LC29T (AA)
EVB User Guide

GNSS Module Series

Version: 1.0

Date: 2024-09-20

Status: Released

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The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal incorporating Quectel LC76G series module. Manufacturers of the terminal should distribute the following safety precautions to users and operating personnel, and incorporate them into all manuals supplied with the product. 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

Document Information	
Title	**LC29T (AA) EVB User Guide**
Subtitle	GNSS Module Series
Document Type	EVB User Guide
Document Status	Released

Revision History

Version	Date	Description
-	2022-12-07	Creation of the document
1.0	2024-09-20	First official release

Contents

Table Index

Figure Index

1 Introduction

This document provides information on the steps needed to evaluate the Quectel LC29T (AA) module using the Evaluation Board (EVB). The EVB is a convenient tool that allows you to become familiar with the LC29T (AA) 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 via QGNSS tool.
- Chapter 5 describes how to test 1PPS signal.
- Chapter 6 describes how to install the EVB and antenna.
- Chapter 7 describes how to measure power consumption for LC29T (IA) module.
- Chapter 8 provides the EVB framework.
- Chapter 9 describes the common issues and troubleshooting.
- Chapter 10 describes the cautions.
- Chapter 11 is an appendix, which summarizes the relevant documents, terms and abbreviations appearing herein.

NOTE

1. For details about documents related to LC29T (AA) module, see *Table 5: Related Documents*.
2. 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, Type-B USB cables, bolts and coupling nuts.

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

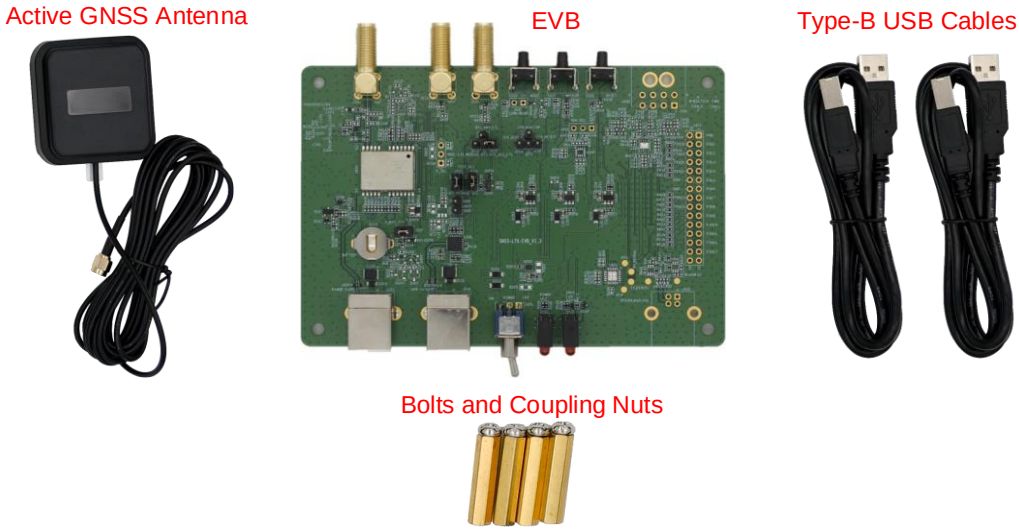


Figure 1: EVB Kit Components

Table 1: List of Kit Components

Items	Description	Quantity
EVB	Evaluation Board Size: 80 mm × 120 mm	1
USB Cable	Type-B USB Cable	2
GNSS Antenna	Active GNSS Antenna: **YB0017AA** Antenna Size: 61.5 mm × 56.5 mm × 23 mm Cable Length: 3000 mm	1

Items	Description	Quantity
	The GNSS antenna supports: ● GPS L1 C/A ● GLONASS L1 ● Galileo E1 ● BDS B1I ● 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 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

1. The EVB can be powered by either "**POWER SUPPLY**" (J201) or "**USB to UART**" interface (J501). Thus, it is optional to connect PC and the "**POWER SUPPLY**" (J201) on the EVB via Type-B USB. For more information, see *Chapter 3.2 EVB Interfaces*.
2. 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.

