

RA8D1 Group

Evaluation Kit for RA8D1 Microcontroller Group
EK-RA8D1
Quick Start Guide

Renesas RA Family
RA8 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 (<https://www.renesas.com>).

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)

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/

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.

Renesas EK- RA8D1 Disclaimer

By using this EK-RA8D1, 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 [renesas.com/legal-notices](https://www.renesas.com/legal-notices).

The EK-RA8D1 is not guaranteed to be error free, and the entire risk as to the results and performance of the EK-RA8D1 is assumed by the User. The EK-RA8D1 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 EK-RA8D1 to be a finished product and therefore the EK-RA8D1 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 EK-RA8D1. 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 EK-RA8D1, 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 RA Family

EK-RA8D1**Contents**

1.	Introduction.....	8
1.1	Assumptions and Advisory Notes.....	8
2.	Kit Contents.....	9
3.	Kit Assembly.....	10
3.1	Nylon Screw Assembly.....	10
3.2	Camera Expansion Board.....	11
4.	Overview of the Quick Start Example Project.....	12
4.1	Quick Start Example Project Flow.....	12
5.	Running the Quick Start Example Project on Display.....	13
5.1	Connecting and Powering Up the EK-RA8D1 Board.....	13
5.2	Running the Quick Start Example Project.....	14
5.3	Common Application Details.....	17
5.4	Connectivity Application Details.....	20
5.4.1	Currency Converter.....	20
5.4.2	World Time Zones.....	21
5.4.3	World Weather.....	21
5.5	AI Application Details.....	22
5.5.1	Face Detection.....	22
5.5.2	Image Classification.....	23
6.	Running the Quick Start Example Project on Console.....	23
6.1	Connectivity Application API Keys.....	24
6.1.1	Currency Converter Refresh.....	25
6.1.2	World Time Zones Refresh.....	26
6.1.3	World Weather Refresh.....	27
6.1.4	API Keys Help and Management.....	28
6.2	Next Steps.....	29
7.	Customizing the Quick Start Example Project.....	30
7.1	Downloading and Installing Software and Development Tools.....	30
7.2	Downloading and Importing the Quick Start Example Project.....	30
7.3	Modifying, Generating, and Building the Quick Start Example Project.....	34
7.4	Setting Up Debug Connection between the EK-RA8D1 board and Host PC.....	36
7.5	Downloading and Running the Modified Quick Start Example Project.....	37

7.6	Firewall Dialog	38
8.	Next Steps	39
9.	Website and Support	39
	Revision History	40

Figures

Figure 1.	EK-RA8D1 Kit Contents	9
Figure 2.	Kit Assembly	10
Figure 3.	Correct Connection for Camera Expansion Board	11
Figure 4.	Incorrect Connection for Camera Expansion Board.....	11
Figure 5.	Incorrect Connection for Camera Expansion Board.....	11
Figure 6.	Quick Start Example Project Flow.....	12
Figure 7.	Connecting the EK-RA8D1 Board to the Host PC via USB Debug Port.....	13
Figure 8.	USB Serial (UART) Device in Windows Device Manager.....	14
Figure 9.	Selecting the Serial Port on Tera Term	15
Figure 10.	Select 115200 on the Speed Pulldown	15
Figure 11.	Various Interactive connectivity and HMI Demos.....	16
Figure 12.	Unsuccessful Configuration.....	16
Figure 13.	Splash Screen	17
Figure 14.	Main Screen	17
Figure 15.	Main Menu.....	18
Figure 16.	Kit Information	18
Figure 17.	Getting Started	19
Figure 18.	User LED Control	19
Figure 19.	Currency Conversion Screen	20
Figure 20.	World Time Zone Screen	21
Figure 21.	World Weather.....	21
Figure 22.	Invalid Configuration Example.....	22
Figure 23.	Face Detection	22
Figure 24.	Image Classification Example	23
Figure 25.	Welcome and Main Menu.....	23
Figure 26.	Kit Information	24
Figure 27.	Interactive AI, Connectivity & HMI Demos	24
Figure 28.	Welcome and Main Menu.....	25
Figure 29.	Currency Converter Refresh	26
Figure 30.	Entering Currency API keys for the first time	26
Figure 31.	World Time Zones Refresh	27
Figure 32.	Entering Time Zone API Keys for the First Time.....	27

Figure 33. World Weather Refresh.....	28
Figure 34. Entering Weather API keys for the First Time.....	28
Figure 35. API Keys Help and Management.....	29
Figure 36. Next Steps.....	29
Figure 37. Creating a New Workspace.....	30
Figure 38. Launching the Workspace.....	31
Figure 39. Importing the Project.....	31
Figure 40. Importing Existing Projects into the Workspace.....	32
Figure 41. Clicking Next to Import Existing Projects into the Workspace.....	32
Figure 42. Selecting the Root Directory.....	33
Figure 43. Finishing Importing the Quick Start Example Project.....	33
Figure 44. Opening the Configurator.....	34
Figure 45. Open Perspective.....	34
Figure 46. Modifying the Configuration Settings.....	35
Figure 47. Saving the Configuration Changes.....	35
Figure 48. Building the Project.....	36
Figure 49. Successful Build Output.....	36
Figure 50. Connecting the EK-RA8D1 Board to the Host PC via USB Debug Port.....	36
Figure 51. Selecting the Debug Option.....	37
Figure 52. Selecting the Debug Image.....	37
Figure 53. Opening the Debug Perspective.....	38
Figure 54. Executing the Project.....	38

1. Introduction

This Quick Start Guide (QSG) provides:

- An overview of the Quick Start example project that the EK-RA8D1 board comes pre-programmed with.
- Instructions for running the Quick Start example project.
- Instructions for importing, modifying, and building the Quick Start example project using Flexible Software Package (FSP) and e² studio Integrated Development Environment (IDE).

1.1 Assumptions and Advisory Notes

1. **Tool experience:** It is assumed that the user has prior experience working with IDEs such as e² studio and terminal emulation programs such as Tera Term.
2. **Subject knowledge:** It is assumed that the user has basic knowledge about microcontrollers, embedded systems, and FSP to modify the example project described in this document.
3. **Default jumper settings:** Prior to running the Quick Start example project or programming the EK-RA8D1 board, default jumper settings must be used. Refer to the EK-RA8D1 user's manual for the default jumper configuration.
4. **Screenshots:** 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 following components are included in the kit:

1. EK-RA8D1 v1 board
2. Micro USB device cable (type-A male to micro-B male)
3. Micro USB host cable (type-A female to micro-B male)
4. Ethernet patch cable
5. Camera Expansion Board
6. MIPI Graphics Expansion Board
7. Nylon mounting stands (4x long, 2x short), nylon screws (6x)

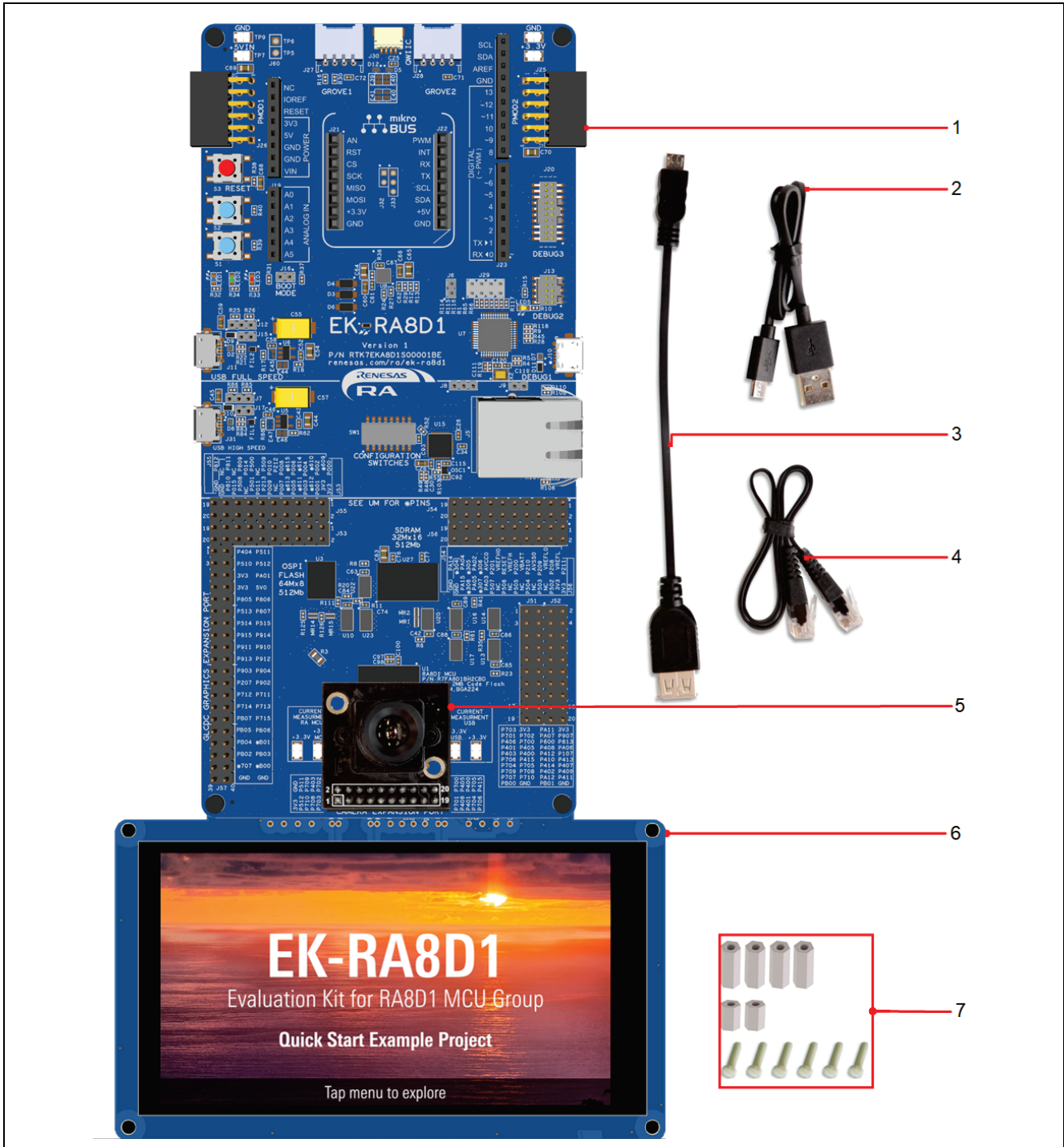


Figure 1. EK-RA8D1 Kit Contents

3. Kit Assembly

3.1 Nylon Screw Assembly

Attach the LCD Board to the PCB using the screws and spacers provided as shown below:

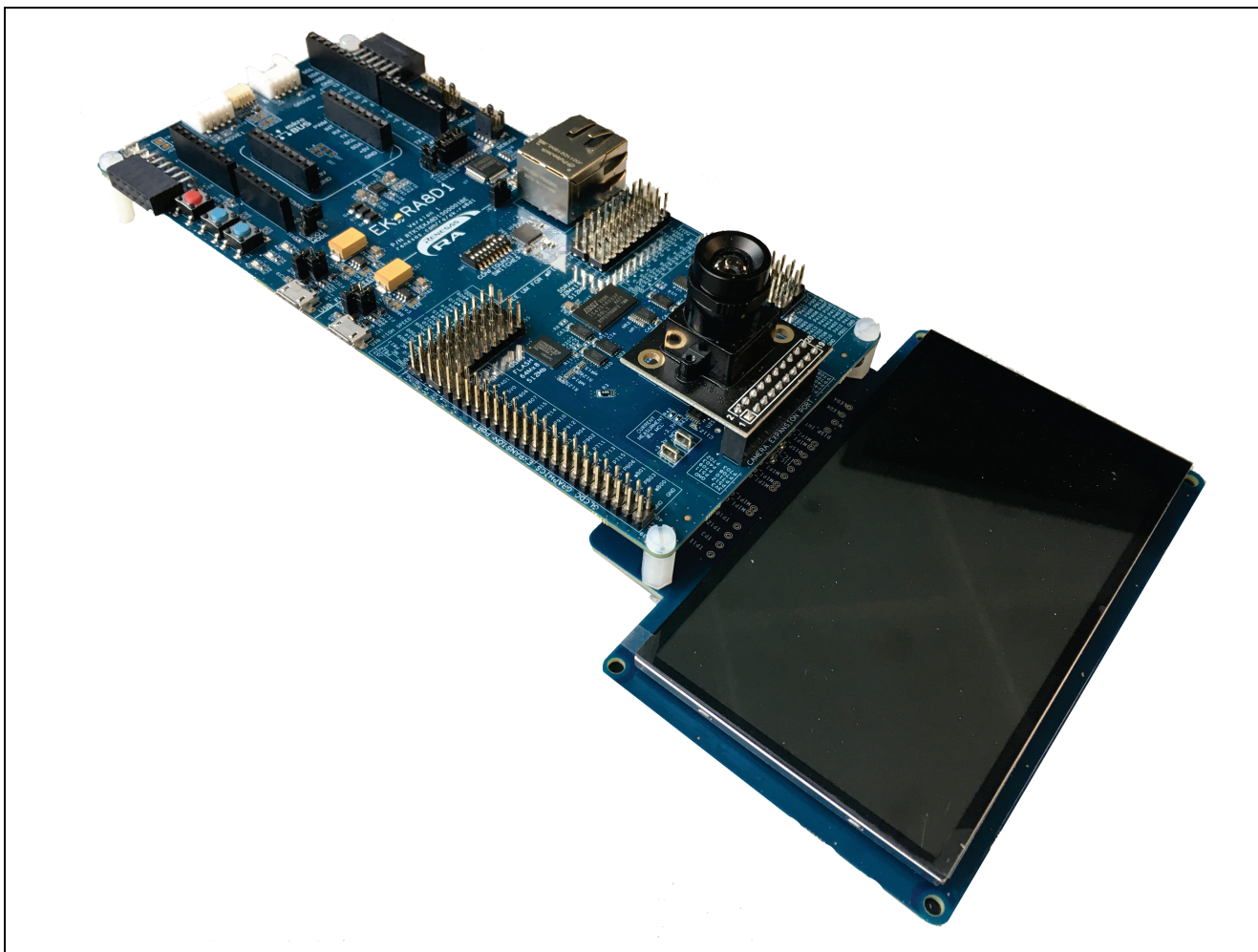


Figure 2. Kit Assembly

Please use the following steps for the installation of screws and spacers:

1. Remove the four rubber feet to expose the holes at each corner of the EK board.
2. There are 2 longer spacers for the EK board only, and two shorter spacers for connecting the MIPI LCD board. A further two long spacers are provided in case of using the EK-RA8D1 without the LCD board.

Note: To avoid damage to the delicate high-speed connector, the physical mounting screws and spacers must be used.

3.2 Camera Expansion Board

Please connect the Camera Expansion Board pin 2 to J59 pin 1 as the following figure shows.

Please do not connect the Camera Expansion Board as shown in Figure 4 and Figure 5.

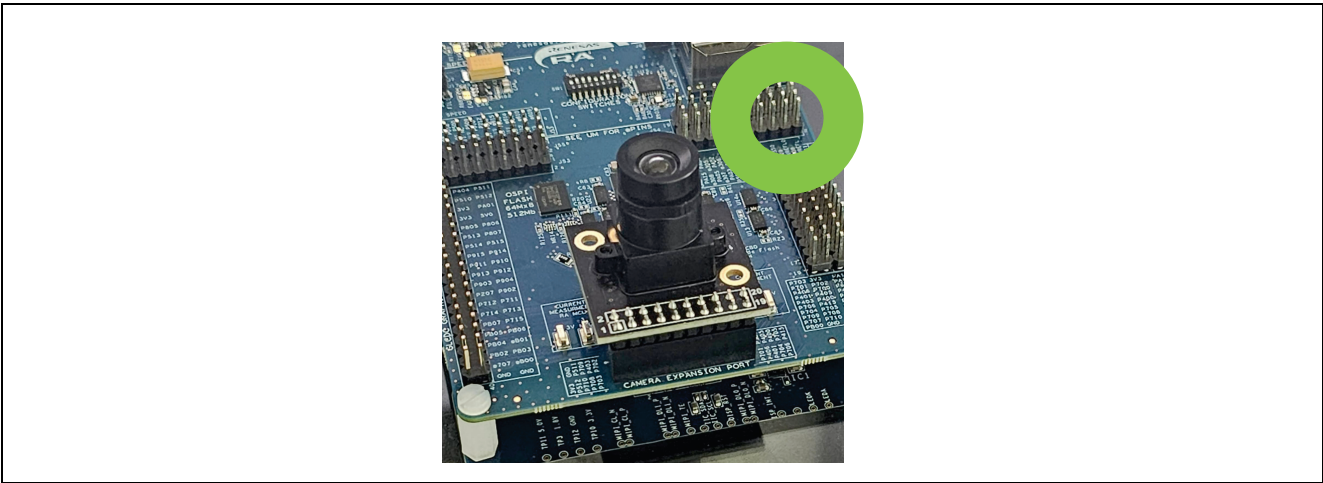


Figure 3. Correct Connection for Camera Expansion Board

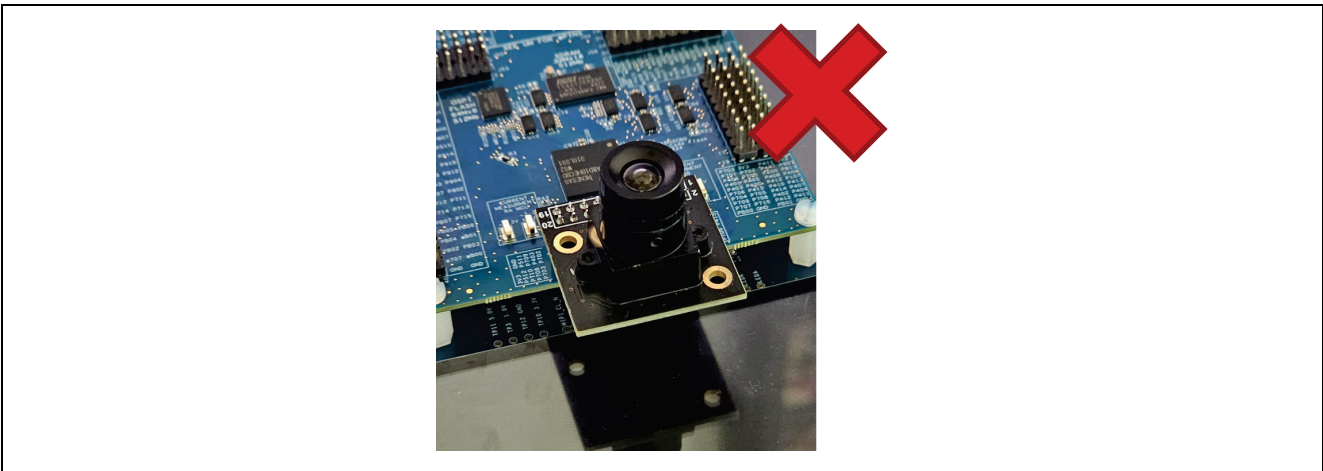


Figure 4. Incorrect Connection for Camera Expansion Board

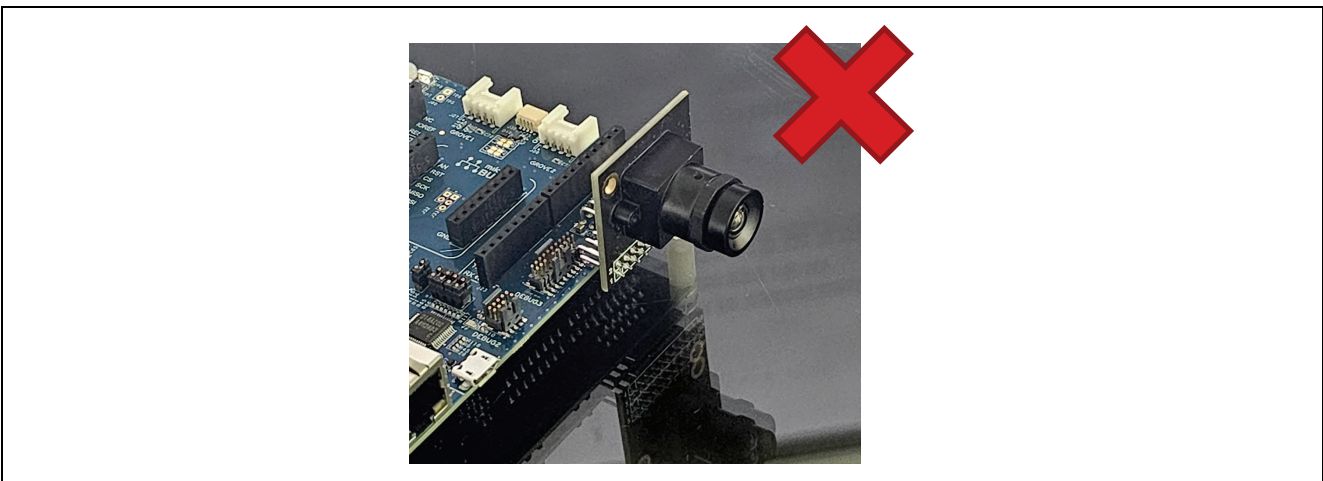


Figure 5. Incorrect Connection for Camera Expansion Board

4. Overview of the Quick Start Example Project

The Quick Start example project allows the user to change the frequency and intensity of the on-board user LED1 (blue) using the user buttons (S1 and S2). The supported frequencies are 1 Hz, 5 Hz, and 10 Hz and the supported intensities are 10%, 50%, and 90%.

