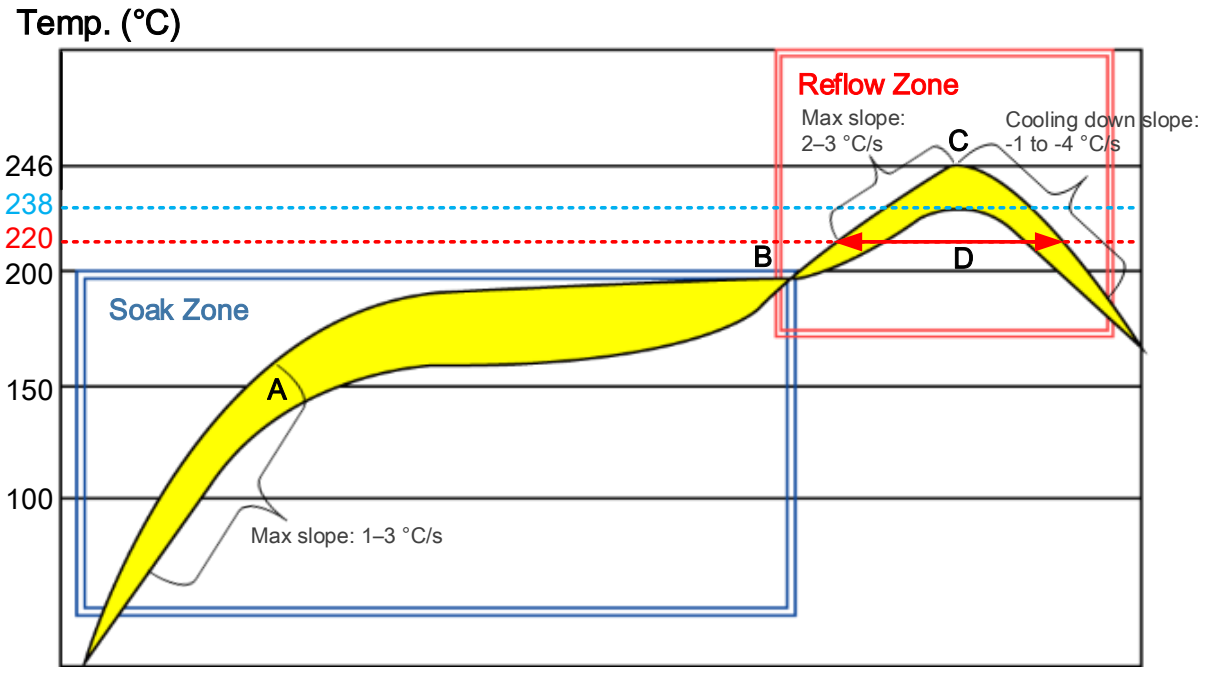

Figure 24: Recommended Reflow Soldering Thermal Profile

Table 15: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Max slope	1–3 °C/s
Soak time (between A and B: 150°C and 200°C)	70–120 s
Reflow Zone	
Max slope	2–3 °C/s
Reflow time (D: over 220°C)	45–70 s
Max temperature	238–246 °C
Cooling down slope	-1 to -4 °C/s
Reflow Cycle	
Max reflow cycle	1

NOTES

1. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.
2. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.

7.3. Tape and Reel Packaging

L26-LB is packaged in tape and reel carriers. One reel is 6.82 meters long and contains 250 modules.

