RISC-V MCU Smart Configurator

User's Guide: IAREW, SEGGER Embedded Studio

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Introduction

This application note describes the basic usage of the RISC-V MCU Smart Configurator (hereafter called the Smart Configurator), and the procedure for importing its output files to IAR Embedded Workbench and SEGGER Embedded Studio.

References to the Smart Configurator and Integrated Development Environment (IDE) in this application note apply to the following version.

- IAR Embedded Workbench for RISC-V V3.30.1 and later
- SEGGER Embedded Studio 8.10 and later
- RISC-V Smart Configurator V1.1.0 and later

Target device and support compiler

Refer to the following URL for the range of supported devices:

https://www.renesas.com/software-tool/risc-v-smart-configurator

Contents

1. Overview 5
1.1 Purpose 5
1.2 Features 5
1.3 Software Components 5

2. Installing and Uninstalling the Smart Configurator 6
2.1 Installing the Smart Configurator 6
2.2 Uninstalling the Smart Configurator 6

3. Operating the Smart Configurator 7
3.1 Procedure for Operations 7
3.2 Starting the Smart Configurator 8
3.3 Creating and Loading a Configuration File 9
3.3.1 Creating a New Smart Configurator Configuration File 9
3.3.2 Opening an Existing Configuration File 10
3.4 Window 11
3.4.1 Main Menu 12
3.4.2 Toolbar 12
3.4.3 Smart Configurator View 13
3.4.4 MCU/MPU Package View 14
3.4.5 Console View 15
3.4.6 Configuration Problems View 15

4. Setting of Peripheral Modules 16
4.1 Board Setting 16
4.1.1 Selecting the Device 16
4.1.2 Selecting the Board 17
4.1.3 Exporting Board Settings 18
4.1.4 Importing Board Settings 18
4.2 Clock Settings 19
4.3 System Settings 20
4.4 Software component settings 21
4.4.1 Switching Between the Component View and Hardware View 21
4.4.2 Adding a Software Component 22
4.4.3 Setting a Code Generator Component 25
4.4.4 Changing the Resource for a Code Generator Configuration 26
4.4.5 Adding a RISC-V MCU Software Integration System Module 28
4.4.6 Changing Version of BSP Configuration 29
4.4.7 Export Component Configuration 31
4.4.8 Import Component Configuration 31
4.4.9 Configure General Setting of the Component 32

4.5 Pin Settings 34
4.5.1 Changing the Pin Assignment of a Software Component 35
4.5.2 Assigning Pins Using the MCU/MPU Package View 36
4.5.3 Show Pin Number from Pin Functions 37
4.5.4 Exporting pin settings 38
4.5.5 Importing pin settings 38
4.5.6 Pin setting using board pin configuration information 39
4.5.7 Pin Filter Feature 40
4.5.8 Pin Errors/Warnings setting 41
4.6 Interrupt Settings 41
4.6.1 Changing Interrupt Priority Setting 42
4.6.2 Interrupt Filter Feature 43
4.6.3 Changing Interrupt Vector or Group Setting 43
4.6.4 Resolving Interrupt error 44

5. Managing Conflicts 46
5.1 Resource Conflicts 46
5.2 Resolving Pin Conflicts 47

6. Generating Source Code 48
6.1 Generating Source Code File 48
6.2 Configuration of Generated Files and File Names 49
6.3 Initializing Clocks 54
6.4 Initializing Pins 55
6.5 Initializing Interrupts 55

7. Loading Generated Files in Integrated Development Environment 56
7.1 Loading in IAR Embedded Workbench 56
7.2 Loading in SEGGER Embedded Studio 58
7.3 Build IAR Project File 59
7.4 Build SEGGER Embedded Studio Project File 59

8. Creating User Programs 60
8.1 Adding Custom Code 60
8.2 Using Generated Code in User Application 62

9. Backing up Generated Source Code 62

10. How to make debug connections via J-Link OB on the FPB Board 63

11. Generating Reports 66
11.1 Report on All Configurations (PDF or Text File) 66
11.2 Configuration of Pin Function List and Pin Number List (in csv Format) 67
11.3 Image of MCU/MPU Package (in png Format) 67

12. User Code Protection Feature for Smart Configurator Code Generation Component 68
12.1 Specific Tags for the User Code Protection Feature 68
12.2 Examples of Using User Code Protection Feature to Add New User Code 68
12.3 What to Do When Merge Conflict Occurs 69
12.3.1 What is Merge Conflict 69
12.3.2 Steps for Resolving the Merge Conflict 70
13. Help 72
14. Documents for Reference 73

1. Overview

1.1 Purpose

This application note describes the basic usage of the RISC-V MCU Smart Configurator (hereafter called the Smart Configurator), and the procedure for importing its output files to IAR Embedded Workbench / SEGGER Embedded Studio.

Refer to the User's Manual of IAR Embedded Workbench / SEGGER Embedded Studio for how to use them.

1.2 Features

The Smart Configurator is a utility for combining software to meet user's needs. It handles the following three functions to support the embedding of drivers from Renesas in user's systems: importing middleware in the form of SW integration feature, generating driver code, and making pin settings.

1.3 Software Components

The Smart Configurator supports three types of software components: Code Generator, Graphical Configurator, and RISC-V MCU Software Integration System:

(1) Code Generator drivers (DTC, A/D Converter, Interrupt Controller, etc.)
The Code Generator drivers is a control program for peripheral functions of microcomputer such as DTC, A/D converter, Interrupt Controller, etc. It is convenient to embed a software component using code generation function.

(2) RISC-V MCU Software Integration System (BSP, etc.)
The RISC-V MCU Software Integration System module is a software component of drivers, middleware SW that provides a simple GUI for generating code.

2. Installing and Uninstalling the Smart Configurator

2.1 Installing the Smart Configurator

Download the Smart Configurator from the URL below.

https://www.renesas.com/software-tool/risc-v-smart-configurator

After activating the installer, install the Smart Configurator by following the procedure of the installer. User will require administrator privileges to do this.

2.2 Uninstalling the Smart Configurator

To uninstall the Smart Configurator, please select "Smart Configurator for RISC-V MCU" from [Apps & features] in the control panel.

3. Operating the Smart Configurator

3.1 Procedure for Operations

Figure 3-1 Operating Procedure, shows the procedure for generating IAR / SEGGER Embedded Studio related files using Smart Configurator and loading it into IAR Embedded Workbench / SEGGER Embedded Studio. For the operation of IAR Embedded Workbench / SEGGER Embedded Studio, refer to relevant document of IAR / SEGGER Embedded Studio.

