Quick Start Guide

Voice Application Combo for RZ/G2LC-EVKIT

Quick Start Guide

Renesas RZ Family
RZ/G Series

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by Renesas Electronics Corp. without notice. Please review the latest information published by Renesas Electronics Corp. through various means, including the Renesas Electronics Corp. website (http://www.renesas.com).

Renesas Electronics
www.renesas.com

Rev.1.00 Feb 2026

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.
   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.
7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION (“Vulnerability Issues”). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Renesas Electronics© All Rights Reserved

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit: www.renesas.com/contact/.

Renesas Electronics© All Rights Reserved

Renesas RZ/G2LC-EVKIT Disclaimer

By using this RZ/G2LC-EVKIT, the User accepts the following terms, which are in addition to, and control in the event of disagreement, with Renesas' General Terms and Conditions available at https://www.renesas.com/en-us/legal/disclaimer.html.

The RZ/G2LC-EVKIT is not guaranteed to be error free, and the entire risk as to the results and performance of the RZ/G2LC-EVKIT is assumed by the User. The RZ/G2LC-EVKIT is provided by Renesas on an "as is" basis without warranty of any kind whether express or implied, including but not limited to the implied warranties of good workmanship, fitness for a particular purpose, title, merchantability, and non-infringement of intellectual property rights. Renesas expressly disclaims any implied warranty.

Renesas does not consider the RZ/G2LC-EVKIT to be a finished product and therefore the RZ/G2LC-EVKIT may not comply with some requirements applicable to finished products, including, but not limited to recycling, restricted substances and electromagnetic compatibility regulations. Refer to Certifications section, for information about certifications and compliance information for the RZ/G2LC-EVKIT. It is the kit User's responsibility to make sure the kit meets any local requirements applicable to their region.

Renesas or its affiliates shall in no event be liable for any loss of profit, loss of data, loss of contract, loss of business, damage to reputation or goodwill, any economic loss, any reprogramming or recall costs (whether the foregoing losses are direct or indirect) nor shall Renesas or its affiliates be liable for any other direct or indirect special, incidental or consequential damages arising out of or in relation to the use of this RZ/G2LC-EVKIT, even if Renesas or its affiliates have been advised of the possibility of such damages.

Renesas has used reasonable care in preparing the information included in this document, but Renesas does not warrant that such information is error free nor does Renesas guarantee an exact match for every application or parameter to part numbers designated by other vendors listed herein. The information provided in this document is intended solely to enable the use of Renesas products. No express or implied license to any intellectual property right is granted by this document or in connection with the sale of Renesas products. Renesas reserves the right to make changes to specifications and product descriptions at any time without notice. Renesas assumes no liability for any damages incurred by you resulting from errors in or omissions from the information included herein. Renesas cannot verify, and assumes no liability for, the accuracy of information available on another company's website.

Precautions

This Evaluation Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.
The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:
• Ensure attached cables do not lie across the equipment.
• Reorient the receiving antenna.
• Increase the distance between the equipment and the receiver.
• Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
• Power down the equipment when not in use.
• Consult the dealer or an experienced radio/TV technician for help.
Note: It is recommended that wherever possible shielded interface cables are used.
The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:
• The user is advised that mobile phones should not be used within 10 m of the product when in use.
• The user is advised to take ESD precautions when handling the equipment.
The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

Renesas Electronics© All Rights Reserved

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the Exampleline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

Renesas Electronics© All Rights Reserved

Voice Application Combo

RZ/G2LC-EVKIT – Quick Start Guide

Contents

Corporate Headquarters 2

Contact information 2

Trademarks 2

1. Introduction 7
1.1 Assumptions and Advisory Notes 7

2. Kit Contents 8
2.1 Kit Contents 8
2.2 Required Equipment (User-Supplied) 8

3. Overview of the Quick Start Guide Project 8
3.1 Description of Natural Language Understanding 9
3.2 Description of Cyberon Speaker Verification 9

4. Running the Quick Start Guide Project 10
4.1 Requirements 10
4.1.1 Hardware Requirements 10
4.1.2 Software Requirements 10
4.2 Preparing and flashing the Linux Image 10
4.2.1 Use balenaEtcher 10
4.2.2 Use WSL 12
4.3 Hardware Setup 14
4.4 Booting and Operating the Demo 15

5. Customizing the Quick Start Guide Project 20
5.1 Requirements 20
5.1.1 Hardware Requirements 20
5.1.2 Software Requirements 20
5.2 Setting Up the Development Environment 20
5.3 Building the Project 20
5.4 Deploying and Testing a Custom Build 21
5.5 Understanding the License Process 22
5.6 How to Reset Bootloader 22

6. Next Steps 26

Renesas Electronics© All Rights Reserved

7. Website and Support 26

Revision History 27

Figures

Figure 1. RZ/G2LC-EVKIT 8
Figure 2 Select image file from balenaEtcher 11
Figure 3 Select target from balenaEtcher 11
Figure 4 Start Flash from balenaEtcher 12
Figure 5 Flash Completed 12
Figure 6. Serial Port Setup 16
Figure 7 Screen of project start up 17
Figure 8 Screen after speaking a wake word 17
Figure 9 Screen after speaking a command 18
Figure 10 Screen after starting speaker registration 18
Figure 11 Screen after finishing speaker registration 18
Figure 12 Screen of speaking wake word after registering your voice 19
Figure 13 Screen of removing speaker voice 19
Figure 14 Screen after booting in SCIF Boot Mode 22
Figure 15 Screen of sending file from Tera Term 23
Figure 16 Screen after transferring Flash Writer file 23
Figure 17 Screen after entering erase command 23
Figure 18 Screen after completing erase command 23
Figure 19 Screen after changing baud rate 24
Figure 20 Screen after entering the XLS2 command and address for BL2 image 24
Figure 21 Screen after completing sending BL2 image 24
Figure 22 Screen after entering the XLS2 command and address for FIP image 25
Figure 23 Screen after completing sending FIP image 25

Renesas Electronics© All Rights Reserved

1. Introduction

This Quick Start Guide (QSG) provides instructions for setting up and running a voice combo application demonstration on the Renesas RZ/G2LC-EVKIT.

This guide demonstrates a powerful combination of voice solutions using Cyberon's SDKs, enabling sophisticated voice interaction on the RZ/G2LC platform:

Cyberon DSpotterNLU | Renesas: For rule-based natural language understanding. This allows the system to comprehend varied command phrasing (e.g., "Turn on the light" vs. "Switch the light on") instead of just fixed keywords.

