L26 Hardware Design

GNSS Module Series

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About the Document

History

Revision	Date	Author	Description
1.0	2013-05-08	King HAO	Initial
1.1	2014-05-10	Tony GAO	1. Modified the input power at RF_IN. 2. Changed the tracking sensitivity to -167dBm.
1.2	2014-06-11	Tony GAO	Updated packaging information.
1.3	2014-12-23	King HAO	Updated series resistance between VCC_RF and V_ANT in Figure 14 &16.

Contents

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1 Introduction

This document defines and specifies L26 GNSS module. It describes L26 module's hardware interface and its external application reference circuits, mechanical size and air interface.

This document can help you quickly understand the interface specifications, electrical and mechanical details of L26 GNSS module. We also offer you other documents such as L26 software application notes and user guider. These documents can ensure you use L26 module to design and set up applications quickly.

2 Product Concept

2.1. General Description

L26 is a single GPS and GLONASS receiver module with the embedded LNA. It is able to achieve the industry's highest level of sensitivity, accuracy and TTFF with the lowest power consumption. The embedded flash memory provides capacity for storing user-specific configurations and allows for future updates.

The L26 GNSS module supports multiple positions and navigation systems including autonomous GPS, GLONASS, SBAS (including WAAS, EGNOS, MSAS and GAGAN), QZSS, and AGPS.

Embedded with many advanced power saving modes including periodic, AlwaysLocate™, standby and backup mode, L26 GNSS module has excellent low-power consumption in different scenes.

EASY technology, as the key feature of L26, is one kind of AGPS. Collecting and processing all internal aiding information like GPS time, Ephemeris, Last Position etc, the GNSS module will have a fast TTFF in either Hot or Warm start.

L26 module supports active antenna detection and short protection. The antenna status will be shown in the NMEA message, so host can query the antenna status timely and conveniently.

L26 GNSS module is an SMD type module with the compact 16mm × 12.2mm × 2.4mm form factor, which can be embedded in your applications through the 24-pin pads. It provides necessary hardware interfaces between the module and main board.

The module is fully ROHS compliant to EU regulation.

2.2. Key Features

Table 1: Features

Feature	Implementation
GNSS	● GPS&GLONASS
Power Supply	● Supply voltage: 2.8V~4.3V Typical voltage: 3.3V
Power Consumption**(NOTE)**	● Acquisition: 26mA @VCC=3.3V (GPS) ● Tracking: 18mA @VCC=3.3V (GPS) ● Acquisition: 29mA @VCC=3.3V (GPS+GLONASS) ● Tracking: 21mA @VCC=3.3V (GPS+GLONASS) ● Standby: 350uA @VCC=3.3V ● Backup: 7uA @V_BCKP=3.3V
Receiver Type	● GPS L1 1575.42MHz C/A Code ● GLONASS L1 1598.0625~1605.375 C/A Code
Sensitivity (Embedded LNA)	● Acquisition: -148dBm ● Re-acquisition: -160dBm ● Tracking: -167dBm
TTFF (EASY Enabled)	● Cold start: <15s typ. @-130dBm ● Warm start: <5s typ. @-130dBm ● Hot start: 1s @-130dBm
TTFF (EASY Disabled)	● Cold start (Autonomous): <35s typ. @-130dBm ● Warm start (Autonomous): <30s typ. @-130dBm ● Hot start (Autonomous): 1s @-130dBm
Horizontal Position Accuracy (Autonomous)	● <2.5 m CEP @-130dBm
Update Rate	● Up to 10Hz, 1Hz by default
Accuracy of 1PPS Signal	● Typical accuracy <15ns (Time service is not supported) ● Time pulse width 100ms
Velocity Accuracy	● Without aid: 0.1m/s
Acceleration Accuracy	● Without aid: 0.1m/s²
Dynamic Performance	● Maximum altitude: 18,000m ● Maximum velocity: 515m/s Maximum ● Acceleration: 4G
UART Port	● UART port: TXD1 and RXD1 ● Supports baud rate from 4800bps to 115200bps, 9600bps by default ● UART port is used for NMEA output, MTK proprietary messages input and firmware upgrade

Temperature Range	● Normal operation: -40°C ~ +85°C ● Storage temperature: -45°C ~ +125°C
Physical Characteristics	● Size: 16±0.15 × 12.2±0.15 × 2.4±0.1mm ● Weight: Approx. 1.0g

NOTE

Measured at update rate 1Hz, and EASY, AIC and SBAS are enabled.

2.3. Block Diagram

The following figure shows a block diagram of L26 GNSS module. It consists of a single chip GNSS IC which includes RF part and Baseband part, a LNA, a SAW filter, a TCXO, a crystal oscillator and a short detection and protection circuit for active antenna.

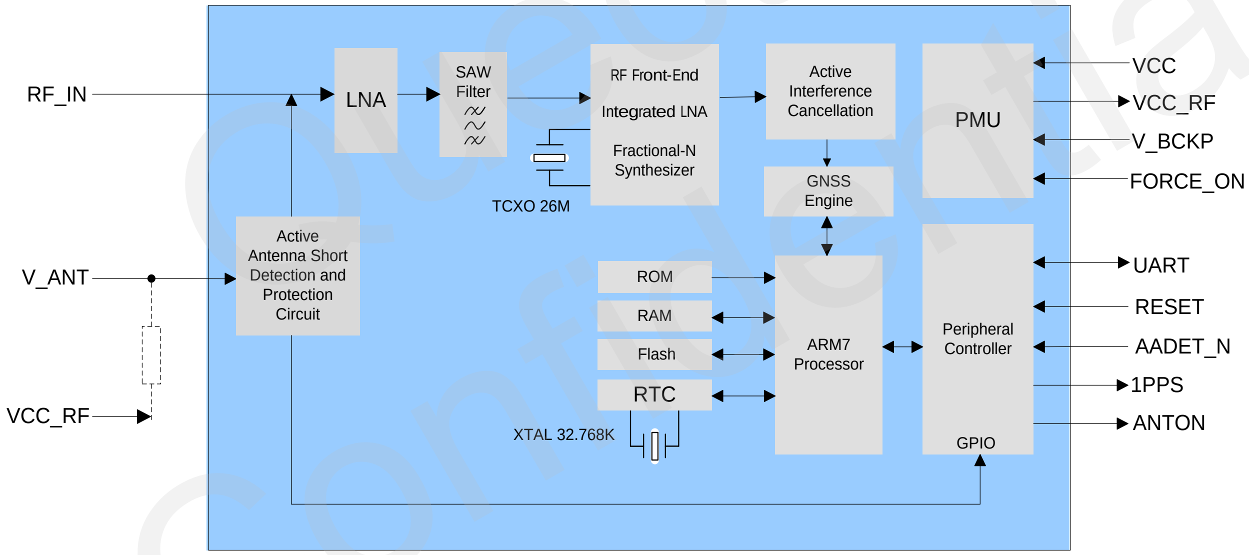

Figure 1: Block Diagram

2.4. Evaluation Board

In order to help you use L26 GNSS module on your applications, Quectel supplies an Evaluation Board (EVB) with micro USB serial cable, active antenna and other peripherals to test the module.

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

2.5. The Protocols Module Supports

Table 2: The Protocols Supported by the Module

Protocol	Type
NMEA	Input/output, ASCII, 0183, 3.01
PMTK	Input, MTK proprietary protocol

NOTE

Please refer to ***document [2]*** about NMEA standard protocol and MTK proprietary protocol.

3 Application

The module is equipped with a 24-pin 1.1mm pitch SMT pad that connects to your application platform. Sub-interfaces included in these pads are described in details in the following chapters.

3.1. Pin Assignment

Figure 2: Pin Assignment

3.2. Pin Definition

Table 3: Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VCC	23	I	Main power supply	Vmax=4.3V Vmin=2.8V Vnom=3.3V	Supply current of no less than 150mA.