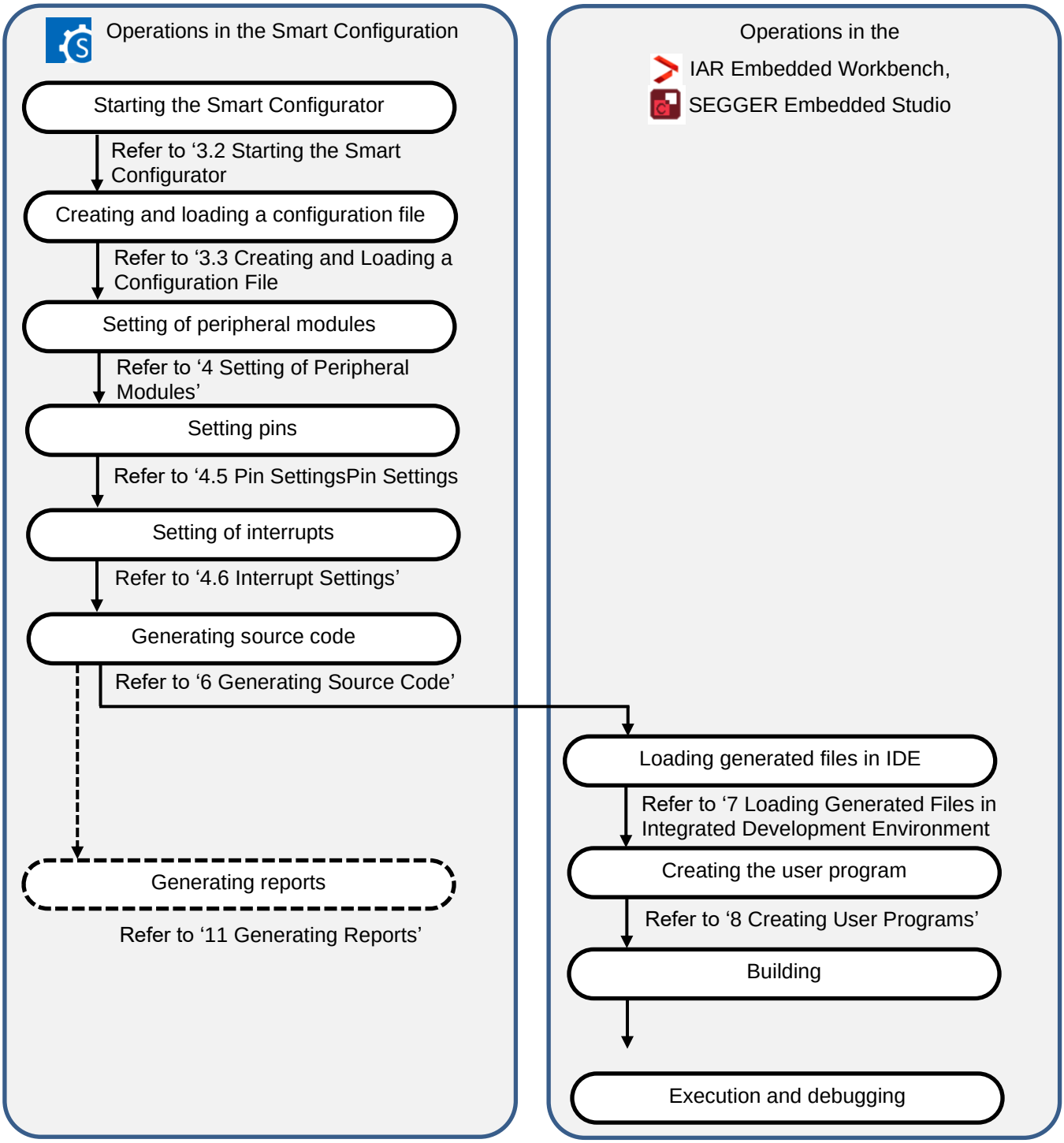


Figure 3-1 Operating Procedure

3.2 Starting the Smart Configurator

Select [Smart Configurator for RISC-V MCU Vx.x.x] of [Renesas Electronics Smart Configurator] from the Windows start menu. The main window of the Smart Configurator will be starting.

Note: Please replace Vx.x.x with user's version.