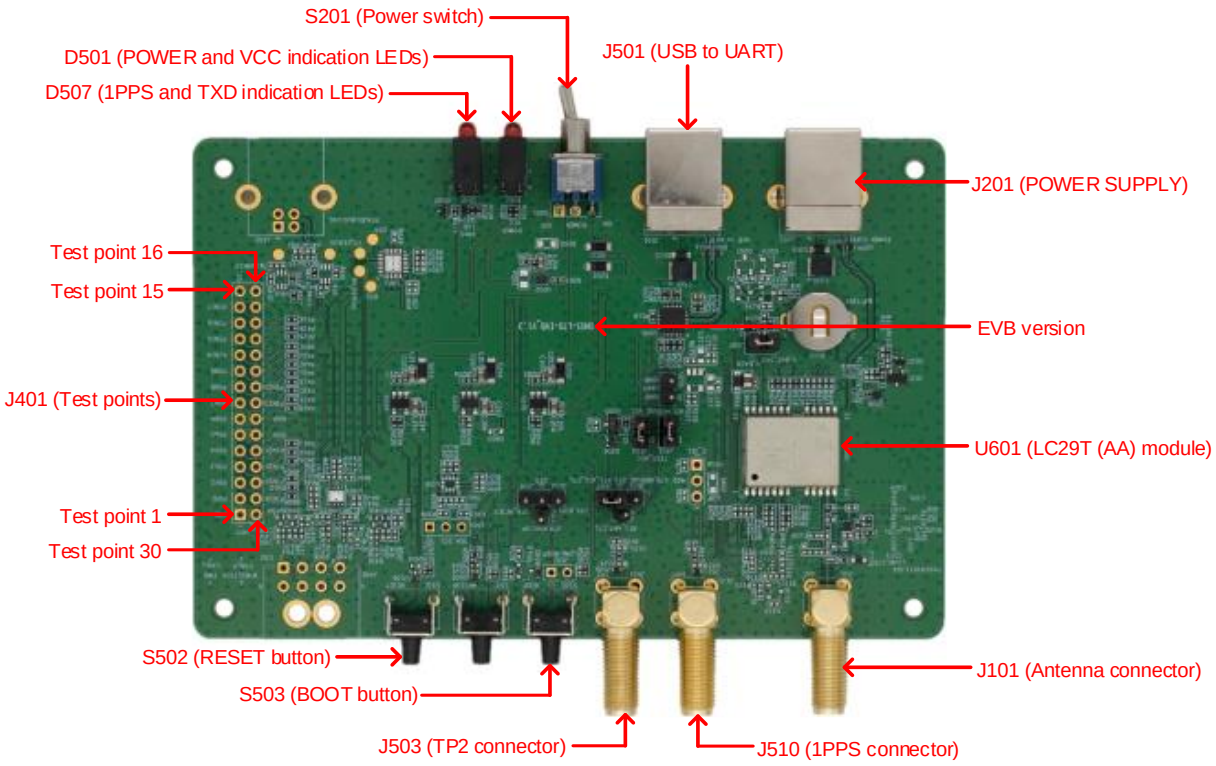


Figure 3: EVB Top View

3.2. EVB Interfaces

The EVB interfaces are detailed in the table below.

Table 2: Detailed EVB Interfaces

Function	Interfaces		Description
Power Supply	J201 POWER SUPPLY		J201: Only used as power supply to avoid the insufficient supply of J501.
	J501 USB to UART		J501: Used for communication and power supply. Power supply input: ● DC power supply: 4.5–5.5 V, Typ. 5.0 V ● Current capability should be > 400 mA
Communication Interface	J501 USB to UART		Supports standard NMEA message, PSTM message and firmware upgrade.
SMA Connector	J101 Antenna connector		Used for connecting the GNSS antenna.
	J510 1PPS connector		Used for testing 1PPS signal.
	J503 TP2 connector		Used for testing CLK_OUT signal.
Signal Indication	D501 Indication LEDs	POWER (Red)	Bright: EVB is powered well. Extinct: EVB is not powered.
		VCC (Green)	Bright: Module is powered well. Extinct: Module is not powered.
	D507 Indication LEDs	1PPS (Red)	1PPS indication LED.
		TXD (Green)	Flashing: Data are being output from UART TXD pin. Extinct or Bright: No data are output from UART TXD pin.
Switches and Buttons	S201 Power switch		Powers the EVB on/off.
	S502 RESET button		Short press the button to reset the module.
	S503 BOOT button		Press and hold the button first before EVB is powered on and then flip the power switch to **ON** position to set the module to Boot download mode.

The J401 test points of LC29T (AA) EVB are listed below:

Table 3: J401 Test Points

Test Point No.	Test Point Label	Test Point Function	I/O	Description
1	GND	GND	-	Ground
2	PIN1	U601: Pin 1	DO	CLK_OUT: Time pulse signal
3	PIN2	U601: Pin 2	-	Reserved
4	PIN3	U601: Pin 3	DO	1PPS: One pulse per second
5	PIN4	U601: Pin 4	-	Reserved
6	PIN5	U601: Pin 5	-	Reserved
7	PIN6	U601: Pin 6	DI	BOOT: Controls module startup mode
8	PIN7	U601: Pin 7	-	Reserved
9	PIN8	U601: Pin 8	DI	RESET_N: Reset the module
10	PIN9	U601: Pin 9	PO	VDD_RF: Supplies power for external RF components
11	PIN14	U601: Pin 14	DO	ANT_ON: Controls external LNA and active antenna
12	PIN15	U601: Pin 15	DI	ANT_DET: Open circuit detection of active antenna
13	PIN16	U601: Pin 16	DI	ANT_SHORT: Short circuit detection of active antenna
14	PIN17	U601: Pin 17	-	Reserved
15	No label	-	-	NC (Not connected)
16	No label	-	-	NC
17	No label	-	-	NC
18	No label	-	-	NC
19	No label	-	-	NC
20	No label	-	-	NC
21	No label	-	-	NC

