LG69T (AA,AD)
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 incorporating Quectel GNSS module. Manufacturers of the terminal should send the following safety information to users and operating personnel, and incorporate these guidelines 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 that incorporate the module to avoid ESD damages.

About the Document

Document Information	
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-	2020-04-23	Creation of the document
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1 Introduction

This document provides information on the steps needed to evaluate the Quectel LG69T (AA) and LG69T (AD) using the Evaluation Board (EVB). The EVB is a reference tool that allows you to become familiar with the LG69T (AA) and LG69T (AD).

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 DR application.
- Chapter 5 describes how to communicate with the modules via QCOM tool.
- Chapter 6 describes how to test the modules via QGNSS tool.
- Chapter 7 describes how to download and upgrade the module firmware via the GNSSFlashTool;
- Chapter 8 is an appendix, which summarizes the relevant documents, terms and abbreviations appearing herein.

NOTE

For EVB schematic and PCB layout design files, contact 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, AT command, or argument, it indicates that the function, feature, interface, pin, AT command, or argument is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.

2 General Overview

2.1. EVB Kit

The EVB Kit includes: Evaluation Board (EVB), Quectel Active GNSS Antenna, Micro-USB Cable, Type-B USB Cable, Bolts and Coupling Nuts. Download the software tools (QCOM, QGNSS and GNSSFlashTool) from our website Download Zone or request them from Quectel Technical Support.

The EVB Kit contents are shown in the figure below. Check ***Table 2*** for details.

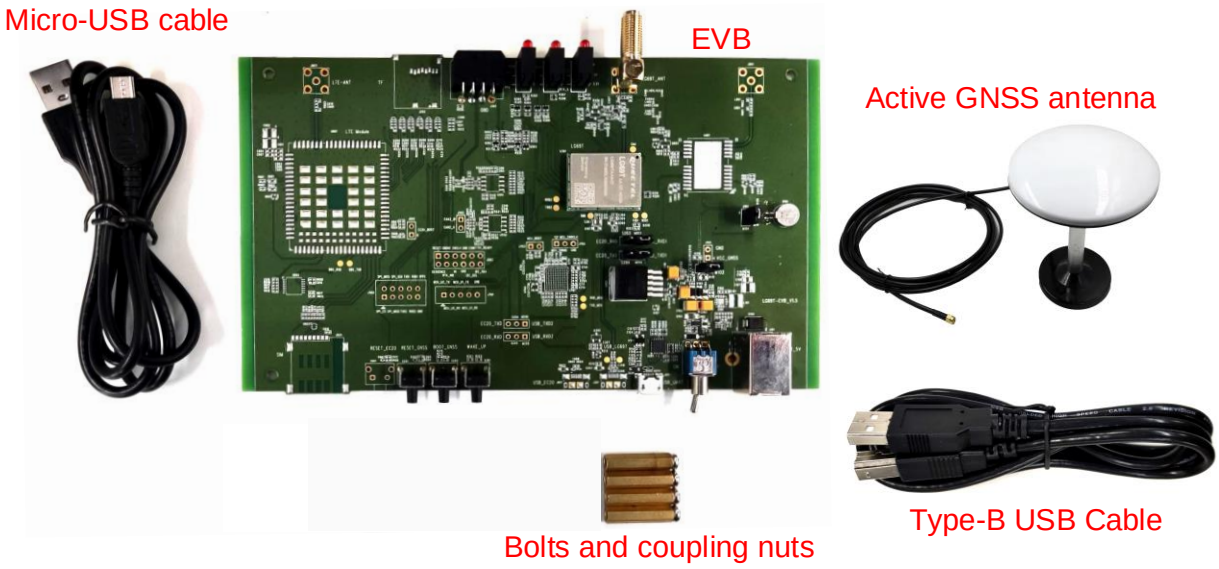


Figure 1: EVB Kit Accessories

Table 2: List of Kit Components

Items	Description	Quantity
EVB	Evaluation Board Size: 100 mm × 175 mm	1
USB Cable	Micro-USB Cable	1

	Type-B USB Cable	1
GNSS Antenna	Quectel Active GNSS antenna: **YEGM011BA** Request the Antenna Datasheet from Quectel Technical Support.	1
Instruction Sheet	Sheet providing instructions on how to connect the EVB and its components, detailed information on EVB contents, etc.	1
Others	Bolts and Coupling Nuts	4 pairs

2.2. Connect Cables and Antenna to EVB

The connection between the EVB and its components is shown in the figure below. For more information on how to connect the EVB and its components, refer to the instruction sheet inside the EVB Kit.

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 User Interfaces

3.1. EVB Top View

EVB top view is shown in the figure below.

