

RA4L1 Group

Renesas Solution Starter Kit Capacitive Touch Evaluation System Quick Start Guide

Renesas RA Family
RA4 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>).

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.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
15. 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

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/.

Trademarks

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

Renesas RTK0EG0057S01001BJ Disclaimer

By using this RTK0EG0057S01001BJ, 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 RTK0EG0057S01001BJ is not guaranteed to be error free, and the entire risk as to the results and performance of the RTK0EG0057S01001BJ is assumed by the User. The RTK0EG0057S01001BJ 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 RTK0EG0057S01001BJ to be a finished product and therefore the RTK0EG0057S01001BJ 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 RTK0EG0057S01001BJ. 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 RTK0EG0057S01001BJ, 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

RA4L1 Group Capacitive Touch Evaluation System Quick Start Guide

Contents

1.	Introduction.....	3
1.1	Assumptions and Advisory Notes.....	3
2.	Contents.....	3
3.	Overview of the Quick Start Example Project.....	4
3.1	Quick Start Example Project Flow.....	4
4.	Running the Quick Start Example Project.....	5
4.1	Connecting and Powering Up the Board.....	6
4.2	Running the Quick Start Example Project.....	7
5.	Customizing the Quick Start Example Project.....	8
5.1	Downloading and Installing Software Development Tools.....	8
5.2	Downloading and Importing the Quick Start Example Project.....	8
5.3	Modifying, Generating, and Building the Quick Start Example Project.....	12
5.4	Setting Up Debug Connection between the RA4L1 Cap Touch CPU Board and Host PC.....	15
5.5	Downloading and Running the Modified Quick Start Example Project.....	16
6.	Next Steps.....	18
7.	Website & Support.....	18

Figures

Figure 1. Quick Start Example Project Flow	4
Figure 2. Connecting and Powering Up the Board	6
Figure 3. USB Serial Device in Windows Device Manager	6
Figure 4. Board default settings	7
Figure 4. Creating a New Workspace	8
Figure 5. Launching the Workspace	8
Figure 6. Importing the Project	9
Figure 7. Importing Existing Projects into the Workspace	9
Figure 8. Clicking Next to Import Existing Projects into the Workspace.....	10
Figure 9. Selecting the Root Directory.....	10
Figure 10. Finishing Importing the Quick Start Example Project.....	11
Figure 11. Opening the Configurator	12
Figure 12. Modifying the Configuration Settings.....	13
Figure 13. Saving the Configuration Changes.....	13
Figure 14. Building the Project.....	14
Figure 15. Successful Build Output	14
Figure 16. Connecting the RA4L1 Cap Touch CPU Board to a Host PC using J-Link OB	15
Figure 16. Selecting the Debug Configurations	16
Figure 17. Selecting J-Link ARM Debugger	16
Figure 18. Selecting the Debug Option	17
Figure 19. Opening the Debug Perspective	17
Figure 20. Executing the Project.....	17

1. Introduction

This Quick Start Guide (QSG) provides:

- An overview of the Quick Start example project that the RA4L1 Capacitive Touch Evaluation System 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 e²studio Integrated Development Environment (IDE).

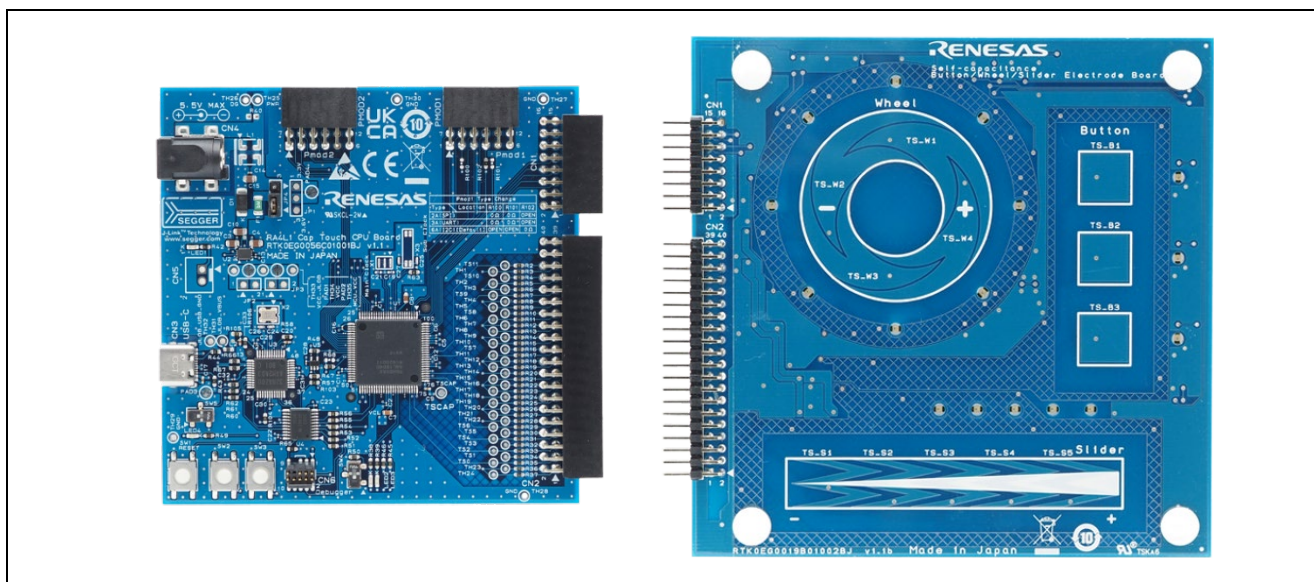
1.1 Assumptions and Advisory Notes

1. Tool experience: It is assumed that the user has prior experience working with IDEs such as e²studio.
2. Subject knowledge: It is assumed that the user has basic knowledge about microcontrollers, embedded systems, FSP, and QE for Capacitive Touch to modify the example project described in this document.
3. 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. Contents

The following components are included in the kit:

1. RA4L1 Cap Touch CPU board (RTK0EG0056C01001BJ)
2. Capacitive Touch Evaluation Application Board
Self-Capacitance Buttons / Wheels / Slider Board (RTK0EG0019B01002BJ)



3. Overview of the Quick Start Example Project

The Quick Start example project detects touch positions from the touch electrodes on the Capacitive Touch Evaluation Application Board which is connected to the Touch CPU board, and lights up the LEDs for the corresponding electrode positions.