Test Point No.	Test Point Label	Test Point Function	I/O	Description
22	PIN23	U601: Pin 23	PI	VCC: Main power supply
23	PIN22	U601: Pin 22	PI	V_BCKP: Backup power supply for backup domain
24	GND	-	-	Ground
25	GND	-	-	Ground
26	PIN21	U601: Pin 21	DI	RXD: Receives data
27	PIN20	U601: Pin 20	DO	TXD: Transmits data
28	PIN19	U601: Pin 19	-	Reserved
29	PIN18	U601: Pin 18	-	Reserved
30	No label	-	-	NC

NOTE

1. Test points of J401 are arranged clockwise, and their serial numbers are shown in *Figure 3: EVB Top View*.
2. A J401 test point refers to the module's corresponding function. For detailed descriptions, see *document [1] hardware design*. For more information on the reference circuits of module pins, see *document [2] reference design*.

4 Test via QGNSS Tool

This chapter explains how to use the QGNSS software tool for verifying the status of a GNSS module. For more information about QGNSS use, see *document [3] QGNSS user guide*. In addition, you can upgrade the module firmware via QGNSS tool, see *document [4] firmware upgrade guide* for details.

4.1. Test via QGNSS

Step 1: Assemble the EVB components.

Step 2: Connect the EVB and the PC with one or two Type-B USB cables via "**USB to UART**" interface, then flip the power switch (S201) to "**ON**" position to power on the EVB.

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

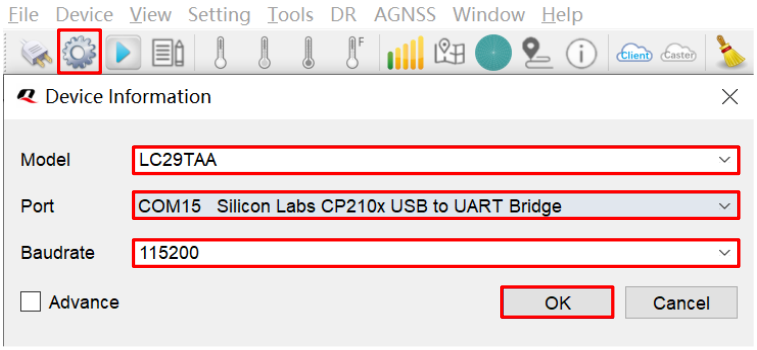


Figure 4: COM Port and Baud Rate Setting

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.

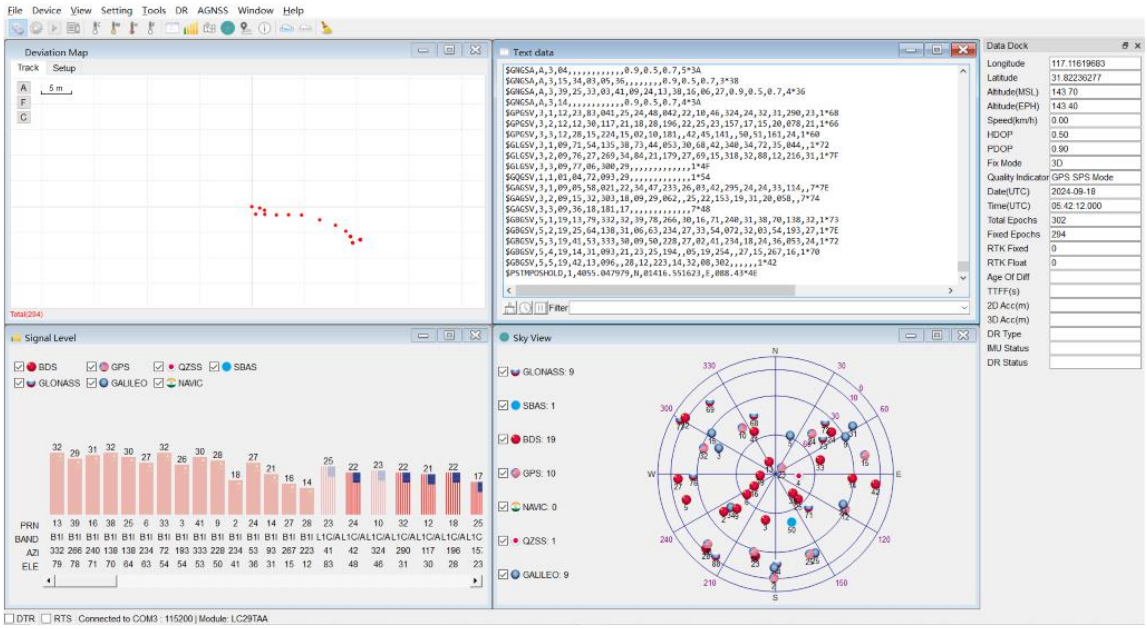


Figure 5: QGNSS Interface (Connected)