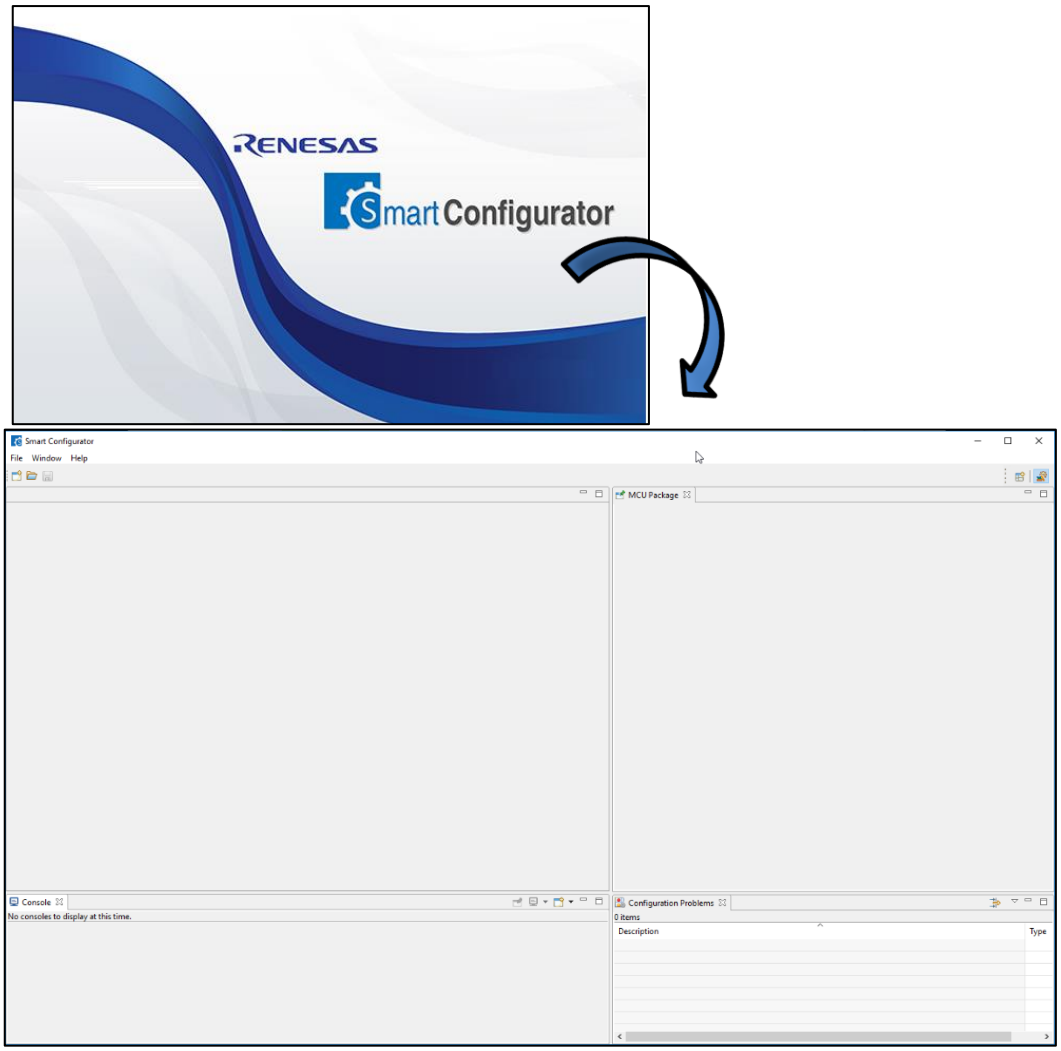


Figure 3-2 Starting of Smart Configurator

3.3 Creating and Loading a Configuration File

Smart Configurator saves and refers to the configuration file (*. scfg) the configuration information of the microcontroller, build tool, peripheral function, pin function etc. used in the project.

3.3.1 Creating a New Smart Configurator Configuration File

On the main window, click the [New Configuration File] button to display the [New Smart Configuration File] dialog box.

(1) In [Platform:] panel, select the Device or Board.

(2) In [Toolchain:] panel, select the toolchain.

To use the IAR compiler, select [IAR RISC-V Toolchain].

To use the SEGGER compiler, select [SEGGER RISC-V Toolchain].

To use the LLVM compiler, select [LLVM for RISC-V Toolchain].

(3) In [File name:], enter the file name.

(4) Confirm [Location:], To change the location, please click [Browse] and select the save destination.

Note:

For IAR RISC-V Toolchain, the *.eww, *.ewp, *.ewd, main.c and buildinfo.ipcf files will be generated to this location after clicking "Generate Code" button. The *.eww, *.ewp, *.ewd and main.c files will be generated only for the first-time code generation, while the buildinfo.ipcf file will be generated always for each time code generation.

For SEGGER RISC-V Toolchain, the *_MemoryMap.xml, SEGGER_Flash_RV32.icf, *. emProject, main.c files will be generated to this location after clicking "Generate Code" button. The *_MemoryMap.xml, SEGGER_Flash_RV32.icf and main.c files will be generated only for the first-time code generation, while the *. emProject file will be generated always for each time code generation.

(5) Click [Next] to select the project template.

"Bare Metal – Blinky" is available for selected Board in step (1).

(6) Click [Finish] to create the configuration file.

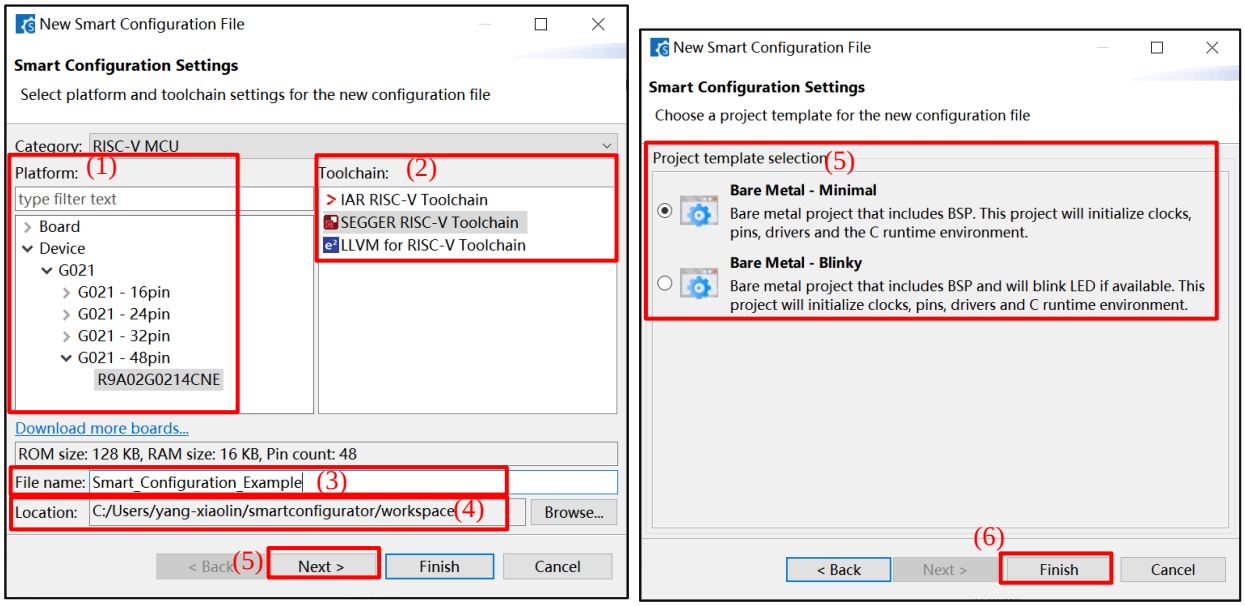


Figure 3-3 Create a Configuration File

(7) Add driver component, configure the setting, generate code, and save the project.

3.3.2 Opening an Existing Configuration File

On the main window, click the [Opening an Existing Configuration File] button to display the [Open] dialog box. Select the (*. scfg) file and click [Open].

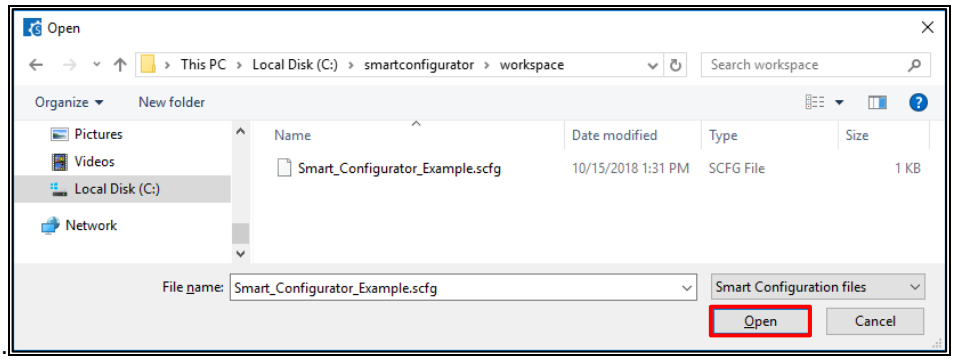


Figure 3-4 Opening an Existing Configuration File

3.4 Window

The main window is displayed when the Smart Configurator is started. The configuration of the window is shown in Figure 3-5, Main Window.