When the EK-RA8D1 board running the Quick Start example project is connected to a host PC via USB as a Full Speed CDC Device, the kit information, MCU die temperature, and user LED blinking frequency are displayed on a terminal console.

4.1 Quick Start Example Project Flow

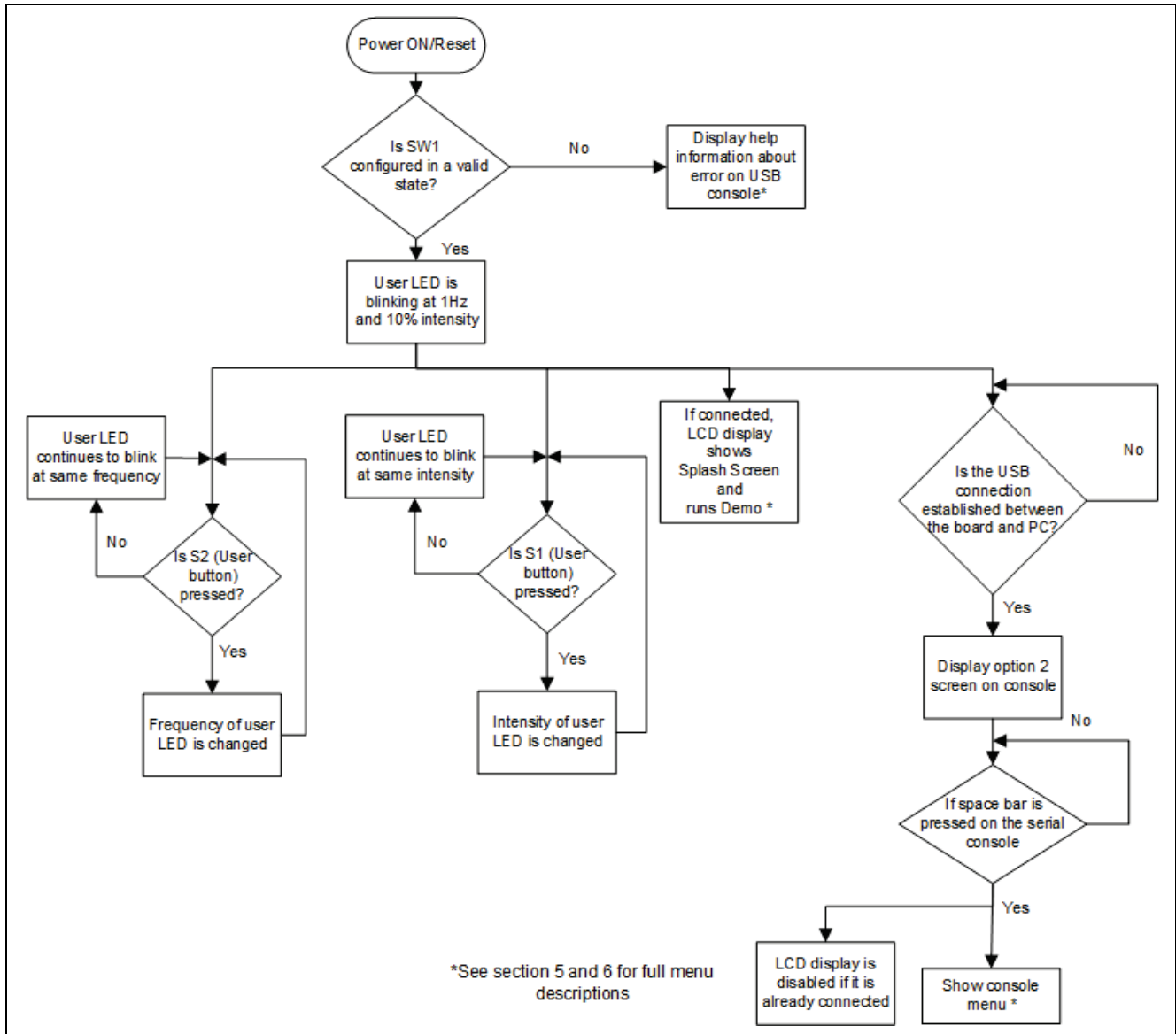


Figure 6. Quick Start Example Project Flow

5. Running the Quick Start Example Project on Display

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

Hardware Requirements

- EK-RA8D1 Board
- Micro USB device cable
- A PC with at least 1 USB port
- Camera Expansion Board
- MIPI Graphics Expansion Board

Software Requirements

- Windows® 10 operating system
- USB Serial Drivers (included in Windows 10)
- Tera Term (or similar) terminal console application

5.1 Connecting and Powering Up the EK-RA8D1 Board

Note: Due to the LCD being connected, the Interactivity and HMI demo (option 2) launches immediately.

1. Please follow the kit assembly instructions from section 3 before proceeding with the following steps.
2. Connect the micro USB end of the micro USB device cable to micro-AB USB Debug port (J10) of the EK-RA8D1 board.
3. Connect the other end of this cable to the USB port of the host PC. Power LED (LED4) on the EK-RA8D1 board lights up white, indicating that the EK-RA8D1 board is powered on.

Note: If the EK-RA8D1 board is not powered through micro-AB USB Debug port (J10) and the host PC, then USB CDC functionality of the Quick Start example project cannot be fully demonstrated because of the absence of a USB Full Speed Device connection with the host PC.

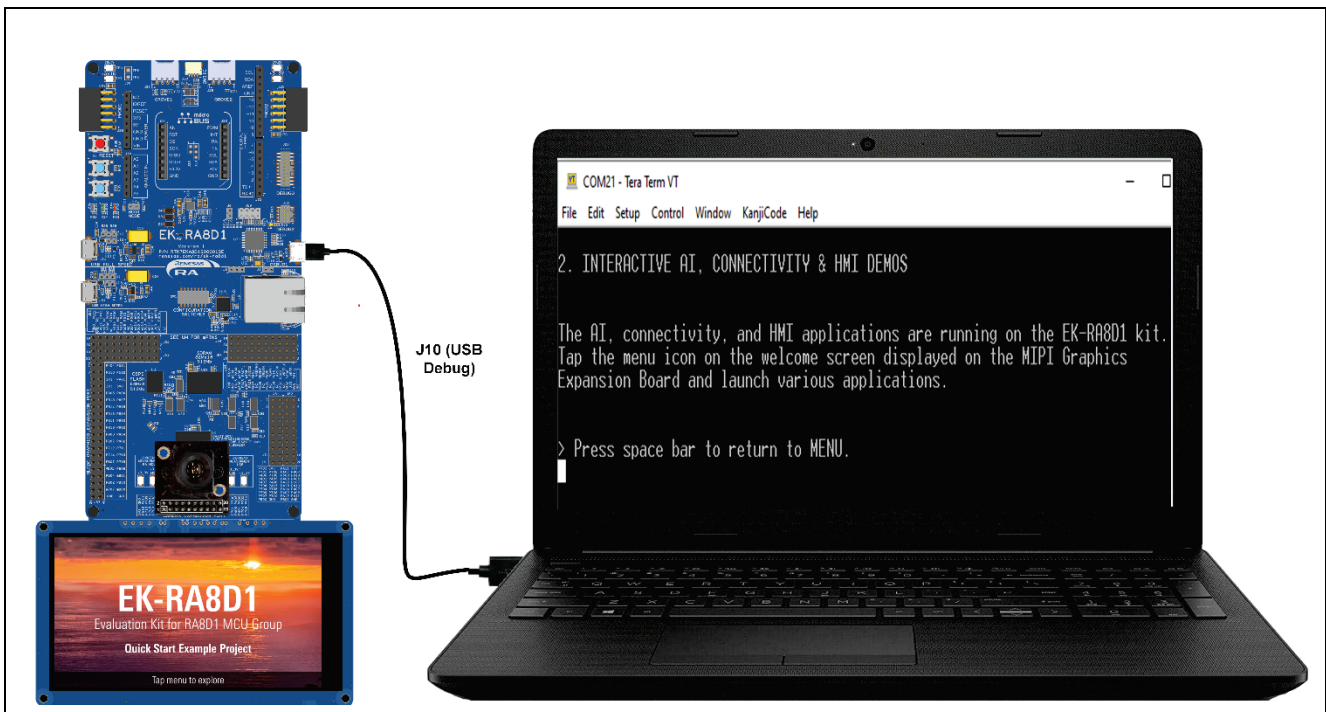


Figure 7. Connecting the EK-RA8D1 Board to the Host PC via USB Debug Port

5.2 Running the Quick Start Example Project

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

1. On power up or RESET, the three user LEDs take on the following states:
 - LED1 Blue – Blinking at 1 Hz frequency and at 10% intensity
 - LED2 Green – Steady, full intensity
 - LED3 Red – Off

Note: If the Red LED is flashing, please check the error from console by following instructions 4 to 6.

2. Press the user button (S1) on the EK-RA8D1 board to change the intensity of the user LED1. With every press of the user button (S1), the intensity switches from 10% to 50% to 90% and cycles back.
3. Press the user button (S2) on the EK-RA8D1 board to change the blinking frequency of the user LED1 (blue). With every press of the user button (S2), the frequency switches from 1 Hz to 5 Hz to 10 Hz and cycles back.
4. On the host PC, open Windows Device Manager. Expand **Ports (COM & LPT)**, locate **JLink CDC UART Port (COMxx)** and note down the COM port number for reference in the next step.

Note: USB Serial Device drivers are required to communicate between the EK-RA8D1 board and the terminal application on the host PC. When the board is connected to the PC for the first time, J-Link drivers are installed. If asked to restart the computer, please do so.

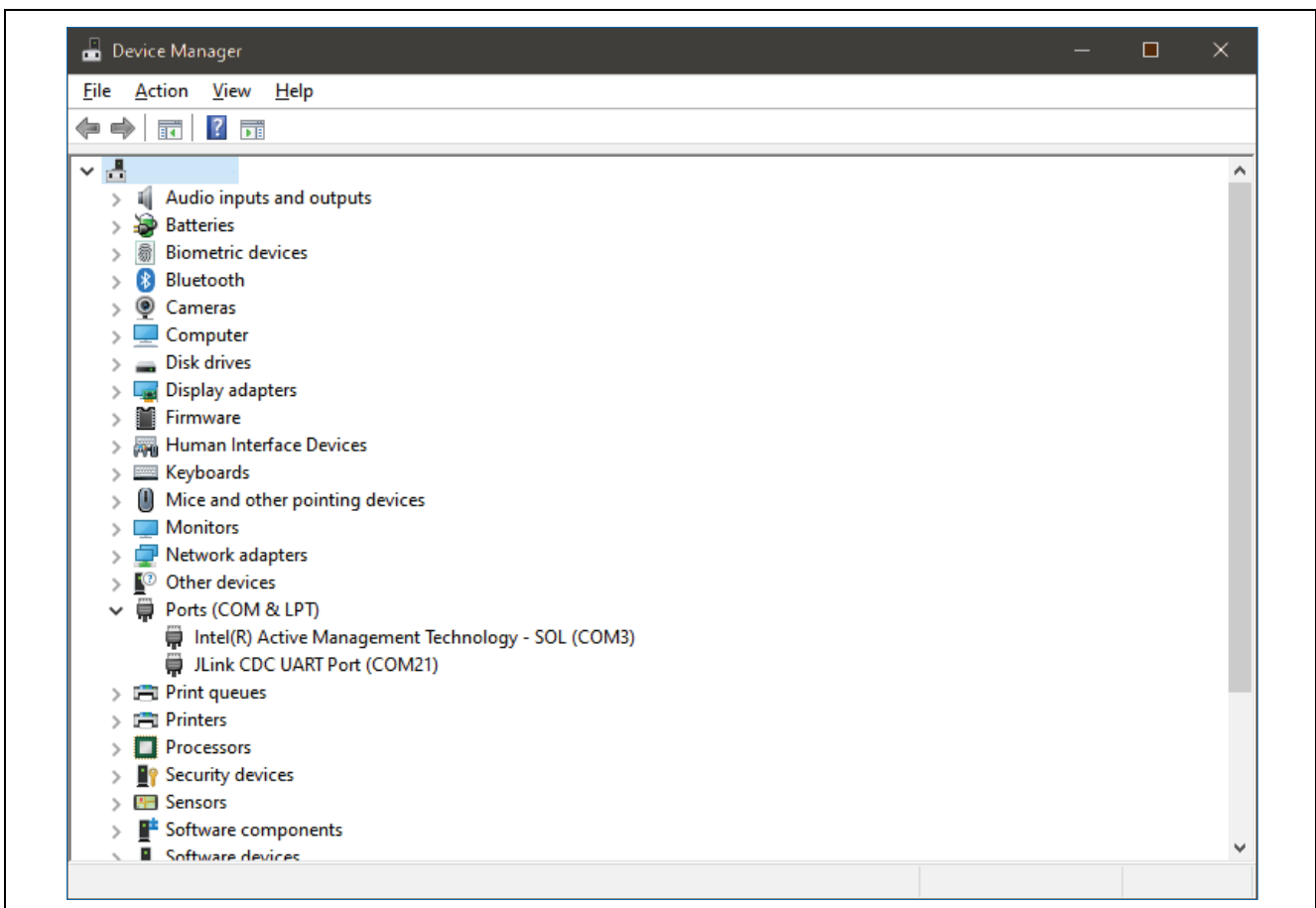


Figure 8. USB Serial (UART) Device in Windows Device Manager

- Open Tera Term, select **Serial** and **COMxx: JLink CDC UART Port (COMxx)** and click **OK**.

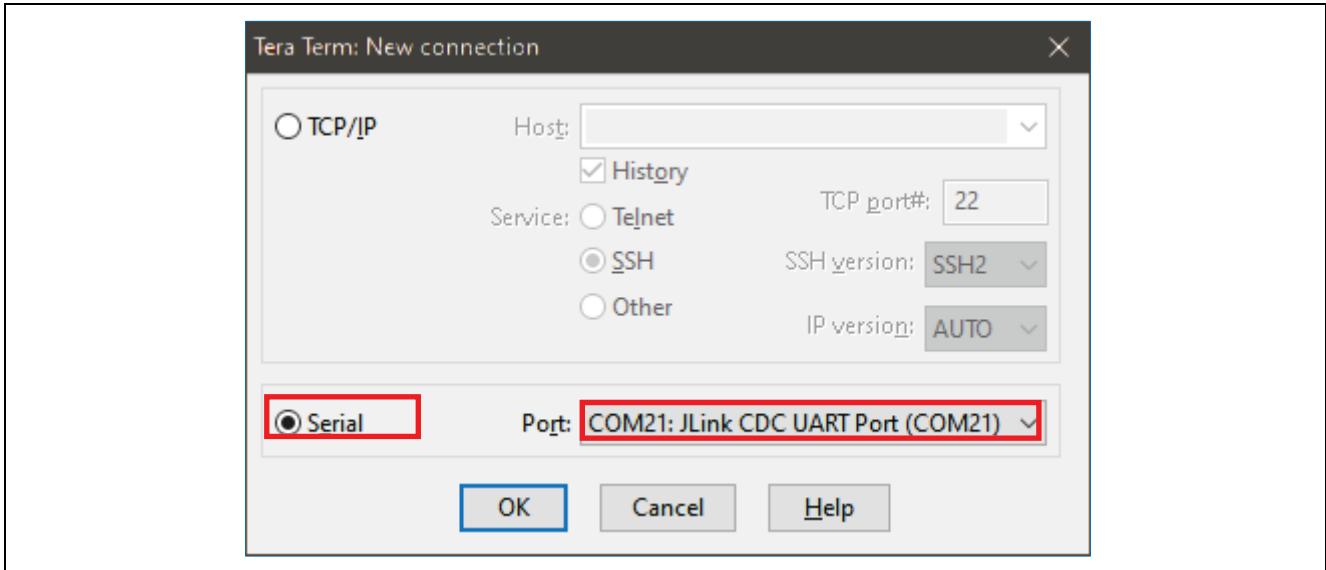


Figure 9. Selecting the Serial Port on Tera Term

- Using the **Setup** menu pull-down, select **Serial port...** and ensure that the speed is set to **115200**, as shown below.

