Renesas Synergy™ Platform

Creating a Custom Board Support Package for SSP v1.2.0 or Later

Introduction

This document provides different approaches to create a new custom board support pack (BSP) for Renesas Synergy Software Package (SSP) v1.2.0 and later. A new pack can be created for SSP v1.2.0 or later, either by using a built-in Synergy Pack Exporter, or by directly working on the files of a pack folder.

Goals and Objectives

The objective of this document is to demonstrate different approaches to creating a custom BSP for the SSP v1.2.0 or later, which is used along with the e^2 studio ISDE (v5.3.1.x or later) or the IAR Embedded Workbench for Renesas Synergy™ (IAR EW for Synergy) (v7.71.1.x or later).

Prerequisites

As the user of this application note, you are assumed to have some experience with the Synergy SSP v1.2.0 or later, and the supported Renesas e^2 studio ISDE, or the IAR EW for Synergy.

Required Resources

To perform the procedures described in this application notes, you will need:

- A PC running Microsoft® Windows® 7 or later with the following Renesas software installed:
  - e^2 studio ISDE v5.3.1.002 or later
  - IAR EW for Synergy v7.71.1.x or later
  - Synergy Software Package (SSP) v1.2.0 or later
  - Synergy Standalone Configurator (SSC) 5.3.1.002 or later
  - A zip software utility supporting the compression method DEFLATE (like 7-Zip (https://www.7-zip.org/)

You can download the required Renesas software and its supported packages from the Renesas Synergy Gallery (https://www.renesas.com/in/en/products/synergy.html).

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1. Board Support Packs in SSP

The Board Support Pack (BSP) is a subset of Synergy Software Package (SSP), and provides an interface for setting up the SSP to work with selected MCUs and specific board HW designs, making it both MCU and board specific. The BSPs created are available for the Renesas Synergy™ Starter/Development/Promotion boards, but users eventually must create new BSPs for implementing their final products.

Synergy is CMSIS-compliant and is based on the CMSIS-core. Therefore, the board pack file structure is organized into folders containing the MCU, board-specific CMSIS information, and is represented as an XML-based pack description (PDSC) file as defined in the CMSIS standard (Keil, 2016). All these files are packed in a ZIP format (`.zip`).

1.1 Pack File Structures in SSP Releases

In earlier SSP releases (prior to SSP v1.2.0), specifications of MCUs and boards are packed into a single pack file, as shown in Figure 1, which restricted the capability of supporting different MCUs and boards.

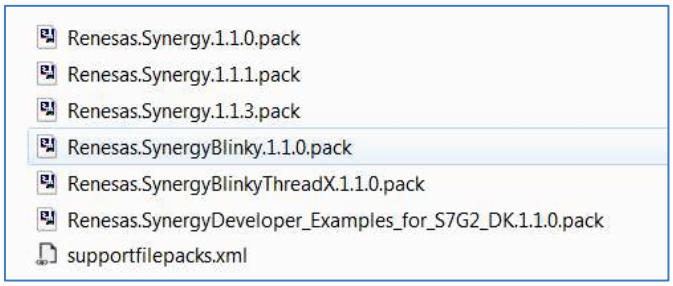

Figure 1. Sample Snapshot of Default Packs Provided in SSP v1.1.3

In SSP v1.2.0 and later, the pack files are classified into MCU specific, board specific categories, and even into some default application templates, making future upgrades and custom extensions more convenient.

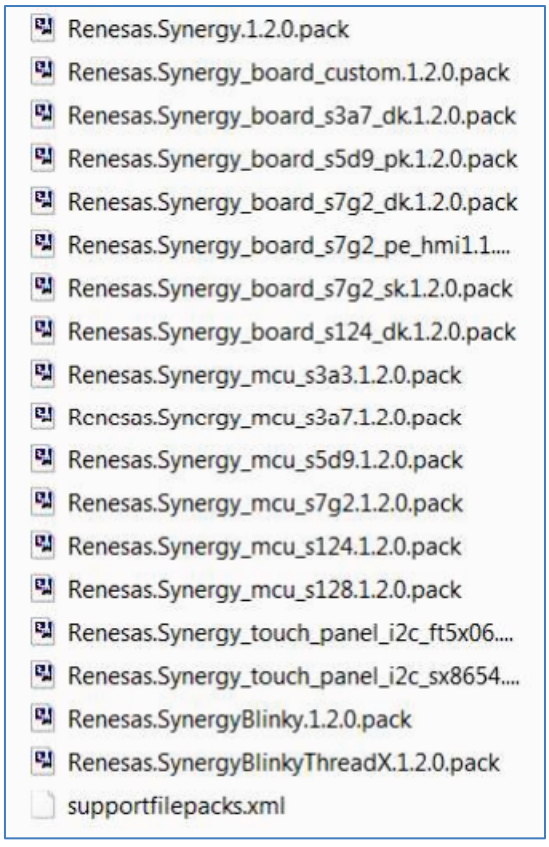

Figure 2. Sample Snapshot of Default Pack Files Provided in SSP v1.2.0 and Later

1.2 BSP Contents in SSP v1.2.0 or Later

Support information to be specified in a BSP is as follows:

- A pin configuration file for the selected device
- Two XML specification files for linking the selected device and expected board indicating their file locations
- A set of drivers for the selected peripherals and pins.

For example, `Renesas.Synergy_board_s7g2_dk.1.2.0.pack` has files as shown in Figure 3.

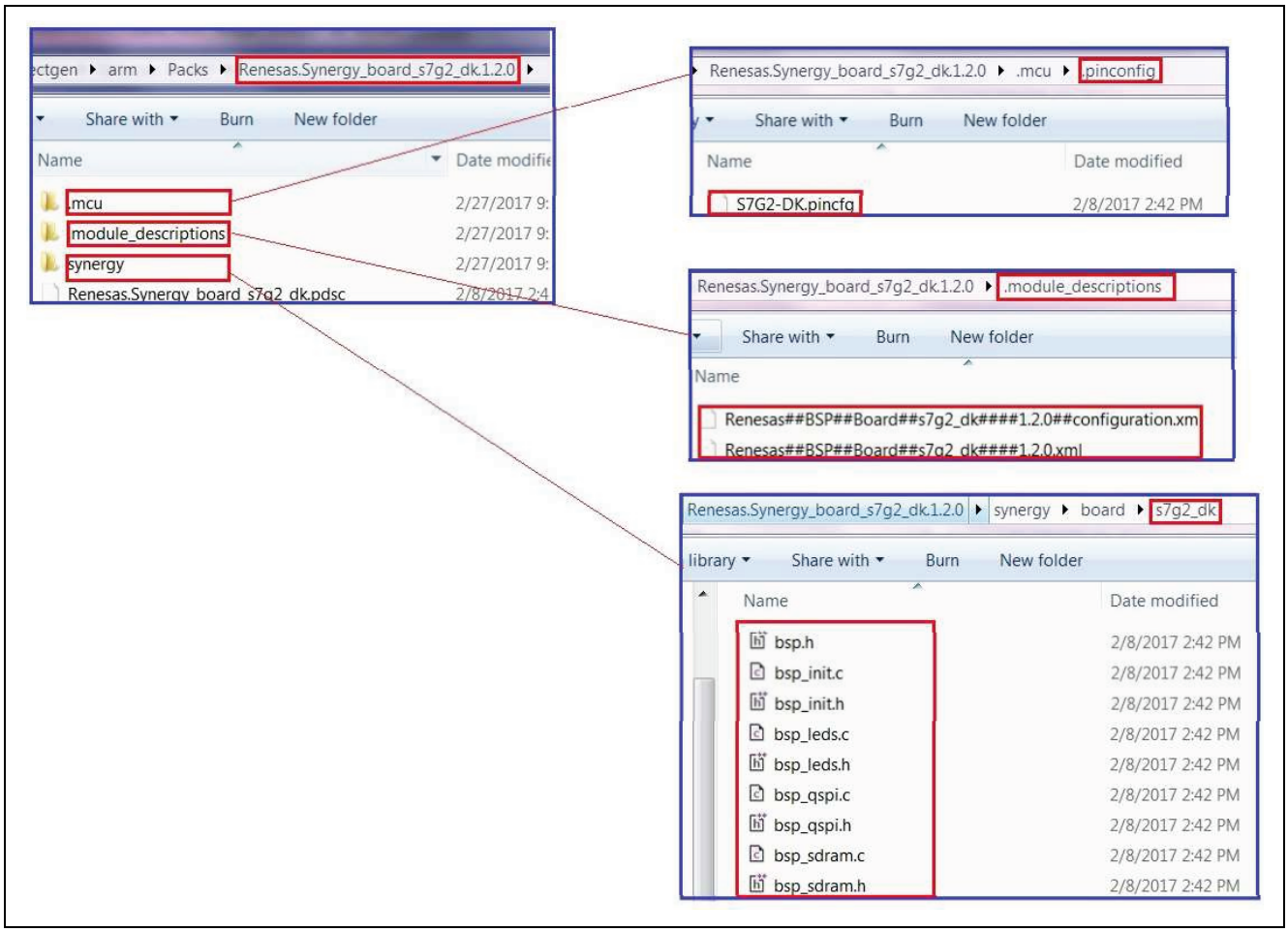

Figure 3. Board Support Information Contained in a BSP Pack (s7g2_dk.pack)

1.3 Creating a BSP in SSP v1.2.0 or Later

Unlike the board pack files provided with the Synergy development or system kits, such as DK-S124 and SK-S7G2, you must create a BSP pack for your custom boards.

While copy/paste of files works to some extent, especially when using the IAR EW for Synergy (v7.71.1.11989), the creation of a custom BSP has been simplified with a built-in CMSIS-pack generator in e² studio 5.3.1.002 or later, IAR EW for Synergy v8.21.1 or later, and SSP v1.2.0 or later. This document provides suggestions for selecting relevant workflows in creating a custom BSP.

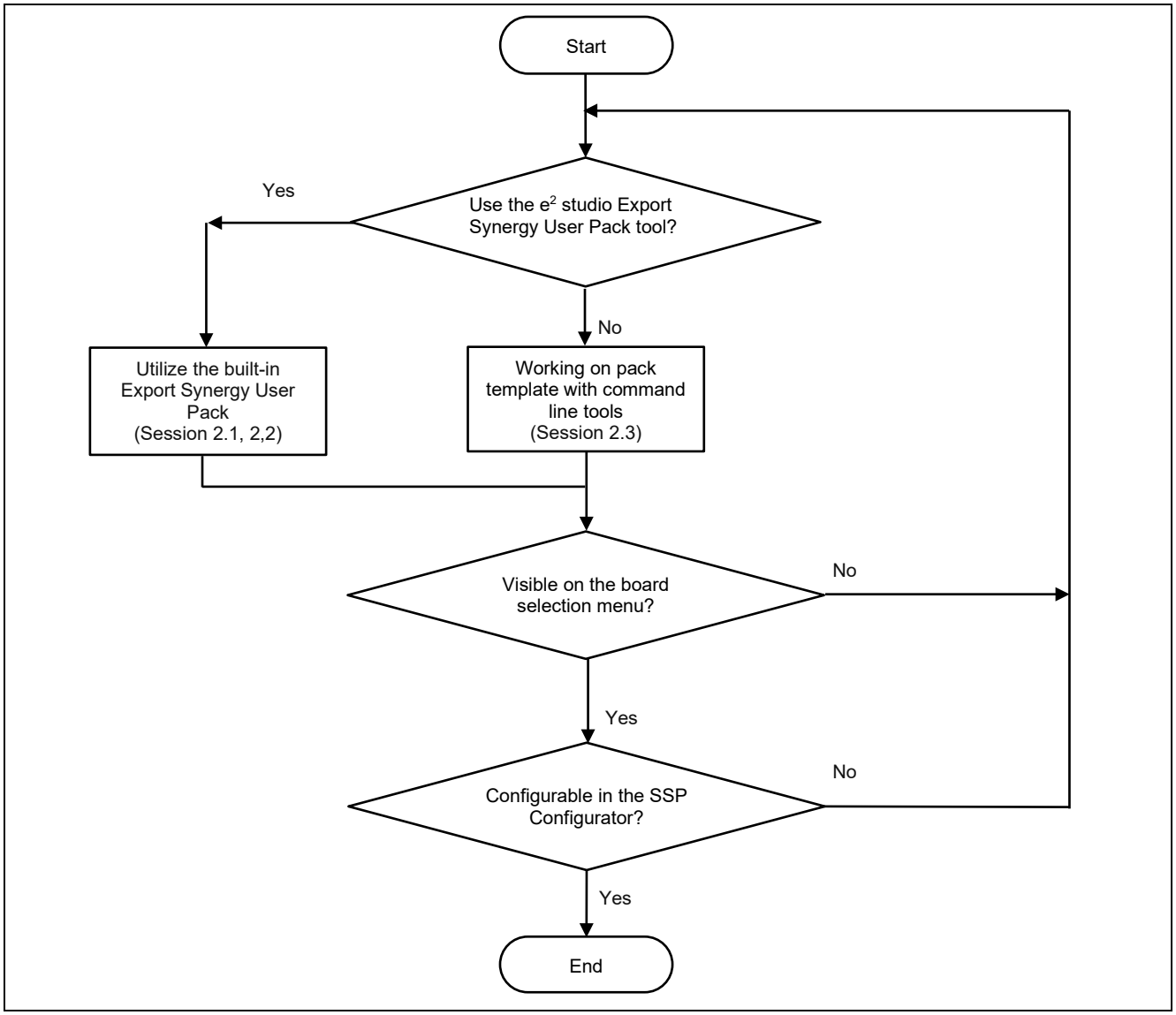

Figure 4. Approaches to Creating a Custom Board Pack in SSP v1.2.0 or Later

2. Custom BSP Files

Figure 4 shows two approaches to creating a custom board pack, which can be described as follows:

- Create a custom board pack based on an existing BSP by replacing existing files with your new board specification, and packing them with the built-in Export Synergy User Pack in e² studio 5.3.1.002 or later and IAR EW for Synergy v8.21.1 or later.
- Work on a selected BSP in the `\internal\projectgen\arm\Packs` folder of your SSP installation as part of e² studio or IAR EWSYN, to manually modify or create related files in the custom pack, and generate a `.zip` format.