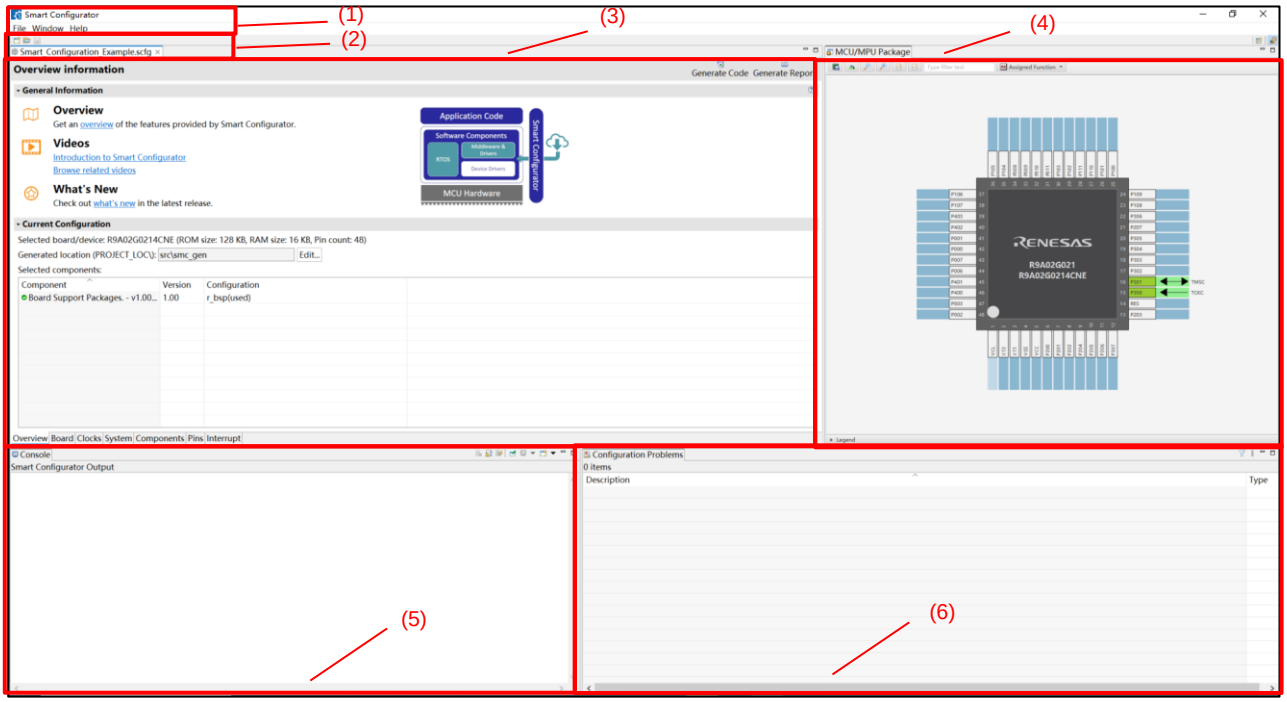


Figure 3-5 Main Window

(1) Menu bar

(2) Main toolbar

(3) Smart Configurator view

(4) MCU/MPU Package view

(5) Console view

(6) Configuration Problems view

3.4.1 Main Menu

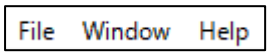
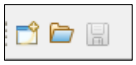


Table 3-1, Main Menu Items, lists the items of the main menu.

Table 3-1. Main Menu Items

Menu		Details
File	New	The dialog box [New Smart Configurator File], which is used to create a new project, is displayed.
	Open	The dialog box [Open], which opens an existing project, is displayed.
	Save	Saves a project with the same name.
	Restart	Smart Configurator is restarted.
	Exit	Execution of the Smart Configurator is terminated.
Window	Preference	The dialog box [Preference], which is used to specify the properties of the project, is displayed.
	Show View	The dialog box [Show view], which is used to set the view of the window, is displayed.
Help	Help Contents	The help menu is displayed.
	Home Page	Open the home page of the Smart Configurator on the Renesas Electronics website.
	Release Notes	Open the release note of the Smart Configurator on the Renesas Electronics website.
	Tool News	Open the tool news of the Smart Configurator on the Renesas Electronics website.
	API Manual	Open the API manual of the Smart Configurator on the Renesas Electronics website.
	About	The version information is displayed.

3.4.2 Toolbar



Some functions of the main menu are allocated to the buttons on the toolbar. Table 3-2 Toolbar Buttons and Related Menu Items, shows the description of those tool buttons.

Table 3-2. Toolbar Buttons and Related Menu Items

Toolbar button	Related menu item
	[File]→[New]
	[File]→[Open]
	[File]→[Save]

3.4.3 Smart Configurator View

The Smart Configurator view consists of seven pages: [Overview], [Board], [Clocks], [System], [Components], [Pins], and [Interrupts]. Select a page by clicking on a tab; the displayed page will be changed.