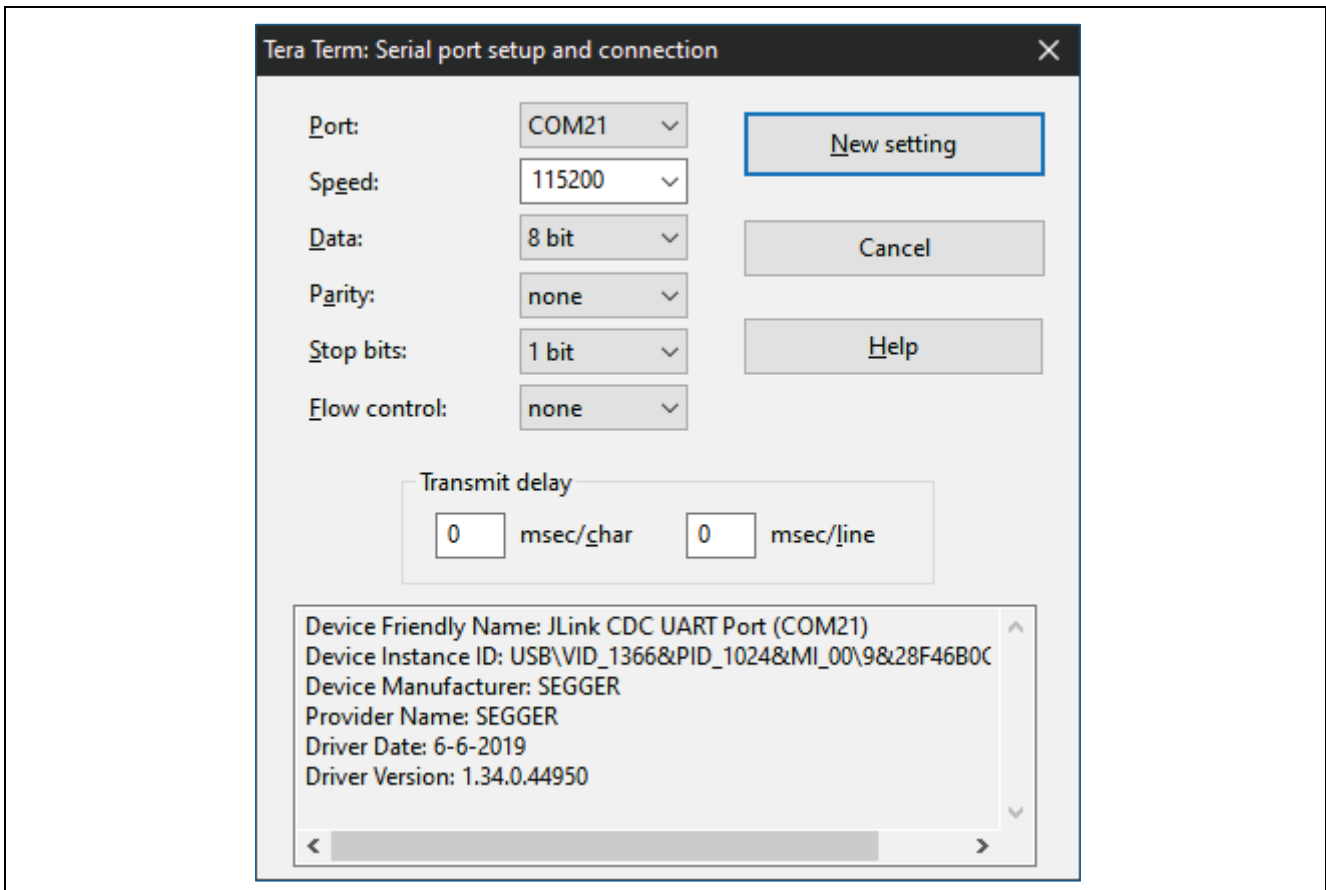


Figure 10. Select 115200 on the Speed Pulldown

Complete the connection. The 'Interactive AI, Connectivity & HMI Demos' screen is displayed and the MIPI graphics screen is displayed as shown in section 5.3.

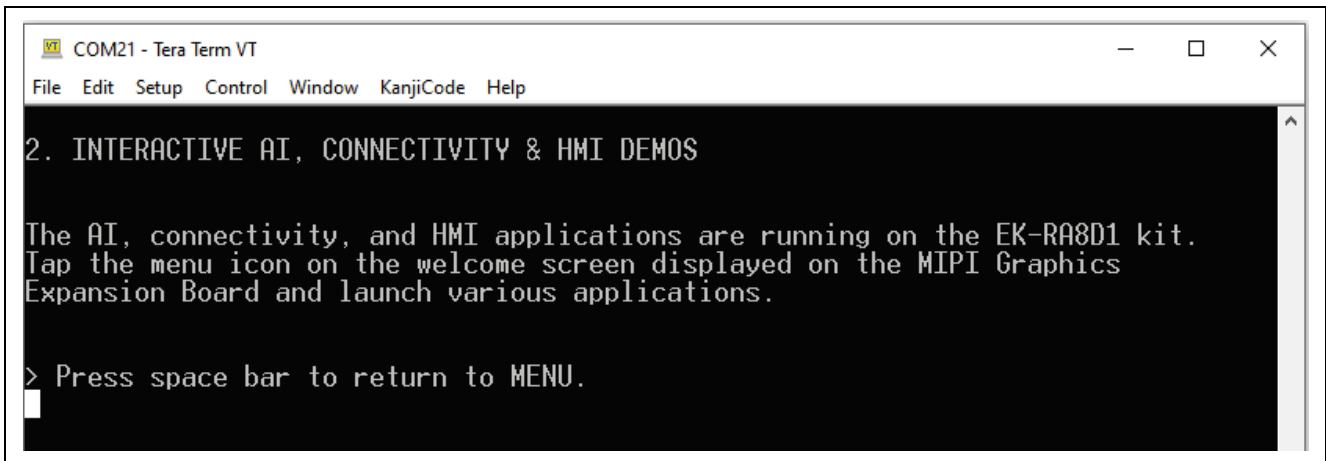


Figure 11. Various Interactive connectivity and HMI Demos

Note: If the required accessories and switch settings are not detected, then the following information is displayed. Please verify the settings by disconnecting the USB power and confirming the switch settings and connections and then re-connecting the USB power.

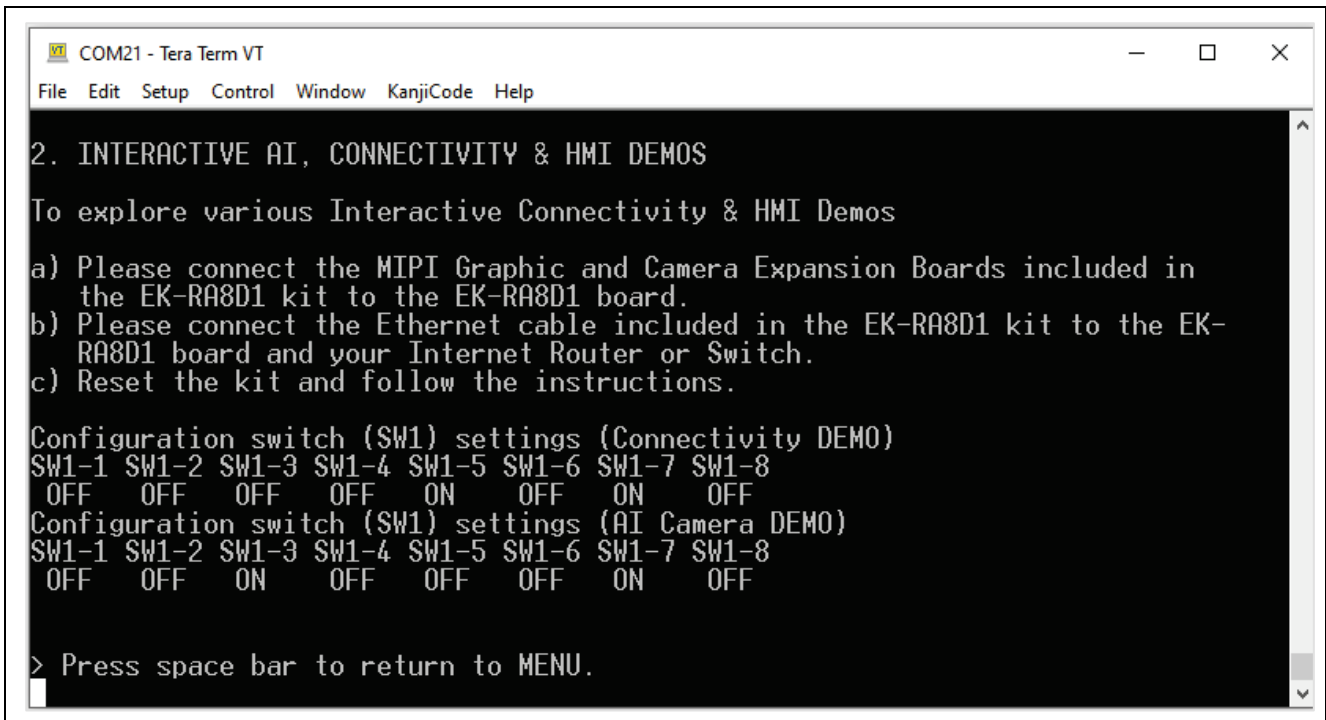


Figure 12. Unsuccessful Configuration

5.3 Common Application Details

1. On power up, the 'Splash' Screen is displayed on the MIPI Graphics Expansion Board momentarily.



Figure 13. Splash Screen

2. Then you will see the main screen.



Figure 14. Main Screen

3. Pressing the Menu button at the top left displays the menu.



Figure 15. Main Menu

- 4. Select the options you want to see. Each menu is described as follows. Pressing the X on the top right on any page takes you back to the Main screen.
- 5. The Kit Information screen duplicates the information available from the serial terminal option 1.

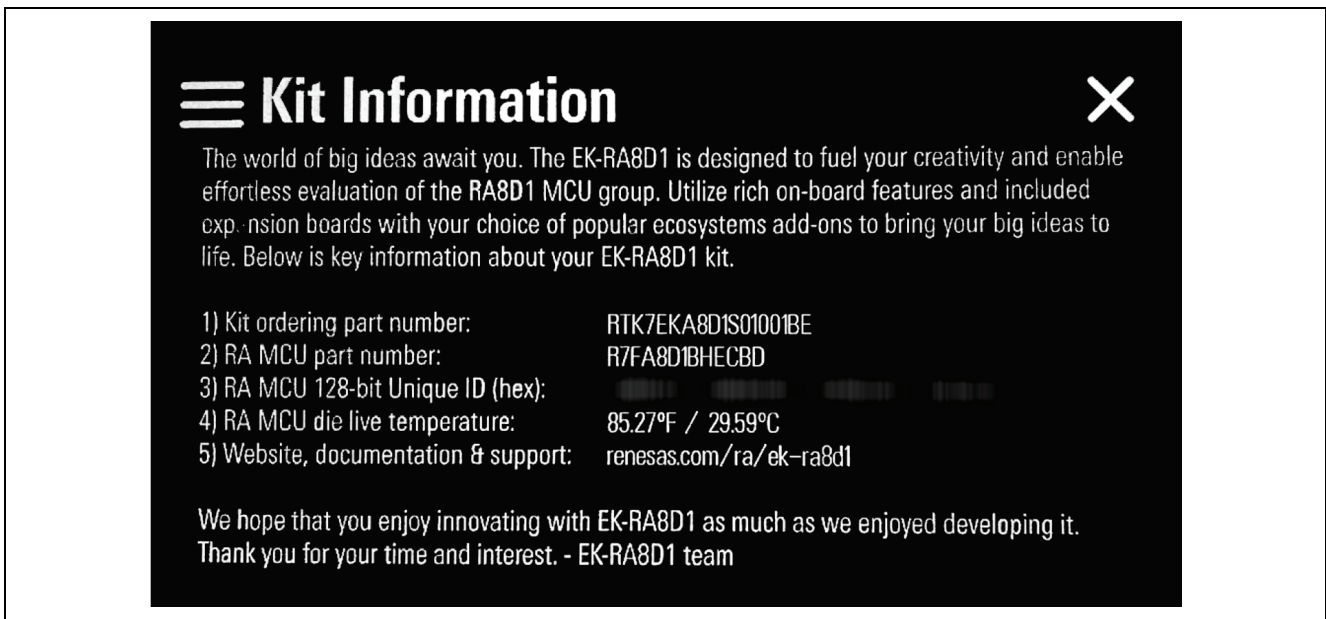


Figure 16. Kit Information

6. The Getting Started screen gives summary information and refers the user to this document.

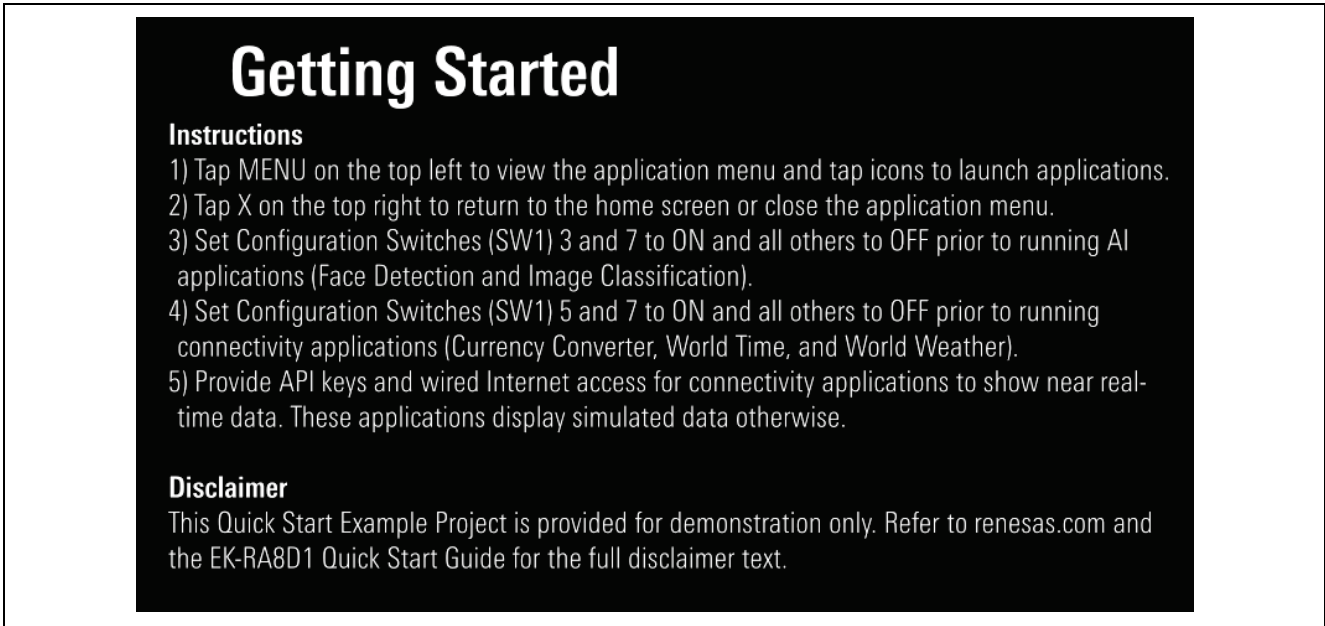


Figure 17. Getting Started

7. The User LED Control changes the operation of the LEDs.

8. Use the sliders to change the intensity and speed of the flashing LEDs on the board.

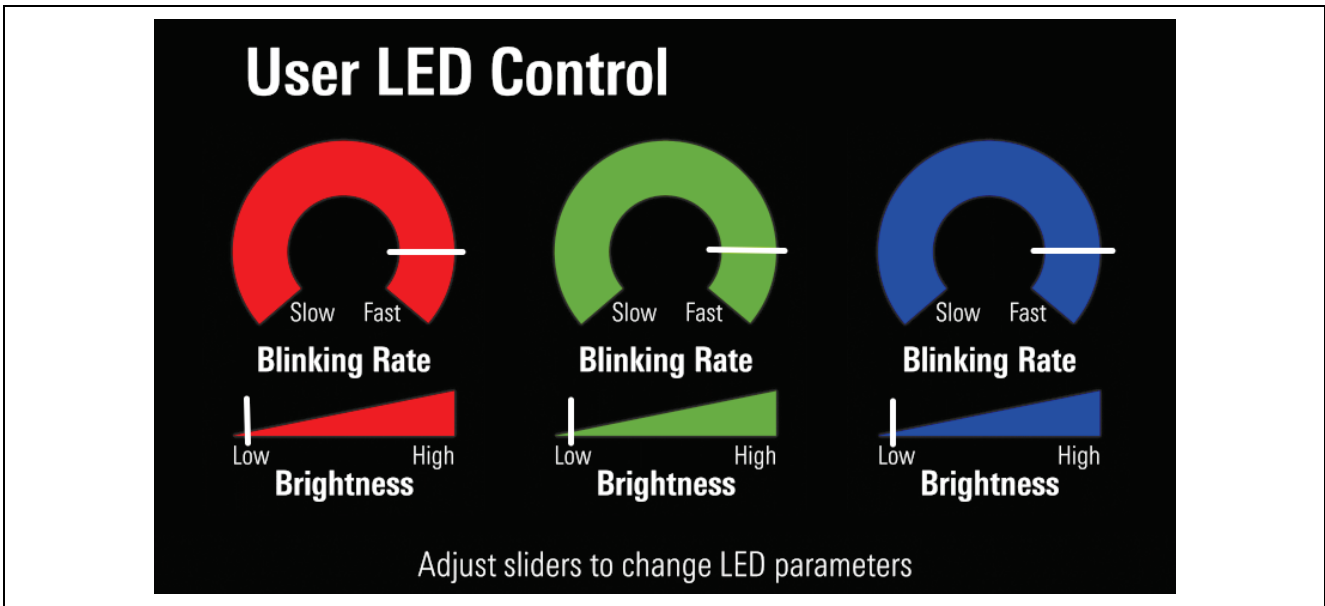


Figure 18. User LED Control

5.4 Connectivity Application Details

- The Demo is provided with some default data for the Weather and Currency screens. These can be updated by the application from two online services.
Please note that these services are not in any way affiliated with Renesas and future operation cannot be relied on. To use these services, you need to obtain a FREE valid API key from each service using your email address.
- Please go to the following websites and obtain a valid API key for each.
www.weatherapi.com
(1,000,000 free requests / month: Each session causes 14 requests.)
www.currencyapi.com
(300 free requests / month: Each session causes 10 requests, allowing for 30 free sessions.)
- To perform the update, please follow the instructions in section 6.1.

5.4.1 Currency Converter

The Currency Converter Screen allows you to use the retrieved data (if available) to compare various currencies shown as follows:

1. Press the Currency Converter Menu option.
2. Tap any flag to set this as the base currency to be compared to.
3. Tap another flag to view the currency conversion rate at the bottom of the screen.
4. Press the 'RESTART' button to restart the conversion by selecting a new base currency to compare to.

Note: If the Connectivity API Keys are not valid then static demonstration data is used.

