

# Face Detection Application Example

Quick Start Guide

Renesas MCU Family  
Using AIK-RA8D1

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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.

## 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 guideline 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.

# AIK-RA8D1

## Face Detection Application Example – Quick Start Guide

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## 1. Introduction

This Quick Start Guide (QSG) provides:

- An overview of the Face Detection example project for AIK-RA8D1 board.
- Instructions for running the Face Detection example project.
- Instructions for importing, modifying, and building the Quick Start example project using Flexible Software Package (FSP) and e<sup>2</sup> studio Integrated Development Environment (IDE)

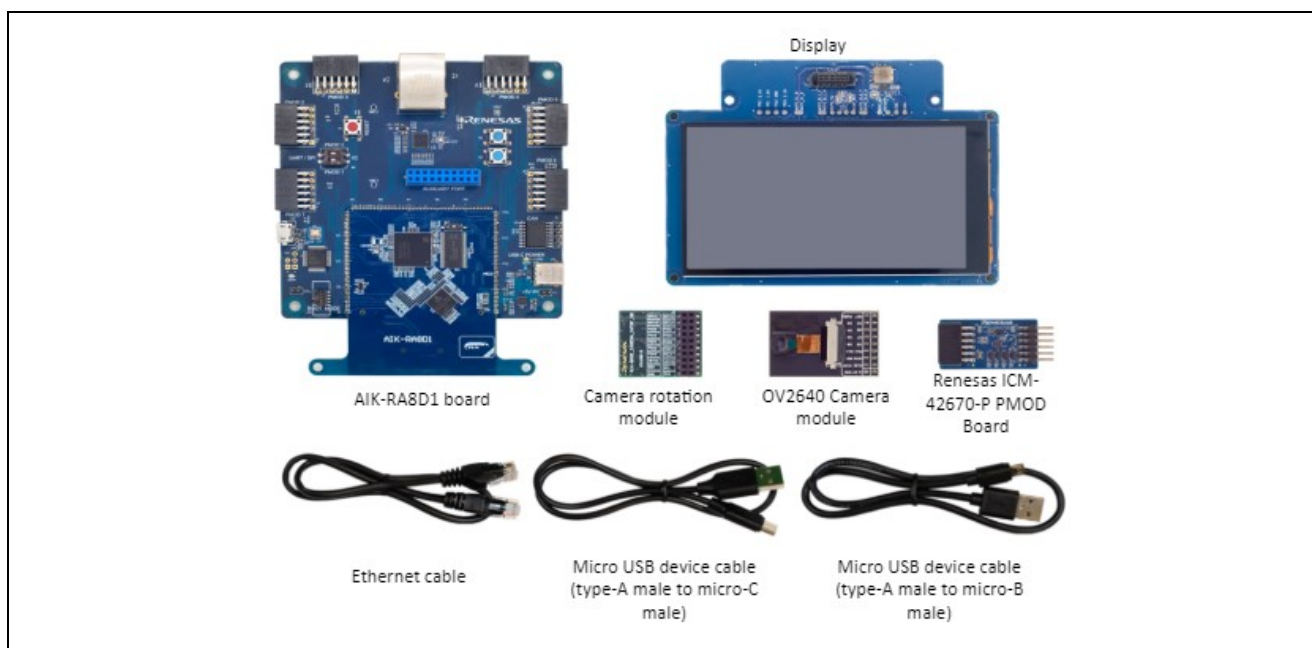
### 1.1 Assumptions and Advisory Notes

1. Tool experience: The user has prior experience working with IDEs such as e<sup>2</sup> studio and terminal emulation programs such as Tera Term.
2. Subject knowledge: The user has basic knowledge about microcontrollers, embedded systems, and FSP to modify the example project described in this document.
3. Use the default jumper settings prior to running the Quick Start example project or programming the AIK-RA8D1 board.. Refer to the AIK-RA8D1 User's Manual for the default jumper settings.
4. The screen shots provided throughout this document are for reference. The actual screen content may differ depending on the version of software and development tools used.

## 2. Kit Contents

The kit contains the following components::

1. AIK-RA8D1 board.
2. OV2640 Camera module
3. Camera rotation module
4. Renesas ICM-42670-P PMOD Board
5. Display
6. Ethernet cable
7. Micro USB device cable (type-A male to micro-B male)
8. Micro USB device cable (type-A male to type-C male)



**Figure 1. AIK-RA8D1 Kit Contents**

### 3. Overview of the Quick Start Guide Project – Face Detection

The Face Detection project uses a camera module and LCD display to display the AI decision results. This table shows the result parameters.

**Table 1. AI results parameters**

No	Content	Description
1	Bounding box	The face detection inference uses a set of bounding boxes to indicate the inference result.
2	No of faces	Displays the number of detected faces.
3	Inference time	Displays inference time in milliseconds.

Power on the AIK-RA8D1 Kit with any of the USB connectors that are available.

The Face Detection operation is demonstrated in [renesas.com/aik-RA8D1](https://renesas.com/aik-RA8D1).

### 3.1 Quick Start Guide Project Flow

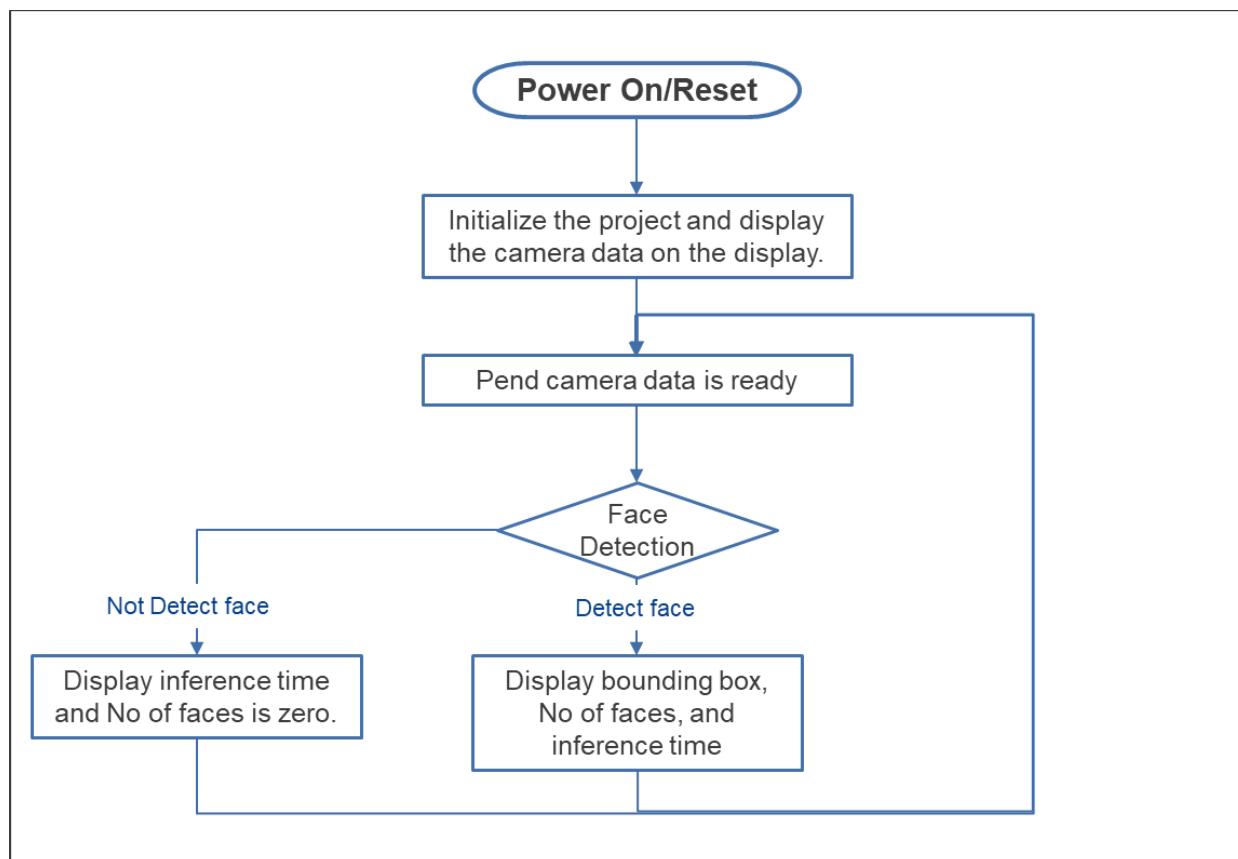


Figure 2. Quick Start Guide Project Flow

## 4. Running the Quick Start Example Project

This section lists the requirements and instructions to power up the AIK-RA8D1 board and run the Quick Start Guide project.

