User's Manual

RA2L1 Group

Renesas Solution Starter Kit
Capacitive Touch Evaluation System
Quick Start Guide

Renesas RA Family
RA2 Series

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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.

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Renesas RA Family

RA2L1 Group Capacitive Touch Evaluation System Quick Start Guide

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1. Introduction

This Quick Start Guide (QSG) provides:

- An overview of the Quick Start example project that the RA2L1 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 e^{2}studio Integrated Development Environment (IDE).

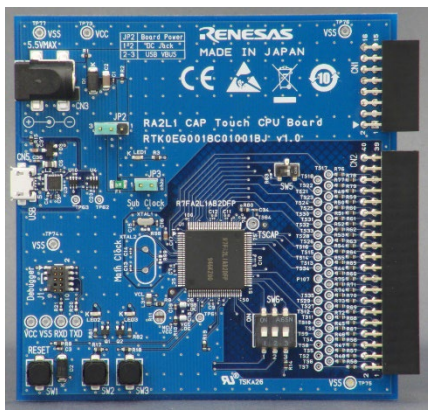
1.1 Assumptions and Advisory Notes

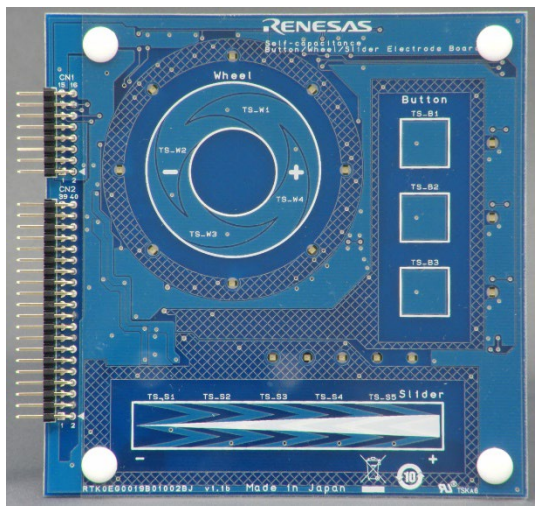
1. Tool experience: It is assumed that the user has prior experience working with IDEs such as e^{2}studio.
2. Subject knowledge: It is assumed that the user has basic knowledge about microcontrollers, embedded systems, FSP, and QE for Capacitive Touch to modify the example project described in this 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. RA2L1 Cap Touch CPU board (RTK0EG0018C01001BJ)
2. Capacitive Touch Evaluation Application Board
   Self-Capacitance Buttons / Wheels / Slider Board (RTK0EG0019B01002BJ)





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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

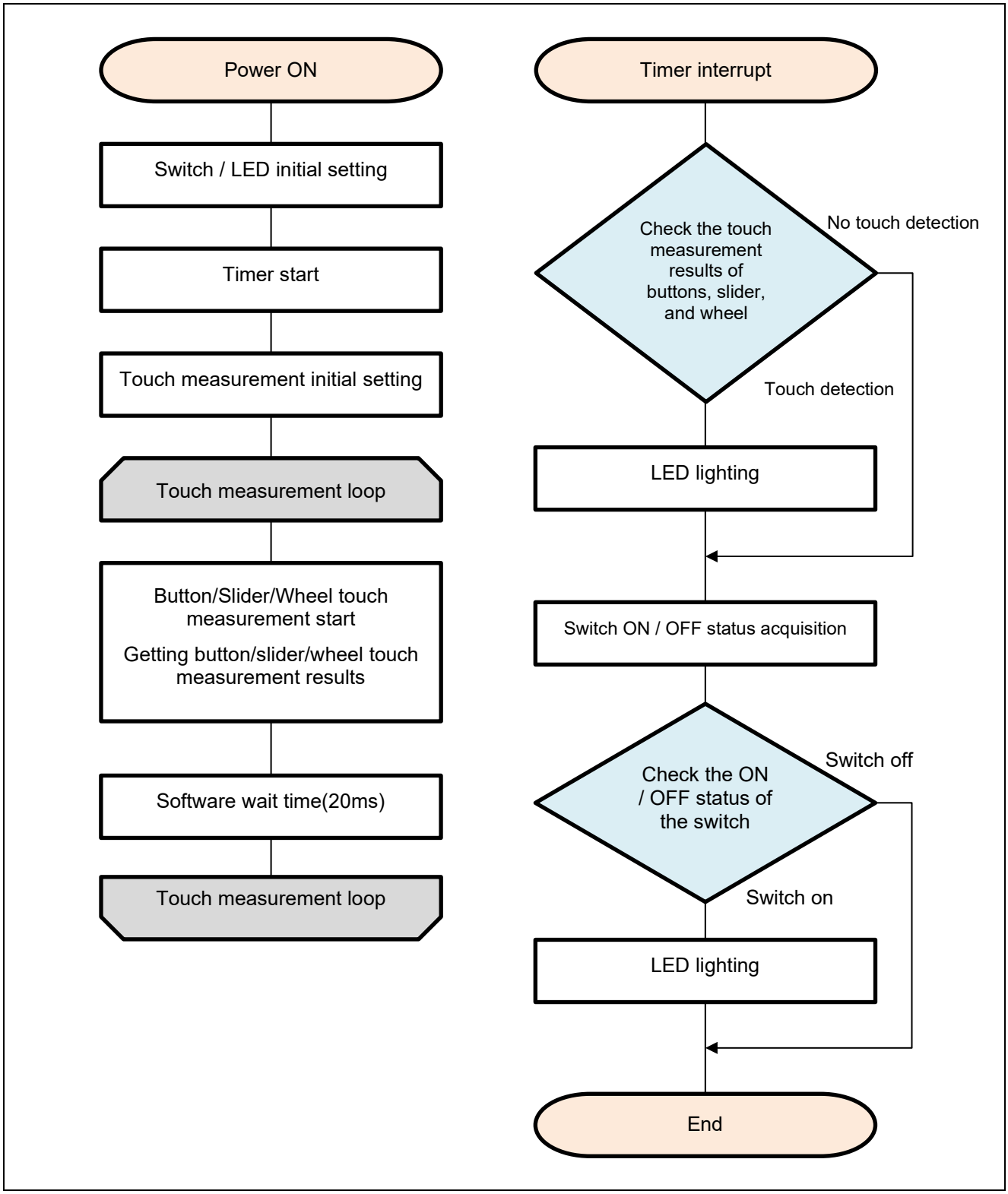


Figure 1. Quick Start Example Project Flow

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4. Running the Quick Start Example Project

This section lists the requirements and instructions to power up the RA2L1 CPU board and run the Quick Start example project.