V_BCKP	22	I	Backup power supply	Vmax=4.5V Vmin=1.5V Vnom=3.3V	Supply power for RTC domain when VCC is powered off.
VCC_RF	9	O	Power supply for external RF components	Vmax=4.3V Vmin=2.8V Vnom=3.3V	Usually supply power for external active antenna or LNA. If unused, keep this pin open. VCC_RF≈VCC
V_ANT	6	I	Active antenna bias voltage		Connect to GND (or leave open) if passive antenna is used. If an active antenna is used, add a 1Ω resistor in front of V_ANT input to the antenna bias voltage or VCC_RF.
Reset					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RESET	8	I	System reset	VILmin=-0.3V VILmax=0.7V VIHmin=2.1V VIHmax=3.1V	Low level active. If unused, keep this pin open or connect it to VCC.
UART Port					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RXD1	21	I	Receive data	VILmin=-0.3V VILmax=0.7V VIHmin=2.1V VIHmax=3.1V	
TXD1	20	O	Transmit data	VOLmax=0.42V VOHmin=2.4V VOHnom=2.8V	
RF Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RF_IN	11	I	RF signal input	Characteristic impedance of 50Ω	Refer to ***Chapter 4***
Other Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
ANTON	14	O	Active antenna power control pin in power	VOLmax=0.42V VOHmin=2.4V VOHnom=2.8V	If unused, keep this pin open.

			saving mode		
AADET_N	5	I	Active antenna detection	VILmin=-0.3V VILmax=0.7V VIHmin=2.1V VIHmax=3.1V	Logic High: Active antenna is unconnected; Logic Low: Active antenna is connected well. If unused, keep this pin open.
1PPS	3	O	One pulse per second	VOLmax=0.42V VOHmin=2.4V VOHnom=2.8V	Synchronized at rising edge, the pulse width is100ms. If unused, keep this pin open.
FORCE_ON	1	I	Logic high will force module to be waked up from backup mode	VILmin=-0.3V VILmax=0.7V VIHmin=2.1V VIHmax=3.1V	Keep this pin open or pulled low before entering into backup mode. It belongs to RTC domain. If unused, keep this pin open.
RESERVED	4,15,16, 18,19				Keep these pins open.

3.3. Power Supply

VCC pin supplies power for BB, RF, I/O and RTC domain. The load current of VCC varies according to the VCC level, processor load and satellites acquisition. Typical VCC peak current may reach to 45mA during module acquisition after power up. So it is important to supply sufficient current and make the power clean and stable. VCC supply ripple voltage should meet the requirement: 54mV (RMS) max @ f=0… 3MHz and 15mV (RMS) max @f>3MHz. You should choose the LDO without built-in output high-speed discharge function to keep long output voltage drop-down period. The decouple combination of 10uF and 100nF capacitor is recommended nearby VCC pin.

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

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

VCC pin not only supplies power for PMU but also for VCC_RF and RTC domain. V_BCKP supplies power for RTC domain only. The two diodes in following figure form an OR gate supply power for RTC domain. FORCE_ON pin belongs to RTC domain. The signal which has been shown as red line in the following diagram can open and close the switch. The following operations will close and open the switch:

- The switch will be closed by default when VCC is supplied power (VCC off → on).
- Based on above step, keep FORCE_ON floating or low, and then send PMTK command to open the switch (full on → backup).
- Based on above step, FORCE_ON logic high can close the switch (backup → full on).

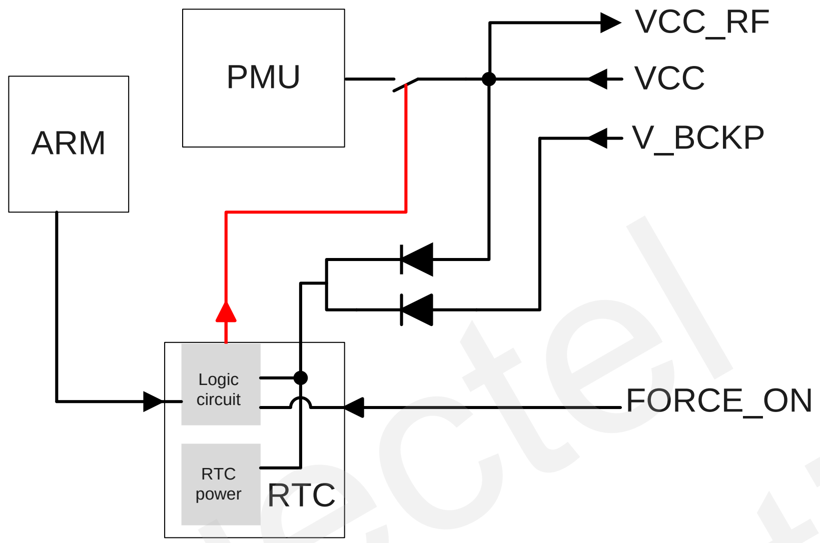

Figure 3: Internal Power Construction

The following picture shows average power and current consumption versus VCC supply voltage. It was tested in open sky and tracking mode based on GPS&GLONASS.

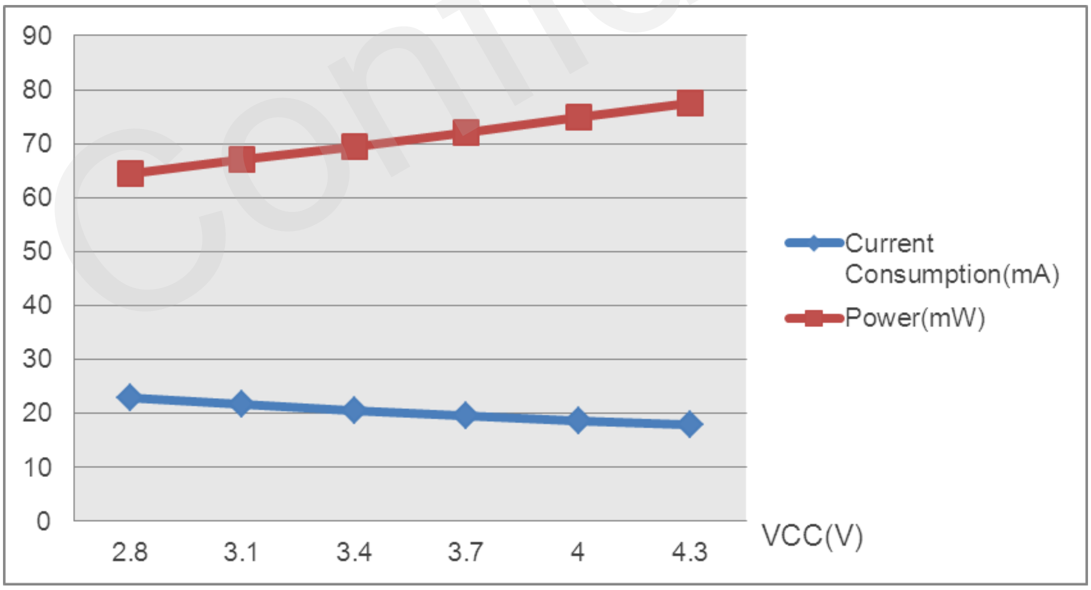

Figure 4: Power and Current Consumption versus VCC

3.4. Operating Modes

The table below briefly illustrates the relationship among different operating modes of L26 GNSS module.

Table 4: Module States Switch

Current Mode	Next Mode				
	Backup	**Standby**	**Full on**	**Periodic**	**AlwaysLocate™**
Backup	N/A	N/A	Refer to ***Chapter 3.4.3***	N/A	N/A
Standby	N/A	N/A	Send any data via UART1	N/A	N/A
Full on	Refer to ***Chapter 3.4.3***	PMTK161	N/A	PMTK225	PMTK225
Periodic	N/A	N/A	Refer to ***Chapter 3.4.4***	N/A	N/A
Always Locate™	N/A	N/A	Refer to ***Chapter 3.4.5***	N/A	N/A

NOTE

Please refer to ***document [2]*** about MTK proprietary protocol for more details.

3.4.1. Full on Mode

Full on mode includes tracking mode and acquisition mode. Acquisition mode is defined as the module starts to search satellites, determine visible satellites and coarse carrier frequency and code phase of satellite signals. When the acquisition is completed, it switches to tracking mode automatically. Tracking mode is defined as the module tracks satellites and demodulates the navigation data from the specific satellites.

Whether the combination of VCC and V_BCKP is valid or only VCC is valid, the module will enter into full on mode automatically and follow the default configurations as below. You can refer to ***Chapter 3.3*** about internal power construction to have a good comprehension. You also can use PMTK commands to change the configurations to satisfy your requirements.

Table 5: Default Configurations

Item	Configuration	Comment
Baud Rate	9600bps	
Protocol	NMEA	RMC, VTG, GGA, GSA, GSV and GLL
Update Rate	1Hz	
SBAS	Enable	
AIC	Enable	
LOCUS	Disable	
EASY Technology	Enable	When update rate exceeds 1Hz, EASY will be disabled automatically.
GNSS	GPS+GLONASS	

In full on mode, the consumption will comply with the following regulation:

When the module is powered on, the peak current will rush to 45mA(typ.) and it will last a few seconds, then the consumption will be decreased to acquisition current marked in ***Table 1*** and we defined this state as acquisition state, also it will last several minutes until it switches to tracking state automatically. The consumption in tracking state is less than acquisition. The value is also listed in ***Table 1.***

Using PMTK commands can switch among multiple position systems:

- $PMTK353,0,1*36: search GLONASS satellites only
- $PMTK353,1,0*36: search GPS satellites only
- $PMTK353,1,1*37: search GLONASS and GPS satellites

3.4.2. Standby Mode

Standby mode is a low-power consumption mode. In standby mode, the internal core and I/O power domain are still active, but RF and TCXO are powered off, the module stops satellites search and navigation. UART1 is still accessible like PMTK commands or any other data, but there is no NMEA messages output.