3.1 Quick Start Example Project Flow

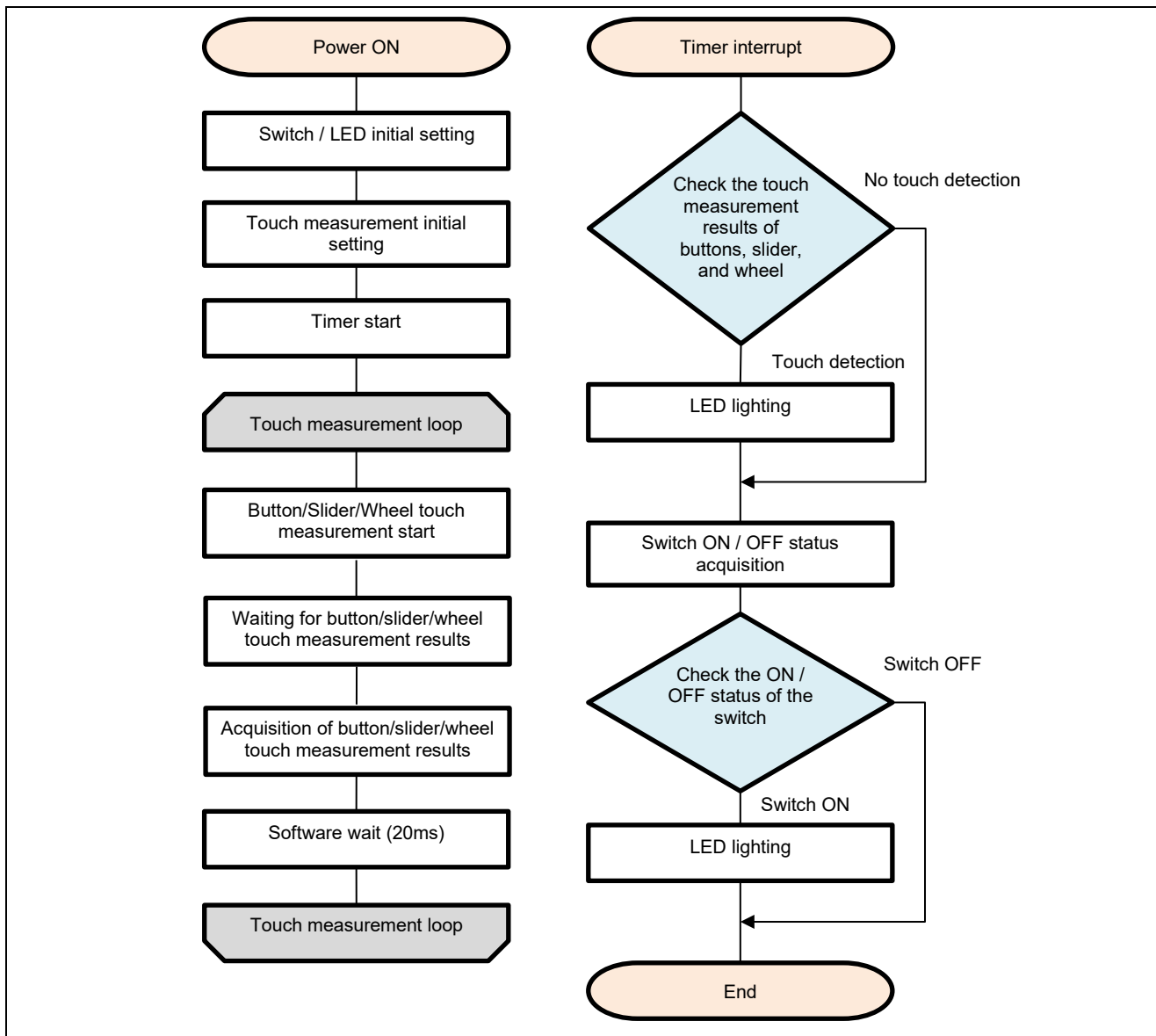


Figure 1. Quick Start Example Project Flow

4. Running the Quick Start Example Project

This section lists the requirements and instructions to power up the RA4L1 CPU board and run the Quick Start example project.

Hardware Requirements:

- RA4L1 Touch CPU board
- Capacitive Touch Evaluation Application Board
 - Self-Capacitance Buttons / Wheel / Slider Board
- One USB Type-A to Type-C or USB Type-C to Type-C cable (Note 1)
- PC with at least one USB port

Note 1: The USB Type-A to Type-C or USB Type-C to Type-C cable is not included in the RTK0EG0057S01001BJ kit, but is required for power supply from the USB port as well as communications between the CPU board and the PC.

Software Requirements:

- Microsoft® Windows® 10 operating system
- e² studio IDE
- FSP
- SEGGER J-Link® USB drivers
- Quick Start example project

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](https://www.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.

4.1 Connecting and Powering Up the Board

1. Connect the CN1 and CN2 headers on the application board to the corresponding CN1 and CN2 connectors on the CPU board. Make sure both headers are inserted to match the direction and number of pins and the pins are fully inserted into the sockets.
2. Insert the MicroB plug end of the USB cable into the CN2 pin on the CPU board, and connect the opposite end of the cable to the USB port on your PC or to a 5V power supply. When the PC is connected, LED1 on the board will light up in red, indicating that the board is powered on.

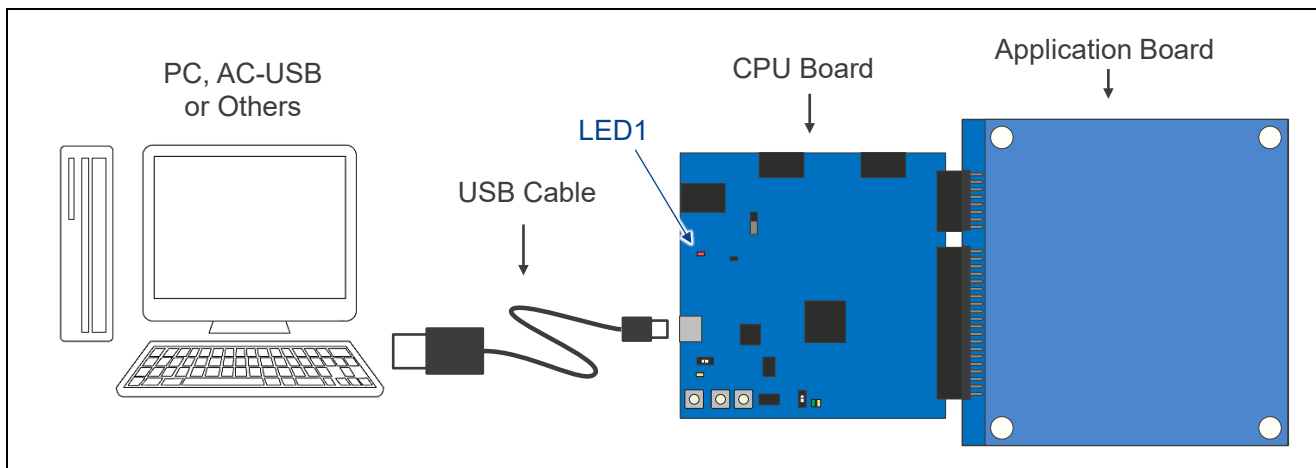


Figure 2. Connecting and Powering Up the Board

Note: When connecting the USB cable to the PC, the USB serial port driver is automatically installed the first time it is connected. Do not remove the USB cable during driver installation. To verify that the USB serial port driver has been successfully installed, open the Windows Device Manager on the host PC. Open the **ports (COM and LPT)** and make sure that the **JLink CDC UART Port (COMxx)** is listed.

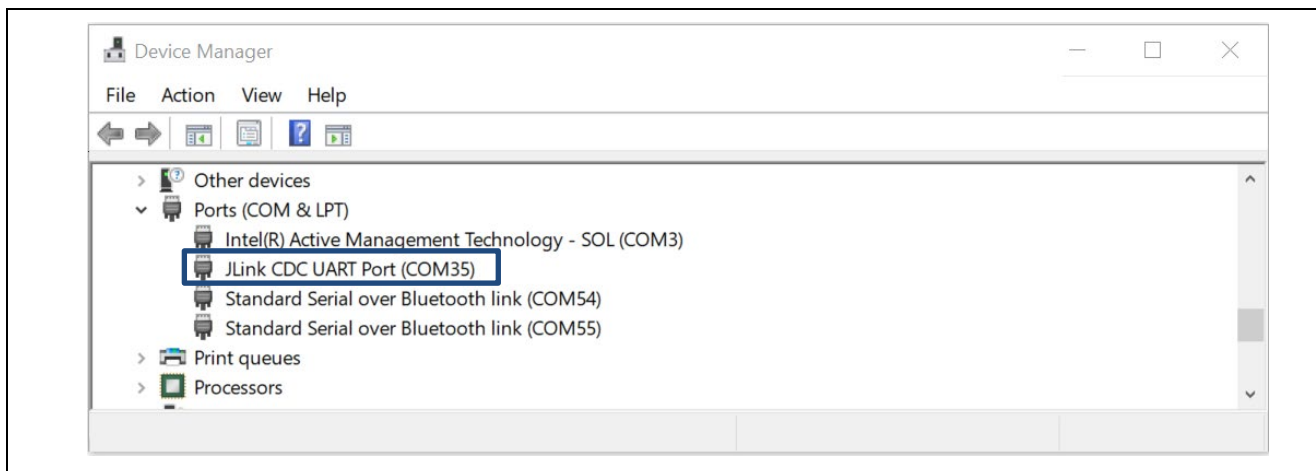


Figure 3. USB Serial Device in Windows Device Manager

4.2 Running the Quick Start Example Project

To run the Quick Start Example Project, use the following instructions:

1. On power up or RESET, After power-up or reset, the CPU board and application board LEDs light up in a pattern. After all the LEDs are turned off, the initial tuning of the touch sensor is executed, and touch detection becomes possible.
2. Touching an electrode will illuminate the associated LED to indicate the touch position.

If the LEDs don't illuminate in response to touch panel operations, make sure the switch and jumpers on the CPU board are set as shown in the following figure. After confirming the correct settings, press the reset button (SW1) to restart operations and check the LEDs again.