Hardware Requirements:

- RA2L1 Touch CPU board
- Capacitive Touch Evaluation Application Board
  - Self-Capacitance Buttons / Wheel / Slider Board
- One USB Type-A to USB Micro-B cable (Note 1)
- SEGGER J-Link® Series In-circuit Emulator (supports SWD interface) and J-Link® 9-pin Cortex-M Adapter (Note 2)
  Or, Renesas Electronics' E2 Emulator/E2 Emulator Lite and RTE0T00020KCAC1000J (20-10-pin cable) (Note 3)
- PC with two or more USB ports

Note 1: The USB Type-A to USB Micro-B cable is not included in the RTK0EG0022S01001BJ kit, but is required for power supply from the USB port as well as communications between the CPU board and the PC.

Note 2: The J-Link® Series In-circuit Emulator and J-Link® 9-pin Cortex-M Adapter are not included in the RTK0EG0022S01001BJ kit, but is required when customizing the Quick Start example project.

Note 3: E2 Emulator/E2 Emulator Lite and RTE0T00020KCAC1000J are not included in the RTK0EG0022S01001BJ kit. E2 Emulator/E2 Emulator Lite is required when customizing the Quick Start example project.

Software Requirements:

- Microsoft® Windows® 10 operating system
- USB Serial Drivers (included in Windows 10)

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.

Note: When connecting the USB cable to the PC, the USB serial port driver is automatically installed the first time it is connected (when using Windows10). Do not remove the USB cable during driver installation.

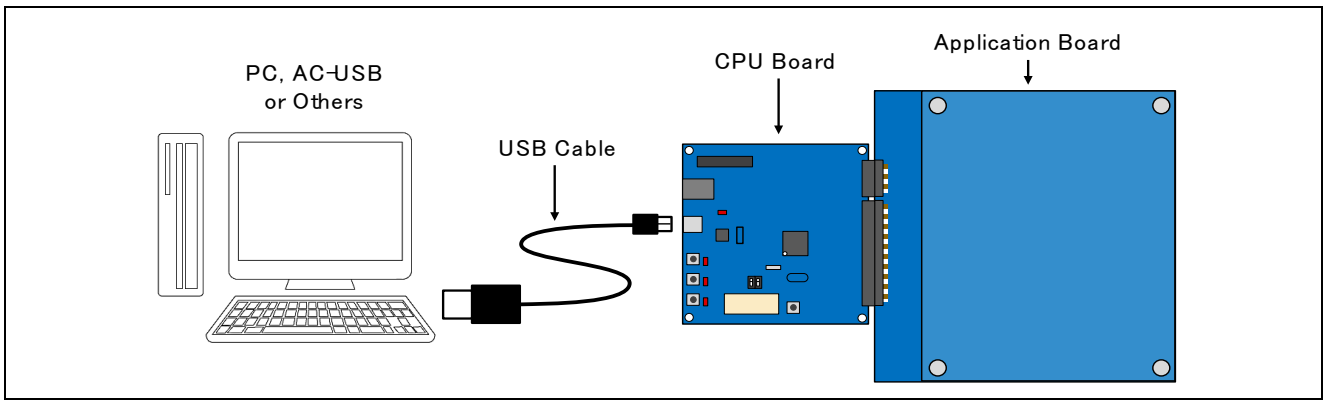


Figure 2. Connecting and Powering Up the Board

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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.

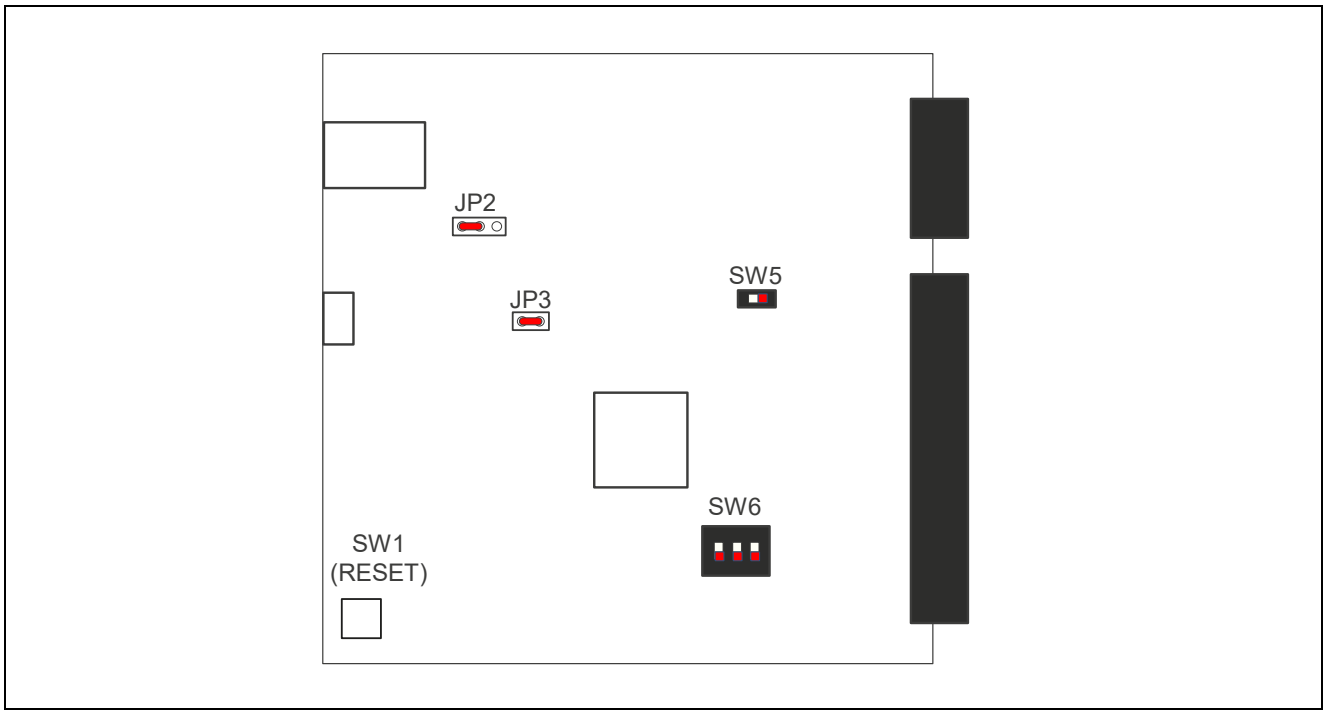


Figure 3. Board default settings

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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 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.

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-ra2l1.
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.