Cyberon Speaker Verification CNSV | Renesas: For speaker verification. This enables the application to identify registered users by their unique voice characteristics, adding a layer of personalization and security.

The guide is structured to first get you started quickly with a pre-built demonstration. Afterwards, it will walk you through advanced topics such as customizing the source code and building the project from scratch.

1.1 Assumptions and Advisory Notes

1. **Tool experience**: It is assumed that the user has prior experience with the following:
    - Serial terminal programs (e.g., Tera Term) for connecting to and interacting with the evaluation board.
    - Basic Linux command-line operations within a **Windows Subsystem for Linux (WSL)** environment. All project customization and building steps described in this guide are performed within WSL.
2. **Subject knowledge**: It is assumed that the user has basic knowledge about microprocessors and embedded Linux systems to understand and modify the example project. This guide does not cover the fundamentals of setting up a Linux development environment.
3. **Screen Captures**: The screenshots provided throughout this document are for reference. The actual screen content may differ depending on the version of software and development tools used.

Renesas Electronics© All Rights Reserved

2. Kit Contents

2.1 Kit Contents

The following components are included in the kit:

RZ/G2LC-EVKIT (RTK9744C22S01000BE)

- Micro USB device cable (type-A male to micro-B male): This cable is used for serial communication with a host PC.

Figure 1. RZ/G2LC-EVKIT

2.2 Required Equipment (User-Supplied)

In addition to the kit contents, you will need the following hardware to complete the steps in this guide:

- **Host PC:** A PC running Windows 10 or later, with at least one available USB port.
- **microSD card:** A high-speed microSD card, 8GB or larger. A card with a speed rating of UHS-I Class 10 / U1 / V10 or higher is strongly recommended for optimal performance.
- **USB Card Reader:** To write the Linux OS image to the microSD card from your host PC.
- **Power Supply:**
  - A USB Type-A power adapter with an output capacity of 5V/1A to 5V/3A.
  - A USB Type-A to **Type-C** cable to power the EVK via the CN6 connector.
- **Audio Equipment:**
  - A microphone with a standard 3.5mm jack.
  - An active (powered) speaker with a standard 3.5mm jack.
- **Ethernet Cable (RJ45):** This is required for the initial setup to allow the board to connect to the internet and download the necessary SDK license file.

3. Overview of the Quick Start Guide Project

This chapter provides an overview of the demonstration project, detailing the key technologies used to create a responsive voice-controlled experience.

The demo application showcases a powerful combination of on-device (edge) voice AI technologies from Cyberon, running efficiently on the RZ/G2LC processor. It is designed to operate without needing a constant cloud connection, ensuring low latency and enhanced privacy. The core of this solution is built upon two key engines: DSpotterNLU for understanding commands and CNSV for identifying speakers.

Renesas Electronics© All Rights Reserved

3.1 Description of Natural Language Understanding

Cyberon's DSpotterNLU (Natural Language Understanding) engine is the core of the voice command system. It provides a sophisticated framework for creating robust, speaker-independent voice recognition applications.

Unlike simple keyword spotting, DSpotterNLU analyzes full sentences to understand the user's intent based on developer-defined grammar. This allows for more flexible and natural user interaction. Key capabilities include:

- **Advanced Voice Command Recognition:** The engine can process varied phrasing and sentence structures, thanks to its rule-based system. This allows developers to define command patterns that tolerate filler words (e.g., "um", "please") and variations in word order.
- **Wake-Word Spotting:** The application is always listening for a specific "wake-word" (e.g., "Hi Renesas") to activate the command recognition phase. This feature is highly optimized for low-power consumption.
- **Voice Activity Detection (VAD):** An integrated VAD detects the presence of human speech, allowing the system to intelligently start and stop recording. This improves recognition accuracy by ignoring silence and non-speech noise.
- **Multi-Language Support:** The DSpotterNLU engine supports over 30 languages, enabling the development of global products with a single, consistent architecture.
- **End-User Customization:** The technology supports features like voice tagging, allowing end-users to create their own voice commands for specific actions.

3.2 Description of Cyberon Speaker Verification

Cyberon's CNSV (Cyberon Speaker Verification) engine adds a layer of personalization and security by identifying who is speaking. It uses advanced neural network algorithms to analyze unique vocal characteristics, a process known as voice biometrics.

This technology is distinct from speech recognition (which understands what is said) and is crucial for applications requiring user-specific access or customized experiences.

Key Features of CNSV SDK:

- **Advanced Neural Network** Technology for Edge Devices: Utilizes state-of-the-art neural network models specifically optimized for edge computing environments, providing high accuracy with minimal computational overhead.
- **Optimized for Embedded Systems and ARM Platforms**: Designed to operate efficiently on resource-constrained devices, making it ideal for embedded systems, ARM-based platforms, and other edge devices like the RZ/G2LC.
- **Speaker Identification**: The demo allows for the registration of multiple users. When a registered user speaks the wake-word, the CNSV engine can identify them from its database of voiceprints.
- **Efficient Resource Usage**: Low CPU and memory consumption ensures that the SDK can be deployed on devices with limited processing power and memory.
- **Robust Performance in Real-World Environments**: Maintains high accuracy and reliability in various conditions, including noisy environments and diverse microphone setups.

By leveraging these two engines, the RZ/G2LC-EVKIT provides a comprehensive demonstration of a modern, on-device voice user interface.

Renesas Electronics© All Rights Reserved

4. Running the Quick Start Guide Project

This chapter provides step-by-step instructions to run the pre-built voice application demo on your RZ/G2LC-EVKIT. By following these steps, you will flash the provided Linux image to a microSD card, set up the hardware, and operate the demo using voice commands.

4.1 Requirements

Before starting the demo, please ensure you have the following hardware and software.