Sending PMTK command “$PMTK161,0*28” will make L26 module enter into standby mode. Sending any data via UART1 can wake the module up. When the module exit from standby mode, it will use all internal aiding information like GNSS time, Ephemeris, Last Position etc., resulting to a fastest possible TTFF in either Hot or Warm start. The typical current consumption in this mode is about 350uA @VCC=3.3V.

3.4.3. Backup Mode

Backup mode is a lower power consumption mode than standby mode. In this mode, the module stops to acquire and track satellites. UART1 is not accessible. But the backed-up memory in RTC domain which contains all the necessary GNSS information for quick start-up and a small amount of user configuration variables is alive. Due to the backed-up memory, EASY technology is available. The typical consumption in this mode can be low as 7uA.

There are two ways to enter into backup mode and back to full on mode.

- Sending command: "$PMTK225,4*2F" (the red line opens the switch in Figure 3) to enter into backup mode forever. The only way to wake up the module is pulling the FORCE_ON high (the red line closes the switch in Figure 3).
- Cutting off VCC and keeping V_BCKP is alive will make the module enter into backup mode from full on mode. As long as the VCC pin is supplied power, the module will back to full on mode immediately. But this method is not recommended.

NOTE

Keep FORCE_ON pin open or low before entering into backup mode or it is not available.

The V_BCKP pin can be directly supplied by an external capacitor or battery (rechargeable or non-chargeable). Please refer to the following figure for RTC backup reference design.

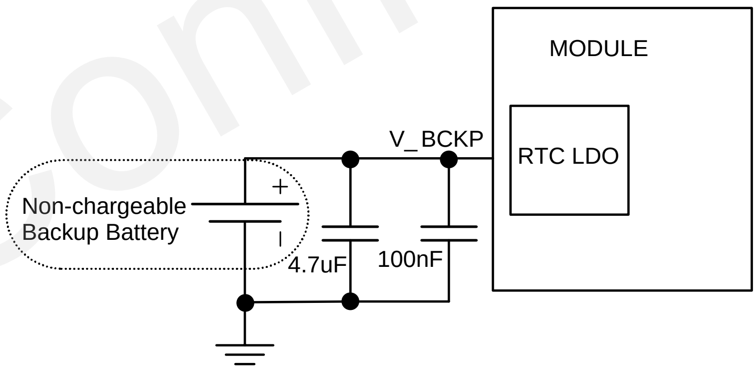

Figure 5: RTC Supply from Non-chargeable Battery

The V_BCKP pin does not support charging function for rechargeable battery. It is necessary to add an external charging circuit for rechargeable battery.

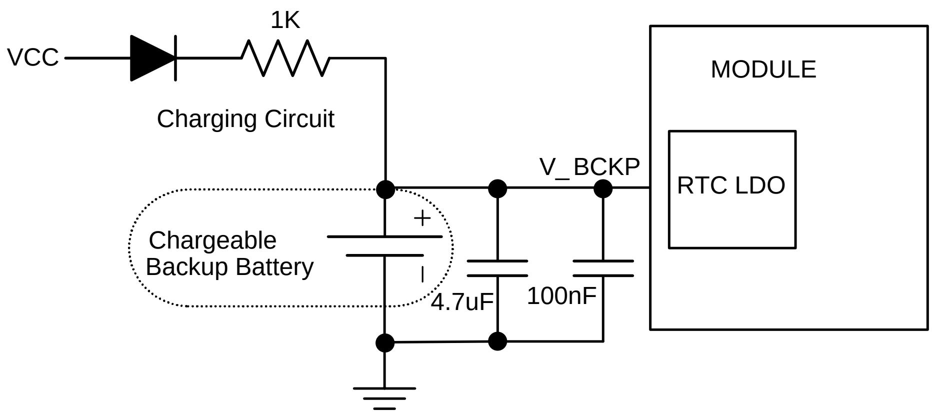

Figure 6: Reference Charging Circuit for Chargeable Battery

Coin-type Rechargeable Capacitor from Seiko (http://www.sii.co.jp/en/) can be used and Schottky diode from ON Semiconductor (http://www.onsemi.com/) is recommended to be used here for its low voltage drop.

3.4.4. Periodic Mode

Periodic mode is a power saving mode of L26 that can control the full on mode and standby/backup mode periodically to reduce power consumption. It contains periodic standby mode and periodic backup mode.

The format of the command which enters into periodic mode is as follows:

Table 6: PMTK Command Format

Format: $PMTK225,<Type>,<Run_time>,<Sleep_time>,<2nd_run_time>,<2nd_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	Full on period (ms)
Sleep_time	Decimal	Standby/Backup period (ms)
2nd_run_time	Decimal	Full on period (ms) for extended acquisition in case module acquisition fails during the **Run_time**
2nd_sleep_time	Decimal	Standby/Backup period (ms) for extended sleep in case module acquisition fails 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>		

Sending "$PMTK225,0*2B" in any time will make the module to full on mode from periodic standby mode.

Pulling the FORCE_ON high and sending "$PMTK225,0*2B" immediately will make the module to full on mode from periodic backup mode.

Sending "$PMTK225,0*2B" in **Run_time** or **2nd_run_time** will also make the module to full on mode from periodic backup mode, but it is hard to operate and not recommended.

NOTES

1. The sleep time in periodic backup mode and AlwaysLocate™ backup mode is equal to the time in backup mode.
2. Keep FORCE_ON pin open or low before entering into periodic backup mode or it is not available.

The following figure has shown the operation of periodic mode. When you send PMTK command, the module will be in the full on mode firstly. After several minutes, the module will enter into the periodic mode and follow the parameters set by you. When the module fails to fix the position in **Run_time**, the module will switch to **2nd_run_time** and **2nd_sleep_time** automatically. As long as the module fixes the position again, the module will return to **Run_time** and **Sleep_time**.

Note that before entering into periodic mode, assure the module is in the tracking mode; otherwise the module will have a risk of failure to track the satellites. If GNSS module is located in weak signal environment, it is better to set the longer **2nd_run_time** to ensure the success of re-acquisition.

The average current value can be calculated by the following formula:

$I_{periodic}= (I_{tracking}*T1+I_{standby/backup}*T2)/ (T1+T2)$ T1: **Run_time**, T2: **Sleep_time**

Example:
PMTK225,2,3000,12000,18000,72000*15 for periodic mode with 3s in tracking mode and 12s in standby mode based on GPS&GLONASS. The average current consumption is calculated below:
$I_{periodic}=(I_{tracking}*T1+I_{standby}*T2)/(T1+T2)=(21mA*3s + 0.35mA*12s)/(3s+12s)\approx 4.5(mA)$

PMTK225,1,3000,12000,18000,72000*16 for periodic mode with 3s in tracking mode and 12s in backup mode based on GPS&GLONASS. The average current consumption is calculated below:
I periodic=(I tracking*T1+Ibackup*T2)/(T1+T2)=(21mA*3s + 0.007mA*12s)/(3s+12s)≈4.2(mA)

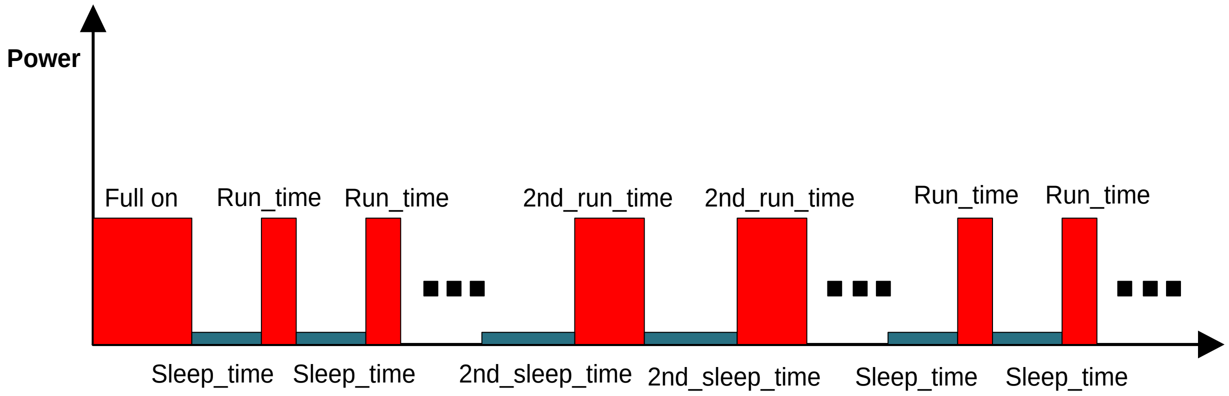

Figure 7: Periodic Mode

3.4.5. AlwaysLocate™ Mode

AlwaysLocate™ is an intelligent power saving mode. It contains AlwaysLocate™ backup mode and AlwaysLocate™ standby mode.