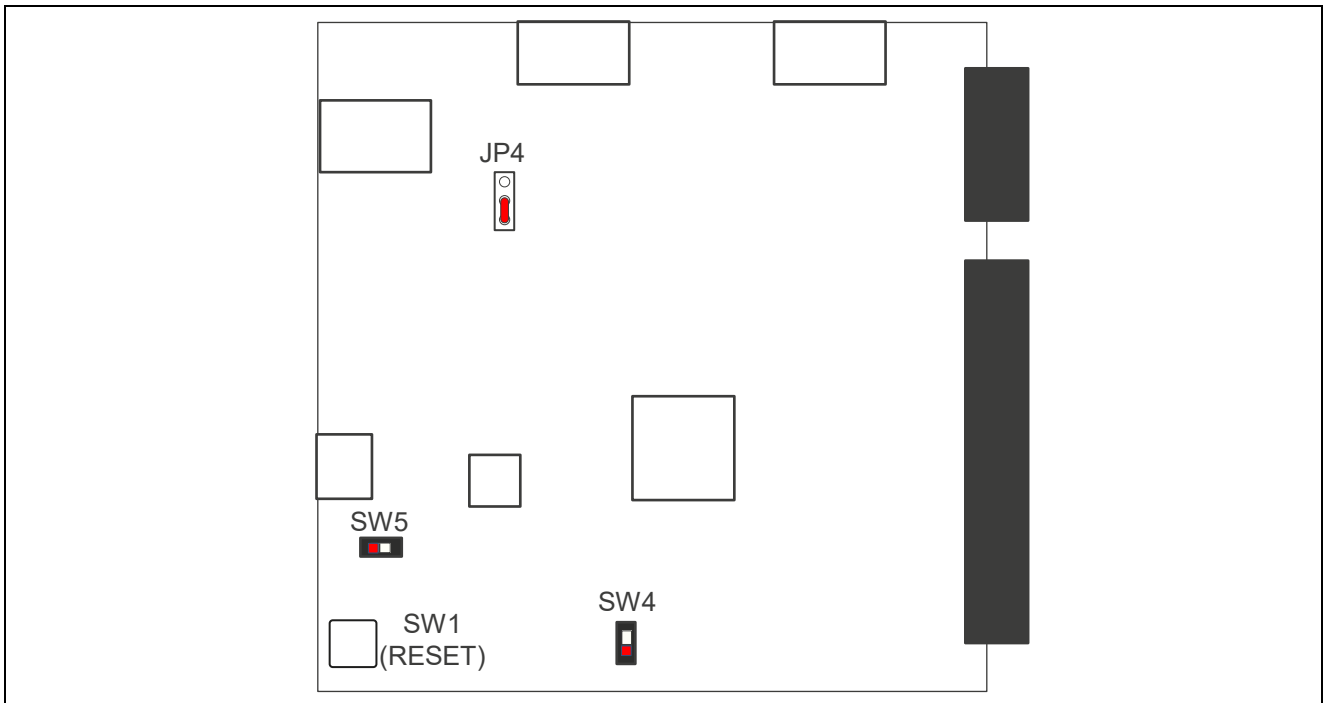


Figure 4. Board default settings

5. Customizing the Quick Start Example Project

This section provides instructions on customizing the Quick Start example project.

5.1 Downloading and Installing Software 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 QE for Capacitive Touch [RA] tool is a capacitive touch sensor development assistance tool necessary for modifying capacitive touch sensor functions. Please download the tool from the following URL and install to the e2studio.

<https://www.renesas.com/qe-capacitive-touch>

5.2 Downloading and Importing the Quick Start Example Project

1. Download the Quick Start example project from [renesas.com/rssk-touch-ra4l1](https://www.renesas.com/rssk-touch-ra4l1).
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.