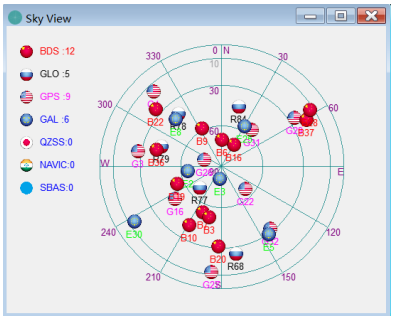
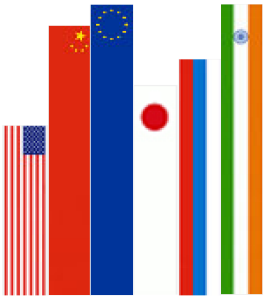
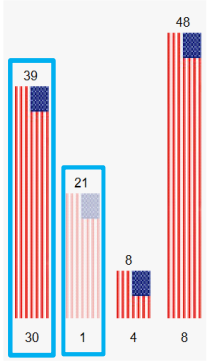
NOTE

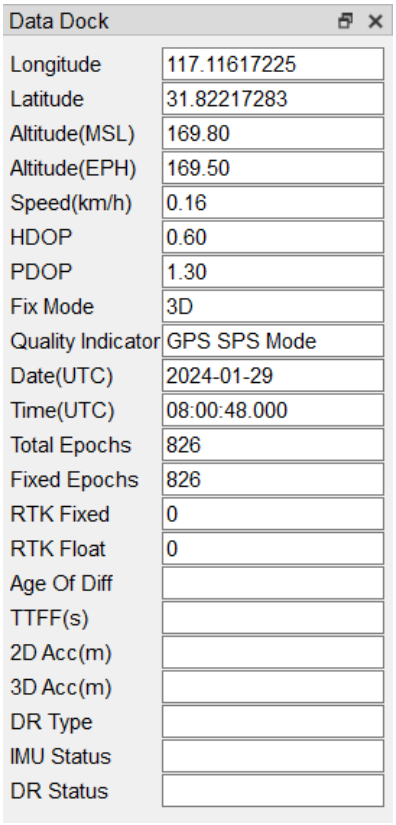
1. Ensure the CP210x driver has been installed when you use the QGNSS tool for the first time. For more information about the driver, please contact Quectel Technical Support (support@quectel.com).
2. For more information on messages supported by the module, see *document [5] protocol specification*.

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 4: 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: 12 ● GLO (GLONASS): 5 ● GPS: 9 ● GAL (Galileo): 6 ● 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, with corresponding country flags for identification. 	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: °) (Decimal Degrees) • Latitude (unit: °) (Decimal Degrees) • 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): UTC date • Time(UTC): UTC time • Total Times • Fixed Times • RTK Fixed • RTK Float • Age of differential GPS data • Last TTFF (Unit: second) • 2D accuracy (Unit: meter) • 3D accuracy (Unit: meter) • DR Type • IMU Status • DR Status

5 Testing 1PPS

5.1. Testing Method

The oscilloscope is used to collect the 1PPS signal of the LC29T (AA) module, and the 1PPS signal output by the GNSS Signal Simulator or the Rubidium Clock is used as the true value. The 1PPS signal of the module is compared with the true value in the PC to calculate the delay error. You can use your equipment instead of the GNSS Signal Simulator or the Rubidium Clock to achieve the appropriate functionality.

NOTE

1. For test result comparison, verify the firmware version used. Contact Quectel Technical Support (support@quectel.com) or see *document [5] protocol specification* for details on the related firmware version.
2. For more information about commands related to 1PPS test, see *document [5] protocol specification*.

5.1.1. Testing 1PPS with GNSS Signal Simulator (Instrument) as the Reference

To test 1PPS using the GNSS Signal Simulator for reference, follow the steps below:

Step 1: Connect the USB to UART interface (J501) of LC29T (AA) EVB to the PC via a Type-B USB cable.

Step 2: Connect the USB cable harness of oscilloscope to your PC.

Step 3: Connect the antenna connector (J101) of the LC29T (AA) EVB to the GNSS Signal Simulator via an RF cable. After a successful connection, flip the power switch (S201) to **ON** to power on the EVB.

Step 4: Connect channel 1 (CH1) of the oscilloscope to the 1PPS signal output interface of the GNSS signal simulator, and connect channel 2 (CH2) of the oscilloscope to the 1PPS connector (J510) of the LC29T (AA) EVB.