2.1 Creating a BSP using Export Synergy User Pack Provided in e² studio v5.3.1 to v22.10.0 and IAR EWSYN v8.21.1 or Later

To create a custom board pack in e² studio environment:

1. Create a new Synergy C Project, for example, **S5D9_CB**.

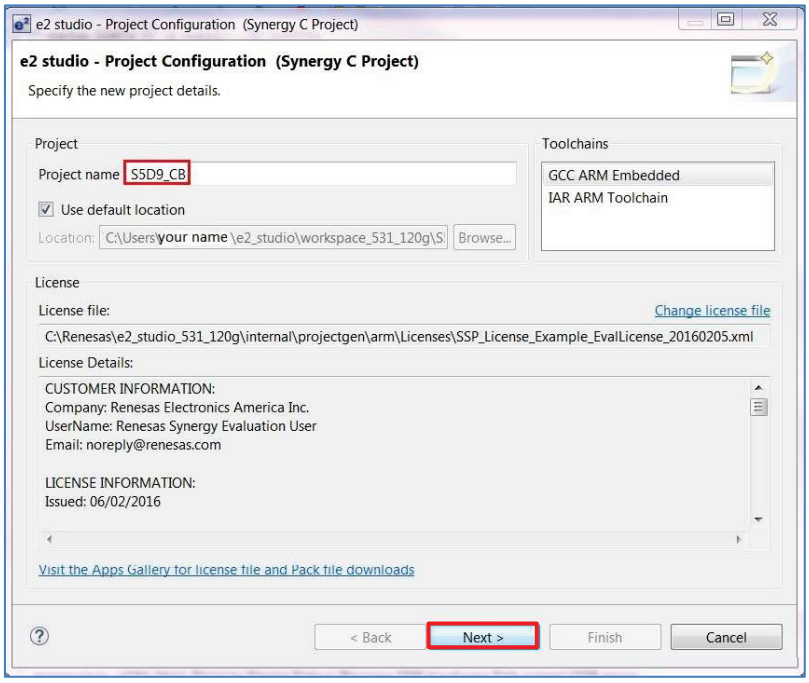

Figure 5. Creating a Project

2. Click **Next** to select a board for your new project.
3. Use the default SSP v1.2.0 or later. In the board pulldown menu, select an already created Synergy board with the same or similar device as your targeted MCU. For example, the **S5D9 PK** with **R7FS5D97E3A01CFC** is selected as a pack template.

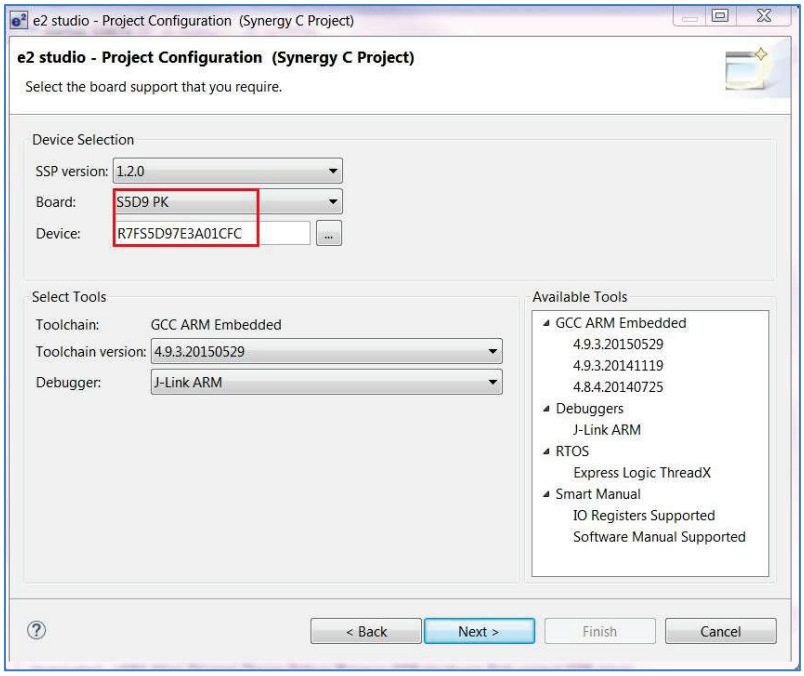

Figure 6. Select an Existing Board with the Same Device as Your Board

4. Click **Next** to select a project template.
5. Select the **BSP** in the **Project Template Selection** for this project, S5D9_CB.

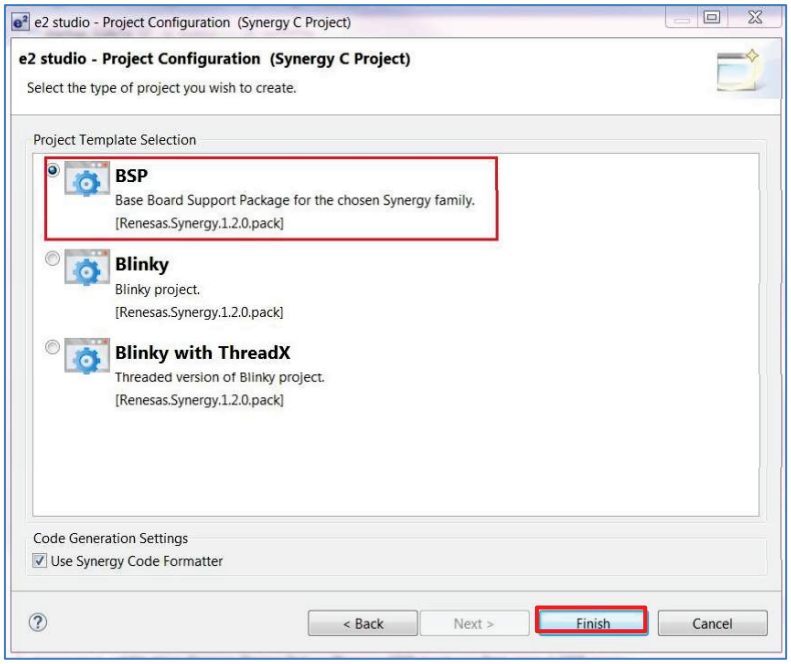

Figure 7. Select the BSP As Your Project Template

6. Click **Finish**. The default BSP files for S5D9-PK are generated automatically. In e² studio, the project explorer shows all the files generated as shown in Figure 8.

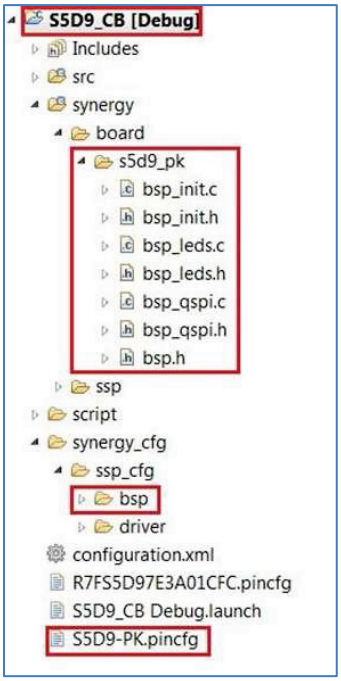

Figure 8. Generated Board Files as Templates for Creating Custom Board Files

In IAR EWSYN v8.21.1 or later, once SSC is closed, the project explorer shows the following generated files. It does not contain the `pincfg` file as shown in Figure 9.

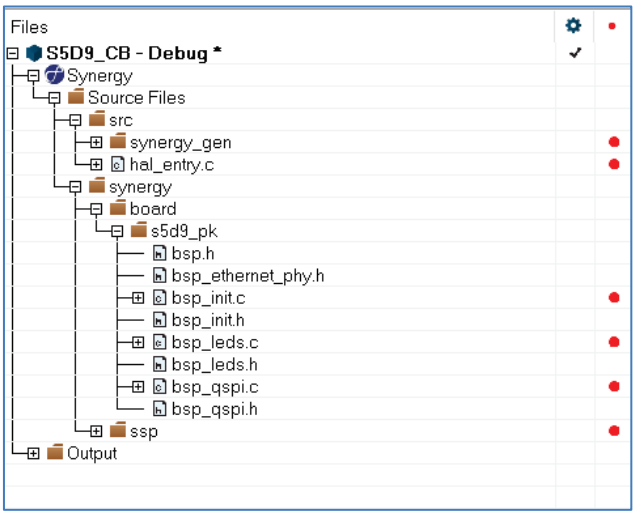

Figure 9. Generated Board Files as Templates in IAR EWSYN

The project in EWSYN workspace should also include the `.pincfg` file to create the custom bsp pack. To include the `.pincfg` file in the project, select **Add Files** option from the project menu and select `S5D9-PK.pincfg` file.

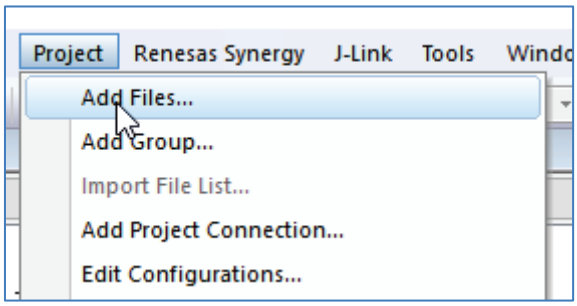

Figure 10. Adding Files to the Project in the EWSYN Workspace

The file is now added to the project.

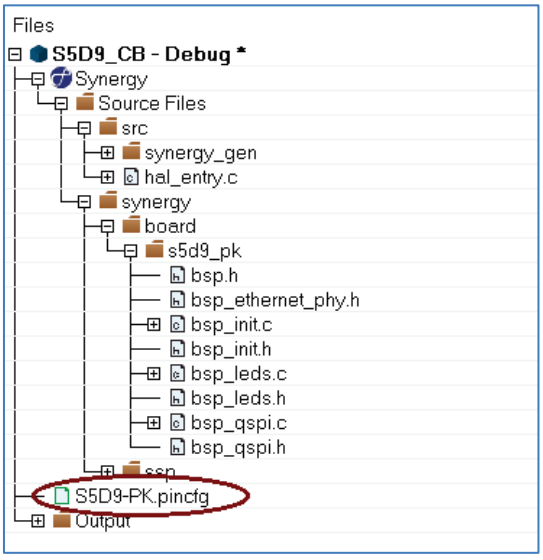

Figure 11. Project Files in IAR EWSYN After Adding the `pinCfg` File

7. Rename the **S5D9-PK.pincfg** to your custom pin configuration file, **S5D9-CB.pincfg**.
8. In the Synergy configurator, change the **pincfg** file in the **Pins** tab from the pulldown menu. Select pin configuration, then select the **S5D9_CB.pincfg** configuration, and select **Generate Data** as **g_bsp_pin_cfg**.