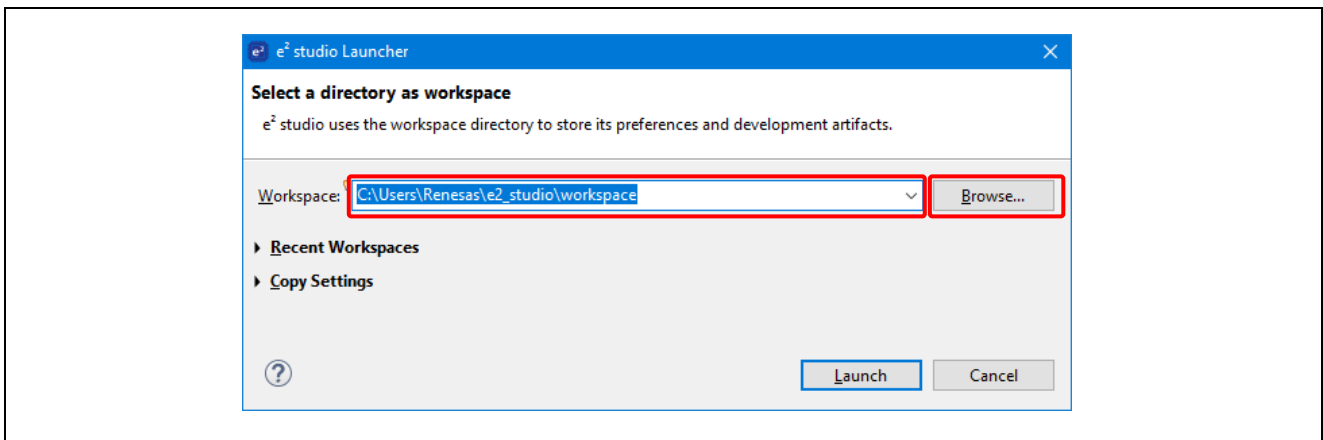


Figure 5. Creating a New Workspace

4. Click **Launch**.

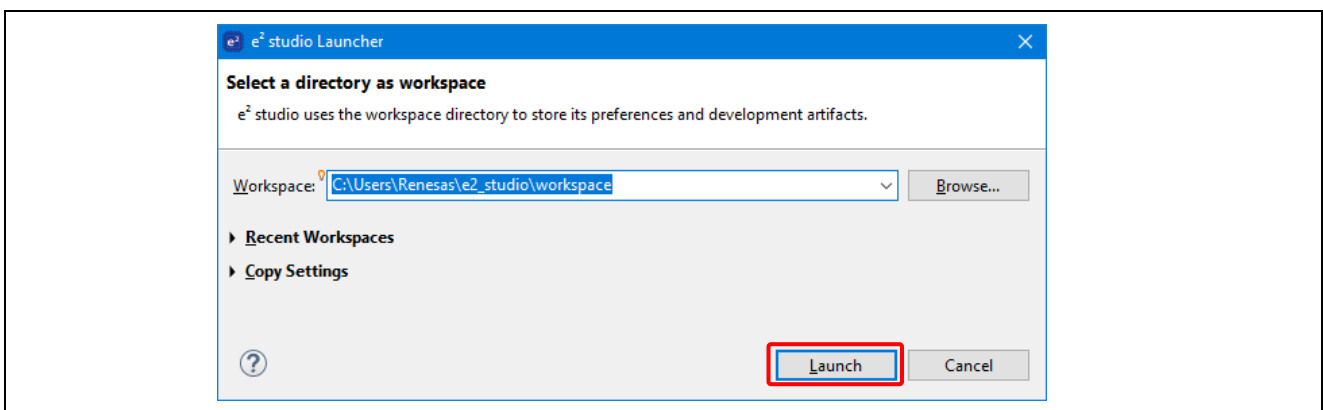


Figure 6. Launching the Workspace

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

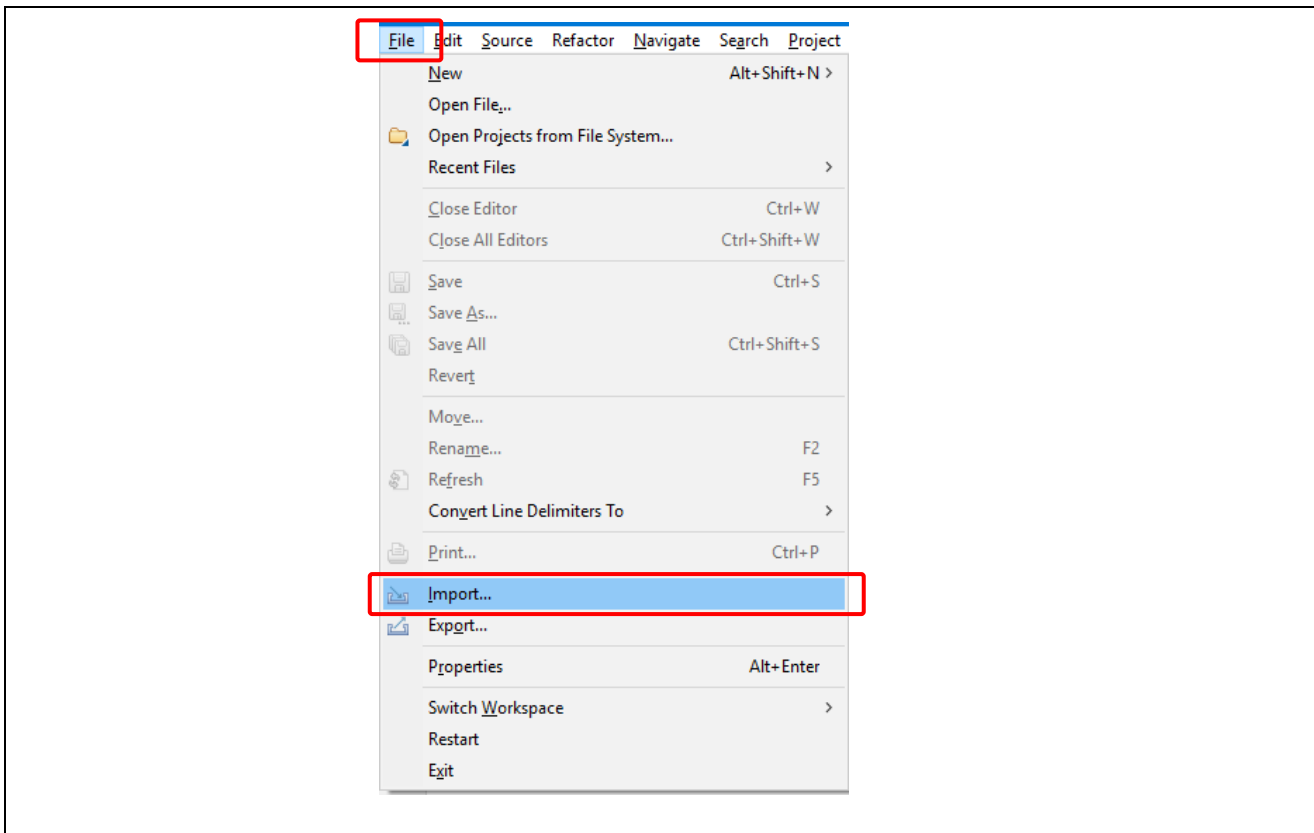


Figure 7. Importing the Project

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

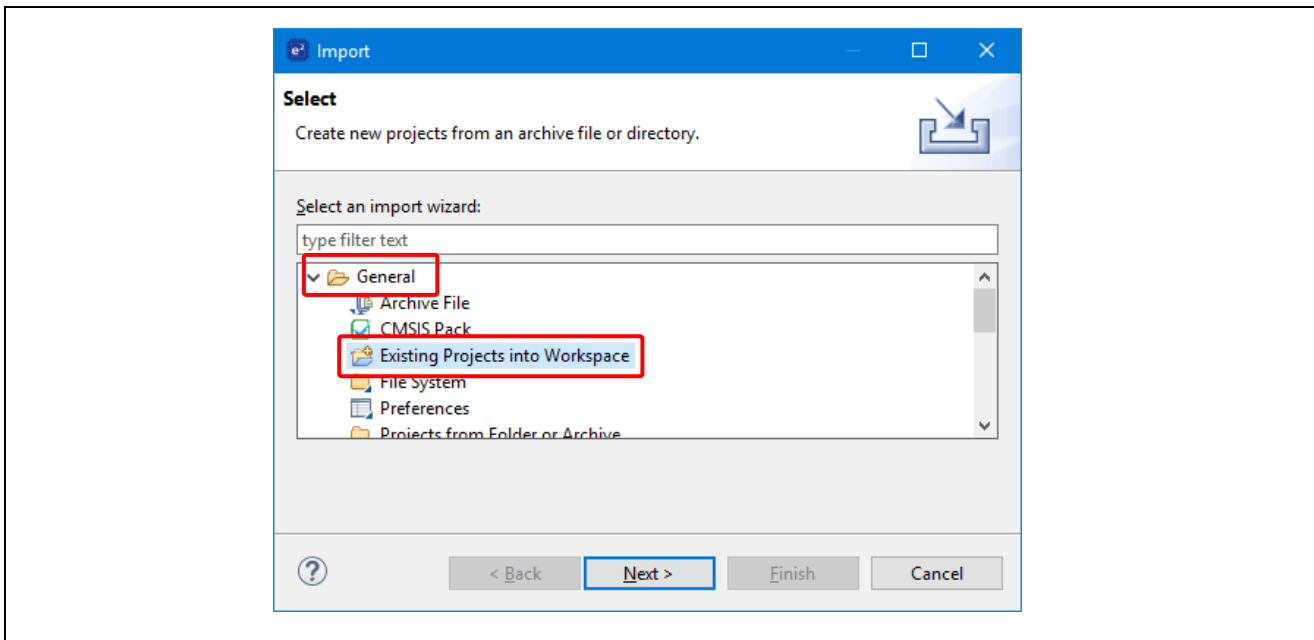


Figure 8. Importing Existing Projects into the Workspace

7. Click **Next**.

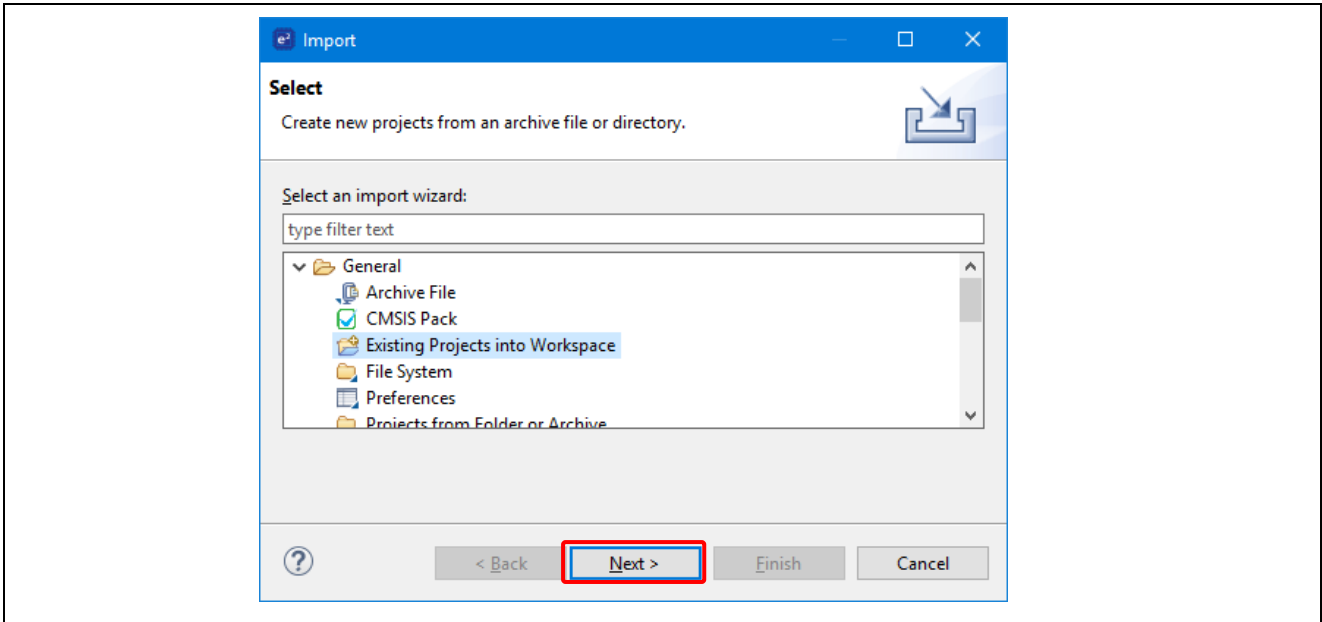


Figure 9. Clicking Next to Import Existing Projects into the Workspace

