L26-DR (AA,ADR,UDR)
EVB User Guide

GNSS Module Series

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Safety Information

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

	Ensure that the product may be used in the country and the required environment, as well as that it conforms to the local safety and environmental regulations.
	Keep away from explosive and flammable materials. The use of electronic products in extreme power supply conditions and locations with potentially explosive atmospheres may cause fire and explosion accidents.
	The product must be powered by a stable voltage source, while the wiring must conform to security precautions and fire prevention regulations.
	Proper ESD handling procedures must be followed throughout the mounting, handling and operation of any devices and equipment incorporating the module to avoid ESD damages.

About the Document

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1.2	2019-12-25	1. Updated the description about calibration result monitoring in Chapter 6.2.2; 2. Moved description about EVB and accessories assembly into Chapter 2.
1.3.0	2023-08-03	Numerous changes were made to this document. It should be read in its entirety.

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1 Introduction

This document provides information on the steps needed to evaluate the Quectel L26-DR (AA, ADR, UDR) module using the Evaluation Board (EVB). The EVB is a convenient tool that allows you to become familiar with the L26-DR (AA, ADR, UDR) module.

Specifically, the document is divided into several sections:

- Chapter 2 provides the general overview of EVB kit.
- Chapter 3 describes the EVB interfaces.
- Chapter 4 describes how to test the module and upgrade firmware via QGNSS tool.
- Chapter 5 describes the DR application.
- Chapter 6 describes the installation of EVB and antenna.
- Chapter 7 describes how to measure power consumption for L26-DR (AA, ADR, UDR) module.
- Chapter 8 provides the EVB framework.
- Chapter 9 describes the common problems and troubleshooting.
- Chapter 10 describes the cautions.
- Chapter 11 is an appendix, which summarizes the relevant documents, terms and abbreviations appearing herein.

The list of documents involved in the document is shown as table below.

Table 1: List of Related Documents

Function	Document Name
Instruction for QGNSS tool	Quectel_QGNSS_User_Guide
Instruction and guidance of DR application for L26-DR (ADR) module	Quectel_L26-DR(ADR)_DR_Application_Note
Instruction and guidance of DR application for L26-DR (UDR) module	Quectel_L26-DR(UDR&ADRC)_DR_Application_Note
Hardware design for L26-DR module series	Quectel_L26-DR_Series_Hardware_Design

NOTE

Request the software tool QGNSS from Quectel Technical Support (support@quectel.com).

2 General Overview

2.1. EVB Kit

The EVB kit includes: Evaluation Board (EVB), active GNSS antenna, Micro-USB cable, bolts and coupling nuts, and OBD connector (Only supported by L26-DR (ADR)).

The EVB kit components are shown in the figure below. Check *Table 2: List of Kit Components* for details.

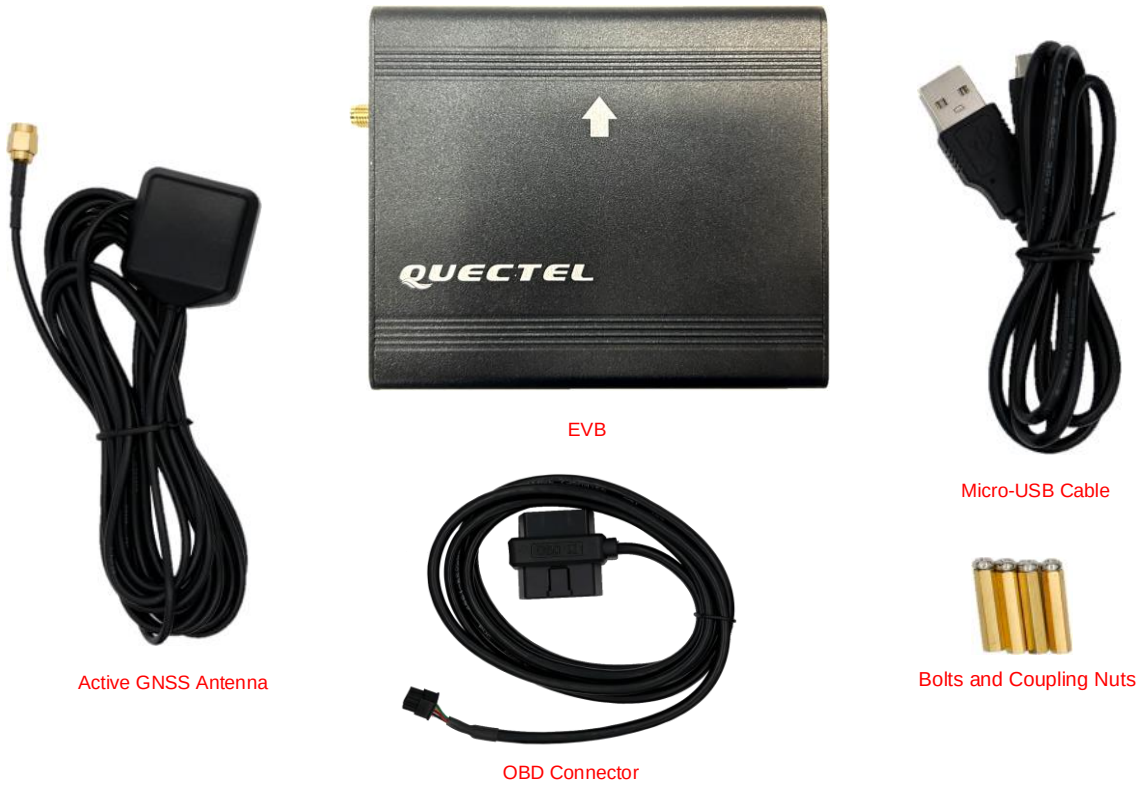


Figure 1: EVB Kit Components

Table 2: List of Kit Components

Items	Description	Quantity
EVB	Evaluation Board Size: 100 mm × 84 mm	1
USB Cable	Micro-USB Cable	1
Active GNSS Antenna with 3000 mm Cable Length	The antenna in the kit supports: ● GPS L1 C/A ● GLONASS L1 ● Galileo E1 ● BDS B1I ● QZSS L1 C/A	1
OBD Connector (Only supported by L26-DR (ADR))	Externally connect to vehicle to get speed information	1
Others	Bolts and Coupling Nuts	4 pairs

NOTE

Request Quectel Technical Support (support@quectel.com) for details about Quectel Active GNSS Antenna.

2.2. Connect Cables and Antenna to EVB

The connection between the EVB and its components is shown in the figure below.



Figure 2: EVB and Components Assembly

NOTE

Make sure that the active GNSS antenna is placed with a clear line of sight to the sky.

3 EVB Interfaces

3.1. EVB Top View

EVB top view is shown in the figure below.

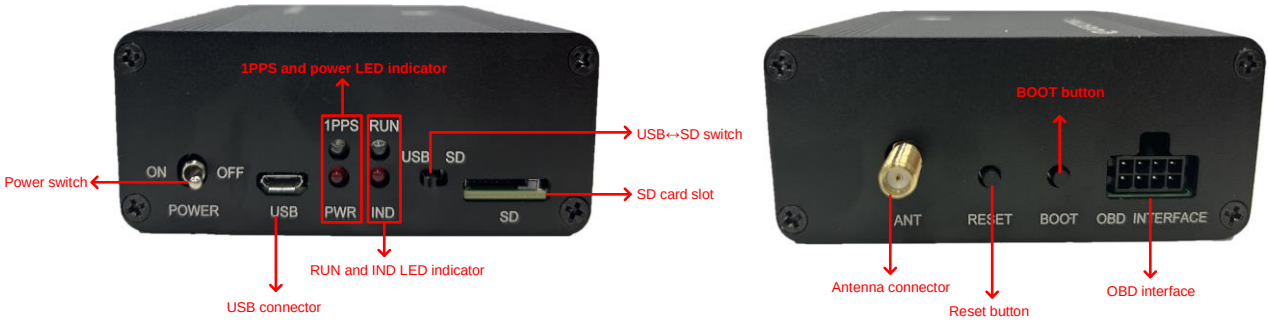


Figure 3: EVB Top View

3.2. EVB Interfaces

The EVB interfaces are detailed in the table below.

Table 3: Detailed EVB Interfaces

Function	Interfaces	Description
Power Supply	USB Connector	Power supply input: ● DC power supply: 4.5–5.5 V, typ. 5.0 V ● Current capability should be > 100 mA
Communication Interface	USB Connector	Supports standard NMEA messages, PSTM message, speed information transmission (Not supported by L26-DR (AA, UDR)), and firmware upgrade.
SMA Connector	ANT	Antenna connector. It is used for connecting GNSS antenna.

Function	Interfaces	Description
Signal Indication	1PPS (Blue LED)	The output frequency is 1 Hz.
	PWR (Red LED)	Bright: The module is powered on. Extinct: the module is powered off .
	RUN (Blue LED)	Unsupported.
	IND (Red LED)	Unsupported.
Switches and Buttons	POWER (ON↔OFF)	Power switch for powering the EVB on/off.
	USB↔SD	USB↔SD selector switch to control the data output interface. It is required to switch to USB interface for transmitting data via Micro-USB.
	BOOT	Press and hold the BOOT button before EVB is powered on to put the module into boot mode.
	RESET	Short press on the button to reset the module.
Others	OBD INTERFACE	For more information, see *Table 4: OBD Interface Pin Assignment* and *Table 5: OBD Interface Pin Description*.
	SD	Unsupported.

The OBD interface pin assignment is shown below:

Table 4: OBD Interface Pin Assignment

GND	CAN_L	CAN_H	SGND
-	WHEELTICK	FWD	GND

Table 5: OBD Interface Pin Description

Pin Name	I/O	Description
GND	-	Ground
CAN_L	DIO	CAN bus low level
CAN_H	DIO	CAN bus high level
SGND	-	Signal ground

Pin Name	I/O	Description
RESERVED	-	Reserved
WHEELTICK	DI	Odometer/wheel-tick pulse input
FWD	DI	Forward/backward status signal input
GND	-	Ground

4 Test and Firmware Upgrade via QGNSS Tool

This chapter explains how to use the QGNSS software tool for verifying the status of GNSS module and firmware upgrade. For more information about QGNSS use, see *document [1] QGNSS user guide*.