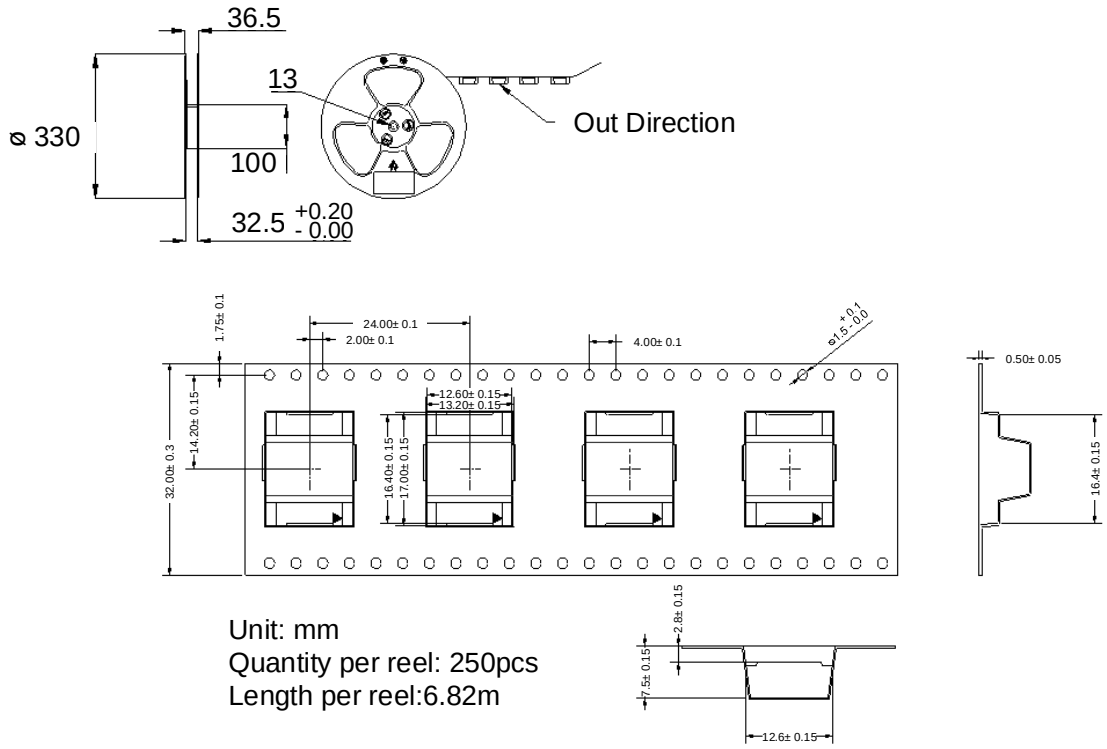

Figure 25: Tape and Reel Specifications

Table 16: Packaging Specifications

MOQ for MP	Minimum Package: 250	Minimum Package × 4 = 1000
250	Size: 370 mm × 350 mm × 56 mm N.W: 0.25 kg G.W: 1.1 kg	Size: 380 mm × 250 mm × 365 mm N.W: 1.0 kg G.W: 4.4 kg

8 Appendix A References

Table 17: Related Documents

SN	Document Name	Remark
[1]	Quectel_L26-LB&L76-LB&LC86L_GNSS_Protocol_Specification	GNSS Protocol Specification for L26-LB, L76-LB and LC86L
[2]	Quectel_L26-LB_EVB_User_Guide	L26-LB EVB User Guide
[3]	Quectel_L26-LB_Reference_Design	L26-LB Reference Design
[4]	Quectel_Module_Secondary_SMT_Application_Note	Module Secondary SMT Application Note
[5]	Quectel_GNSS_SDK_Commands_Manual	GNSS Module SDK Commands Manual

Table 18: Terms and Abbreviations

Abbreviation	Description
AGNSS	Assisted GNSS
AIC	Active Interference Cancellation
CEP	Circular Error Probable
DGPS	Differential GPS
EASY™	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
EMC	Electromagnetic Compatibility
EPO	Extended Prediction Orbit
ESD	Electro-Static Discharge
GPS	Global Positioning System
GNSS	Global Navigation Satellite System

GGA	Global Positioning System Fix Data
GLL	Geographic Position – Latitude/Longitude
GSA	GNSS DOP and Active Satellites
GSV	GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
IC	Integrated Circuit
I/O	Input /Output
Kbps	Kilo Bits Per Second
LNA	Low Noise Amplifier
MSAS	Multi-Functional Satellite Augmentation System
NMEA	National Marine Electronics Association
PDOP	Position Dilution of Precision
PMTK	MTK Proprietary Protocol：
PMU	Power Management Unit
PPS	Pulse Per Second
PQ	Quectel Proprietary Protocol
PRN	Pseudo Random Noise Code
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RHCP	Right Hand Circular Polarization
RMC	Recommended Minimum Specific GNSS Data
RTC	Real Time Clock
RTCM	Radio Technical Commission for Maritime Services
SAW	Surface Acoustic Wave
SBAS	Satellite-based Augmentation System
SRAM	Static Random Access Memory

SV	Satellite Vehicle
TCXO	Temperature Compensate X'tal (crystal) Oscillator
TXT	Text Transmission
UART	Universal Asynchronous Receiver & Transmitter
VDOP	Vertical Dilution of Precision
VTG	Course over Ground and Ground Speed
WAAS	Wide Area Augmentation System
Imax	Maximum Load Current
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
V_{IH}max	Maximum Input High Level Voltage Value
V_{IH}min	Minimum Input High Level Voltage Value
V_{IL}max	Maximum Input Low Level Voltage Value
V_{IL}min	Minimum Input Low Level Voltage Value
$V_I$max	Absolute Maximum Input Voltage Value
$V_I$min	Absolute Minimum Input Voltage Value