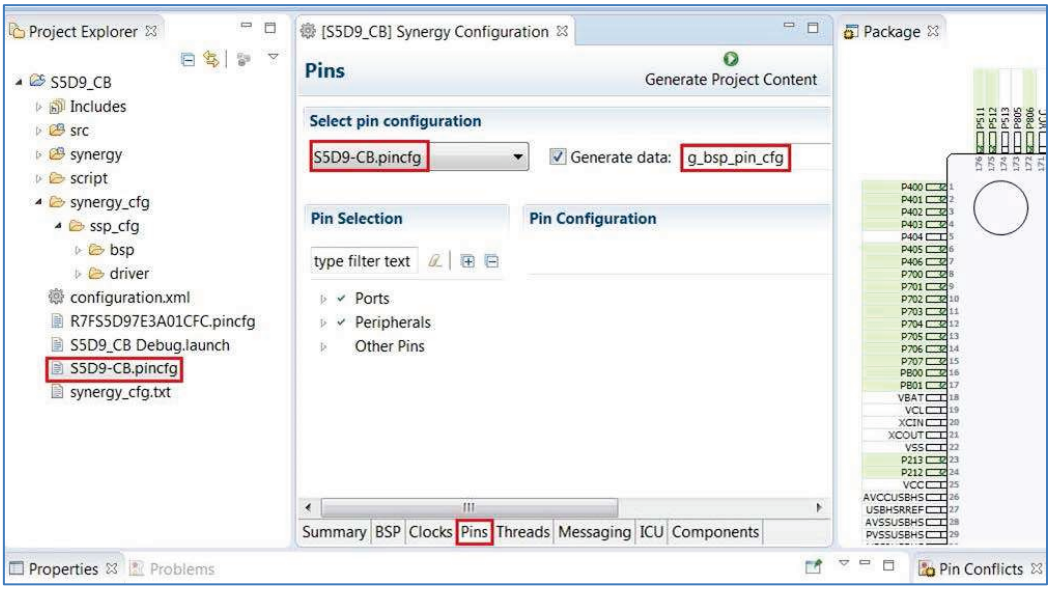

Figure 12. Specify the Data Structure to Hold Your Pin Configuration

9. Based on your board I/O schematics, create a new **g_bsp_pin_cfg** structure by deselecting the unused peripherals/ports, and select the required components on the custom board in the Synergy Configuration, **Pins** panel. For example, the custom board S5D9_CB has a high-speed USB host and a full-speed USB device as shown in Figure 13.

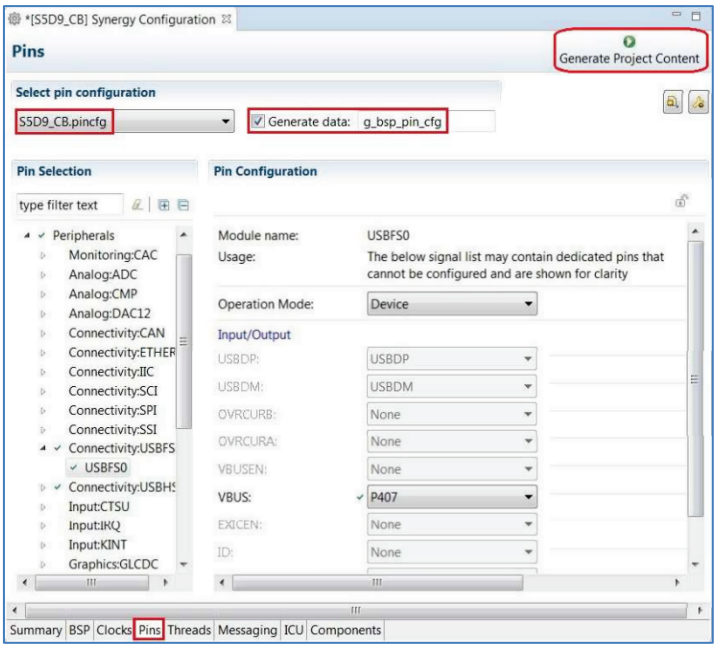

Figure 13. Set the Connection Between Pins and Peripherals on Your Board

10. Click the **Generate Project Content** button to generate new Synergy files based on the configuration on each tab, such as **Clocks**, **Pins**, and so forth, and then save these generated configuration files.

11. On the project folder in your workspace, under **module_description** subfolder, use the default Windows search function to replace the original board name such as S5D9_PK with a new board name, which is **S5D9_CB** in the current project as shown in Figure 15.
12. From e² studio v7.3.0 or SSC 7.3.1 or later versions, **module_description** folder is available only at the application level. It is the **modules** (**module_description** in versions prior to e² studio 7.3.0) directory within the SSP installation directory as shown in Figure 14.

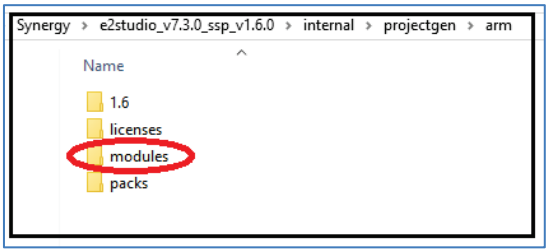

Figure 14. Modules Folder in e² studio v7.3.0 or Later

Make a copy of the original board files of PK-S5D9 and rename them with the new board name as shown in Figure 15.

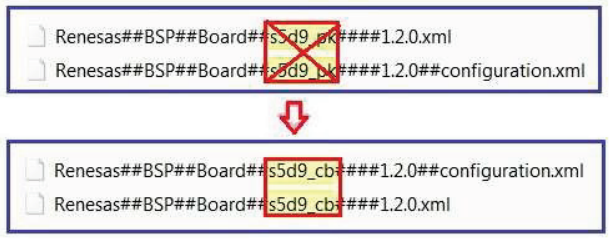

Figure 15. Replace the Existing BSP Name with Your BSP Name

Note: The new board name, S5D9_CB is assigned to the Export Synergy User Pack window as shown in the step 11 or 12. Specifically, the macro **BSP_BOARD_S5D9_PK** should be replaced with **BSP_BOARD_S5D9_CB** in existing board files.

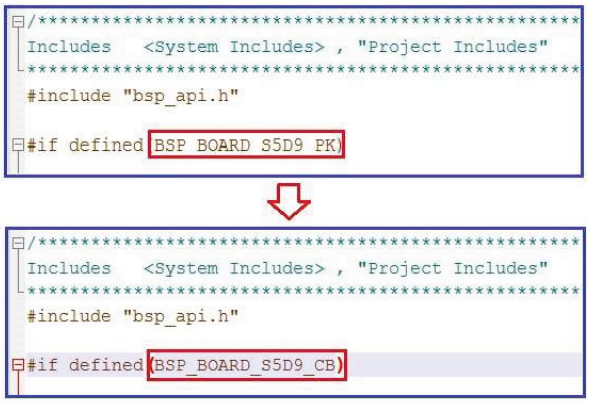

Figure 16. Replacing Template Board Name with Your Board Name in Generated Synergy Files

13. Rename the folder (generic bsp folder to custom bsp folder, for example, **s5d9_dk** or **s5d9_pk** to **s5d9_cb**).
14. Edit `bsp_init.c` to rename **BSP_BOARD_S5D9_PK** to **BSP_BOARD_S5D9_CB** and disable or delete the line `bsp_qspi_init()` as required by the project based on the drivers needed for the new BSP.
15. Edit `bsp.h` and remove the line `#include "../s5d9_cb/bsp_qspi.h`. Rename **BSP_BOARD_S5D9_PK** to **BSP_BOARD_S5D9_CB** under macro definitions.

16. Delete driver files for unused peripherals, such as `bsp_qspi.h/c`, since no QSPI is selected in the pincfg.

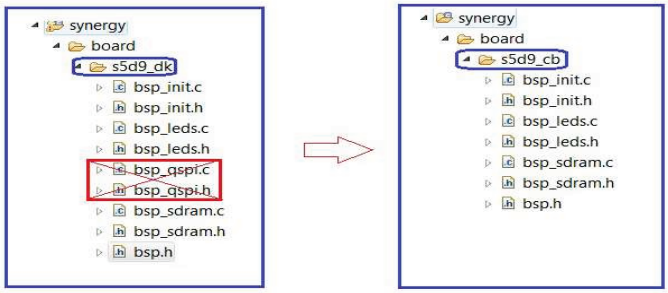

Figure 17. Delete Files for Unused Components

17. Based on your board layout, modify the board files to include GPIO driven components, such as LEDs, which are defined in the `bsp_leds.c/h` file:

```
/**  Array  of  LED  IOPORT  pins.  */
static  const  ioport_port_pin_t  g_bsp_prv_leds[]  =
{

                IOPORT_PORT_04_PIN_08,      ///<  LED1_R
                IOPORT_PORT_04_PIN_09,      ///<  LED2_G
};
```

18. Export the new board files with a build-in CMSIS-Pack generator.
    There are three ways to access the Export User Packet Wizard in e² studio:
    A. Right-click the project, then run the operation Export Synergy User Pack...
    B. Select the project, click **File -> Export** in e² studio, then select Renesas Synergy User Pack in the Export window, or
    C. Right-click on the project, and select the Export. menu item, then select the type of Renesas Synergy User Pack in the Export window.

    To access **Export Synergy User Pack** in IAR EWSYN v8.21.1 or later, select the option Export Synergy User Pack... in the Renesas Synergy menu.

    A dialog window is displayed after one of the above operations, as shown in the following figure.

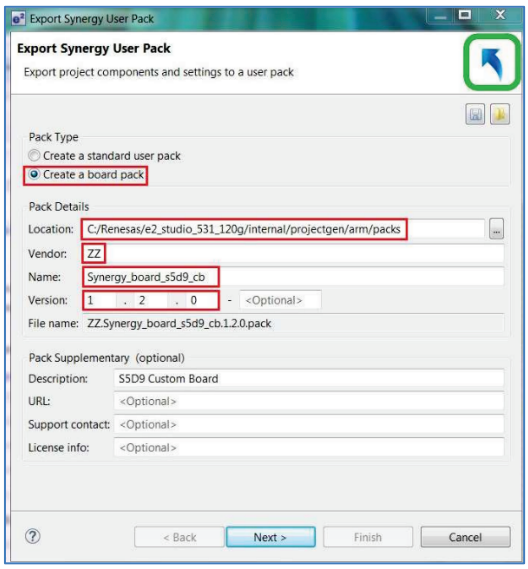

Figure 18. Specify Vendor Information in the Synergy User Pack

Perform the following steps to create a custom board pack:

A. Select **Create a board pack**.
B. Set the location for the new pack, as per your e² studio installation. In this example project, we have chosen `C:\Renesas\e2_studio_531_120g\internal\projectgen\arm\packs`.
C. Fill out the Vendor, Name, and Version information, and click **Next**.
   This brings up the dialog in Figure 19.

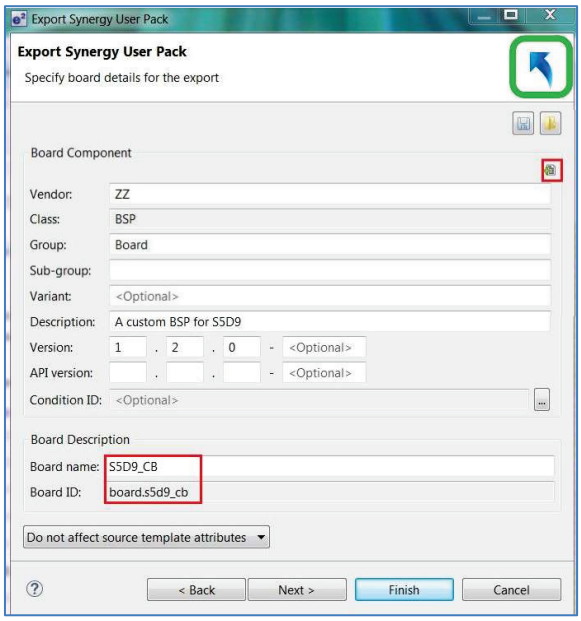

Figure 19. Specify the Custom Board Information in the Synergy User Pack

D. Fill out the **Group** name and **Version**.
E. For **Board name**, enter S5D9_CB.
   Note: The board name must match the board folder name that you used in step 13.
F. Click the **Add** button  on the screen to select the files that you want to include in the pack.
   Note: Make sure to include your pin configuration file and board source files.