4.1. Test via QGNSS

Step 1: Assemble the EVB components.

Step 2: Connect the EVB and the PC with a Micro-USB cable, then flip the power switch to **ON** position to power on the EVB.

Step 3: Start the QGNSS and click "**Setting**" and "**Serial Port Configuration**" (default baud rate: 115200 bps [1]).

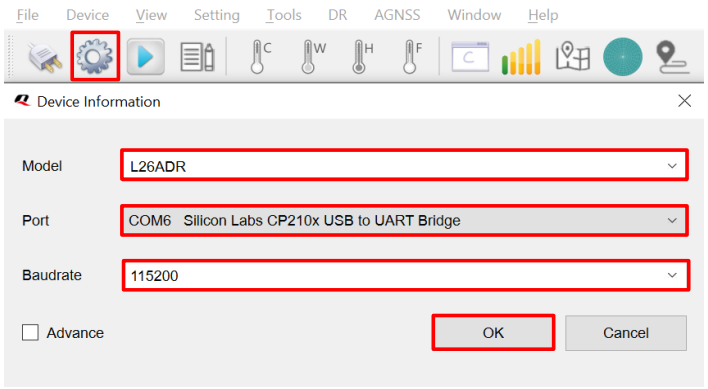


Figure 4: COM Port and Baud Rate Setting

Step 4: Click the  "**Connect or disconnect**" button. The interface shown in the figure below appears once the module is connected.

[1] UART interface default settings may vary depending on software versions.

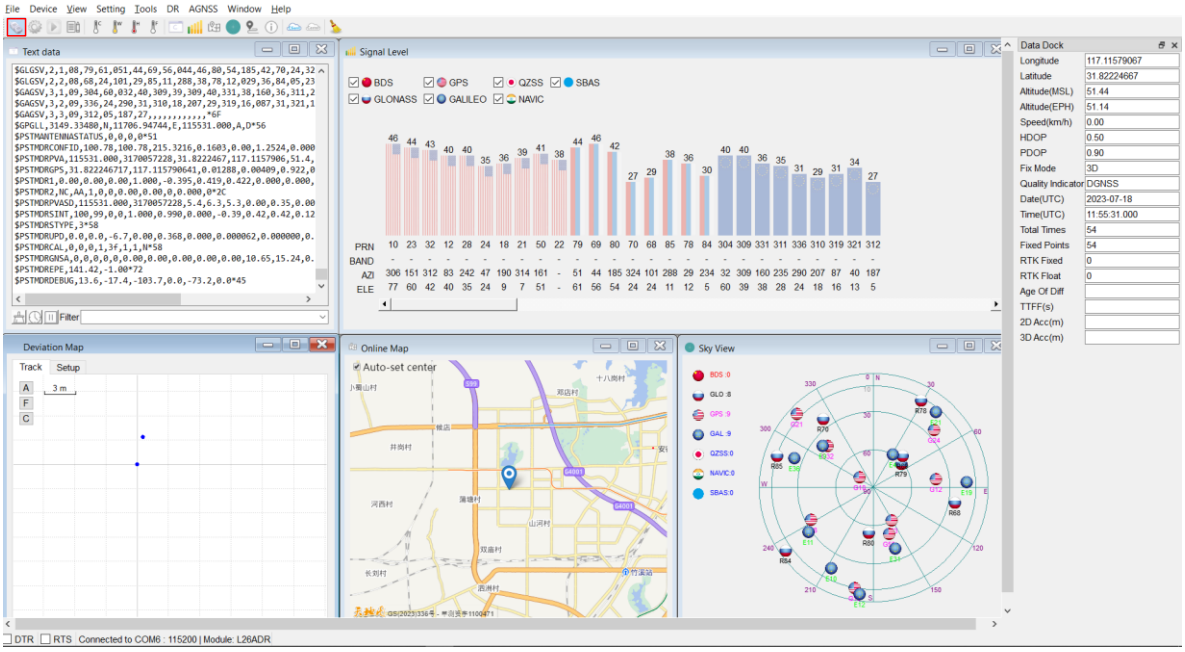


Figure 5: QGNSS Interface (Connected)

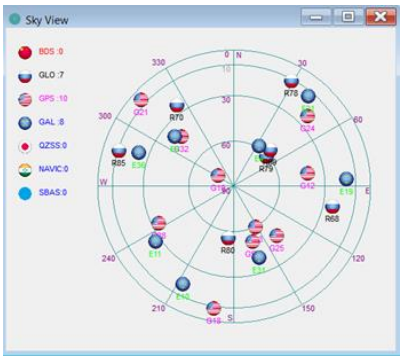
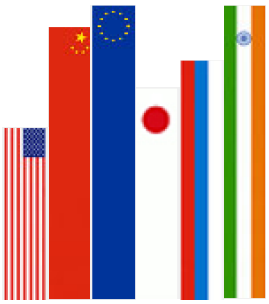
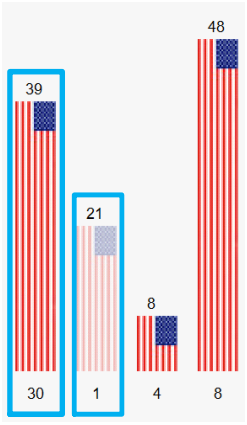
NOTE

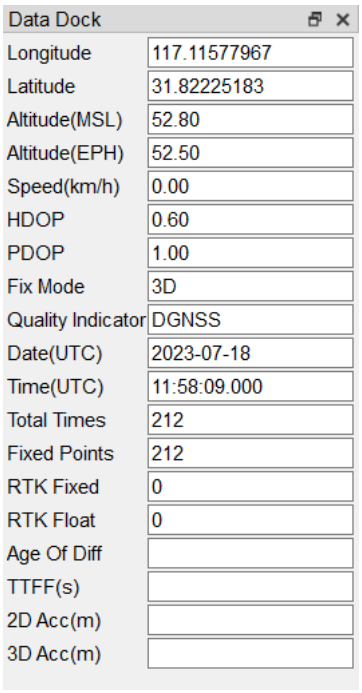
Ensure the CP210x driver has been installed when you use the QGNSS tool for the first time. For more information about the driver, please contact the Quectel Technical Support (support@quectel.com).

4.2. QGNSS Interface Explanation

You can view GNSS information, such as C/N_0 message, time, position, speed, and precision in the QGNSS interface. See the following table to find out more about these parameters.

Table 6: QGNSS Interface Explanation

Icon	Explanation
	This sky view interface shows the position of the satellites in use. 1) The left column icons show the satellites in use and their number. ● BDS: 0 ● GLO (GLONASS): 7 ● GPS: 10 ● GAL (Galileo): 8 ● QZSS: 0 ● NAVIC: 0 ● SBAS: 0 2) The sky view on the right shows the position of the satellites in use.
The signal view shows the C/N_0 values for each satellite on each supported band and is identified by the corresponding country flags. 	● GPS satellite ● BDS satellite ● GLONASS satellite ● Galileo satellite ● QZSS satellite ● NAVIC satellite
Visible satellites and their used status examples are shown below: 	● Column in bright red means that the navigation data of the satellites are in use. ● Column in light red means that the navigation data of the satellites are not in use. ● Examples are shown below: ➢ PRN 30 C/N_0 is 39 dB-Hz and used in solution. ➢ PRN 1 C/N_0 is 21 dB-Hz and not used in solution.

Icon	Explanation
	• Longitude (unit: °) • Latitude (unit: °) • Altitude (MSL) (unit: m) • Altitude (EPH) (unit: m) • Receiver speed (unit: km/h) • Horizontal dilution of precision • Position dilution of precision • Fix Mode: 2D, 3D • Quality Indicator: DGNSS, DGPS, GPS SPS, Float RTK and Fixed RTK modes • Date: UTC date • Time: UTC time • Total Times • Fixed Points • RTK Fixed • RTK Float • Age of differential GPS data • Last TTFF (unit: s) • 2D accuracy (unit: m) • 3D accuracy (unit: m)

4.3. Firmware Download in Boot Download Mode

Before firmware download process, connect the EVB to a PC with Micro-USB cable and flip the power switch to **OFF** position.

Firmware downloading steps:

Step 1: Open QGNSS tool, and click "**Tools**" and select "**Firmware Download**" in the drop-down box.

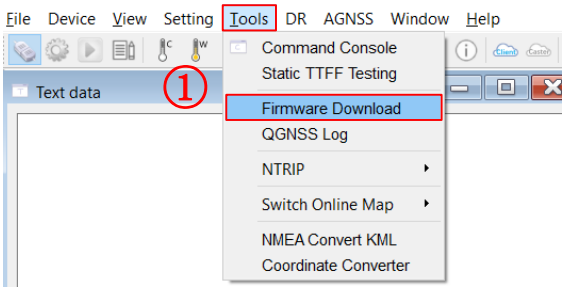


Figure 6: Tool Startup

Step 2: Select the appropriate "**Download Baudrate**" (57600 bps, 115200 bps or 230400 bps) in the drop-down box of "**Settings**".

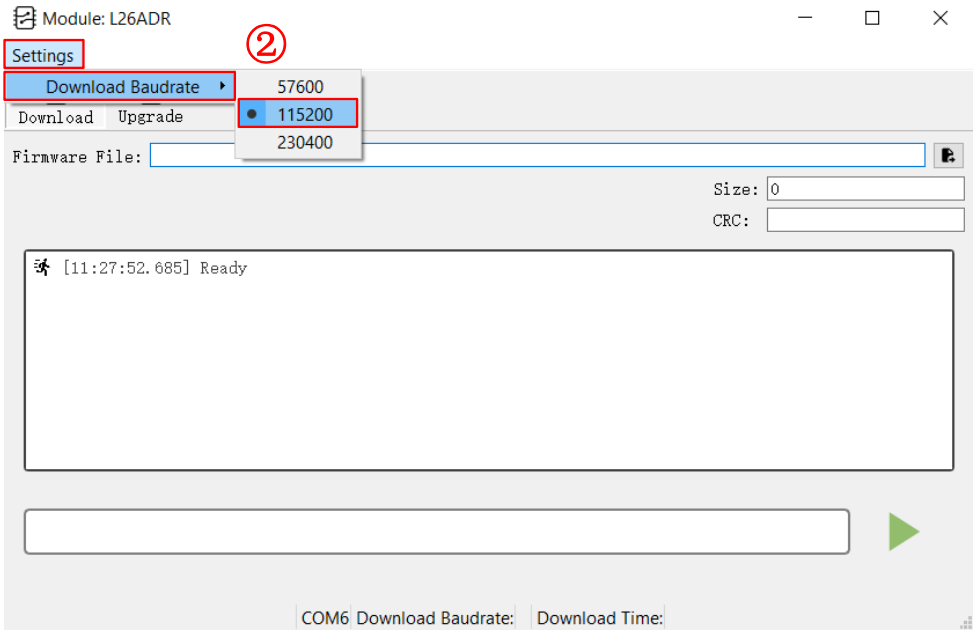


Figure 7: Tool Setting

Step 3: Select "**Download**" and then click the "**Open Config File**" button to select firmware file, e.g., "**L26ADRNR02A01_BOOT.bin**".