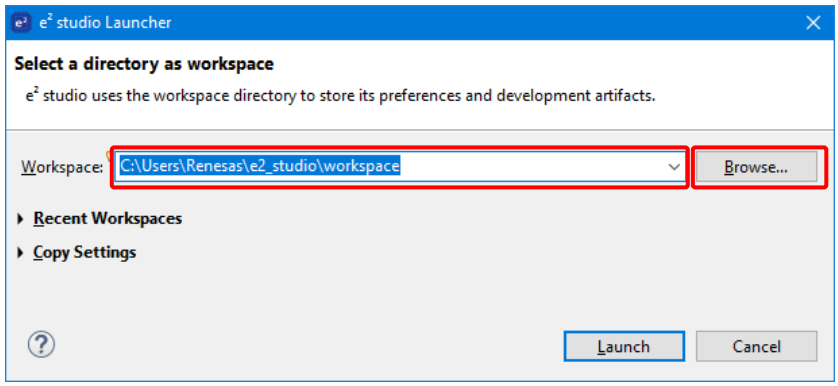


Figure 4. Creating a New Workspace

4. Click **Launch**.

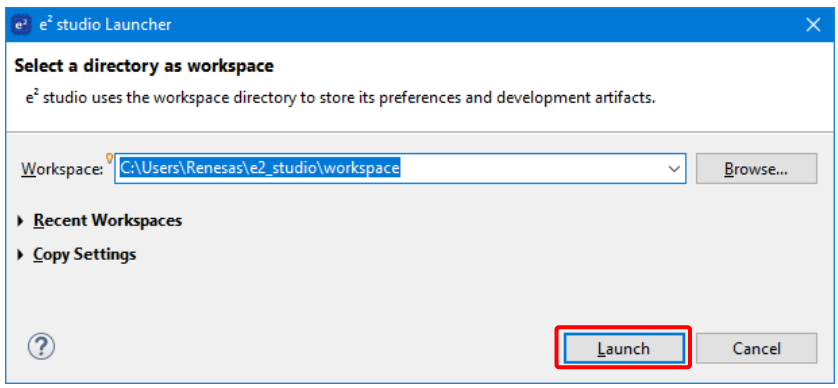


Figure 5. Launching the Workspace

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

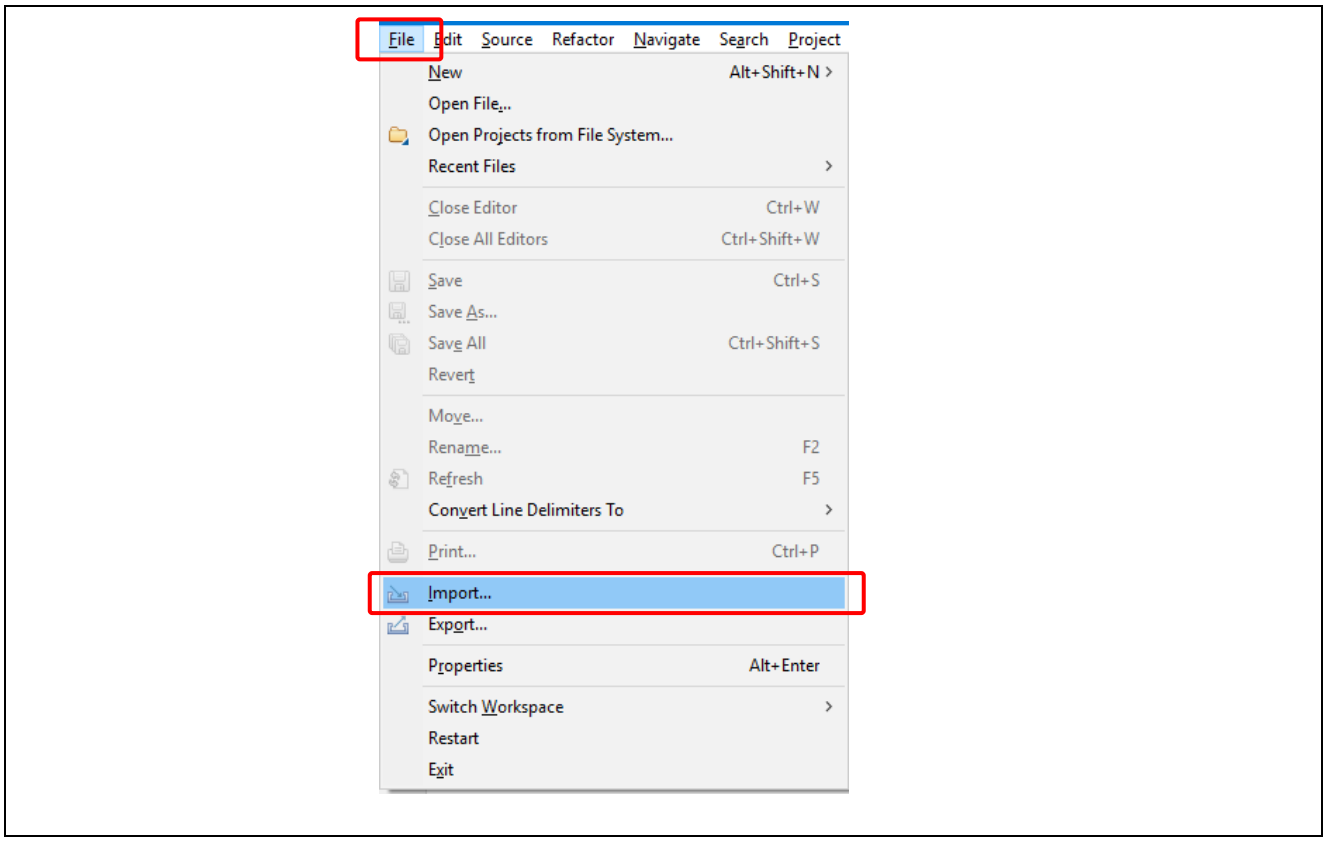


Figure 6. Importing the Project

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

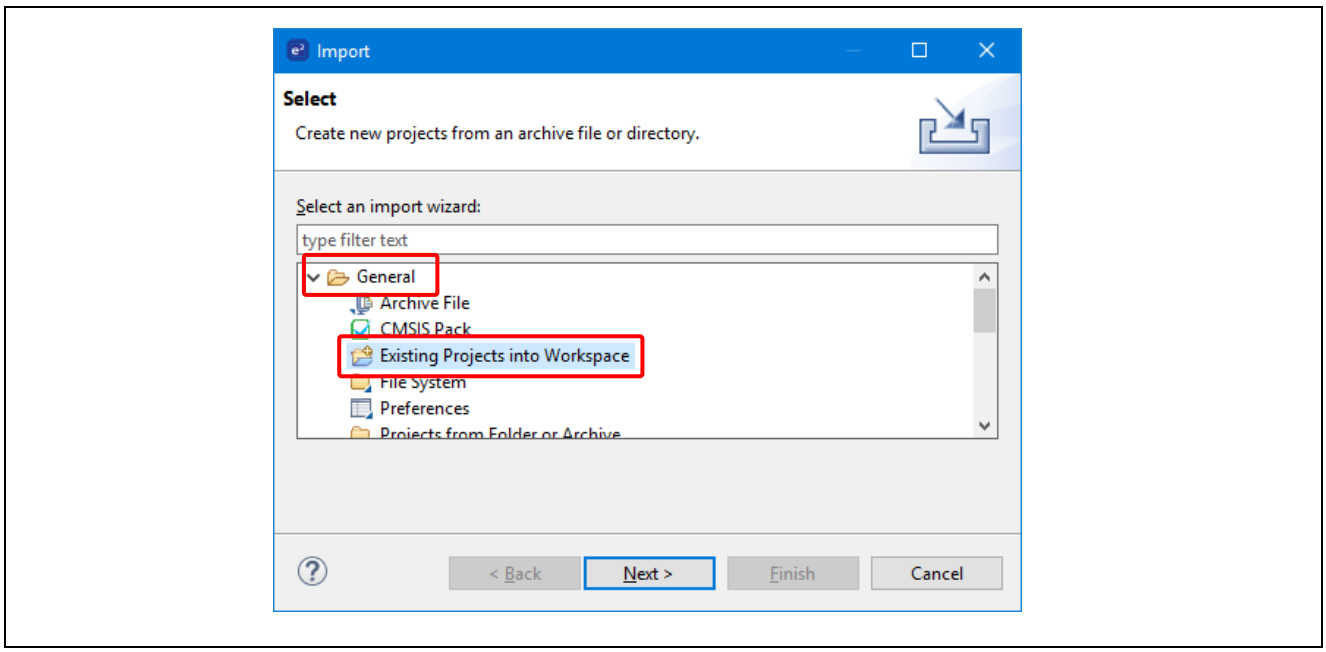


Figure 7. Importing Existing Projects into the Workspace

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7. Click **Next**.