4.1.1 Hardware Requirements

- RZ/G2LC-EVKIT
- A PC with at least 1 USB port
- USB card reader
- High speed (UHS-I C10/U1/V10) microSD card (8GB or more)
- USB Type-A power adapter, output capacity 5V1A ~ 5V3A
- Audio speaker with 3.5mm jack interface
- Microphone with 3.5mm jack interface
- USB Type-A to micro-B cable for serial communication between PC and G2LC EVK
- RJ45 Ethernet cable (only used for obtain the SDK license through the Internet)

4.1.2 Software Requirements

- Windows Subsystem for Linux (WSL): Ubuntu 20.04 LTS is recommended
- PowerShell x64 on Windows
- usbipd-win: This is necessary to operate USB devices connected to Windows from wsl2.
  - Please refer to the official document (usbipd-win)
- Terminal Software: A program capable of serial communication, such as Tera Term
- FTDI Driver: This is necessary to recognize RZ/G2LC COM Port from your host PC (FTDI Driver)
- Demo Linux Image: To be downloaded in the next section
  - [Optional] balenaEtcher: A cross-platform tool to flash OS images onto SD cards and USB drives safely and easily.
    - ✧ Please refer to the official web page (balenaEtcher)

4.2 Preparing and flashing the Linux Image

The demo environment, including the Linux OS, libraries, and the application executable, is provided as a single image file. You will write this image to your microSD card.

4.2.1 Use balenaEtcher

By using balenaEtcher, you can write Linux images containing QSG projects to microSD cards even without a WSL environment and usbipd-win.

(1) Download the Demo Linux Image

1. Download the demo Linux image file (`g2lc_nlu_cnsv_demo.img.zip`) from the provided link shown in 4.1.2.
2. On your host PC, extract the archive. This will produce the image file: `g2lc_nlu_cnsv_demo.img`.

Renesas Electronics© All Rights Reserved

(2) Flash the image using balenaEtcher

(a) Insert your microSD card

Insert your microSD card into the USB card reader and connect it to your windows host PC.

(b) Open balenaEtcher

Open balenaEtcher from your windows host PC.

(c) Select image file

Select Linux image file from balenaEtcher “Flash from file”.

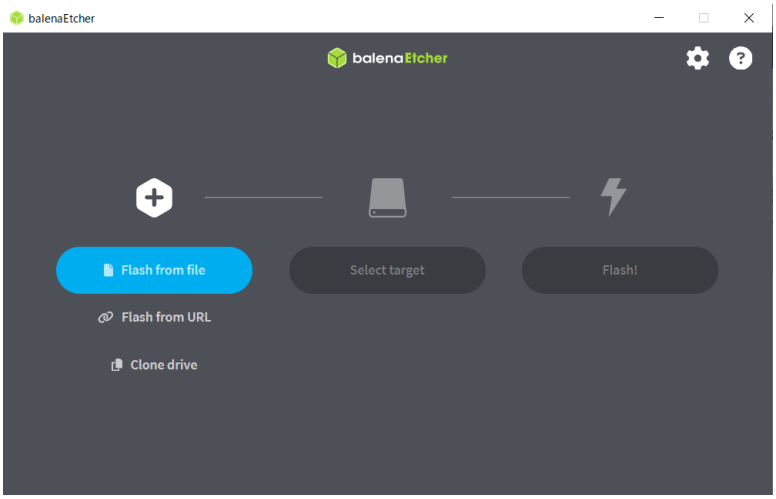


Figure 2 Select image file from balenaEtcher

(d) Select targe device

Select your microSD card from balenaEtcher “Select target”.

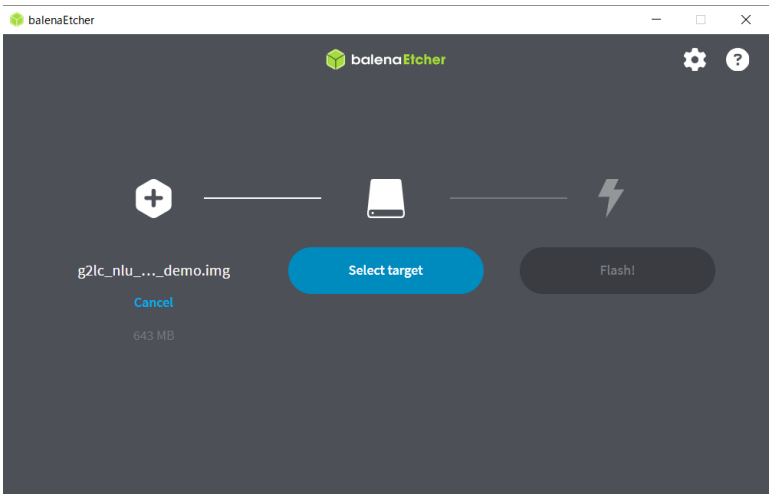


Figure 3 Select target from balenaEtcher

(e) Flash the image to microSD card

Renesas Electronics© All Rights Reserved

Click “Flash” button from balenaEtcher.

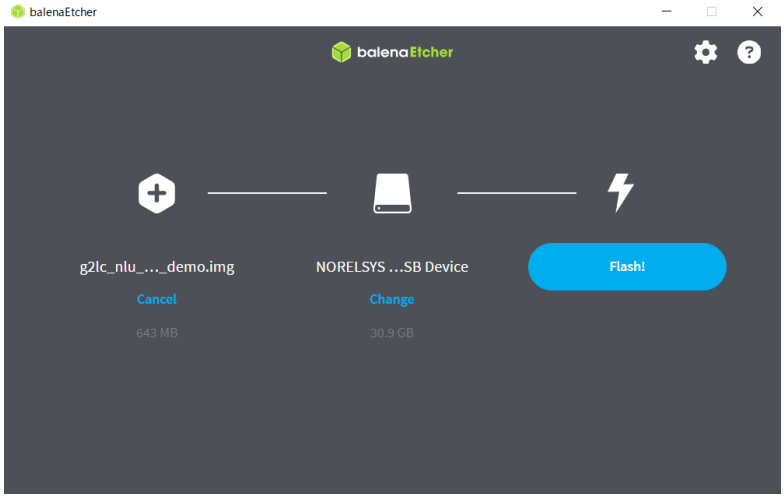


Figure 4 Start Flash from balenaEtcher

When finish writing, “Flash Completed!” is displayed on balenaEtcher.