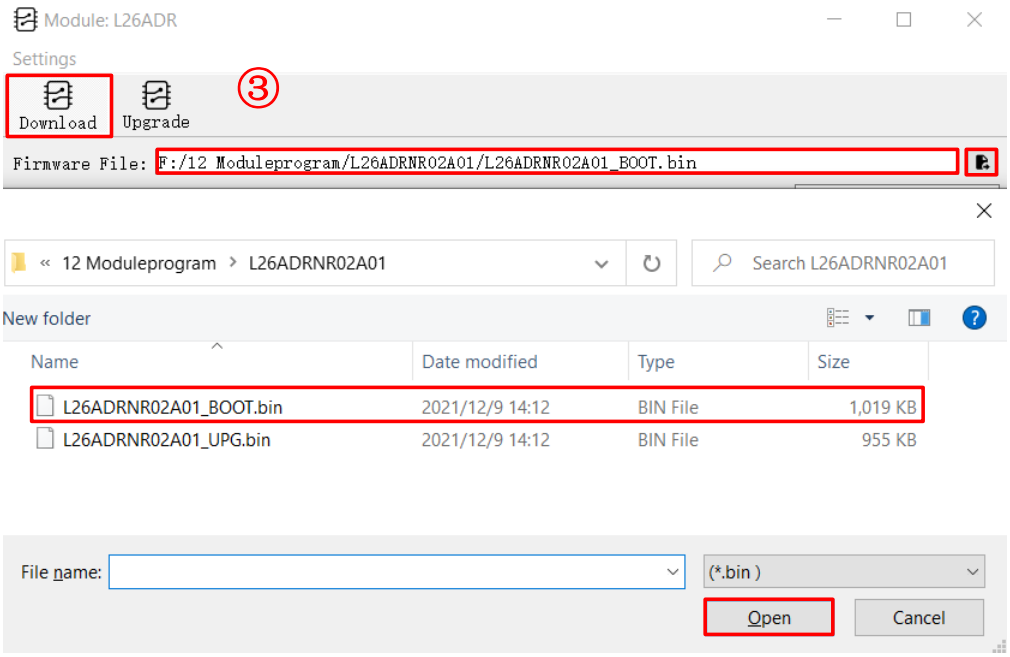


Figure 8: Firmware Selecting

Step 4: Press and hold the BOOT button before flipping the power switch to **ON** position, and release the BOOT button to set the module to Boot download mode. Then click ▶ "**Run**" button.

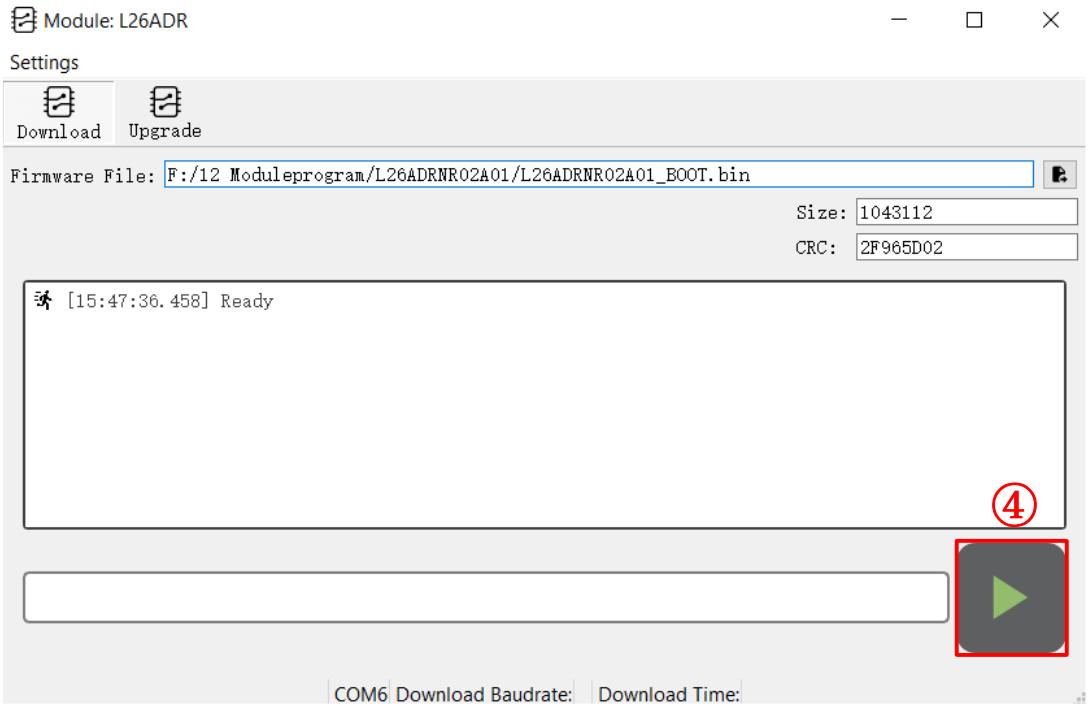


Figure 9 : Firmware Downloading – 1

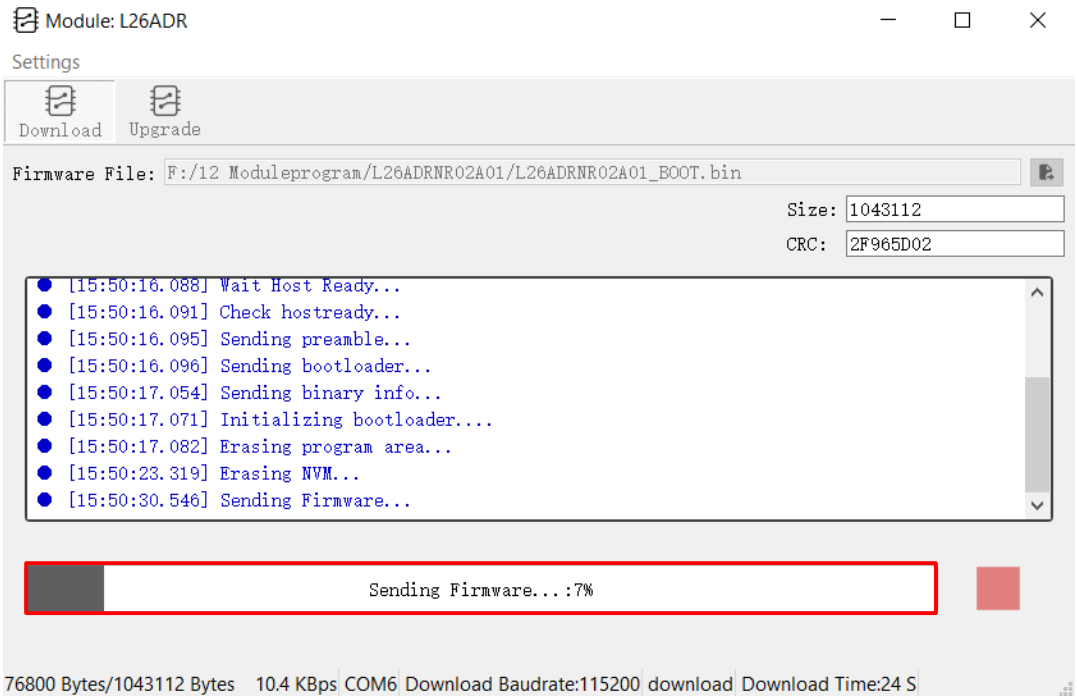


Figure 10 : Firmware Downloading – 2

Step 5: Upon successful firmware downloading, the QGNSS tool's progress bar on the screen will indicate "100 %".

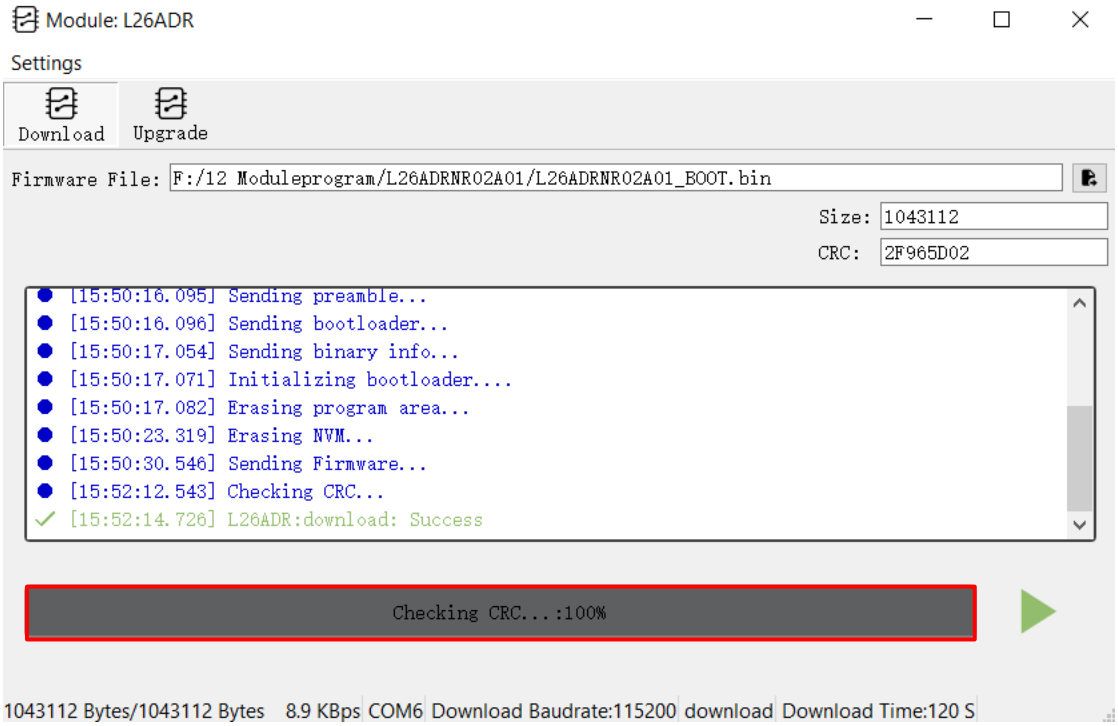


Figure 11: Successful Firmware Downloading

NOTE

Be careful to wipe out the factory activation code when redownloading the BOOT file for the L26-DR (UDR). For more information about the activation code, please contact the Quectel Technical Support (support@quectel.com).