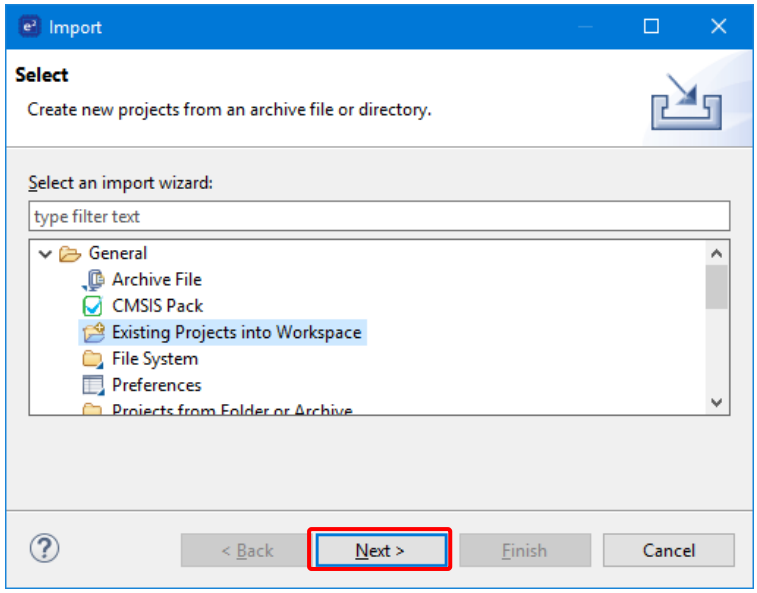


Figure 8. Clicking Next to Import Existing Projects into the Workspace

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

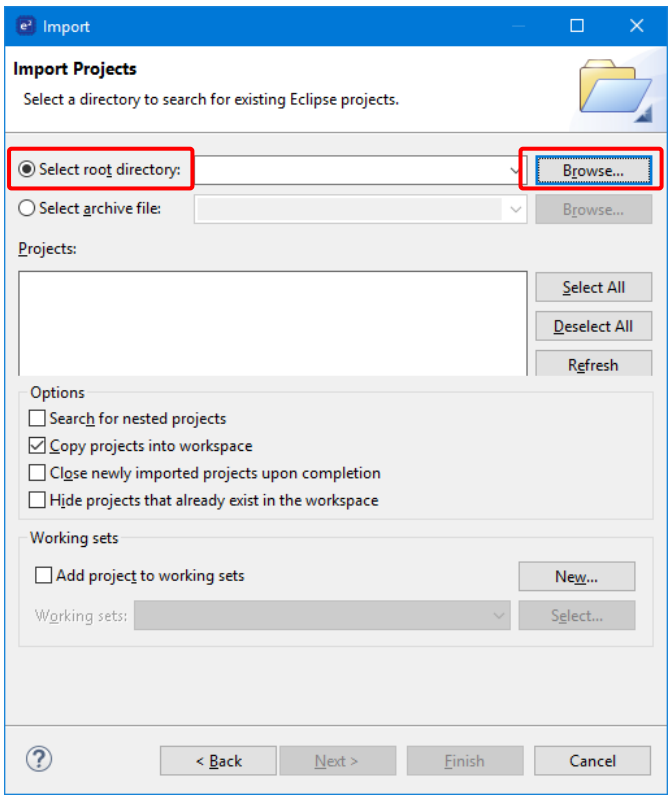


Figure 9. Selecting the Root Directory

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

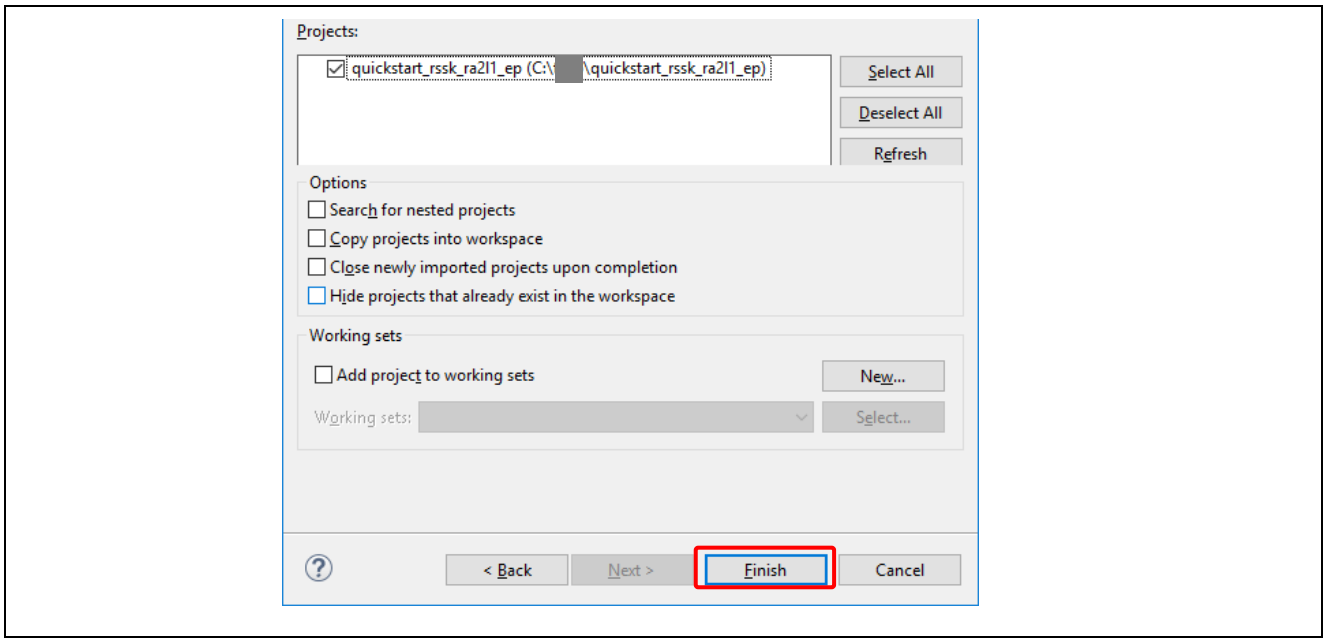