AlwaysLocate™ standby mode supports the module to switch automatically between full on mode and standby mode. According to the environmental and motion conditions, the module can adaptively adjust the full on time and standby time to achieve a balance between positioning accuracy and power consumption. Sending "$PMTK225,8*23" and the module returning: "$PMTK001,225,3*35" means the module accesses AlwaysLocate™ standby mode successfully. It will benefit power saving in this mode. Sending "$PMTK225,0*2B" in any time will make the module back to full on mode.

AlwaysLocate™ backup mode is similar to AlwaysLocate™ standby mode. The difference is that AlwaysLocate™ backup mode switches automatically between full on mode and backup mode. The PMTK command to enter into AlwaysLocate™ backup mode is "$PMTK225,9*22". Pulling FORCE_ON high and sending "$PMTK225,0*2B" immediately will make the module back to full on mode.

The position accuracy in AlwaysLocate™ mode will be somewhat degraded, especially in high speed. The following picture shows the rough power consumption of L26 module in different daily scenes when AlwaysLocate™ mode is enabled.

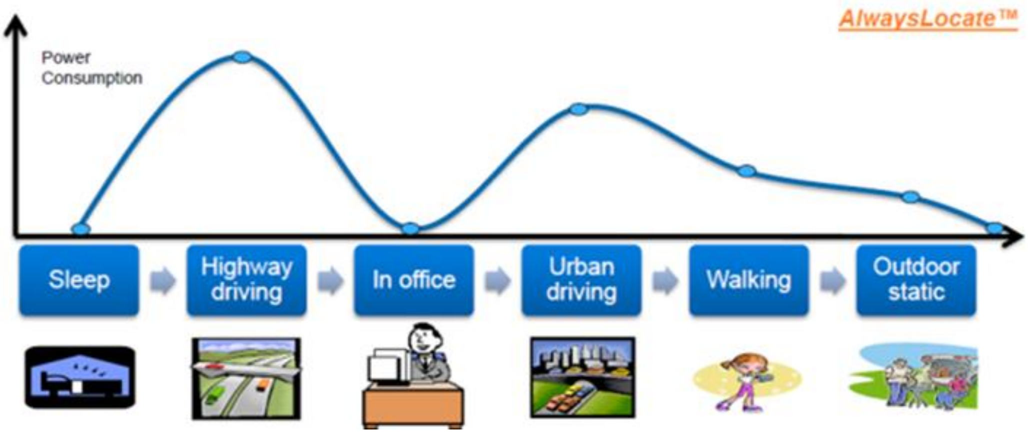

Figure 8: AlwaysLocate™ Mode

Example:
The typical average consumption is about 2.8mA in AlwaysLocate™ standby mode and 2.7mA in AlwaysLocate™ backup mode.

NOTES

1. Power consumption is measured in GPS&GLONASS system under outdoor static mode with active antenna.
2. The sleep time in periodic backup mode and AlwaysLocate™ backup mode is equal to the time in backup mode.
3. Keep FORCE_ON pin open or low before entering into AlwaysLocate™ backup mode or it is not available.

3.5. Reset

L26 GNSS module can be restarted by driving the RESET to a low level voltage for a certain time and then releasing it. This operation will reset the digital part of the GNSS receiver. Note that Non-Volatile RTC RAM content is not cleared and thus fast TTFF is possible. An OC driver circuit shown as below is recommended to control the RESET.

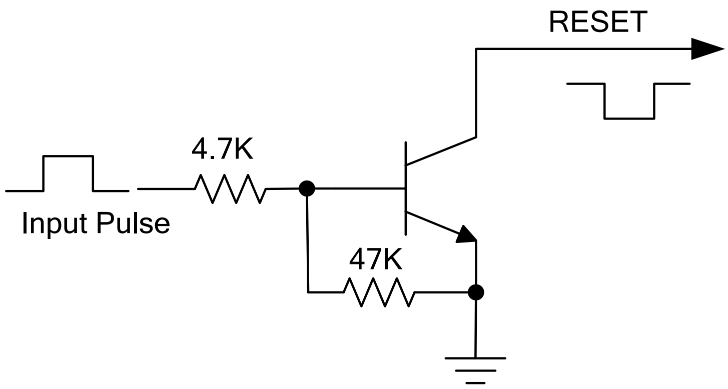

Figure 9: Reference Reset Circuit Using OC Circuit

The following picture shows the timing of L26 module.

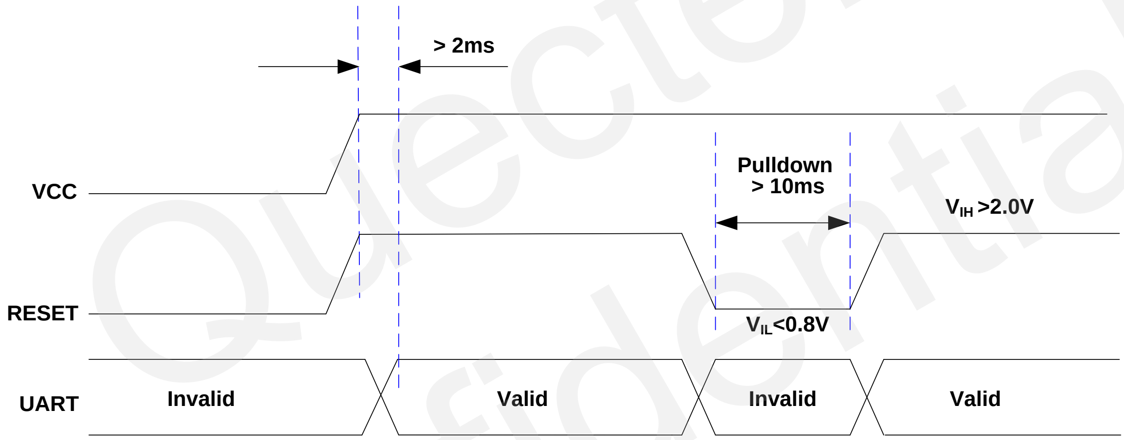

Figure 10: Module Timing

3.6. UART Interface

The module provides one universal asynchronous receiver & transmitter serial port. The module is designed as a DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the following signals shown as following figure. It supports data baud-rate from 4800bps to 115200bps.

UART port:

- TXD1: Send data to the RXD signal line of DTE
- RXD1: Receive data from the TXD signal line of DTE

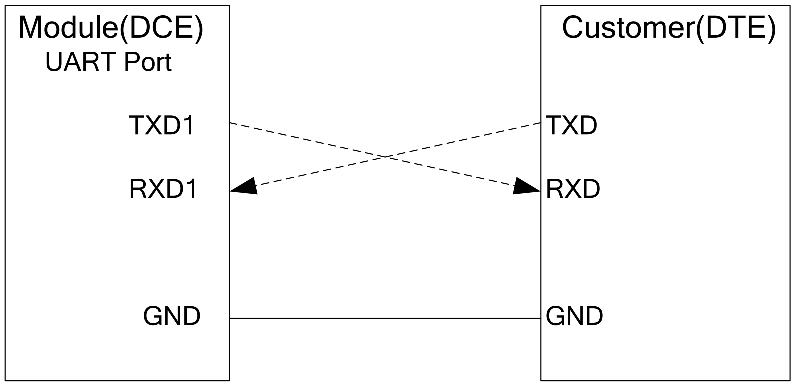

Figure 11: Connection of Serial Interfaces

This UART port has the following features:

- UART port can be used for firmware upgrade, NMEA output and PMTK proprietary commands input.
- The default output NMEA type setting is **RMC, VTG, GGA, GSA, GSV and GLL**.
- UART port supports the following data rates:
  4800, 9600, 14400, 19200, 38400, 57600, 115200.
  The default setting is 9600bps, 8 bits, no parity bit, 1 stop bit.
- Hardware flow control and synchronous operation are not supported.

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. Please refer to the following figure.