4.4. Firmware Upgrade in Normal Operating Mode

Power on the EVB before you upgrade the firmware, see *Chapter 4.1 Test via QGNSS* for details.

Firmware upgrade steps:

Step 1: Open QGNSS tool, and click "**Tools**" and select "**Firmware Download**" in the drop-down box.

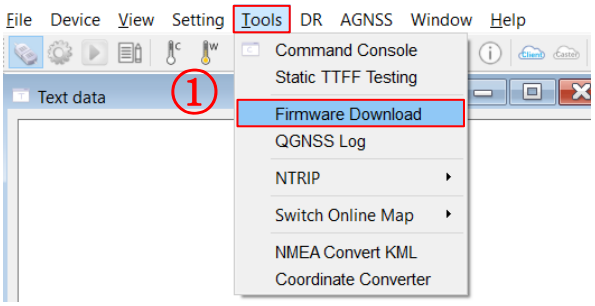


Figure 12: Tool Startup

Step 2: Select the appropriate "**Download Baudrate**" (57600 bps, 115200 bps or 230400 bps) in the drop-down box of "**Settings**".

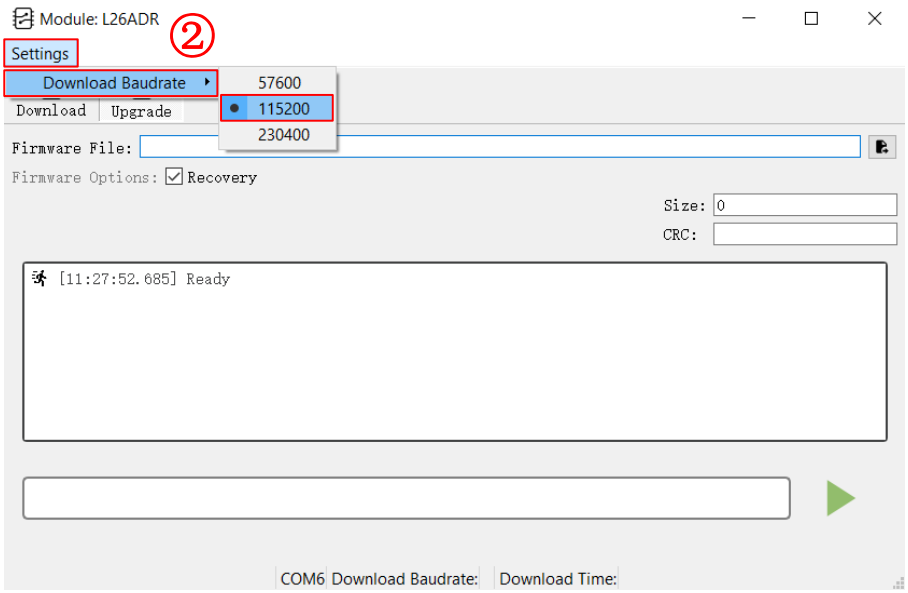


Figure 13: Tool Setting

Step 3: Click the "**Open**" button to select firmware file, e.g., "**L26ADRNR02A01_UPG.bin**".

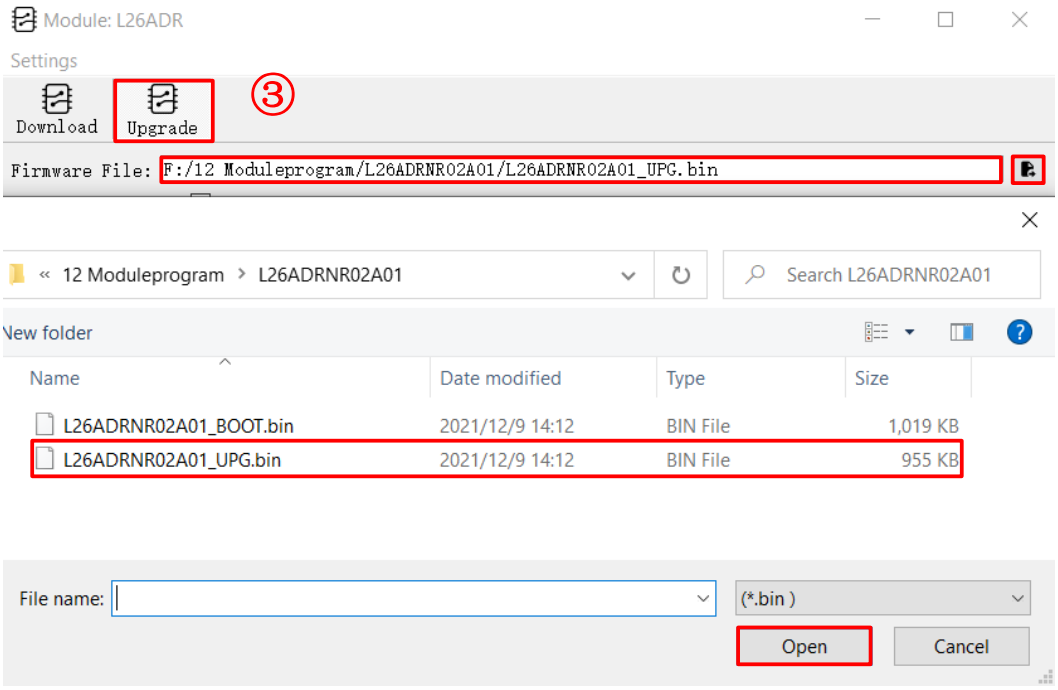


Figure 14: Firmware Selecting

Step 4: Click the "**Run**" button and then short press on the reset button to reset the module to start downloading the firmware.

