LC86G Series
EVB User Guide

GNSS Module Series

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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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-	2022-07-29	Creation of the document
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Contents

Table Index

Figure Index

1 Introduction

This document provides information on the steps needed to evaluate the Quectel LC86G series module using the Evaluation Board (EVB). The EVB is a convenient tool that allows you to become familiar with the module.

The Quectel LC86G series module includes three variants: LC86G (AA), LC86G (AB) and LC86G (LA).

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 QGNSS software tool 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.

The EVB kit components are shown in the figure below. Check *Table 1: List of Kit Components* for details.

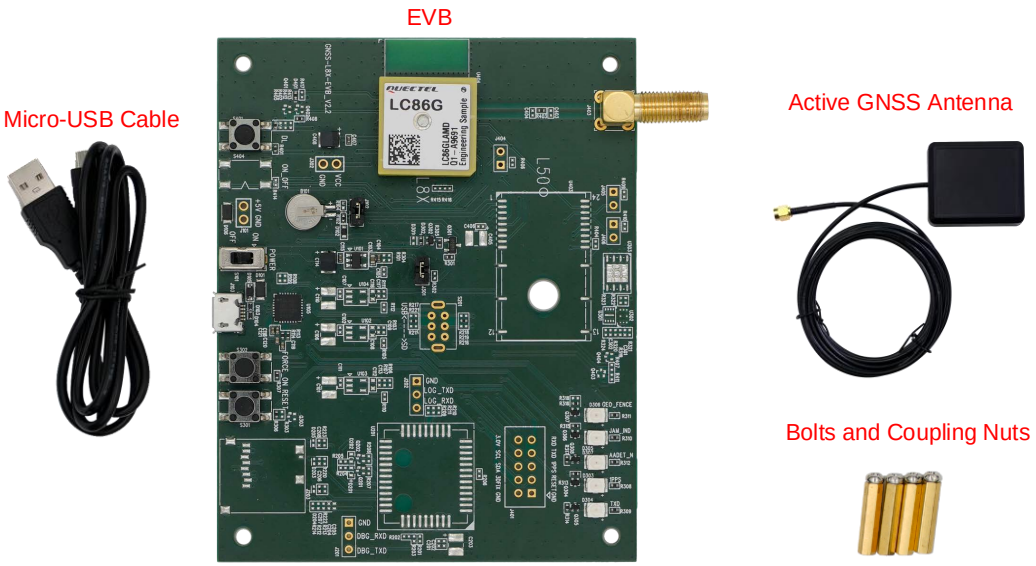


Figure 1: EVB and Components

Table 1: List of Kit Components

Items	Description	Quantity
EVB	Evaluation Board Size: 80 mm × 100 mm	1
USB Cable	Micro-USB Cable	1
GNSS Antenna	Active GNSS Antenna: YEGM020AA	1

Items	Description	Quantity
	Antenna Size: 47 mm × 55 mm × 16.2 mm Cable Length: 3000 mm	
	The antenna in the kit supports: ● GPS L1 C/A ● GLONASS L1 ● Galileo E1 ● BDS B1I, BIC ● QZSS L1 C/A ● SBAS L1	
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.

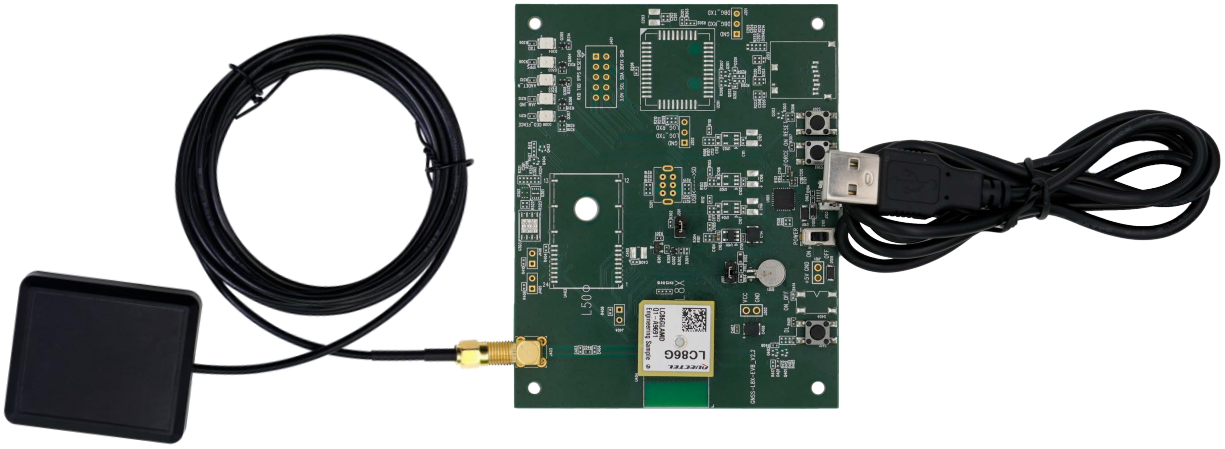


Figure 2: EVB and Components Assembly

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.