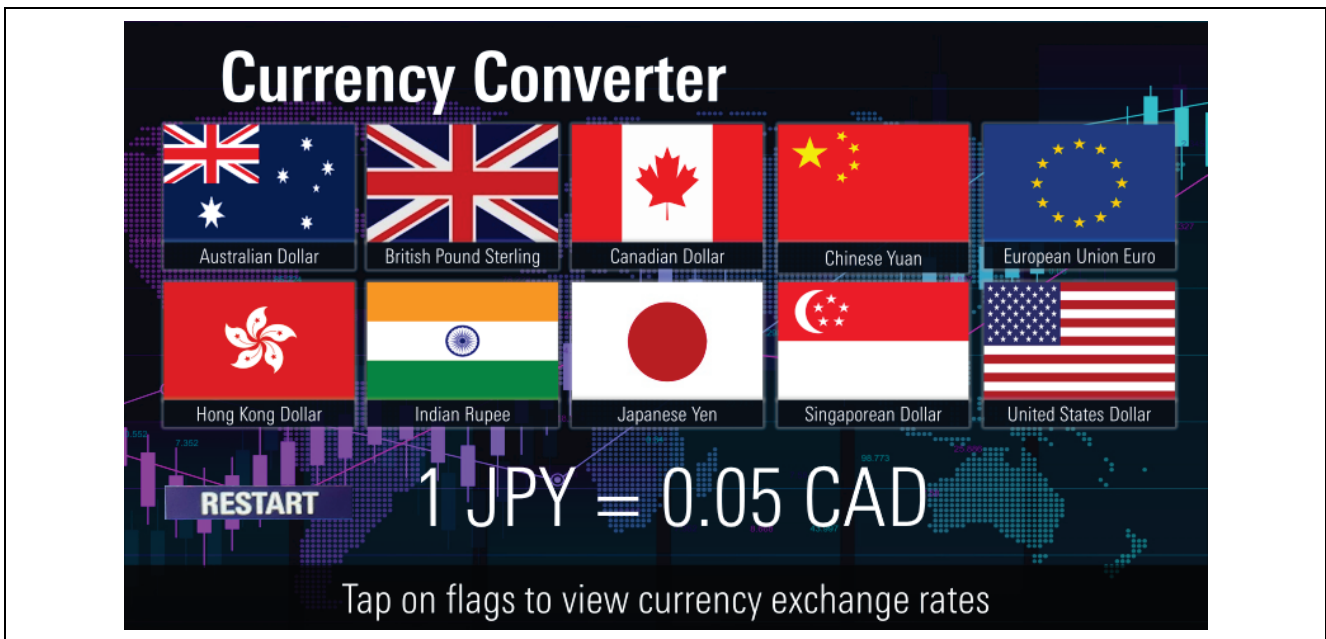


Figure 19. Currency Conversion Screen

5.4.2 World Time Zones

The World Time Zones screen allows you to use the retrieved data (if available) to show the time in a variety of regions.

1. Press the World Time Zones Menu option.
2. Press the small dot at a city location to see the name and time at that location.

Note: If the Connectivity API Keys are not valid, then time from power on, with 12:00 pm in the United Kingdom, is used.

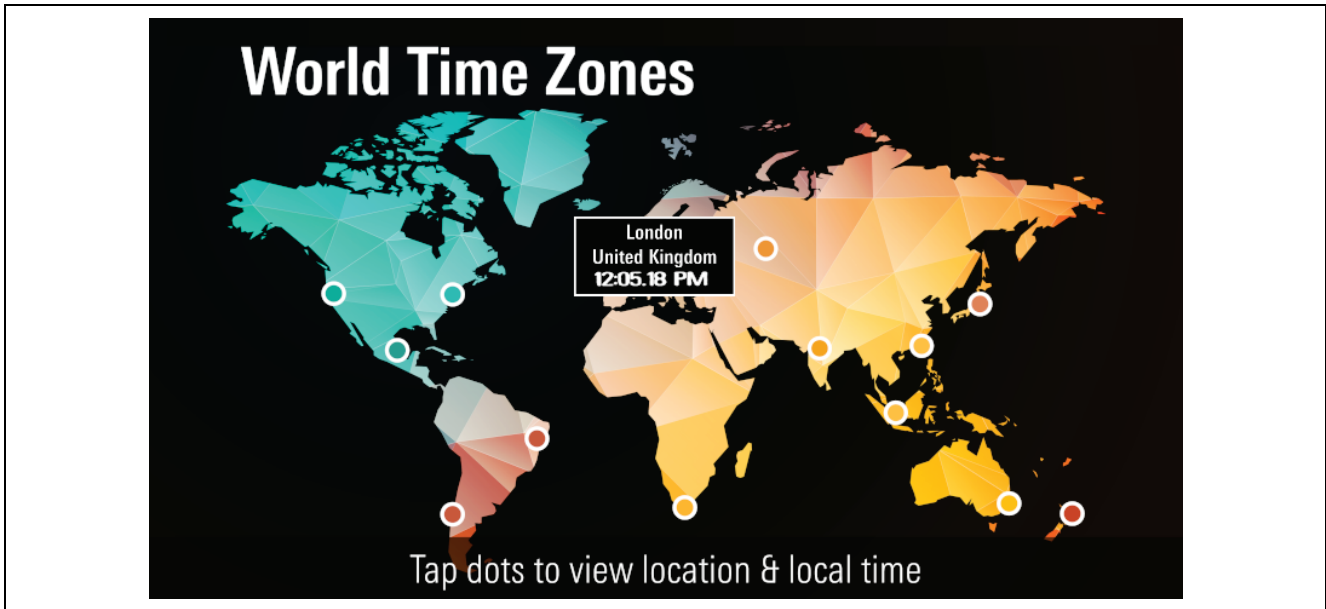


Figure 20. World Time Zone Screen

5.4.3 World Weather

The World Weather screen allows you to use the retrieved data (if available) to show the weather in a variety of regions as follows:

1. Press the World Weather Menu option.
2. Swipe from the center to the left or right of the screen to swap between regions.

Note: If the Connectivity API Keys are not valid, then, static demonstration data is used.



Figure 21. World Weather

5.5 AI Application Details

- If the settings are not correct, the application screen is displayed without a picture and the text guidance is shown as follows:

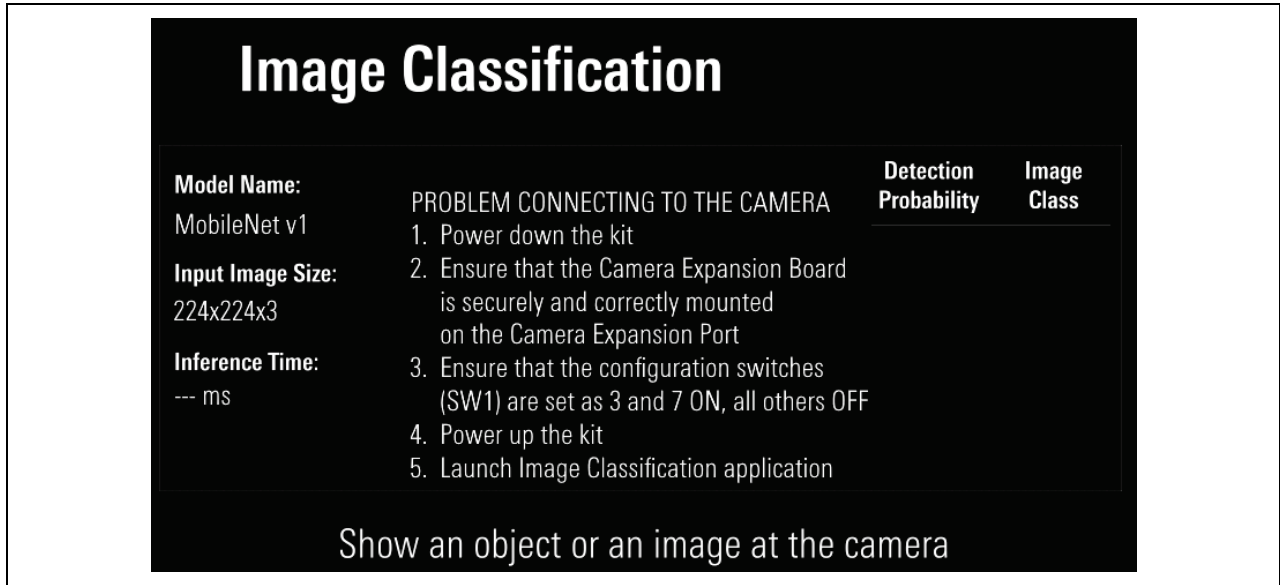


Figure 22. Invalid Configuration Example

5.5.1 Face Detection

Face Detection application uses the AI engine to detect one or more faces in the camera view. Either face the camera or present a picture with one or more faces to be detected.

1. The inference engine runs continuously to show the number of faces detected and draws a red box around the detection area.

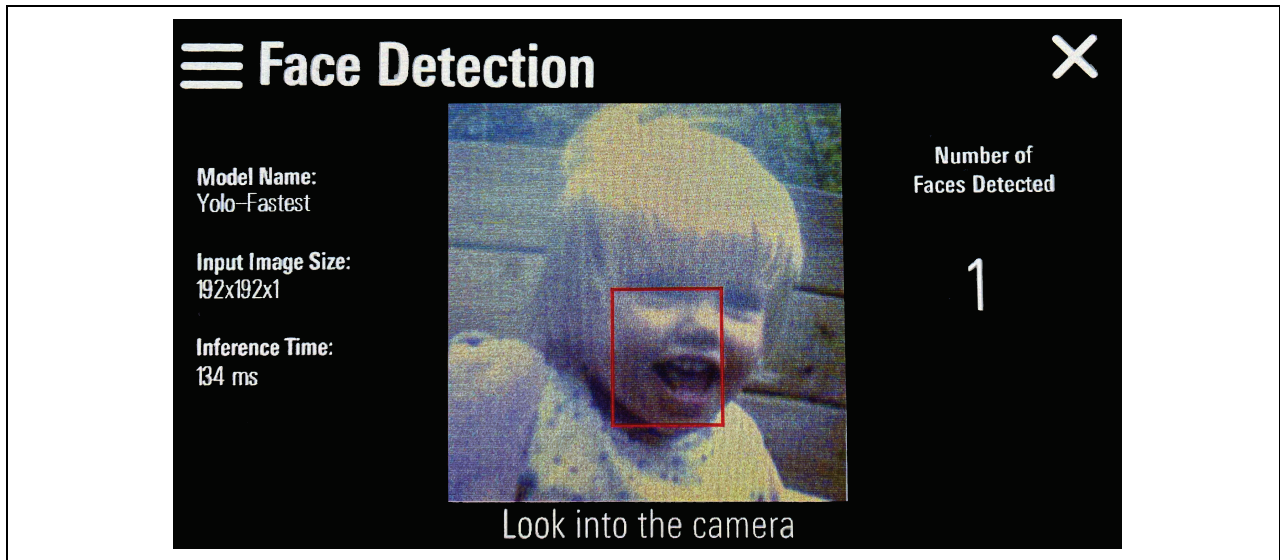


Figure 23. Face Detection

5.5.2 Image Classification

Image Classification uses the AI inference engine to detect objects in the camera view.

1. Place a selection of objects or pictures in front of the camera.
The inference engine runs continuously to show the top 5 possible items detected.

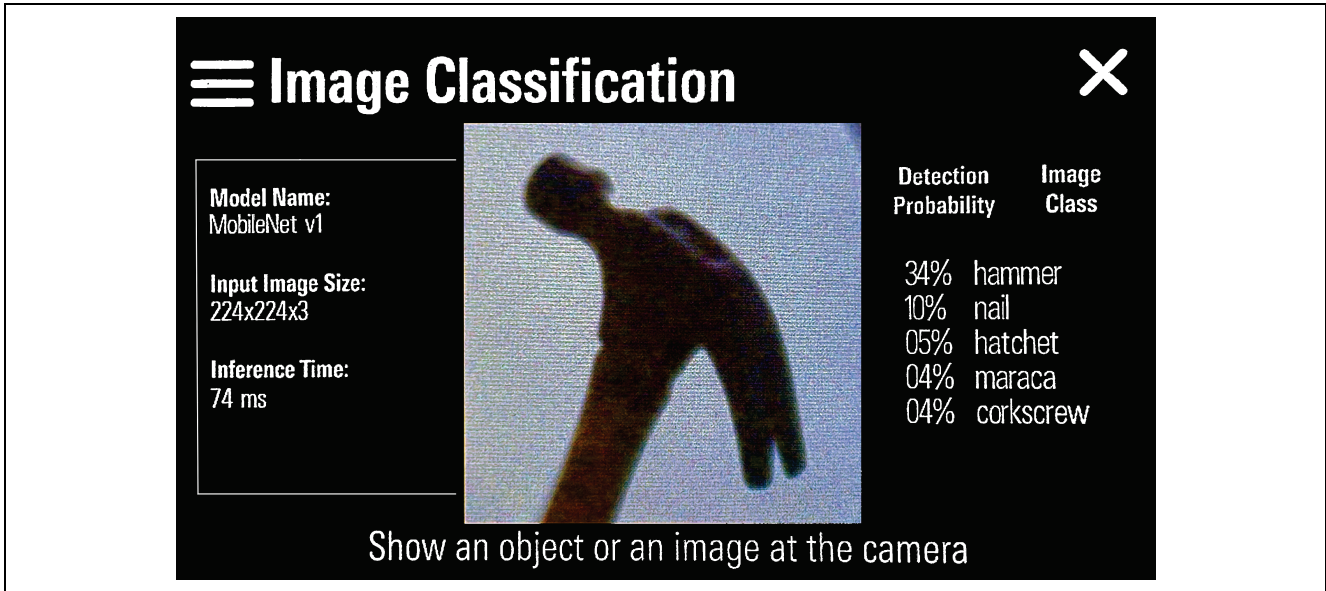


Figure 24. Image Classification Example

6. Running the Quick Start Example Project on Console

1. Return to the serial console.
2. Press **space** to return to the 'welcome and main menu' screen.

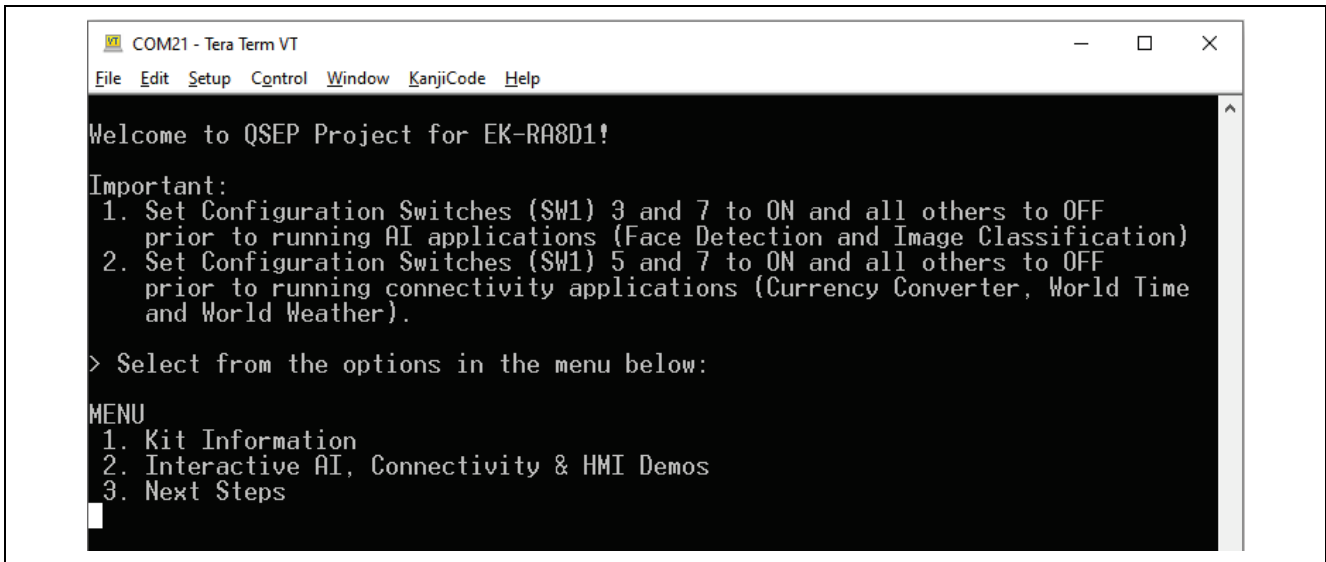


Figure 25. Welcome and Main Menu

- Press **1** to display the **Kit Information** including the kit name, ordering part number, device part number, MCU ID, MCU die temperature, and the user LED's current blinking frequency and intensity.

```

COM21 - Tera Term VT
File Edit Setup Control Window KanjiCode Help
1. KIT INFORMATION
a) Kit name: EK-RA8D1
b) Kit ordering part number: RTK7EKA8D1S01001BE
c) RA Device part number: R7FA8D1BHECBD
d) RA MCU 128-bit Unique ID (hex):
e) RA MCU Die temperature (F/C): 86.72/30.40
f) Blue LED blinking frequency (Hz): 1
g) Blue LED blinking intensity (%): 10
> Press space bar to return to MENU

```

Figure 26. Kit Information

- Press **space** to return to the 'welcome and main menu' screen.
- Press **2** to run the **Interactive AI, Connectivity & HMI Demos**.

```

COM21 - Tera Term VT
File Edit Setup Control Window KanjiCode Help
2. INTERACTIVE AI, CONNECTIVITY & HMI DEMOS
The AI, connectivity, and HMI applications are running on the EK-RA8D1 kit.
Tap the menu icon on the welcome screen displayed on the MIPI Graphics
Expansion Board and launch various applications.
> Press space bar to return to MENU.

```

Figure 27. Interactive AI, Connectivity & HMI Demos

- The 'Interactive AI, Connectivity & HMI Demos' run on the MIPI Graphic Expansion Board. Please see section 5 for more information.

Note: Depending on the setting of SW1-3 and SW1-5, either Camera functionality or Ethernet functionality is enabled.

In either mode, by default, stored data is used until valid API keys have been entered for third party services. This is covered in the following section where the operation of each screen is described.

6.1 Connectivity Application API Keys

Note: Due to the LCD being connected, the Interactivity and HMI demo (option 2) launches immediately. To update the connectivity application on the board, the following steps are required:

- Disconnect the micro USB end of the micro USB device cable from micro-AB USB Debug port (J10) of the EK-RA8D1 board.
- Please configure the board for ethernet functionality, setting SW1-5 ON and SW1-7 ON and all other switches on SW1 OFF.
- Please ensure an internet connected ethernet cable is attached to the board ethernet port.
- Reconnect the micro USB end of the micro USB device cable to micro-AB USB Debug port (J10) of the EK-RA8D1 board. Power LED (LED4) on the EK-RA8D1 board lights up white, indicating that the EK-RA8D1 board is powered on.

Note: If the EK-RA8D1 board is not powered through micro-AB USB debug port (J10) and the host PC, then USB CDC functionality of the Quick Start example project cannot be fully demonstrated because of the absence of a USB Full Speed Device connection to the host PC.

Hardware Requirements

- EK-RA8D1 kit
- Micro USB device cable
- A PC with at least 1 USB port
- Ethernet cable
- A router that can connect to the internet.

Software Requirements

- Windows® 10 operating system
- USB Serial Drivers (included in Windows 10)
- Tera Term (or similar) terminal console application

Note: In corporate settings where root certificates are managed, the connection to the web services may fail due to the website root certificate failing the certificate checks. The Trusted Root certificate for these sites as of October 2023 is stored in the code. If this changes, then the certificates need to be replaced and the code re-built (file: `root_ca.h`).

Using the console options 3 (Currency), 4 (Time) and 5 (Weather), please enter your API key into the terminal relating to the service selected. The API keys are stored in the device Data Flash and do not need to be re-entered unless the keys are deleted using option 6 or the key becomes invalid. Sample instructions are shown in the following section.