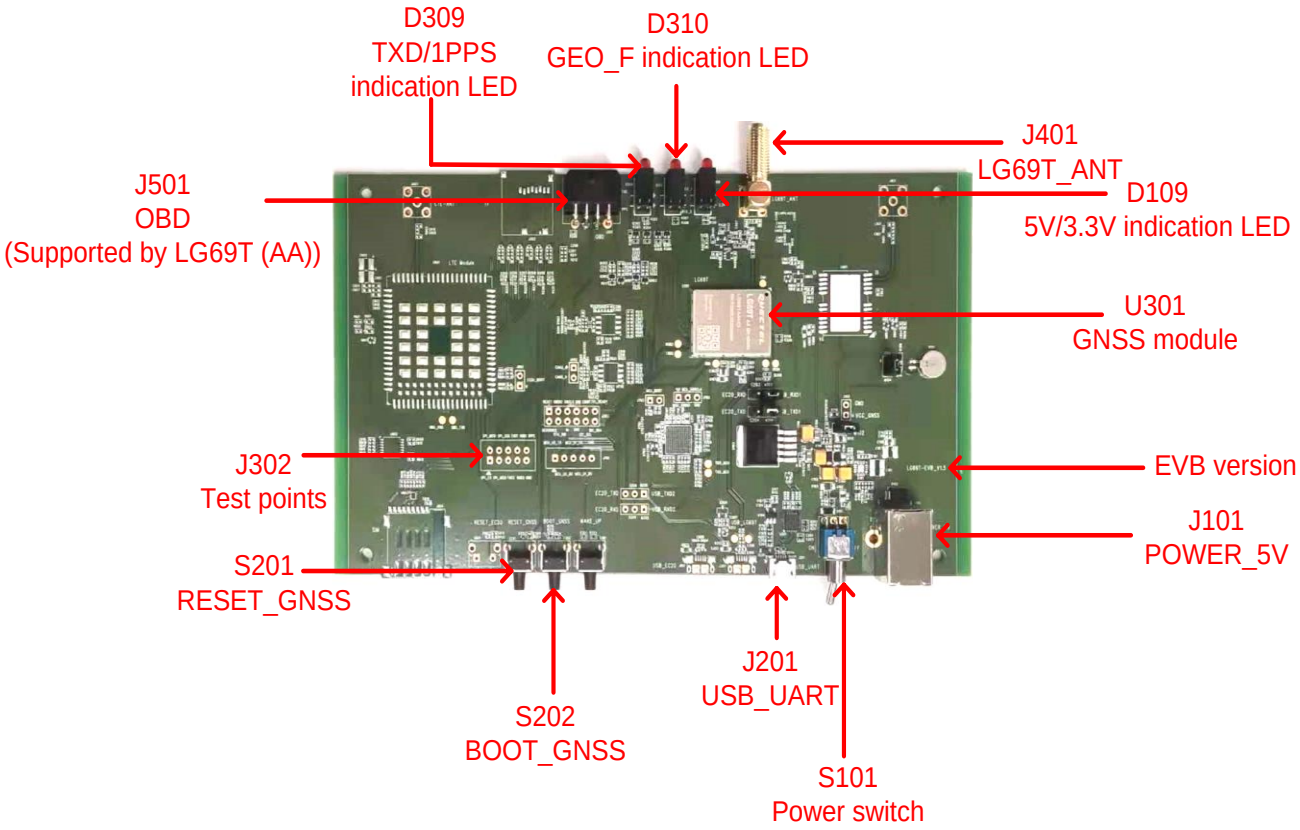


Figure 3: EVB Top View

3.2. Board User Interfaces

The EVB interfaces are detailed in the table below.

Table 3: Detailed EVB Interfaces

Function	Interfaces		Description
Power Supply	J101 POWER_5V		Power supply input: ● DC power supply: 4.5–5.5 V, typ. 5.0 V. ● Current capability should be > 1 A.
Communication Interface	J201 USB_UART		**Enhanced COM Port**: Used for configuring the modules, firmware upgrade, and NMEA/RTCM message output. **Standard COM Port**: No message input/output, reserved for future use.
RF Input	J401 LG69T_ANT Antenna Connector		The antenna in the kit supports: ● GPS/QZSS L1 C/A and L5 ● Galileo E1 and E5a ● BDS B1I and B2a ● SBAS * L1
Signal Indication	D309 TXD/1PPS indication LED	1PPS (Red LED)	Flash: Outputs pulse signal of 1 Hz. Extinct: 1PPS is unavailable.
		TXD (Green LED)	Flash: Message output from UART1 TXD. Extinct/Bright: No message output from UART1 TXD.
	D109 5 V/3.3 V Indication LED	3.3 V (Red LED)	EVB 3.3 V power indicator.
		5 V (Green LED)	EVB 5 V power indicator.
	D310 GEO_F Indication LED	GEO_F (Red LED)	Geofence indicator.
Switch and Buttons	S101 Power Switch		Power the EVB on/off.
	S201 RESET_GNSS		Short press the button to reset the modules.
	S202 BOOT_GNSS		Press and hold the button first and then flip the power switch to **ON** position to make the modules enter Boot download mode.
Test Points	J501		Pins are detailed in ***Table 4*** below.

	OBD [1]	
	J302 Test Points	Pins are detailed in ***Table 5*** below.

Test points distributions are shown below:

J501 Pin Assignment:

NC	NC	NC	NC
NC	WHEELTICK	FWD	GND

Table 4: J501 Pin Detailed Description

Pin Name	I/O	Description
NC	-	-
NC	-	-
NC	-	-
NC	-	-
NC	-	-
WHEELTICK	DI	Odometer wheel-tick input.
FWD	DI	Forward/Backward signal input. Low level: Forward.
GND	-	Ground

J302 Pin Assignment:

SPI_MOSI	SPI_SCK	TXD1	RXD1	1PPS
SPI_CS	SPI_MISO	TXD2	RXD2	GND

[1] The LG69T (AA) module supports the OBD interface, whereas LG69T (AD) module does not.

Table 5: J302 Pin Detailed Description

Pin Name	I/O	Description
SPI_MOSI	-	NC (Not connected)
SPI_SCK	-	NC
TXD1	DO	TXD1 Transmit data
RXD1	DI	RXD1 Receive data
1PPS	DO	One pulse per second
SPI_CS	-	NC
SPI_MISO	-	NC
TXD2	DO	TXD2 Transmit data
RXD2	DI	RXD2 Receive data
GND	-	Ground

4 DR Application

LG69T (AA) supports Dead Reckoning (DR) function. This chapter outlines how to configure the DR function. A valid module calibration is essential for utilizing its DR capabilities, see ***Chapter 4.2*** for details. Fix the module on the vehicle frame. Any displacement, turn or tilt of the device, however small, will cause performance issues and/or void calibration. The IMU axis direction inside the module is presented below for your reference.

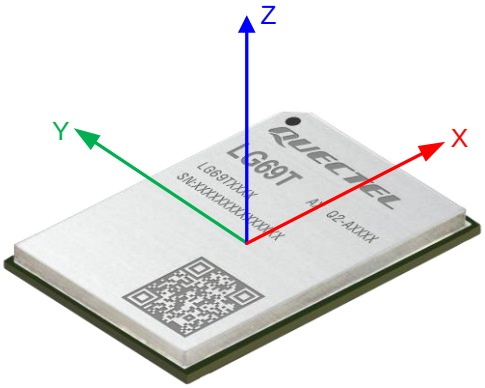


Figure 4: IMU Axis Direction

4.1. Installation

Installation of LG69T (AA) EVB allows for flexibility, since it is not dependent on angle or direction. The module can automatically identify the installation angle deviation and compensate for it through internal algorithm calculations. The installation diagram is presented in the figure below:

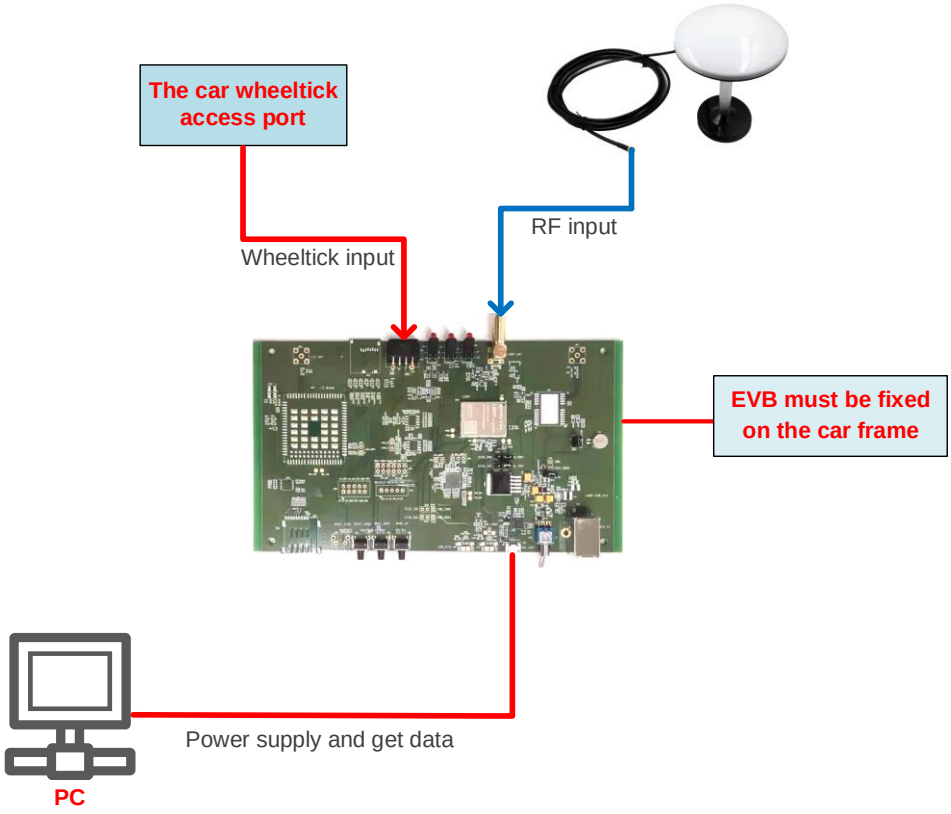


Figure 5: Installation Diagram

4.2. Calibration Procedure

This chapter details the calibration steps of LG69T (AA) EVB. Before calibration, it is necessary to confirm the EVB installation angle. The calibration procedure is based on the premise that the user has fixed the EVB on the car frame. No displacement or rotation of the EVB should occur after calibration, as described in the following chapters.

The calibration procedure needs to be repeated only in the following cases:

- The EVB has been moved and reinstalled.
- During a DR cold start and when the NVM is blank or invalid.

NOTE

Please strictly follow the steps in ***Chapter 4.2.1*** to complete the angle calibration procedure, because any improper handling may affect the calibration.

4.2.1. EVB Installation Angle Confirmation

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

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

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

Step 3: Keep the vehicle stationary for at least 20 s on a flat road (the tolerance of the gravity direction is 1°–2°).

Step 4: Drive the vehicle for 1 minute.

Step 5: Stop the vehicle and keep it still for at least 5 seconds. The module saves the calculated installation angle to the flash memory through software logic.

4.2.2. Yaw Rate Calibration

The yaw rate calibration steps of LG69T (AA) EVB are as follows:

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

Step 1: Based on **Step 5** above, the yaw rate offset will be automatically initialized with a reliable value. After it is initialized, drive in a straight road (speed > 30 km/h) for at least 5 minutes.

Step 2: Drive in areas rich in curved roads (speed > 30 km/h). This is required for calibrating the yaw rate gain. It is important to make tight turns (with narrow curvature radius). Typical scenarios that allow proper performance of this step involve roundabouts, tight turns, and sharp bends greater than 90 degrees. Broader 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 rather on 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. The same turn can be repeated many times.

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

NOTE

Please note that the hybrid GNSS/DR navigation mode will not be available until a proper calibration procedure is performed, and that only single GNSS navigation will be available.

4.3. Calibration Result Monitoring

The calibration result will be reported in an NMEA message. The following figure illustrates how to check the calibration status message.

Step 1: Enter the related software command in the "**Text Console**" to filter out the NMEA message, as shown in the figure below. For more information on the command, see ***document [1]***.

Step 2: When the fifth parameter becomes "1", it means that the whole calibration procedure has been completed.