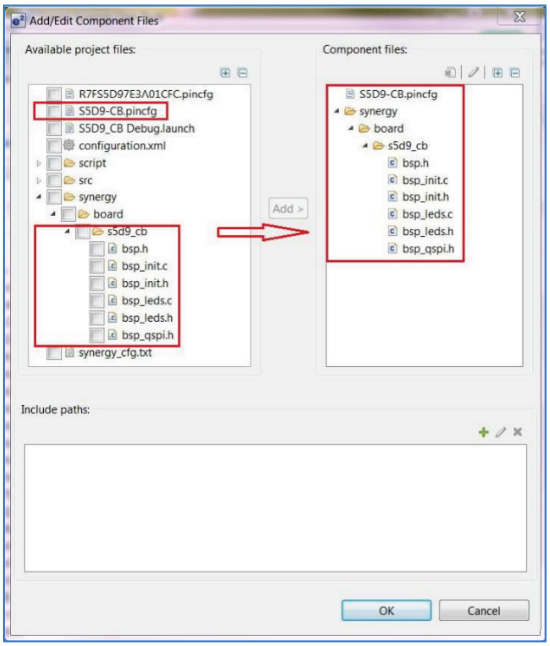

Figure 20. Specify Files Included in the Synergy User Pack

G. Press **OK** and **Finish** to create the custom board pack, `ZZ.Synergy_board_s5d9_cb.1.2.0.pack`.

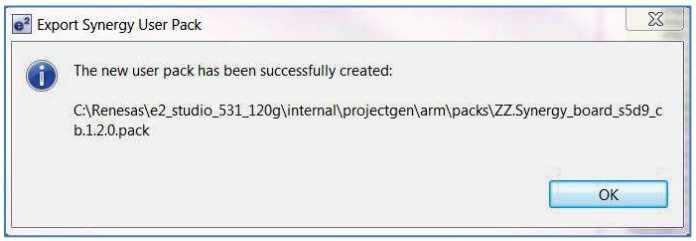

Figure 21. Location of a New Board Pack Created Successfully

19. Test this custom BSP pack by creating a new project, selecting **S5D9_CB** from BSP the in e² studio, and then making other Synergy configurations.

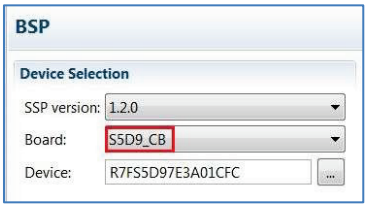

Figure 22. Select and Test Your Created Custom BSP Pack

2.2 Creating a BSP using Export Synergy User Pack in e² studio v23.7.0 or Later, and IAR EWSYN v8.21.1 or Later

To create a custom board pack in e² studio v23.7.0 environment or later, see the following steps:

1. Create a new Synergy C Project. Click **Next**.

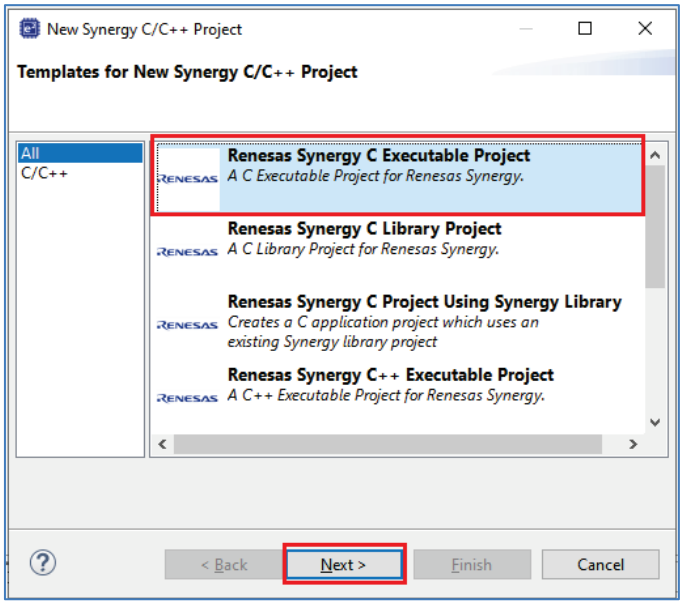

Figure 23. Creating a Project in e² studio

2. Name the project as, for example, **S5D9_CB**. Then, click **Next** to select a board for your new project.

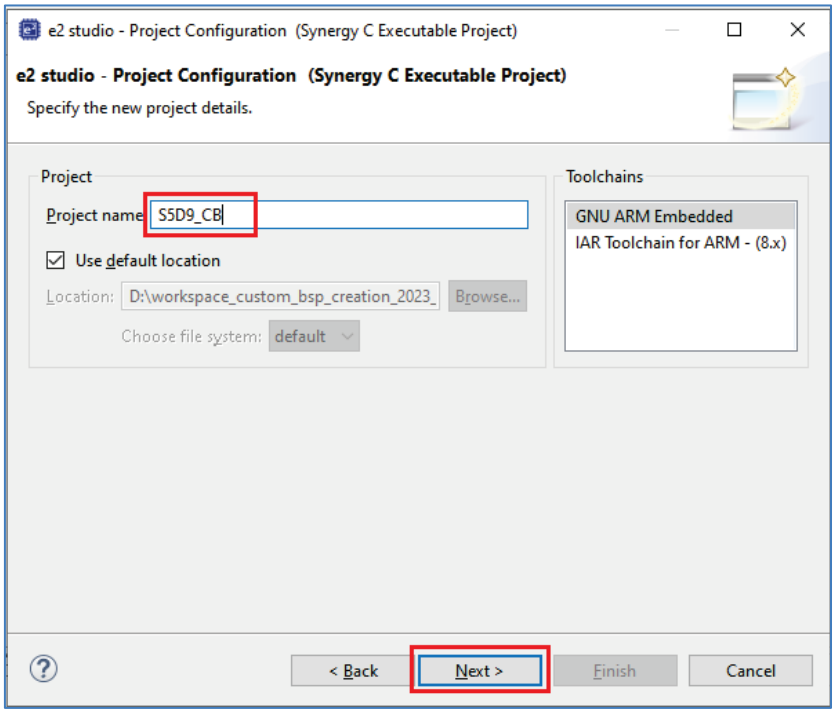

Figure 24. Name the New Project

3. Use the default or latest SSP pack. In the board pulldown menu, select an already created Synergy board with the same or similar device as your targeted MCU. For example, select **S5D9 PK** with **R7FS5D97E3A01CFC** as a pack template. Click **Next** to select a project template.

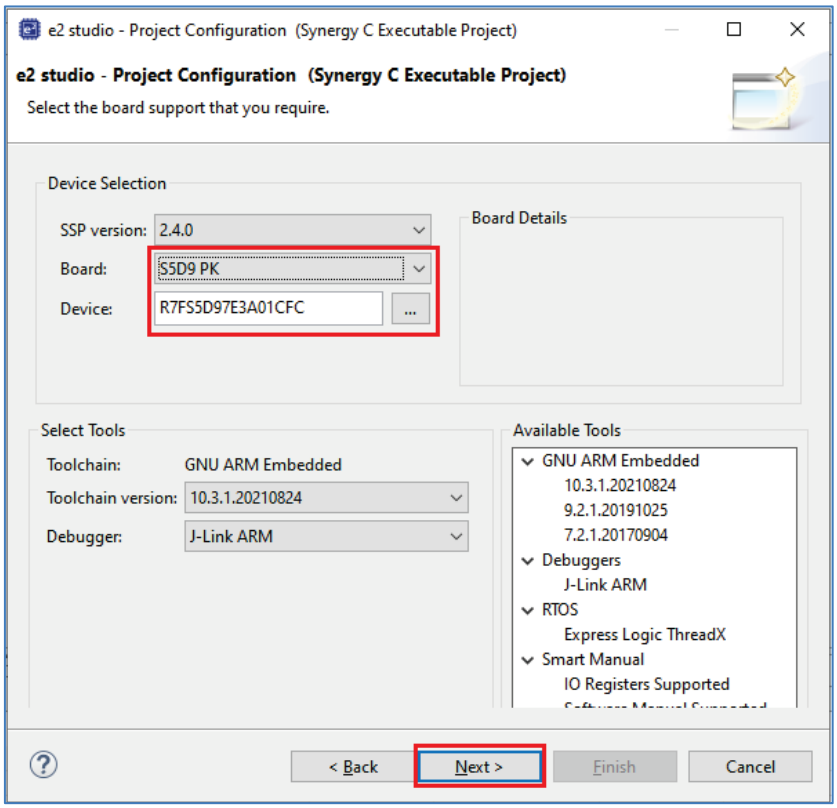

Figure 25. Select an Existing Board with the Same Device as Your Board

4. Select **BSP** in the Project Template Selection for this project, S5D9_CB.

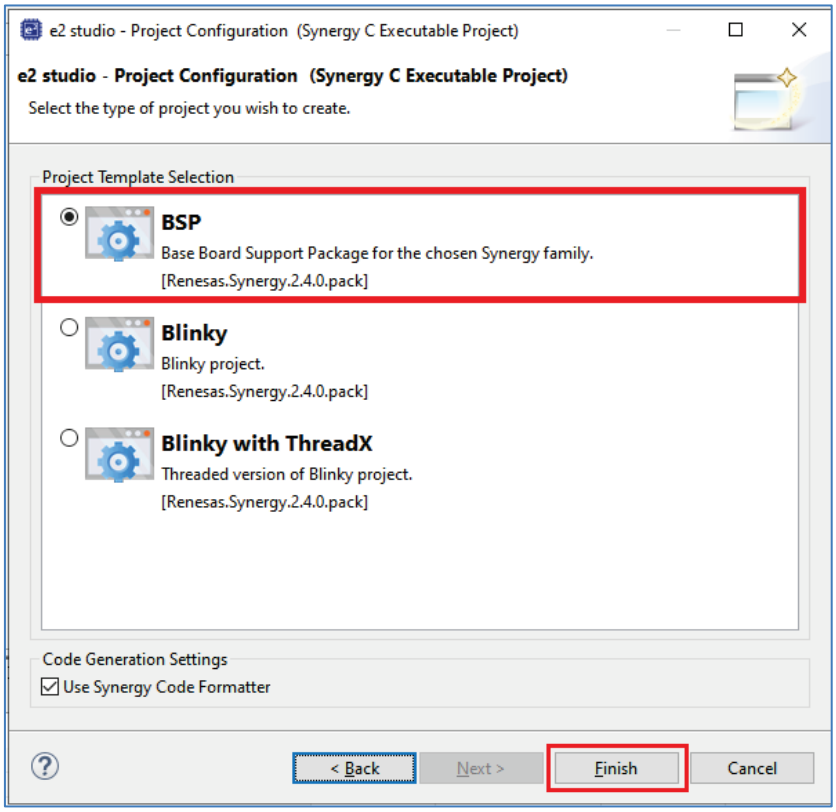

Figure 26. Select the BSP as Your Project Template

5. Click **Finish**. The default BSP files for S5D9-PK are generated automatically. In e² studio, the project explorer shows all the files generated as shown in the following figure.