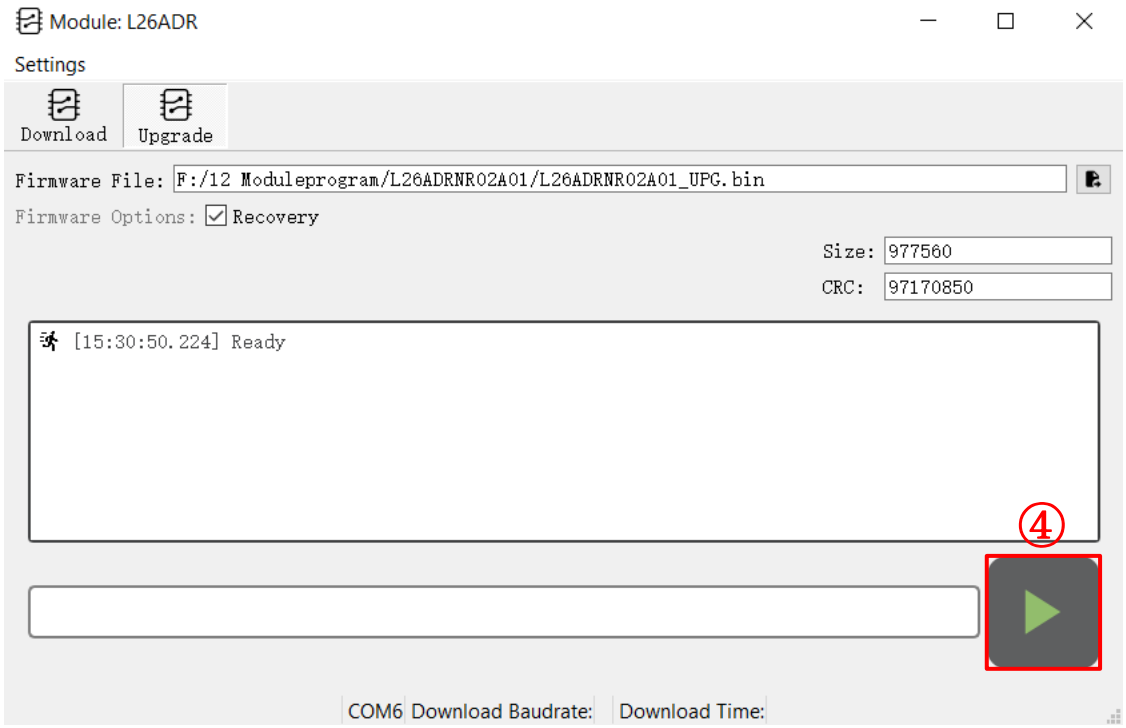


Figure 15: Firmware Upgrade – 1

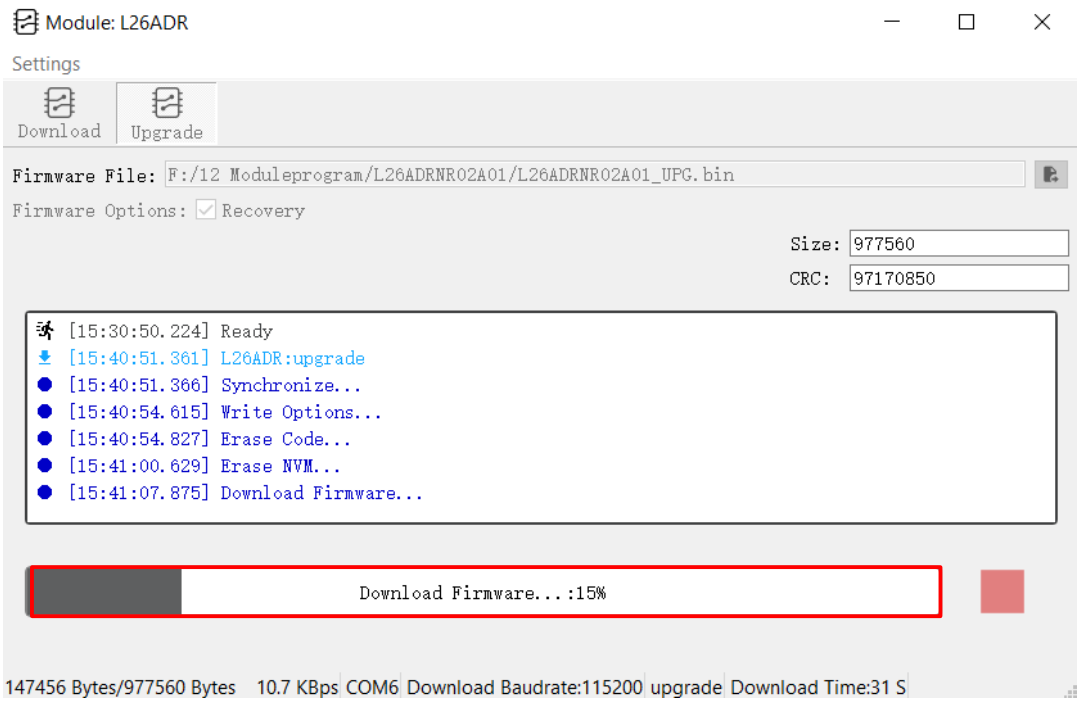


Figure 16: Firmware Upgrade – 2

Step 5: Upon successful firmware upgrade, the QGNSS tool's progress bar on the screen will indicate "100 %".

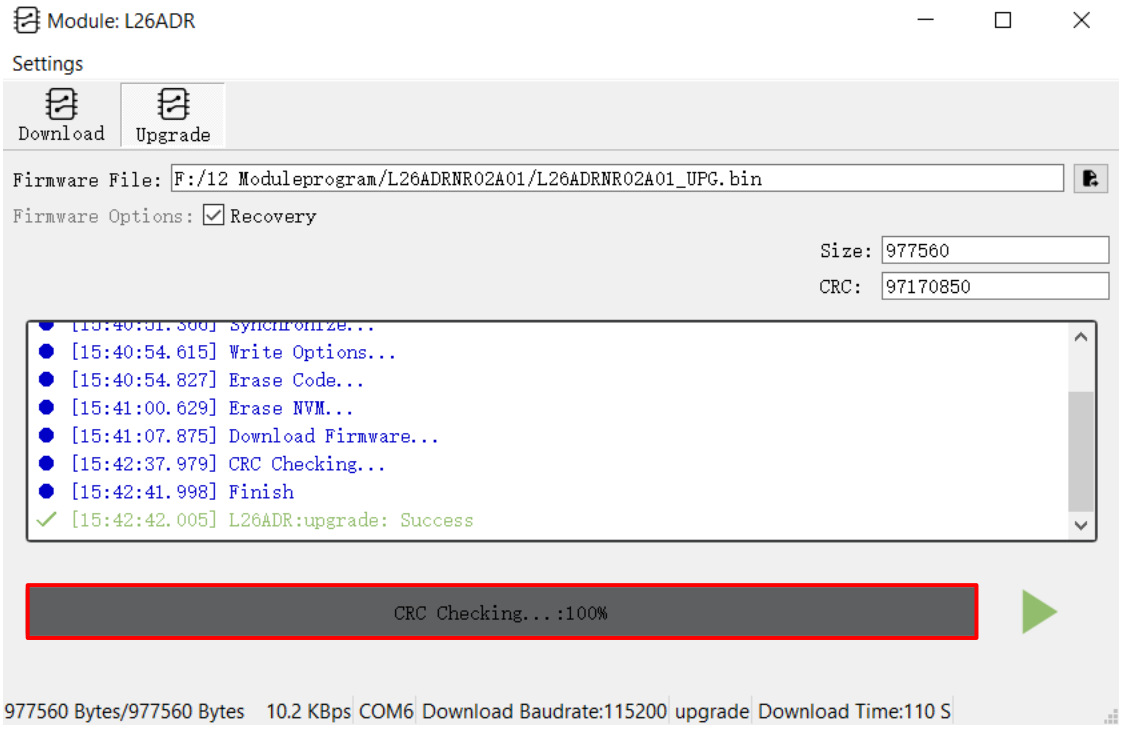


Figure 17: Successful Firmware Upgrade

5 DR Application

L26-DR (ADR, UDR) supports the Dead Reckoning technology. In order to utilize Dead Reckoning (DR) capabilities of L26-DR (ADR, UDR), a valid calibration is essential. This chapter outlines the implementation of the DR function and calibration.

Before using the DR function, the module integrated IMU needs be calibrated. To ensure module performance, the EVB must be mounted properly on the vehicle in such a way that it is firmly attached to the vehicle during use and no relative movement is allowed between the vehicle and the EVB. The calibration result can be confirmed via corresponding message with QGNSS tool. For more information, see *documents [3]* and *[4] DR application note*.

5.1. Calibration for L26-DR (ADR)

L26-DR (ADR) EVB allows for flexible installation regardless of the angle and direction. The module automatically recognizes the mounting angle deviation and compensates by internal algorithmic calculations.

NOTES

1. This calibration process in this chapter is based on the precondition that users have fixed the EVB. And no displacement or rotation of the EVB should happen after the calibration.
2. The calibration process needs to be repeated only when:
   - The EVB has been moved and reinstalled.
   - During a DR cold start and when the NVM is blank or invalid.

   It is necessary to clear old calibration data before restarting the calibration process. The commands are shown as below:
   $PSTMGPSSUSPEND
   $PSTMNVMITEMINV,80,1
   $PSTMNVMITEMINV,81,1
   $PSTMSRR
3. Please follow the steps in *Chapter 5.1.2 Determination Process of EVB Installation Angle* to finish the angle determination process as any improper operation may affect the calibration.

5.1.1. Get Speed Information

The OBD connector is provided in the EVB kit of L26-DR (ADR) for external vehicle connection to facilitate the module to obtain speed information. The connection is shown as figure below.

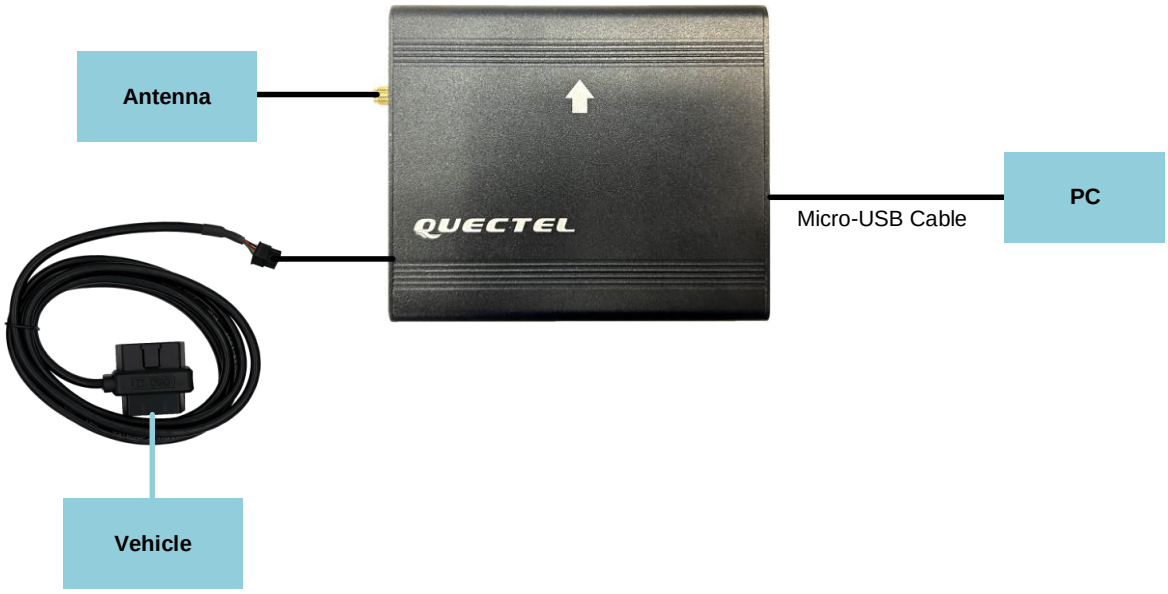


Figure 18: Get Speed Information

5.1.2. Determination Process of EVB Installation Angle

Before the 6-axis accelerometer sensor is available, EVB installation angle needs to be determined by the following steps:

Step 1: Install the EVB on a vehicle and connect the active GNSS antenna.

Step 2: Start the vehicle and power on the EVB.

Step 3: Keep the vehicle unmoved for at least 30 s on a flat road (1°–2° tolerance in gravity direction).

Step 4: After driving the vehicle for 1 minute, stop and keep the vehicle unmoved for at least 5 s.

5.1.3. Main Calibration Procedure

Once installation angle is determined, the following steps should be performed to fine tune the calibration accurately.

Step 6: After *Step 4*, the yaw rate offset is automatically initialized with a reliable value. Then, drive in a straight road (with speed > 30 km/h) for at least 5 minutes.

Step 7: Drive in areas rich of curves (with speed > 30 km/h). This process is needed to calibrate the yaw rate gain. It is important that tight turns (with narrow radius of curvature) are required. Typical scenes that allow this step to be performed properly are roundabouts, tight turns, and road curves with direction changed in 90° or more. Large turns (e.g., smooth turns on highway, lane changes, etc.) will not work.

Please note that the success of this operation does not depend on its duration, but the number of valid turns. In order to have a fine-tuned yaw rate gain, it is suggested that the first-boot calibration route should include at least 10 tight turns described above. During this procedure, the same turn can be repeated for many times.