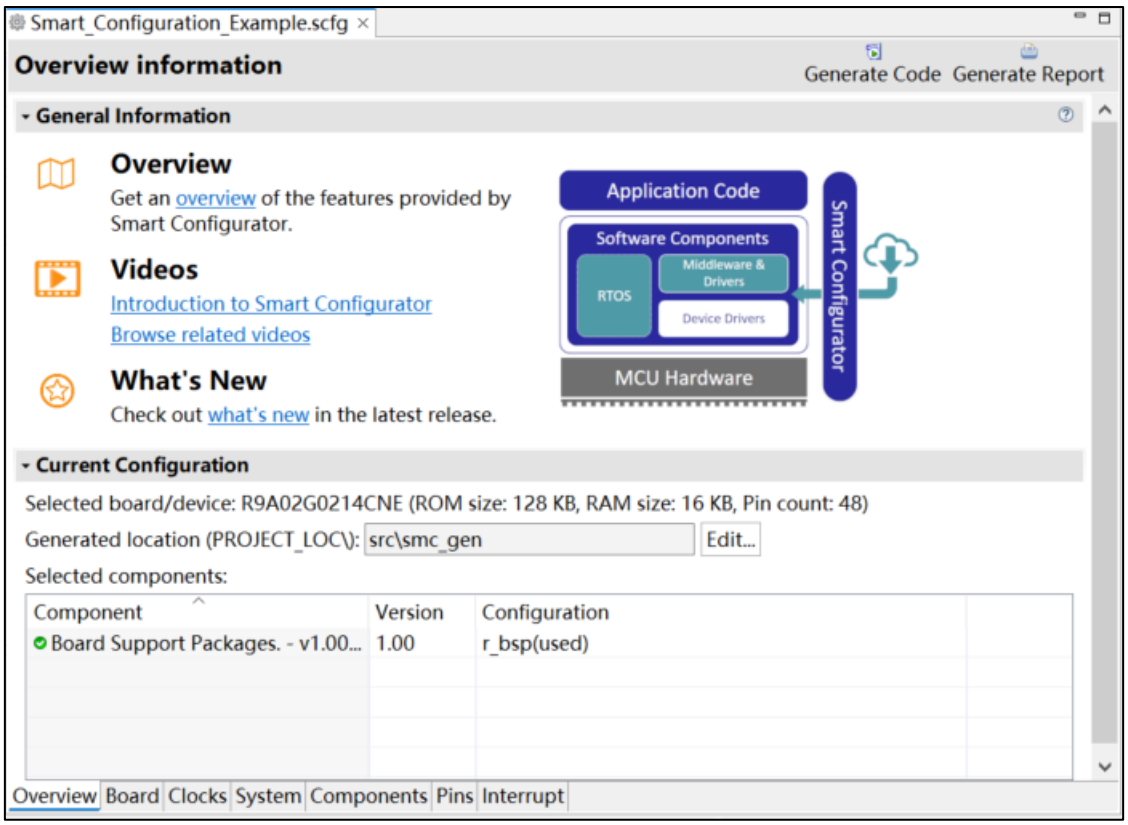


Figure 3-6 Smart Configurator View

3.4.4 MCU/MPU Package View

The states of pins are displayed on the figure of the MCU/MPU package. The settings of pins can be modified from here.

Three types of package view can be switched among [Assigned Function], [Board Function] and [Symbolic Name].

- [Assigned Function] displays the assignment status of the pin setting.
- [Board Function] displays the initial pin setting information of the board. The initial pin setting information of the board is the pin information of the board selected by [Board:] on the [Board] page (refer to "chapter 4.1 Board Setting" and "chapter 4.5.6 Pin setting using board pin configuration information").
- [Symbolic Name] displays the symbolic name defined by user for the pin. Macro definition for the symbolic name will be generated together with port read or write functions in Pin.h file.

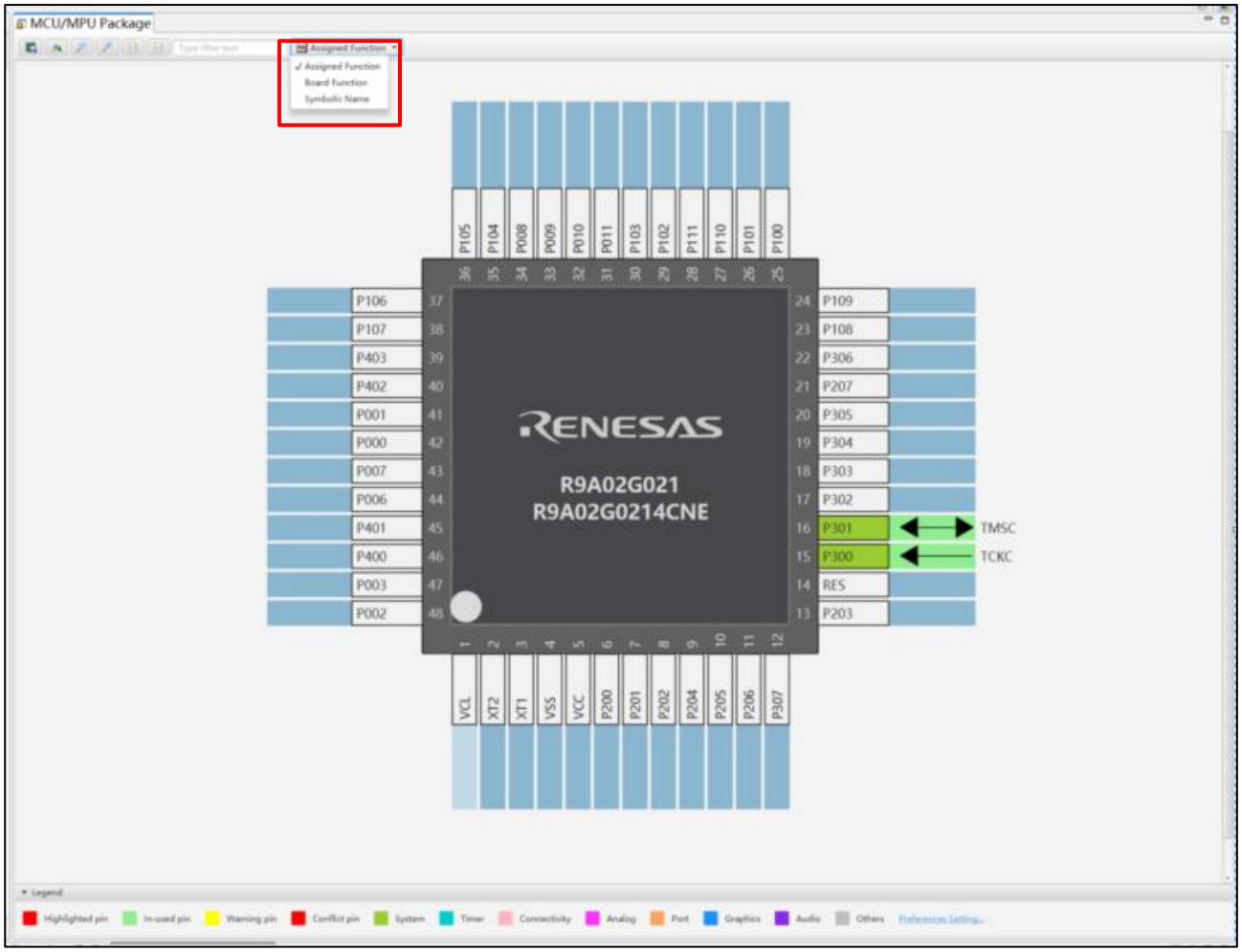


Figure 3-7 MCU/MPU Package View

3.4.5 Console View

The Console view displays details of changes to the configuration made in the Smart Configurator or MCU/MPU Package view.