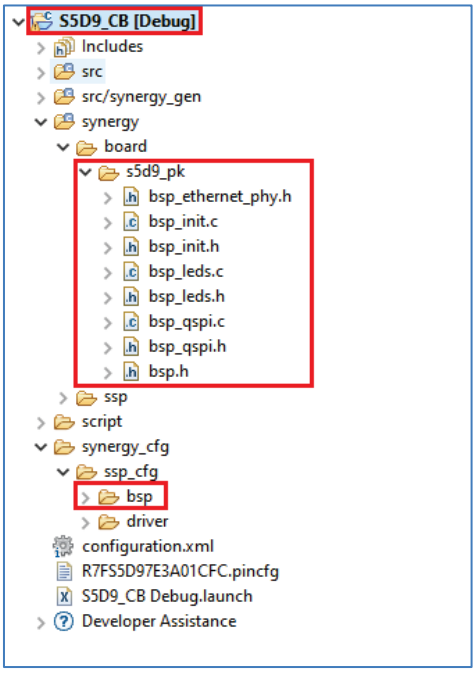

Figure 27. Generated Board Files as Templates for Creating Custom Board Files

6. In the Synergy configurator, under **Pins** tab, click **Manage configurations...**.

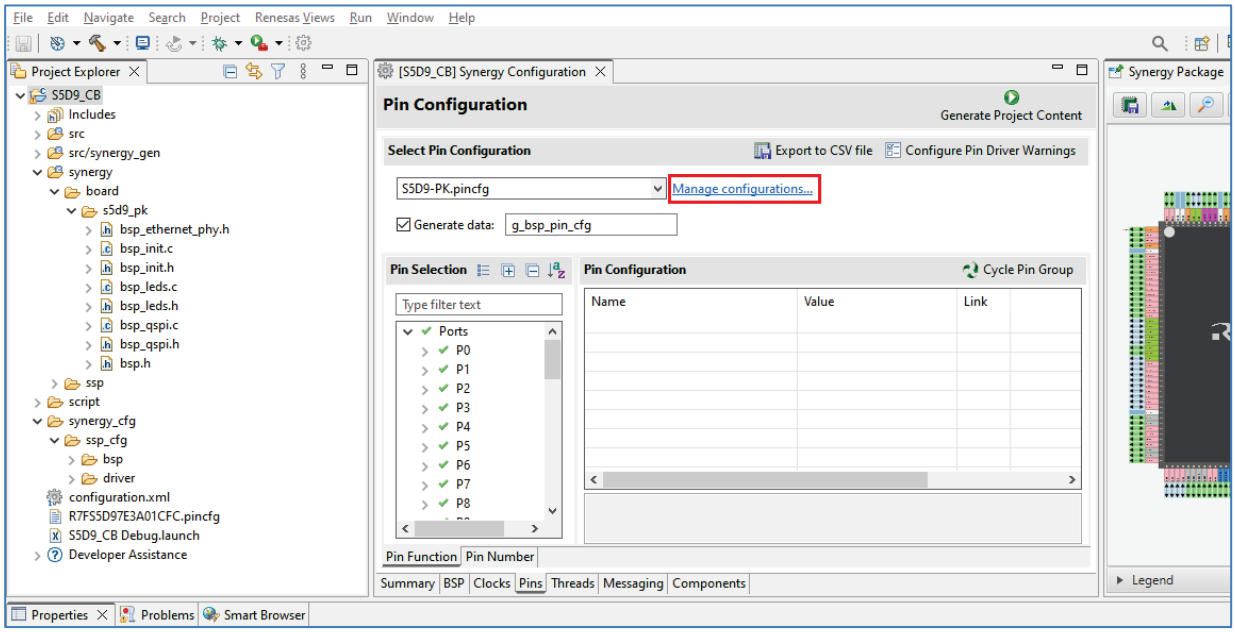

Figure 28. Manage Configurations

7. The following window pops up:

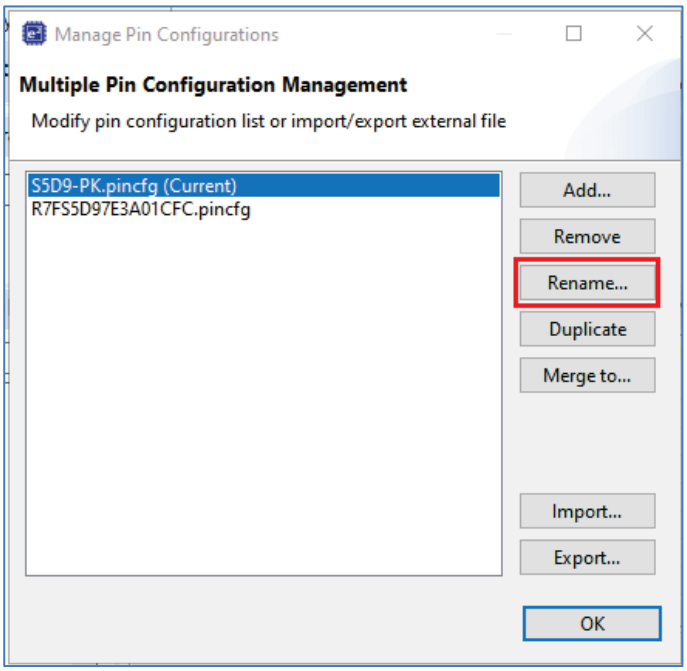

Figure 29. Rename Option for pincfg

Select "**S5D9-PK.pincfg**" and click **Rename**.

8. Rename it to the custom board, in the following example, "**S5D9-CB.pincfg**". Click **OK**.

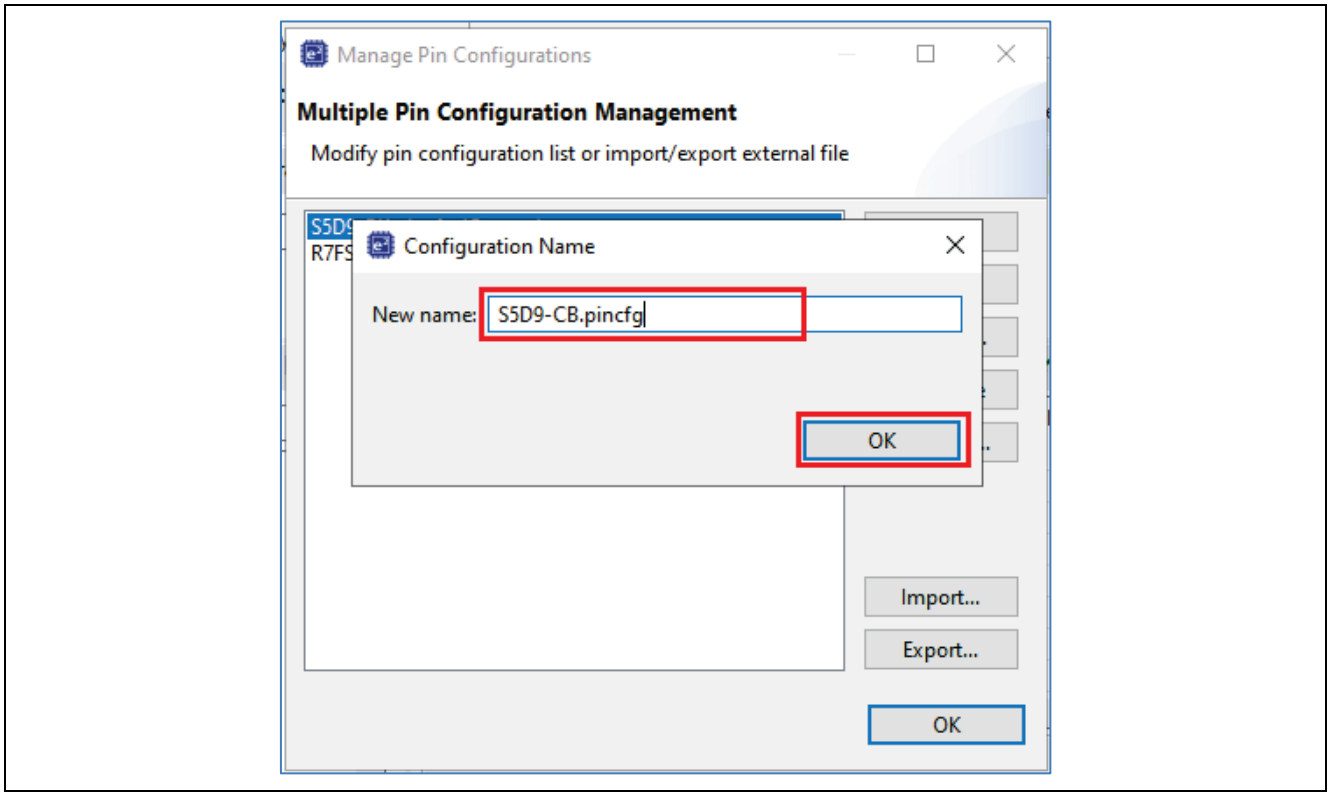

Figure 30. Rename pincfg file for the Custom Board

9. The renamed `.pincfg` file is reflected under **Manage Pin Configurations**. Click **OK**.

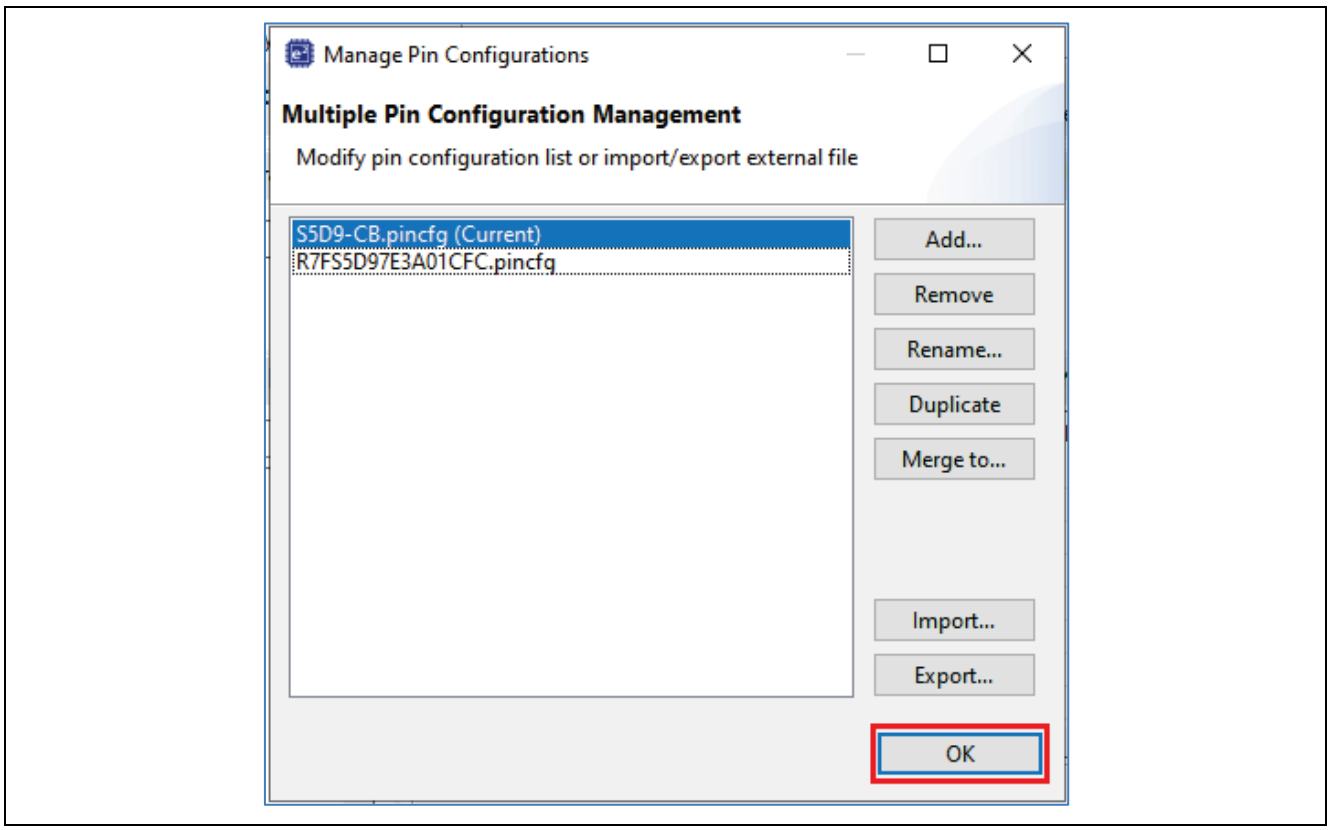

Figure 31. Custom Board pincfg File

10. The renamed `.pincfg` file will automatically be populated under **Pin Configuration**.

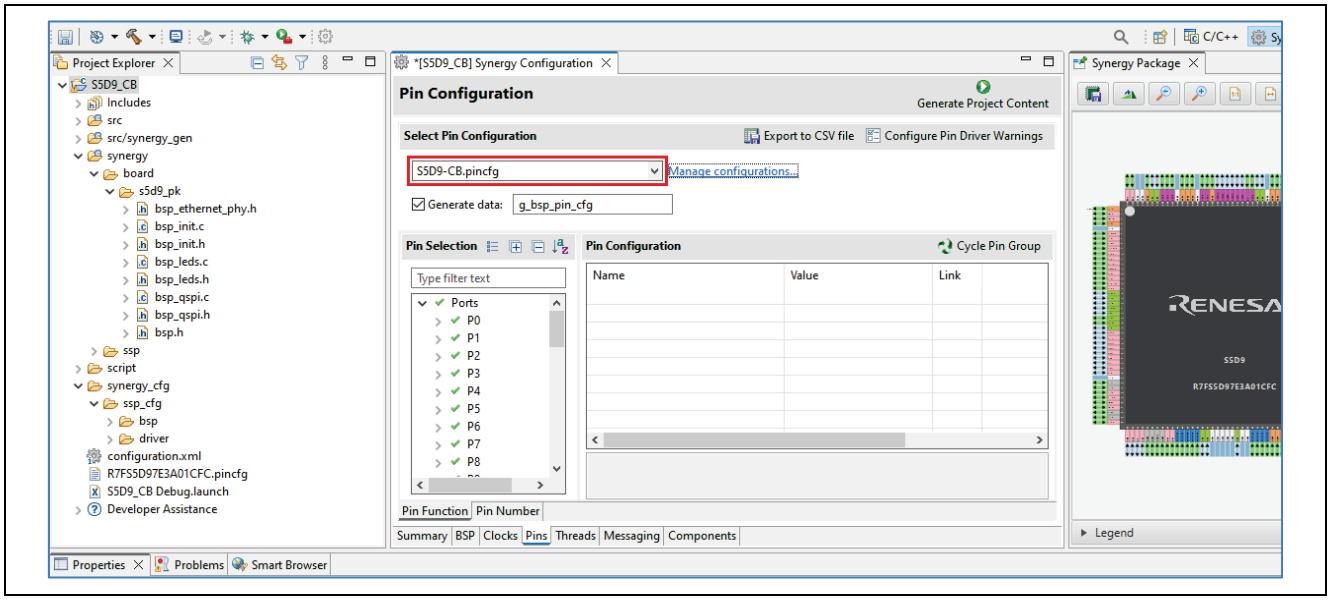

Figure 32. Pin Configuration Tab Showing the Custom New Board pincfg File

11. Based on your board I/O schematics, create a new `g_bsp_pin_cfg` structure by deselecting the unused peripherals/ports, and select the required components on the custom board in the Synergy Configuration Pins panel. For example, the custom board S5D9_CB has a high-speed USB host and a full-speed USB device as shown below:

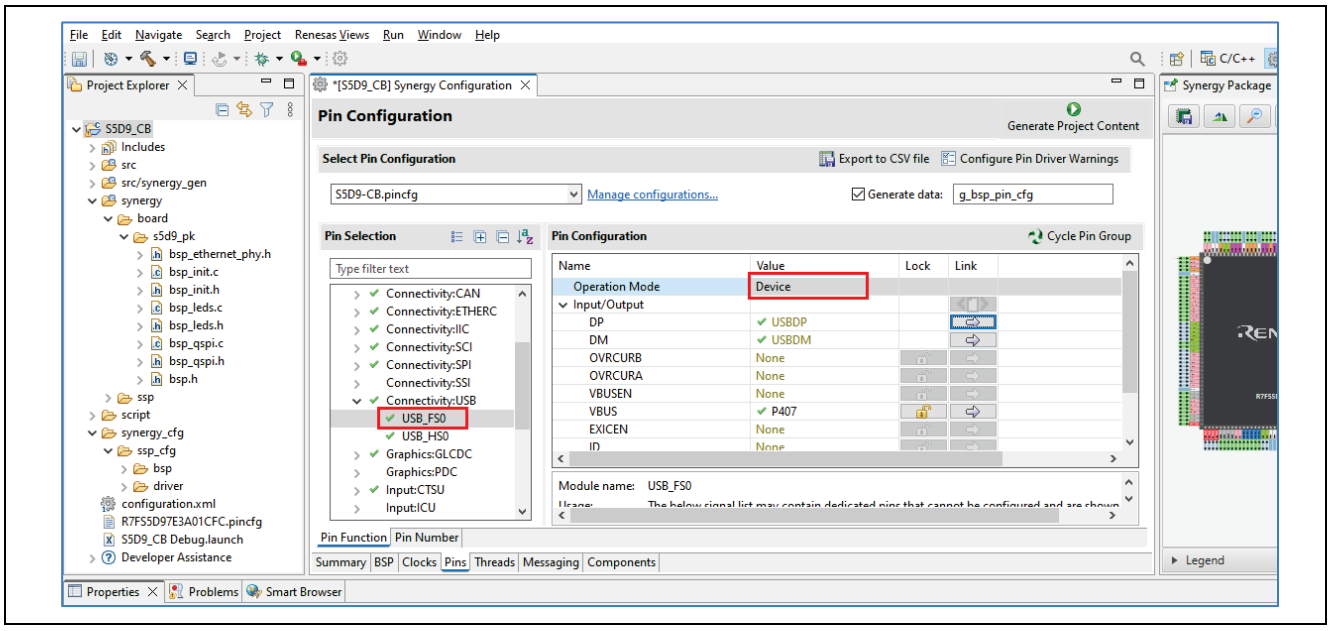

Figure 33. Set the Connection Between Pins and Peripherals for Your Board

12. Click **Generate Project Content** button and **Proceed** to generate new Synergy files based on the configuration on each tab, such as **Clocks**, **Pins**, and so forth, and then save these generated configuration files.

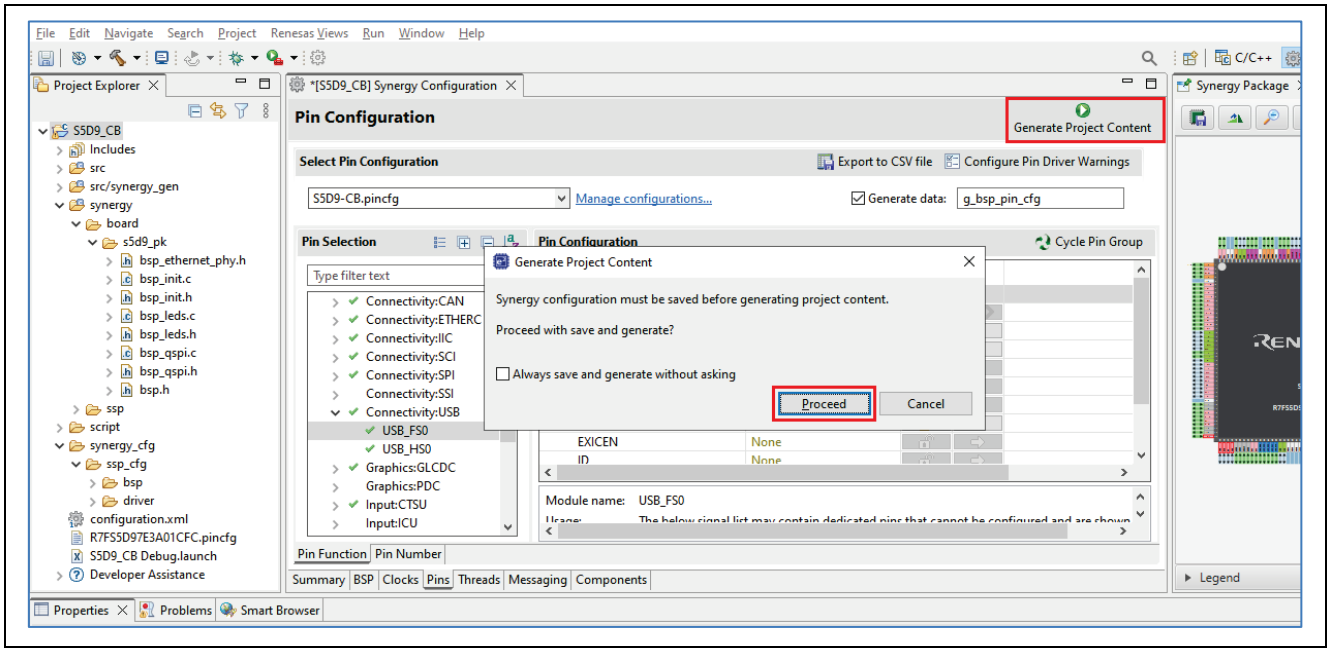

Figure 34. Generate the Project Content

13. The **modules** folder used by e² studio is stored in the **support folder** of e² studio. The **support folder** can be opened by selecting **Help** > **About e² studio** from the e² studio menu and clicking the **Installation Details** > **Support Folders** > **e² studio support area** link from the dialog box as shown below.

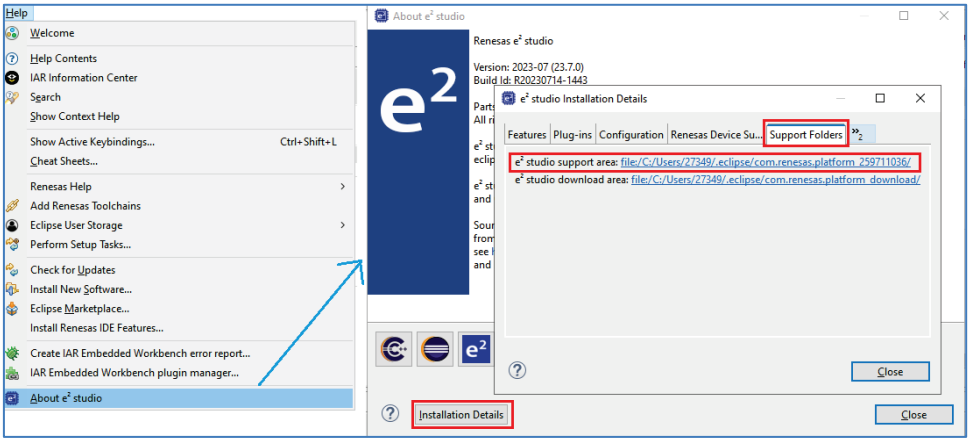

Figure 35. Support Folder in e² studio

14. Open the `modules` folder by clicking the "`e² studio support area`" link and navigating to "internal\projectgen\arm"

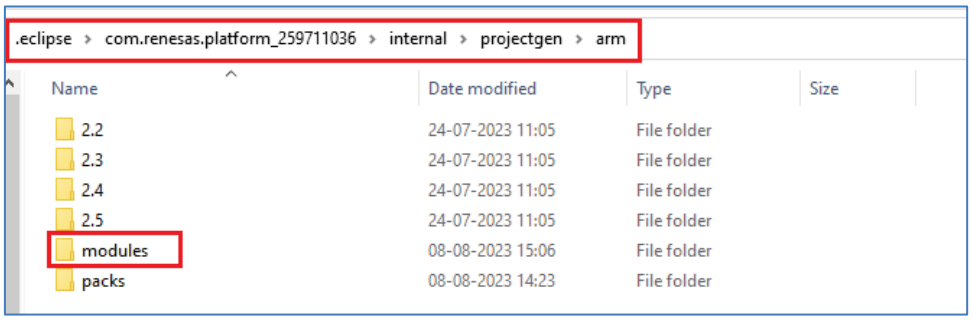

Figure 36. Modules Folder in e² studio v7.3.0 or Later

15. Make a copy of the original board files of PK-S5D9 and rename them with the new board name as shown in the following figure.

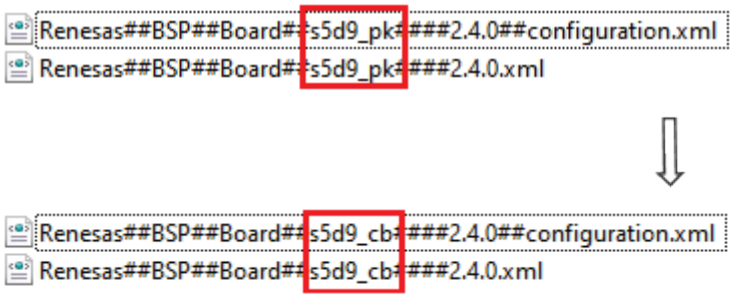

Figure 37. Replace the Existing BSP Name with Your Custom Board Name

16. Rename the generic BSP folder to custom BSP folder, for example, **s5d9_pk** to **s5d9_cb**.

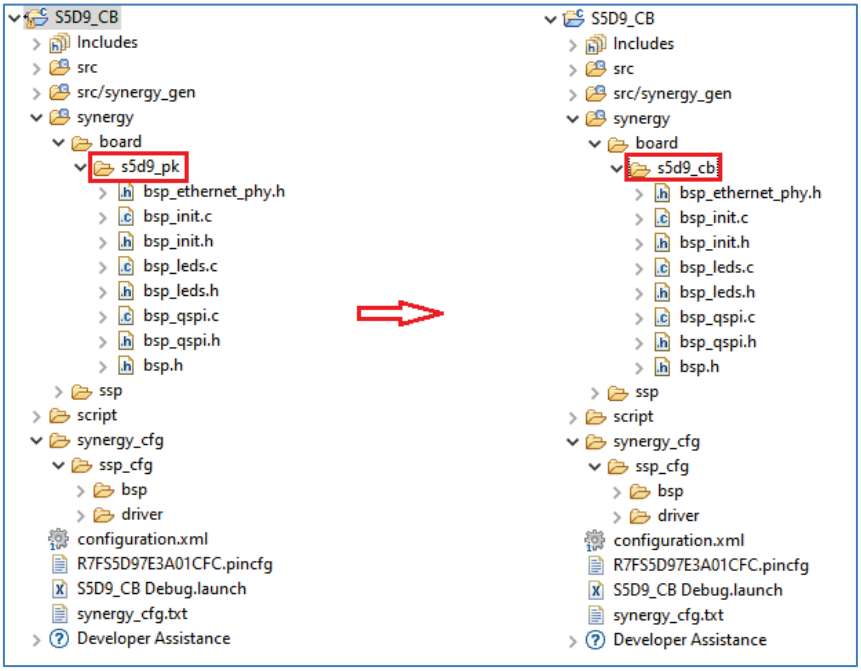

Figure 38. Renaming to Custom Board Folder

17. The macro “**BSP_BOARD_S5D9_PK**” should be replaced with “**BSP_BOARD_S5D9_CB**” in all existing board files.

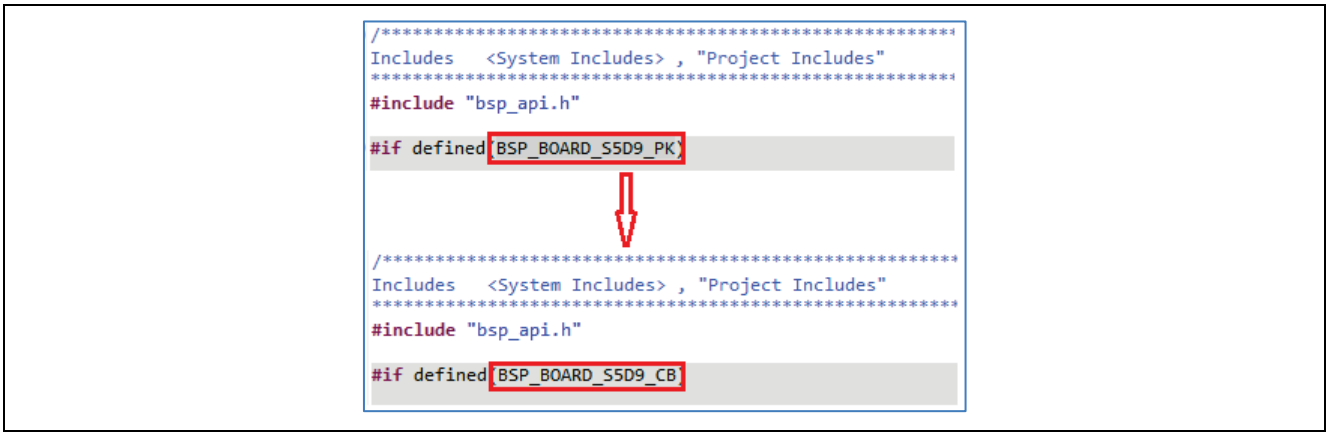

Figure 39. Replacing Template Board Name with Your Board Name in Generated Synergy Files