### Hardware Requirements

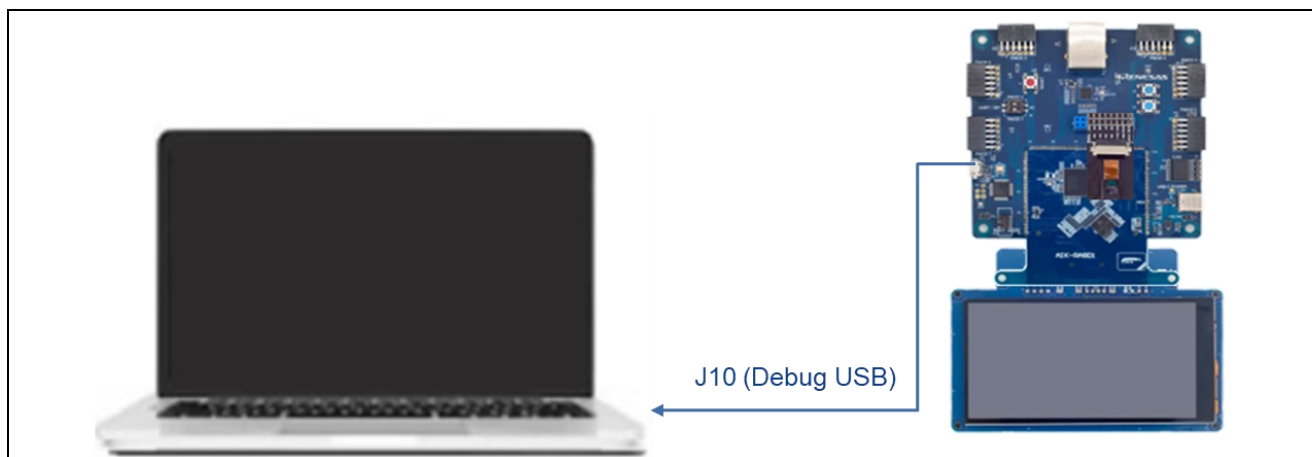
- AIK-RA8D1 board
- Micro USB device cable
- A PC with at least 1 USB port

### Software Requirements

- Windows® 10 or 11 operating system

### 4.1 Connecting and Powering Up the AIK-RA8D1 Board

1. Attach the camera module.
2. Attach the display.
3. Connect the micro USB end of the micro USB device cable to micro-AB USB Full Speed port (J10) of the AIK-RA8D1 board.
4. Connect the other end of the micro USB cable to the USB port of the host PC. The power LED (LED2) on the AIK-RA8D1 board lights up blue, indicating that the AIK-RA8D1 board is powered on.



**Figure 3. Connecting the AIK-RA8D1 Board to the Host PC via USB Debug Port**

## 4.2 Programming the application example

Use the binary that comes with this Quick Start Guide to flash the device.

In the folder Flasher you can see the following files:

- Flash Device.bat
- Flash Device.jlink
- JLink.exe
- JLink\_x64.dll
- AIK\_RA8D1\_Face\_Detection.hex

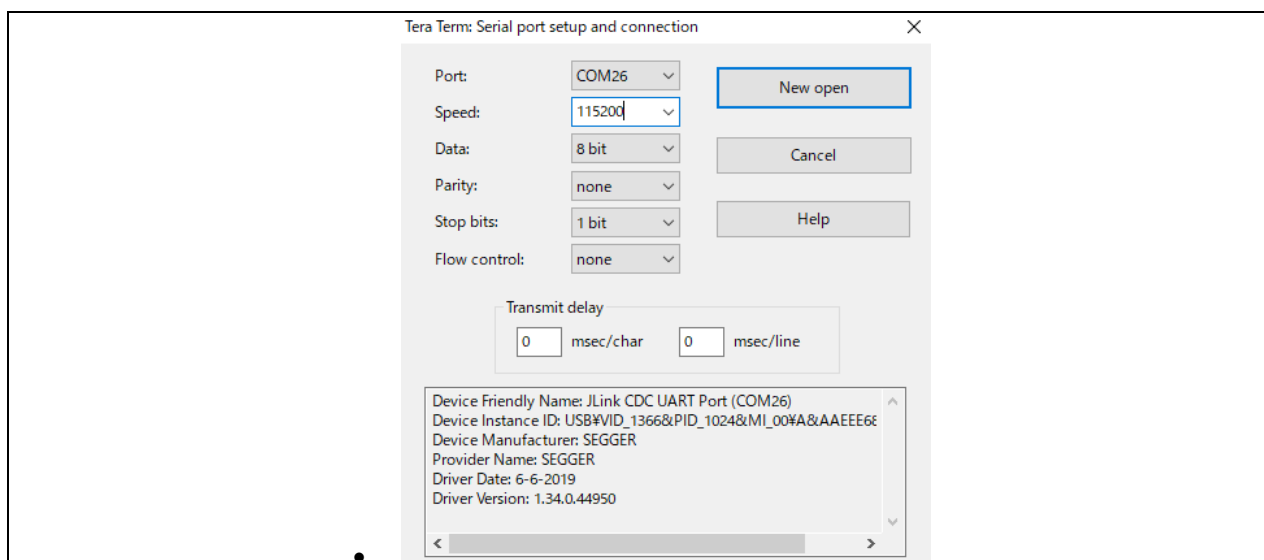
Verify that the AIK-RA8D1 board is connected to the PC and run the Flash Device.bat file. The project is automatically downloaded to the DUT.

## 4.3 UART Terminal Output; optional

On power on, the sample project output system information as like image process time and refreshed rate. This utility is provided to help with system debugging.

For that the user needs to set up the serial terminal as follows:

- Speed / Baud Rate      115,200
- Data                      8 bit
- Parity                    none
- Stop bits                1 bit
- Flow Control            none



**Figure 4. Serial Port Setup**

## 4.4 Running the Quick Start Guide Project

To run the Quick Start Guide project, use the following instructions:

1. On power up or RESET.

Note: The debug LED (LED4) will blink or light up orange; this can be ignored for now.

2. Display camera data on the LCD display.
3. Display bounding box, no of faces, and inference time when detecting faces.
4. Display inference time and no of faces is zero.

## 5. Customizing the Quick Start Guide Project

This section lists the requirements and instructions for customizing the Face Detection project.

### Hardware Requirements

- AIK-RA8D1 board
- OV2640 Camera module
- Camera rotation module
- Display
- Micro USB device cable
- A PC with at least 1 USB port

### Software Requirements

- Windows® 10 or 11 operating system
- e² studio IDE
- Flexible Software Package (FSP)
- Face Detection project

## 5.1 Downloading and Installing Software and Development Tools

Before the Quick Start example project can be modified, it is necessary to download and install software and development tools on the host PC.

The FSP, J-Link USB drivers, and e<sup>2</sup> studio are bundled in a downloadable platform installer available on the FSP webpage at [renesas.com/ra/fsp](https://renesas.com/ra/fsp). New users are recommended to use the **Quick Install** option provided in the installation wizard, to minimize the amount of manual configuration needed.

There is no need to download and install software, development tools, and drivers separately. When installing the e<sup>2</sup> studio using Quick Install / Default Options, if you are using RA family boards, you need to select the proper FSP version\* in the Additional Software section of the installer. All the necessary plugins will be installed automatically. (\*RA [Flexible Software Package \(FSP\) v5.7.0](#) or later).

## 5.2 Downloading and Importing the Quick Start Example Project

1. Download and extract the Face Detection project to a local directory on the host PC.
  - a. The Face Detection project (source code and project files) is available in <https://github.com/renesas/aiot-ready>
  - b. Download the Face Detection project to a local directory on the host PC.
2. Launch e<sup>2</sup> studio.
3. Browse to the Workspace where the project file is imported. Enter the name in the Workspace dialog box to create a new workspace.

