QUECTEL LC76G Series GNSS Positioning Module User Guide

LC76G Series
EVB User Guide

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LC76G Series GNSS Positioning Module

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	Ensure that the product may be used in the country and the required environment, as well as that it conforms to the local safety and environmental regulations.
	Keep away from explosive and flammable materials. The use of electronic products in extreme power supply conditions and locations with potentially explosive atmospheres may cause fire and explosion accidents.
	The product must be powered by a stable voltage source, 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

Document Information

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–	7/19/2022	Creation of the document
1	4/21/2023	First official release

Introduction

This document provides information on the steps needed to evaluate the Quectel LC76G series module using the Evaluation Board (EVB). The EVB is a convenient tool that allows you to become familiar with the module. Specifically, the document is divided into several sections:

- Chapter 2 provides the general overview of EVB kit.
- Chapter 3 describes the EVB user interfaces.
- Chapter 4 describes how to test the module and upgrade the firmware via QGNSS tool.
- Chapter 5 describes the installation of EVB and antenna.
- Chapter 6 describes how to measure power consumption for the module.
- Chapter 7 provides the EVB framework.
- Chapter 8 describes the common problems and troubleshooting.
- Chapter 9 describes the cautions.

- Chapter 10 is an appendix, which summarizes the relevant documents, terms and abbreviations appearing herein.

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

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, or argument, it indicates that the function, feature, interface, pin, or argument is under development a nd currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.

General Overview

2.1. EVB Kit

The EVB kit includes: Evaluation Board (EVB), active GNSS antenna, Type-B USB cable, bolts and coupling nuts. The EVB kit contents are shown in the figure below. Check Table 2: List of Kit Components for details.

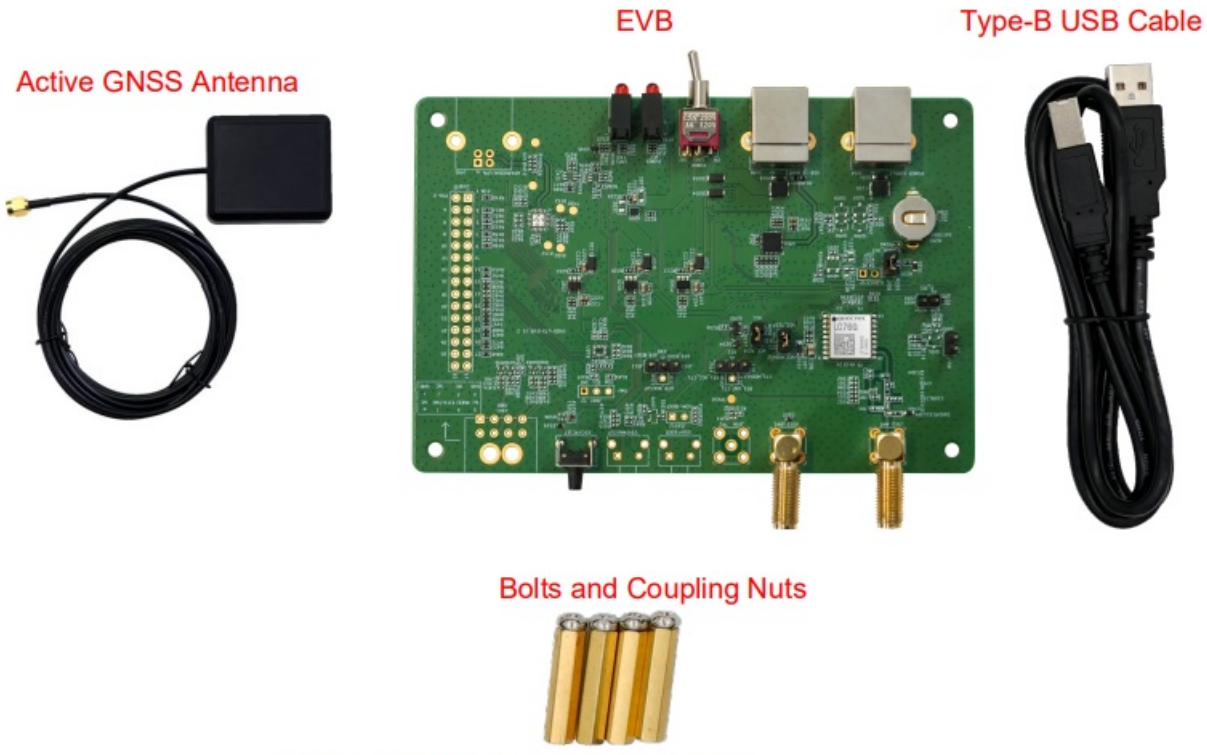


Figure 1: EVB and Components

Table 2: List of Kit Components

Items	Description	Quantity
EVB	Evaluation Board Size: 80 mm × 120 mm	1
USB Cable	Type-B USB Cable	1
GNSS Antenna	Active GNSS Antenna (Model: YEGM020AA) Antenna Size: 47 mm × 55 mm × 16.2 mm Cable Length: 3000 mm	
	The GNSS antenna supports: GPS L1 C/A GLONASS L1 Galileo E1 BDS B1I, BIC QZSS L1 C/A SBAS L1	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 Cable 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.

EVB Interfaces

3.1. EVB Top View

EVB top view is shown in the figure below.

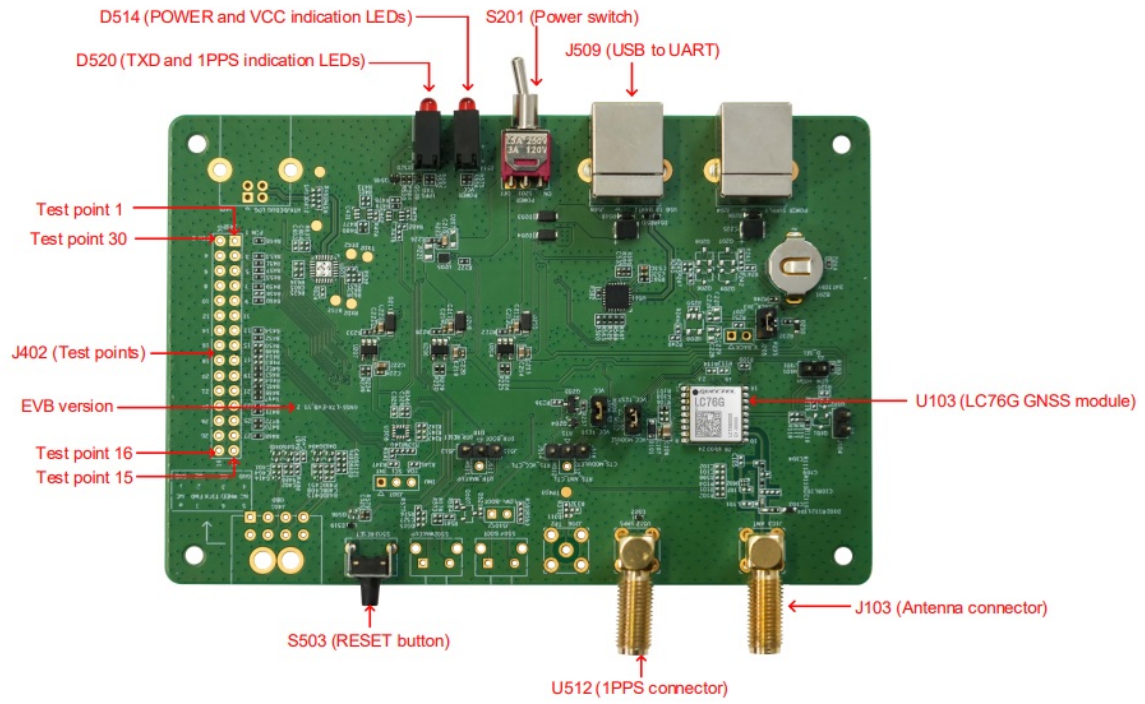


Figure 3: EVB Top View

3.2. EVB Interfaces

The EVB interfaces are detailed in the table below.