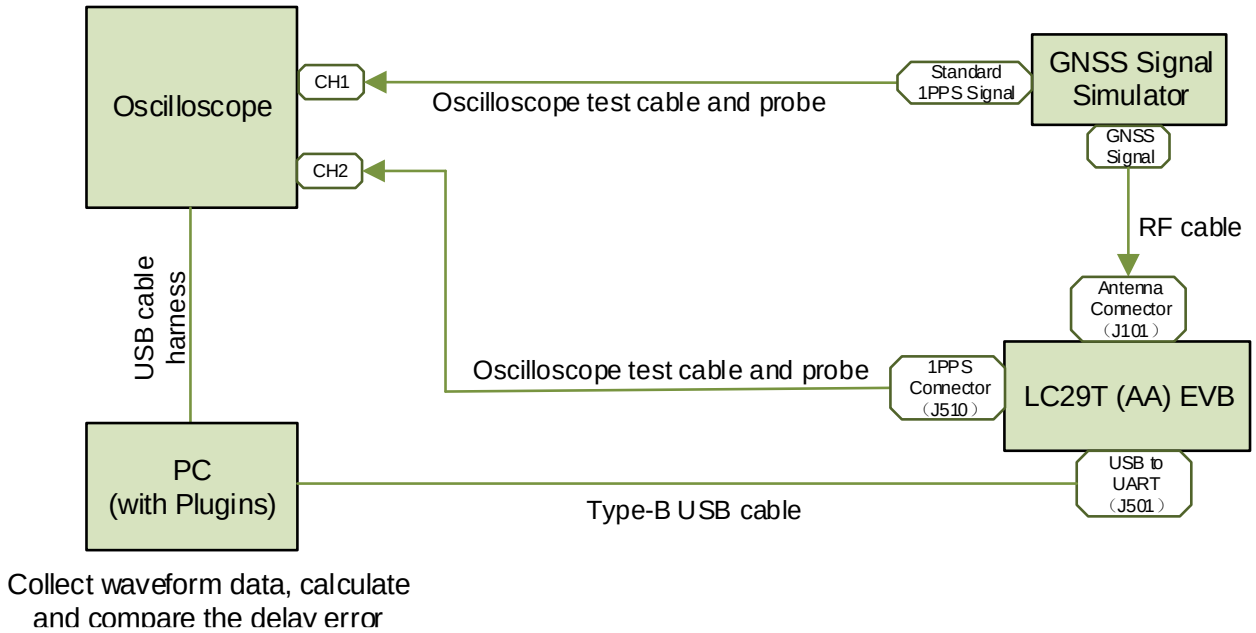


Figure 6: Testing 1PPS with GNSS Signal Simulator as the Reference

5.1.2. Testing 1PPS with Rubidium Clock (Real Network) as the Reference

To test 1PPS using the Rubidium clock for reference, follow the steps below:

Step 1: Connect the USB to UART interface (J501) of LC29T (AA) EVB to the PC via a Type-B USB cable.

Step 2: Connect the USB cable harness of the oscilloscope to your PC.

Step 3: Connect the active GNSS antenna to the GNSS signal input interface of the Rubidium Clock and the antenna interface (J101) of the LC29T (AA) EVB respectively through the power divider. After a successful connection, flip the power switch (S201) to **ON** to power on the EVB.

Step 4: Connect channel 1 (CH1) of the oscilloscope to the 1PPS signal output interface of the Rubidium Clock, and connect channel 2 (CH2) of the oscilloscope to the 1PPS connector (J510) of the LC29T (AA) EVB.

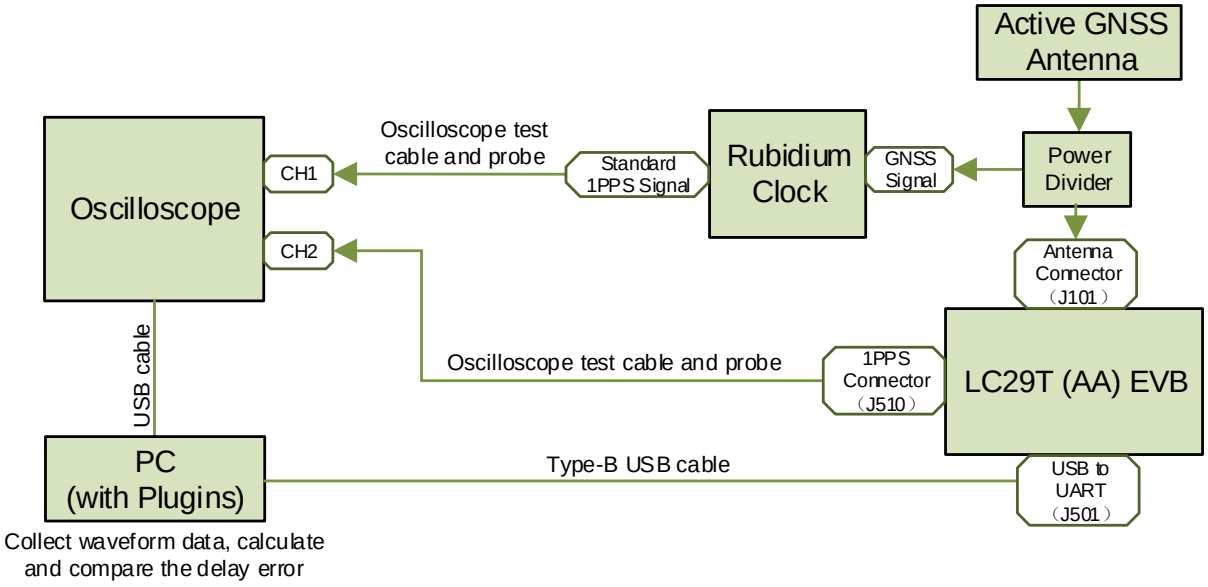


Figure 7: Testing 1PPS with Rubidium Clock as the Reference

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 also impact its reception performance. Therefore, it is important to avoid obstacles and interference when installing antennas. Place the ceramic patch antenna horizontally and make sure it radiates toward the sky. For more information on GNSS antenna, see *document [6] GNSS antenna application note*.