Figure 10. Finishing Importing the Quick Start Example Project

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.

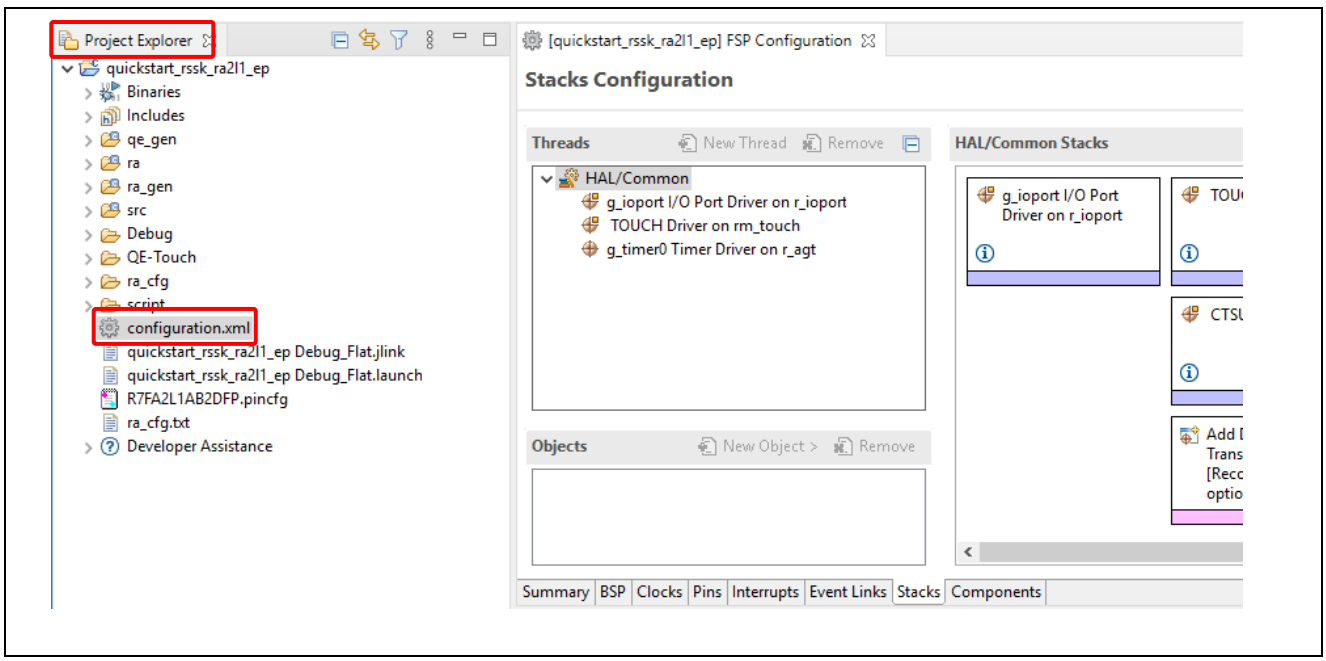


Figure 11. Opening the Configurator

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2. 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.