Table 3: Detailed EVB Interfaces

Function	Interfaces		Description
Power Supply	J509 USB to UART		Power supply input: DC power supply: 4.5-5.5 V, Typ. 5.0 V Current capability should be > 100 mA
Communication Interface	J509 USB to UART		Supports RTCM and standard NMEA message, PAIR/PQTM message and binary data, and firmware upgrade.
i. SMA Connectors	J103 Antenna connector		Used for connecting GNSS antenna.
	U512 1PPS connector		Used for testing 1PPS signal.
Signal Indication	D514 Indication LEDs	POWER (Red)	Bright: EVB is powered well. i, Extinct: EVB is not powered.
		VCC (Green)	Bright: Module is powered well. Extinct: Module is not powered.
	D520 Indication LEDs	1PPS (Red)	Flashing: Successful position fix. Frequency: 1 Hz. Extinct: No position fix.
		TXD (Green)	Unsupported.
Switches and Buttons	S201 Module power switch		Powers the module VCC on/off.
	ir S503 RESET		Short press the button to reset the module.

The J402 test point of LC76G EVB is shown below:

Table 4: J402 Pin Detailed Description

Test Point No.	Test Point Label	Test Point Function	I/O	Description
1	PIN1	GND	–	Ground
2	3	U103: Pin 3	DI	RXD: Receives data
3	5	U103: Pin 5	–	Reserved
4	7	U103: Pin 7	–	Reserved
5	9	U103: Pin 9	DI	RESET_N: Resets the module
6	11	U103: Pin 11	–	NC (Not Connected)
7	13	U103: Pin 13	DI	ANT_ON: Power control for external LNA or active antenna in power saving mode
8	15	U103: Pin 15	–	Reserved
9	17	U103: Pin 17	DI	I2C_SCL: I2C serial clock
10	19	U103: Pin 19	–	Reserved
11	21	U103: Pin 21	DO	GEOFENCE: Indicates geofence st atus
12	23	U103: Pin 23	DO	3D_FIX*: 3D position fix indication
13	25	U103: Pin 25	DI	SPI_CLK*: SPI clock signal
14	27	U103: Pin 27	DI	SPI_MOSI*: SPI master output, slave input
15	No label	–	–	NC
16	No label	–	–	NC
17	28	GND	–	Ground
18	26	U103: Pin 26	DO	SPI_MISO*: SPI master input, slave output
19	24	U103: Pin 24	DI	D_SEL: Selects UART/SPI interface to download
20	22	U103: Pin 22	DO	JAM_IND*: Jamming indication
21	20	U103: Pin 20	DI	SPI_CS*: SPI chip-select
22	18	U103: Pin 18	–	Reserved
23	16	U103: Pin 16	DIO	I2C_SDA: I2C serial data
24	14	U103: Pin 14	PO	VDD_RF: Power supply for external RF components
25	12	GND	–	Ground

26	10	GND	–	Ground
27	8	U103: Pin 8	PI	VCC: Main power supply
28	6	U103: Pin 6	PI	V_BCKP: Backup power supply for backup domain of module
29	4	U103: Pin 4	DO	1PPS: 1 pulse per second
30	PIN2	U103: Pin 2	DO	TXD: Transmits data

NOTE

1. Te s t points of J402 are arranged clockwise, and their serial numbers are shown in Figure 3: EVB Top View.
2. A J402 test point refers to the module's corresponding function. For detailed descriptions, see document [1] hardware design.

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 for firmware upgrade. For more information about QGNSS use, see document [2] QGNSS user guide.

4.1. Test via QGNSS

Step 1: Assemble the EVB components.
Step 2: Connect the EVB and the PC with a Type-B USB cable then flip the power switch (S201) of the module to ON position to power on the module.
Step 3: Start the QGNSS and click "Device" and "Set Device Information" (default baud rate: 115200 bps 1).