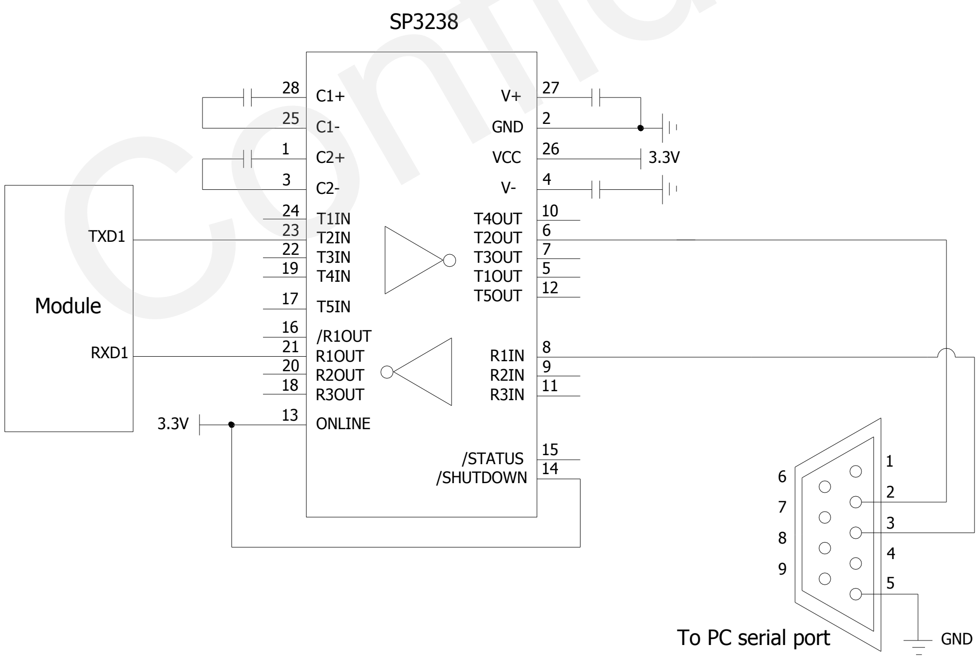

Figure 12: RS-232 Level Shift Circuit

NOTE

As GNSS module outputs more data than single GPS system. The default output NMEA types running in 4800 baud rate and 1Hz update rate will lose some data. The solution to avoid losing data in 4800 baud rate and 1Hz update rate is to decrease the output NMEA types. 9600 baud rate is enough to transmit GNSS NMEA in default settings and it is recommended.

3.7. EASY Technology

EASY technology works as embedded software which can accelerate TTFF by predicting satellite navigation messages from received ephemeris. The GNSS engine will calculate and predict orbit information automatically up to 3 days after first receiving the broadcast ephemeris, and saving the predicted information into the internal memory. GNSS engine will use this information for positioning if no enough information from satellites, so the function will be helpful for positioning and TTFF improvement.

The EASY function can reduce TTFF to 5s for warm start. In this case, RTC domain should be valid. In order to gain enough broadcast ephemeris information from GPS satellites, the GNSS module should receive the information for at least 5 minutes in a good signal condition after fixing the position.

EASY function is enabled by default. The command “$PMTK869,1,0*34” can be used to disable EASY function. For more details, please refer to the ***document [2].***

3.8. Multi-tone AIC

L26 GNSS module has a function called multi-tone AIC (Active Interference Cancellation) to decease harmonic of RF noise from Wi-Fi, Bluetooth, GSM and 3G.

Up to 12 multi-tone AIC embedded in the module can provide effective narrow-band interference and jamming elimination. The GNSS signal could be recovered from the jammed signal, which can ensure better navigation quality. AIC function is enabled by default. Opening AIC function will increase about 1mA @VCC=3.3V consumption. The following commands can be used to set AIC function.

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

3.9. ANTON

L26 GNSS module provides a pin called ANTON which is related to the module states. Its voltage level will be changed in different module states. When the module works in full on mode, this pin is a high level, while works in standby mode, backup mode as well as sleep time in periodic mode and AlwaysLocate™ mode, this pin is a low level. Based on this characteristic, ANTON pin can be used to control the power supply of an active antenna to save power consumption. Please refer to ***Chapter 3.2*** for more electrical characteristics about this pin. There is an example of this pin's application described in ***Chapter 4.2***.

3.10. LOCUS

The L26 GNSS module supports the embedded logger function called LOCUS. It can log position information to internal flash memory automatically when this function is enabled by sending PMTK command "$PMTK185, 0*22". Due to this function, the host can go to sleep to save power consumption and do not need to receive the NMEA information all the time. The module can provide a log capacity of more than 16 hours.

The detail procedures of this function are as follows:

- The module has fixed the position (only 3D_fixed is available);
- Sending PMTK command "$PMTK184,1*22" to erase internal flash;
- Sending PMTK command "$PMTK185,0*22" to start log;
- Module logs the basic information (UTC time, latitude, longitude and height) every 15 seconds to internal flash memory;
- Stop logging the information by sending "$PMTK185,1*23";
- MCU can get the data via UART1 by sending "$PMTK622,1*29" to the module.

The raw data which MCU gets has to be parsed via LOCUS parser code provided by Quectel. For more details, please contact Quectel technical support.

4 Antenna Interface

L26 GNSS module supports both GPS and GLONASS systems. The RF signal is obtained from the RF_IN pin. The impedance of RF trace should be controlled by 50 Ohm, and the length should be kept as short as possible.

4.1. Antenna Specification

The L26 GNSS module can be connected to a dedicated GPS/GLONASS passive or active antenna in order to receive both GPS and GLONASS satellite signals. The recommended antenna specification is given in following table.

Table 7: Recommended Antenna Specification

Antenna Type	Specification
Passive Antenna	GPS frequency: 1575.42±2MHz GLONASS frequency : 1602±4MHz VSWR: <2 (Typ.) Polarization: RHCP or Linear Gain: >0dBi
Active Antenna	GPS frequency: 1575.42±2MHz GLONASS frequency: 1602±4MHz VSWR: <2 (Typ.) Polarization: RHCP or Linear Noise figure: <1.5dB Gain (antenna): >-2dBi Gain (embedded LNA): 20dB (Typ.) Total gain: >18dBi (Typ.)

4.2. Recommended Circuit for Antenna

Both passive and active antenna can be used for L26 GNSS module.

4.2.1. Passive Antenna

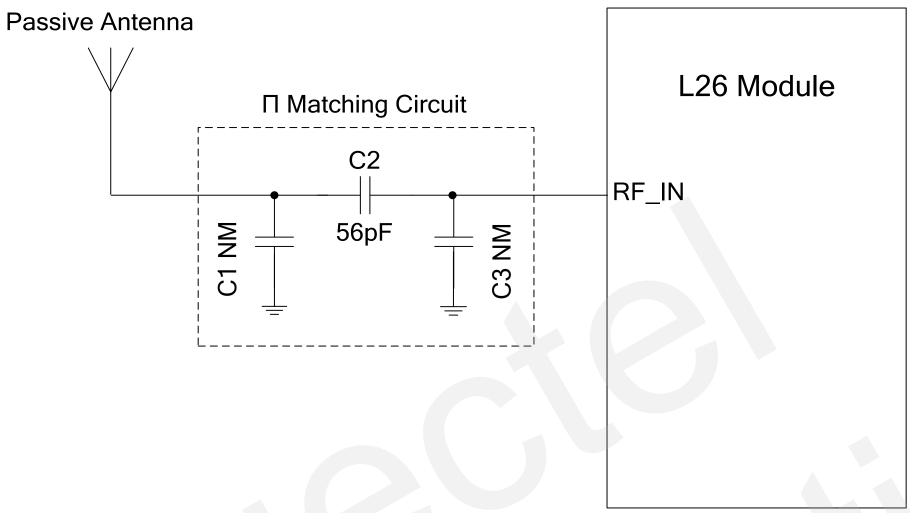

Figure 13: Reference Design with Passive Antenna

Passive antenna does not require a DC bias voltage and can be connected to RF_IN pin directly. The above figure is a typical reference design with passive antenna.

C1, C2, C3 are reserved matching circuit for antenna impedance modification. By default, C1 and C3 are not mounted, C2 is 56pF. Impedance of RF trace should be controlled by 50 ohm and the length should be kept as short as possible.

4.2.2. Active Antenna

Short protection and antenna detection for active antenna are supported by L26 module. Short protection circuit is embedded in the module, while to implement the antenna detection function needs a support of an external circuit.

NMEA message about the status of the active antenna is provided by L26 module, host can acquire the status of active antenna timely via querying the NMEA message.

4.2.2.1. Active Antenna with Short Protection

Active antenna has an integrated low-noise amplifier which could be connected to RF_IN directly. If an active antenna is connected to RF_IN, the integrated low-noise amplifier of the antenna needs to be supplied with the correct voltage through pin V_ANT. Usually, the supply voltage is fed to the antenna through the coaxial RF cable. VCC_RF or an external LDO can be used to supply power for V_ANT. When RF_IN is shorted accidentally, the route from V_ANT to RF_IN will be cut off by the internal short protection circuit to protect the module and the active antenna. The following figure has illustrated the principle of short protection function. If VCC_RF voltage is not suitable for your active antenna, it could be replaced with an external LDO.