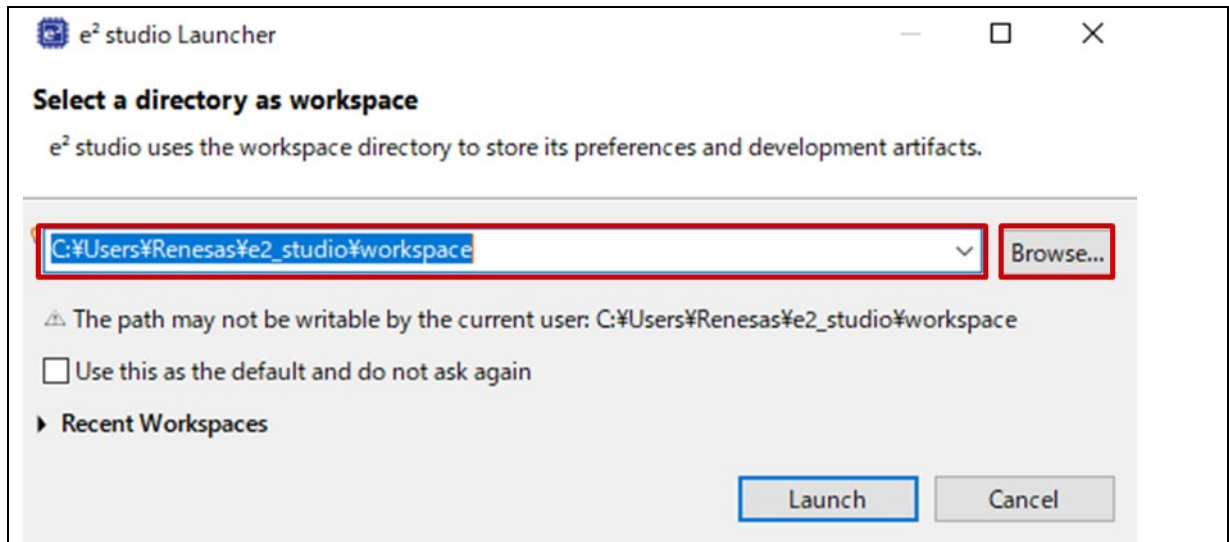


Figure 5. Creating a New Workspace

4. Click **Launch**.

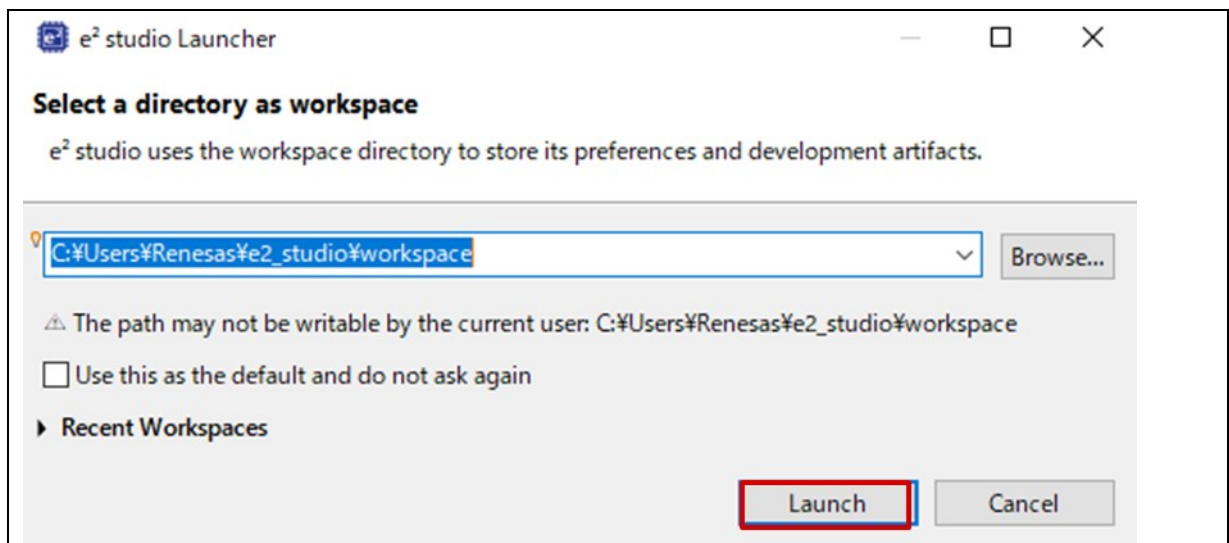


Figure 6. Launching the Workspace

- Click Import from the File drop-down menu.

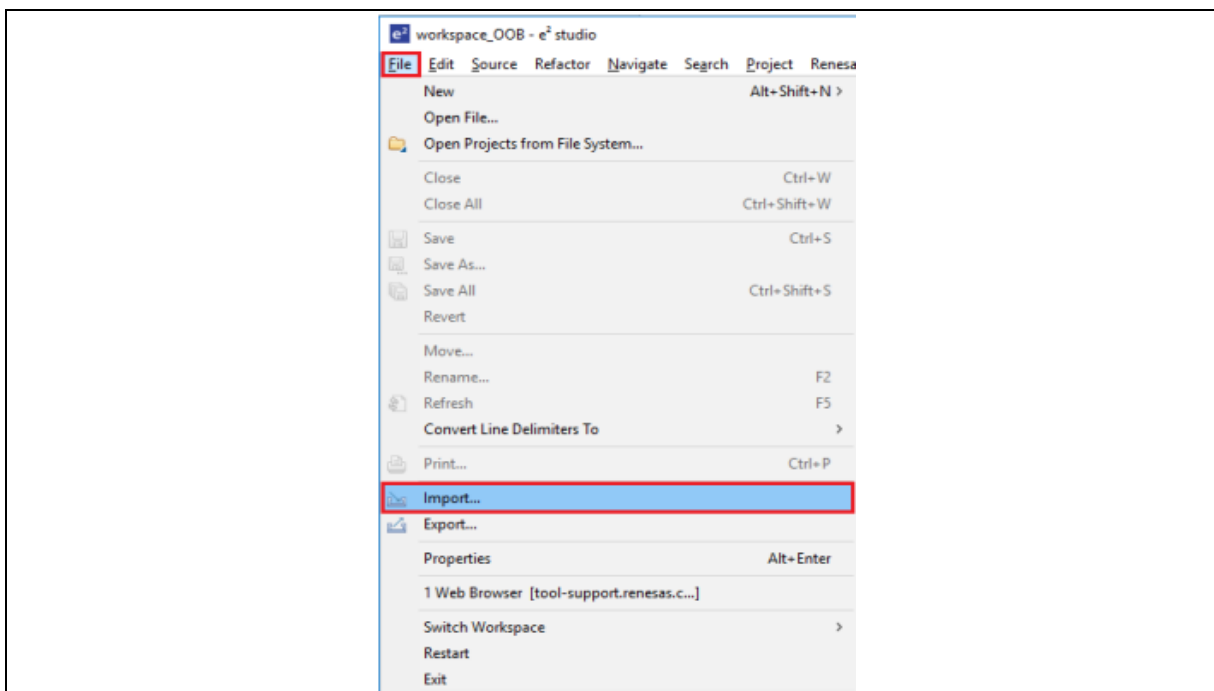


Figure 7. Importing the Project

- In the **Import** dialog box, select **General**, and then select **Existing Projects into Workspace**.