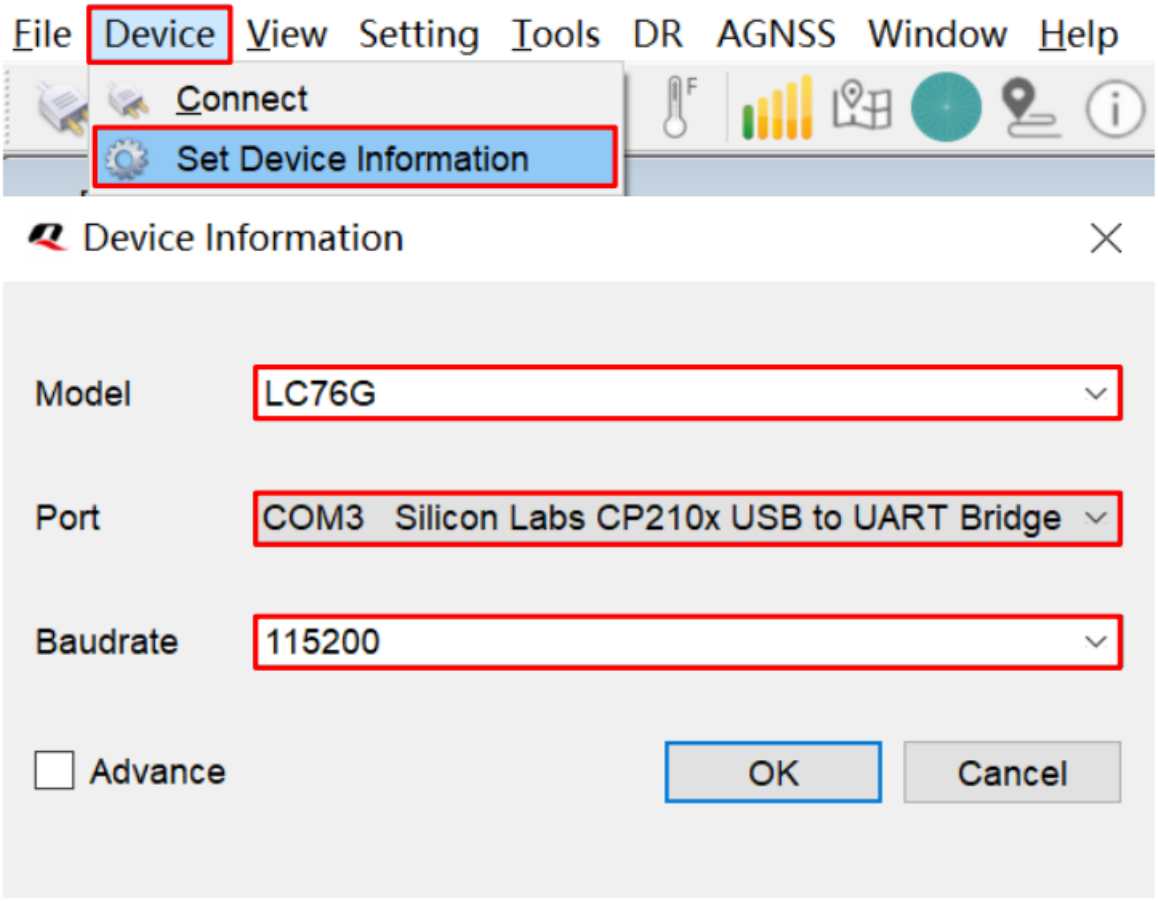


Figure 4: COM Port and Baud Rate Setting

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

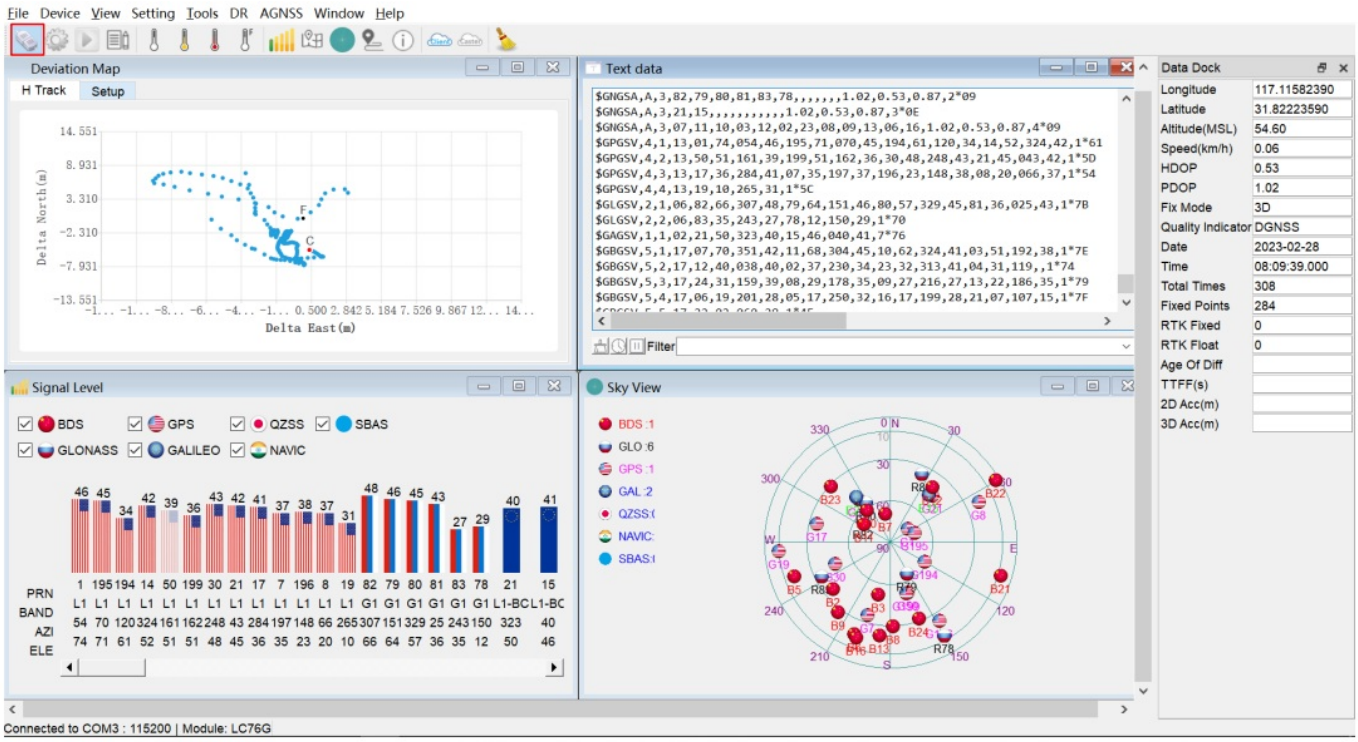


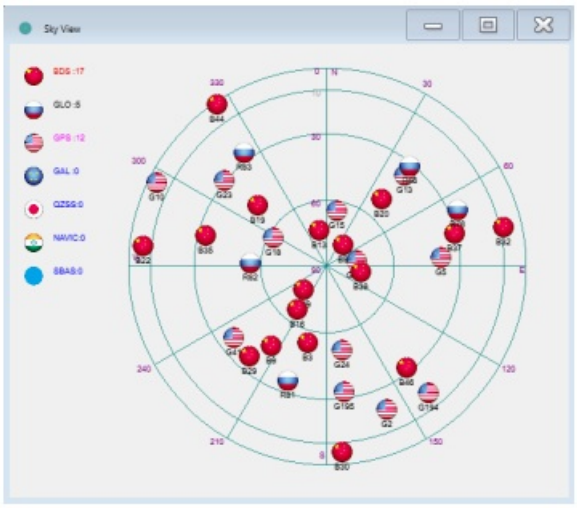
Figure 5: QGNSS Interface (Connected)

4.2. GNSS Interface Explanation

You can view GNSS information, such as C/N0 message, time, position, speed, and precision in the QGNSS interface. See the following table to find out more about these parameters.

Table 5: 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 numbers.

- BDS: 17
- GLO (GLONASS): 5
- GPS: 12
- GAL (Galileo): 0
- QZSS: 0
- NAVIC: 0
- SBAS: 0

Icon

2) The sky view on the right shows the position of the satellites in use.

GPS satellite

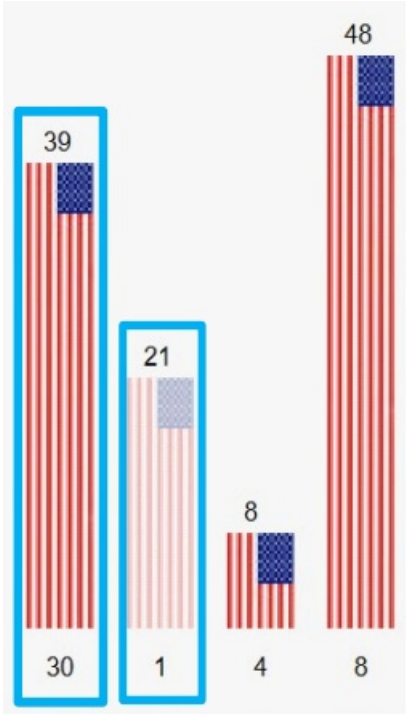
BD S satellite

GLONASS satellite

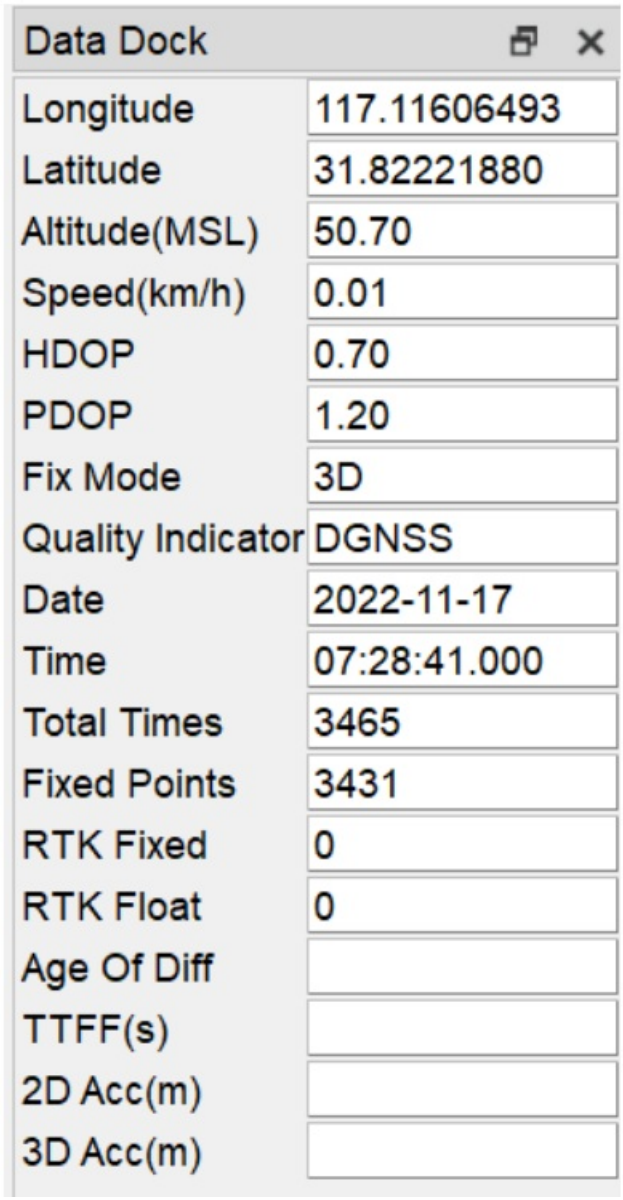
Galileo satellite

QZSS satellite

NavIC satellite



- PRN 30 C/N0 is 39 dB-Hz.
- Column in bright red mean that the navigation data of the satellites are in use.
- PRN 1 C/N0 is 21 dB-Hz.
- Column in light red means that the navigation data of the satellites are not in use.



- Longitude (unit: °)
- Latitude (unit: °)
- Altitude (MSL) (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
- TTFF (unit: s)
- 2D accuracy (unit: m)

- 3D accuracy (unit: m)

4.3. Firmware Upgrading

Power on the EVB before upgrading the firmware, see Chapter 4.1 Test via QGNSS for details.
Firmware upgrading steps:
Step 1: Open QGNSS tool, and click “Tools” and select “Firmware Download” in the drop-down box.