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.

6.2. EVB Installation

If dynamic testing is required, make sure the EVB is fixed to the device under test 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 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

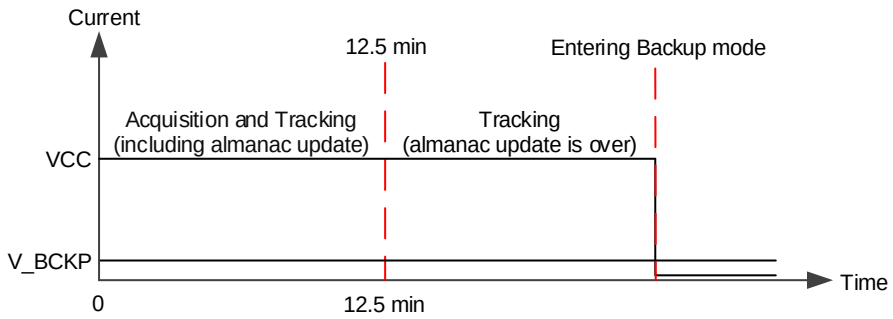


Figure 8: Power Consumption at Different Stages

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 Tool*.

Detailed steps for measuring VCC power consumption with an ammeter:

Step 1: Switch off the power supply (S201) of the module and pull out the VCC_MODULE jumper cap (J601). Connect the ammeter in series to the pins of J601 as shown below.

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

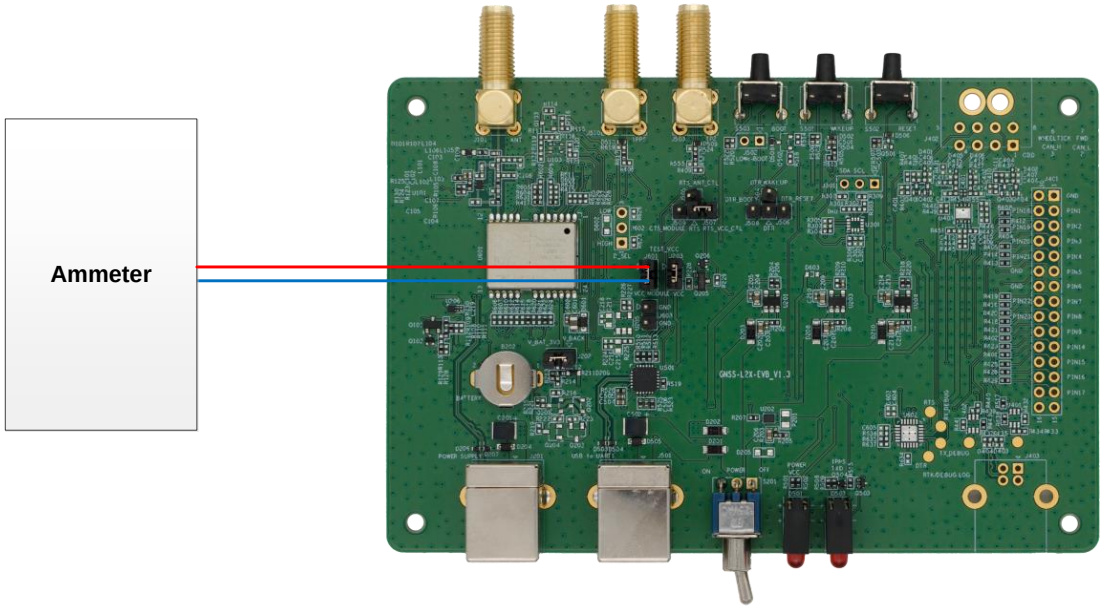


Figure 9: VCC Power Consumption Measured with Ammeter

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

Step 1: Switch off the power supply (S201) of the module and pull out the VCC_MODULE jumper cap (J601). Make sure the positive pole of the power consumption meter is connected to pin 2 (without arrow silkscreen) of J601, and the negative pole is connected to GND.