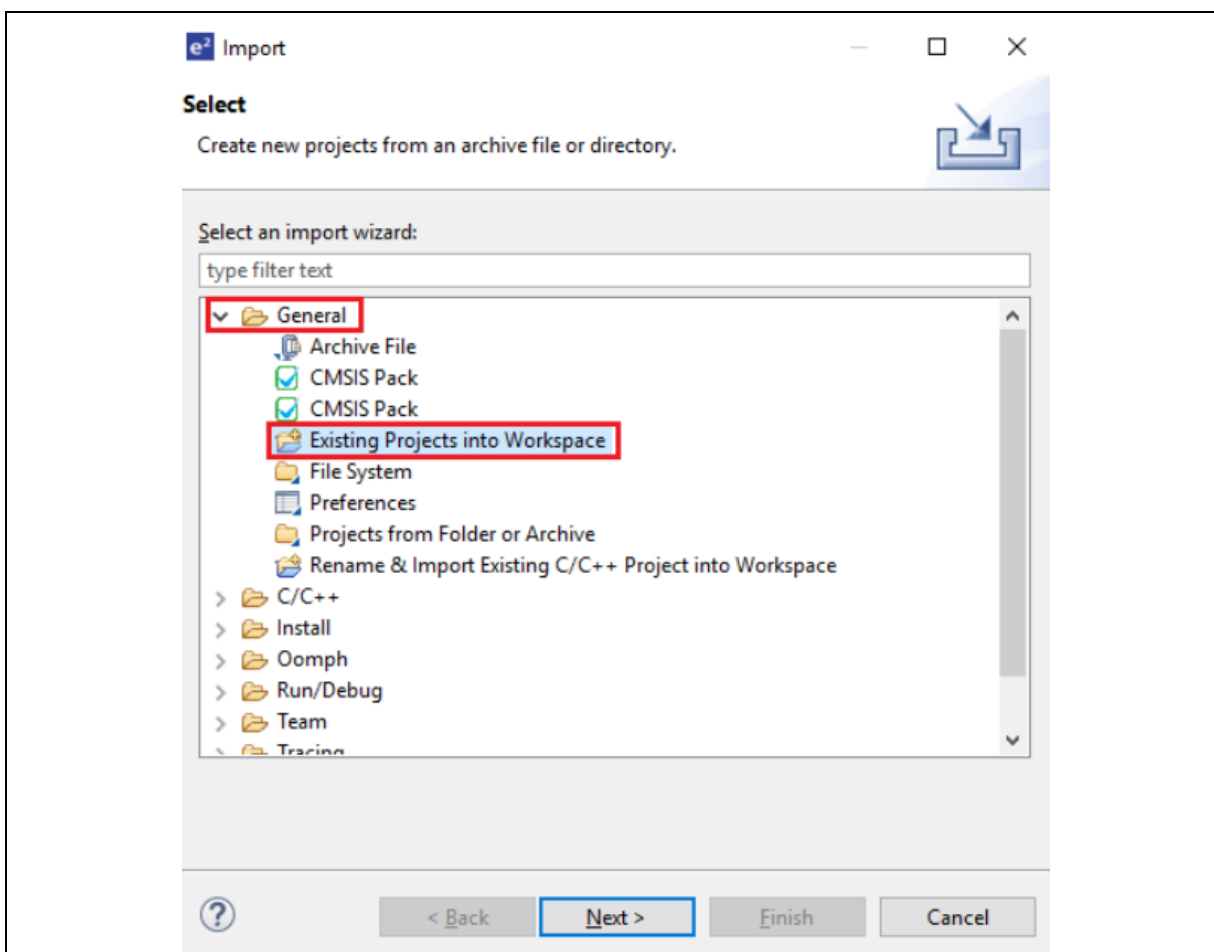
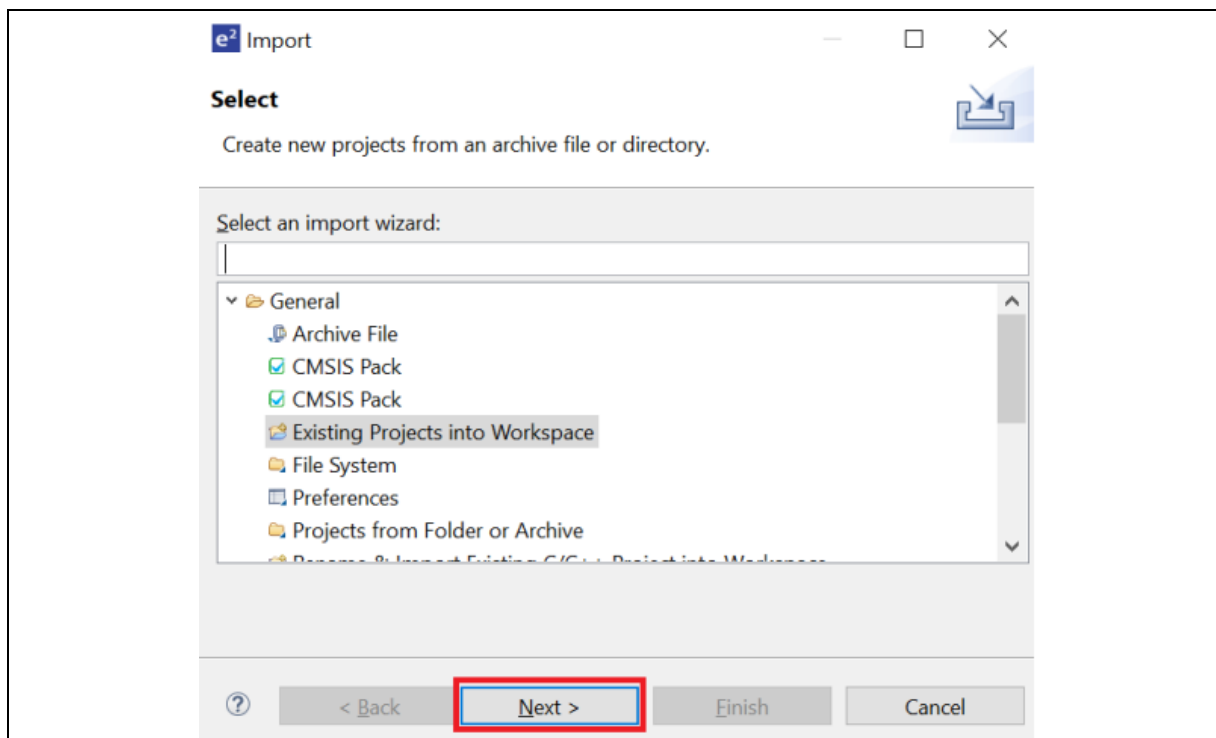


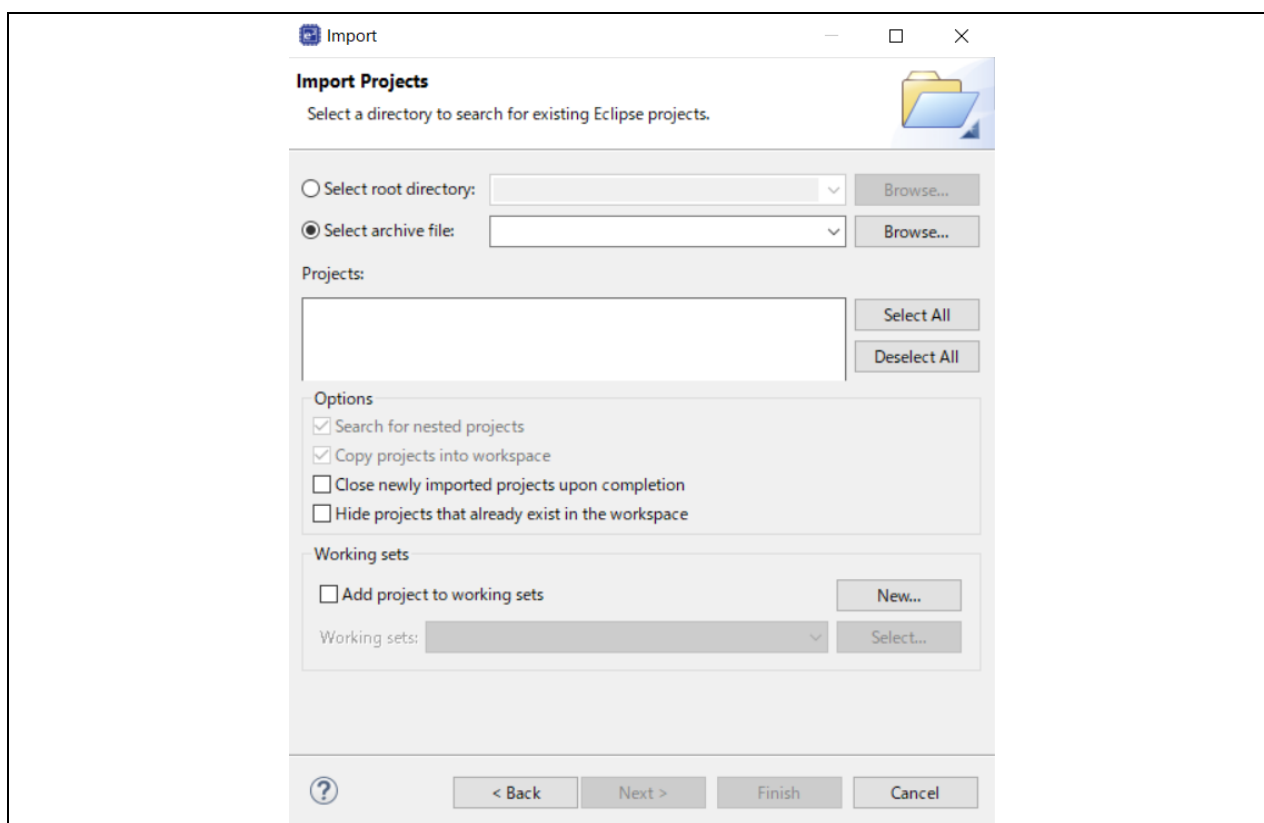
Figure 8. Importing Existing Projects into the Workspace