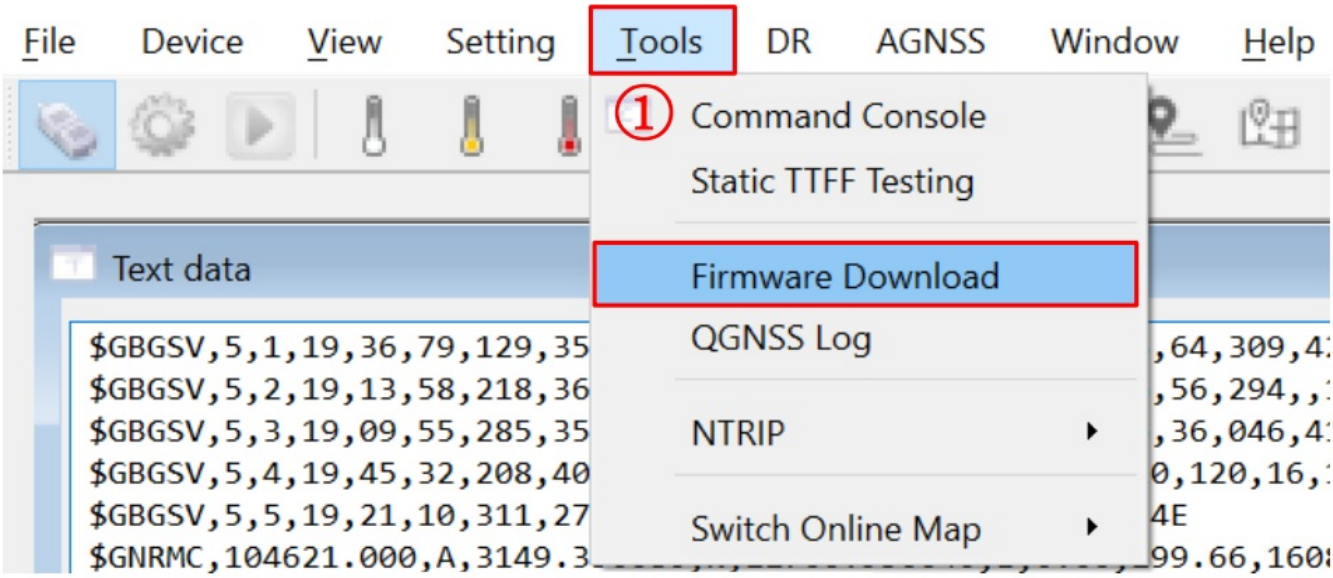


Figure 6: Tool Startup

Step 2: Select the appropriate “Download Baudrate” in the drop-down box of “Settings”.

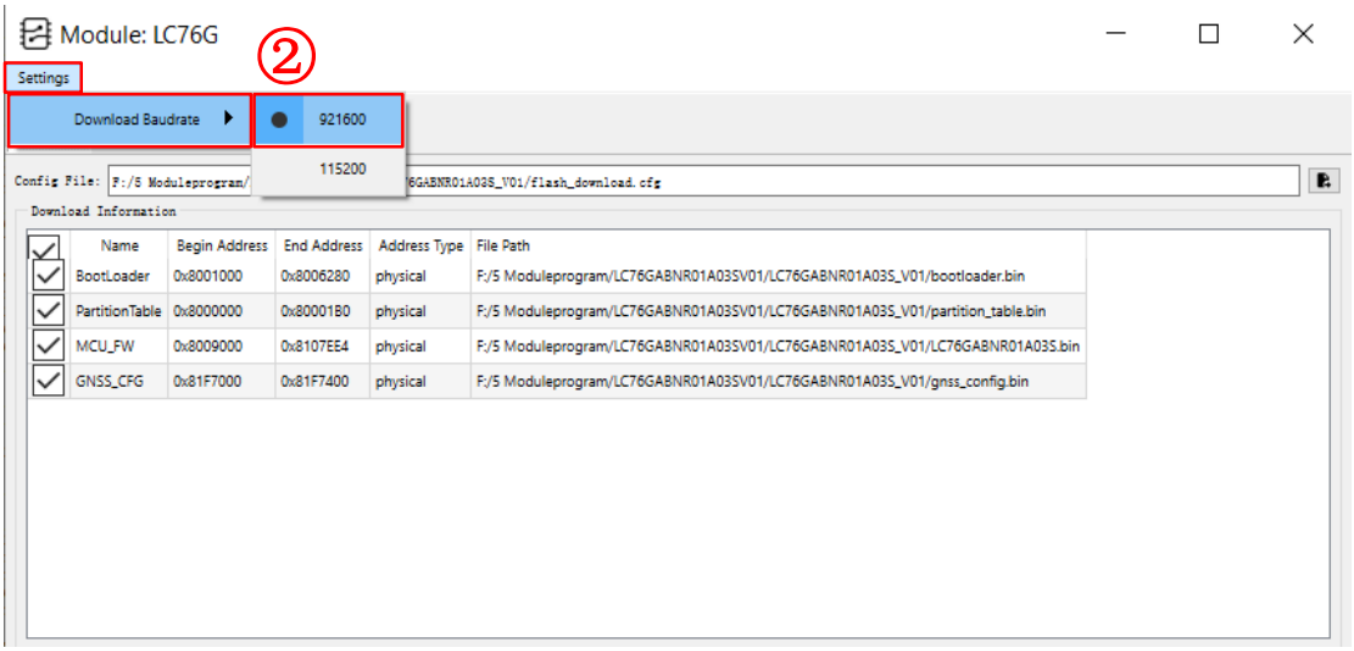


Figure 7: Tool Setting

Step 3: Click the  “Open Config File” button to select Config file, e.g., “flash_download.cfg”.