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

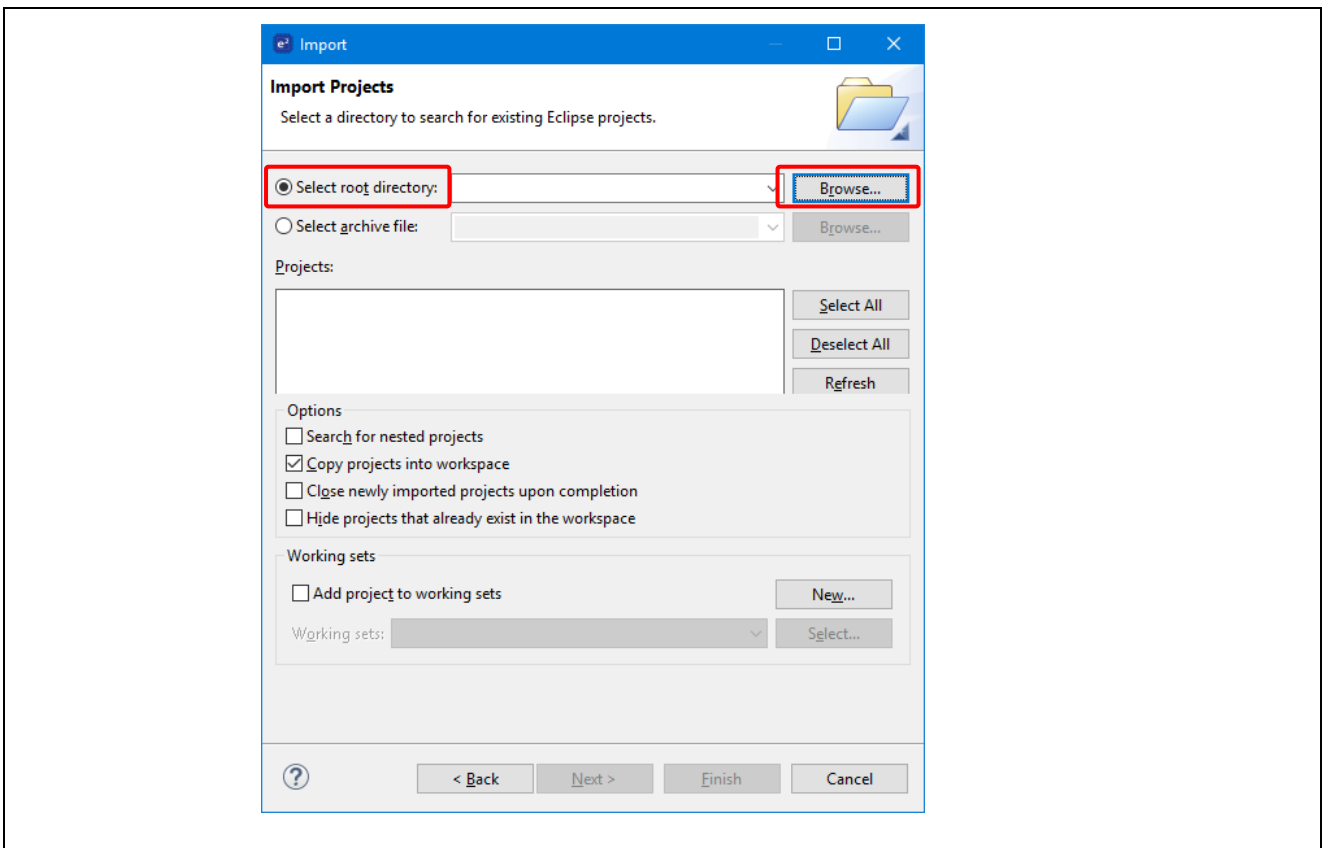


Figure 10. Selecting the Root Directory

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

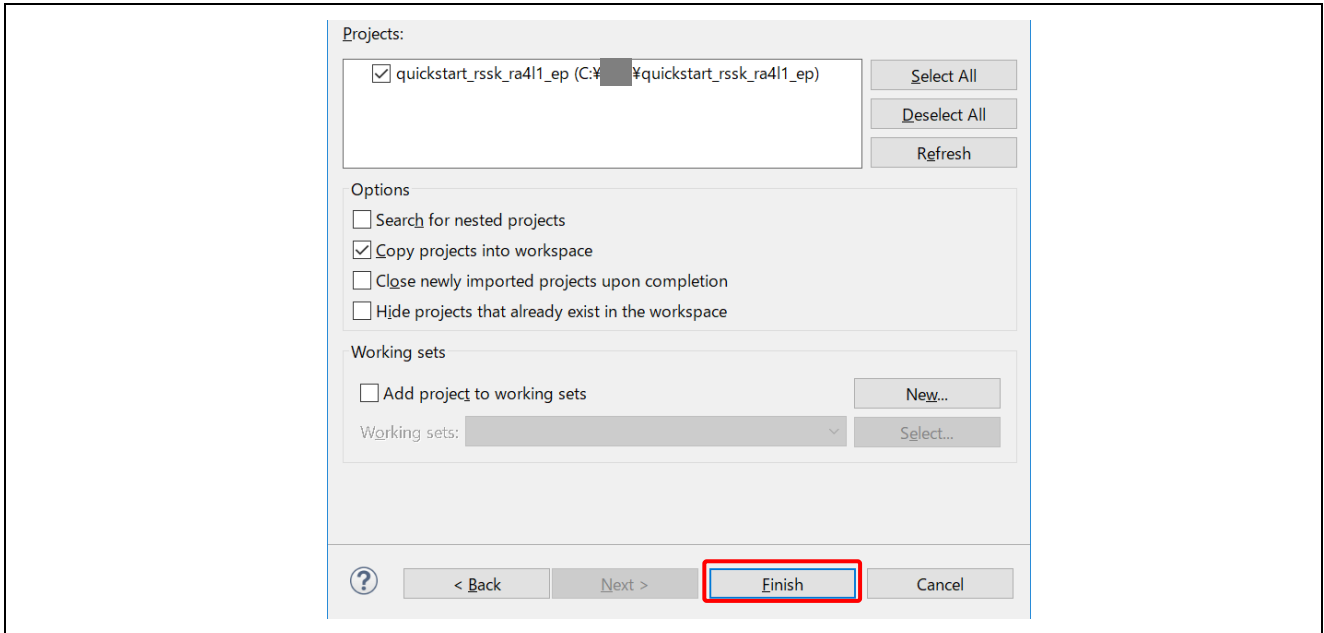


Figure 11. Finishing Importing the Quick Start Example Project

5.3 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 performed 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 MCU peripherals, pins, clocks, and so forth.

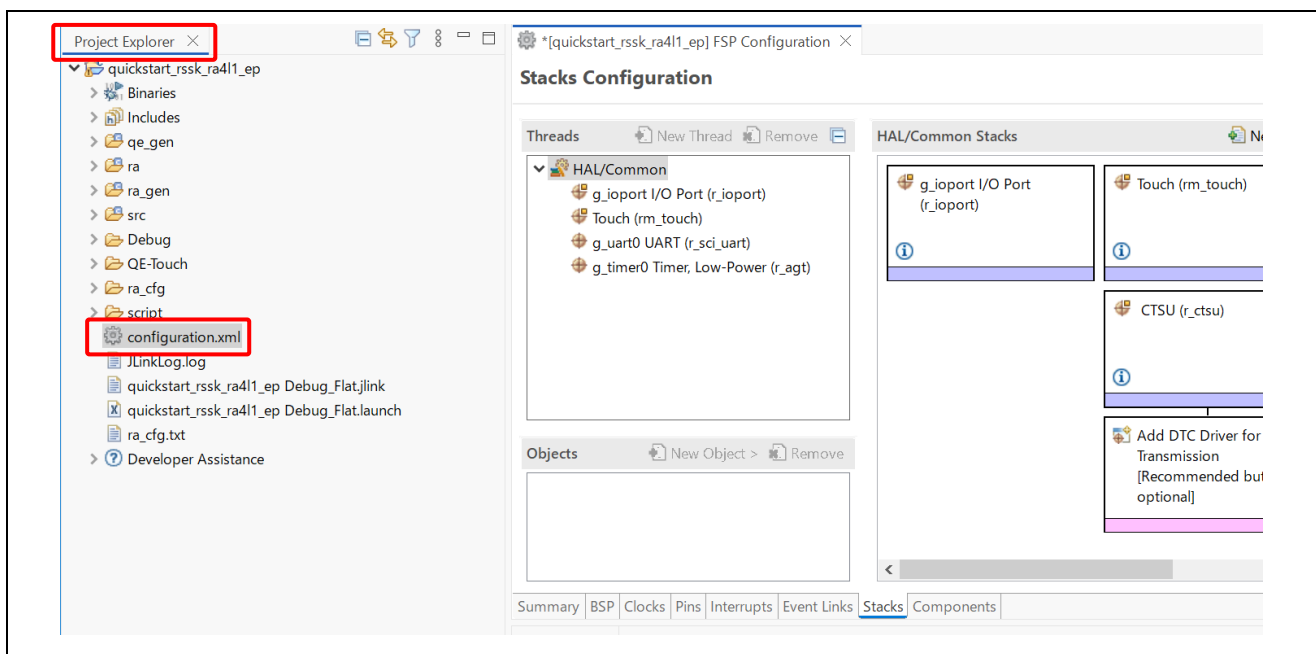


Figure 12. Opening the Configurator

- 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 timer driver configuration.