7. Click **Next**.



**Figure 9. Clicking Next to Import Existing Projects into the Workspace**

8. Click **Select root directory** and click **Browse** to go to the location of the Quick Start example project folder.



**Figure 10. Selecting the archive file**

9. Select the Quick Start Guide project and click **Finish**.

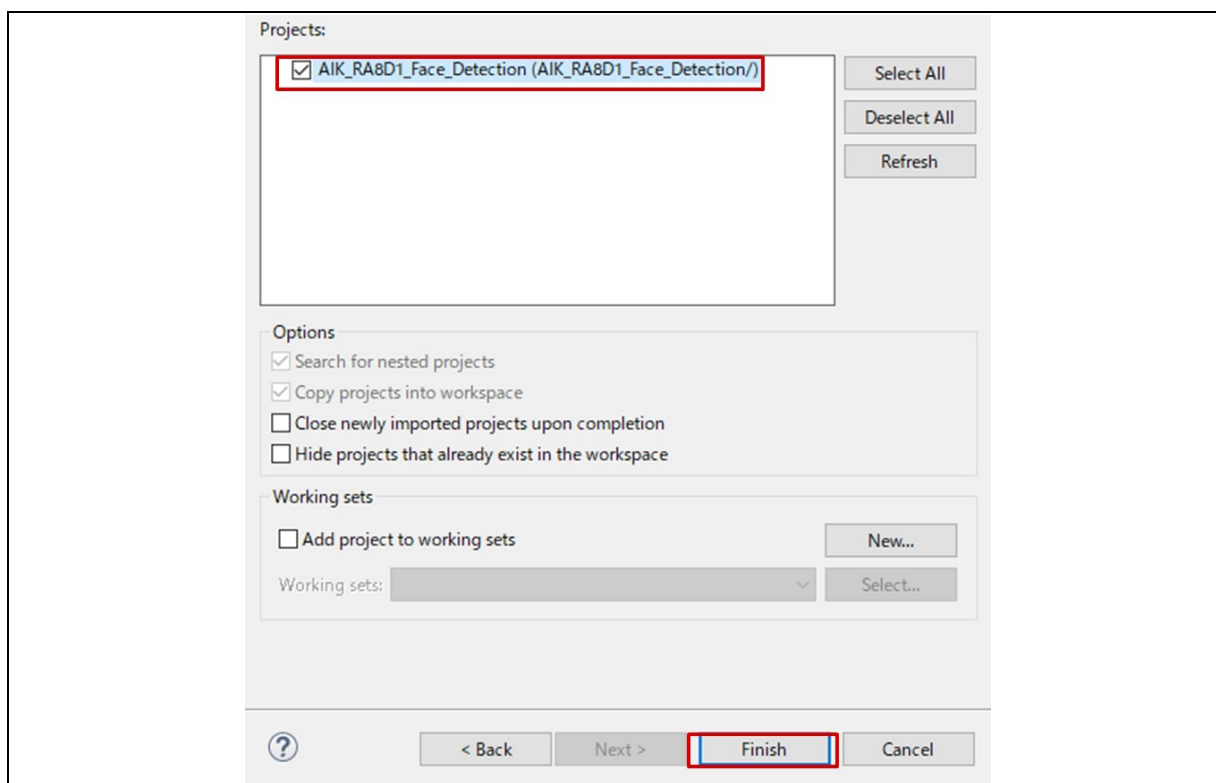


Figure 11. Finishing Importing the Quick Start Guide Project

### 5.3 Modifying, Generating, and Building the Quick Start Guide Project

This section provides instructions to modify the Face Detection project. The Face Detection project can be modified by editing the source code and reconfiguring the properties of the MCU peripherals, pins, clocks, interrupts, and so forth.

Note: The specific modifications that can be performed to the Face Detection project is not prescribed in this QSG. User discretion is advised while modifying the Face Detection project.

1. Once Face Detection project is imported, click the configuration.xml file to open the configurator. The configurator provides an easy-to-use interface to configure the properties of MCU peripherals, pins, clocks, and so forth.

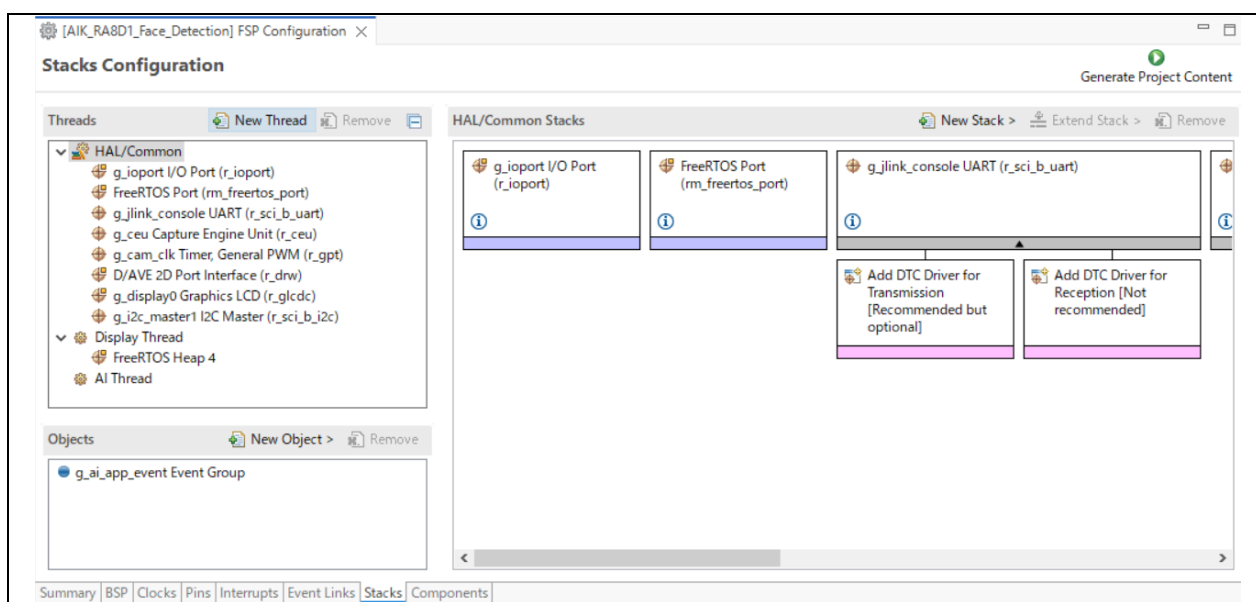
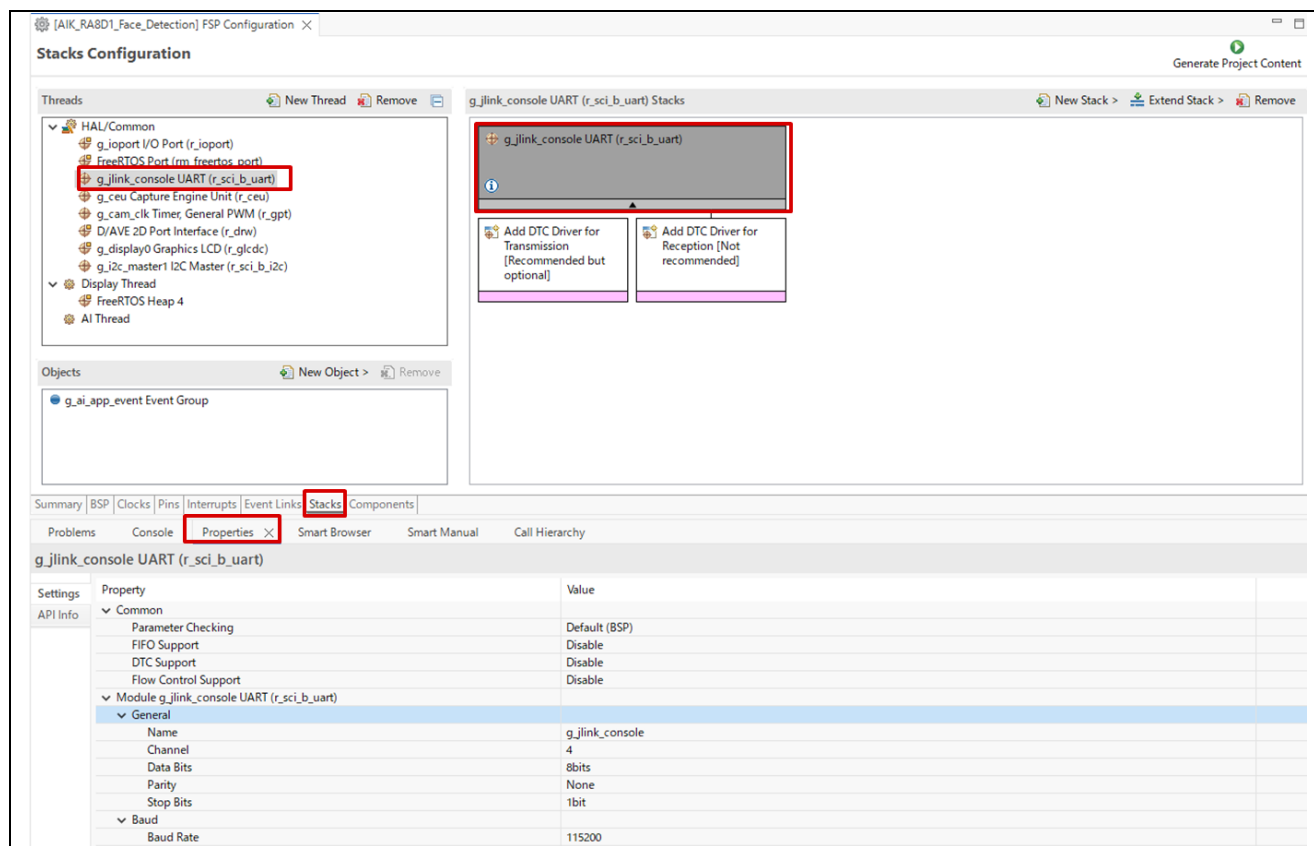