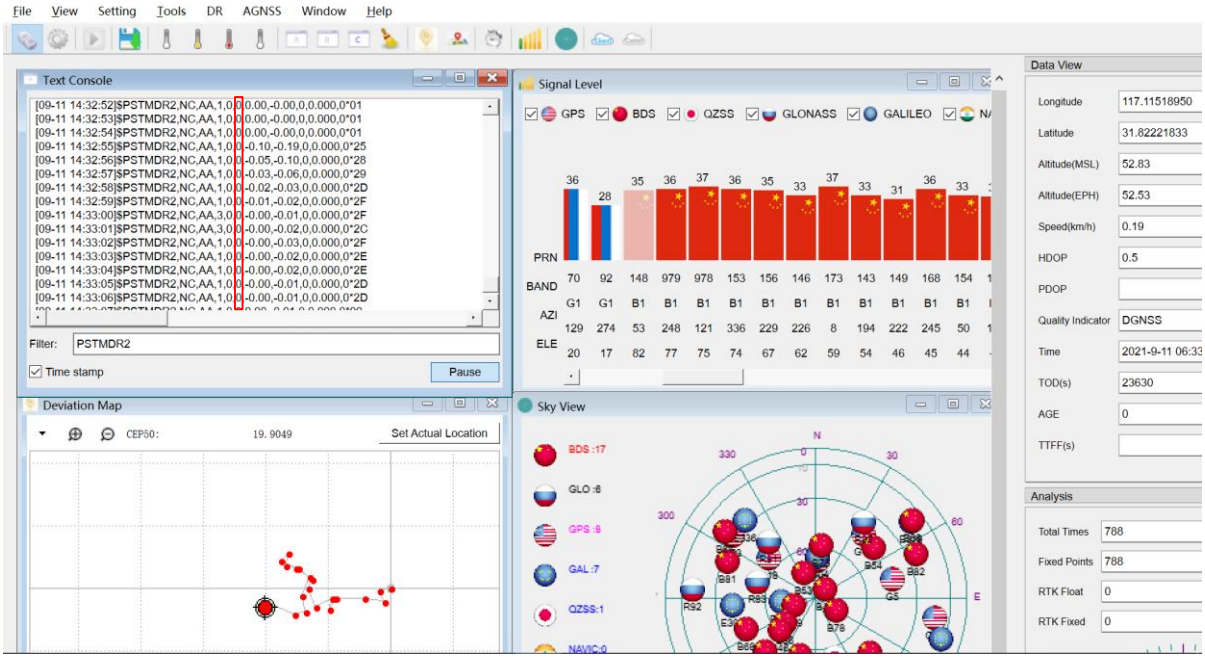


Figure 6: LG69T (AA) Calibration Status

5 Communication via QCOM Tool

This chapter explains how to use the QCOM tool to communicate with the module via the Micro-USB interface. For more information, see ***document [2]***.

Download the QCOM tool from our website Download Zone or request it from Quectel Technical Support.

5.1. Communication via Micro-USB Interface

Step 1: Connect the EVB and the PC with a Micro-USB cable.

Step 2: Connect the EVB and the PC with a Micro-USB cable. Flip the Power switch (S101) to **ON** position to power on the EVB.

Step 3: View the USB port numbers in the Device Manager.

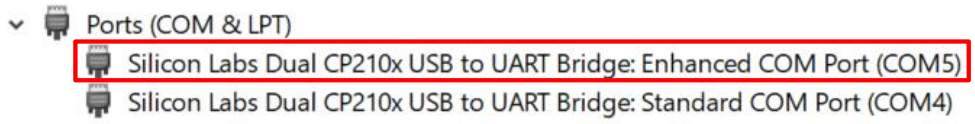


Figure 7: USB Ports

Step 4: Install the QCOM tool provided by Quectel. The COM interface for QCOM port setting is shown in the figure below (the LG69T (AA) module supports 460800 bps [2] and LG69T (AD) module supports 115200 bps [2] by default).

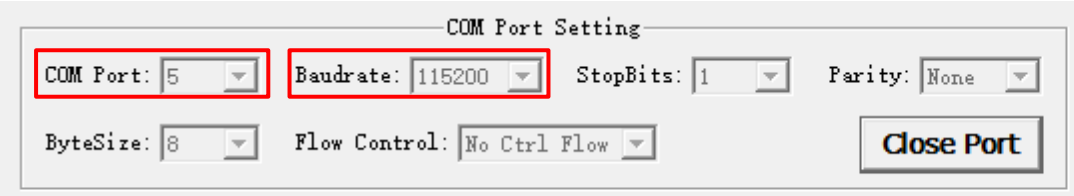


Figure 8: COM Port Setting Interface of QCOM

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

Step 5: Select the correct "**COM Port**" (shown in ***Figure 7*** above) and the "**Baudrate**".

Step 6: Click "**Open Port**" to establish communication with the EVB. The NMEA message output by the module will be displayed in the receiving bar of the QCOM tool.

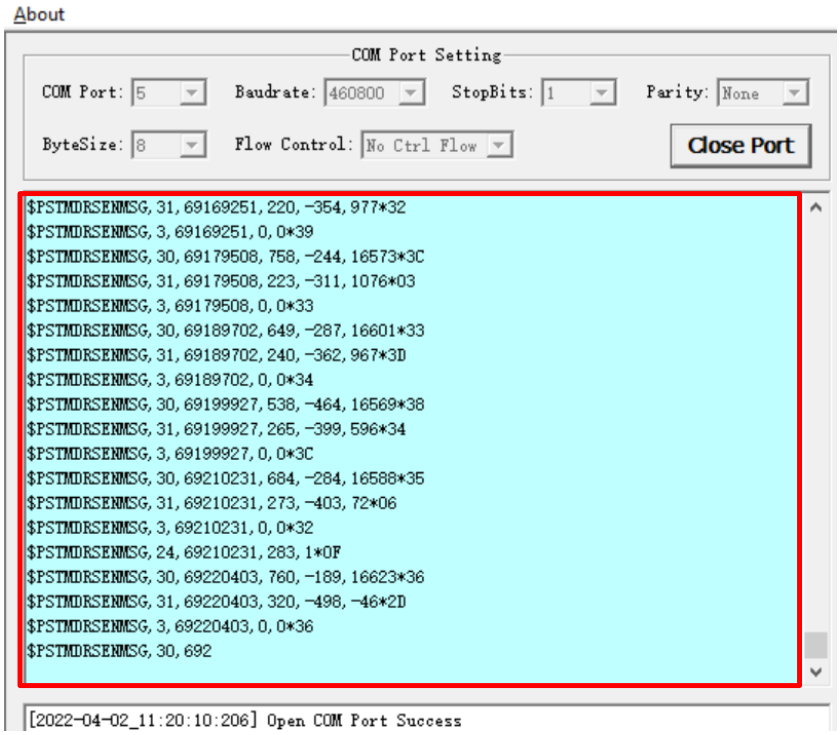


Figure 9: NMEA Sentence Output – Displayed on QCOM Tool Interface

6 Test via QGNSS Tool

This chapter explains how to use the QGNSS software tool for verifying the status of GNSS modules. You can request the QGNSS from Quectel Technical Support. For more information on QGNSS use, see ***document [3]***.

6.1. QGNSS Setting

Step 1: Assemble the EVB components.

Step 2: Flip the Power Switch (S101) to **ON** position to power on the EVB.

Step 3: Start the QGNSS and click "**Setting**" and "**Serial Port Configuration**". In the "**Model**" list, LG69T (AA) module select "**LG69T**", and LG69T (AD) module select "**None**" (the LG69T (AA) module supports 460800 bps [3] and LG69T (AD) module supports 115200 bps [3] by default).