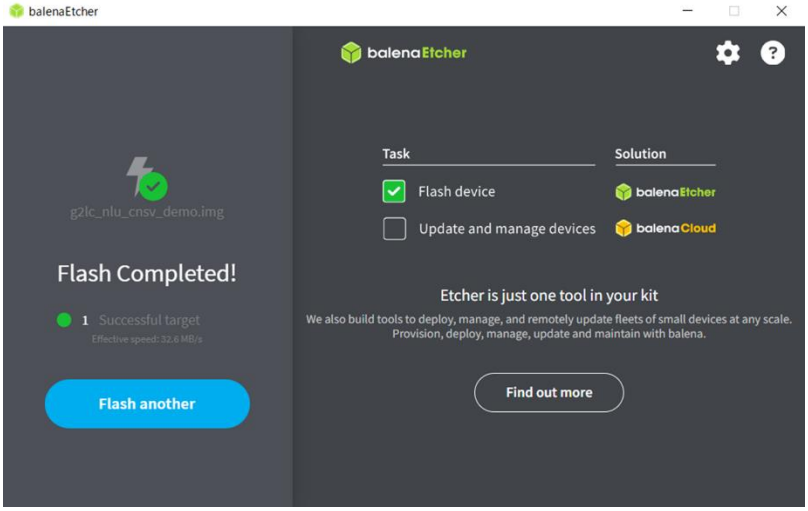


Figure 5 Flash Completed

4.2.2 Use WSL

You can also write images using commands from WSL. This method will also be necessary when customizing in Chapter 5.

(1) Download the Demo Linux Image

3. Download the demo Linux image file (`g2lc_nlu_cnsv_demo.img.tar.bz2`) from the provided link shown in 4.1.2.
4. On your host PC, use a suitable tool (e.g., 7-Zip) or your WSL environment to extract the archive. This will produce the image file: `g2lc_nlu_cnsv_demo.img`.

```
tar xvf g2lc_nlu_cnsv_demo.img.tar.bz2
```

(2) Connect the microSD card Reader to WSL

To make the microSD card accessible from WSL, use the usbipd tool in Windows PowerShell.

Renesas Electronics© All Rights Reserved

(a) Insert your microSD card

Insert your microSD card into the USB card reader and connect it to your PC.

(b) Run PowerShell as an administrator

(c) List the available USB devices to find the BUSID of your card reader

Execute the following commands in PowerShell to make the card reader accessible from WSL.

```
usbipd list
```

Look for your card reader in the output. Note its BUSID (e.g., 4-1 in the example below).

```
BUSID  VID:PID      DEVICE                    STATE
...
4-1    0bda:0169    Generic USB Storage       Device Not attached
...
```

(d) Bind the device and attach it to WSL

Bind the device and attach it to WSL, replacing 4-1 with the BUSID you identified.

```
usbipd bind --busid 4-1
usbipd attach --wsl --busid 4-1
```

The card reader is now accessible from within your WSL environment.

(3) Flash the Image using dd command

This step writes the image file to the microSD card. **Extreme caution is required.**

(a) Launch your WSL terminal (Ubuntu 20.04)

(b) Identify the device name of your microSD card

Use the `lsblk` command and check the SIZE column to ensure you have the correct device.

```
lsblk
```

In the example below, the 14.9G device `/dev/sdd` is the microSD card.

```
NAME   MAJ:MIN      RM     SIZE   RO     TYPE         MOUNTPOINT
sda    8:0          0      238.5G 0      disk
```


Renesas Electronics© All Rights Reserved

```
sdb    8:16         0      1G     0      disk [SWAP]
sdd    8:48         1      14.9G  0      disk
├─sdd1 8:49         1      7.6M   0      part
└─sdd2 8:50         1      2.4G   0      part
```

WARNING: CRITICAL STEP

Writing to the wrong device (e.g., your PC's hard drive) will cause irreversible data loss. Double-check that the device name (e.g., `<code>/dev/sdd</code>`) corresponds exactly to your microSD card before proceeding.

(c) Flash the image using the dd command

Use the identified device name to write the image file to the microSD card. Specify the path to your image file for `if=` and the identified device name for `of=`.

```
sudo dd if=/mnt/DRIVE/PATH_OF_IMAGE/g2lc_nlu_cnsv_demo.img of=/dev/sdd bs=1M
status=progress
```

(d) ensure all data is written to the card

Once the writing process is complete, run the following command to ensure all data is written to the card, then unmount it safely.

```
sync
```

You can now close WSL and PowerShell and safely remove the card reader.

4.3 Hardware Setup

Next, prepare and connect the RZ/G2LC-EVKIT.

(1) Set the DIP Switches

Configure the DIP switches on the board as follows. This setting enables booting from the SD card.

- **SW1:** `1/5/6` to ON, `2/3/4` to OFF
- **SW11:** `1/2/3` to OFF, `4` to ON

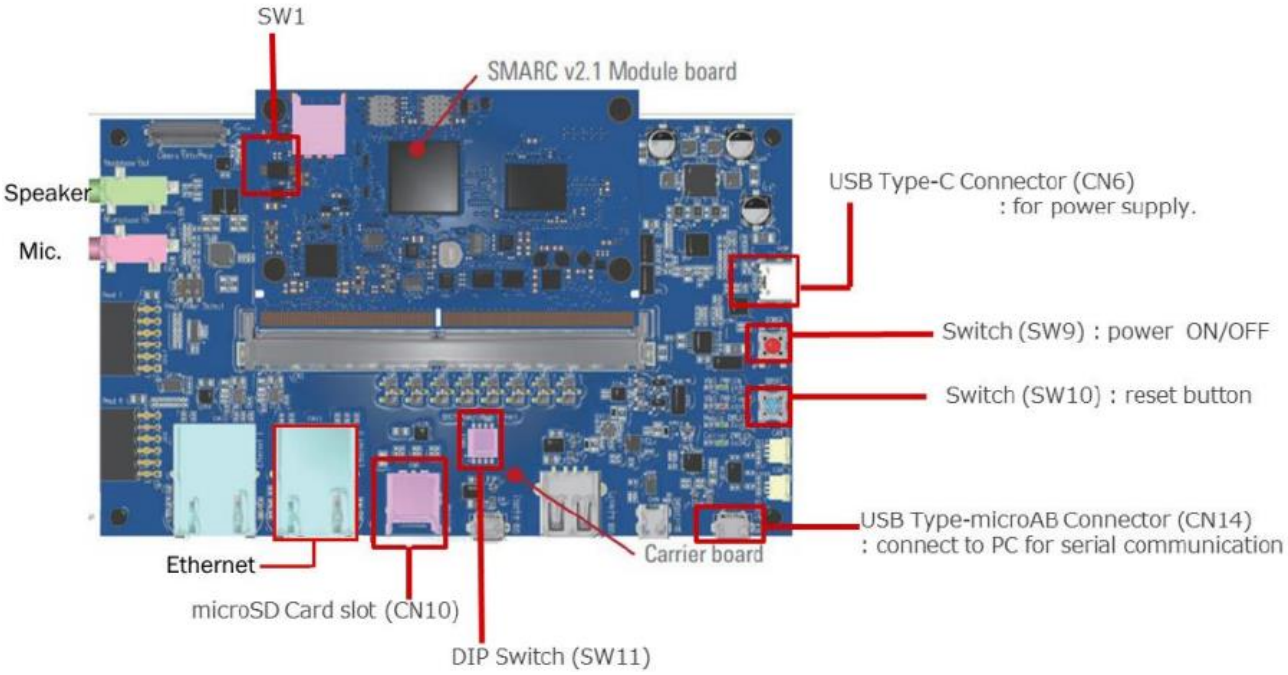
(2) Insert the microSD card

Insert the prepared microSD card into the **microSD card slot (CN10)** on the back of the board.