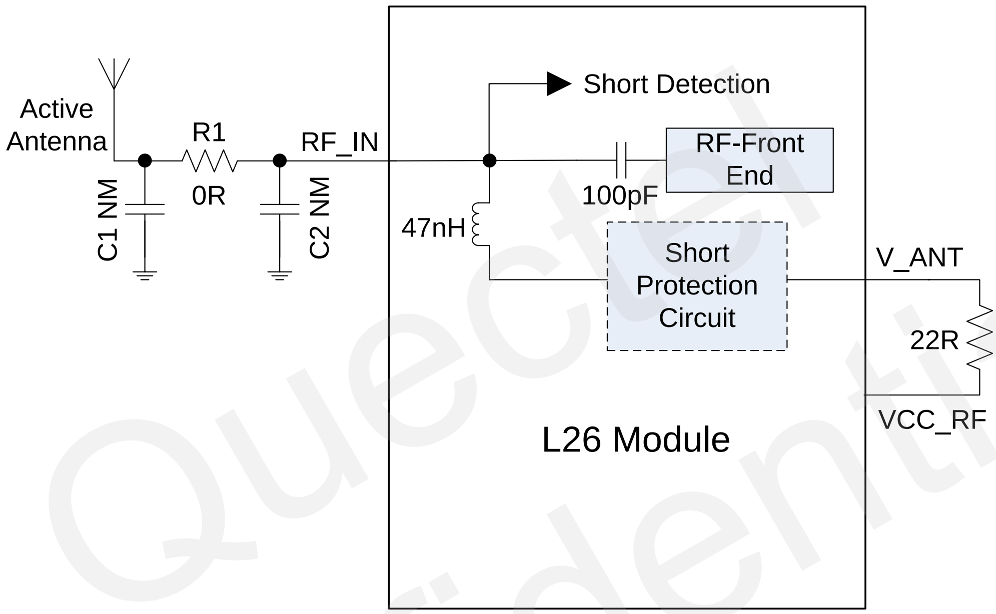

Figure 14: Active Antenna Reference Design with Short Protection

C1, R1, C2 are reserved matching circuit for antenna impedance modification. By default, C1 and C2 are not mounted, R1 is 0 ohm.

4.2.2.2. Active Antenna with Detection

The following figure is a typical reference design about active antenna with detection function.

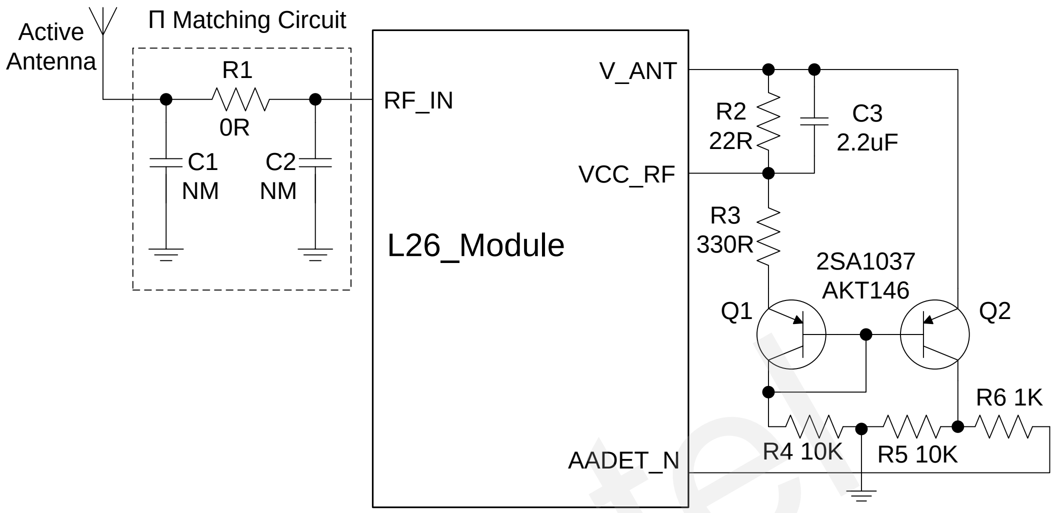

Figure 15: Active Antenna Reference Design with Antenna Detection

When active antenna is not connected to RF_IN or poor contact, AADET_N will keep a high level to indicate the active antenna absent. AADET_N will change to a low level when active antenna is connected well.

C1, R1, C2 are reserved matching circuit for antenna impedance modification. By default, C1 and C2 are not mounted, R1 is 0ohm.

4.2.2.3. Active Antenna with ANTON Circuit

In order to cut off the power supply of active antenna to reduce power consumption in power saving mode, the pin “ANTON” can be used to control the power supply of active antenna.

The reference circuit for active antenna with “ANTON” function is given as below. VCC_RF also can be replaced with an external LDO if it is not meet your requirement.

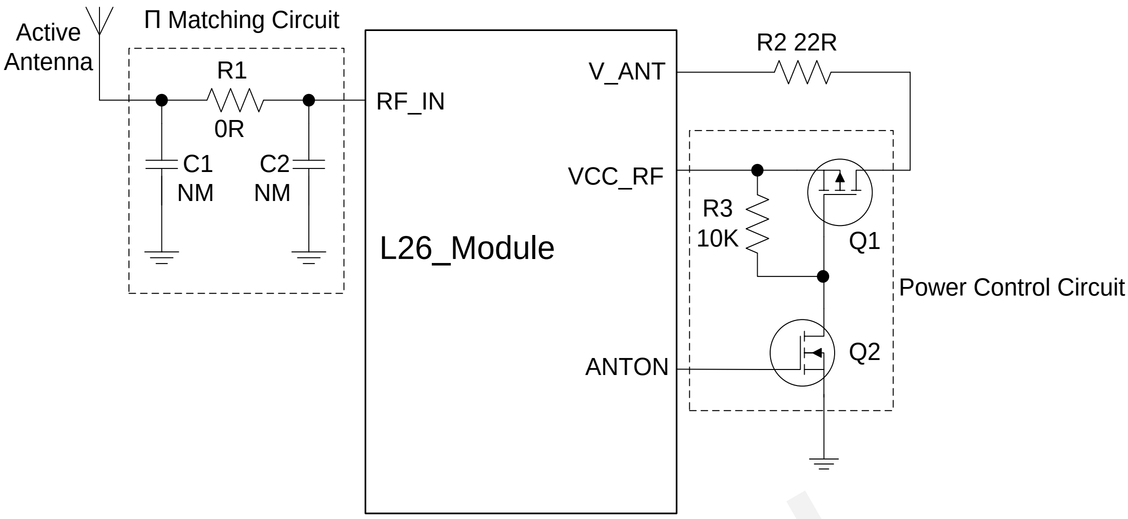

Figure 16: Reference Design for Active Antenna with ANTON

ANTON is an optional pin which can be used to control the power supply of active antenna. When the ANTON pin is pulled down, MOSFET Q1 and Q2 are in high impedance state and the power supply for antenna is cut off. When ANTON is pulled high, it will make Q1 and Q2 in the on-state, VCC_RF provides power supply for the active antenna. The high and low level of ANTON pin is determined by the module states. Please refer to ***Chapter 3.9*** for more details. If unused, please keep ANTON pin open.

C1, R1, C2 are reserved matching circuit for antenna impedance modification. By default, C1 and C2 are not mounted, R1 is 0ohm.

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 the following table.

Table 8: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
Power Supply Voltage (VCC)	-0.3	5	V
Backup Battery Voltage (V_BCKP)	-0.3	5	V
Input Voltage at Digital Pins	-0.3	3.6	V
Input Power at RF_IN (P_{RF_IN})		15	dBm
Storage Temperature	-45	125	°C

NOTE

Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against over voltage or reversed voltage. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

5.2. Operating Conditions

Table 9: The Module Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VCC	Supply voltage	Voltage must stay within the min/max values, including voltage drop, ripple, and spikes.	2.8	3.3	4.3	V
I_{VCCP}	Peak supply current	VCC=3.3V			150	mA
V_BCKP	Backup voltage supply		1.5	3.3	4.5	V
VCC_RF	Output voltage RF section			VCC		V
TOPR	Normal operating temperature		-40	25	85	°C

NOTES

1. The figure I_{VCCP} can be used to determine the maximum current capability of power supply.
2. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

5.3. Current Consumption

The values for current consumption are shown in following table.

Table 10: The Module Current Consumption

Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{VCC} @Acquisition	@VCC=3.3V (GPS)		26		mA
I_{VCC} @Tracking	@VCC=3.3V (GPS)		18		mA
I_{VCC} @Acquisition	@VCC=3.3 (GPS+GLONASS)		29		mA

I_{VCC} @Tracking	@VCC=3.3V (GPS+GLONASS)	21	mA
I_{VCC} @Standby	@VCC=3.3V	350	uA
I_{BCKP} @backup	@V_BCKP=3.3V	7	uA

NOTES

1. The VCC_RF current is not reckoned in above consumption.
2. The tracking current is tested in following condition:
   - For Cold Start, 10 minutes after First Fix.
   - For Hot Start, 15 seconds after First Fix.

5.4. Electro-static Discharge

L26 GNSS module is an ESD sensitive device. ESD protection precautions should still be emphasized. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application.

The ESD bearing capability of the module is listed in following table. Note that you should add ESD components to module pins in the particular application.