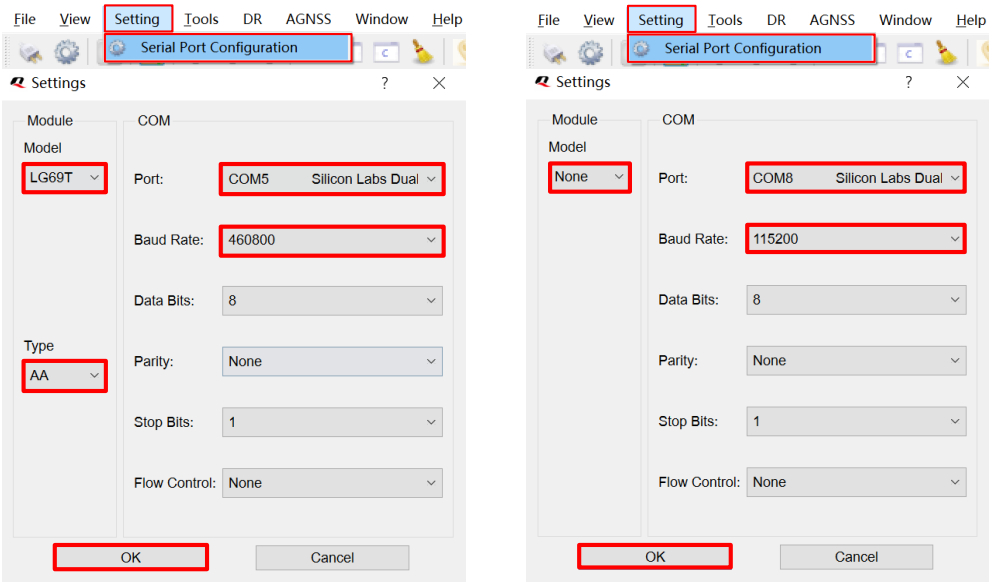


Figure 10: COM Port Setting Interface of QGNSS

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

Step 4: Click the  "**Connect or disconnect**" button. Depending on the module version, the interface shown below appears once the module is connected.

Figure 11: QGNSS Interface (Connected) – LG69T (AA)

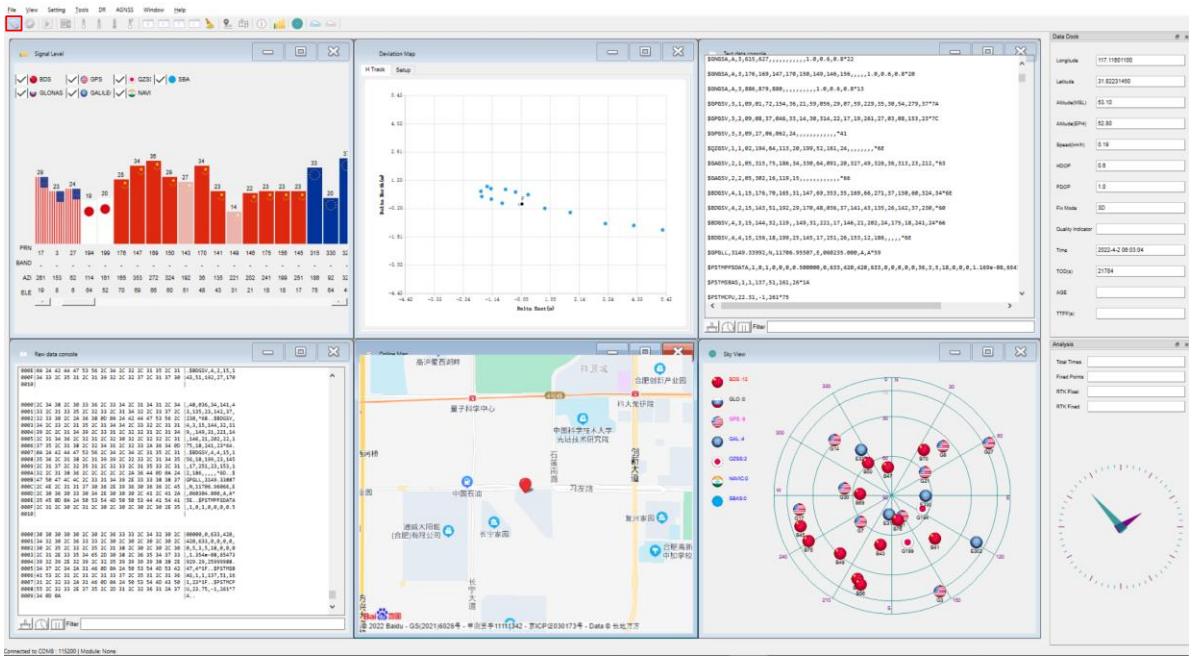
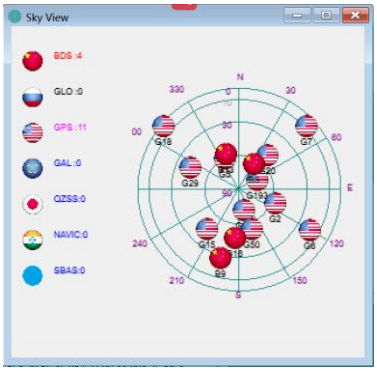
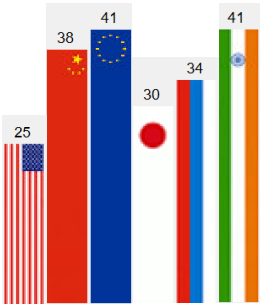
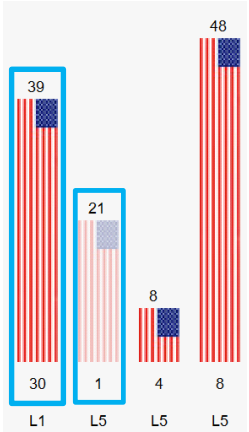


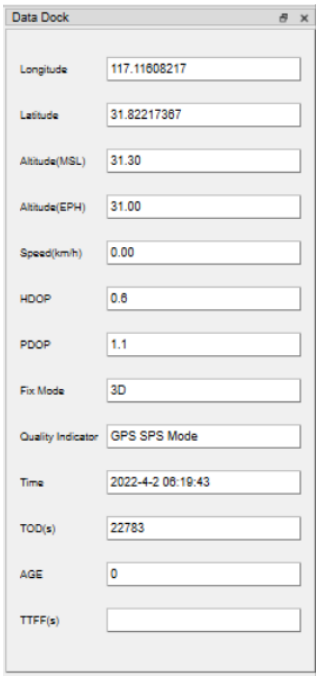
Figure 12: QGNSS Interface (Connected) – LG69T (AD)

6.1.1. QGNSS Interface Explanation

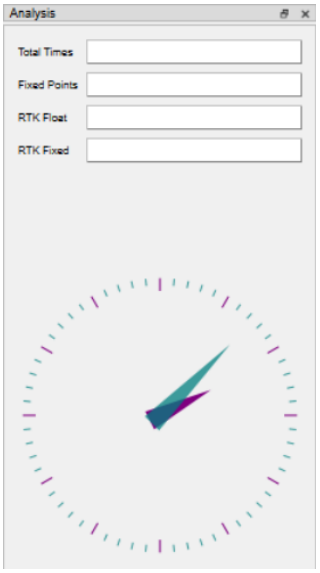
You can view GNSS information, such as C/N_0 message, time, position, speed, and precision in the QGNSS interface. See the following table to find out more about these parameters.