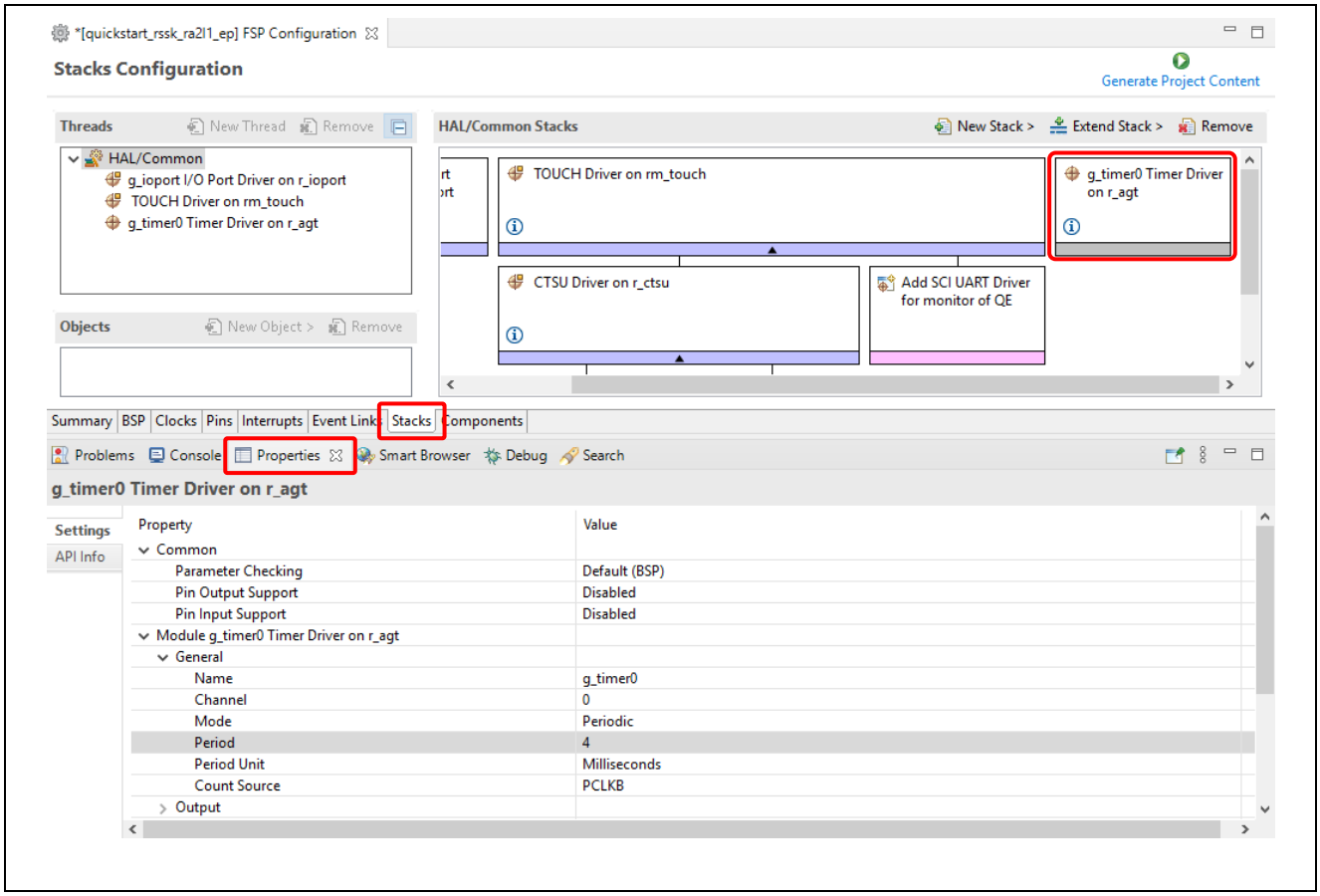


Figure 12. Modifying the Configuration Settings

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

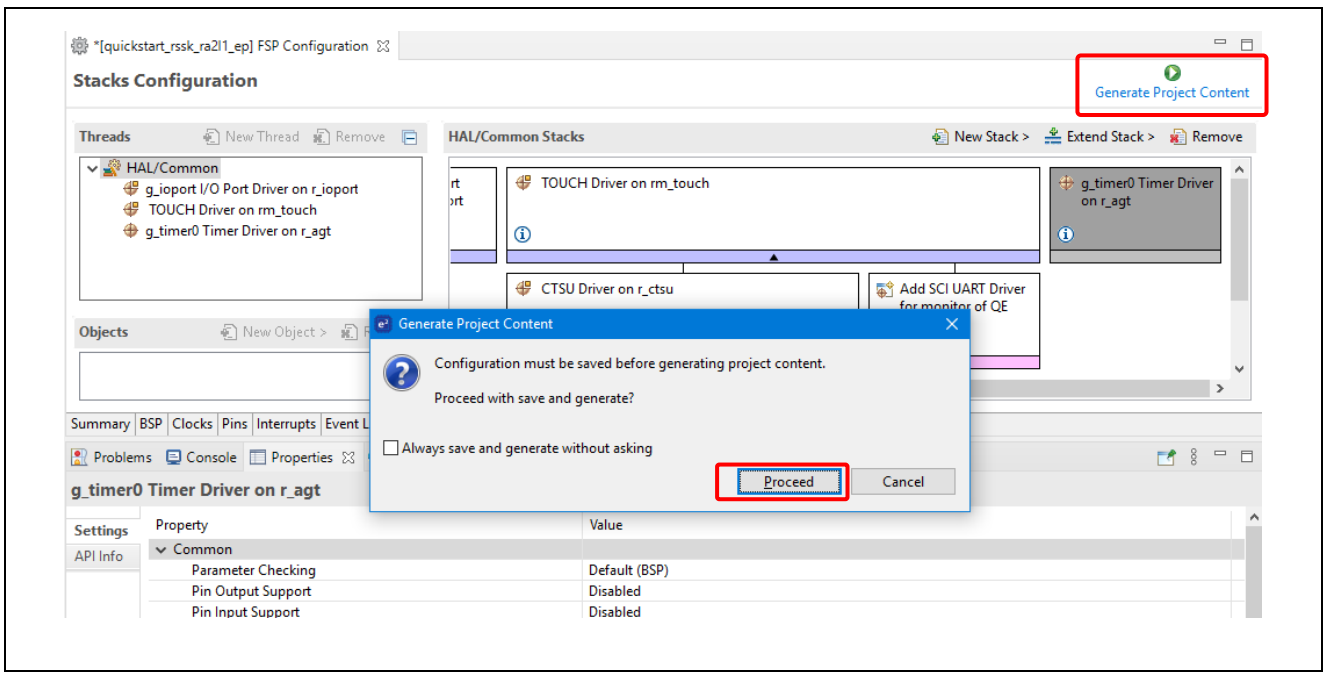


Figure 13. Saving the Configuration Changes

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

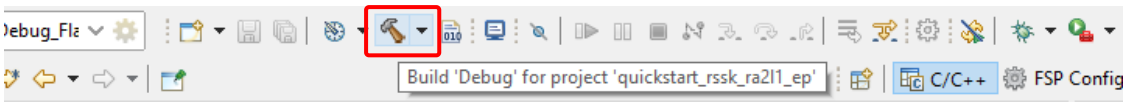


Figure 14. Building the Project

6. A successful build produces an output as follows.

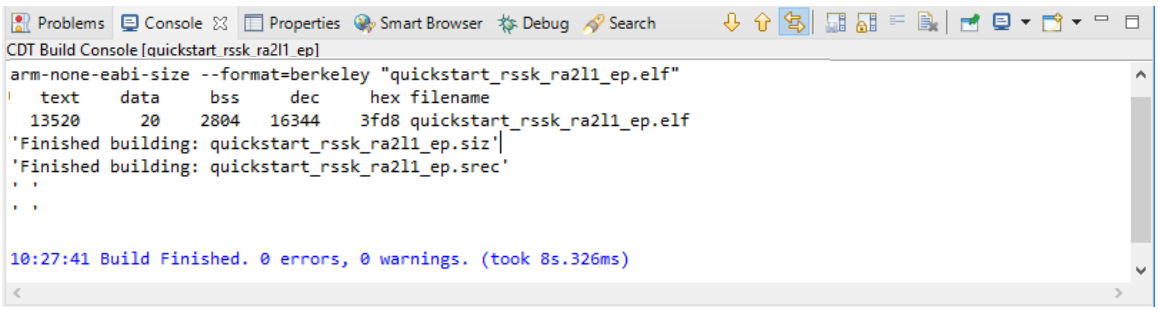


Figure 15. Successful Build Output

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5.4 Downloading and Running the Modified Quick Start Example Project

Note: To download the project to the RA2L1 Cap Touch CPU board, you will need to connect either the J-Link® Series In-Circuit Emulator or the E2 Emulator/E2 Emulator Lite to the USB port of the host PC and the J1 on the RA2L1 Cap Touch CPU board.