It is of the utmost importance that all these operations should be performed under adequate GNSS signal conditions, which means that the antenna must have maximum sky visibility. Thus, the calibration should be performed in an open area, i.e., the area away from high-rise buildings, forests, tunnels, and any other element that may cause signal blocking or reflection.

NOTE

Please notify that the hybrid GNSS/DR navigation mode is not be available until a valid calibration is done. Without a valid calibration, only single GNSS navigation is available.

5.1.4. Calibration Result Monitoring

The calibration result can be confirmed via the message as shown below. For more information, see *document [2] DR application note*.

Synopsis:

```
$PSTMDRCAL,<DR_IsCalib>,<OdoIsCalib>,<GyroSensitivityIsCalib>,<GyroBiasIsCalib>,<IMU_Flag>,<GyroIntegrityFlag>,<AccIntegrity>,<DR_CalibMode>*<Checksum><CR><LF>
```

```
$PSTMDR2,<IMU_Cal>,<AS_Cal>,<MotionStatus>,<ErrCode>,<Sr>,<CrossTrackError>,<AlongTrackError>,<Sa>,<VroWs>,<VroSt>*<Checksum><CR><LF>
```

In ADR mode, after the L26-DR (ADR) module is successfully positioned, the module outputs **$PSTMDRCAL,1,1,1,1,ff,1,1,F*04** and **<Sr>** field of **$PSTMDR2** should read 1 to indicate that the module is fully calibrated and operational.

In UDR mode, **<Sr>** field of **$PSTMDR2** should read 1 to indicate that the module is fully operational.

If there is no successful calibration as shown below, the calibration process should be repeated.

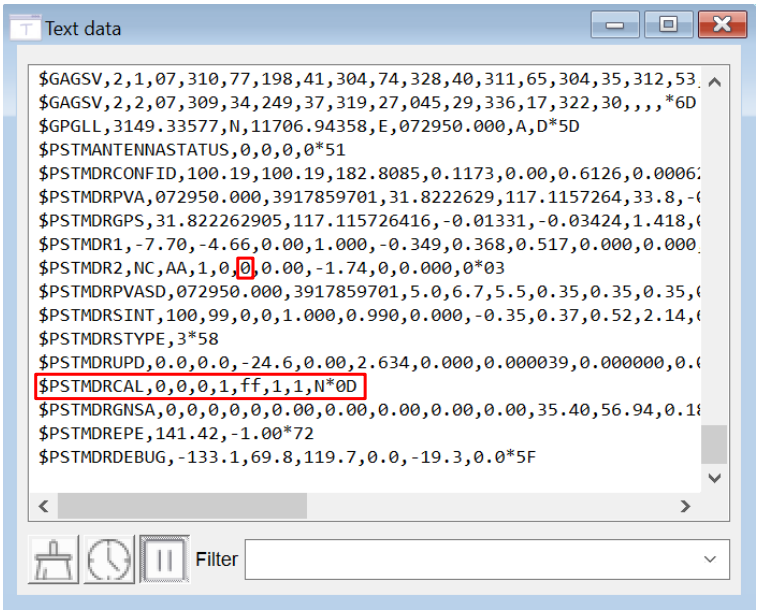


Figure 19: L26-DR (ADR) Calibration Result – Without Calibration

5.2. Calibration for L26-DR (UDR)

The installation of L26-DR (UDR) EVB is relatively more demanding, one of the X, Y and Z axis, shown in the following figure, should be perpendicular to the horizontal plane, and the deviation should be less than 15°. In this case, there is no limit to the placement direction on the plane formed by the other two axes.

For instance, if axis Z is perpendicular to the horizontal plane, there is no limit to the mounting direction of the EVB on the plane formed by axes X and Y.

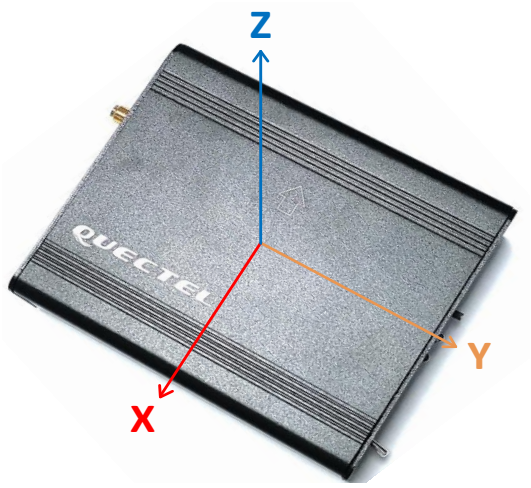


Figure 20: Axis of L26-DR (UDR) EVB

NOTE

L26-DR (UDR) does not need to get speed information.

5.2.1. Calibration Procedure

Step 1: Install the EVB on a vehicle and connect the antenna.

Step 2: Power on the EVB.

Step 3: Keep the vehicle unmoved for 30 s–60 s.

Step 4: Then start the vehicle and drive under strong GNSS signals, with speed changed for 2 times.

5.2.2. Calibration Result Monitoring

The calibration result can be confirmed by **$PQSOL** message. The calibration process is considered complete when **<NavMode>** field in **$PQSOL** message. For more information about the message, see *document [3] DR application note*. The examples of calibration are shown as figure below.

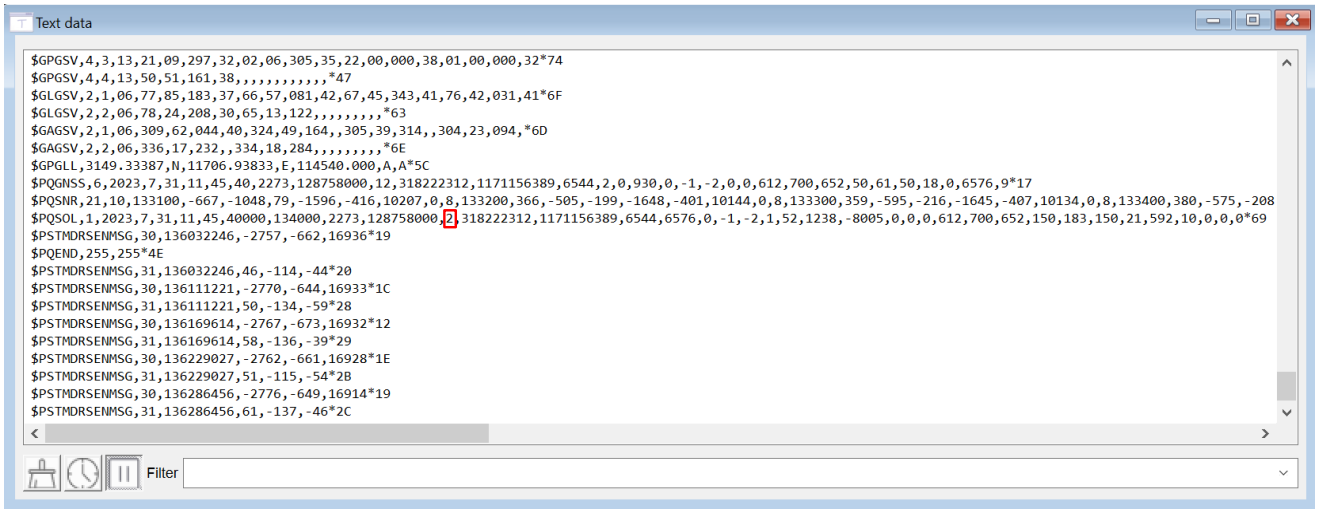


Figure 21: L26-DR (UDR) EVB Calibration Result – Without Calibration

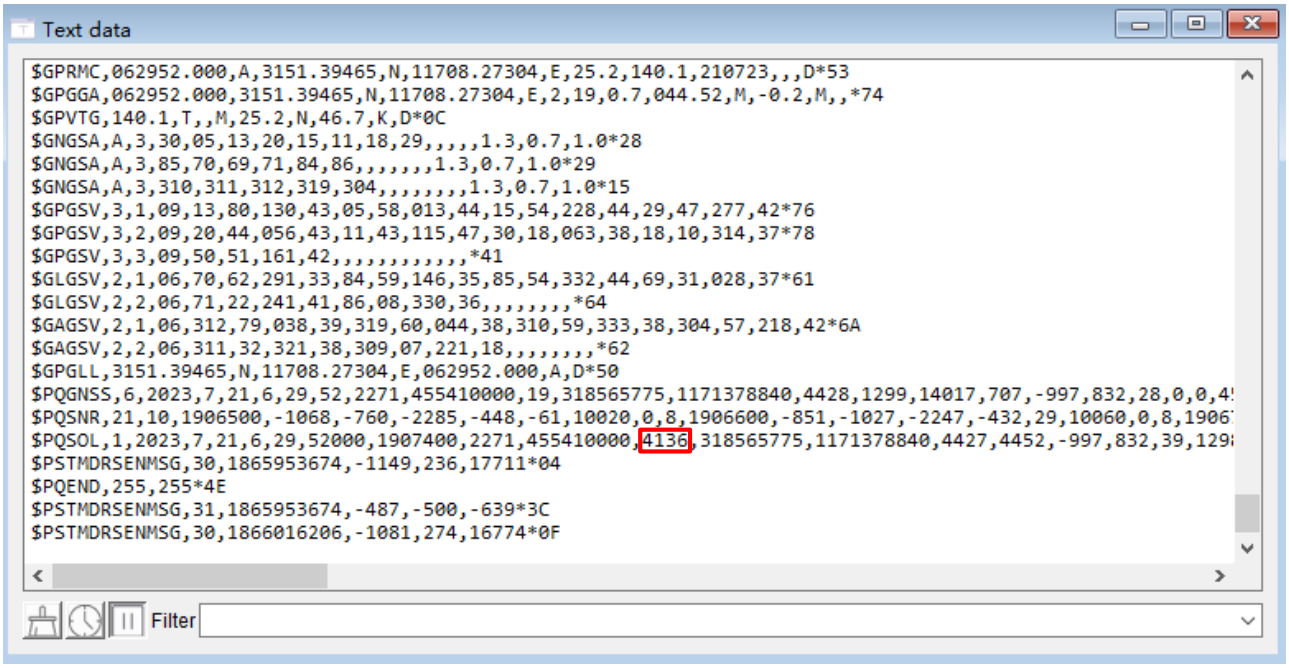


Figure 22: L26-DR (UDR) EVB Calibration Result – Complete Calibration

6 EVB and Antenna Installation

6.1. GNSS Antenna Installation

The installation environment affects antenna reception performance and satellite visibility, which in turn affect the positioning performance of a GNSS receiver. In addition, antenna's position and direction can also impact its reception performance. Therefore, it is important to avoid obstacles and interference when installing antenna. For automotive applications, it is recommended to fix the antenna firmly on the roof of the car, as shown in the figure below. Place the ceramic patch antenna horizontally and make sure it radiates toward the sky. Ensure that the antenna cable is undamaged during the test. Any damage to the cable can affect reception performance and test results.