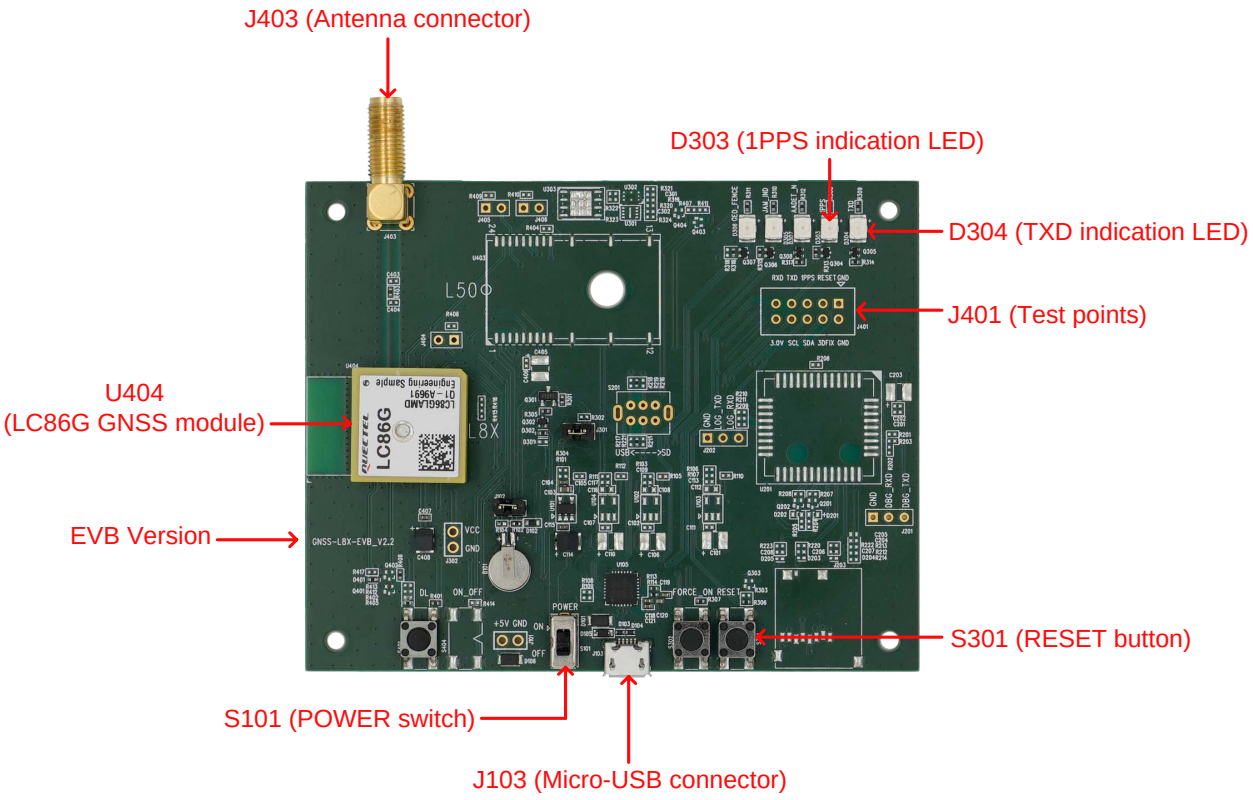


Figure 3: EVB Top View

3.2. EVB Interfaces

The EVB interfaces are detailed in the table below.

Table 2: Detailed EVB Interfaces

Function	Interfaces	Description
Power Supply	J103 Micro-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	J103 Micro-USB connector	Supports standard NMEA message, PAIR message and firmware upgrade.
RF Input	U404 LC86G GNSS module	Integrated patch antenna. Used for receiving GNSS signals.
SMA Connector	J403 Antenna connector	Used for connecting external GNSS antenna.
Signal Indication	D304 TXD indication LED	Flashing: Data are being output from UART TXD pin. Extinct or Bright: No data are output from UART TXD pin.
	D303 1PPS indication LED	Flashing: Successful position fix. Frequency: 1 Hz. Extinct: No position fix.
Switches and Buttons	S101 POWER switch	Powers the EVB on/off.
	S301 RESET button	Short press on the button to reset the module.

The J401 pin assignment is shown below:

Table 3: J401 Pin Assignment

RXD	TXD	1PPS	RESET	GND
3.0 V	SCL	SDA	3DFIX	GND

Table 4: J401 Pin Detailed Description

Pin Name	I/O	Description
GND	-	Ground
RESET	DI	Resets the module
1PPS	DO	1 pulse per second
TXD	DO	Transmits data
RXD	DI	Receives data
3.0V	-	NC (Not connected)
SCL	-	NC
SDA	-	NC
3DFIX	-	NC
GND	-	Ground

4 Test and Firmware Upgrading 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 [2] QGNSS user guide*.

4.1. Testing via QGNSS

Step 1: Assemble the EVB components.

Step 2: Connect the EVB and the PC with a Micro-USB cable via "**Micro-USB**" interface. Then flip the power switch (S101) to **ON** position to power on the EVB.

Step 3: Start the QGNSS and click "**Device**" and "**Set Device Information**" (default baud rate: 115200 bps [1]).