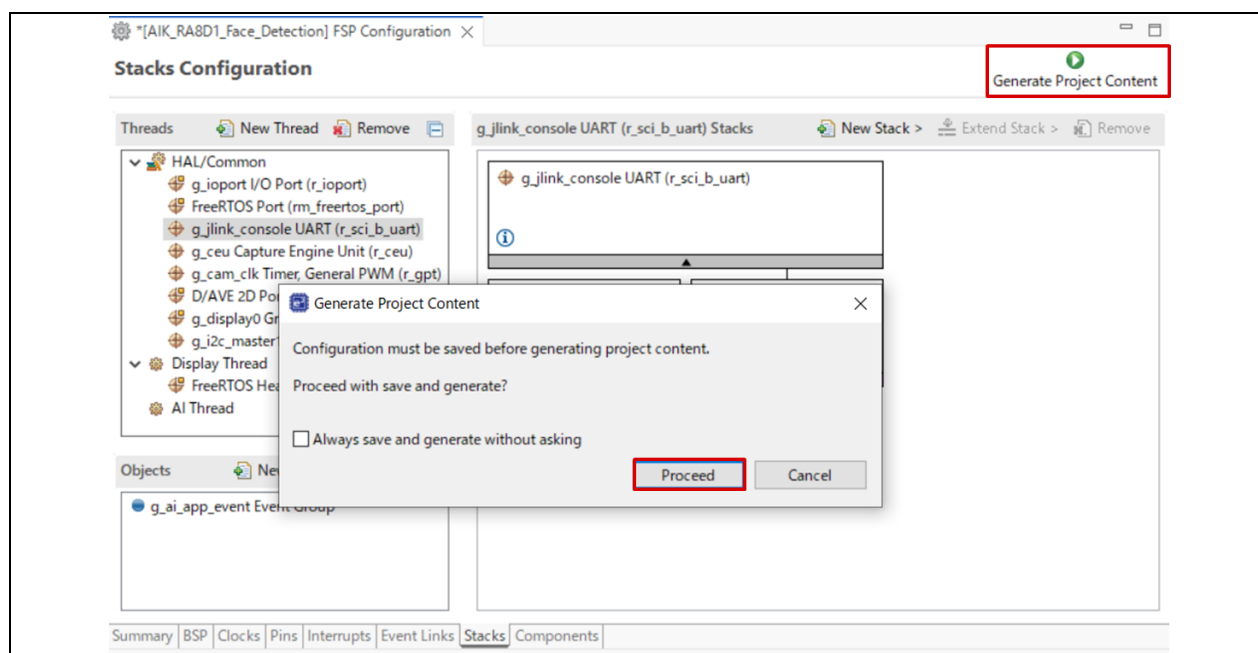
Figure 12. Opening the Configurator

- For example, in the **Stacks** tab of the configurator, the user can click to select modules to modify the configuration settings, as required. The following screen shot illustrates modifying the UART configuration.



**Figure 13. Modifying the Configuration Settings**

- After making the desired modifications, click **Generate Project**. A dialog box may appear with an option of saving the configuration changes. Click **Proceed**.



**Figure 14. Saving the Configuration Changes**

- Modify the source files in the **/src** folder as needed and save the changes.
- Build the project by clicking the build icon.



Figure 15. Building the Project

6. A successful build produces an output as follows.

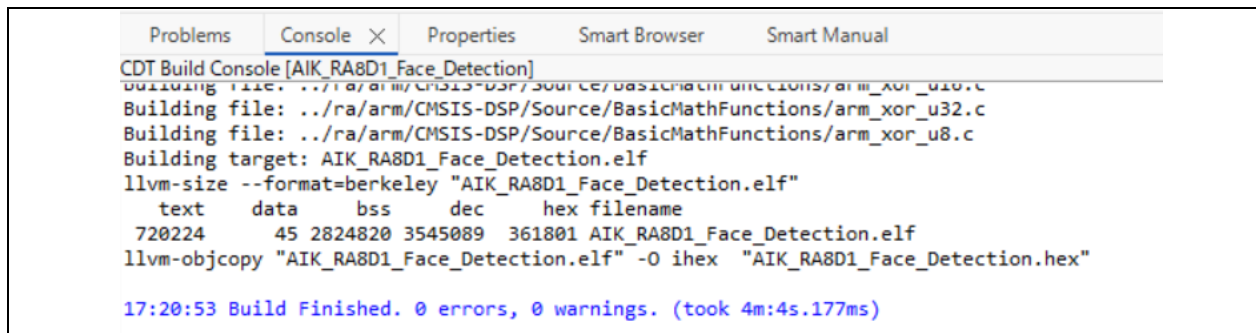


Figure 16. Successful Build Output

## 5.4 Setting Up Debug Connection between the AIK-RA8D1 board and Host PC

To program the modified Face Detection project on to the AIK-RA8D1 board, a debug connection is necessary between the AIK-RA8D1 board and host PC.

1. Connect the USB cable to the micro-B USB debug port (J10) of the AIK-RA8D1 board.
2. Verify that the debug LED (LED4) stops blinking and lights up orange indicating that the J-Link drivers are detected by the AIK-RA8D1 board.

Note: The debug LED (LED4) continues to blink when AIK-RA8D1 board does not detect the J-Link drivers. In that case, make sure that the AIK-RA8D1 board is connected to the host PC through the micro-B USB debug port (J10) and that J-Link drivers are installed on the host PC by checking in the Windows Device Manager (expand **Universal Serial Bus controller**, and locate **J-Link driver**)

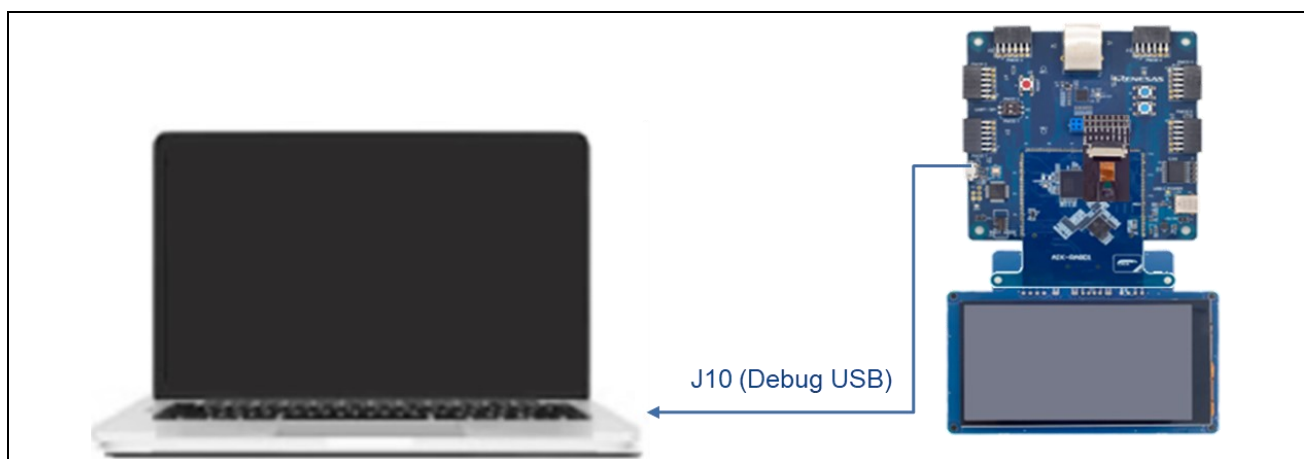
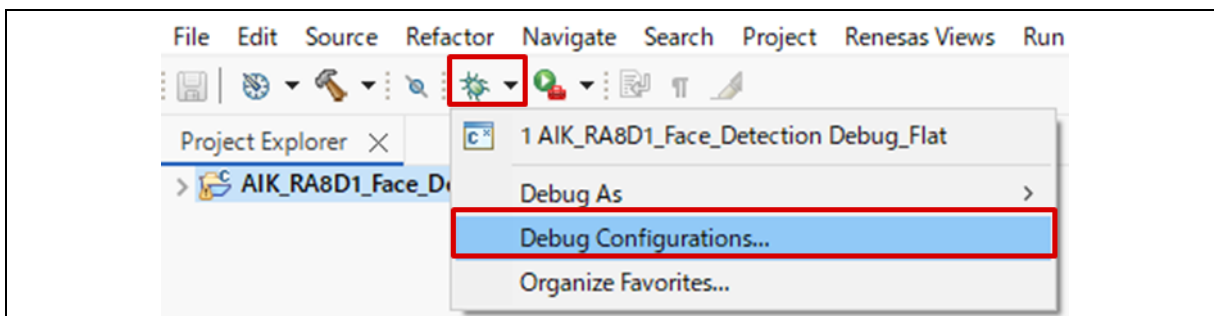