If dynamic testing is required, make sure that the antenna is firmly fixed to the device under test. No relative movement or vibration between the antenna and device is allowed.

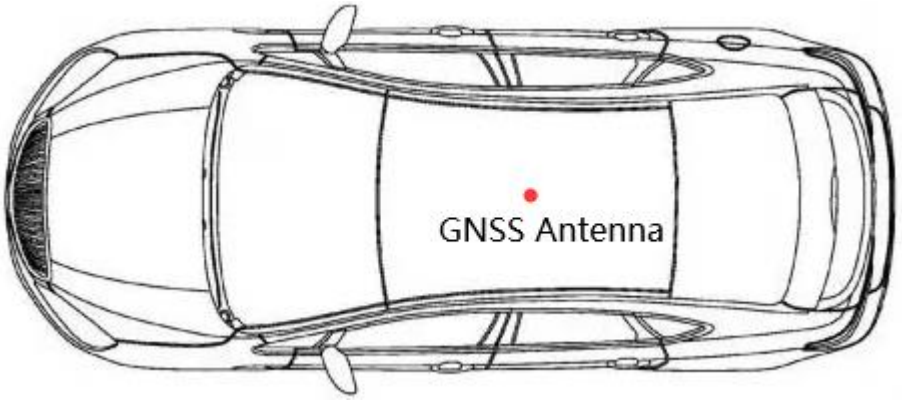


Figure 23: GNSS Antenna Installation

6.2. EVB Installation

If dynamic testing and DR performance testing are required, make sure the EVB is fixed to the device under test so as to avoid any movement or vibration with respect to the device.

7 Measuring Power Consumption

7.1. Power Consumption at Different Stages

Module power consumption is measured in four stages: acquisition and tracking (including almanac update), tracking (almanac update is over), upon entering Standby mode and upon entering Backup mode.

- Acquisition and tracking (including almanac update): 0 s to 12.5 min
- Tracking (almanac update is over): > 12.5 min
- Entering Standby mode
- Entering Backup mode

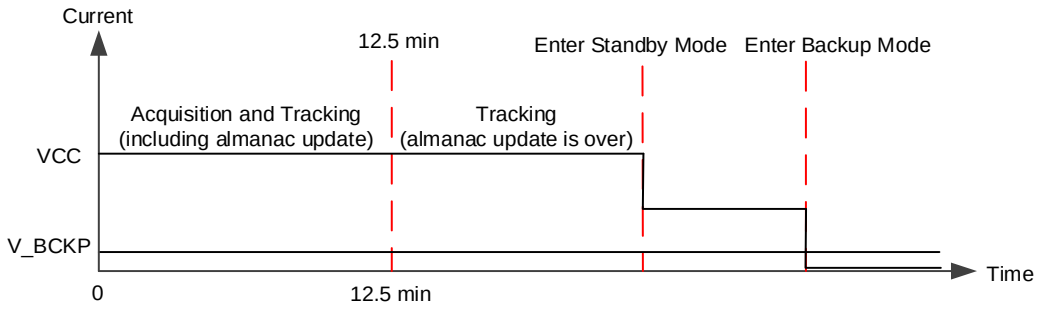


Figure 24: Power Consumption at Different Stages

7.2. VCC Power Consumption Measurement

Before measuring the VCC power consumption, you must connect the components to the EVB to ensure that the module can communicate and fix normally. See *Chapter 4.1 Test via QGNSS*.

Detailed steps for measuring VCC power consumption with an ammeter:

Step 1: Switch off the power supply (S201). Connect the ammeter in series to both ends of the head pins of J102 as shown below.

Step 2: Switch on the power supply (S201) and read the ammeter.

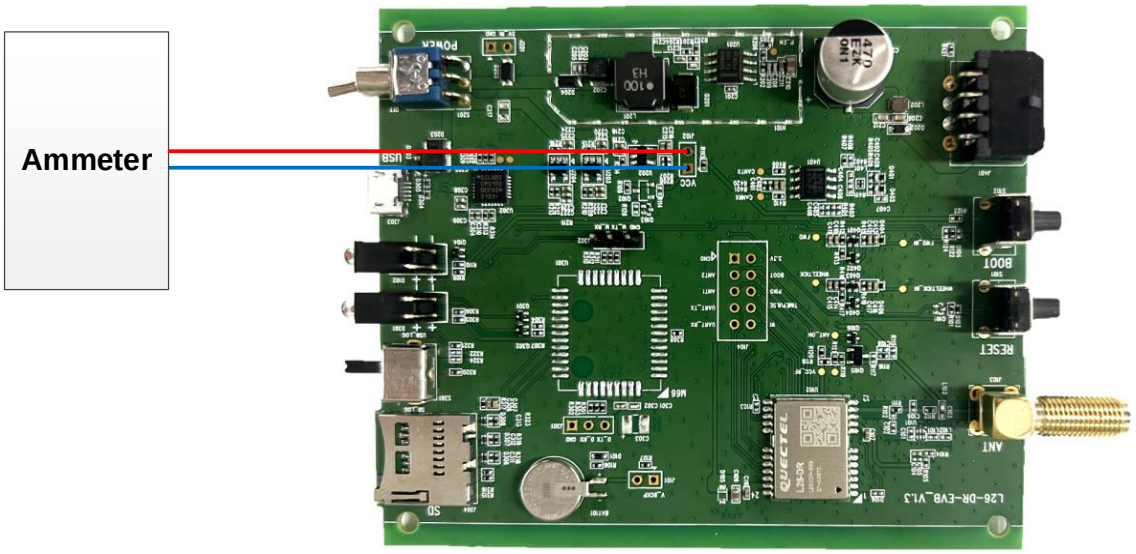


Figure 25: VCC Power Consumption Measured with Ammeter

Detailed steps for measuring VCC power consumption with a power consumption meter:

Step 1: Switch off the power supply (S201). Make sure the positive pole of the power consumption meter consumption meter is connected to VCC (with arrow silkscreen) of J102, and the negative pole is connected to GND.

Step 2: Switch on the power supply (S201) and read the power consumption meter.

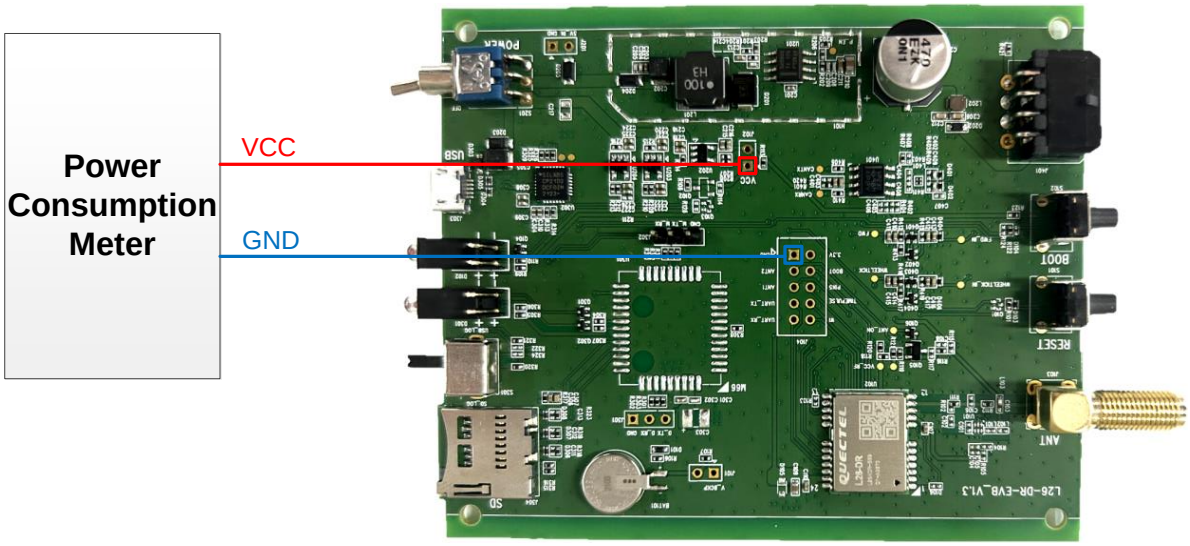


Figure 26: VCC Power Consumption Measured with Power Consumption Meter

7.3. V_BCKP Power Consumption Measurement

Before measuring the V_BCKP power consumption, you must connect the components to EVB to ensure that the module can communicate and fix normally. See *Chapter 4.1 Test via QGNSS*.

Detailed steps for measuring V_BCKP power consumption with an ammeter:

Step 1: Switch off the power supply (S201). Connect the ammeter in series to both ends of the head pins of J101, as shown below.

Step 2: Switch on the power supply (S201) and read the ammeter.