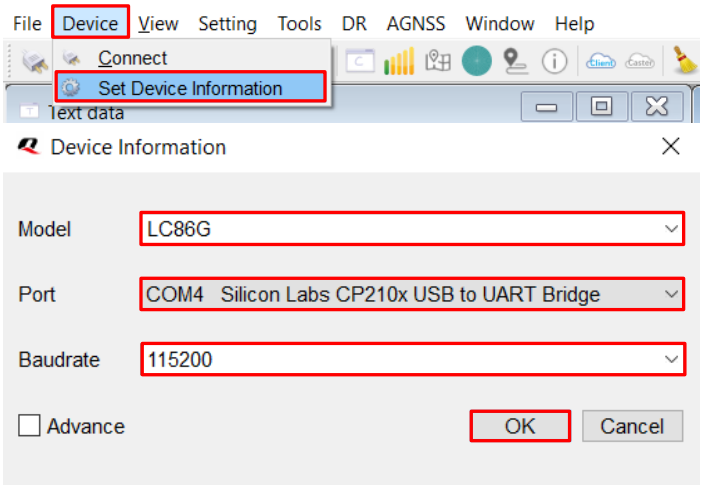


Figure 4: COM Port and Baud Rate Setting

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

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

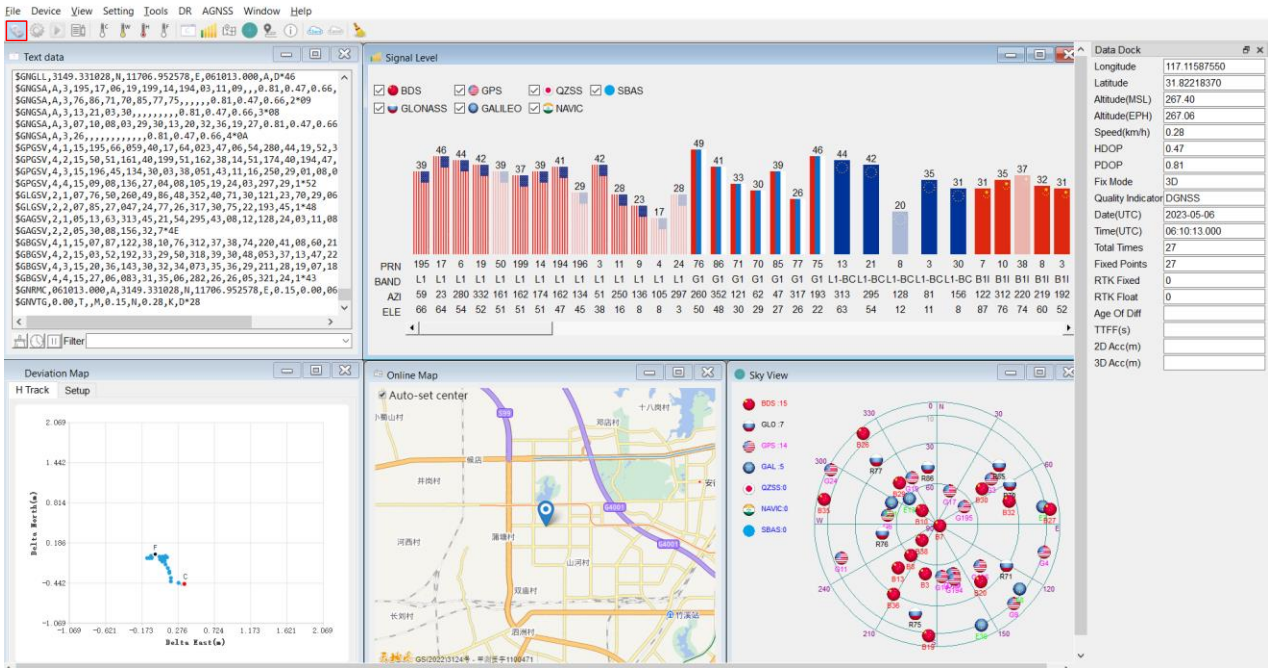


Figure 5: QGNSS Interface (Connected)

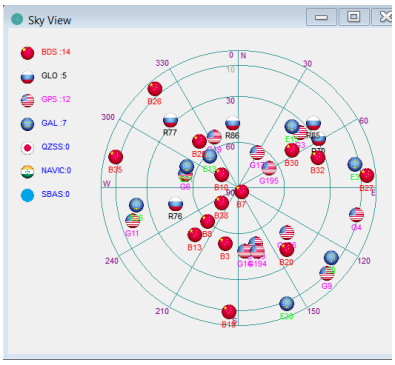
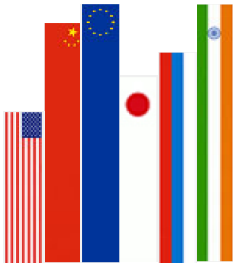
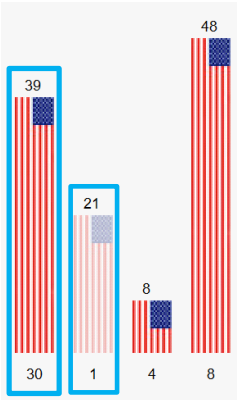
NOTE

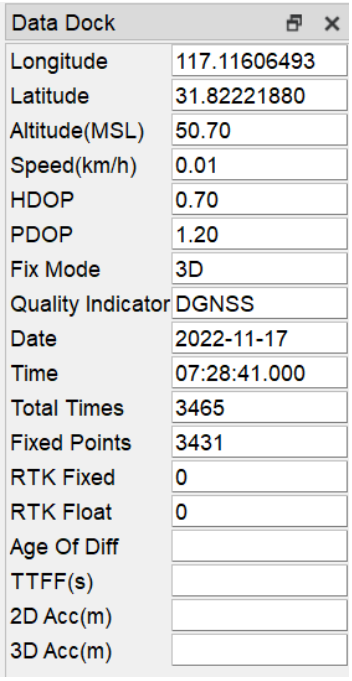
Ensure the CP210x driver has been installed when you use the QGNSS tool for the first time. For more information about the driver, please contact the Quectel Technical Support (support@quectel.com).