Table 6: QGNSS Interface Explanation

Icon	Explanation
	This sky view interface shows the position of the satellites in use. 1) The left column icon shows the satellites in use and their number. ● BDS: 4 ● GLO (GLONASS): 0 ● GPS: 11 ● GAL (Galileo): 0 ● QZSS: 0 ● NavIC (IRNSS)SBAS: 0 2) The grid map on the right shows the position of the satellites in use.
	● GPS satellite ● BDS satellite ● GLONASS satellite ● Galileo satellite ● QZSS satellite ● NavIC (IRNSS) satellite
	● PRN 30 C/N_0 is 39 dB-Hz. ● Column in bright red means that the navigation data of the satellites are in use. ● PRN 1 C/N_0 is 21 dB-Hz. ● Column in light red means that the navigation data of this satellites are not in use.



- Longitude (unit: degree)
- Latitude (unit: degree)
- 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: GPS SPS mode
- UTC date and time
- Time of day [4] (unit: second)
- Age of differential GPS data
- Last TTFF(s) (unit: second)



- Total Times
- Fixed Points
- RTK Float
- RTK Fixed

[4] Total number of seconds elapsed since midnight of the current day.

7 Firmware Download and Upgrade via GNSSFlashTool

The modules upgrade firmware with GNSSFlashTool via the UART interface. You can request the GNSSFlashTool from Quectel Technical Support. For more information about GNSSFlashTool use, see ***document [4]***.

7.1. Firmware Download in Boot Download Mode

Before you start the module firmware download process:

First: Connect the EVB to a PC with a Micro-USB cable.

Second: Flip the Power Switch (S101) to **OFF** position before powering on the EVB

Firmware download steps in Boot download mode:

Step 1: Open GNSSFlashTool or click "**Tools**" and select "**Firmware Download**" in QGNSS tool.

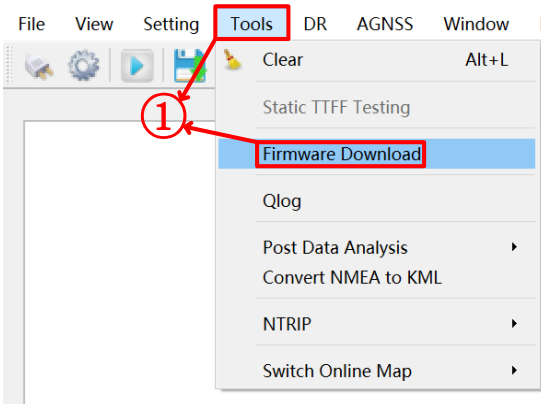


Figure 13: Firmware Download – Step 1

Step 2: Select "**LG69TAA_Download**" for the modules as shown in the figure below.

Figure 14: Firmware Download – Step 2

Step 3: Click "**Open File**" to select module firmware, e.g. "**LG69TAANR01A01V01_4WDR_ST_BETA0810A_BOOT.bin**" for LG69T (AA) module, "**LG69TADNR01A01V01_BOOT.bin**" for LG69T (AD).

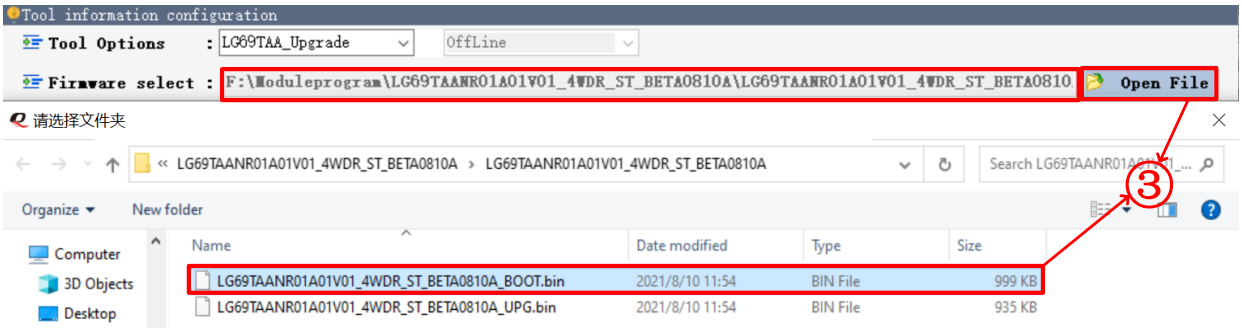


Figure 15: Firmware Download – Step 3

Step 4: Confirm the "**Port**" and "**Baud Rate**" as the enhanced COM Port and then click "**Start**" button. Press and hold the BOOT_GNSS button before flipping the power switch to **ON** position, and then release the BOOT_GNSS button to enter Boot download mode.