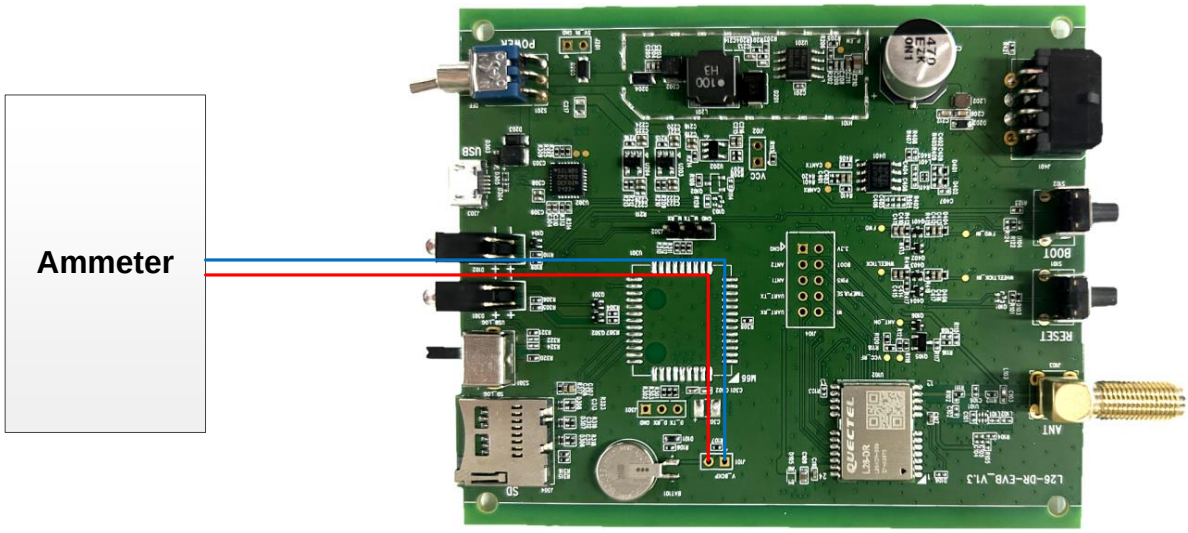


Figure 27: V_BCKP Power Consumption Measured with Ammeter

Detailed steps for measuring V_BCKP power consumption with a power consumption meter:

Step 1: Switch off the power supply (S201). Make sure the positive pole of the power consumption meter is connected to V_BCKP (with arrow silkscreen) of J101, and the negative pole is connected to GND.

Step 2: Switch on the power supply (S201) and read the power consumption meter.

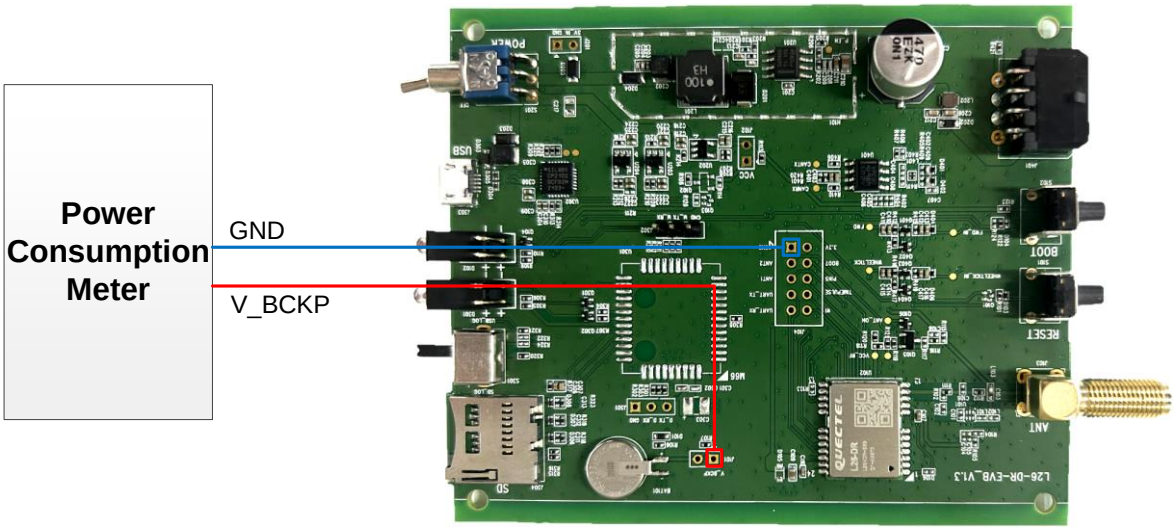


Figure 28: V_BCKP Power Consumption Measured with Power Consumption Meter

NOTE

1. Adjust the current resolution when using the power consumption meter.
2. Formula for calculating the power value: $P = V_{Supply} \times I_{Test}$.
3. Before measuring the V_BCKP power consumption in Backup mode, ensure that the module has entered Backup mode, and then cut off the power supply of VCC. For more information about the way to enter/exit Backup mode, see *document [4] hardware design*.

8 EVB Framework

The power is supplied to EVB via Micro-USB, and then to the GNSS module via a Low-dropout Regulator (LDO). GNSS module outputs the signals from communication interface on EVB via USB-to-UART Bridge Chip (CP2102N). There are an antenna interface and control buttons on EVB. All functions of the module are available, including debugging.

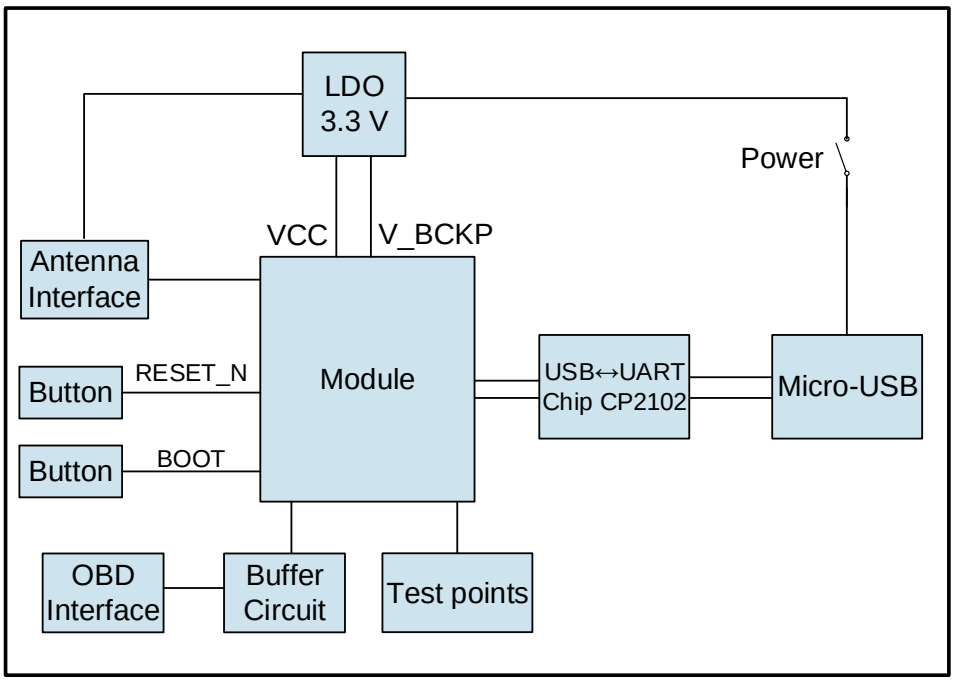


Figure 29: EVB Framework

9 Common Problems and Troubleshooting

1. **Unable to find COM port in the Device Manager when EVB is connected to PC with a USB cable.**
   - Check that the EVB communication interface is properly connected to the PC.
   - Verify that CP210x Driver has been installed successfully.

2. **Communication interface not outputting any messages or commands.**
   - Check that the power supply indication LED on the EVB is illuminated.
   - Verify that the jumper cap(s) is(/are) connected correctly.
   - Ensure that the module's power supply is normal.

3. **Module unable to search for satellite signals.**
   - If there is no transponder indoors, test the module in an open-sky environment.

4. **Module unable to enter BOOT download mode or upgrade mode.**
   - Verify whether the module is in BOOT download mode or normal operating mode.
   - Check that the downloaded firmware is correct.
   - Confirm that the correct COM port has been selected.

NOTE

For the problem(s) that cannot be solved, you can contact Quectel Technical Support (support@quectel.com).

10 Cautions

- Make sure to conduct tests under the same environment when comparing different parameters of GNSS modules.
- Note that parameters, such as cold start, acquisition and tracking, may be defined differently by chip suppliers.
- Ensure that the measurement method is correct. If there are significant differences between parameters tested via EVB and those provided by Quectel, please contact Quectel Technical Support.
- Note that momentary data obtained from measurement cannot always be regarded as reference data, because it may be affected by various factors, such as satellite positions at different times, environmental conditions, temperature, humidity and altitude.
- Keep in mind that the QGNSS Tool may updated periodically to fix bugs or improve performance. Please make sure that you are using the latest version of the Tool.

11 Appendix References

Table 7: Related Documents

Document Name
[1] Quectel_QGNSS_User_Guide
[2] Quectel_L26-DR(ADR)_DR_Application_Note
[3] Quectel_L26-DR(UDR&ADRC)_DR_Application_Note
[4] Quectel_L26-DR_Series_Hardware_Design

Table 8: Terms and Abbreviations

Abbreviation	Description
1PPS	One Pulse Per Second
2D	2 Dimension
3D	3 Dimension
BDS	BeiDou Navigation Satellite System
C/N_0	Carrier-to-Noise Ratio
CAN	Controller Area Network
CEP	Circular Error Probable
COM Port	Communication Port
DC	Direct Current
DGNSS	Differential Global Navigation Satellite System
DGPS	Differential Global Positioning System
DI	Digital Input

Abbreviation	Description
DO	Digital Output
DR	Dead Reckoning
EPH	Ellipsoidal Height
ESD	Electrostatic Discharge
EVB	Evaluation Board
Galileo	Galileo Satellite Navigation System (EU)
GLONASS	Global Navigation Satellite System (Russia)
GND	Ground
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HDOP	Horizontal Dilution of Precision
I/O	Input/Output
IMU	Inertial Measurement Unit
LDO	Low-dropout Regulator
LED	Light Emitting Diode
Micro-USB	Micro Universal Serial Bus
MSL	Mean Sea Level
NavIC	Indian Regional Navigation Satellite System
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
NVM	Non-volatile Memory
OBD	On Board Diagnostics
PC	Personal Computer
PDOP	Position Dilution of Precision
PRN	Pseudo Random Noise

Abbreviation	Description
PSTM	ST Proprietary Message
QZSS	Quasi-zenith Satellite System
RF	Radio Frequency
RTK	Real Time Kinematic
SBAS	Satellite-based Augmentation System
SD	Secure Digital Memory Card
SMA	SubMiniature Version A
SPS	Standard Positioning System
TTFF	Time to First Fix
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
UTC	Coordinated Universal Time