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 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 number of satellites in use for each constellation. ● BDS: 14 ● GLO (GLONASS): 5 ● GPS: 12 ● GAL (Galileo): 7 ● QZSS: 0 ● NAVIC: 0 ● SBAS: 0 2) The sky view on the right shows the position of the satellites in use and their PRN numbers.
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 colour means that the navigation data of that satellite is used. ● Column in light colour means that the satellite is visible but not used. ● 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: °) (Decimal Degrees) • Latitude (unit: °) (Decimal Degrees) • 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, and ensure you have an working serial connection to the module as described in *Chapter 4.1 Testing via QGNSS* for details.

Firmware upgrading steps:

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

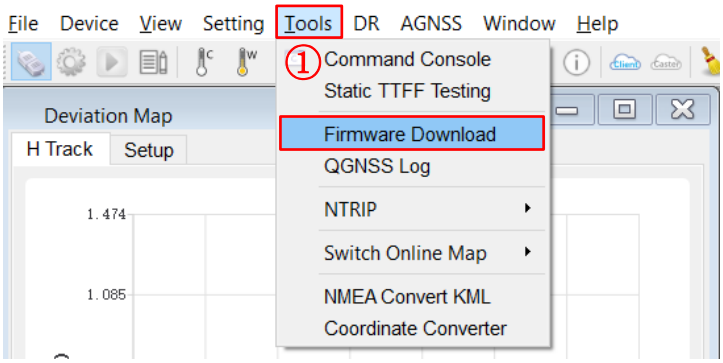


Figure 6: Tool Startup

Step 2: Select the "**Download Baudrate**" (921600 bps or 115200 bps) in the drop-down box of "**Settings**".

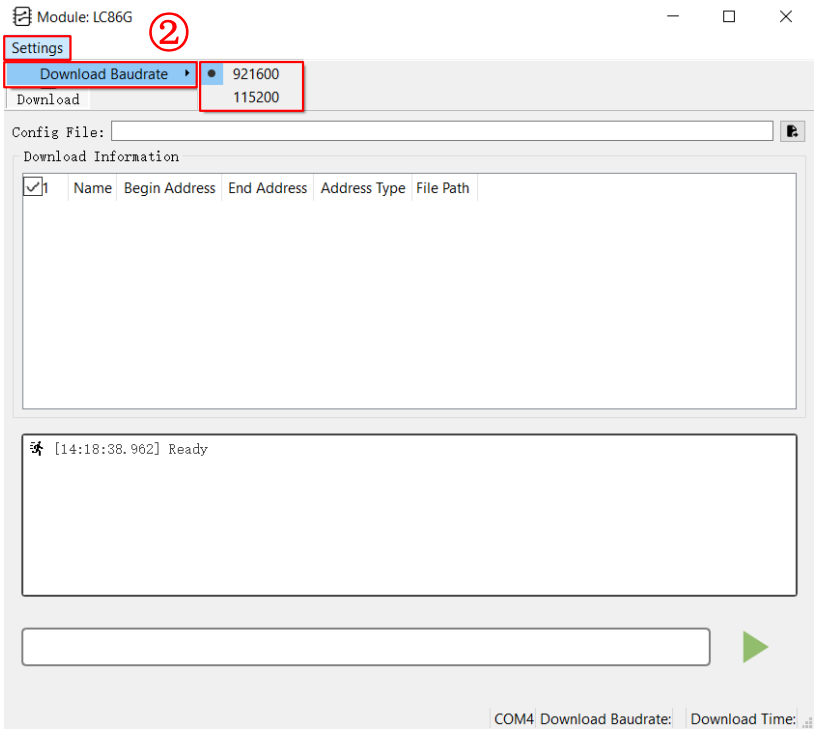


Figure 7: Tool Setting

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

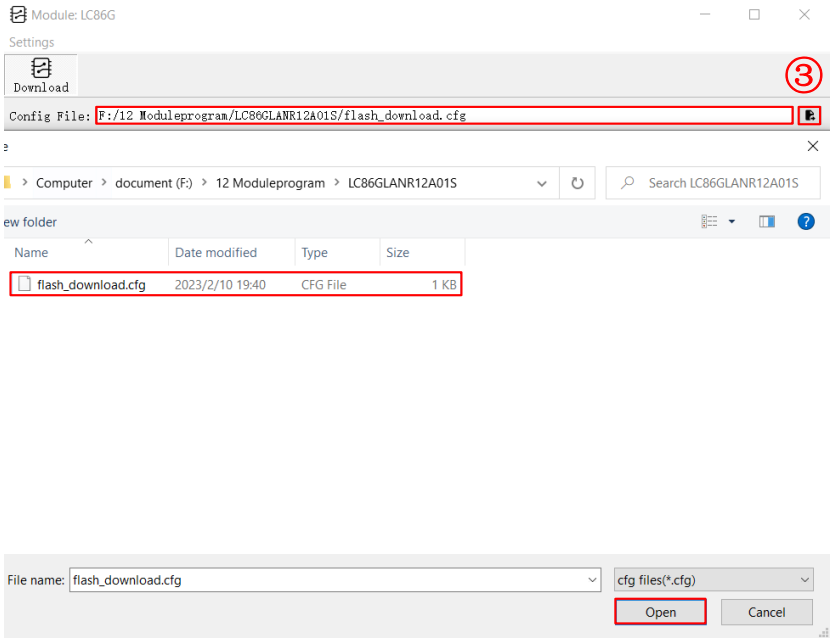


Figure 8: Firmware Selecting

Step 4: Click the ▶ "**Run**" button and then short press on the reset button after the progress bar prompts you to reset the module.