If using the J-Link® Series In-Circuit Emulator, proceed to Step 1.

If using the E2 Emulator/E2 Emulator Lite, click the drop-down menu for debug icon, and select **Debug Configurations**.

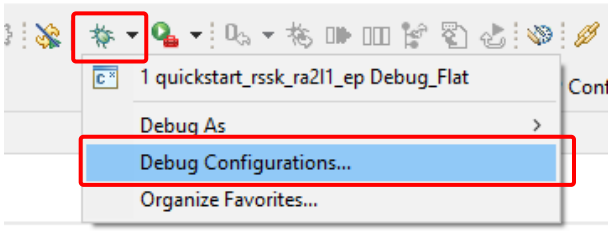


Figure 16. Selecting the Debug Configurations

When the Debug Configurations window opens, click the **Debugger** tab, and select **E2 Emulator** from the Debug Interface drop-down menu. If the Target Device has switched to something other than R7FA2L1AB, please reselect R7FA2L1AB. 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.

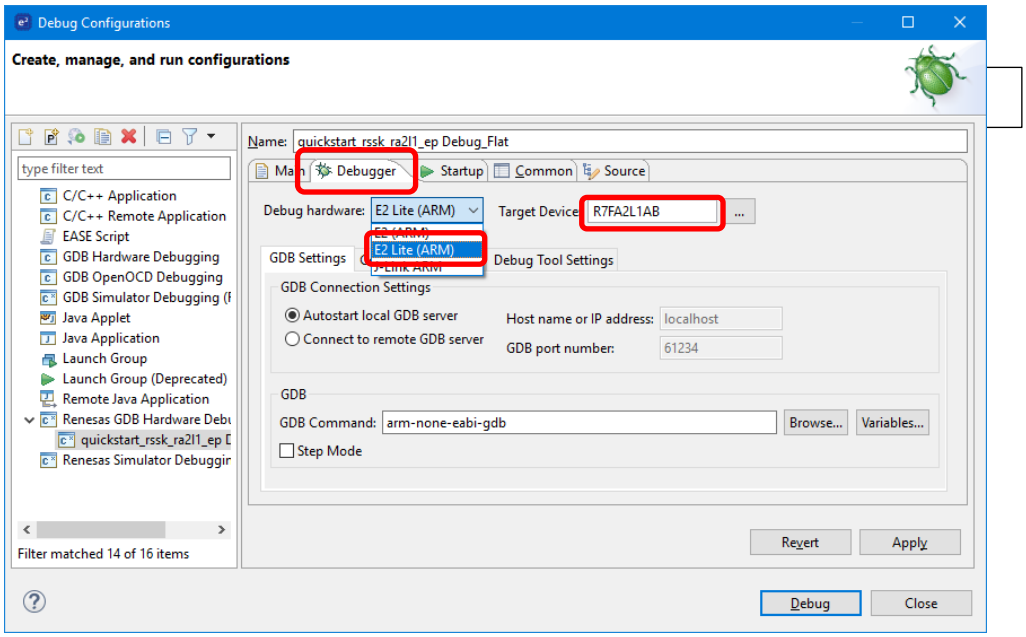


Figure 17. Selecting E2 / E2Lite Emulator

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1. In e2 studio, click the drop-down menu for debug icon, select **Debug As** option, and choose **Renesas GDB Hardware Debugging**.

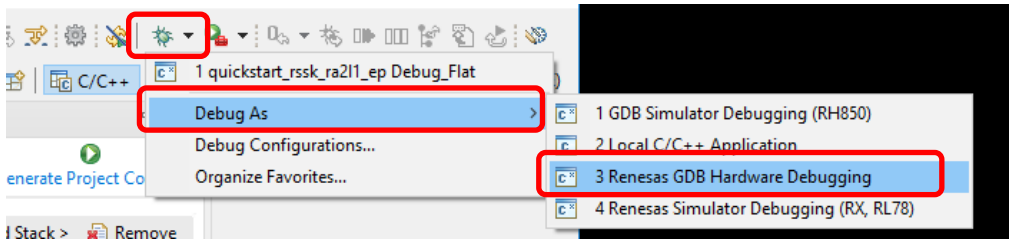


Figure 18. Selecting the Debug Option

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

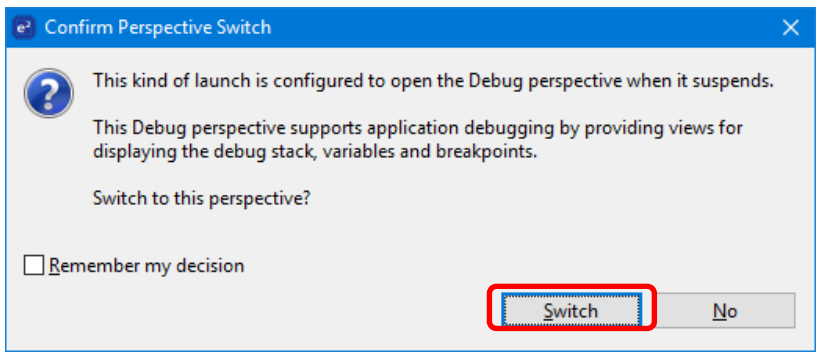


Figure 19. Opening the Debug Perspective

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

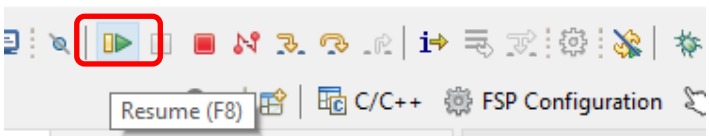


Figure 20. Executing the Project

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.

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6. Next Steps

1. To learn more about the RA2L1 kit, refer to the RA2L1 Group user's manual and design package available on the RA2L1 Group Capacitive Touch Evaluation System webpage at renesas.com/ra/ek-ra2a1.
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.

RA2L1 Group Capacitive Touch Evaluation System Example Project (R20AN0595)

https://www.renesas.com/search?keywords=r20an0595

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.