18. Delete the driver files for unused peripherals, for example, `bsp_qspi.h/c`, if no QSPI is selected in the pincfg.
19. Based on your board layout, modify the board files to include GPIO driven components, such as LEDs, which are defined in the `bsp_leds.c/h` file:

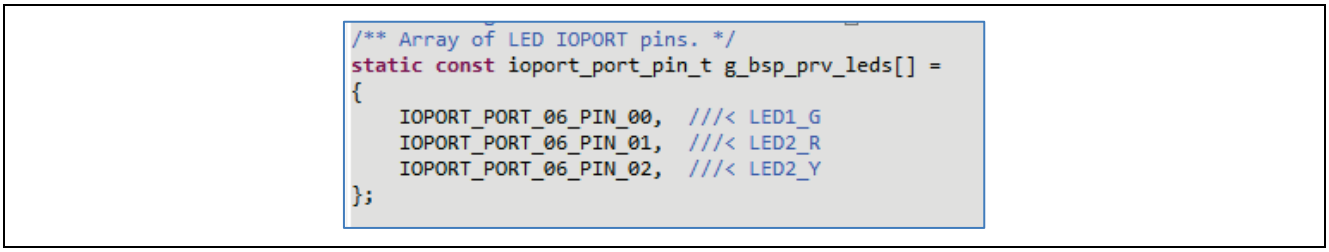

Figure 40. Modify GPIO Driven Components

20. Export the new board files with a built-in CMSIS-Pack generator. There are three ways to access the Export Synergy User Pack Wizard in e² studio:
    A. Right-click the project, click **Export**.
    B. Select the project, click **File** > **Export** in e² studio.
    For both (A) and (B), the following window pops up:

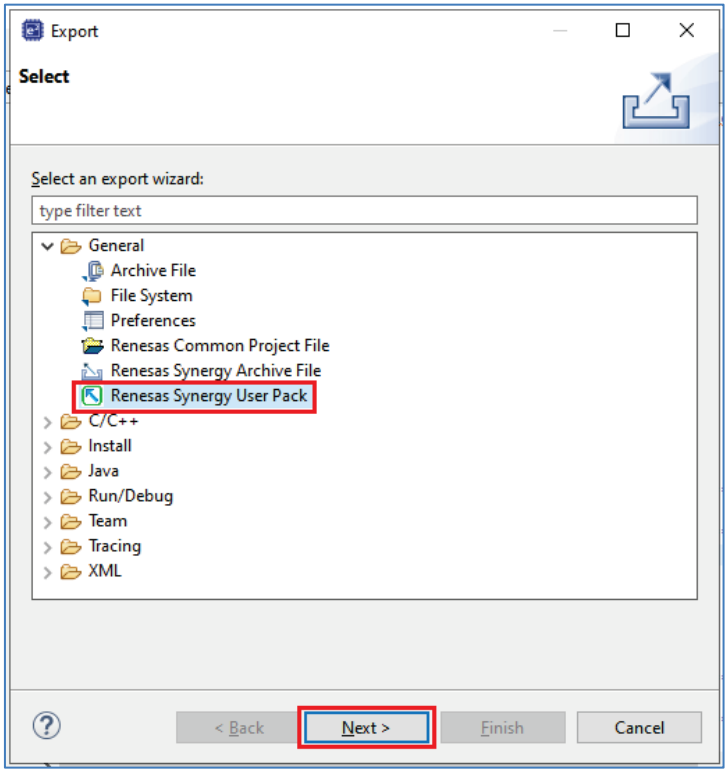

Figure 41. Export Synergy User Pack Wizard

Under **General**, select **Renesas Synergy User Pack** for proceeding with the further steps to create the custom BSP pack.

C. Right-click on the project, select **Renesas Synergy Export** and then select **Export Synergy User Pack...**

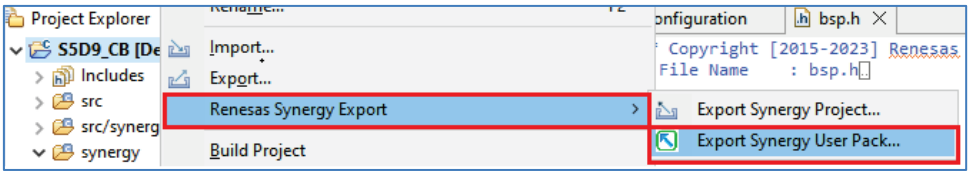

Figure 42. Renesas Synergy Export Option

A dialog window is displayed after one of the above operations, as shown in the following figure:

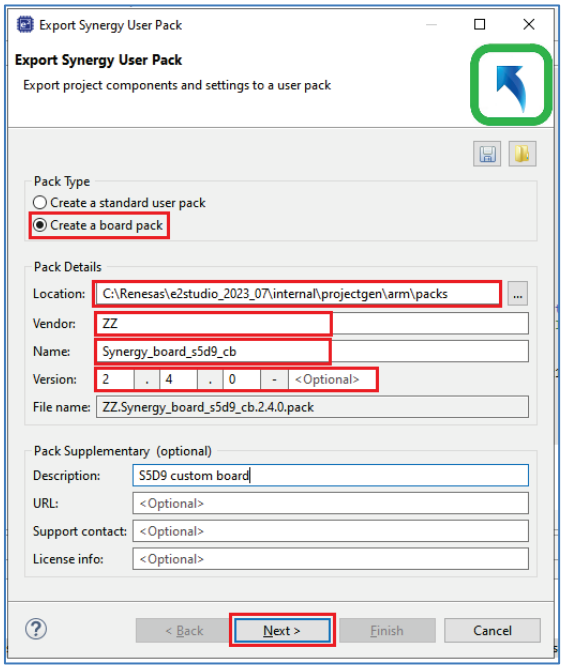

Figure 43. Specify Vendor Information in the Synergy User Pack

Perform the following steps to create a custom board pack:

a. Select **Create a board pack**.
b. Set the location for the new pack, as per your e² studio installation. In this example project, we have chosen `C:\Renesas\e2studio_2023_07\internal\projectgen\arm\packs`.
c. Fill out the **Vendor**, **Name**, and **Version information**, and click **Next**.
This brings up the dialog box as shown below:

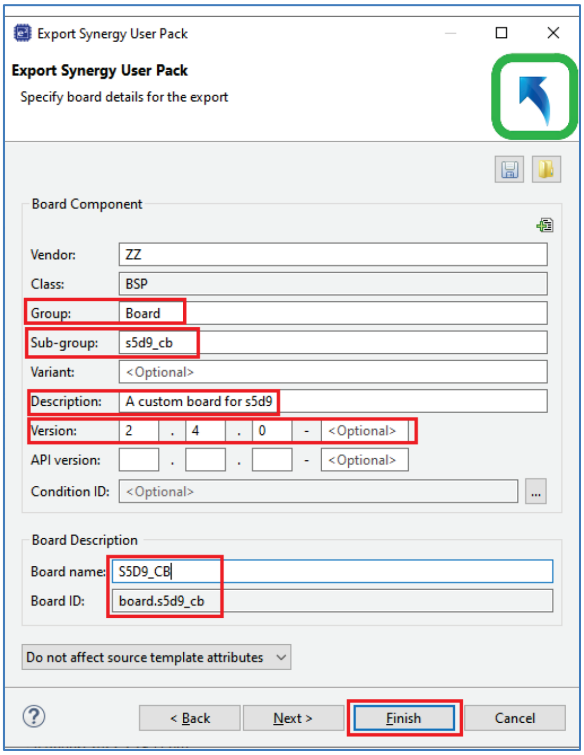

Figure 44. Specify the Custom Board Information in the Synergy User Pack

d. Fill out the **Group**, **Subgroup**, **Version** and **Description**.
e. For **Board name**, enter **S5D9_CB**.
   Note: The board name must match the board folder name that you used in step 16.

f. Click the **Add** button  on the screen to select the files that you want to include in the pack.
   Note: Make sure to include all board source files.

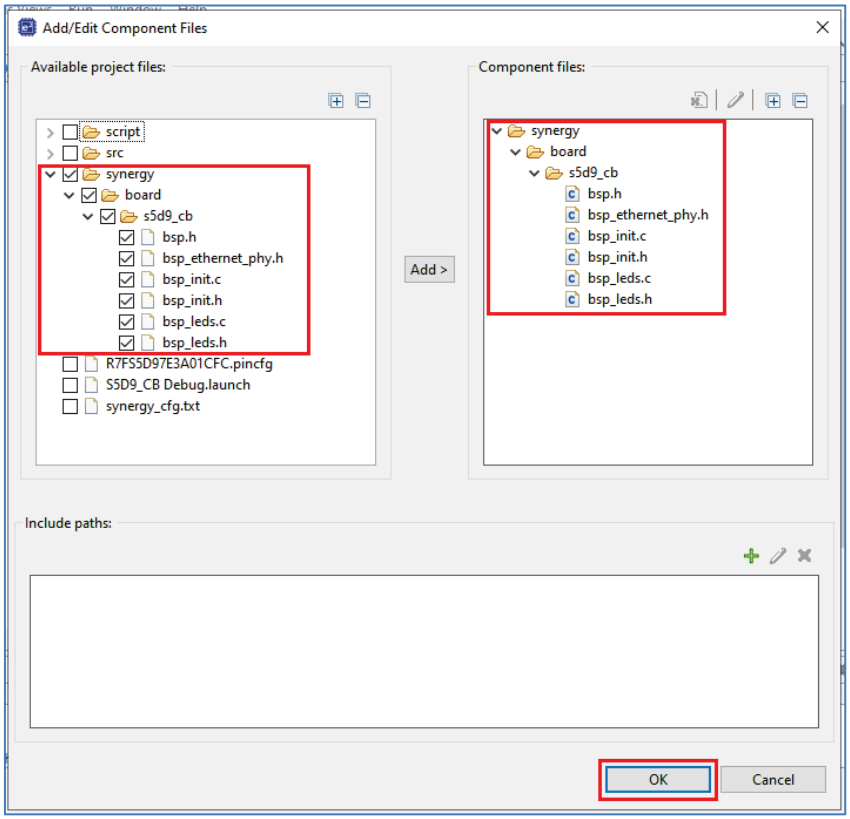

Figure 45. Specify Files To be Included in the Synergy User Pack

g. Press **OK** and **Finish** to create the custom board pack, `ZZ.Synergy_board_s5d9_cb.2.4.0.pack`.

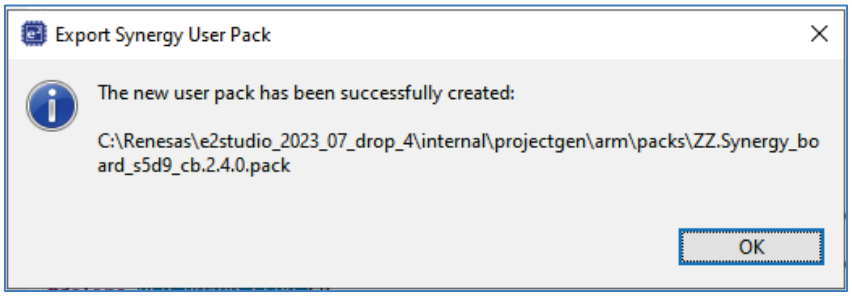

Figure 46. New User Pack successfully created

21. Test this custom BSP pack by creating a new project, selecting **S5D9_CB** from **BSP** in the e^2 studio, and then making other Synergy configurations.