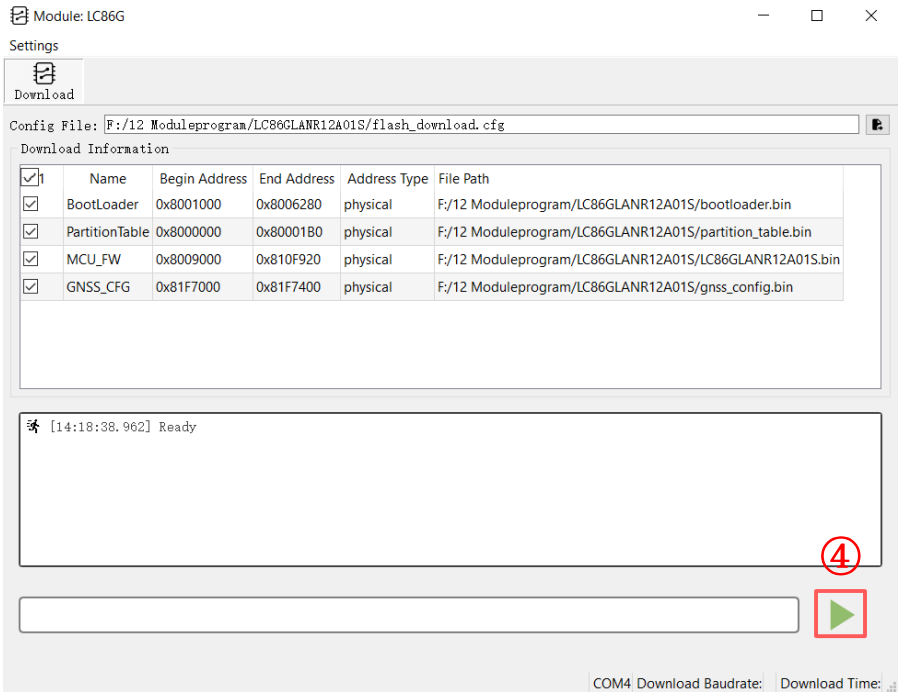


Figure 9: Firmware Upgrading – 1

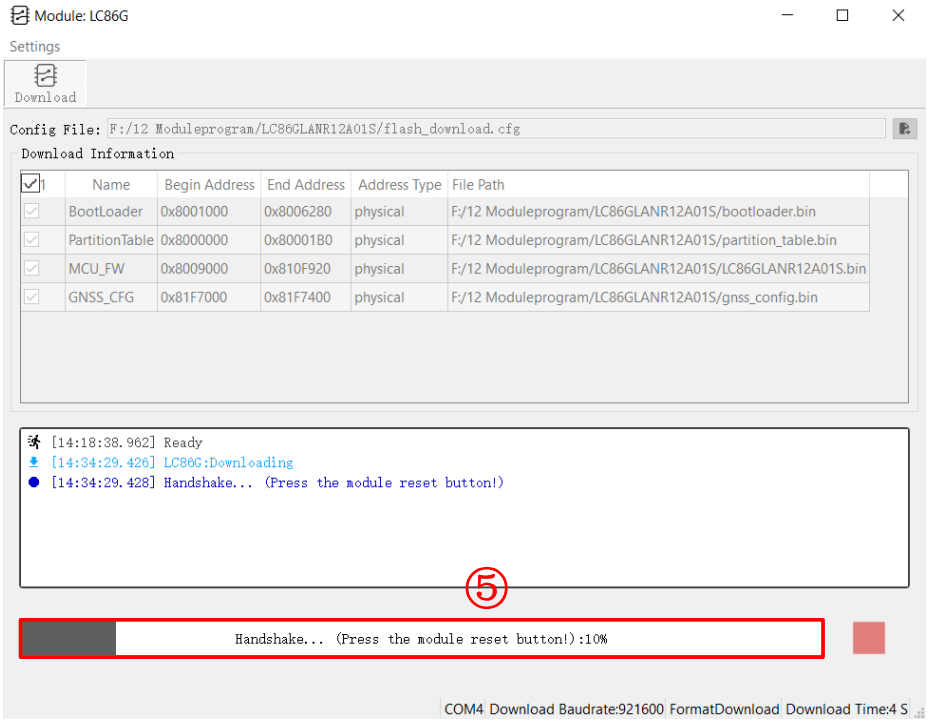


Figure 10: Firmware Upgrading – 2

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

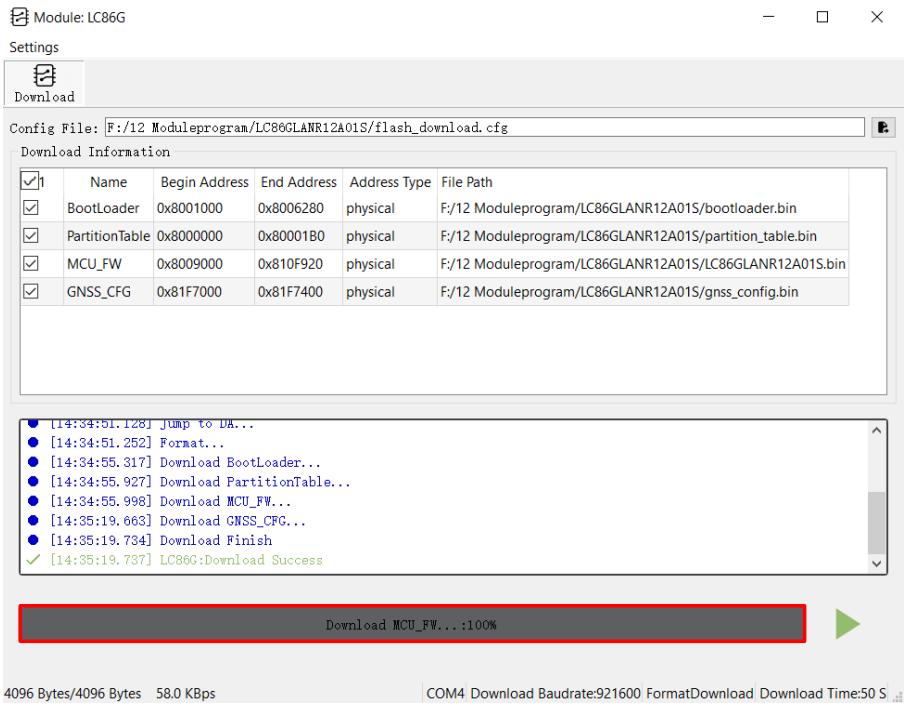


Figure 11: Successful Firmware Upgrading

5 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 vehicle under test so as to avoid any movement or vibration with respect to the vehicle.

6 Measuring Power Consumption

6.1. Power Consumption at Different Stages

Module power consumption is measured in three stages: acquisition and tracking (including almanac update), tracking (almanac update is over) 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 Backup mode

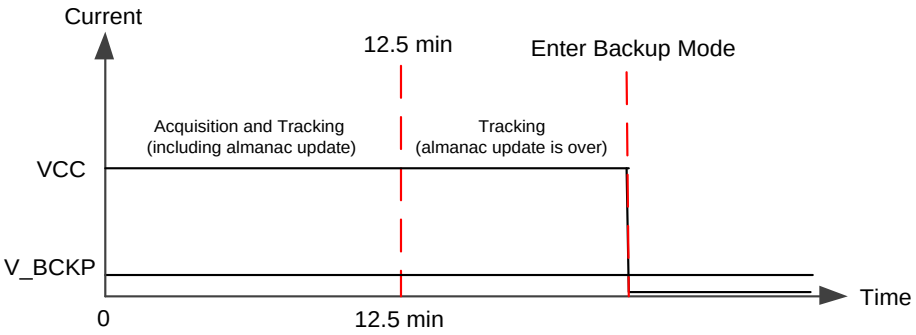