6.1.1 Currency Converter Refresh

1. Press **space** to return to the 'welcome and main menu' screen.

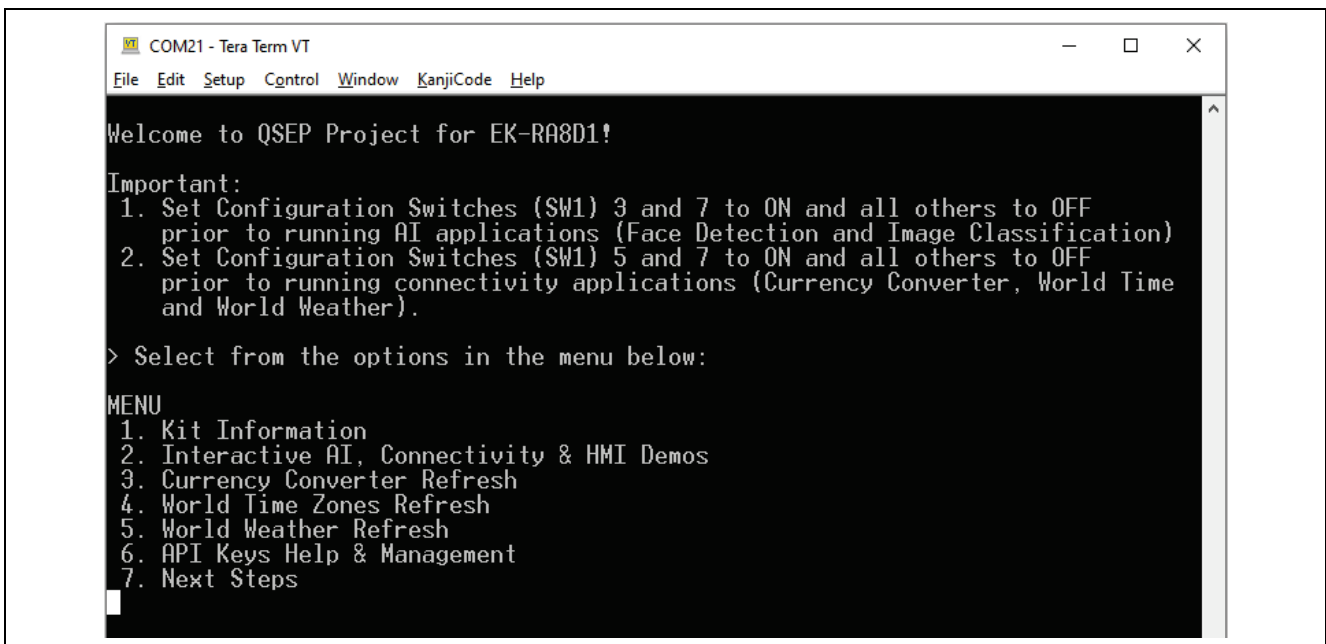


Figure 28. Welcome and Main Menu

2. Press **3** to **Currency Converter Refresh**.

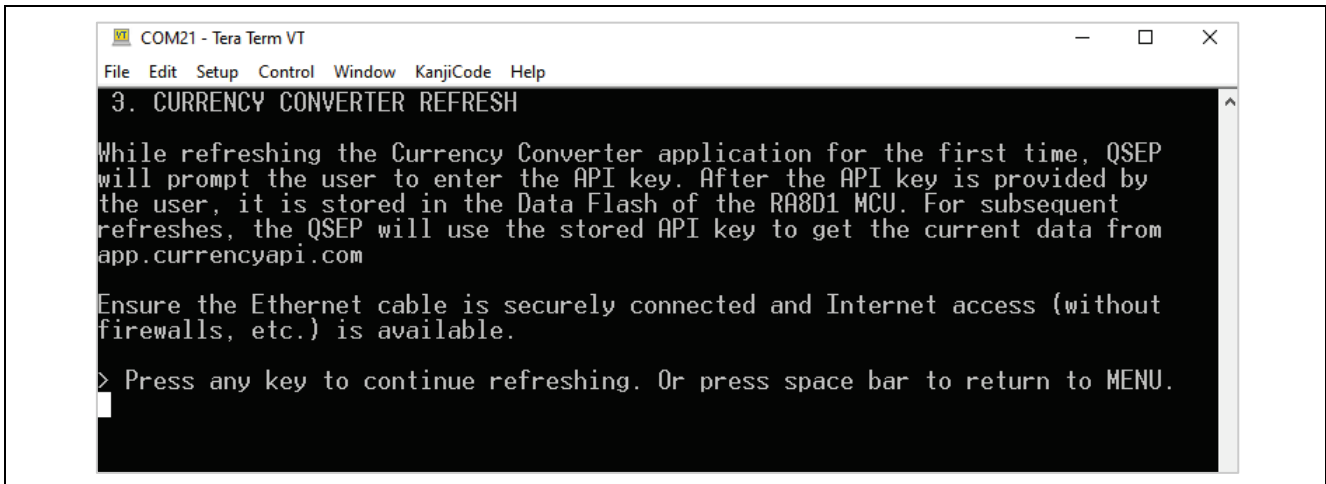


Figure 29. Currency Converter Refresh

3. Press **any key** to refresh the data for currency converter.
4. If the API key does not exist, the console display is as shown in Figure 30.
5. Press **any key** to update the API key.
6. Paste the API key into the console.
7. Press **Enter**.

If the API key is valid, the update starts as shown in the following figure.

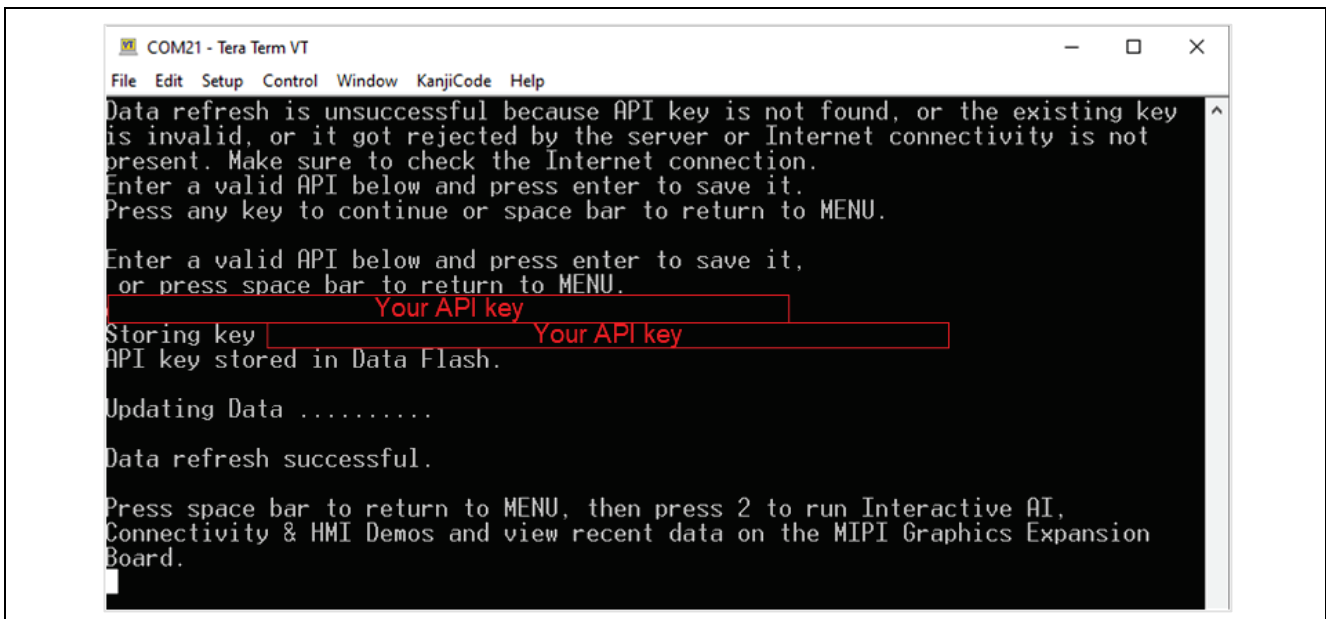


Figure 30. Entering Currency API keys for the first time

6.1.2 World Time Zones Refresh

1. Press **space** to return to the 'welcome and main menu' screen.
2. Press **4** to **World Time Zones Refresh**.

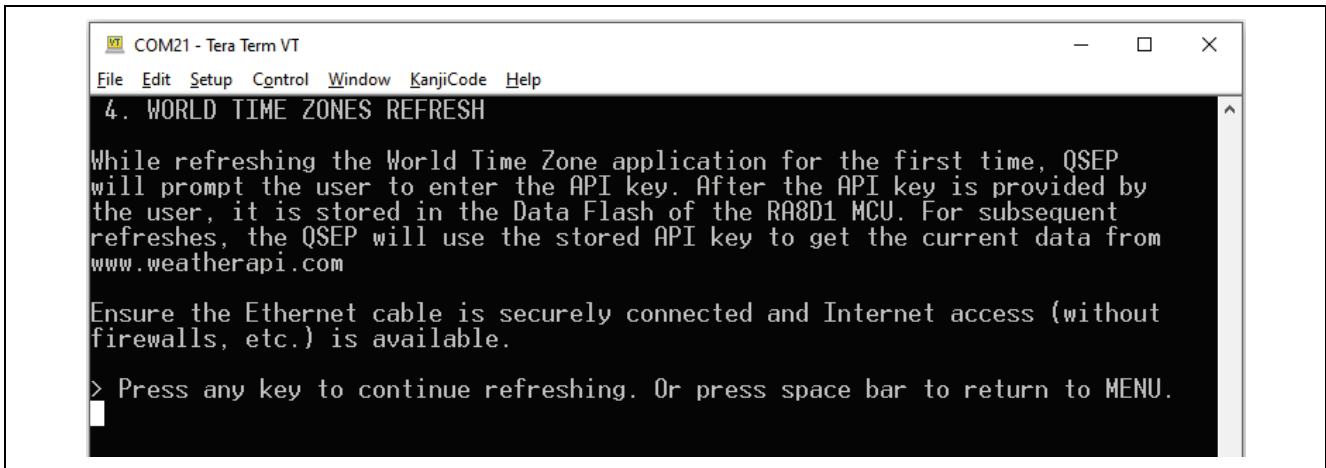


Figure 31. World Time Zones Refresh

3. Press **any key** to refresh the data for world time zones application.
4. If the API key does not exist, the console display is as shown in Figure 32.
5. Press **any key** to update the API key.
6. Paste the API key into the console.
7. Press **Enter**.

If the API key is valid, the update starts as shown in the following figure.

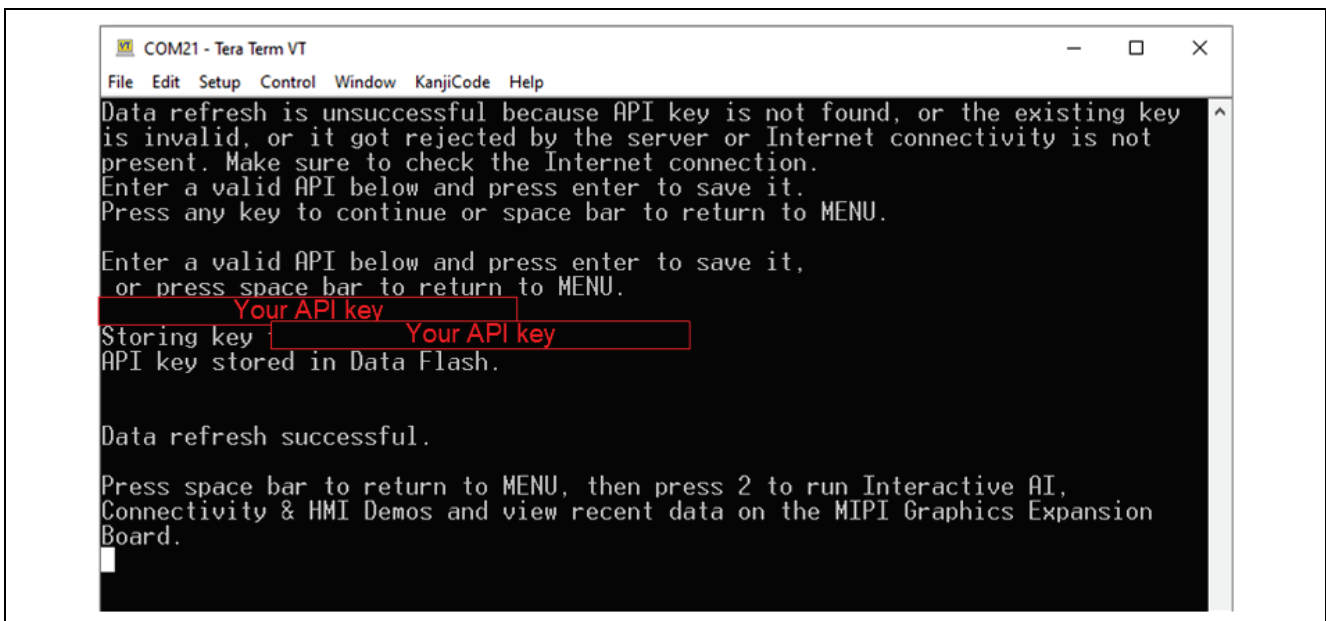


Figure 32. Entering Time Zone API Keys for the First Time

6.1.3 World Weather Refresh

1. Press **space** to return to the 'welcome and main menu' screen.
2. Press **5** to **World Weather Refresh**.

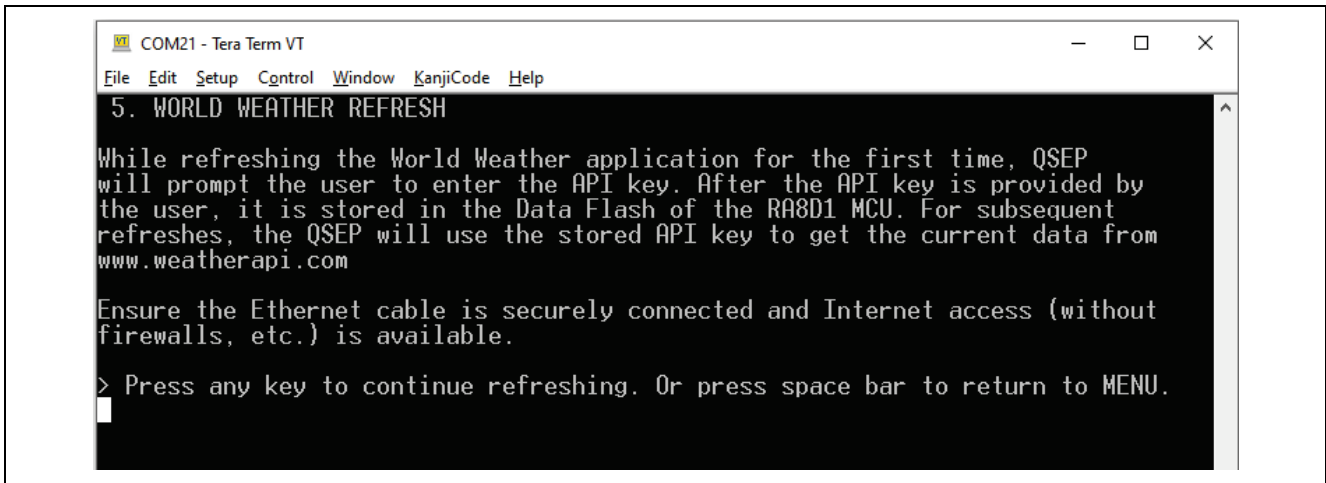


Figure 33. World Weather Refresh

3. Press **any key** to refresh the data for world weather application.
4. If the API key does not exist, the console display is as shown in Figure 34.
5. Press **any key** to update the API key.
6. Paste the API key into the console.
7. Press **Enter**.

If the API key is valid, the update starts as shown in the following figure.

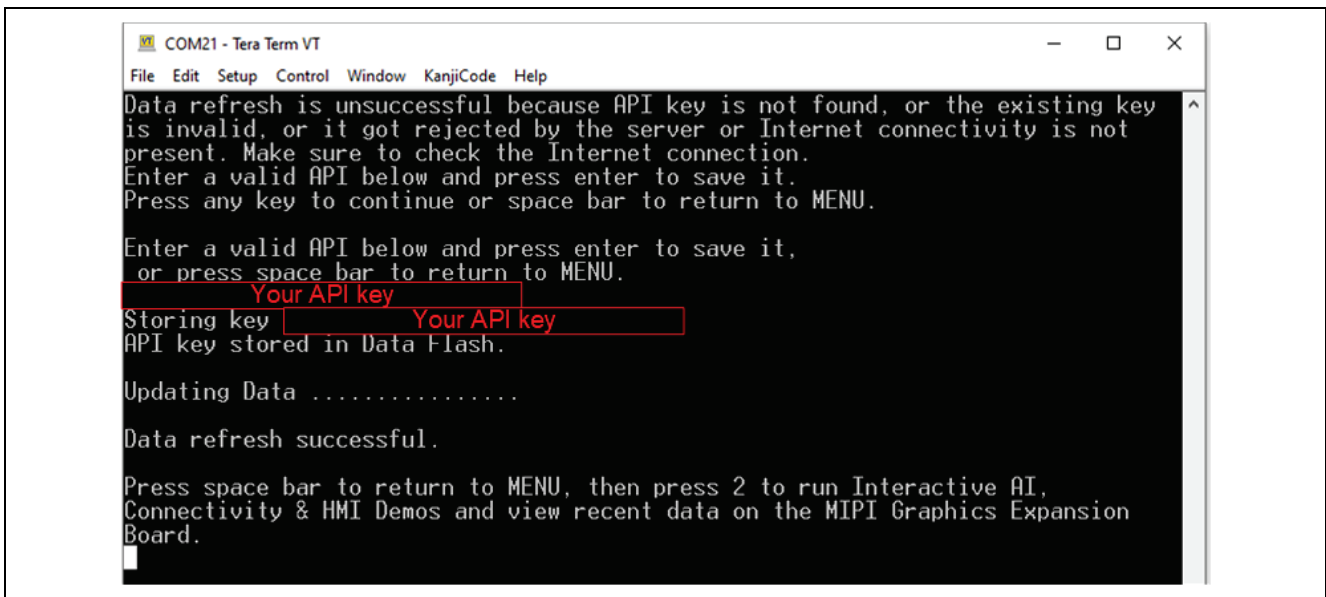


Figure 34. Entering Weather API keys for the First Time

6.1.4 API Keys Help and Management

To update the API key stored in the flash, API Keys Help & Management must be run to erase the API key.