(3) Connect the Cables

Connect the various cables as shown in the diagram below.

Renesas Electronics© All Rights Reserved



- **Microphone:** Connect a 3.5mm jack microphone to the **Mic input jack**.
- **Speaker:** Connect a 3.5mm jack active speaker to the **Speaker output jack**.
- **Serial Communication:** Connect your PC's USB port to the board's **USB Type-microAB connector (CN14)** with a USB cable. This is used to control the board from your PC.
- **Power:** Connect a USB power adapter (5V/3A recommended) to the board's **USB Type-C connector (CN6)** with a USB Type-C cable. **Do not plug the power adapter into the outlet yet.**
- **Ethernet:** Connect the RZ/G2LC-EVKIT to the Internet via an RJ45 Ethernet cable. **This step is only required the first time you run the sample code to download the license file.**

4.4 Booting and Operating the Demo

Now, let's boot up the demo. You will connect to and operate the board from your PC's terminal software.

(1) Power On

Press the **power button (SW9)** on the board to turn it on. If the power is not turned on, the communication port will not be recognized by the terminal program.

(2) Launch and Configure the Terminal Software

Launch a terminal program on your PC (e.g., Tera Term on Windows) and connect to the COM port associated with the RZ/G2LC-EVKIT using the following settings:

- Port — The COM port identified in your Device Manager
- Speed / Baud Rate — 115200
- Data — 8 bit
- Parity — none
- Stop bits — 1 bit
- Flow Control — none

Renesas Electronics© All Rights Reserved

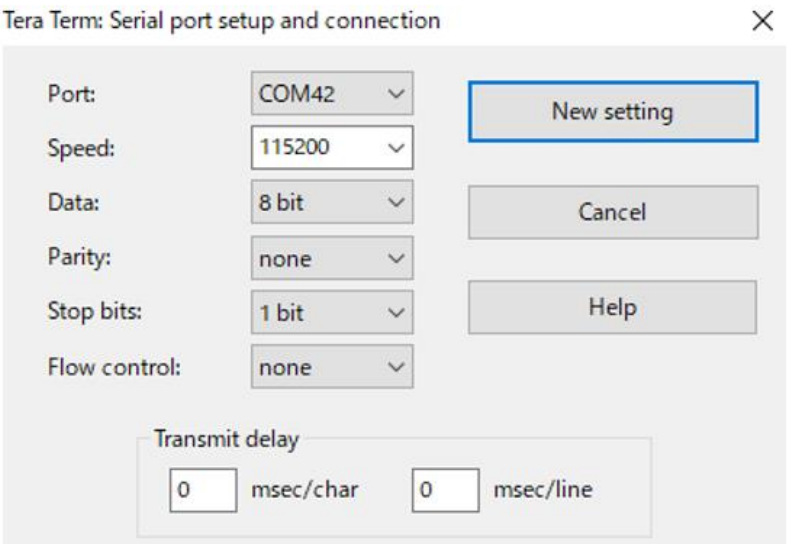


Figure 6. Serial Port Setup

(3) Reset and Boot the Board

Press the **reset button (SW10)** on the board to reboot it. You should see the Linux boot log scrolling in the terminal window.

(4) Log In

Once the boot process is complete, you will be prompted to log in. Enter the following:

```
(login): root
```

No password is required.

(5) Run the Demo

After logging in, enter the following commands to run the demo program:

```
cd /usr/DSpotterNLU_CNSV_Demo
./Run.sh
```

Note: If you encounter a "Permission denied" error, run `chmod +x Run.sh` first.

After running the demo by shell script, the following response is displayed.

Renesas Electronics© All Rights Reserved

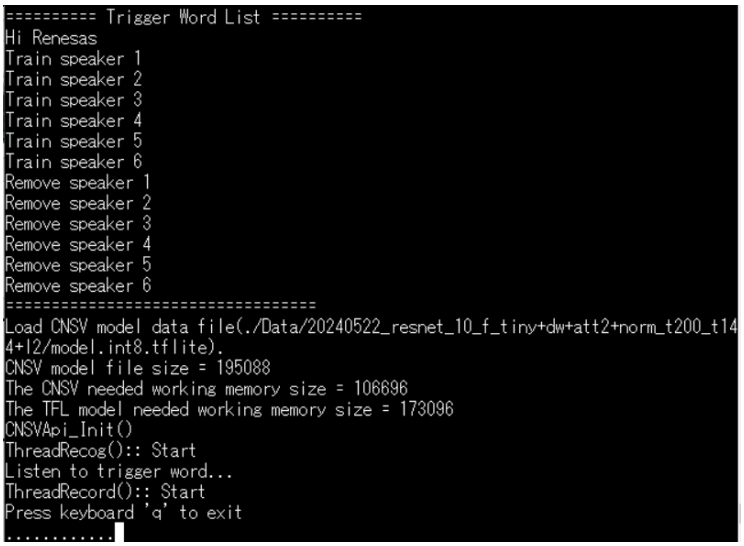


Figure 7 Screen of project start up

(6) Operation with Voice Commands

Speak towards the board using the following commands. First, say the wake word, followed by a command.