Figure 12: Power Consumption at Different Stages

6.2. 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 it normally. See *Chapter 4.1 Testing via QGNSS*.

Detailed steps for measuring VCC power consumption with an ammeter:

Step 1: Switch off the power supply (S101) and pull out the J301 jumper cap. Connect the ammeter in series to both pins of J301 as shown below.

Step 2: Switch on the power supply (S101) and read the ammeter.

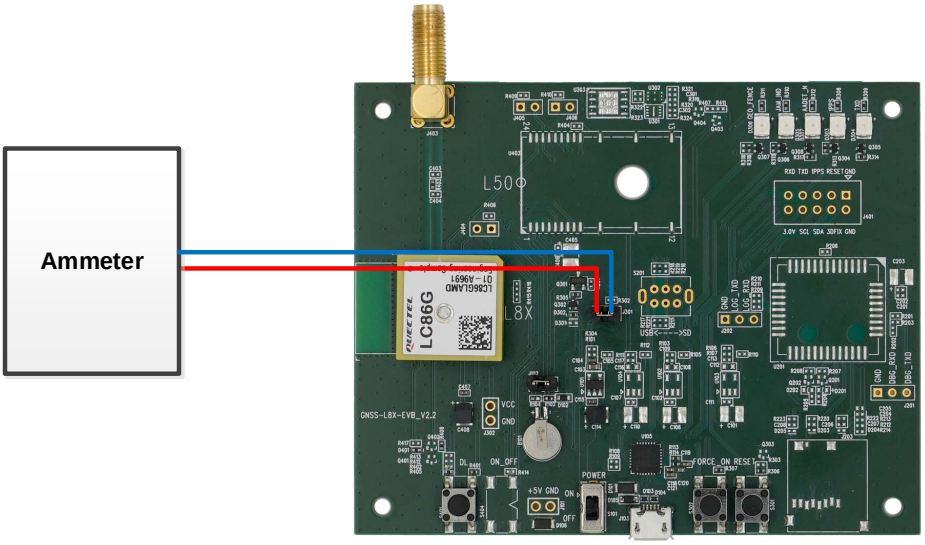


Figure 13: VCC Power Consumption Measured with Ammeter

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

Step 1: Switch off the power supply (S101) and pull out the J301 jumper cap. Make sure the positive terminal of the power consumption meter is connected to J301, and the negative terminal is connected to GND.