Table 11: The ESD Endurance Table (Temperature: 25ºC, Humidity: 45%)

Pin	Contact Discharge	Air Discharge
RF_IN	±4KV	±8KV
VCC	±5KV	±10KV
UART	±3KV	±6KV
Others	±2KV	±4KV

5.5. Reliability Test

Table 12: Reliability Test

Test Item	Conditions	Standard
Thermal Shock	-30°C...+80°C, 144 cycles	GB/T 2423.22-2002 Test Na IEC 68-2-14 Na
Damp Heat, Cyclic	+55°C; >90% Rh 6 cycles for 144 hours	IEC 68-2-30 Db Test
Vibration Shock	5~20Hz, 0.96m2/s3; 20~500Hz, 0.96m2/s3-3dB/oct, 1hour/axis; no function	2423.13-1997 Test Fdb IEC 68-2-36 Fdb Test
Heat Test	85°C, 2 hours, operational	GB/T 2423.1-2001 Ab IEC 68-2-1 Test
Cold Test	-40°C, 2 hours, operational	GB/T 2423.1-2001 Ab IEC 68-2-1 Test
Heat Soak	90°C, 72 hours, non-operational	GB/T 2423.2-2001 Bb IEC 68-2-2 Test B
Cold Soak	-45°C, 72 hours, non-operational	GB/T 2423.1-2001 A IEC 68-2-1 Test

6 Mechanics

This chapter describes the mechanical dimensions of the module.

6.1. Mechanical View of the Module

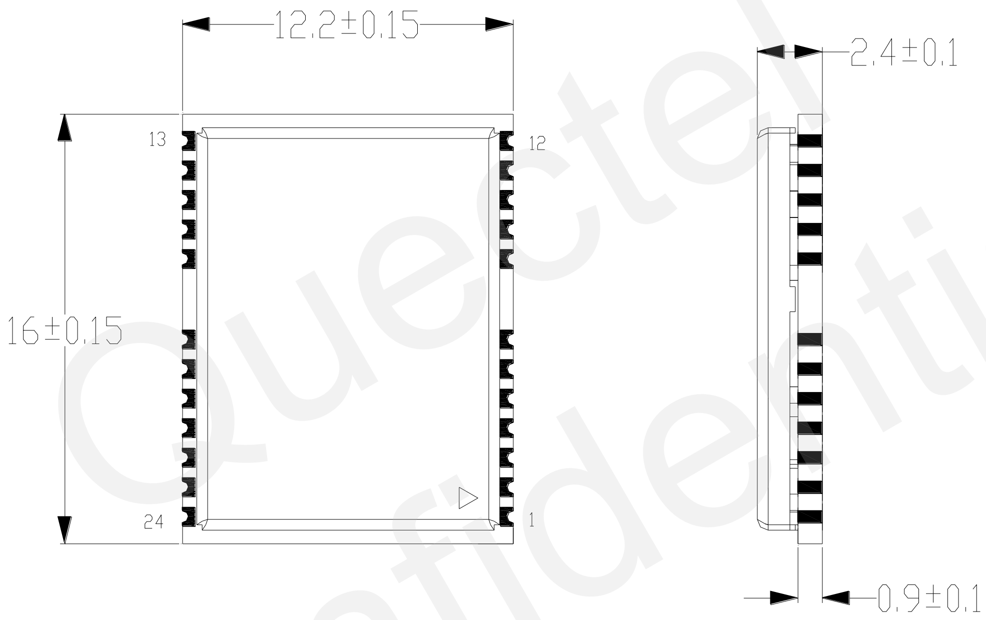

Figure 17: Top View and Side View (Unit: mm)

6.2. Bottom Dimension and Recommended Footprint

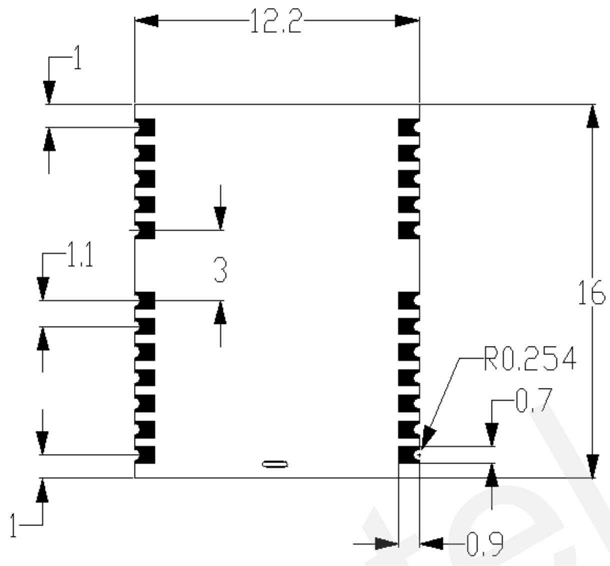

Figure 18: Bottom Dimension (Unit: mm)

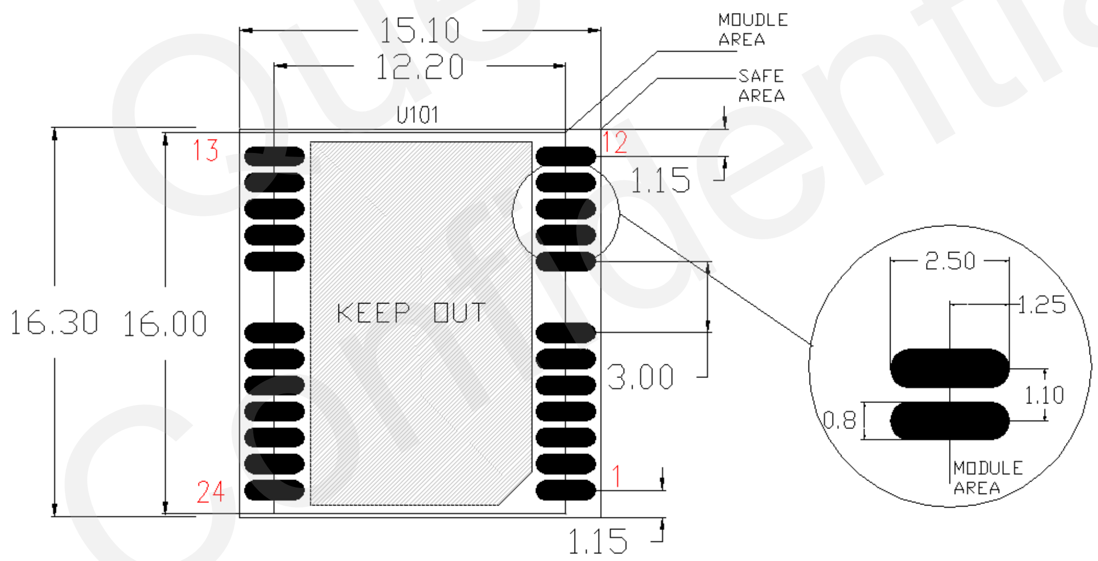

Figure 19: Footprint of Recommendation (Unit: mm)

NOTES

1. For easy maintenance of this module and accessing to these pads, please keep a distance of no less than 3mm between the module and other components in host board.
2. The keep-out area should be covered by solder mask and top silk layer for isolation between the top layer of host board and the bottom layer of the module.

6.3. Top View of the Module

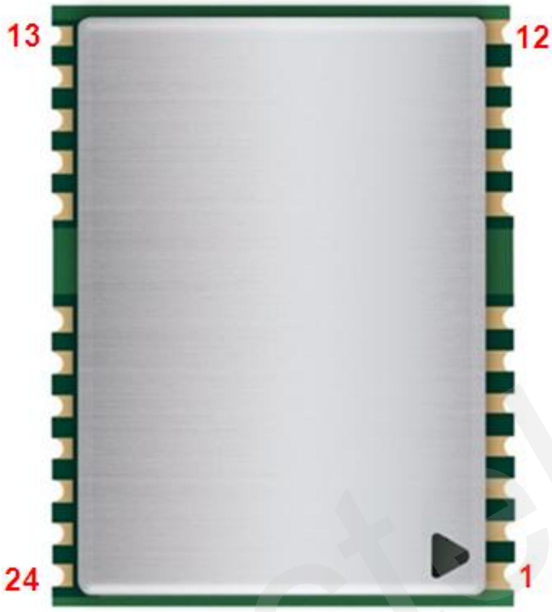

Figure 20: Top View of the Module

6.4. Bottom View of the Module

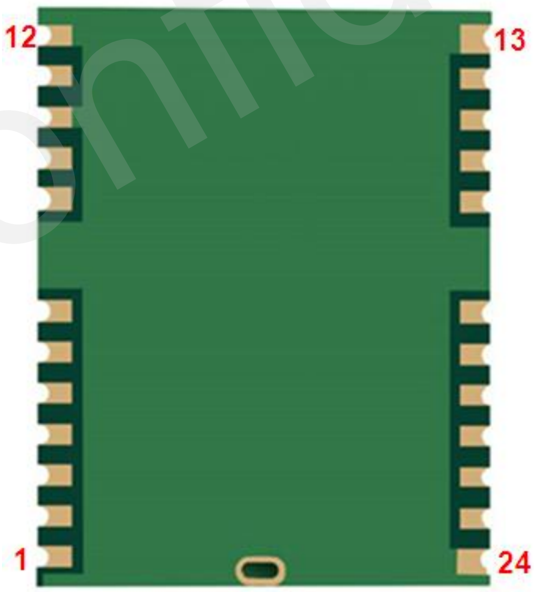

Figure 21: Bottom View of the Module

7 Manufacturing

7.1. Assembly and Soldering

L26 GNSS module is intended for SMT assembly and soldering in a Pb-free reflow process on the top side of the PCB. It is suggested that the minimum height of solder paste stencil is 130um to ensure sufficient solder volume. Pad openings of paste mask can be increased to ensure proper soldering and solder wetting over pads. It is suggested that peak reflow temperature is 235~245ºC (for SnAg3.0Cu0.5 alloy). Absolute max reflow temperature is 260ºC. To avoid damage to the module when it is repeatedly heated, it is suggested that the module should be mounted after the first panel has been reflowed. The following picture is the actual diagram which we have operated.