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

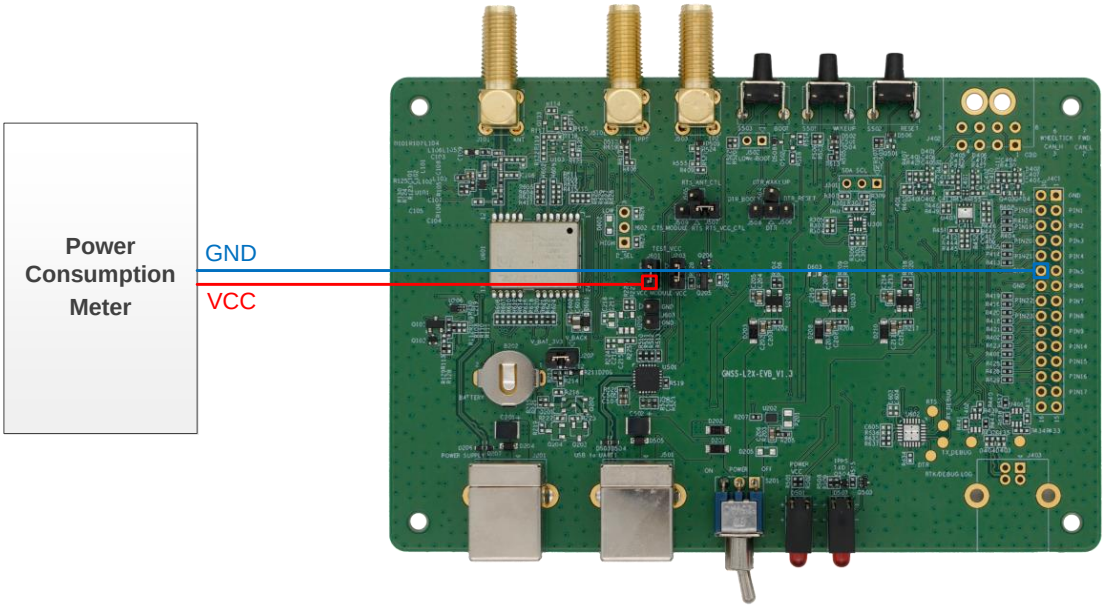


Figure 10: VCC Power Consumption Measured with Power Consumption Meter

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) of the module and pull out the V_BACK jumper cap (J202). Connect the ammeter in series to the pins of J202 as shown below.

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

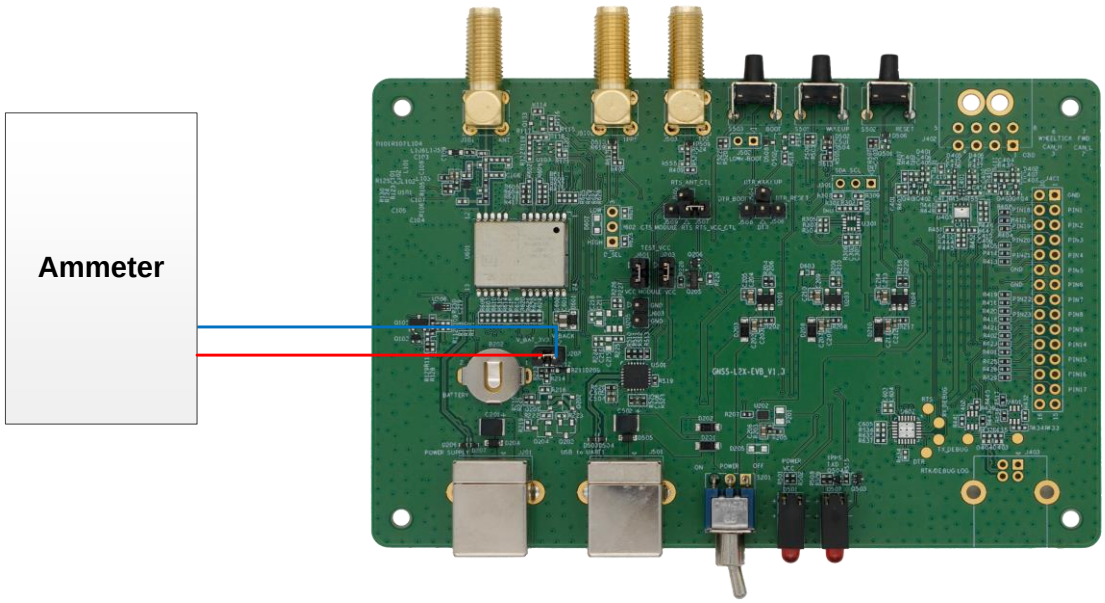


Figure 11: V_BCKP Power Consumption Measured with Ammeter

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

Step 1: Switch off the power supply (S201) of the module and pull out the V_BACK jumper cap (J202). Then, ensure the positive pole of the power consumption meter is connected to pin 1 (with arrow silkscreen) of J202, and the negative pole is connected to GND.