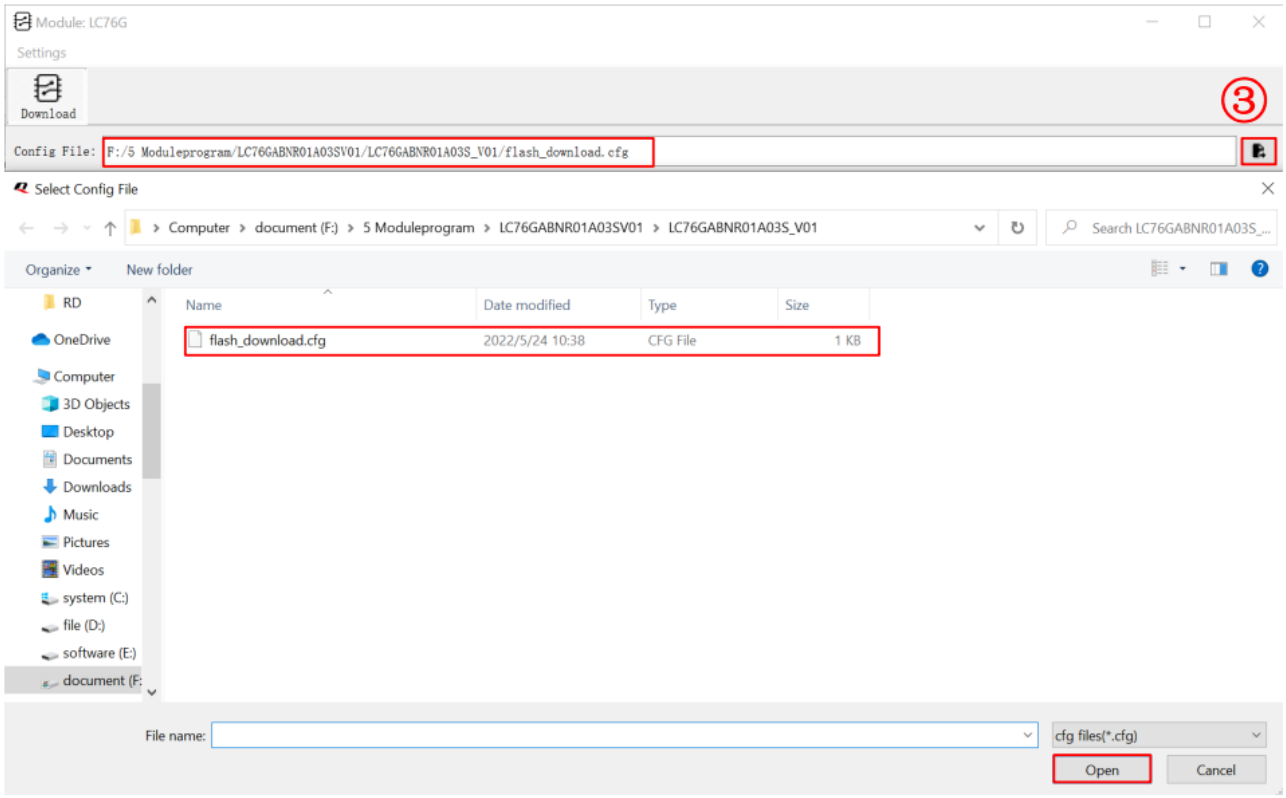


Figure 8: Firmware Selecting

Step 4: Click the  “Run” button and then short-press on the reset button after the progress bar prompts you to reset the module.

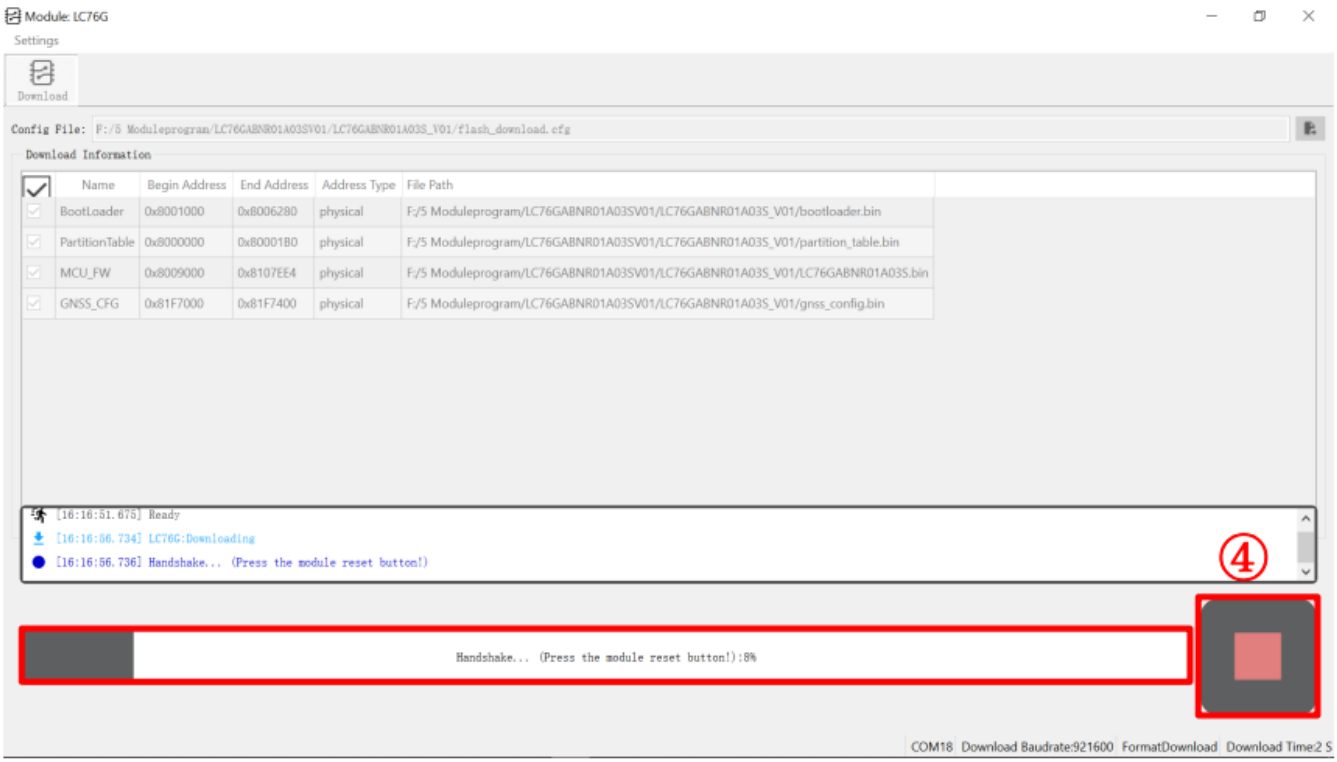


Figure 9: Firmware Upgrading

Step 5: Upon successful firmware upgrading, the QGNSS tool’s progress bar on the screen will indicate “100 %”.

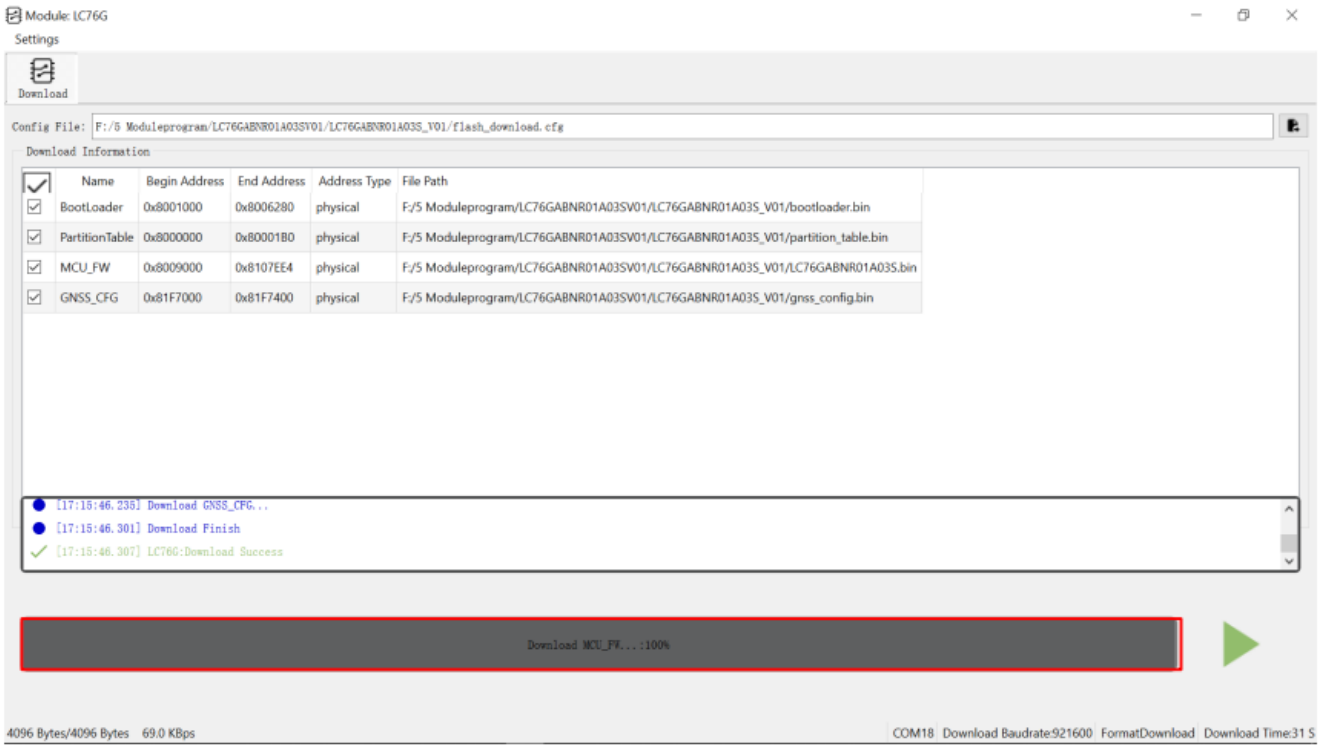


Figure 10: Successful Firmware Upgrading

NOTE
Make sure the module is in Continuous mode before upgrading firmware.