- **Wake Word:** **"Hi Renesas"**

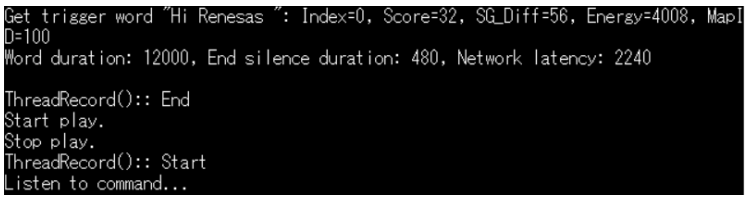


Figure 8 Screen after speaking a wake word

Example Command	Recognized Action
"Turn on the light" / "Turn light on "	Open Light
"Turn off the light" / "Switch light off"	Close Light
“Play music” / “Listen to music”	Play Music
“Stop music”	Stop Music
“Pause music”	Pause Music
“Resume music”	Resume Music
“Previous track” / “Previous song”	Previous Music
“Next track” / “Next song”	Next Music
“Turn up volume” / “Increase volume”	Volume Up
“Turn down volume” / “Volume softer”	Volume Down
“Volume is too low” / “Music is too small”	Volume too Low
“Volume is too loud” / “Music is too high”	Volume too Loud

Renesas Electronics© All Rights Reserved

Figure 9 Screen after speaking a command

(7) Register speaker

When speaking the following word, this project will train your voice for recognizing speaker.

- **Triger Word: "Train speaker 1"**

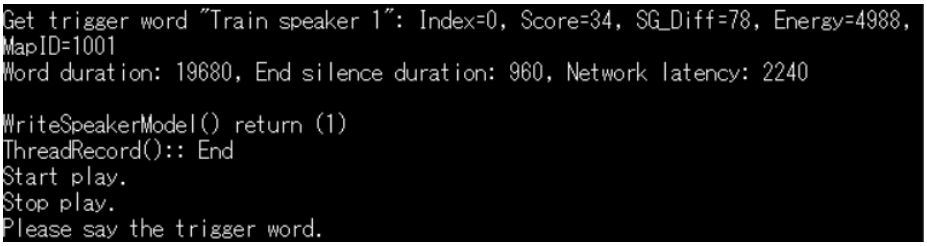


Figure 10 Screen after starting speaker registration

After speaking this word, you can register your voice by speaking wake word following application sound.

Figure 11 Screen after finishing speaker registration

After registering your voice, your voice is recognized by application when speaking wake word.

Renesas Electronics© All Rights Reserved

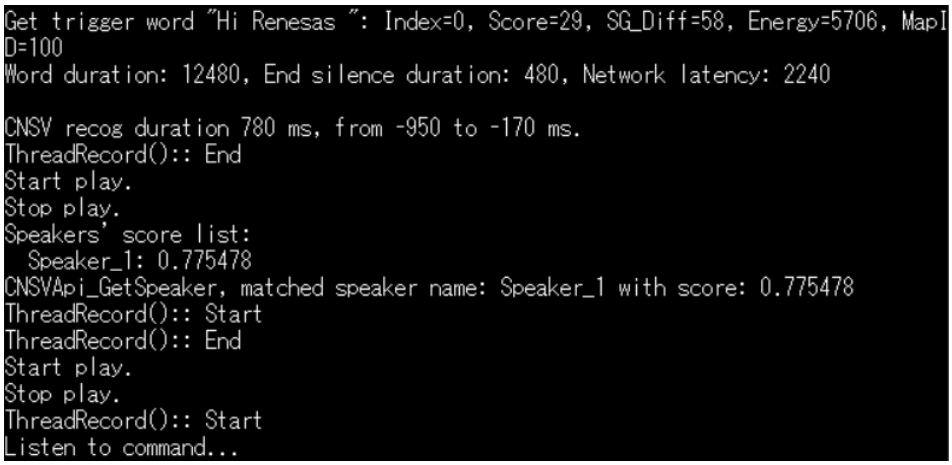


Figure 12 Screen of speaking wake word after registering your voice

If you want to remove your voice registration, you can delete by speaking the following word.

- **Triger Word:** **"Remove speaker 1"**

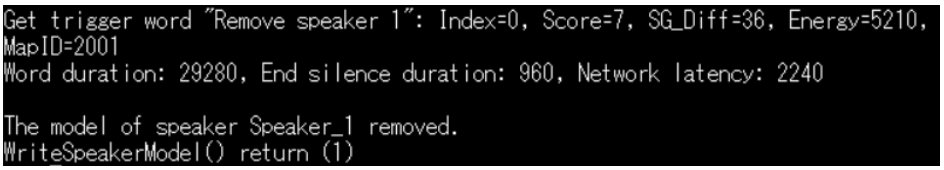


Figure 13 Screen of removing speaker voice

(8) Exiting and Shutting Down the Demo

To exit the demo, press `Ctrl+C` or `q` in the terminal.

To prevent data corruption when turning off the board, always shut down the Linux system with the following command:

```
shutdown -h now
```

When "Power down." is displayed in the terminal, it is safe to unplug the board's power cable.

Renesas Electronics© All Rights Reserved

5. Customizing the Quick Start Guide Project

This chapter provides instructions for users who wish to modify the project source code, build the application, and customize the voice recognition models. The following sections assume you have successfully run the pre-built demo as described in 4. Running the Quick Start Guide Project.

5.1 Requirements

Before starting, ensure you have the same hardware and software as listed in Chapter 4, with the addition of the following development-specific software.

5.1.1 Hardware Requirements

All hardware listed in 4.1.1 Hardware Requirements.

5.1.2 Software Requirements

- All software listed in 4.1.2 Software Requirements.
- Compiler toolchain in HMI SDK:
  - https://renesas-rz.github.io/rzg_hmi_sdk/latest/getting_started/#1-necessary-equipment
  - Please click the “Get HMI SDK” button to download it.
- Project Source Code
  - Download and extract the sample project source code package to a location accessible from your WSL environment (e.g., `/mnt/c/Users/YourUser/Projects/`).

5.2 Setting Up the Development Environment

To build the project, you must first set up a cross-compilation environment on your host PC using WSL.

(1) Install the RZ/G2LC Toolchain

The toolchain contains the cross-compiler and libraries needed to build applications for the RZ/G2LC.

1. Launch your WSL (Ubuntu 20.04) terminal.
2. Navigate to the directory where you downloaded the HMI SDK installer.
3. Run the toolchain installer script. The default installation path is /opt/poky/3.1.31.

```
sudo sh ./poky-glibc-x86_64-core-image-weston-aarch64-smarc-rzg2lc-toolchain-3.1.31.sh
```

(2) Configure the Toolchain Environment

Before building, you must set up environment variables for the toolchain. Run the following command in your WSL terminal each time you open a new session for development.

```
source /opt/poky/3.1.31/environment-setup-aarch64-poky-linux
```

To make this permanent, you can add this line to the end of your ~/.bashrc file.

5.3 Building the Project

With the environment set up, you can now compile the source code.