RTK0EG0022S01001BJ Resources	renesas.com/rssk-touch-ra2l1
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
QE for Capacitive Touch	renesas.com/qe-capacitive-touch

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Appendix. Application Board Pins Connection Table

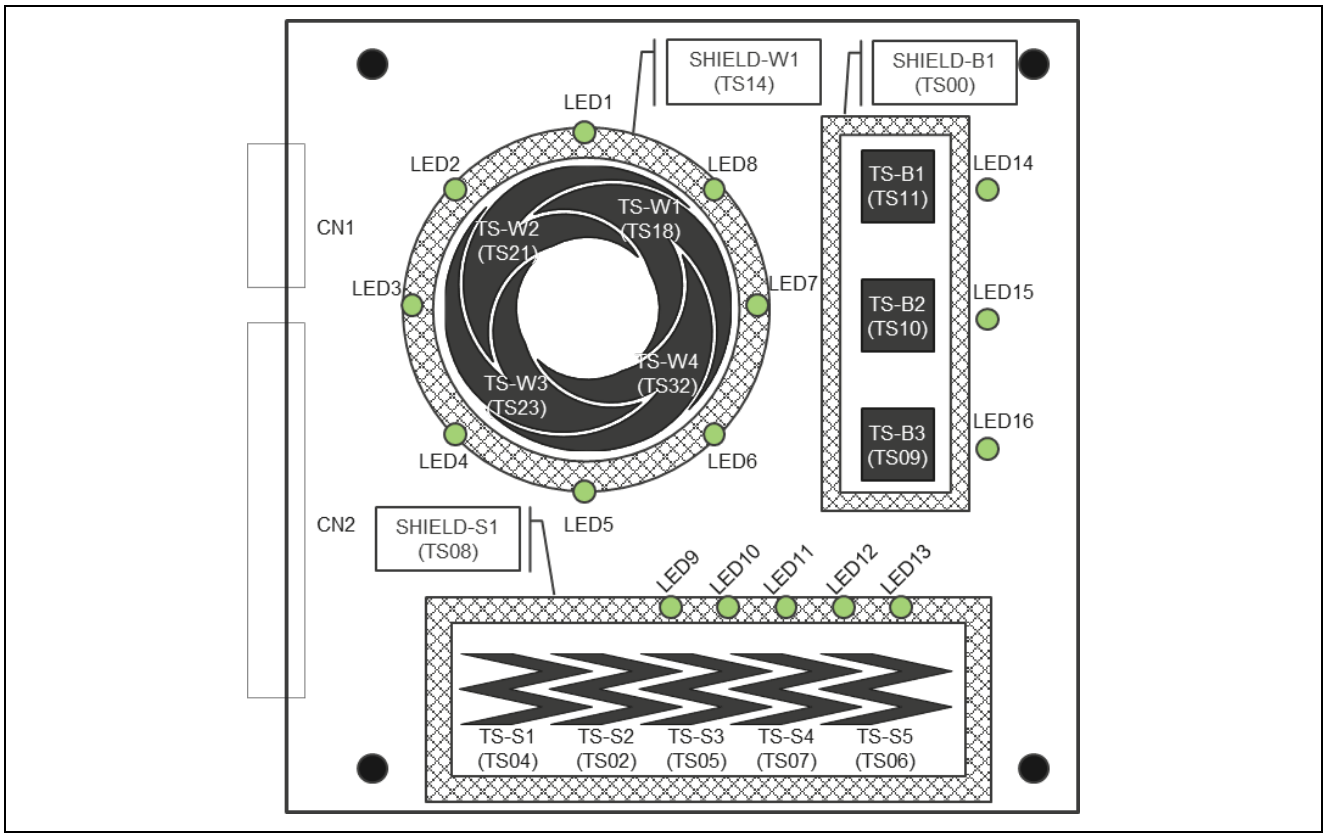


Figure.1 Assignments of Touch electrodes and TS Pins

Table.1 Application Header (CN2)

CN2 Pin	Touch Electrode	CTSU (RA2L1)	CN2 Pin	Touch Electrode	CTSU (RA2L1)
39	—	—	40	—	TSCAP
37	—	—	38	—	—
35	—	TS17	36	TS-W1	TS18
33	—	TS22	34	TS-W2	TS21
31	TS-W3	TS23	32	—	TS24
29	—	TS25	30	—	TS30-CFC
27	—	TS31-CFC	28	TS-W4	TS32-CFC
25	—	TS33-CFC	26	—	TS28-CFC
23	—	TS26-CFC	24	—	TS16-CFC
21	—	TS15-CFC	22	SHIELD-W1	TS14-CFC
19	—	TS13-CFC	20	—	TS34-CFC
17	—	—	18	—	—
15	—	—	16	—	—
13	—	TS35-CFC	14	—	TS29-CFC
11	—	TS27-CFC	12	—	TS12-CFC
9	TS-B1	TS11-CFC	10	TS-B2	TS10-CFC
7	SHIELD-B1	TS00	8	TS-B3	TS09-CFC
5	TS-S1	TS04	6	SHIELD-S1	TS08-CFC
3	TS-S3	TS05	4	TS-S2	TS02-CFC
1	TS-S5	TS06	2	TS-S4	TS07

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Table.2 Application Header (CN1)

CN1 Pin	Function	MCU Connection	CN1 Pin	Function	MCU Connection
15	VCC	VCC	16	VSS（GND）	VSS
13	LED_ROW0	P414	14	LED_ROW1	P006
11	LED_ROW2	P708	12	LED_ROW3	P415
9	—	P404	10	—	P401
7	LED_COL3	P406	8	—	P405
5	LED_COL1	P400	6	LED_COL2	P714
3	—	P502	4	LED_COL0	P504
1	—	P501	2	—	P503

Table.3 LED and MCU Port Output Settings

LED	LED_ROWn Port	LED_COLn Port
Turn On	Low	High
Turn Off	High	Low

Note：n=0~3

Table.4 LED Matrix Correspondence Table

	LED_COL0	LED_COL1	LED_COL2	LED_COL3
LED_ROW0	LED1	LED5	LED13	LED9
LED_ROW1	LED2	LED6	LED14	LED10
LED_ROW2	LED3	LED7	LED15	LED11
LED_ROW3	LED4	LED8	LED16	LED12

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Nov.16.20	-	First release
2.00	Mar.03.23	-	Modified Figure 1. Revised description of step 1 in Section 4.2. Removed Section “5.5 Capacitive Touch Sensor Monitoring”. Added touch sensor monitoring procedure to step 2 of Chapter 6. Added step 3 to Chapter 6.
2.01	Oct.27.23	-	Supported example code version

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