Figure 17. Connecting the AIK-RA8D1 Board to the Host PC via USB Debug Port

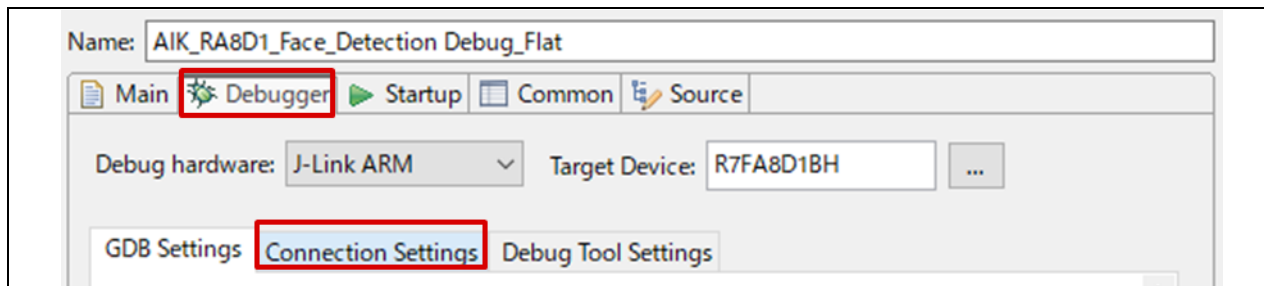
## 5.5 Downloading and Running the Modified Quick Start Example Project

1. In e<sup>2</sup> studio, click the drop-down menu for the debug icon, select Debug Configurations.



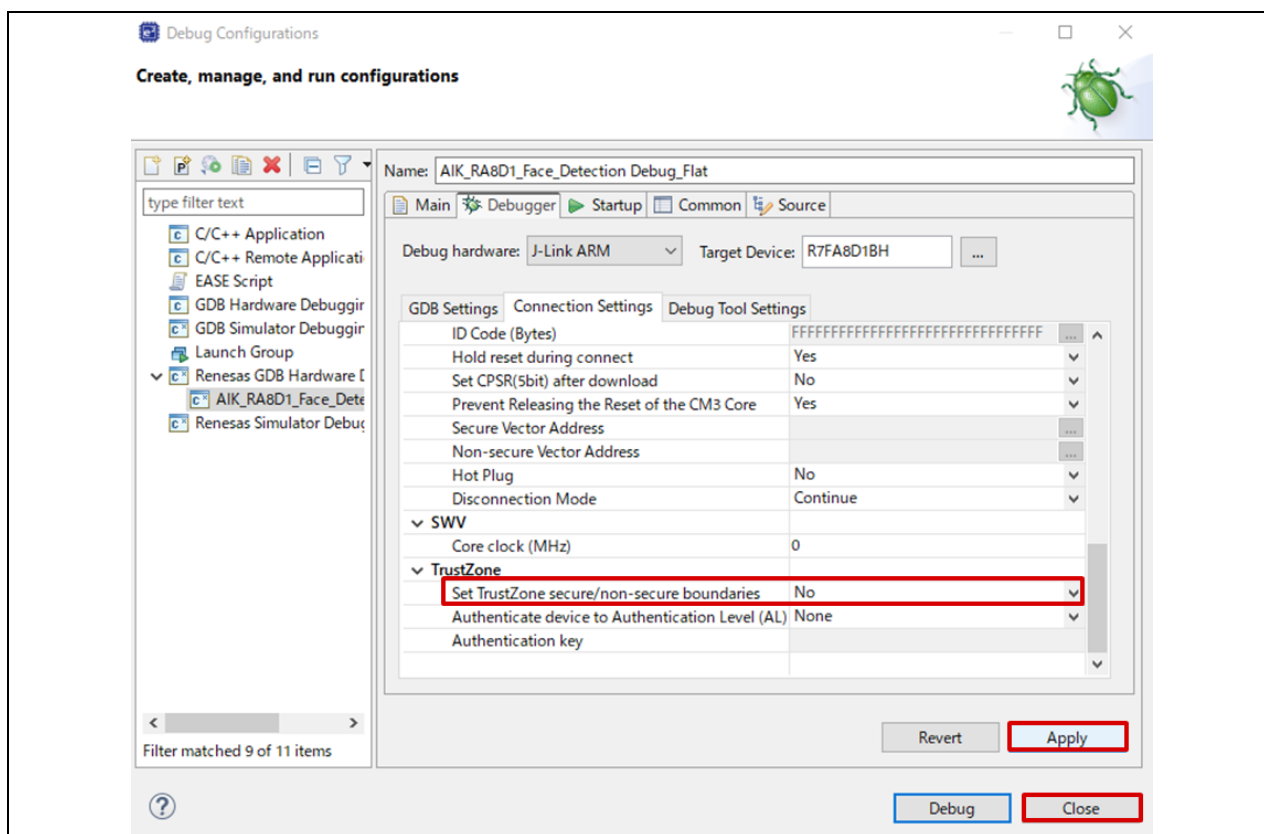
**Figure 18. Selecting Debug Configuration**

2. A Debug Configuration window appeared, click the Debugger tab, and move to Connection setting.



**Figure 19. Selecting Connection Settings**

3. Specify Connection Setting > TrustZone > "Set TrustZone secure/non-secure boundaries" is "No".
4. After that, click Apply and Close,



**Figure 20. Applying TrustZone setting**

5. In e<sup>2</sup> studio, click the drop-down menu for the debug icon, select Debug As option, and choose Renesas GDB Hardware Debugging.