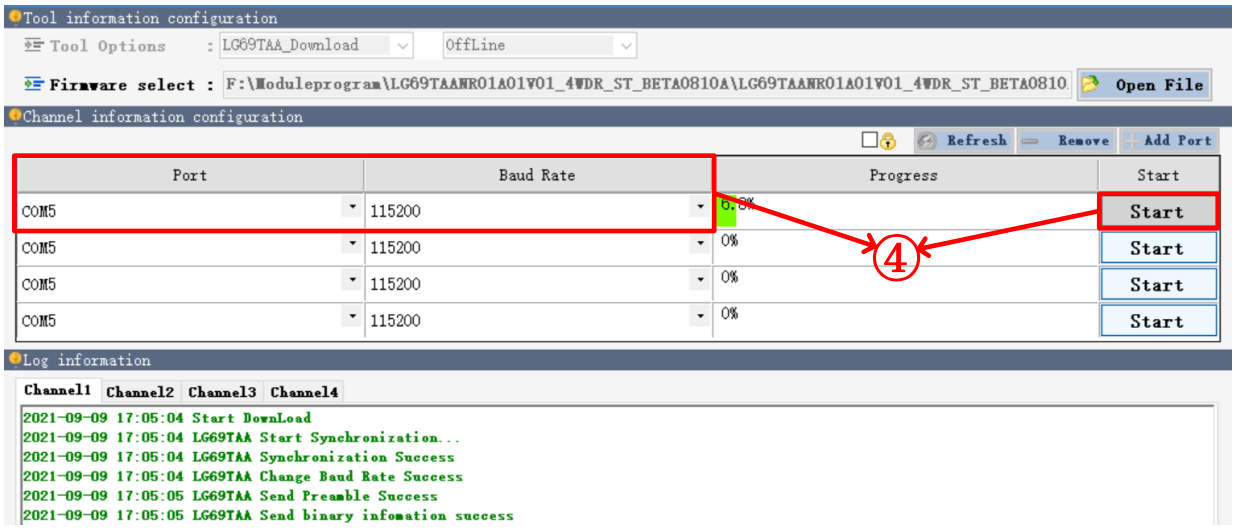


Figure 16: Firmware Download – Step 4

Step 5: Upon successful firmware download, the GNSSFlashTool green progress bar on the screen will indicate “100%”.

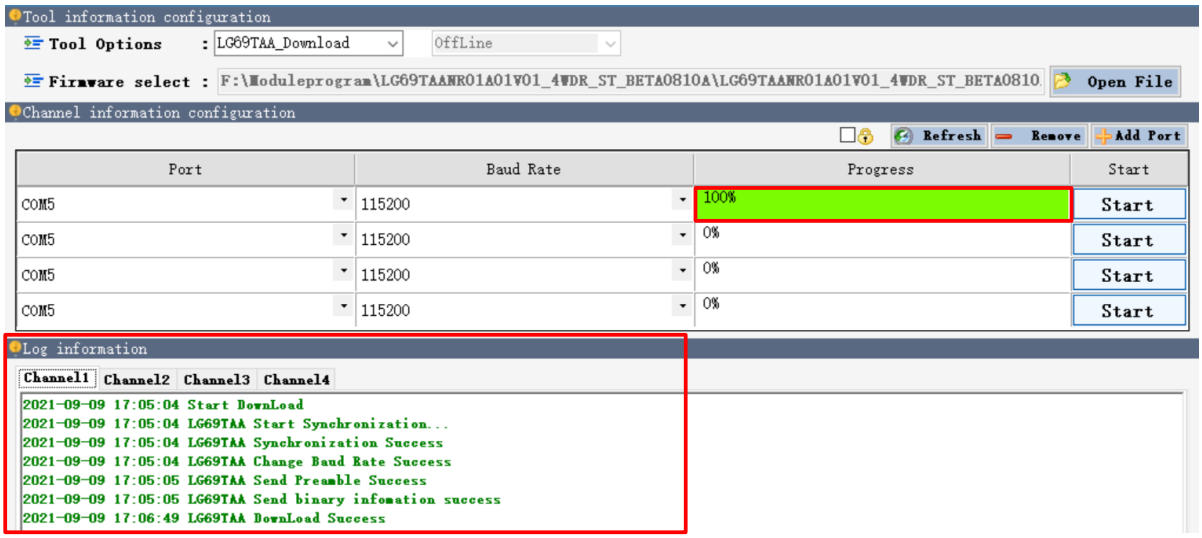


Figure 17: Successful Firmware Download – Step 5

7.2. Firmware Upgrade in Normal Operating Mode

Before you start the firmware upgrade process, connect the EVB to a PC with a Micro-USB Cable.

First: Connect the EVB to a PC with a Micro-USB Cable.

Second: Flip the Power Switch (S101) to **OFF** position before powering on the EVB.

Step 1: Open GNSSFlashTool or click “**Tools**” and select “**Firmware Download**” in QGNSS tool.

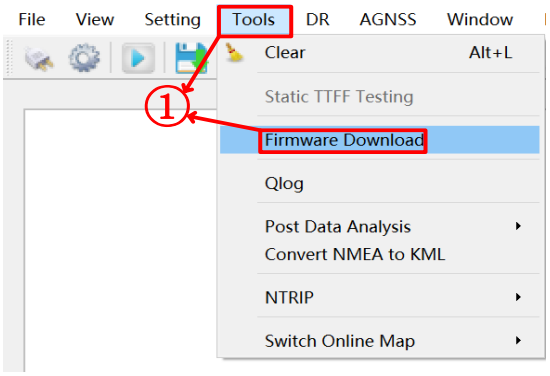


Figure 18: Firmware Upgrade – Step 1

Step 2: Select "**LG69TAA_Upgrade**" in the drop-down box of "**Tool Options**".

Figure 19: Firmware Upgrade – Step 2

Step 3: Click "**Open File**" to select module firmware, e.g. "**LG69TAANR01A01V01_4WDR_ST_BETA0810A_UPG.bin**" for LG69T (AA) and "**LG69TADNR01A01V01_UPG.bin**" for LG69T (AD).

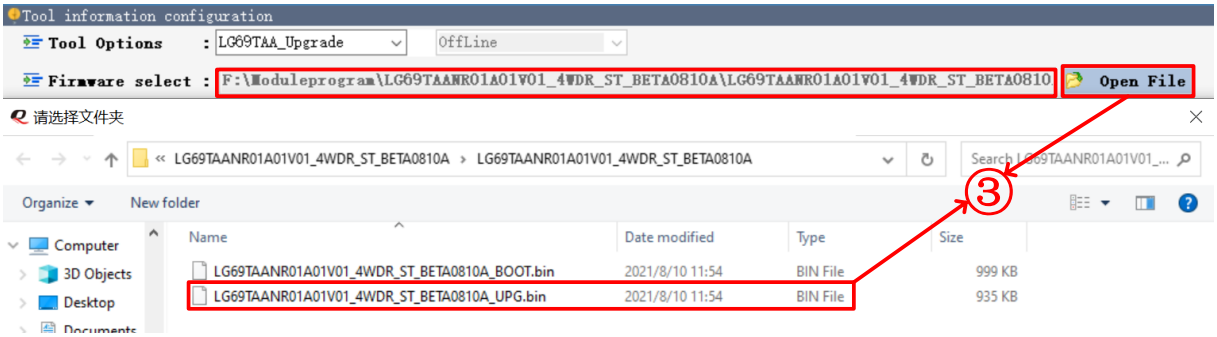


Figure 20: Firmware Upgrade – Step 3

Step 4: Confirm the "**Port**" and "**Baud Rate**" as the enhanced COM Port. Click "**Start**" button and then flip the power switch to **ON** position. Press and release RESET_GNSS button on the EVB when the progress bar becomes **98.46%**. If the operation is not performed, the firmware download will fail.