1. Press **space** to return to the 'welcome and main menu' screen.
2. Press **6** to **API Keys Help & Management**.

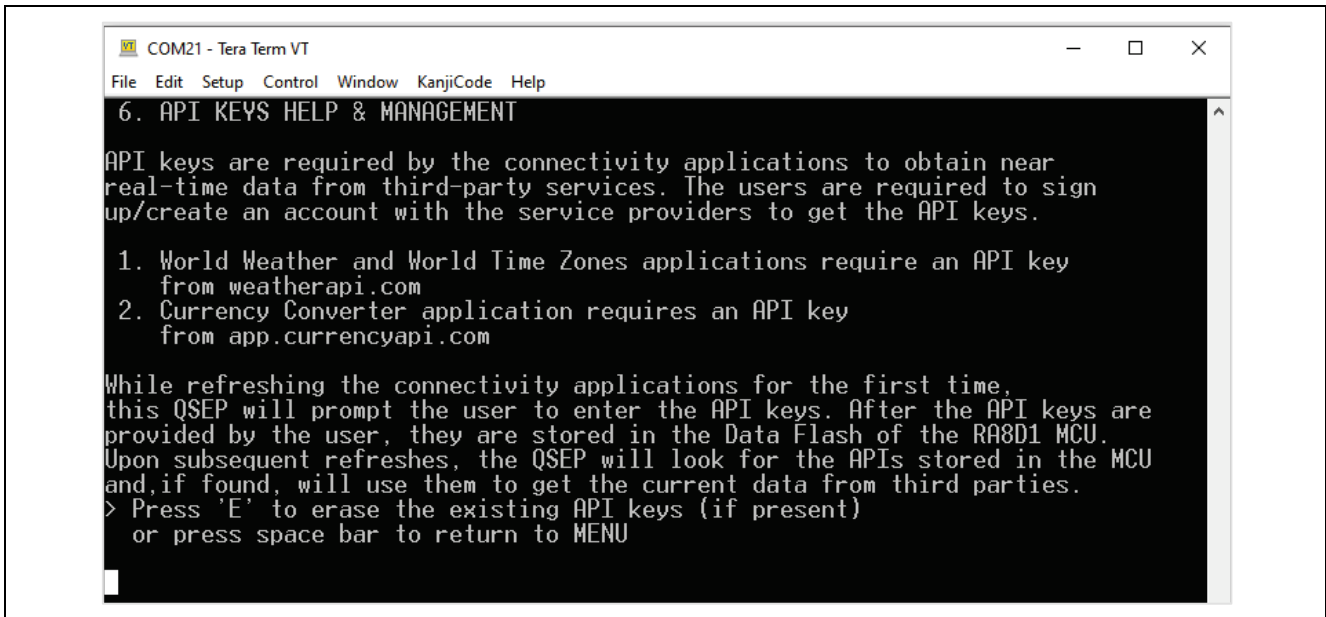


Figure 35. API Keys Help and Management

3. Press **E** to erase all existing API keys.

Note: Due to the limited number of free requests, the keys are not used on power up unless the above menu options 3, 4 and 5 are selected.

To check the result on board, please follow section 5.4 to open the respective page.

6.2 Next Steps

1. Press **space** to return to the 'welcome and main menu' screen.
2. Press **7** to display **Next Steps**.

Note: The Next Steps section number will change depending on the SW setting. For SW 1-3 and SW 1-7 ON, the number will be 3. For SW1-5 and SW1-7 ON the number will be 7.

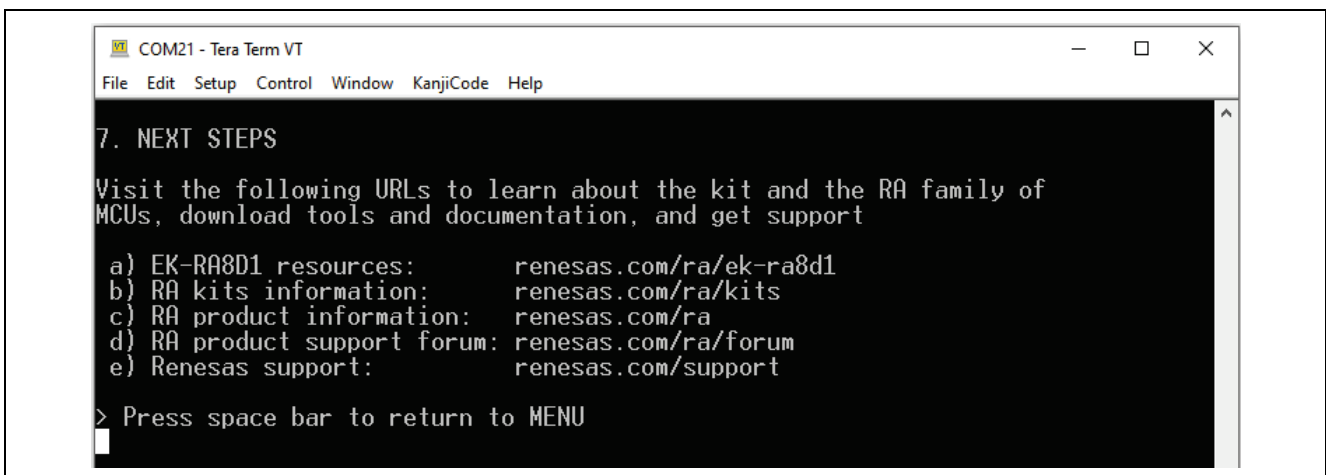


Figure 36. Next Steps

3. Press **space** to return to the 'welcome and main menu' screen.

7. Customizing the Quick Start Example Project

This section lists the requirements and instructions for customizing the Quick Start example project.

Hardware Requirements

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

Software Requirements

- Windows® 10 operating system
- e² studio IDE 2023-10 (or later)
- SEGGER J-Link® USB drivers
- FSP v5.1.0 (or later)
- Quick Start example project

7.1 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 e² studio are bundled in a downloadable platform installer available on the FSP webpage at 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.

7.2 Downloading and Importing the Quick Start Example Project

1. Download and extract the Quick Start example project to a local directory on the host PC.
 - The Quick Start example project (source code and project files) is available in the EK-RA8D1 Example Projects Bundle that is available in the **Documentation** tab of EK-RA8D1 webpage at renesas.com/ra/ek-ra8d1
 - Download and extract the example projects bundle (xxxxxxxxxxxxxxxx-ek-ra8d1-exampleprojects.zip) to a local directory on the host PC.
 - Browse to the Quick Start example project at xxxxxxxxxxxxxxxxxxx-ek-ra8d1-exampleprojects\ek_ra8d1_quickstart\quickstart_ek_ra8d1_ep
2. Launch e² studio.
3. Browse to the Workspace where the project file is to be imported. Enter the name in the Workspace dialog box to create a new workspace.