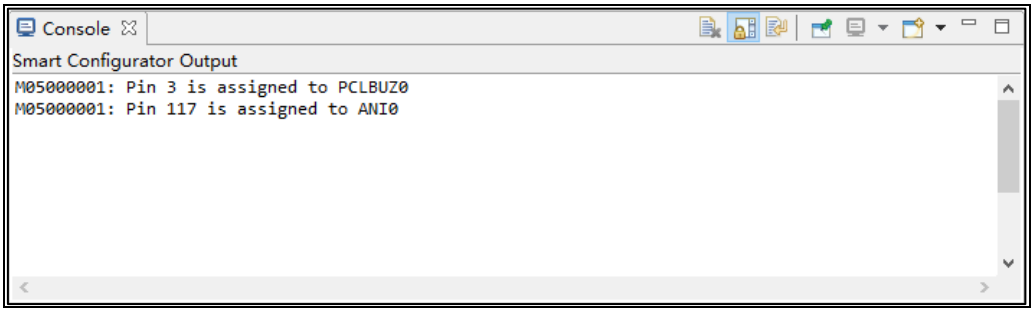


Figure 3-8 Console View

3.4.6 Configuration Problems View

The Configuration Problems view displays the details of conflicts between driver used interrupts, configured peripherals, used pins, used settings.

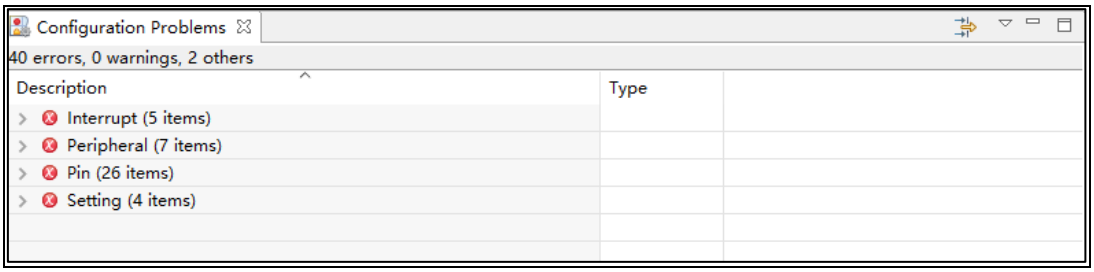


Figure 3-9 Configuration Problems View

4. Setting of Peripheral Modules

User can select peripheral modules from the Smart Configurator view.

4.1 Board Setting

User can change the board and device on the [Board] page.

4.1.1 Selecting the Device

Click on the [...] button to select a device.

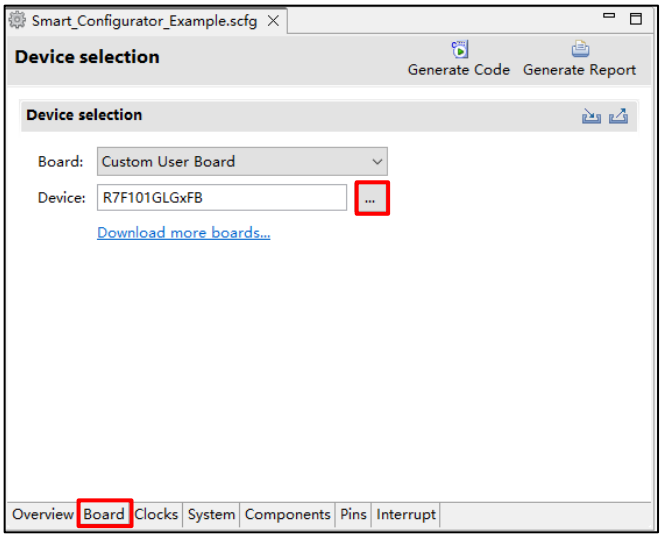


Figure 4-1 Selecting the Device

Note: Device change is not reflected to the device (micro controller) of IAR project.

The following message is displayed when changing the device. For each button operation, refer to "Table 4-1 Device Change Confirmation Operation List".

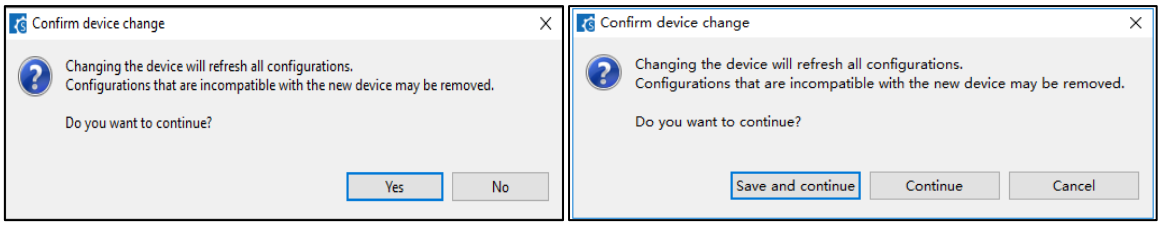


Figure 4-2 Confirm Device Change

Table 4-1. Device Change Confirmation Operation List

Button	Operation explanation
Yes	Change to the selected device.
No	It does not change the device.
Save and continue(Note*1)	After saving the current configuration contents to the configuration file, change to the selected device.
Continue(Note*1)	Changes to the selected device without saving the current configuration contents to the configuration file.
Cancel(Note*1)	It does not change the device.

Note *1: Smart Configurator view is marked with dirty *.

4.1.2 Selecting the Board

Click on the [ ] to select a board from the list. After board selection, the pins, clock and system setting will be automatically configured according to board connection.

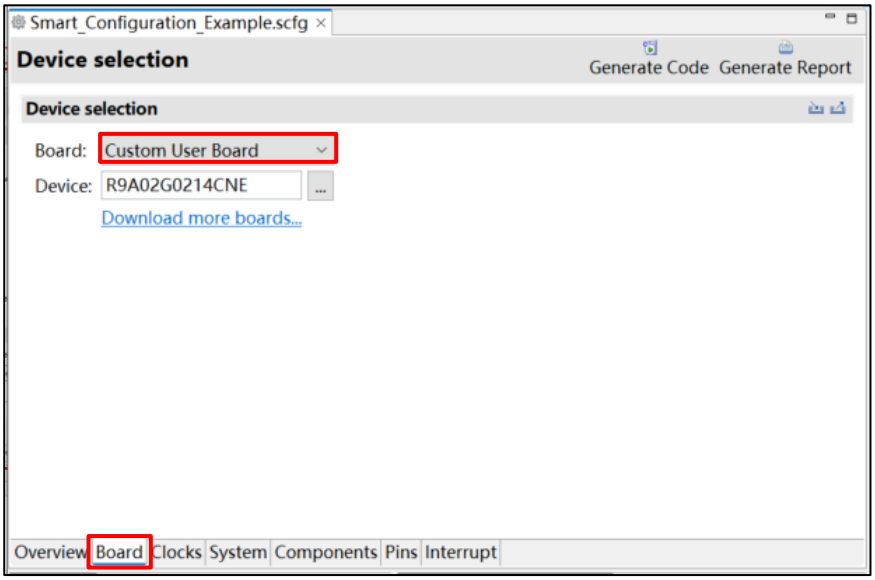


Figure 4-3 Selecting the Board

The following items are changed according to the configuration of the selected board.