EVB and Antenna Installation

5.1. 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. Place the ceramic patch antenna horizontally and make sure it faces toward the sky.
If dynamic testing is required, make sure that the GNSS antenna is firmly fixed to the device under test so as to avoid any movement or vibration with respect to the device.

5.2. EVB Installation

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

Measuring Power Consumption

6.1. 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 ALP mode and Backup mode.

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

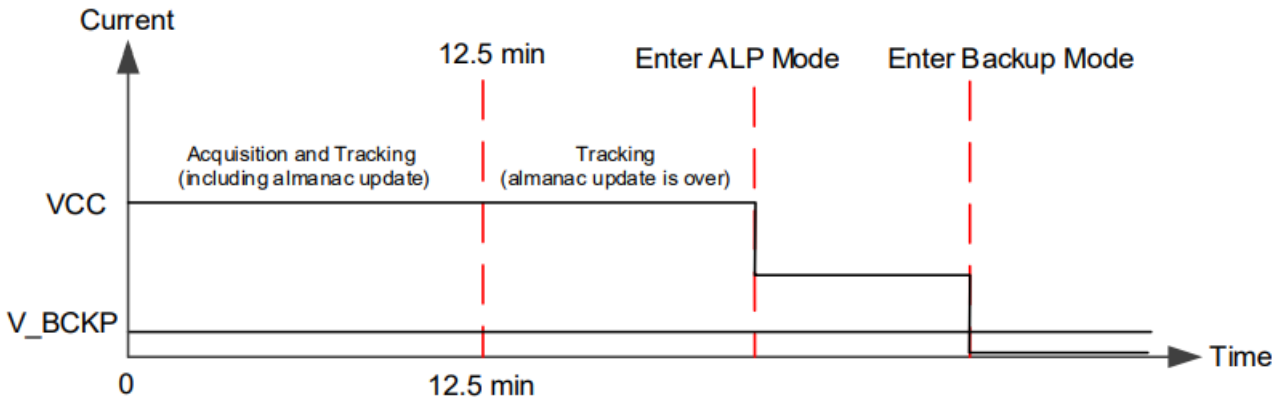


Figure 11: Power Consumption at Different Stages

NOTE

The EVB works normally. After entering the tracking mode, the module enters the ALP mode when the $PAIR732,1*21 command is sent. Then, the power consumption of the ALP mode can be measured. Record the average value after the power consumption of the ALP mode is stable. For more information, see document [3] protocol specification.

6.2. Power Consumption Measurement for VCC or in ALP Mode

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

Detailed steps for measuring power consumption of VCC or in ALP mode with an ammeter:

Step 1: Switch off the power supply (S201) of the module and pull out the VCC_MODULE jumper cap (J102). Connect the ammeter in series to the pins of J102 as shown below.

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

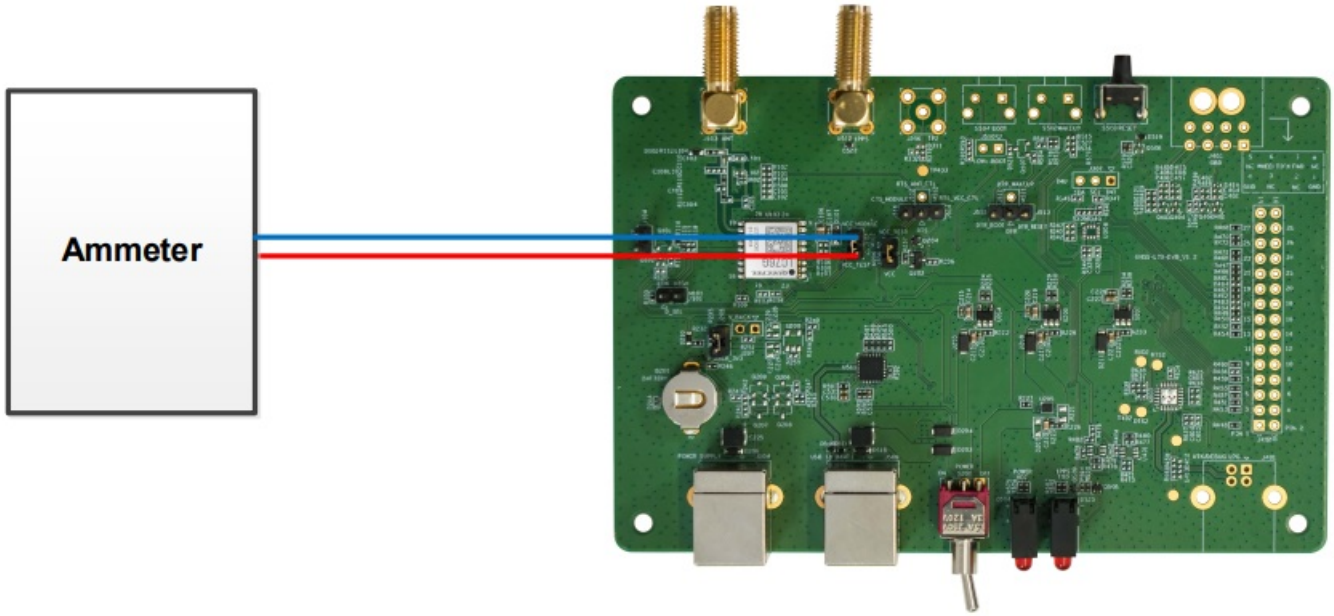


Figure 12: Measured with Ammeter for VCC or in ALP Mode

Detailed steps for measuring power consumption of VCC or in ALP mode with a power consumption meter:

Step 1: Switch off the power supply (S201) of the module and pull out the VCC_MODULE jumper cap (J102). Make sure the positive pole of the power consumption meter is to be connected to pin 2 (without arrow silkscreen) of J102, and the negative pole is connected to GND.

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

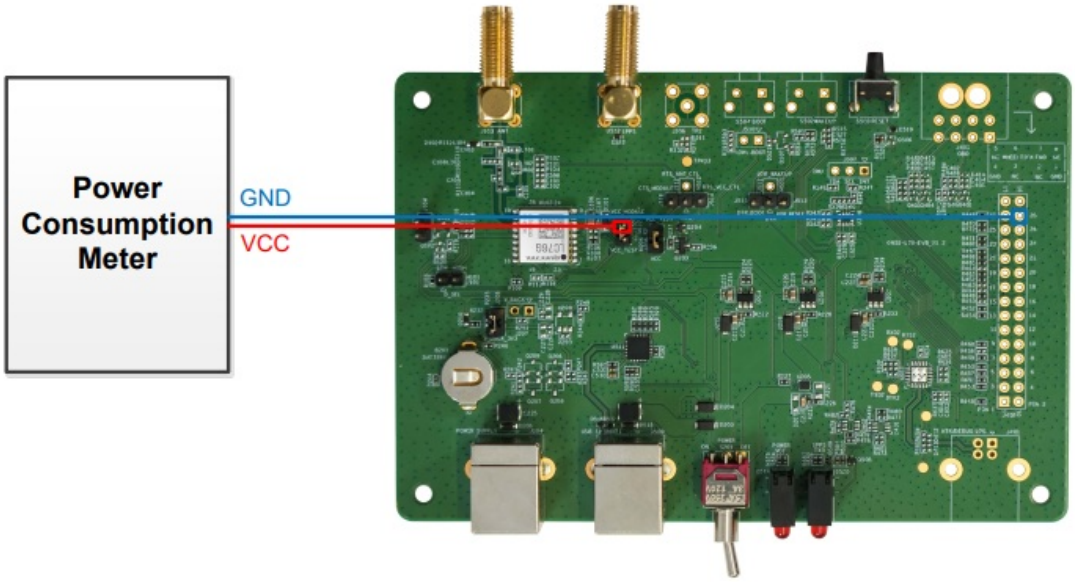


Figure 13: Measured with Power Consumption Meter for VCC or in ALP Mode

NOTE

The EVB works normally. After entering the tracking mode, the module enters the ALP mode when the $PAIR732,1*21 command is sent. Then, the power consumption of the ALP mode can be measured. Record the average value when the power consumption in the ALP mode is stable. For more information, see document [3] protocol specification.