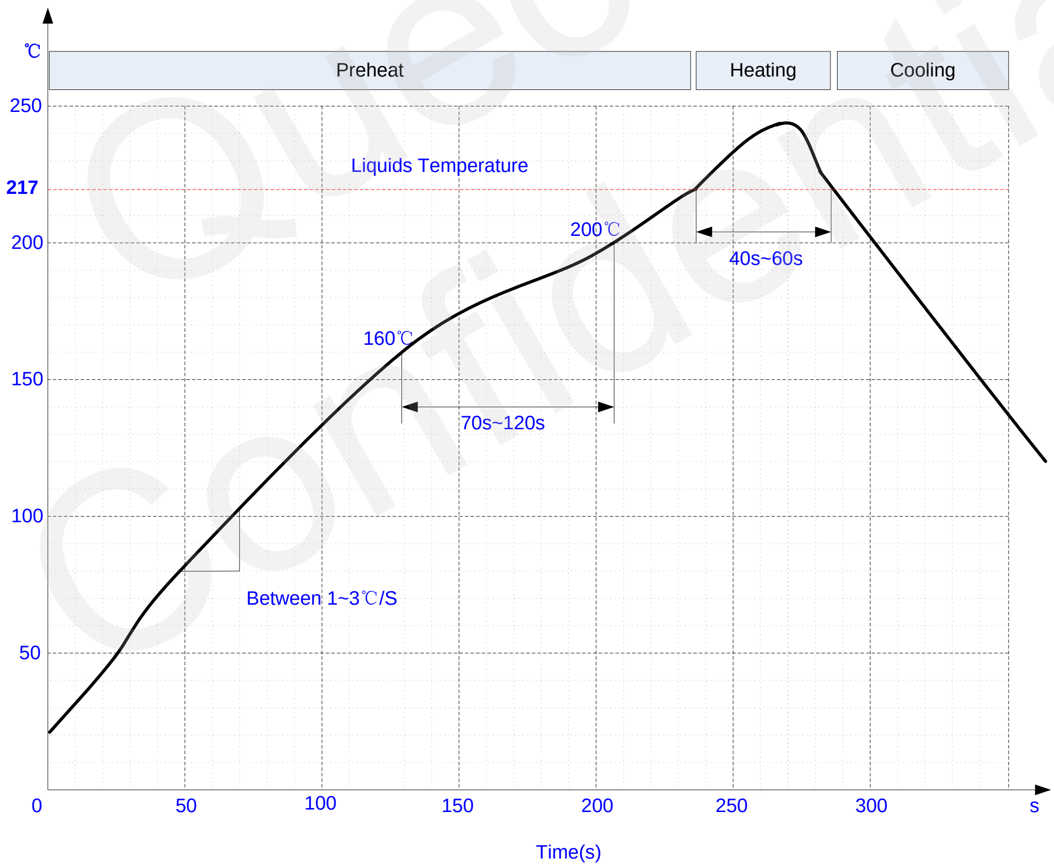

Figure 22: Ramp-soak-spike-reflow of Furnace Temperature

7.2. Moisture Sensitivity

L26 GNSS module is sensitivity to moisture absorption. To prevent L26 GNSS module from permanent damage during reflow soldering, baking before reflow is required in following cases:

- Humidity indicator card: At least one circular indicator is no longer blue
- The seal is opened and the module is exposed to excessive humidity.

L26 GNSS module should be baked for 192 hours at temperature 40ºC+5ºC/-0ºC and <5% RH in low-temperature containers, or 24 hours at temperature 125ºC±5ºC in high-temperature containers. Care should be taken that plastic tape is not heat resistant. L26 GNSS module should be taken out before preheating, otherwise, the tape maybe damaged by high-temperature heating.

7.3. ESD Protection

L26 module is sensitive to ESD and requires special precautions when handling. Particular care must be exercised when handing patch antenna, due to the risk of electrostatic charges.

7.4. Tape and Reel

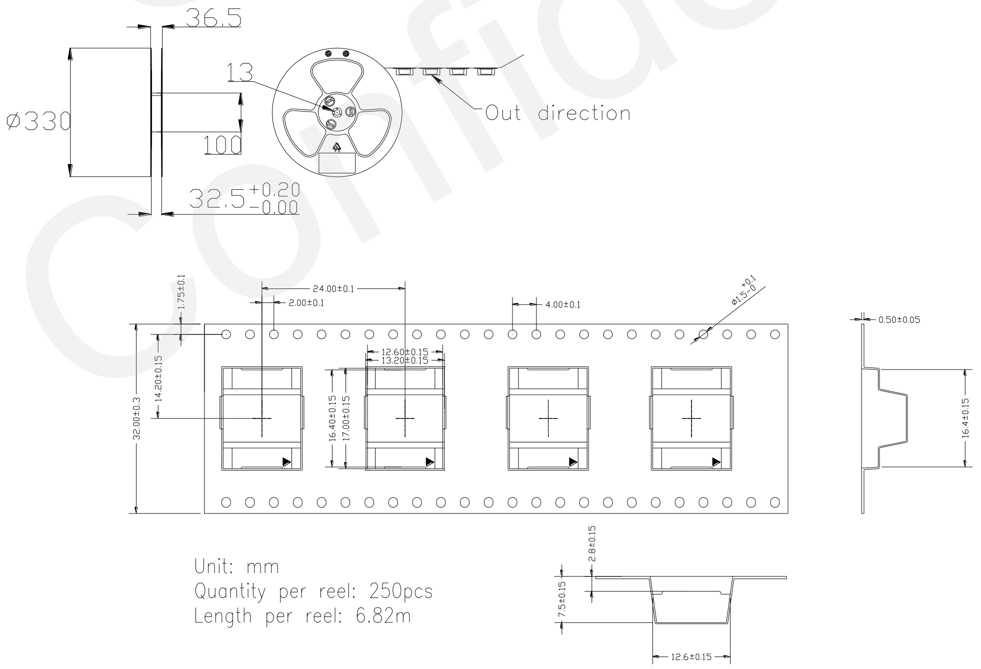

Figure 23: Tape and Reel Specification

Table 13: Reel Packing

Model Name	MOQ for MP	Minimum Package: 250pcs	Minimum Package × 4=1000pcs
L26	250pcs	Size: 370mm × 350mm × 56mm N.W: 0.26kg G.W: 1.00kg	Size: 380mm × 250mm × 365mm N.W: 1.1kg G.W: 4.6kg

7.5. Ordering Information

Table 14: Ordering Information

Model Name	Ordering Code
L26	L26-M33

8 Appendix Reference

Table 15: Related Documents

SN	Document Name	Remark
[1]	Quectel_L26_EVB_User Guide	L26 EVB User Guide
[2]	Quectel_L26_GNSS_Protocol_Specification	L26 GNSS Protocol Specification
[3]	Quectel_L26_Reference_Design	L26 Reference Design

Table 16: Terms and Abbreviations

Abbreviation	Description
AGPS	Assisted GPS
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	Electrostatic Discharge
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
GGA	GPS Fix Data
GLL	Geographic Position – Latitude/Longitude

GLONASS	Global Navigation Satellite System
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
MOQ	Minimum Order Quantity
NMEA	National Marine Electronics Association
PDOP	Position Dilution of Precision
PMTK	MTK Proprietary Protocol
PPS	Pulse Per Second
PRN	Pseudo Random Noise Code
QZSS	Quasi-Zenith Satellite System
RHCP	Right Hand Circular Polarization
RMC	Recommended Minimum Specific GNSS Data
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite-based Augmentation System
SAW	Surface Acoustic Wave
TTFF	Time To First Fix
UART	Universal Asynchronous Receiver & Transmitter
VDOP	Vertical Dilution of Precision
VTG	Course over Ground and Ground Speed, Horizontal Course and Horizontal Velocity
WAAS	Wide Area Augmentation System

Inom	Nominal Current
Imax	Maximum Load Current
Vmax	Maximum Voltage Value
Vnom	Nominal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value