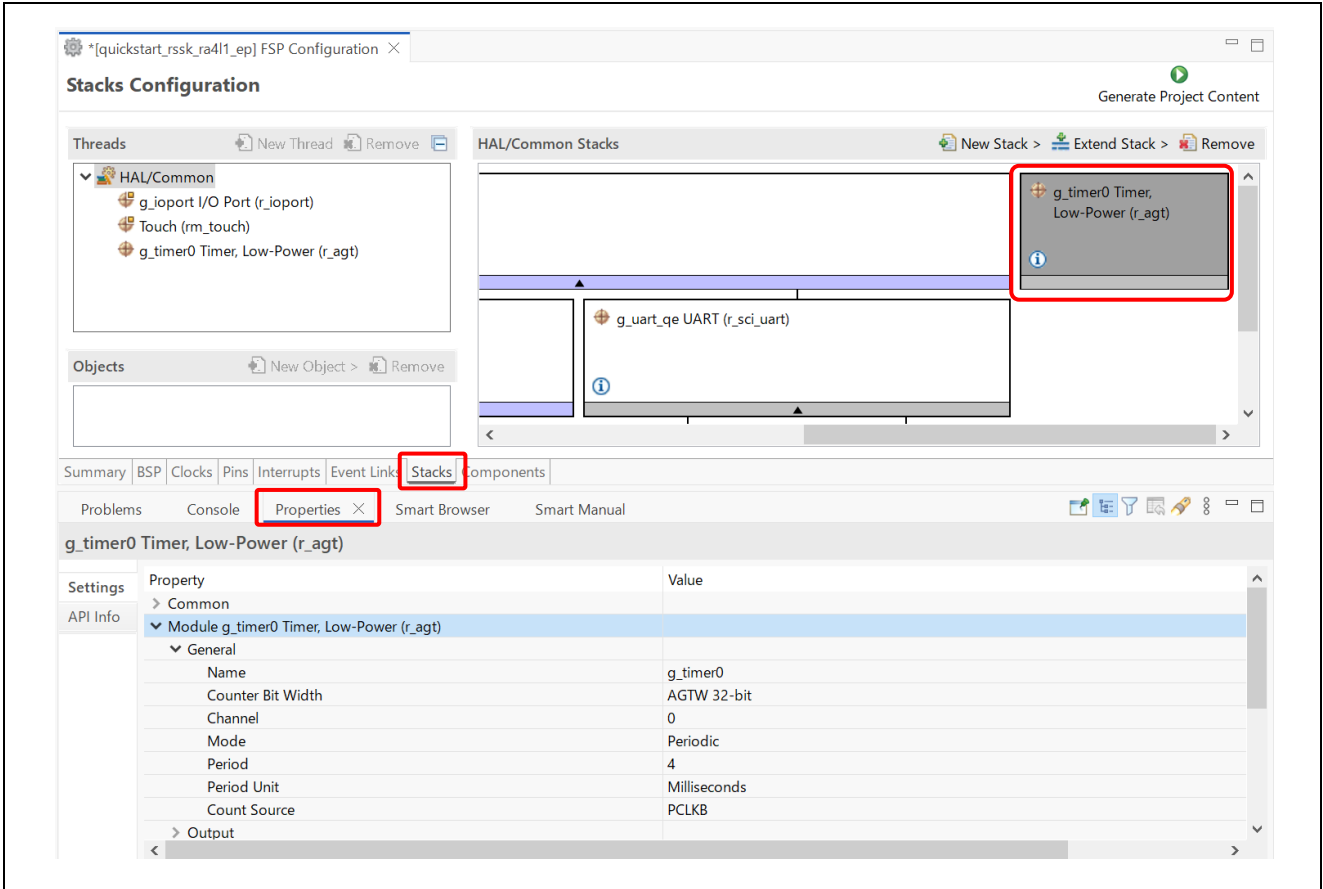


Figure 13. Modifying the Configuration Settings

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

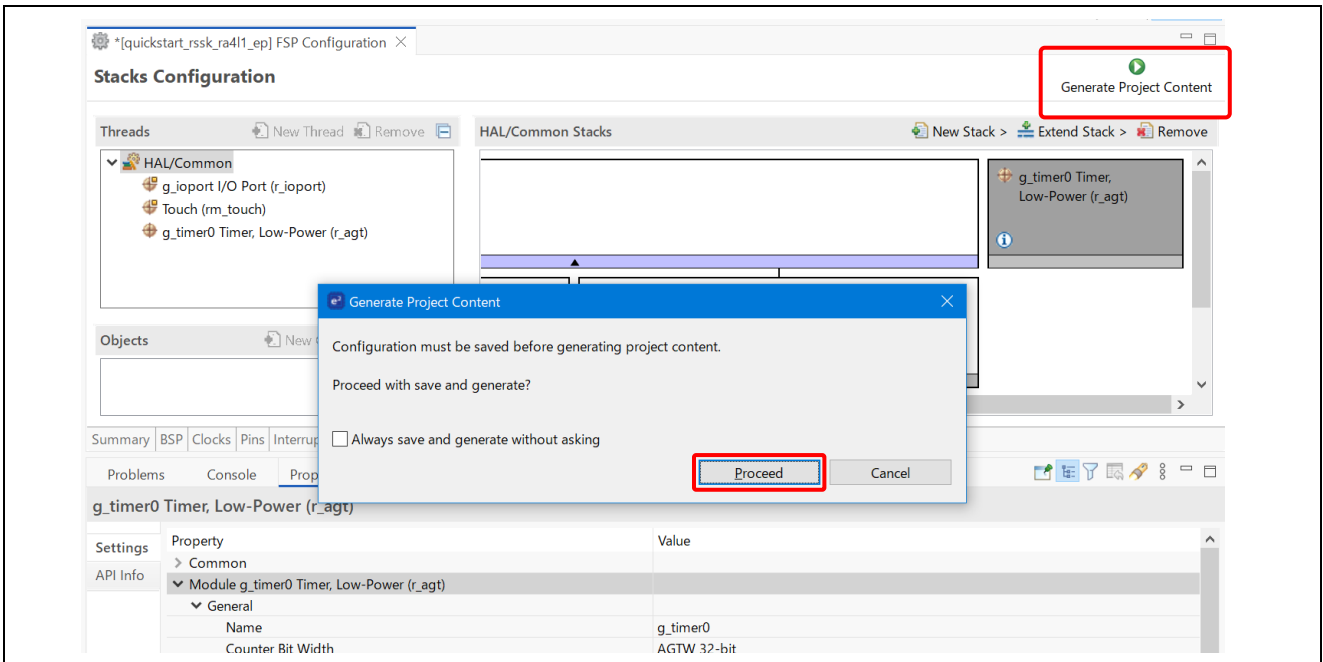


Figure 14. Saving the Configuration Changes

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

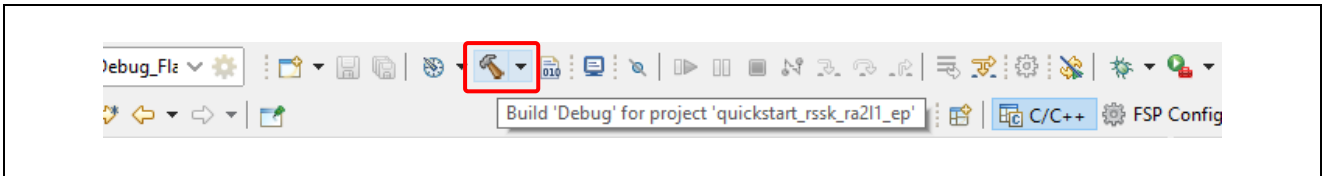


Figure 15. Building the Project

6. A successful build produces an output as follows.

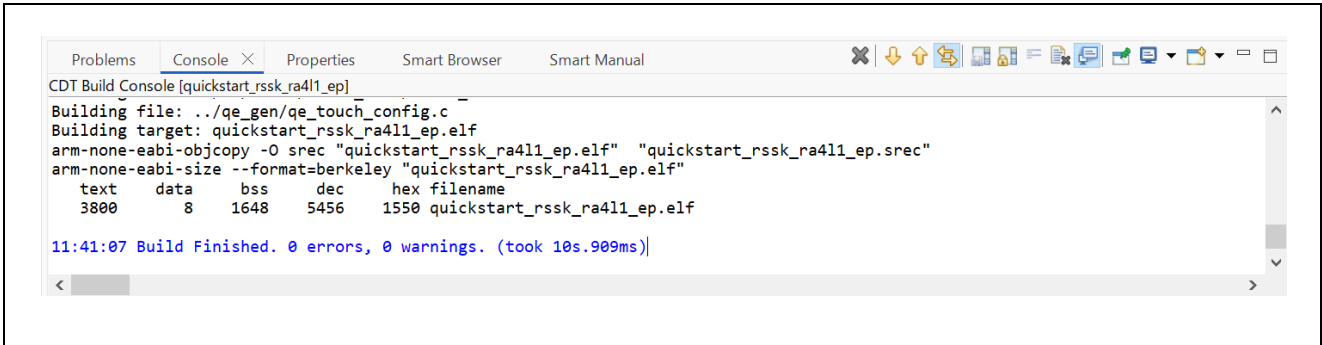


Figure 16. Successful Build Output

5.4 Setting Up Debug Connection between the RA4L1 Cap Touch CPU Board and Host PC

To program the modified Quick Start example project on to the RA4L1 Cap Touch CPU board, a debug connection is necessary between the RA4L1 Cap Touch CPU board and host PC.

1. Connect the USB cable to the USB Type-C connector (CN3) on the RA4L1 Cap Touch CPU board.

Note: The RA4L1 Cap Touch CPU board supports 2 debugging modes. In this section and the following sections, default debugging interface, J-Link onboard (J-Link OB) is used. More information on debugging interface is available in RA4L1 Group Capacitive Touch Evaluation System user's manual.

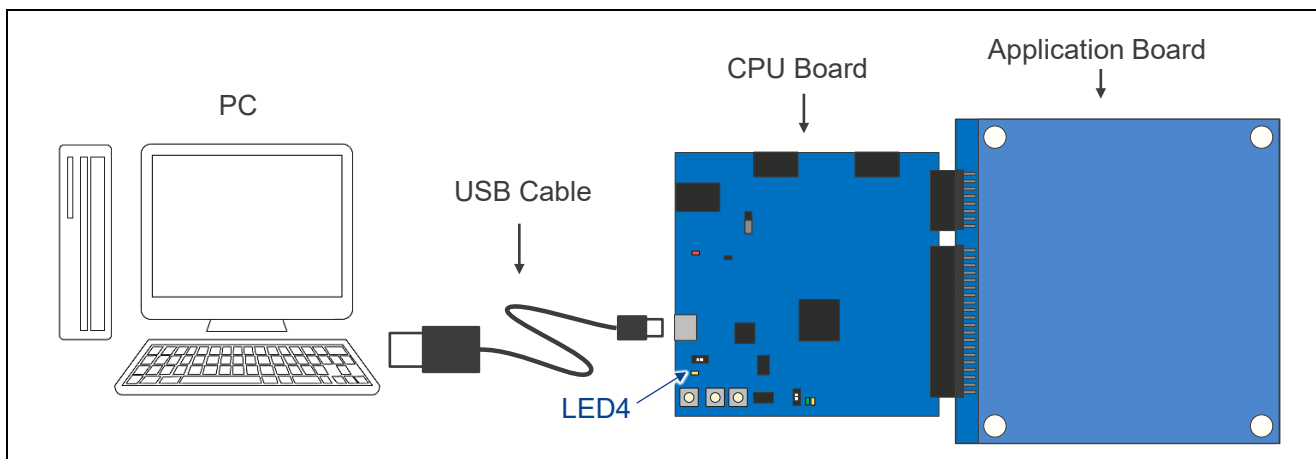