6.3. 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).

For LC76G (AB, PA), pull out the V_BACK_3V3 jumper cap (J205). Connect the ammeter in series to the pins of J205, as shown below.

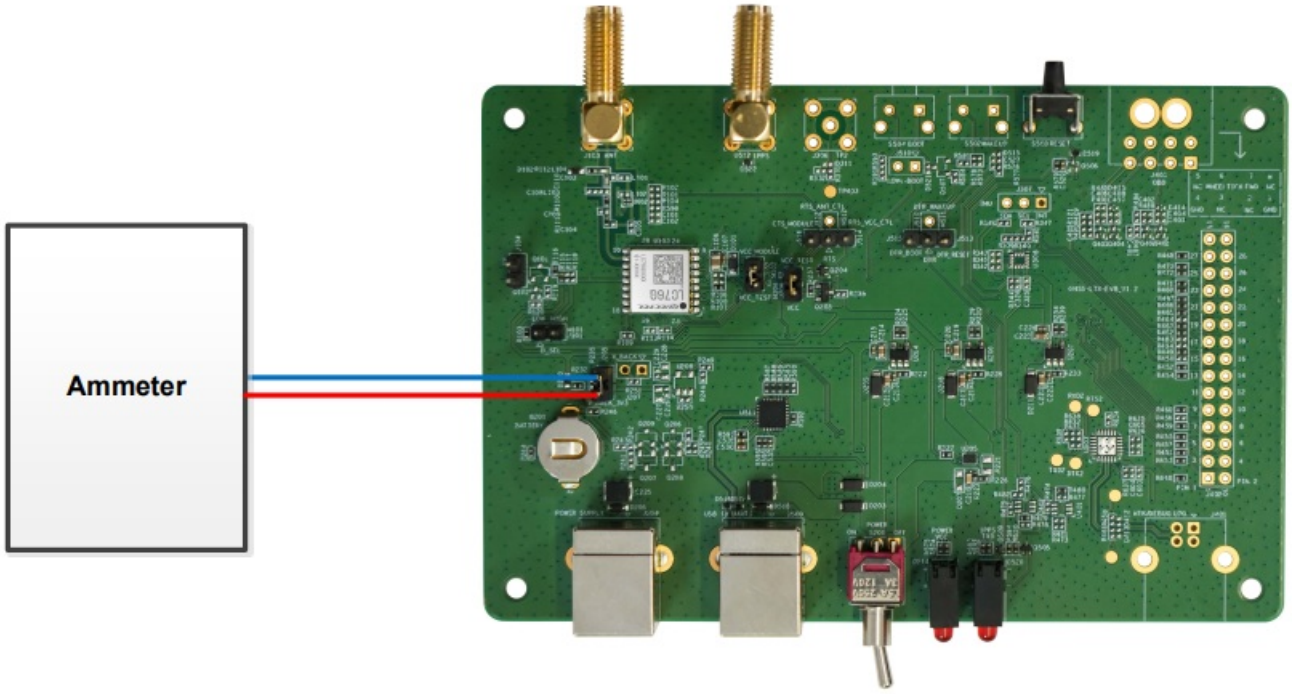


Figure 14: Measured with Ammeter for LC76G (AB, PA)

For LC76G (PB), pull out the V_BACK jumper cap (J207). Connect the ammeter in series to the pins of J207, as shown below.

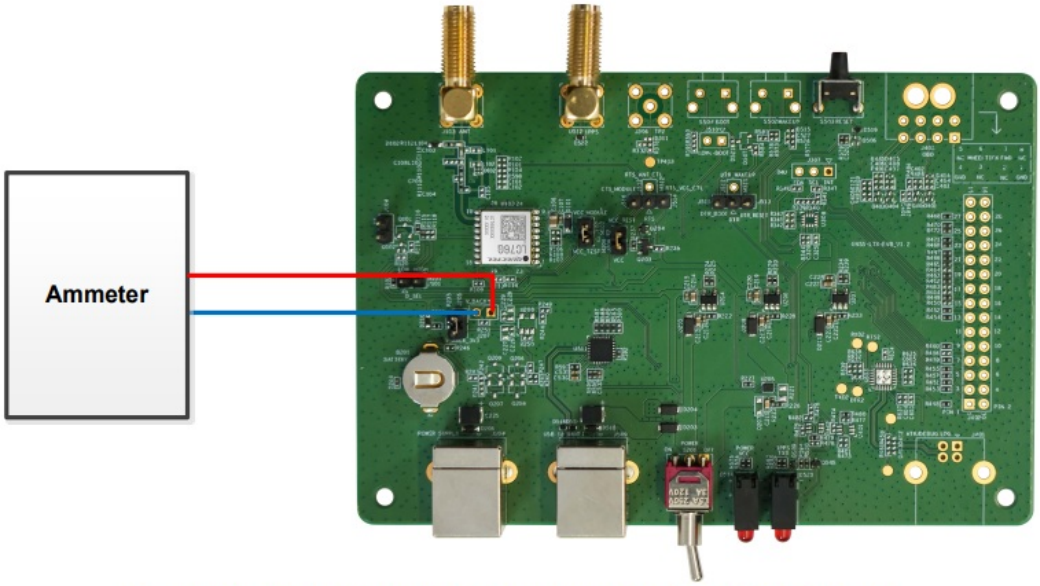


Figure 15: Measured with Ammeter for LC76G (PB)

Step 2: Switch on the power supply and read the ammeter.
Detailed steps for measuring V_BCKP power consumption with power consumption meter:
Step 1: Switch off the power supply (S201) of the module. Ensure the positive pole of the power consumption meter is connected to the head pin of V_BACK_3V3, and the negative pole is connected to GND.
For LC76G (AB, PA), pull out the V_BACK_3V3 jumper cap (J205). Then, ensure the positive pole of the power consumption meter is connected to pin 2 (with arrow silkscreen) of J205, and the negative pole is connected to GND.

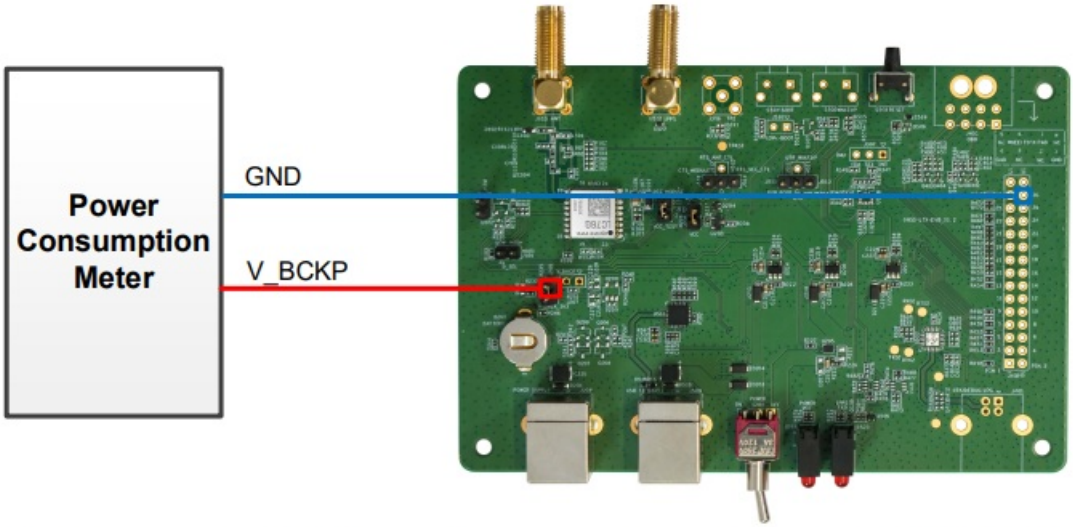


Figure 16: Measured with Power Consumption Meter for LC76G (AB, PA)

For LC76G (PB), pull out the V_BACK jumper cap (J207). Then, ensure the positive pole of the power consumption meter is connected to pin 2 (without arrow silkscreen) of J207, and the negative pole is connected to GND.