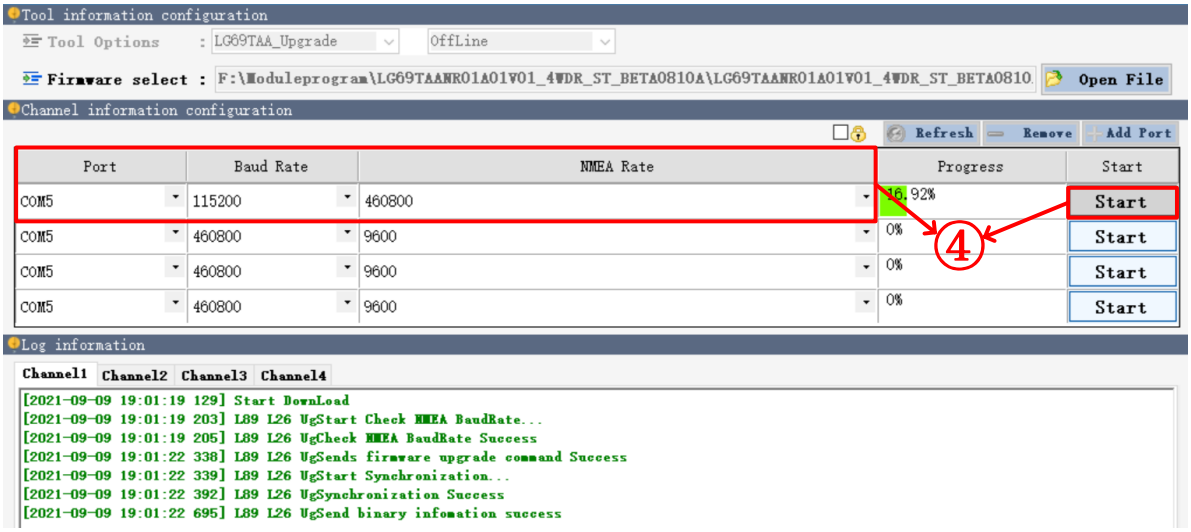


Figure 21: Firmware Upgrade – Step 4

Step 5: Upon successful firmware upgrade, the GNSSFlashTool green progress bar on the screen will indicate "**PASS**".

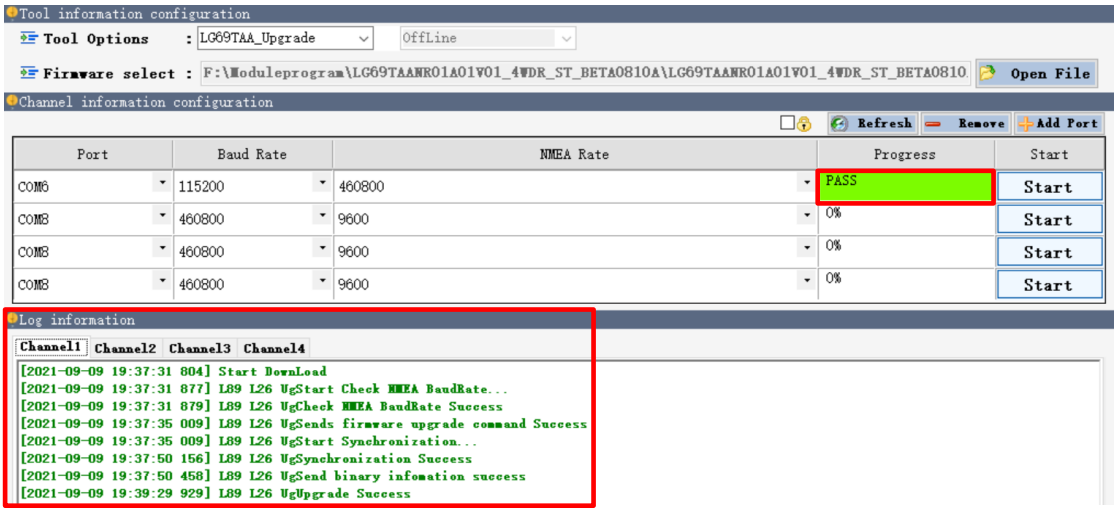


Figure 22: Successful Firmware Upgrade – Step 5

8 Appendix Reference

Table 7: Related Document

Document Name	
[1]	Quectel_LG69T(AA,AD,AI,AJ)_GNSS_Protocol_Specification
[2]	Quectel_QCOM_User_Guide
[3]	Quectel_QGNSS_User_Guide
[4]	Quectel_GNSSFlashTool_User_Guide

Table 8: Terms and Abbreviations

Abbreviation	Description
BDS	BeiDou Navigation Satellite System
CEP	Circular Error Probable
C/N_0	Carrier-to-Noise Ratio
COM Port	Communication Port
DI	Digital Input
DO	Digital Output
DR	Dead Reckoning
ESD	Electrostatic Discharge
EVB	Evaluation Board
Galileo	Galileo Satellite Navigation System (EU)
GLONASS	Global Navigation Satellite System (Russia)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System

I/O	Input/Output
LED	Light Emitting Diode
MISO	Master In Slave Out
MOSI	Master Out Slave In
MSL	Mean Sea Level
NMEA	National Marine Electronics Association
PC	Personal Computer
PCB	Printed Circuit Board
1PPS	One Pulse Per Second
PRN	Pseudorandom Noise
QZSS	Quasi-Zenith Satellite System
RTCM	Radio Technical Commission for Maritime services
RTK	Real-Time Kinematic
RXD	Receive Data (Pin)
SBAS	Satellite-Based Augmentation System
TTFF	Time to First Fix
TXD	Transmit Data (Pin)
USB	Universal Serial Bus
UTC	Coordinated Universal Time