Figure 17. Connecting the RA4L1 Cap Touch CPU Board to a Host PC using J-Link OB

2. Verify that the debug LED (LED4) stops blinking and lights up orange indicating that the J-Link drivers are detected by the RA4L1 Cap Touch CPU board.

Note : The debug LED (LED4) continues to blink when J-Link drivers are not detected by the RA4L1 Cap Touch CPU board. In that case, make sure that the RA4L1 Cap Touch CPU board is connected to the host PC through the USB Type-C onboard debug interface(CN3) 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**).

5.5 Downloading and Running the Modified Quick Start Example Project

In e²studio, click the drop-down menu for the debug icon, select Debug Configurations option.

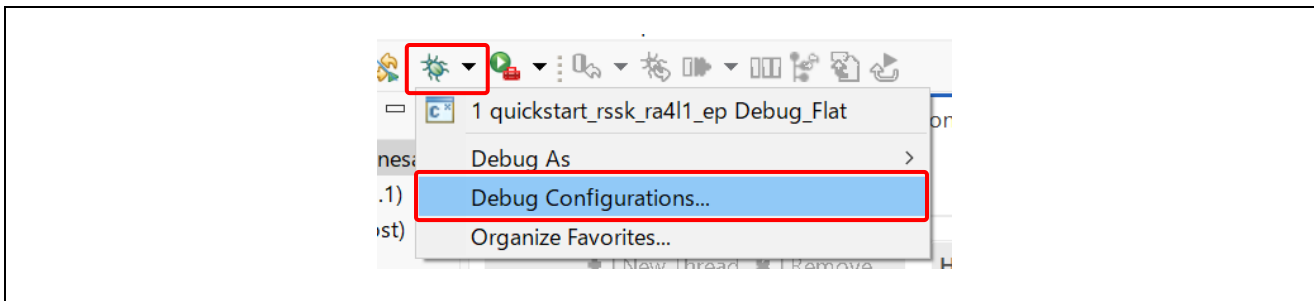


Figure 18. Selecting the Debug Configurations

When the Debug Configurations window opens, click the **Debugger** tab, and select **J-Link ARM** from the Debug hardware drop-down menu. If the Target Device has switched to something other than **R7FA4L1BD**, please reselect **R7FA4L1BD**. After completing the selections, click **Close**. When the Save Modifications dialog box opens, select **YES** to save the new configuration. After your configuration is completed, proceed to step 1.