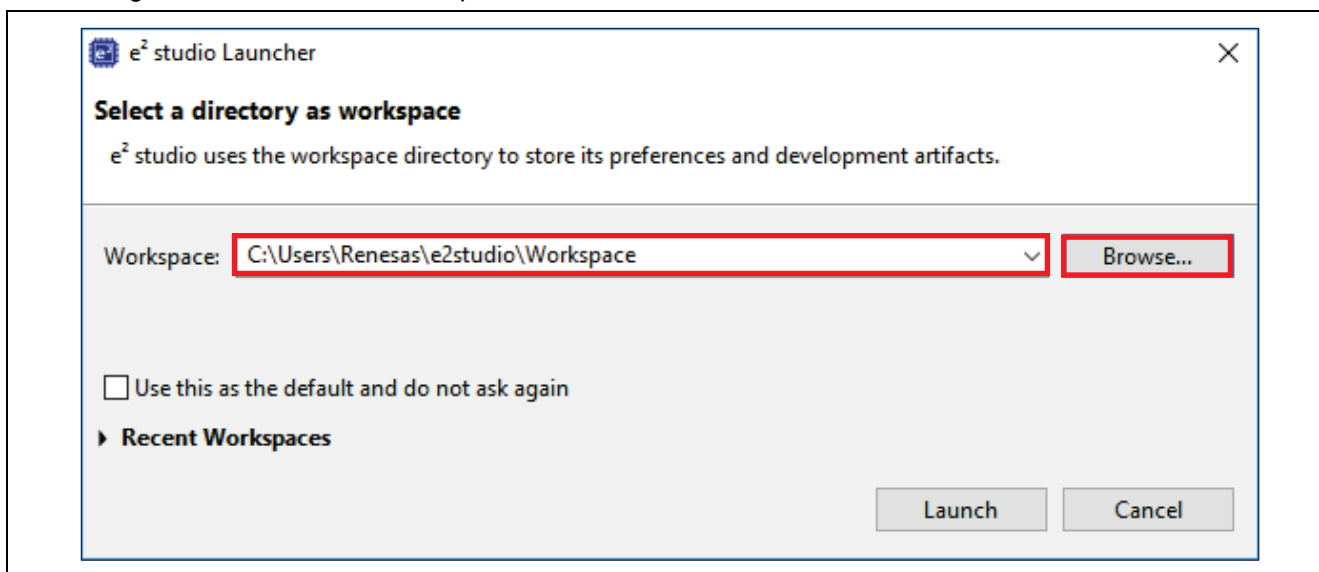


Figure 37. Creating a New Workspace

4. Click **Launch**.

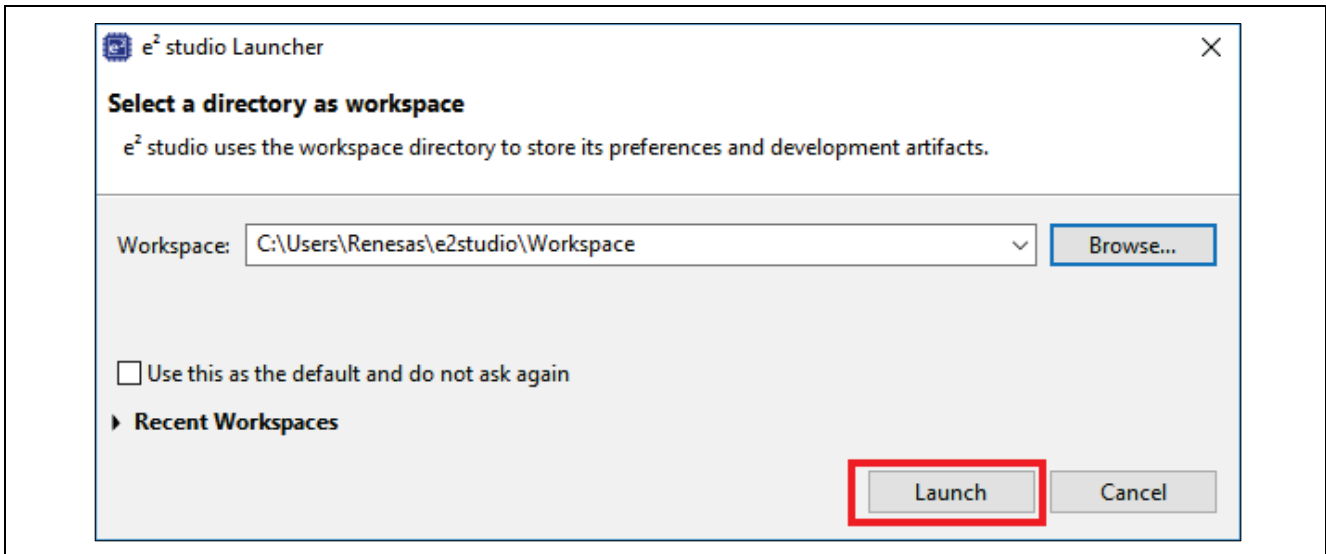


Figure 38. Launching the Workspace

5. Click **Import** from the **File** drop-down menu.

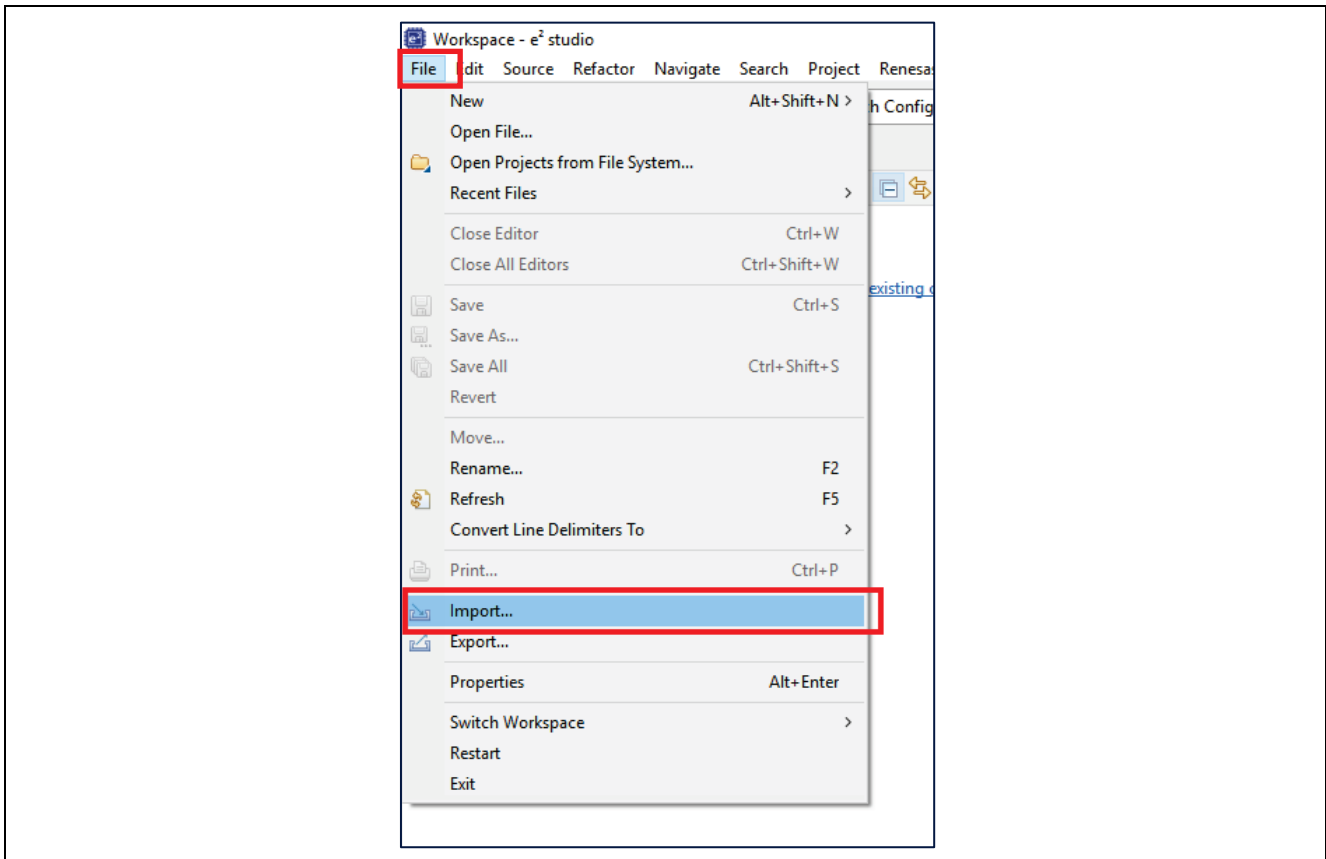


Figure 39. Importing the Project

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

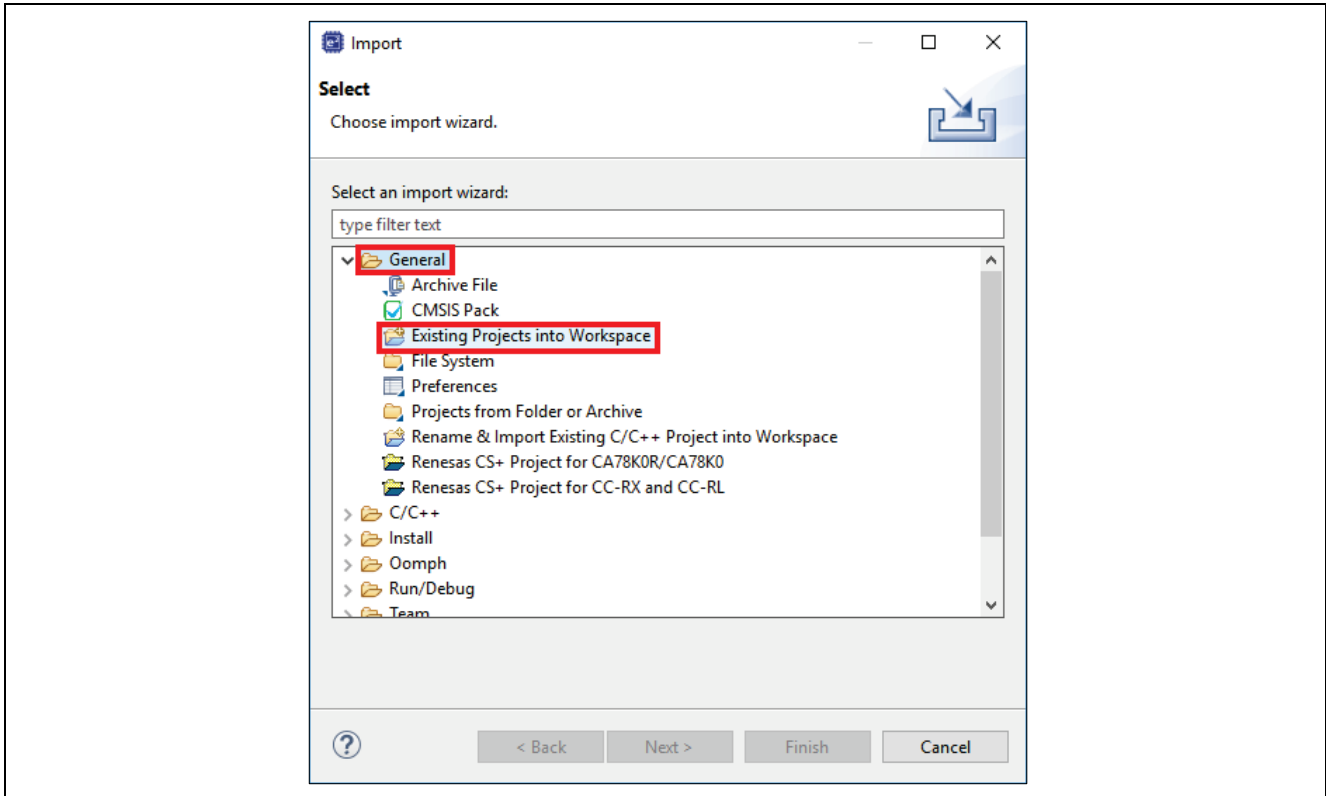


Figure 40. Importing Existing Projects into the Workspace

7. Click **Next**.

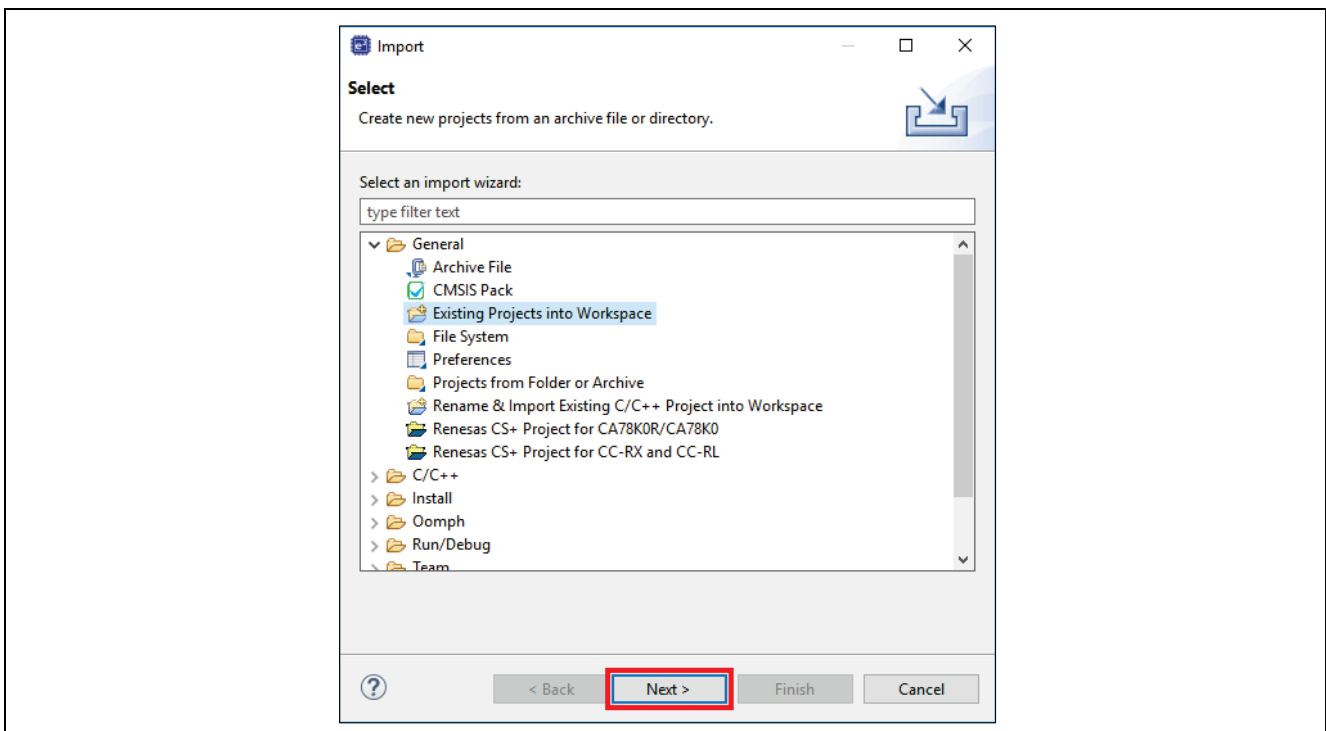


Figure 41. Clicking Next to Import Existing Projects into the Workspace

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

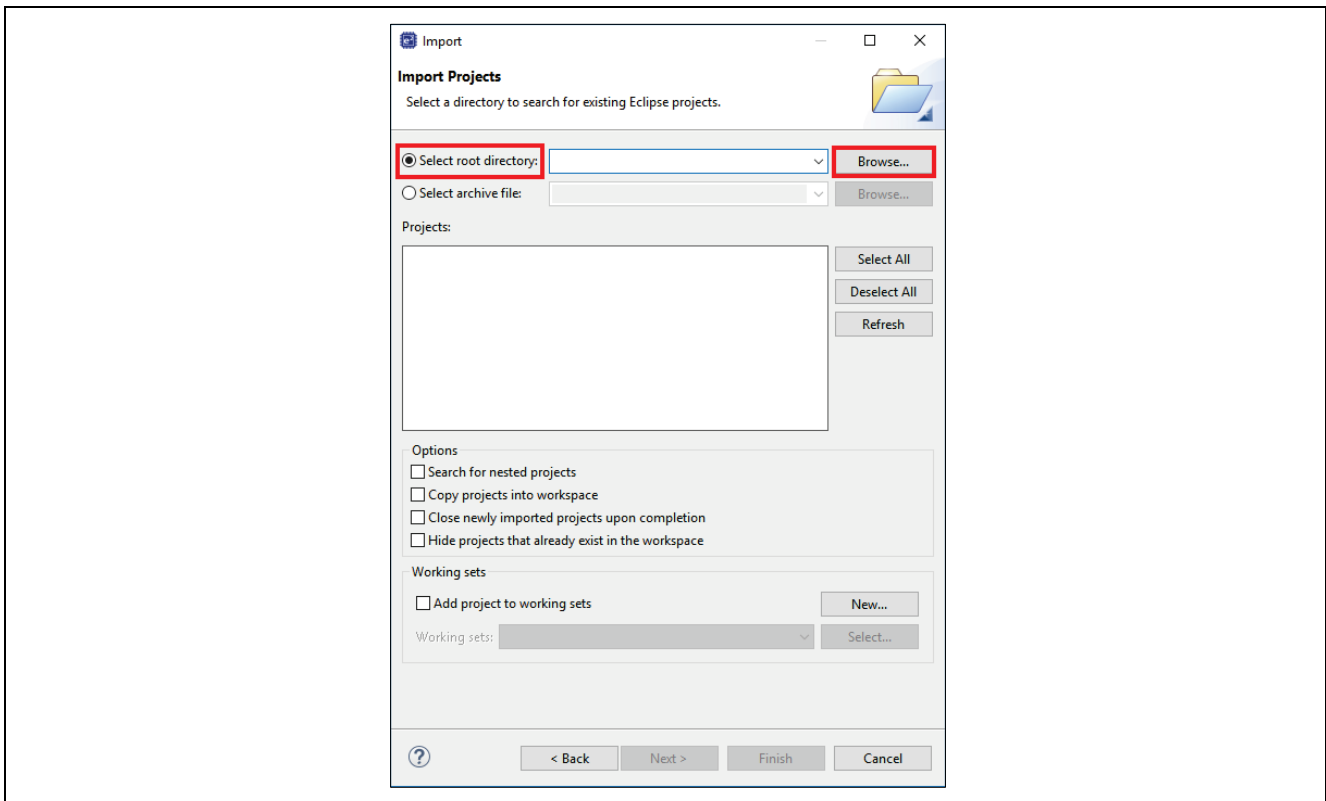


Figure 42. Selecting the Root Directory

- Select the Quick Start example project and click **Finish**.

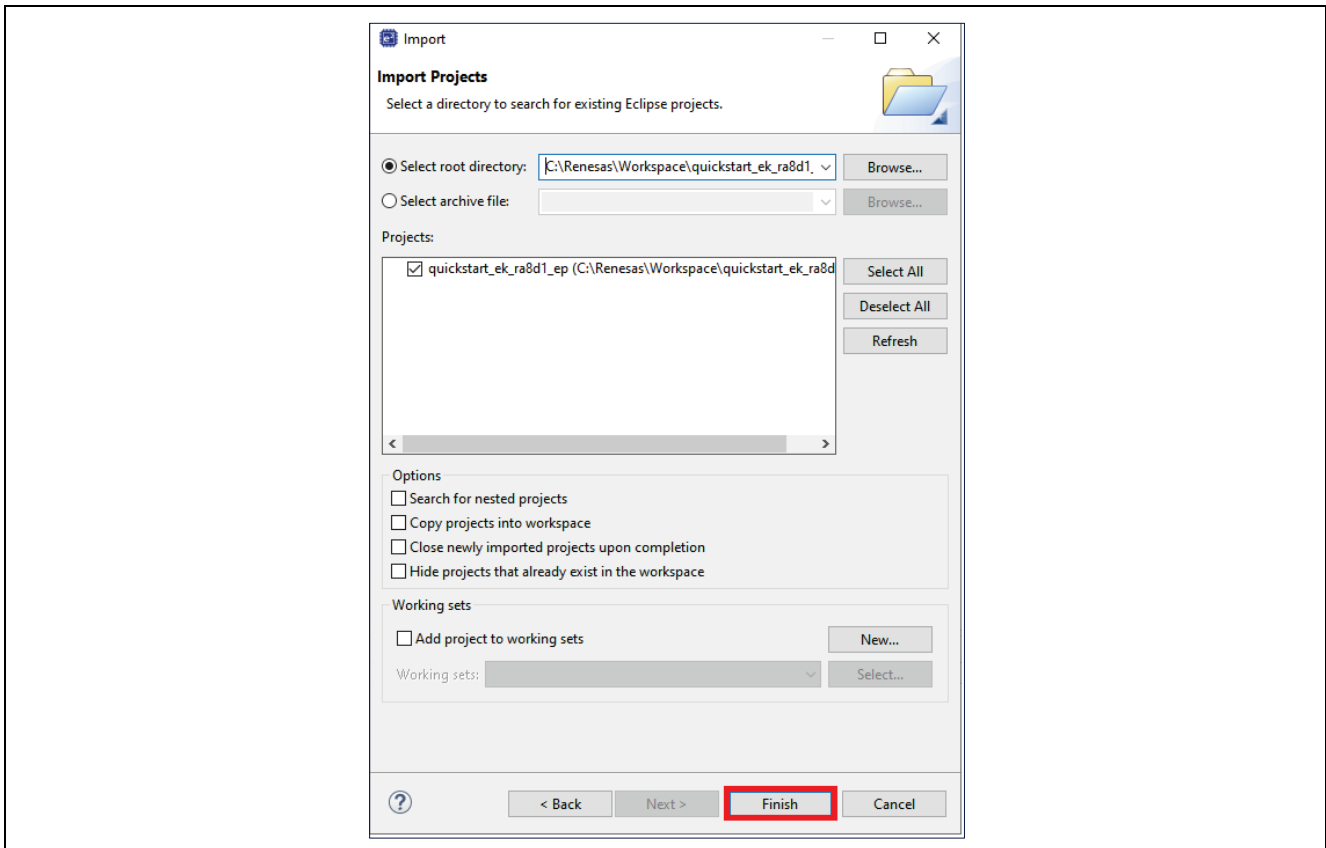


Figure 43. Finishing Importing the Quick Start Example Project

7.3 Modifying, Generating, and Building the Quick Start Example Project

This section provides instructions to modify the Quick Start example project. The Quick Start example 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 made to the Quick Start example project are not prescribed in this QSG. User discretion is advised while modifying the Quick Start example project.

1. Once the Quick Start example 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 the MCU peripherals.

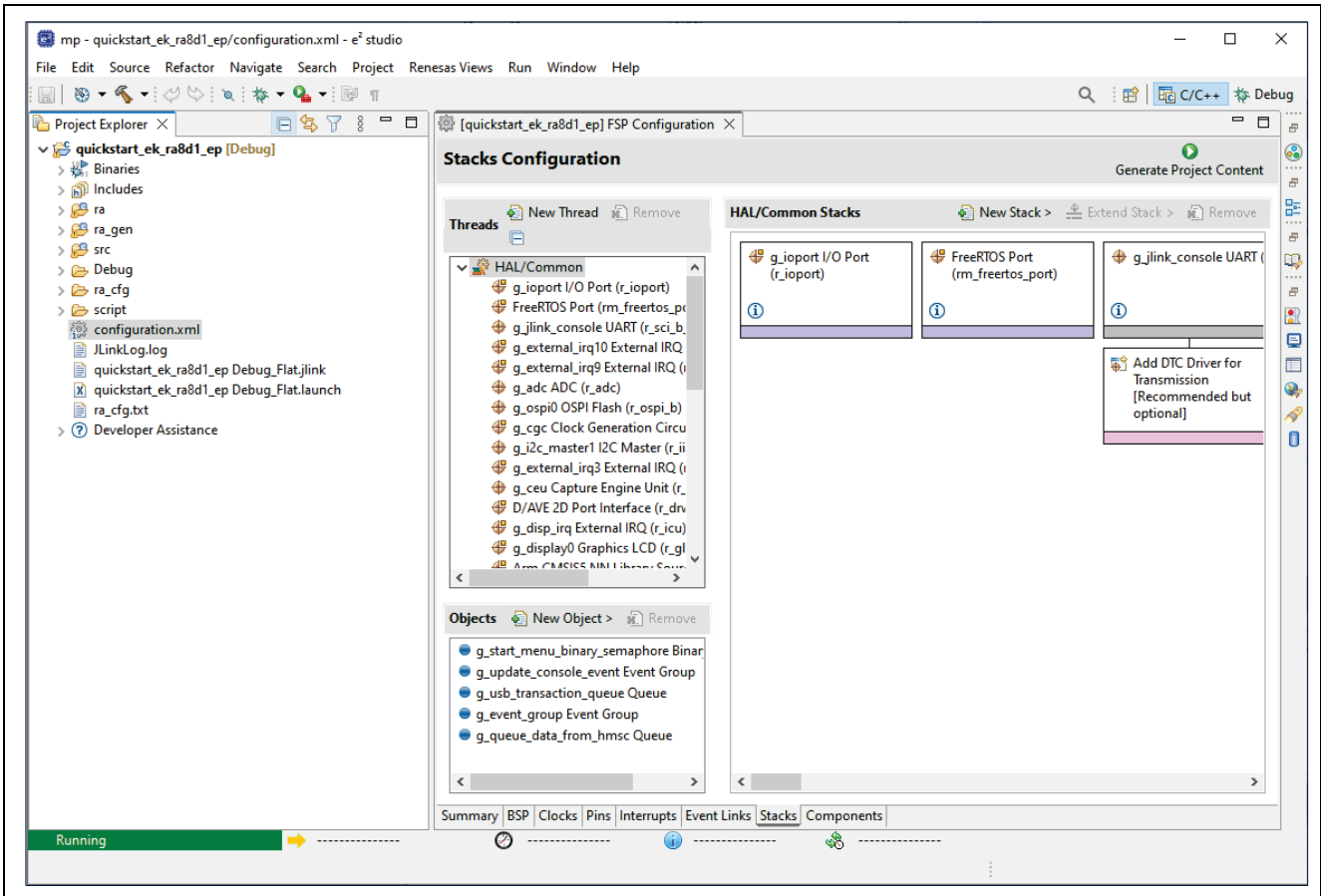


Figure 44. Opening the Configurator

2. For example, in the **Stacks** tab of the configurator, the user can click to select modules to modify the configuration settings, as required, in the **Properties** tab. Figure 46 illustrates modifying the Configuration Settings.

Note: To access the stack component properties, the **view** must be set to **FSP Configuration**. Use the **Open Perspective** button, if necessary.

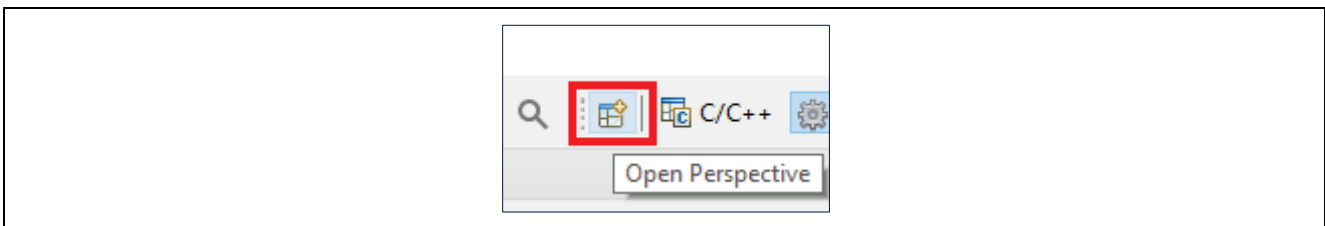


Figure 45. Open Perspective

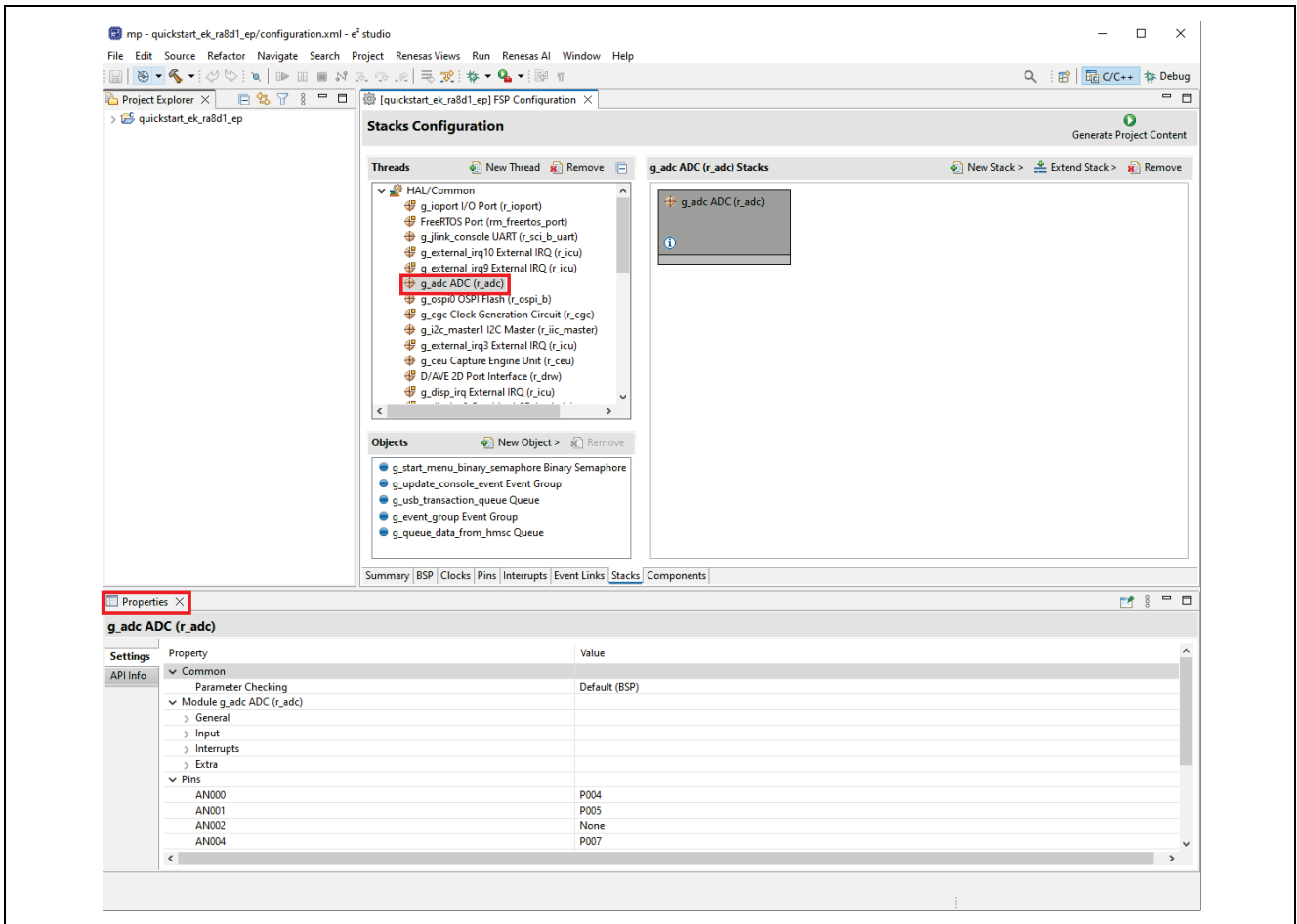


Figure 46. Modifying the Configuration Settings

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

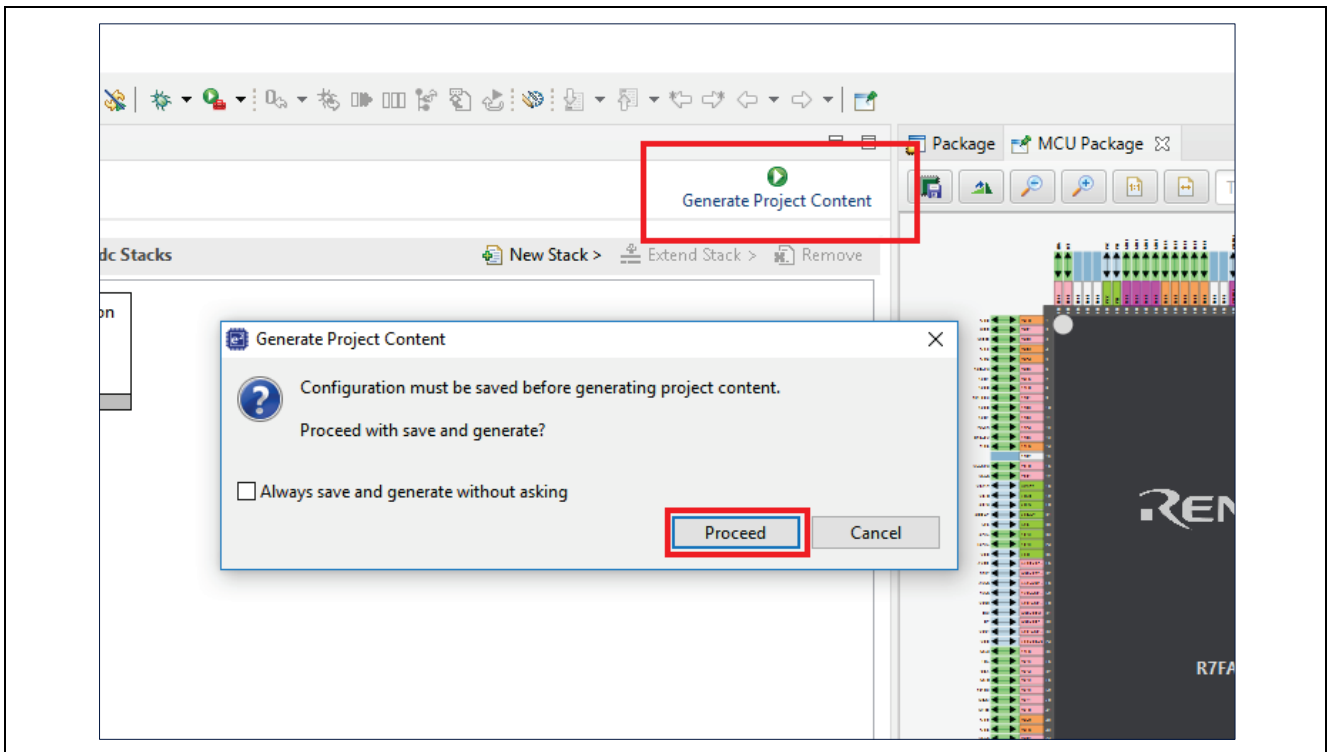


Figure 47. Saving the Configuration Changes

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

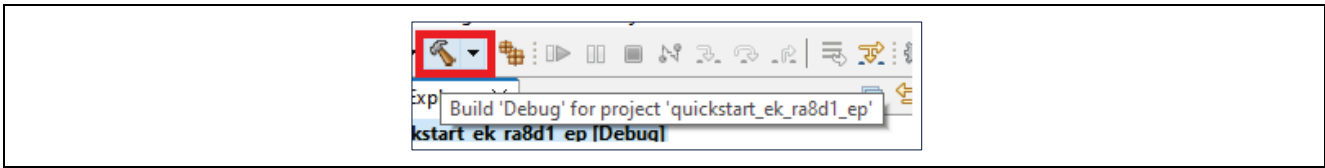


Figure 48. Building the Project

6. A successful build produces an output as follows.

Note: Warnings are acceptable for a successful build whereas errors are not.