Step 2: Switch on the power supply (S101) and power consumption meter, and then read the power consumption meter.

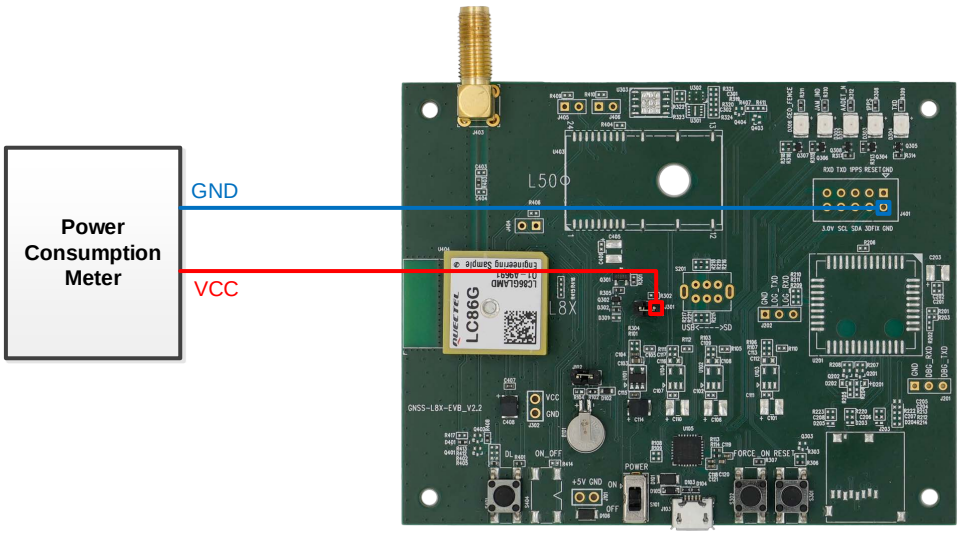


Figure 14: VCC Power Consumption Measured with Power Consumption Meter

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 Testing via QGNSS*.

Detailed steps for measuring V_BCKP power consumption with an ammeter:

Step 1: Switch off the power supply (S101) and pull out the J102 jumper cap. Connect the ammeter in series to both pins of J102, as shown below.

Step 2: Switch on the power supply (S101) and read the ammeter.

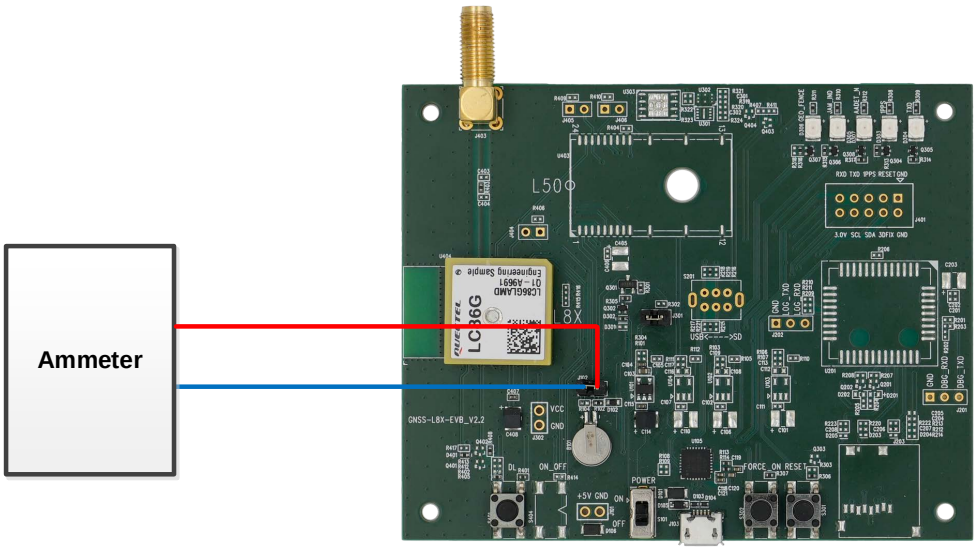


Figure 15: V_BCKP Power Consumption Measured with Ammeter

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

Step 1: Switch off the power supply (S101) and pull out the J102 jumper cap. Then, ensure the positive pole of the power consumption meter is connected to J102, and the negative pole is connected to GND. Switch on the power consumption meter.

Step 2: Switch on the power supply (S101) and read the power consumption meter.