- Pin assignment (Initial pin setting)
- Frequency of the main clock
- Frequency of the subsystem clock
- Target device
- On-chip debug operation setting and emulator setting

If user change the board, the message shown in "Figure 4-2" or the following message will be displayed. For each button operation, refer to "Table 4-2 Board Change Confirmation Operation List".

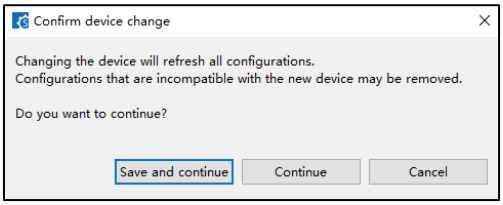


Figure 4-4 Confirm Board Change

Table 4-2. Board Change Confirmation Operation List

Button	Operation explanation
Save and continue	After saving the current configuration contents to the configuration file, change to the selected device.
Continue	Changes to the selected device without saving the current configuration contents to the configuration file.
Cancel	It does not change the device.

Note: Depending on the board selected, the device will change, Device change is not reflected to the device (microcontroller) of IAR project.

4.1.3 Exporting Board Settings

The board settings can be exported for later reference. Follow the procedure below to export the board settings.

(1) Click on the [(Export board setting)] button on the [Board] tabbed page.

(2) Select the output location and specify a name (Display Name) for the file to be exported.

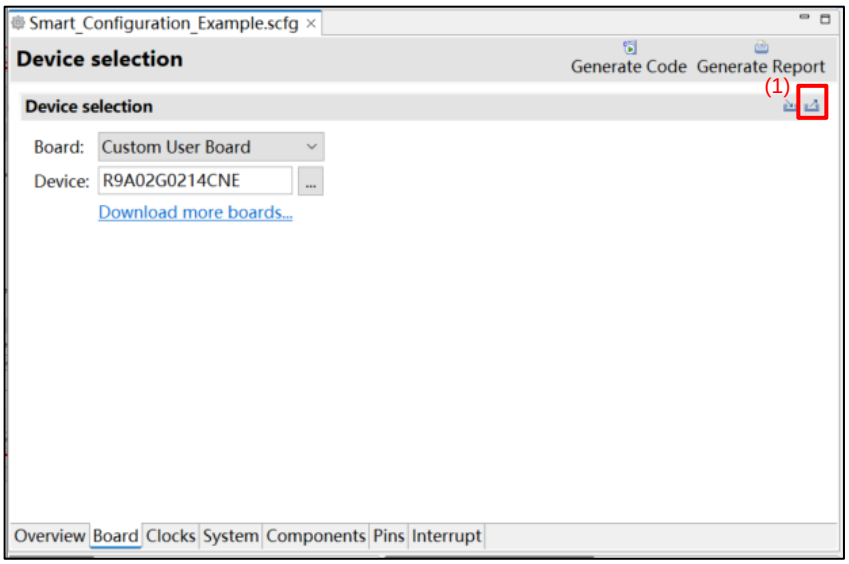


Figure 4-5 Exporting Board Settings (bdf Format)

4.1.4 Importing Board Settings

Follow the procedure below to import board settings.

(1) Click on the [(Import board setting)] button and select a desired bdf file.

(2) The board of the imported settings is added to the board selection menu.

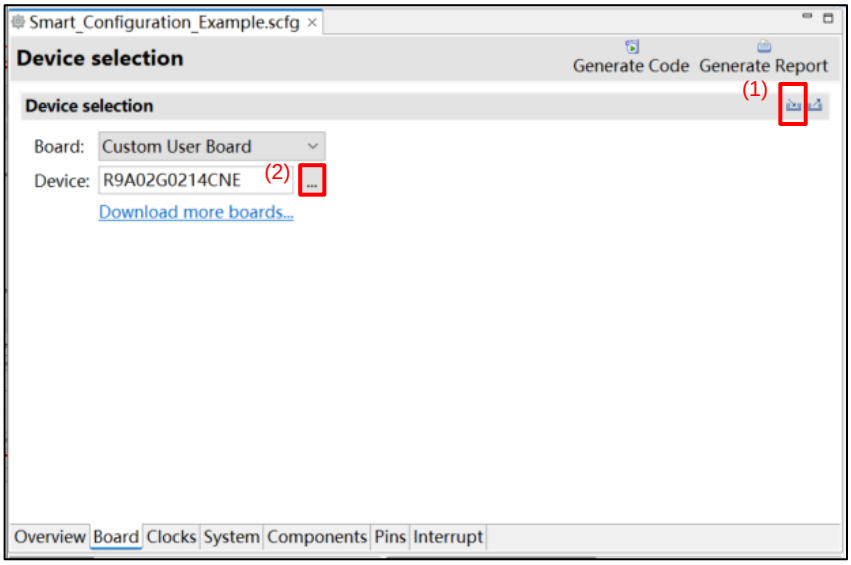


Figure 4-6 Importing Board Settings (bdf Format)

Once a board setting file is imported, the added board is also displayed in the board selection menu of other projects for the same device group.

4.2 Clock Settings

User can set the system clock on the [Clocks] page. The settings made on the [Clocks] page is used for all drivers.

Follow the procedure below to modify the clock settings.

(1) Specify the operation mode and VCC setting.

(2) Select the clocks required for device operations on the board (the high-speed on-chip oscillator is selected by default).

(3) Specify the frequency of each clock in accordance with the board specifications (note that the frequency is fixed for some internal clocks).

(4) For the multiplexer symbol, select the clock source for the output clocks.