Renesas Electronics© All Rights Reserved

(1) Navigate to the Project Directory

In your WSL terminal, navigate to the directory containing the sample project source code.

```
cd /mnt/c/Users/YourUser/Projects/DSpotterNLU_CNSV_Demo
```

(2) Build the Application

Run the `make` command to compile the project.

```
make
```

This will generate the executable file (e.g., `DSpotterNLU_CNSV_Demo`) in the project directory.

5.4 Deploying and Testing a Custom Build

After building the project, you need to copy the new executable to the microSD card.

(1) Mount the microSD card in WSL

Follow the procedure in 4.2.2 Connect the microSD card Reader to WSL using usbipd to connect your microSD card reader to WSL. Then, mount the root partition of the microSD card.

```
sudo mount /dev/sdd2 /mnt/sdcard
```

(2) Copy the Executable File

Copy the newly built executable from your project directory to the appropriate location on the microSD card, overwriting the old one.

```
cp ./DSpotterNLU_CNSV_Demo /mnt/sdcard/usr/DSpotterNLU_CNSV_Demo/
```

(3) Unmount the microSD card

Safely unmount the microSD card before removing it.

```
sync
sudo umount /mnt/sdcard
```

(4) Test on the EVKIT

Insert the microSD card into the RZ/G2LC-EVKIT and follow the steps in 4.4 Booting and Operating the Demo to run your custom-built application.

Renesas Electronics© All Rights Reserved

5.5 Understanding the License Process

Cyberon SDK requires a valid license to run.

- **Evaluation:** For the initial evaluation, the EVK must be connected to the internet via an Ethernet cable. When the sample application runs for the first time, it will automatically contact Cyberon's server using a provided certificate (CybServer_...bin) and download a license file (CybLicense.bin) to the device.
- **Mass Production:** For mass production, you must obtain a formal certificate file from Renesas. The application must be modified to use this new certificate. The license generation process will be the same, but it will be tied to your specific product. The formal certificate should be deleted from the final product image, leaving only a recovery certificate.

5.6 How to Reset Bootloader

If RZ/G2LC fails to start up when the power is turned on, the boot loader may have failed to initialize. Please try initializing using the following method.

(1) Preparation: Booting in SCIF Boot Mode

To start the RZ/G2LC in a mode that accepts a program from the serial port.

1. With the board powered OFF, turn ON DIP switch SW11-2. (SW11: OFF-ON-OFF-ON)
2. Press the power button (SW9) to turn ON the board.
3. Connect the PC and the board with a serial cable, then launch and connect with Tera Term. (Baud rate: 115200 bps)
4. Press the reset button (SW10).

This action will cause a message like "SCIF Download" and “please send !” to appear in Tera Term.

Figure 14 Screen after booting in SCIF Boot Mode

(2) Transfer and Execute Flash Writer

To transfer the program for writing to SPI Flash memory (Flash Writer) to RAM and execute it.

1. From the Tera Term menu, select [File] -> [Send file...].
2. Select and transfer the `Flash_Writer_SCIF_RZG2LC_SMARC_DDR4_1GB_1PCS.mot` file.
3. After the transfer is complete, confirm that the prompt > is displayed.

Renesas Electronics© All Rights Reserved

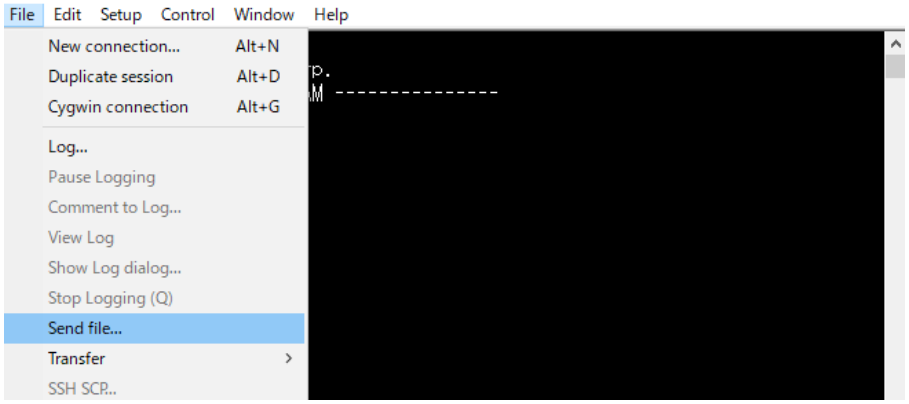


Figure 15 Screen of sending file from Tera Term

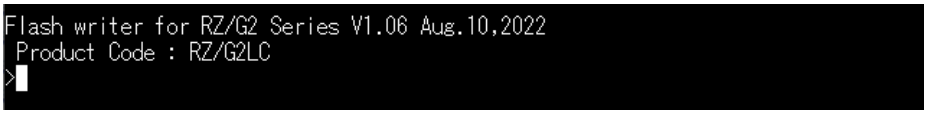


Figure 16 Screen after transferring Flash Writer file

(3) Erase Entire SPI Flash Memory

To completely erase the contents of the SPI Flash memory before writing the new bootloader.

1. At the > prompt, type `XCS` and press Enter.
2. For the confirmation message ALL ERASE SpiFlash memory Clear OK?(y/n), type y and press Enter.

Figure 17 Screen after entering erase command

Figure 18 Screen after completing erase command

(4) Increase Communication Speed (Recommended)

To reduce the time required for file transfer.

1. At the > prompt, type `SUP` and press Enter.
2. From the Tera Term menu, open [Setup] -> [Serial port...] and change the baud rate (Speed) to 921600.
3. After changing baud rate, press Enter key to tera term.

Renesas Electronics© All Rights Reserved

Figure 19 Screen after changing baud rate

(5) Write BL2 Image

To write the initial stage of the bootloader, BL2 (Boot Loader stage 2), to the SPI Flash.

1. At the > prompt, type `XLS2` and press Enter.
2. When Please Input : H' is displayed, enter the Program Top Address `11E00` and press Enter.
3. When Please Input : H' is displayed, enter the QSPI Save Address `00000` and press Enter.
4. When “Please send !” is displayed, transfer the `bl2_bp-smarc-rzg2lc.srec` file.