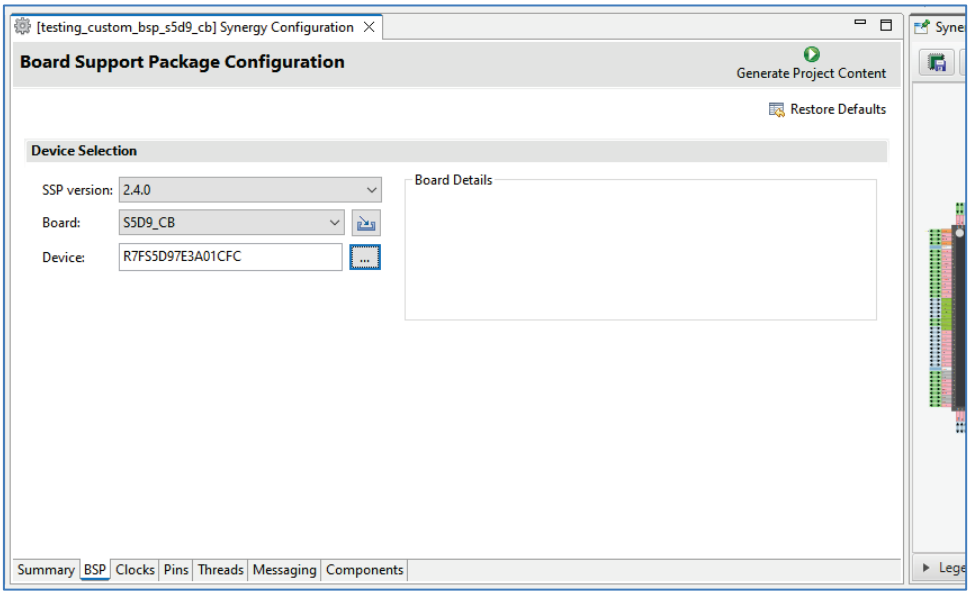

Figure 47. Select and Test Your Created Custom BSP Pack

2.3 Creating a Pack Based on an Existing Pack in SSP v1.2.0 or Later

This example shows how to create a custom board pack in the IAR environment, or directly make a custom board pack from an existing Synergy board pack. IAR for EWSYN v7.71.1 does not have the option to use the built in Synergy export tool. and so use this approach to create the custom board pack.

Follow these steps:

1. Navigate to your SSP v1.2.0 or later; and go to the `\internal\projectgen\arm\Packs` folder of your packs installation for the IAR EW for Synergy.
2. As shown in Figure 2, board packs that are already installed are listed there.
3. Find a pack with the same or similar device as your targeted MCU, such as s3a7_dk, to make your conversion process faster.
4. Pick a board name you want to use, such as s3a7_iot_enabler. Make sure to use that name throughout this process.
5. Copy the board pack from step 3 and rename it with your board name. The board name must begin with “Synergy_board_”, such as “Renesas.Synergy_board_s3a7_iot_enabler.1.2.0.pack” for example.
6. Extract the contents of this new pack file from a file archive utility, such as 7-Zip.
7. Replace “s3a7dk.pincfg” file with your board name, “s3a7_iot_enabler.pincfg”.
8. Modify the XML file in .module_descriptions. Replace all instances of the old board name “s3a7_dk” with your new board name “s3a7_iot_enabler”.
9. Choose the part number in Device attribute as your targeted device.
10. Rename the XML file to use your board name. Go to the synergy/board folder and rename the board folder “s3a7- dk” to be your board name “s3a7_iot_enabler”.
11. To this newly renamed folder, add your BSP files, such as `bsp.h`, `bsp_init.c`, and `bsp_init.h`. You can make a copy from an existing board, and then manually modify it.
12. Rename the `*.pdsc` file in the root directory of your new board.
13. Modify the contents of the PDSC file:
    - Replace board name with your board name
    - Make sure there is a <file> element in the <component> for each file you want delivered as part of this pack.

14. Select all files and folders, then create a zip format of the file as `Renesas.Synergy_board_s3a7_iot_enabler.1.2.0.zip`, then change its name to `Renesas.Synergy_board_s3a7_iot_enabler.1.2.0.pack`. You must use a Zip software utility supporting the compression method DEFLATE, like 7-Zip (https://www.7-zip.org/) to create the file. Note that you should make the Zip file by selecting the `.mcu`, `.module_descriptions`, and `synergy` folders and the `Renesas.Synergy_board_s3a7_iot_enabler.1.2.0.pack` file. Then right-click and select **7-ZIP > Add to Renesas.Synergy_board_s3a7_iot_enabler.1.2.0.zip**.

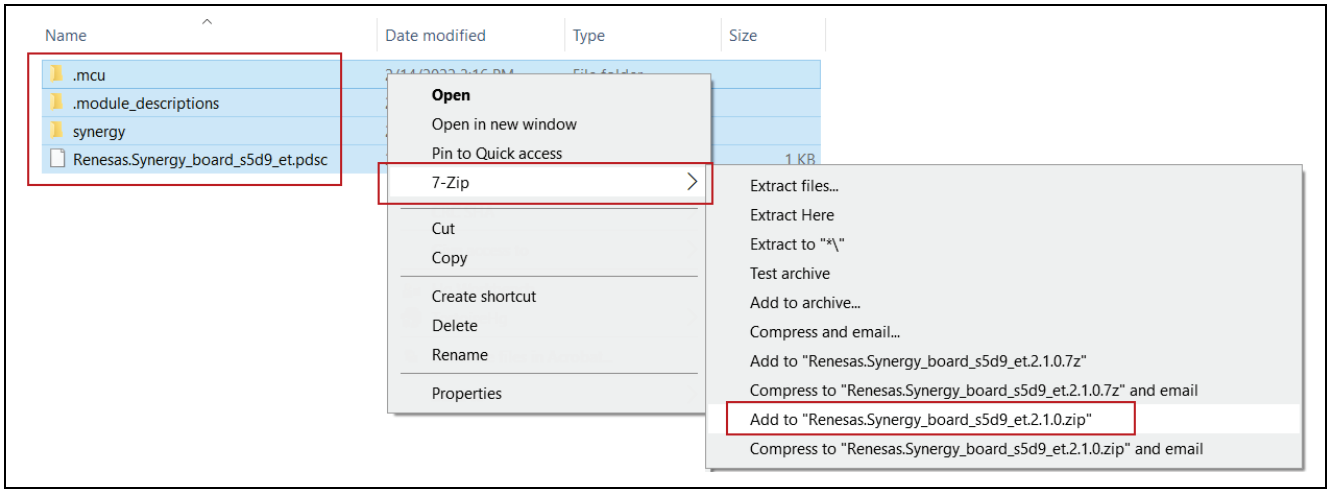

Figure 48. Create Zip Format File

3. Conclusion

Two different approaches for upgrading or creating a custom board pack for SSP v1.2.0 or later have been presented in this guide. By following the step by step instructions, users can recreate a pack for SSP v1.2.0 or later from an existing custom pack in the SSP v1.2.0 or later, or create a new pack from scratch either by using a built-in Export Synergy User Pack or directly working on the files of a board folder.

4. Known Issues

While using e² studio 5.4.0.23 for creating the Custom BSP from ground up, without using the board BSP and Board pin config supported by SSP, the user may run into issues when **Export Synergy User Pack** is used. Users need to change the file attribute from **none** to **template**. This issue is not seen in other e² studio released for SSP v1.2.0 onwards.

Note: By using the steps in the section 2.1 to create the Custom BSP, the user will not see the issue mentioned below.

The snapshot of the attribute change required to create a Custom BSP using e² studio 5.4.0.23 is shown in Figure 49.

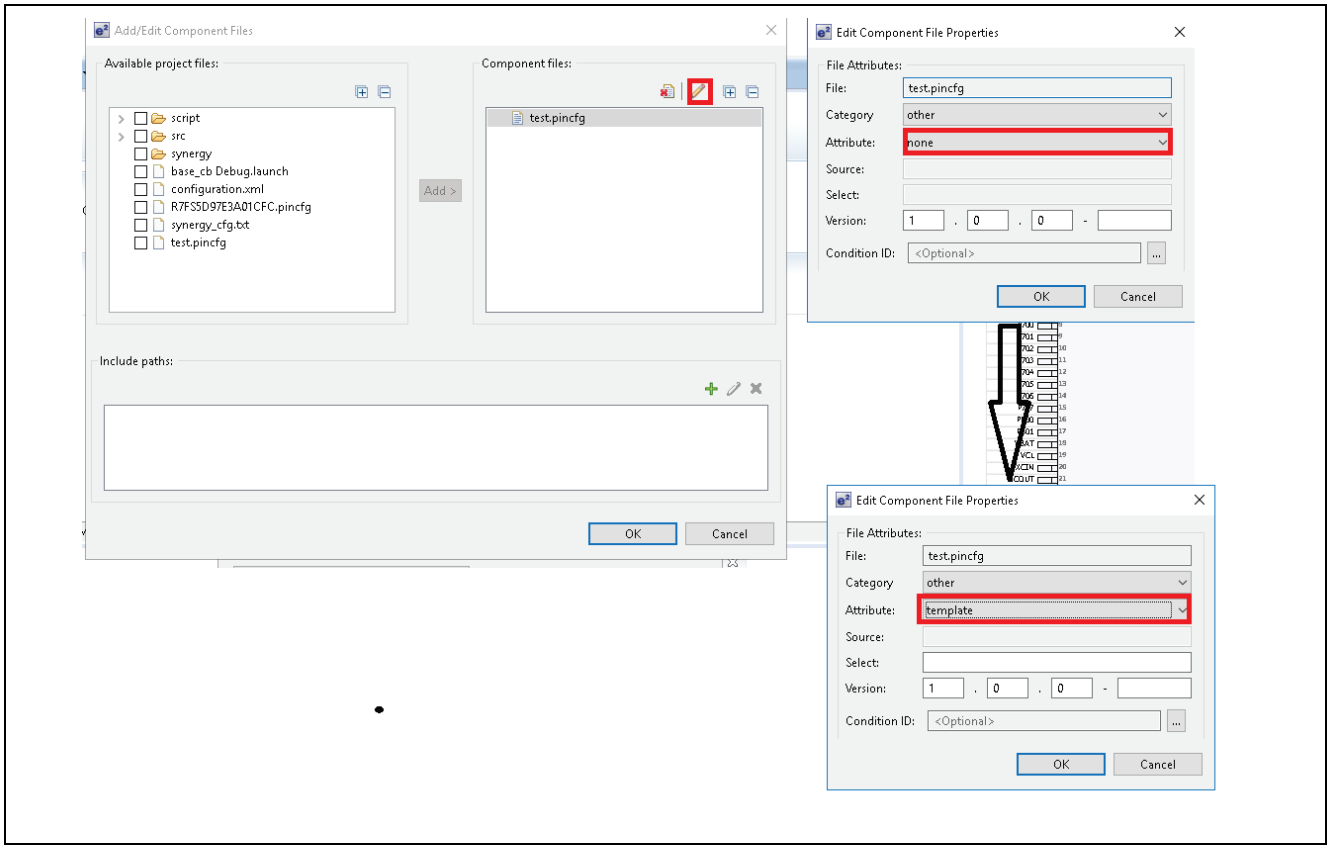

Figure 49. Attribute Change Required to Create Custom BSP in e² studio 5.4.0.23

5. References

1. IAR Embedded Workbench, Getting Started with IAR Embedded Workbench® for Renesas Synergy™.
2. Keil, CMSIS-Pack (v 1.4.1). Retrieved from Usage and Description: http://www.keil.com/pack/doc/CMSIS/Pack/html/pages.html
3. Renesas Synergy™ Software Package v1.2.0 or later.

Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

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Synergy Community	Renesas Synergy™ Platform - Renesas Community
Training	Academy | Renesas Synergy™
Videos	Renesas Synergy™ Platform - YouTube

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Dec.14.16	-	Initial release
1.01	Jan.20.17	-	Incorporated feedback
1.10	Mar.3.17	-	Upgrade to SSP v1.2.0. Added a session to describe the SSP contents.
1.11	Oct.12.18	-	Minor update.
1.12	Jun.18.19	-	Corrections to Figure 4
1.13	Feb.14.22	13-14	Updated instructions for creating pack based on existing pack.
1.14	Jul.26.23	-	Added section 2.2.
1.15	Aug.09.23	-	Added clarification to step 14, 15, 16 in section 2.2.

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