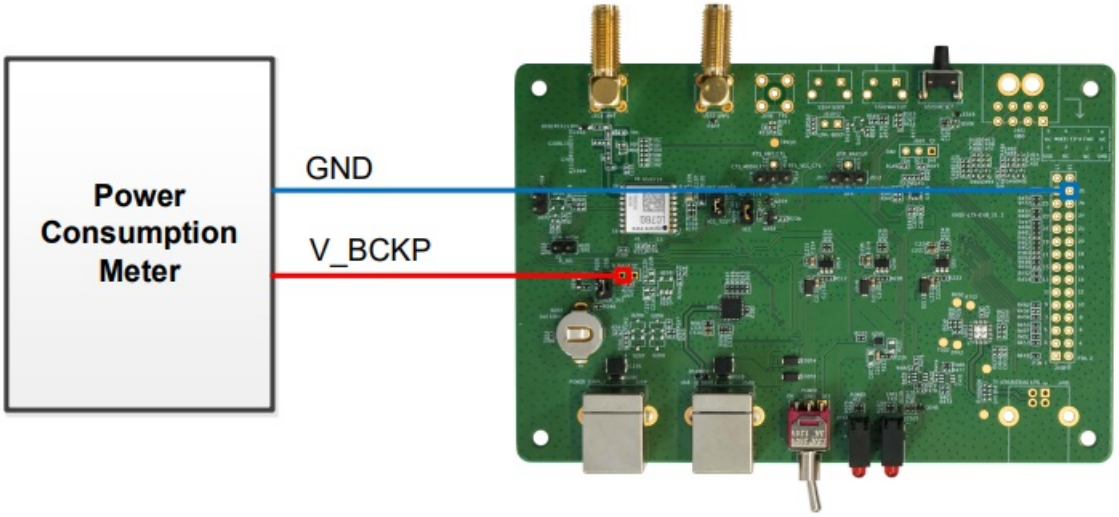


Figure 17: Measured with Power Consumption Meter for LC76G (PB)

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

NOTE

1. Adjust the current resolution when using the power consumption meter.
2. The power value can be calculated according to the following formula: P = V Supply× I Test.
3. When measuring the V_BCKP power consumption in Backup mode, ensure that the module has entered Backup mode, and then remove the jumper cap of VCC_MODULE (J102) to cut off the power supply of VCC. For more information about the way to enter/exit Backup mode, see document [1] hardware design.

EVB Framework

The power is supplied to EVB via Type-B, and then power to GNSS module via a Linear voltage 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 a control button on EVB. All functions of the module are available, including debugging.

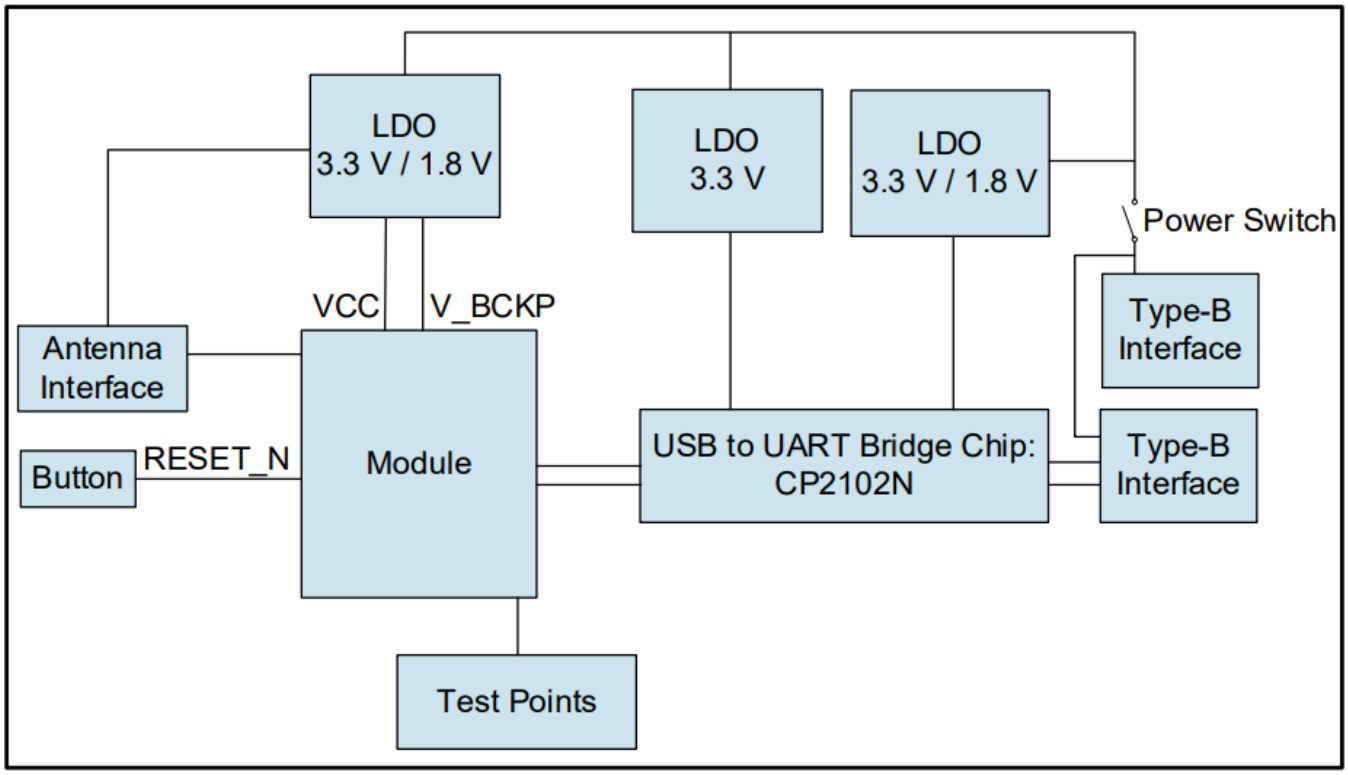


Figure 18: EVB Framework

NOTE
The operating voltage of LC76G (AB, PA) is 3.3 V, while the operating voltage of LC76G (PB) is 1.8 V.

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, as shown in Figure 1: EVB and Components.
   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 upgrade.
   Verify whether the module is in 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, please contact Quectel Technical Support (**support@quectel.com**).

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.

Appendix References

Table 6: Related Documents

Document Name

[1] Quectel_LC76G_Series_Hardware_Design

[2] Quectel_QGNSS_User_Guide

[3] Quectel_LC26G&LC76G&LC86G_Series_GNSS_Protocol_Specification

Table 7: Terms and Abbreviations

Abbreviation	Description
2D	2 Dimension
3D	3 Dimension
BDS	BeiDou Navigation Satellite System
C/N0	Carrier-to-Noise Ratio
CEP	Circular Error Probable
COM Port	Communication Port
DC	Direct Current
DI	Digital Input
DO	Digital Output
ECEF	Earth-Centered, Earth-Fixed
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

I2C	Inter-Integrated Circuit
I/O	Input/Output
NAV I C	Indian Regional Navigation Satellite System
LED	Light Emitting Diode
LLA	Longitude, Latitude, and Altitude
MSL	Mean Sea Level
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
PC	Personal Computer
PCB	Printed Circuit Board
PDOP	Position Dilution of Precision
PI	Power Input
PO	Power Output
1PPS	One Pulse Per Second
PRN	Pseudo Random Noise
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RTK	Real Time Kinematic
RXD	Receive Data (Pin)
SBAS	Satellite-Based Augmentation System
SDA	I2C Serial Data
SPS	Standard Positioning Service
TTFF	Time to First Fix
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
UTC	Coordinated Universal Time
WGS84	World Geodetic System 1984

Documents / Resources

	**QUECTEL LC76G Series GNSS Positioning Module** [pdf] User Guide LC76G Series GNSS Positioning Module, LC76G Series, GNSS Positioning Module, Positioning Module, Module

References

- **User Manual**