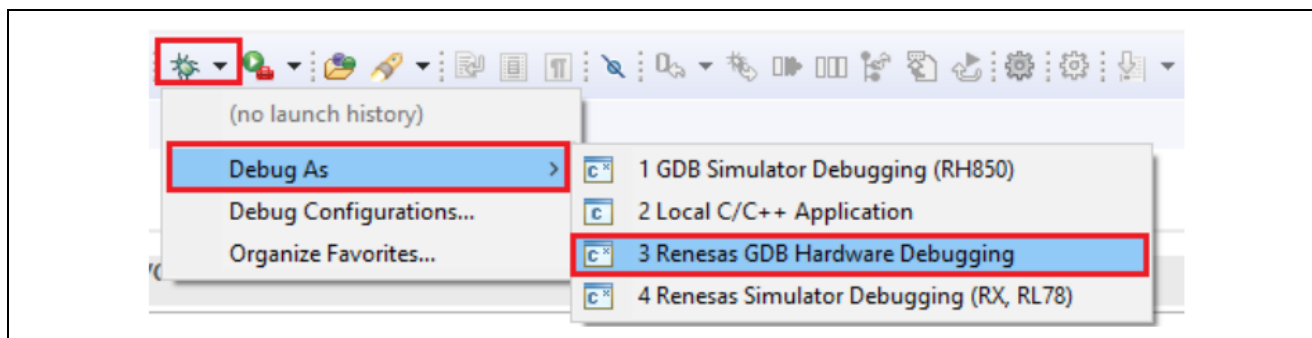


Figure 21. Selecting the Debug Option

6. A dialog box may appear. Click **Yes**.

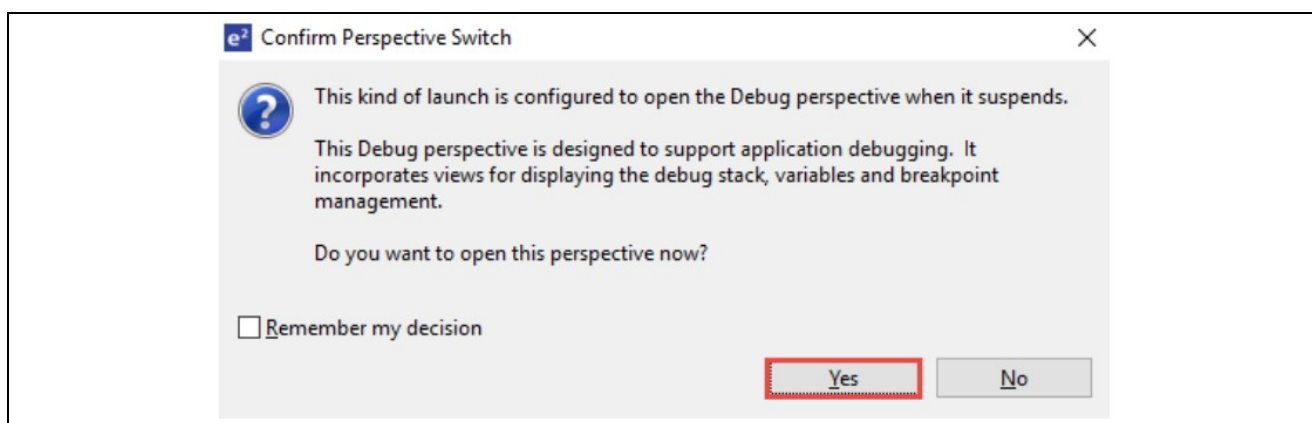


Figure 22. Opening the Debug Perspective

7. Press **F8** or click the **Resume** icon to begin executing the project.

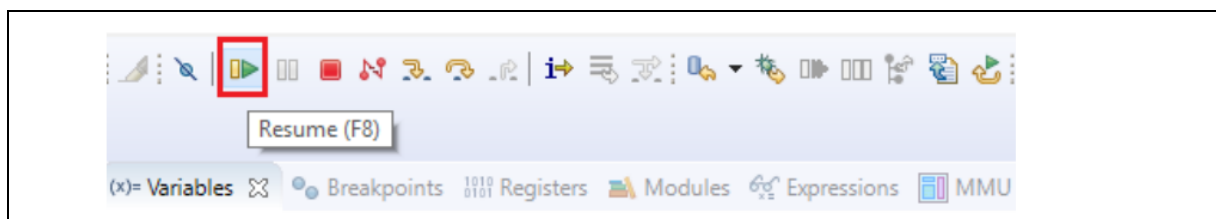


Figure 23. Executing the Project

8. The modified Face Detection project is programmed into the AIK-RA8D1 board and is running. The project can be paused, stopped, or resumed using the debug controls.

## 5.6 Reset to factory defaults

The Device Initialization function restores the microcontroller to its factory default state. When used at the start of debugging sessions, this function resets RAM contents, registers, and peripheral device settings to their initial states, ensuring a clean development environment. This prevents unexpected behavior caused by residual states from previous executions and enables highly reproducible debugging.

1. In e<sup>2</sup> studio, open Renesas Device Partition Manager from “Run > Renesas Debug Tools > Renesas Device Partition Manager”.

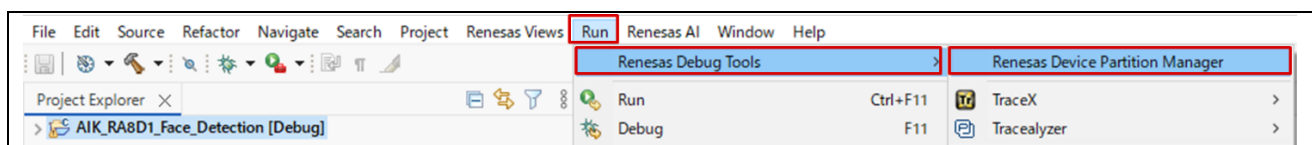
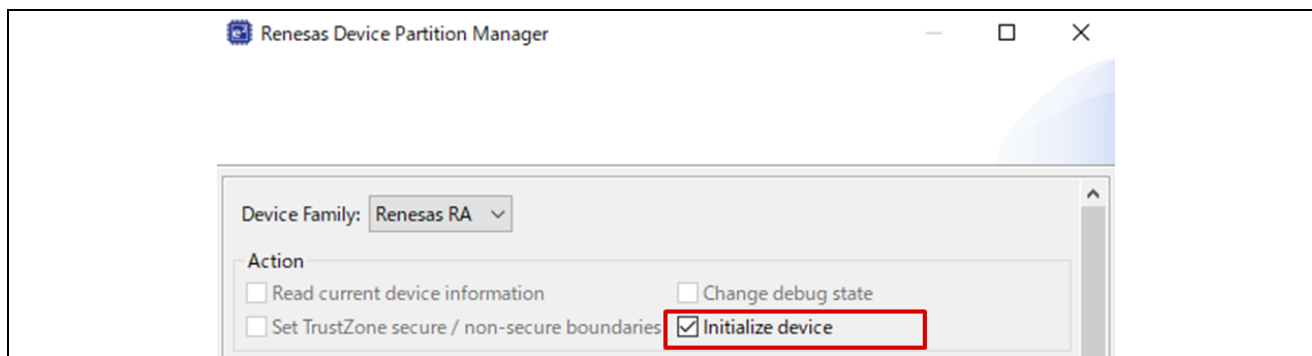


Figure 24. Selecting Renesas Device Partition Manager

2. In the checkbox beside Initialize device, check Initialize device.



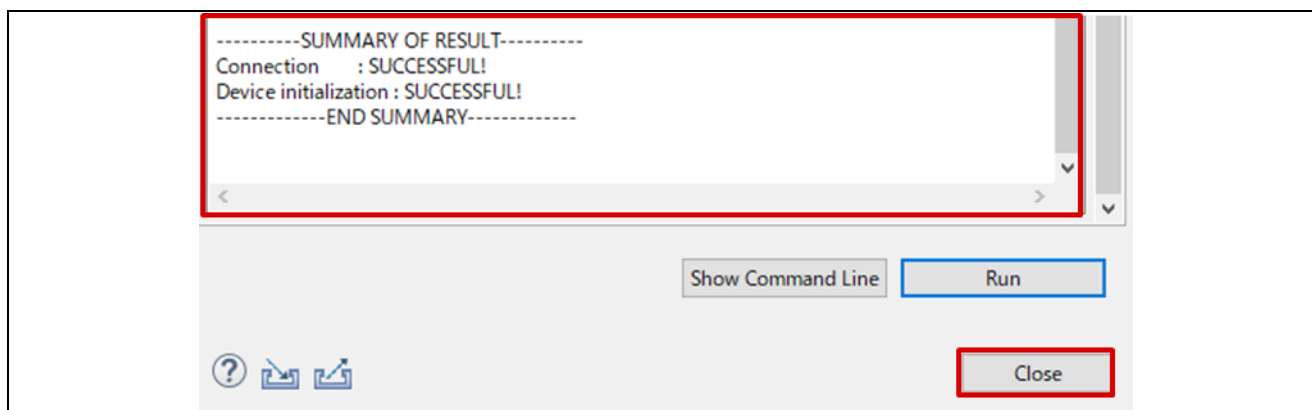
**Figure 25. Specifying checkbox of initial device**

3. Click Run button.



**Figure 26. Executing initialization**

4. Check logs and Click Close.



**Figure 27. Checking initialization logs and closing**

## 6. Next Steps

1. To learn more about the AIK-RA8D1 kit, refer to the AIK-RA8D1 user's manual and design package available in the Documents and Download tabs respectively of the AIK-RA8D1 webpage at [renesas.com/aik-RA8D1](http://renesas.com/aik-RA8D1).
2. Renesas provides several example projects that demonstrate different capabilities of the RA MCUs. 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 kits with RA8D1 are available in the Example Project Bundle and can be reused with AIK-RA8D1. The example projects bundle is available in the Downloads tab of MCU Evaluation Kit webpage.
3. To learn how to create a new e<sup>2</sup> studio project from scratch, refer to Chapter 2 Starting Development in the FSP User Manual ([renesas.com/ra/fsp](http://renesas.com/ra/fsp)). To learn how to use e<sup>2</sup> studio, refer to the User Manual provided on the e<sup>2</sup> studio webpage ([renesas.com/software-tool/e-studio](http://renesas.com/software-tool/e-studio)).

## 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.

AIK-RA8D1 Resources	<a href="http://www.renesas.com/aik-ra8d1">www.renesas.com/aik-ra8d1</a>
RA Product Information	<a href="http://www.renesas.com/ra">www.renesas.com/ra</a>
RA Product Support Forum	<a href="http://www.renesas.com/ra/forum">www.renesas.com/ra/forum</a>
Renesas Support	<a href="http://www.renesas.com/support">www.renesas.com/support</a>

For further information and inquiries, please request a demo from [Reality AI | Renesas Electronics](#)

### Provide Feedback/ Request a Feature

Renesas aims to provide the best microcontroller kit experience to help jumpstart customer innovation with RA family of microcontrollers and take products to market faster. The Renesas RA microcontroller 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/ra/kitfeedback](http://renesas.com/ra/kitfeedback)

## Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Mar.10.25	—	Initial release

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