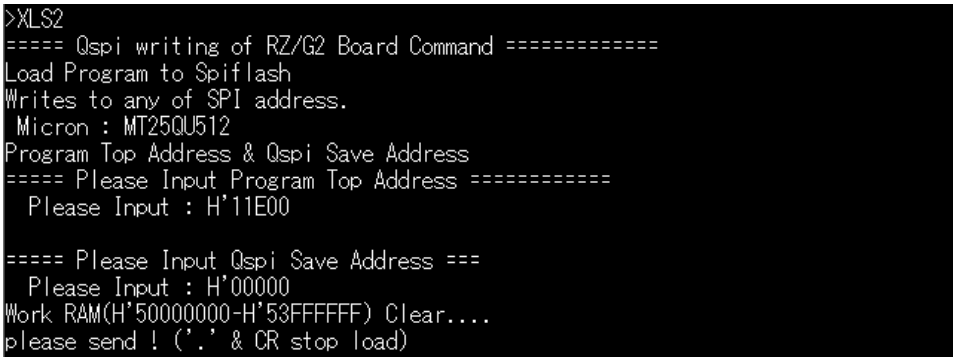


Figure 20 Screen after entering the XLS2 command and address for BL2 image

Figure 21 Screen after completing sending BL2 image

(6) Write FIP Image

To write the main body of the boot process, FIP (Firmware Image Package), to the SPI Flash.

1. At the > prompt, type `XLS2` and press Enter.
2. When Please Input : H' is displayed, enter the Program Top Address `00000` and press Enter.
3. When Please Input : H' is displayed, enter the QSPI Save Address `1D200` and press Enter.
4. When “Please send !” is displayed, transfer the `fip-smarc-rzg2lc.srec` file.

Renesas Electronics© All Rights Reserved

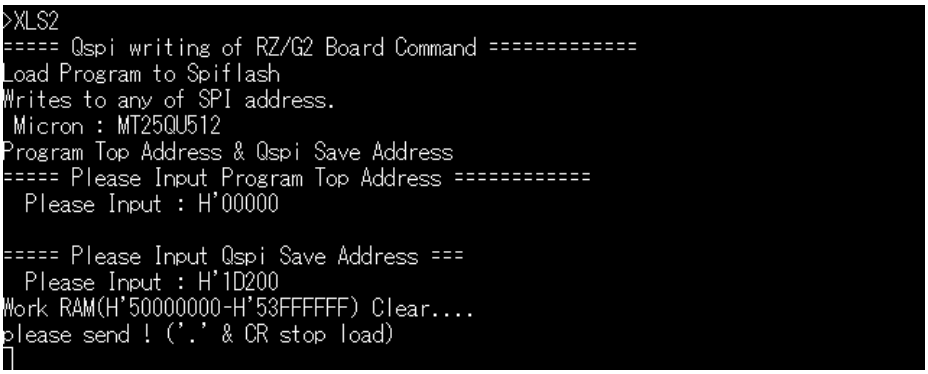


Figure 22 Screen after entering the XLS2 command and address for FIP image

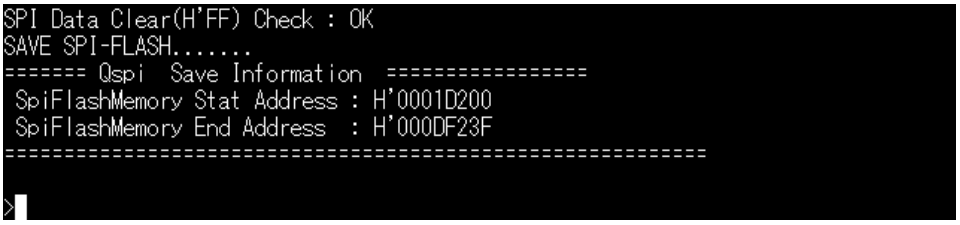


Figure 23 Screen after completing sending FIP image

(7) Clean-up and Return to Normal Boot Mode

To complete the process and restore the settings to allow normal booting from SPI Flash memory next time.

1. Change the Tera Term baud rate setting back to the original 115200 bps.
2. Press the power button (SW9) to turn the board completely OFF.
3. Turn OFF SW11-2. (SW11: OFF-OFF-OFF-ON)

(8) The update process is now complete

The updated bootloader will be used the next time the board is powered on.

Renesas Electronics© All Rights Reserved

6. Next Steps

1. To learn more about the RZ/G2LC, refer to the RZ/G2LC-EVKIT user's manual and design package available in the Documents and Download tabs respectively of the RZ/G2LC webpage at renesas.com/RZ/G2LC.
2. Renesas provides several example projects that Voice Demonstrate different capabilities of the RZ MPUs. These example projects can serve as a good starting point for users to develop custom applications. Example projects (source code and project files) for other devices are available in the Example Project Bundle and can be reused.
3. To learn how to create a new e2 studio project from scratch, refer to Chapter 2 Starting Development in the FSP User Manual (renesas.com/ra/fsp). To learn how to use e2 studio, refer to the User Manual provided on the e2 studio webpage (renesas.com/software-tool/e-studio)
4. For further information, inquiries, or should you start the real project development:
    - Please contact your local Renesas Sales Representatives
    - Or request demo from Reality AI CS
    - Create your voice commands model with our free text to model tools Request for Cyberon's DSpotterNLU | Renesas

7. Website and Support

Visit the following URLs to learn about the kit and the RA family of microcontrollers, download tools and documentation, and get support.

RZ/G2LC-EVKIT Resources	renesas.com/RZ/G2LC-EVKIT
Renesas Artificial Intelligence (AI)	renesas.com/ai
RZ Product Information	renesas.com/rz
RZ Product Support Forum	renesas.com/rz/forum
Renesas Support	renesas.com/support
Cyberon DSpotterNLU	Cyberon DSpotterNLU | Renesas
Cyberon Speaker Verification CNSV	Cyberon Speaker Verification CNSV | Renesas

Provide Feedback/ Request a Feature

Renesas aims to provide the best experience to help jumpstart customer innovation and take products to market faster. The Renesas RZ kits have been designed with a lot of attention-to-detail and customer-centric thinking at every aspect of design. Renesas aims to exceed customer expectations.

Renesas looks forward to hearing your feedback and knowing how we can enhance your experience. Please share your feedback at renesas.com/rz/kitfeedback

Renesas Electronics© All Rights Reserved

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb.10.2026	—	Initial release

Renesas Electronics© All Rights Reserved

Voice Application Combo for RZ/G2LC-EVKIT

Publication Date: February.10.2026

Published by: Renesas Electronics Corporation

Voice Application Combo for RZ/G2LC-EVKIT

Renesas Electronics Corporation

R30QS0028EE0100