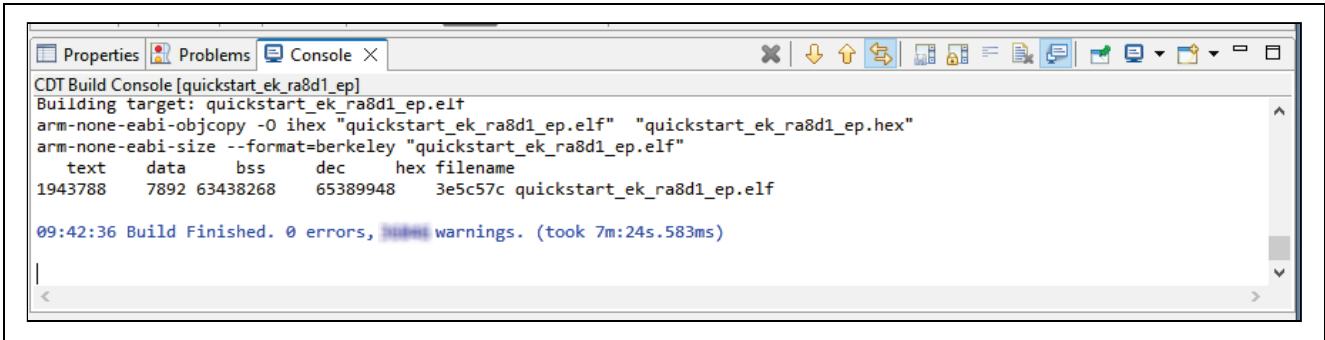


Figure 49. Successful Build Output

7.4 Setting Up Debug Connection between the EK-RA8D1 board and Host PC

To program the modified Quick Start example project on to the EK-RA8D1 board, a debug connection is necessary between the EK-RA8D1 board and host PC. This is provided via J10 that has been used for the serial terminal, so no connection changes are needed.

1. Connect micro USB cable to the debug port (J10) of the EK-RA8D1 board to your PC.

Note: The EK-RA8D1 board supports 3 debugging modes. In this section and the following sections, default debugging mode, Debug On-Board, is used. More information on debugging modes is available in EK-RA8D1 user's manual.

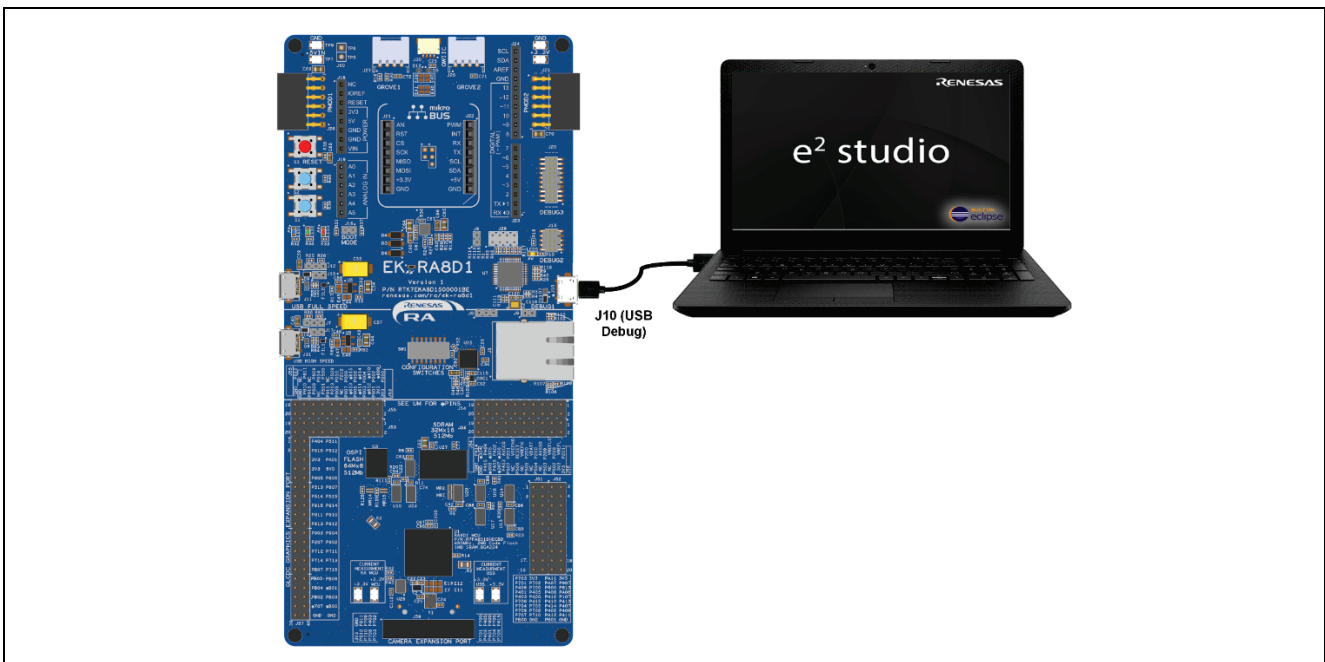


Figure 50. Connecting the EK-RA8D1 Board to the Host PC via USB Debug Port

- Verify that the debug LED (LED5) stops blinking and lights up orange indicating that the J-Link drivers are detected by the EK-RA8D1 board.

Note: The debug LED (LED5) continues to blink when J-Link drivers are not detected by the EK-RA8D1 board. In that case, make sure that the EK-RA8D1 board is connected to the host PC through the micro-B USB debug port (J10) and that J-Link device is detected on the host PC by checking in the Windows Device Manager (expand **Ports (COM & LPT)**, and locate **JLink CDC UART Port**).

7.5 Downloading and Running the Modified Quick Start Example Project

- In e² studio, click the drop-down menu for the debug icon, select **Debug Configurations** option.

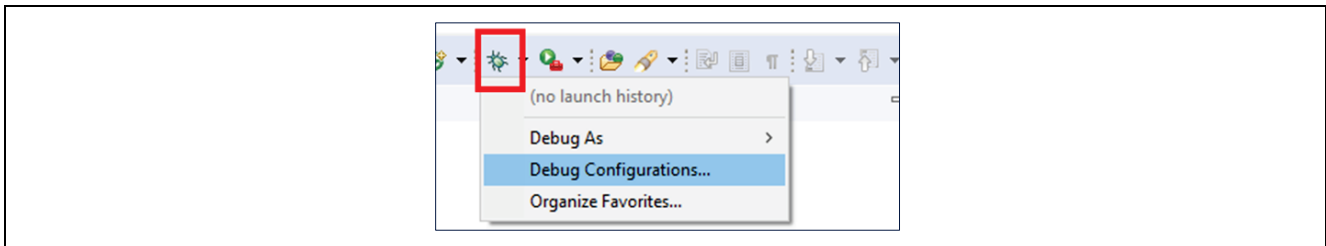


Figure 51. Selecting the Debug Option

- In the dialog on the left-hand pane, expand the **Renesas GDB Hardware Debugging** and select the built image to debug. In this case, the **quickstart_ek_ra8d1_ep Debug_Flat**.

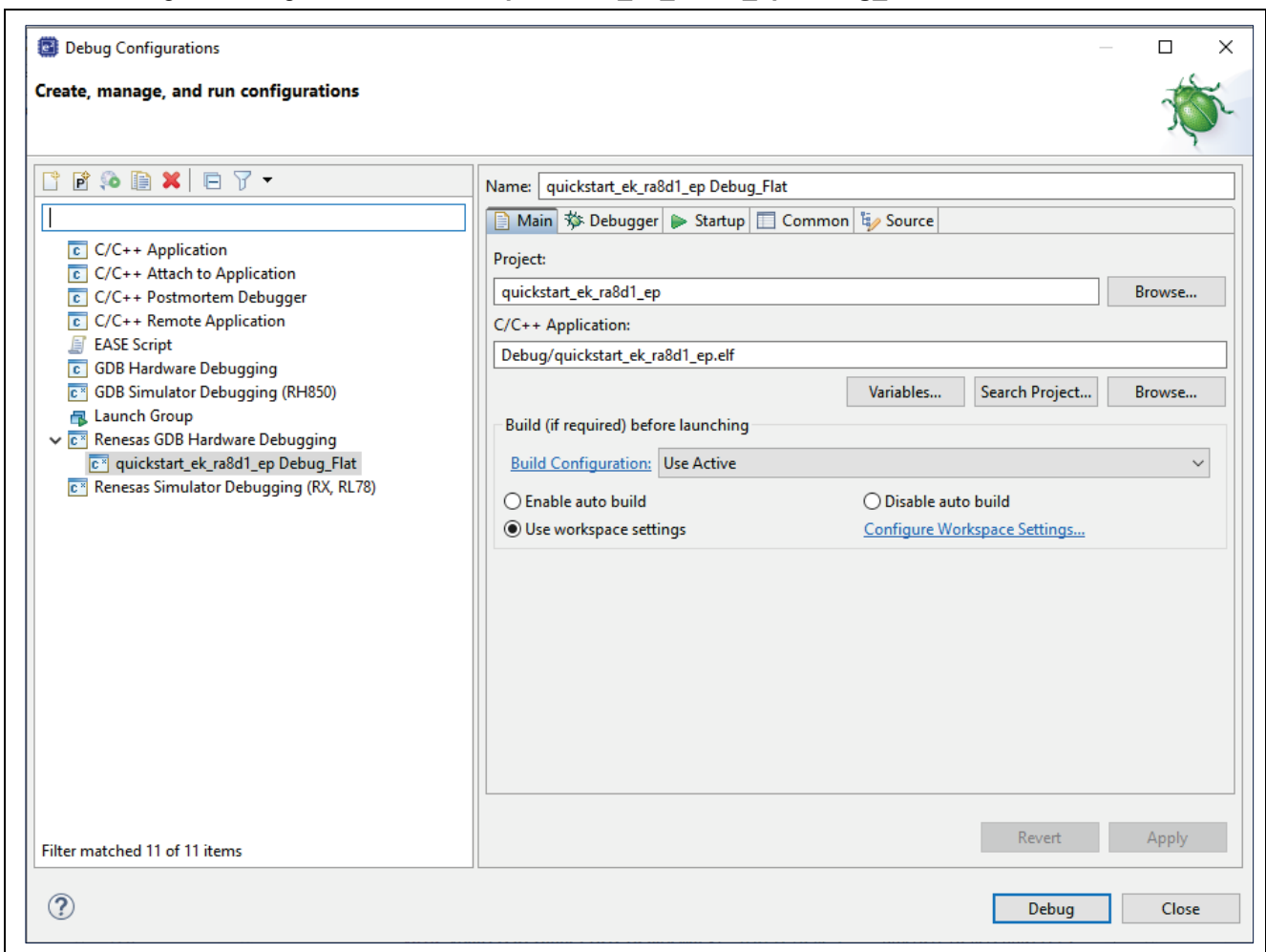


Figure 52. Selecting the Debug Image

- Click **Debug**.

7.6 Firewall Dialog

1. A firewall warning may be displayed for '**e2- server-gdb.exe**'. Check the '**Private networks, such as my home or work network**' box and click '**Allow access**'.
2. A user account control dialog may be displayed. Enter the administrator password and click **Yes**.
3. A dialog box may appear. Click **Switch**.

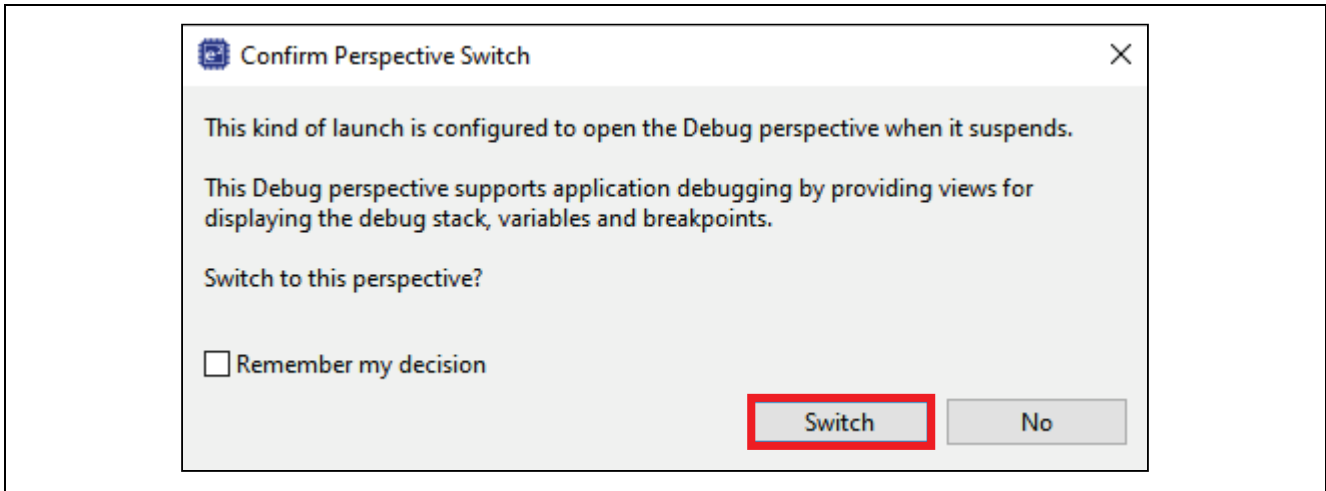


Figure 53. Opening the Debug Perspective

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

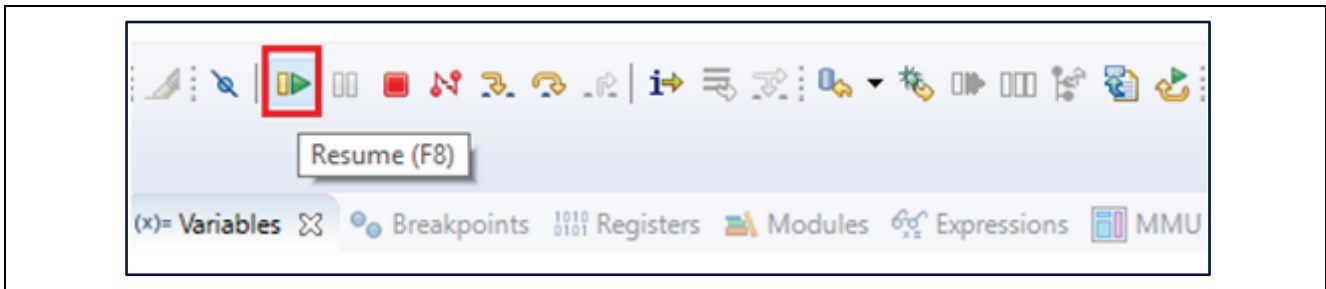


Figure 54. Executing the Project

5. The modified Quick Start example project is programmed into the EK-RA8D1 board and is running. The project can be paused, stopped, or resumed using the debug controls.

8. Next Steps

1. To learn more about the EK-RA8D1 kit, refer to the EK-RA8D1 user's manual and design package available in the Documents and Download tabs respectively of the EK-RA8D1 webpage at renesas.com/ra/ek-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 EK-RA8D1 kit are available in the EK-RA8D1 Example Projects Bundle. The example projects bundle is available in the **Documentation** tab of EK-RA8D1 webpage.
 - Download and extract the example projects bundle (xxxxxxxxxxxxxxxx-ek-ra8d1-exampleprojects.zip) to a local directory on the host PC.
 - Refer to the list of all example projects (xxxxxxxxxxxxxxxx-ek-ra8d1-exampleprojects.pdf) available inside the example projects bundle.
 - Browse to the desired example project (for example: adc_ek_ra8d1_ep) in the example projects bundle (xxxxxxxxxxxxxxxx-ek-ra8d1-exampleprojects\ek_ra8d1\adc\adc_ek_ra8d1_ep)
 - For help on using example projects, refer to Example Project Usage Guide.pdf in the RA Example Repository on GitHub at: github.com/renesas-ra/fsp-examples/tree/master/example_projects
 - The archived versions of the source code of the example projects are available in the example project repository.

9. 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.

EK-RA8D1 Resources	renesas.com/ra/ek-ra8d1
RA kits information	renesas.com/ra/kits
RA Product Information	renesas.com/ra
RA Product Support Forum	renesas.com/ra/forum
RA Videos	renesas.com/ra/videos
RA Kit Feedback and Feature Request	renesas.com/ra/kitfeedback
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Dec.06.23	—	Initial release
1.01	Jan.25.24	30 35, 36, 39	Updated Figure 46. Updated content in sections 7.2, 7.4, 8.

EK-RA8D1 – Quick Start Guide

Publication Date: Jan.25.24

Published by: Renesas Electronics Corporation

EK-RA8D1 – Quick Start Guide