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

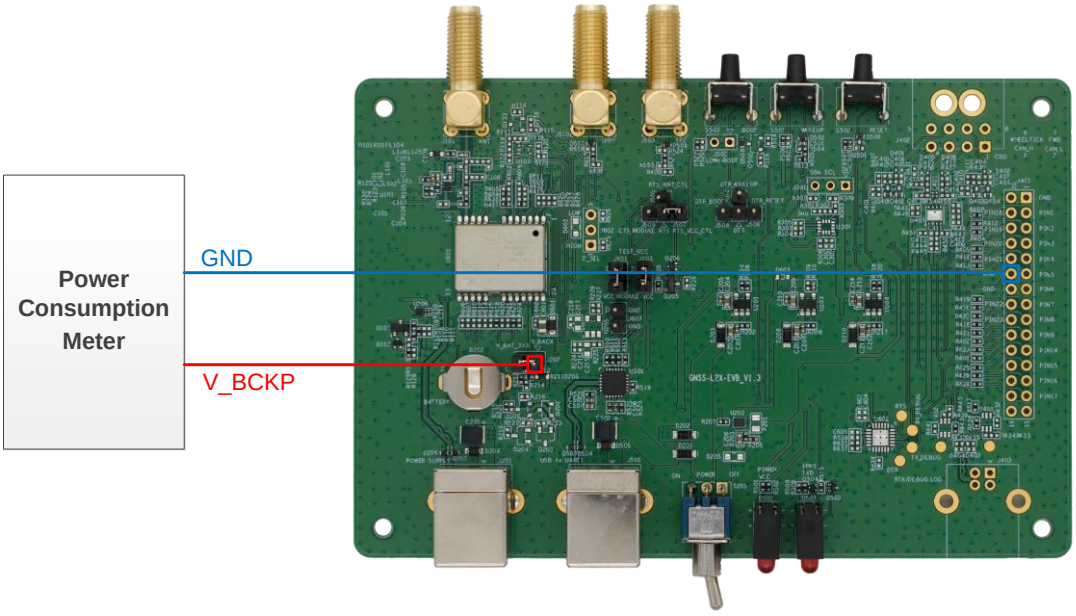


Figure 12: V_BCKP Power Consumption Measured with Power Consumption Meter

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. 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 (J601) to cut off the power supply of VCC. For more information about the method to enter/exit Backup mode, see *document [1] hardware design*.

8 EVB Framework

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

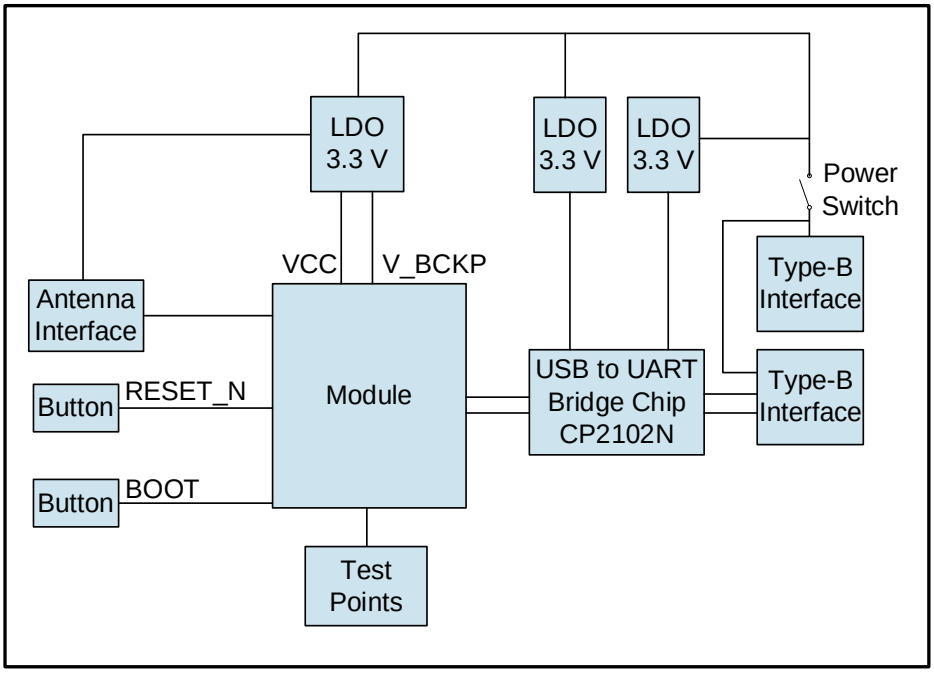


Figure 13: EVB Framework

9 Common Issues 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 3: EVB Top View*.
   - 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.**
   - 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 issue(s) that cannot be solved, you can contact Quectel Technical Support (support@quectel.com).

10 Cautions

- Make sure to conduct tests at the same time and 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 be updated periodically to fix bugs or improve performance. Please make sure that you are using the latest version of the tool. If a newer update is available when you open the tool, you will receive an automatic prompt to upgrade.

11 Appendix References

Table 5: Related Documents

Document Name
[1] Quectel_LC29T(AA)_Hardware_Design
[2] Quectel_LC29T(AA)_Reference_Design
[3] Quectel_QGNSS_User_Guide
[4] Quectel_LG69T(AA,AD,AF,AI,AJ,AR)&LC29T(AA)&LC99T(IA)_Firmware_Upgrade_Guide
[5] Quectel_LC29T(AA)&LC99T(IA)_GNSS_Protocol_Specification
[6] Quectel_GNSS_Antenna_Application_Note

Table 6: 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
COM Port	Communication Port
DC	Direct Current
DI	Digital Input
DO	Digital Output
DR	Dead Reckoning

Abbreviation	Description
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
I2C	Inter-integrated Circuit
I/O	Input/Output
NavIC (IRNSS)	Indian Regional Navigation Satellite System
LED	Light Emitting Diode
MSL	Mean Sea Level
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
PC	Personal Computer
PI	Power Input
PO	Power Output
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

Abbreviation	Description
SMA	SubMiniature Version A
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