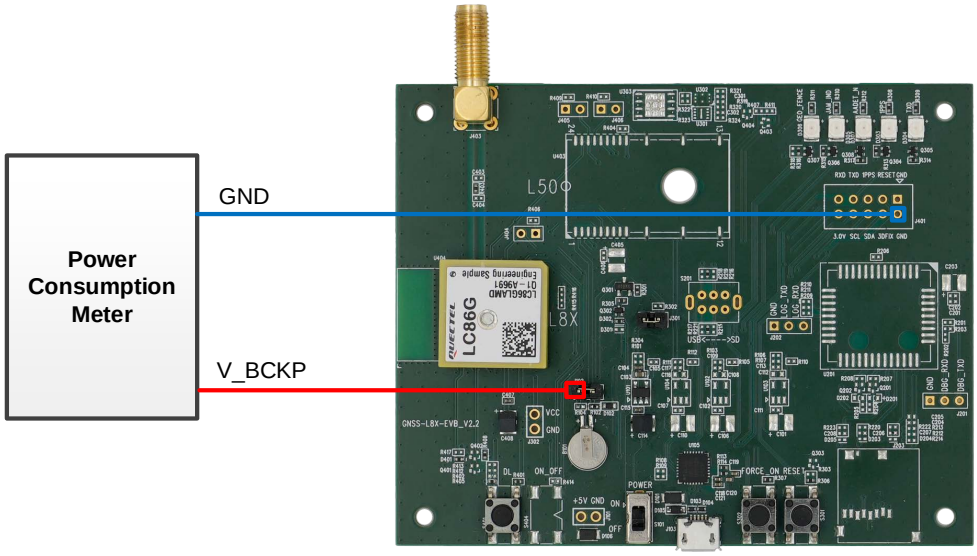


Figure 16: V_BCKP Power Consumption Measured with Power Consumption Meter

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 remove the J301 jumper cap to cut off the power supply of VCC. For more information about the way to enter/exit Backup mode, see *document [1] hardware design*.

7 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 (CP2102). There are an antenna interface and a control button on EVB. All functions of the module are available, including debugging.

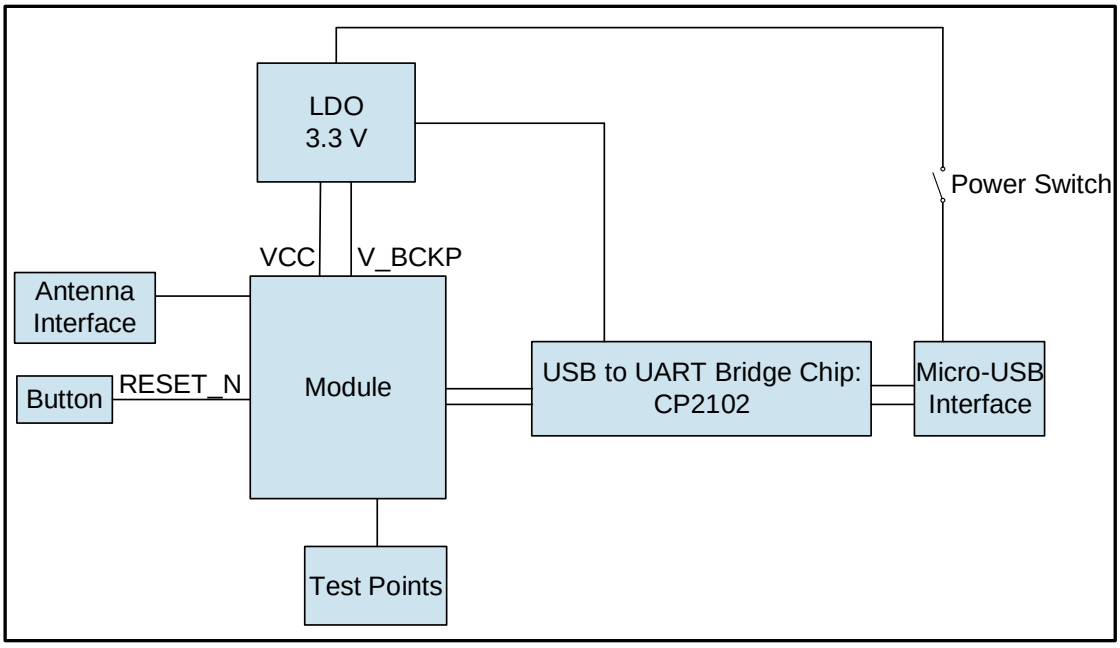


Figure 17: EVB Framework

8 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).

9 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. If an update is published and is more recent than the one you have, an automatic prompt will open up and provide an option to upgrade when opening the tool.

10 Appendix References

Table 6: Related Documents

Document Name
[1] Quectel_LC86G_Series_Hardware_Design
[2] Quectel_QGNSS_User_Guide
[3] Quectel_LC26G&LC76G&LC86G_Series_GNSS_Protocol_Specification

Table 7: Terms and Abbreviations

Abbreviation	Description
1PPS	Pulse Per Second
2D	2 Dimension
3D	3 Dimension
BDS	BeiDou Navigation Satellite System
CEP	Circular Error Probable
COM Port	Communication Port
C/N_0	Carrier-to-noise Ratio
DC	Direct Current
DGNSS	Differential Global Navigation Satellite System
DGPS	Differential Global Positioning System
DI	Digital Input
DO	Digital Output
ESD	Electrostatic Discharge

Abbreviation	Description
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
I/O	Input/Output
NAVIC	Indian Regional Navigation Satellite System
LED	Light Emitting Diode
Micro-USB	Micro Universal Serial Bus
MSL	Mean Sea Level
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
PC	Personal Computer
PCB	Printed Circuit Board
PRN	Pseudo Random Noise
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RMS	Root Mean Square
RTK	Real Time Kinematic
RXD	Receive Data (Pin)
SBAS	Satellite-Based Augmentation System
SCL	Serial Clock Line
SDA	Serial Data Line
SPS	Standard Positioning Service

Abbreviation	Description
TTFF	Time to First Fix
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
UTC	Coordinated Universal Time