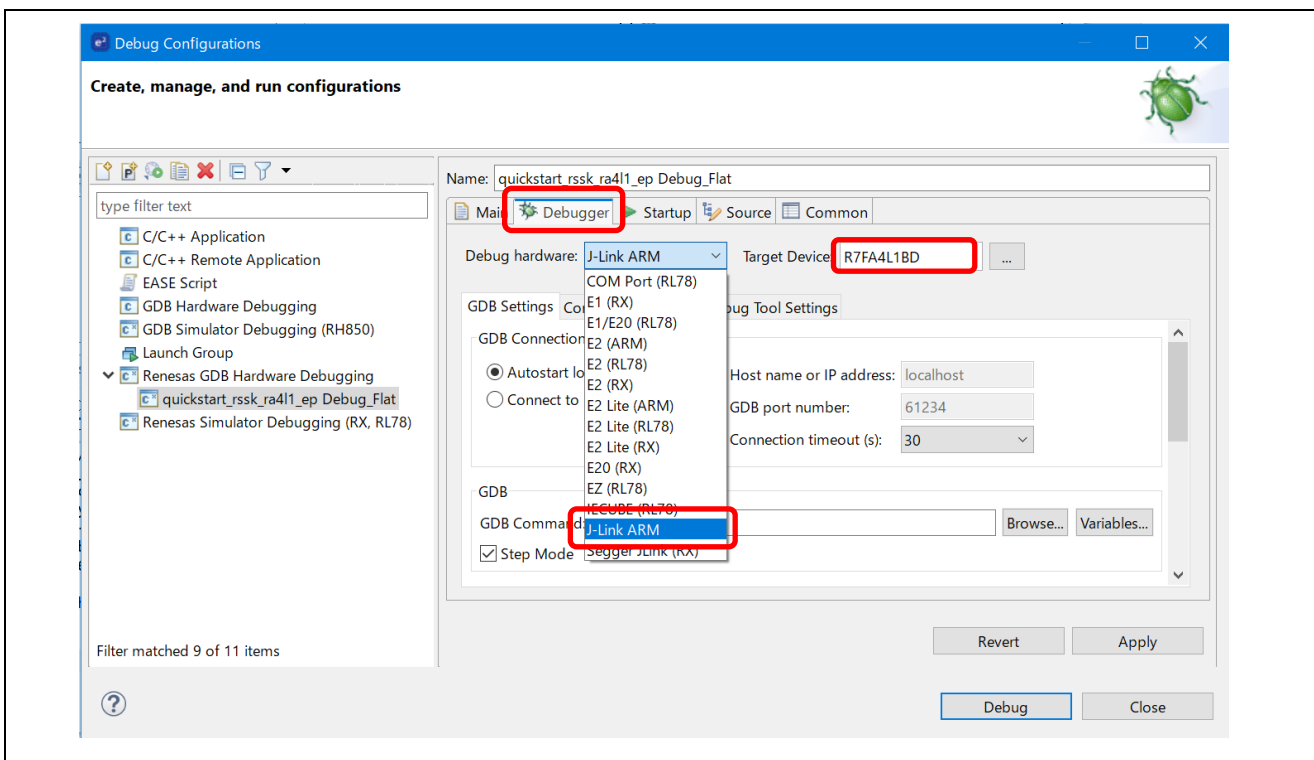


Figure 19. Selecting J-Link ARM Debugger

1. In e2studio, click the drop-down menu for debug icon, select **Debug As** option, and choose **Renesas GDB Hardware Debugging**.

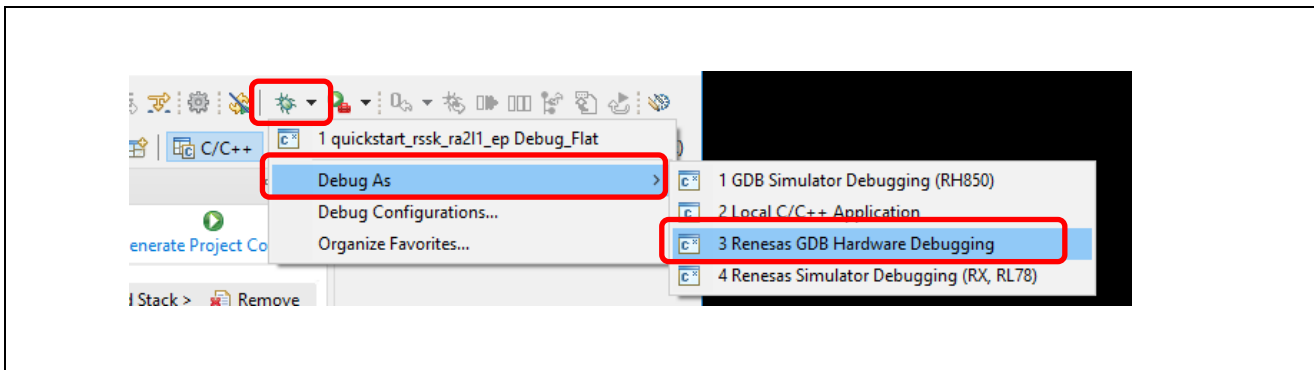


Figure 20. Selecting the Debug Option

2. A dialog box may appear. Click **Switch**.

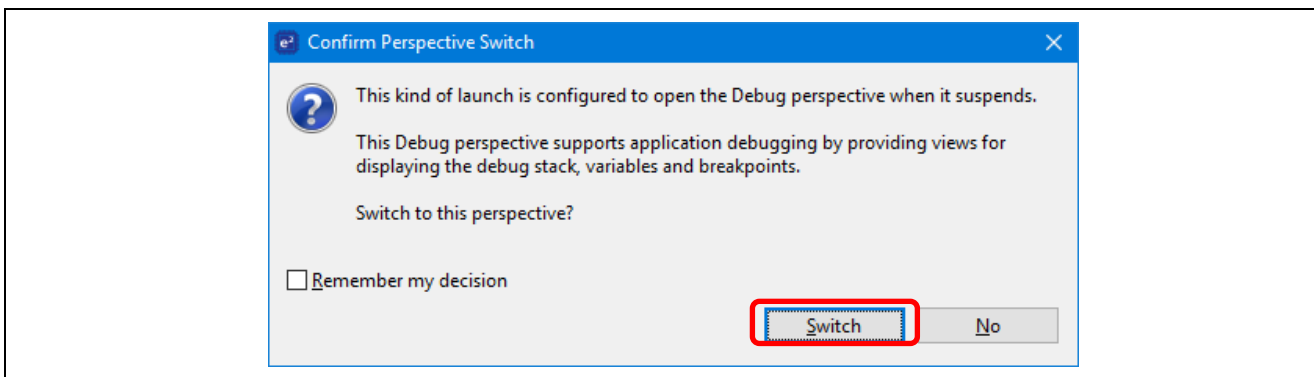


Figure 21. Opening the Debug Perspective

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

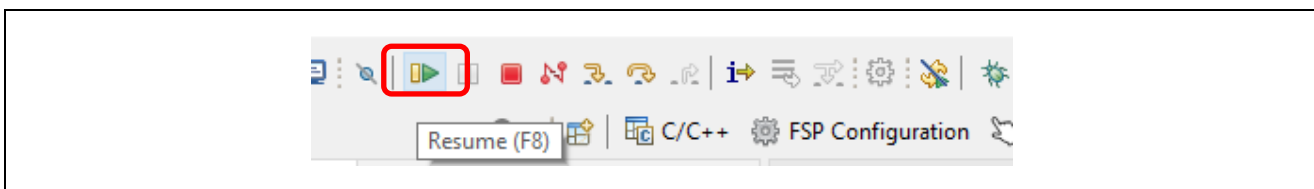


Figure 22. Executing the Project

4. The modified Quick Start example project is programmed into the kit and is running. The project can be paused, stopped, or resumed using the debug controls.

6. Next Steps

1. To learn more about this product, refer to the user's manual and design package available on the RA4L1 Group Capacitive Touch Evaluation System web page at [renesas.com/rssk-touch-ra4l1](https://www.renesas.com/rssk-touch-ra4l1).
2. To learn more about using QE for Capacitive Touch (RA) and FSP to create touch interface for capacitive touch sensors, tune touch sensors, implement touch middleware in an application, and monitoring touch performance, refer to the following application note.

RA Family Using QE and FSP to Develop Capacitive Touch Applications (R01AN4934)
<https://www.renesas.com/us/en/document/apn/using-qe-and-fsp-develop-capacitive-touch-applications?r=1398061>

3. For more information about quickstart sample project, refer to the following application note.

RA4L1 Group Capacitive Touch Evaluation System Sample Code (R20AN0785)
<https://www.renesas.com/search?keywords=r20an0785>

7. Website & Support

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

RTK0EG0057S01001BJ Resources	renesas.com/rssk-touch-ra4l1
RA Product Information	renesas.com/ra
RA Product Support Forum	renesas.com/ra/forum
Renesas Support	renesas.com/support
Renesas Capacitive Touch Key Portal	renesas.com/solutions/touch-key

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb.19.25	-	First release

RA4L1 Group Renesas Solution Starter Kit
Capacitive Touch Evaluation System Quick Start Guide

Publication Date: Rev.1.00 Feb.19.25

Published by: Renesas Electronics Corporation

Renesas RA4L1 Group
Renesas Solution Starter Kit
Capacitive Touch Evaluation System
Quick Start Guide