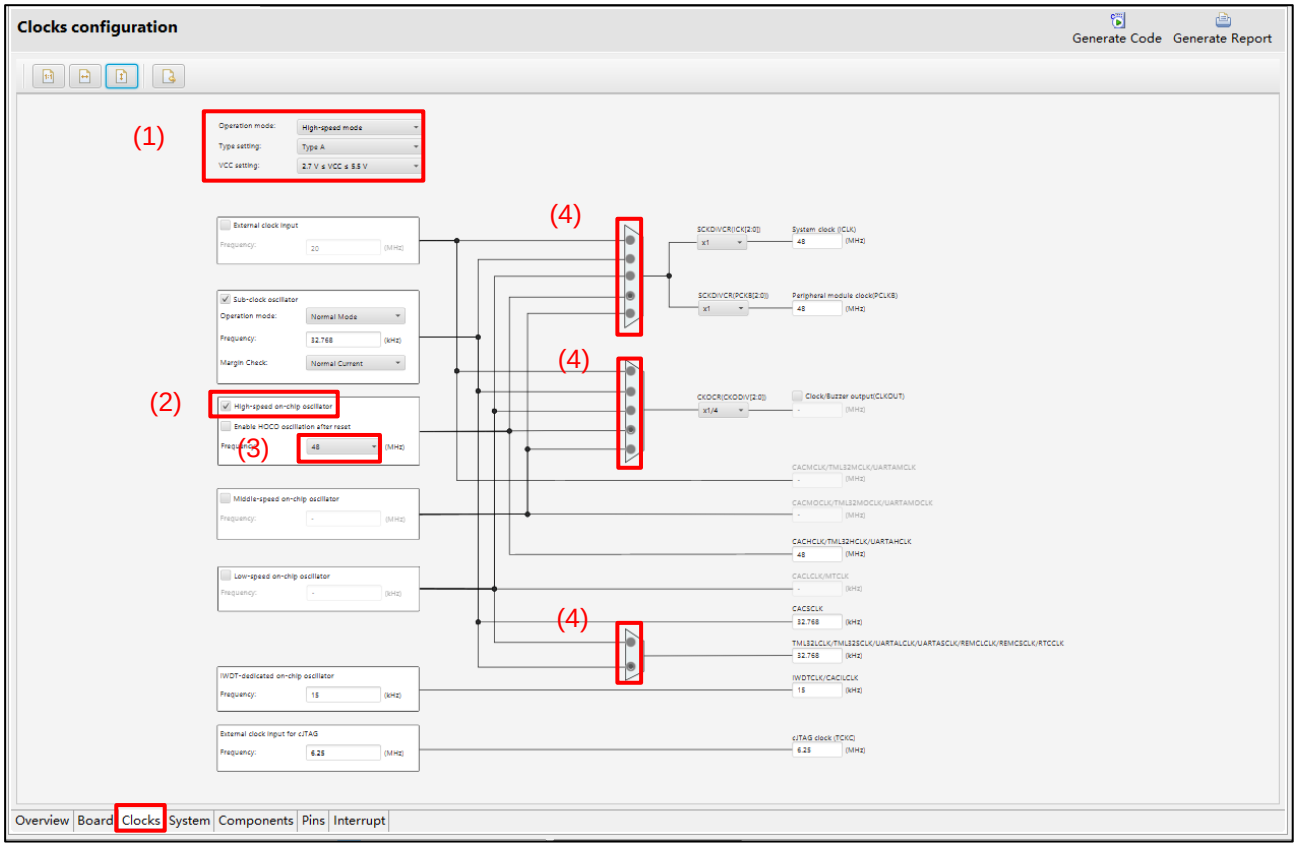


Figure 4-7 [Clocks] Page

4.3 System Settings

You can set the debug interface pins at [System] tabbed page.

There are 1 type of debug interface available: cJTAG

You can check the pins configured from Console message or MCU/MPU Package view.

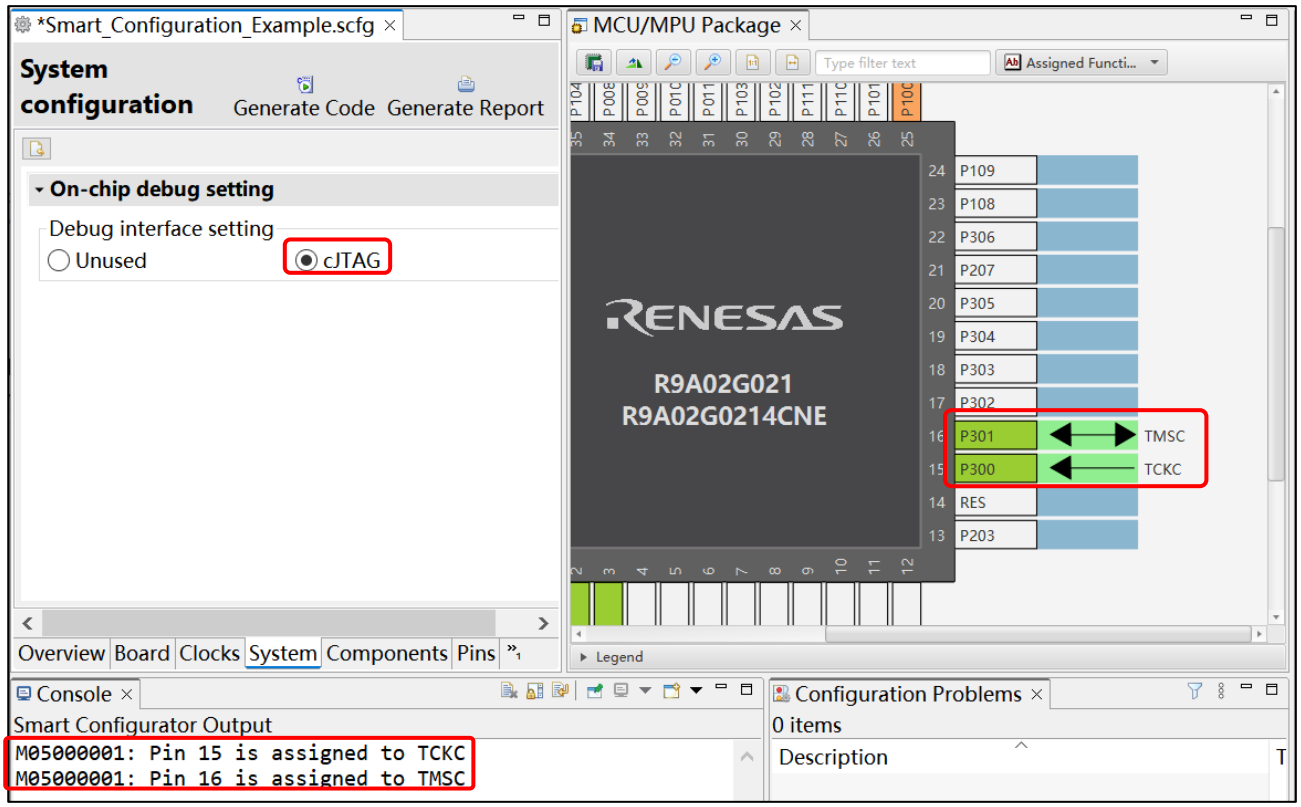


Figure 4-8 Smart Configurator [System] Page Setting

4.4 Software component settings

Drivers and middleware can be combined as software components on the [Components] page. Added components are displayed in the tree view at the left of the page.

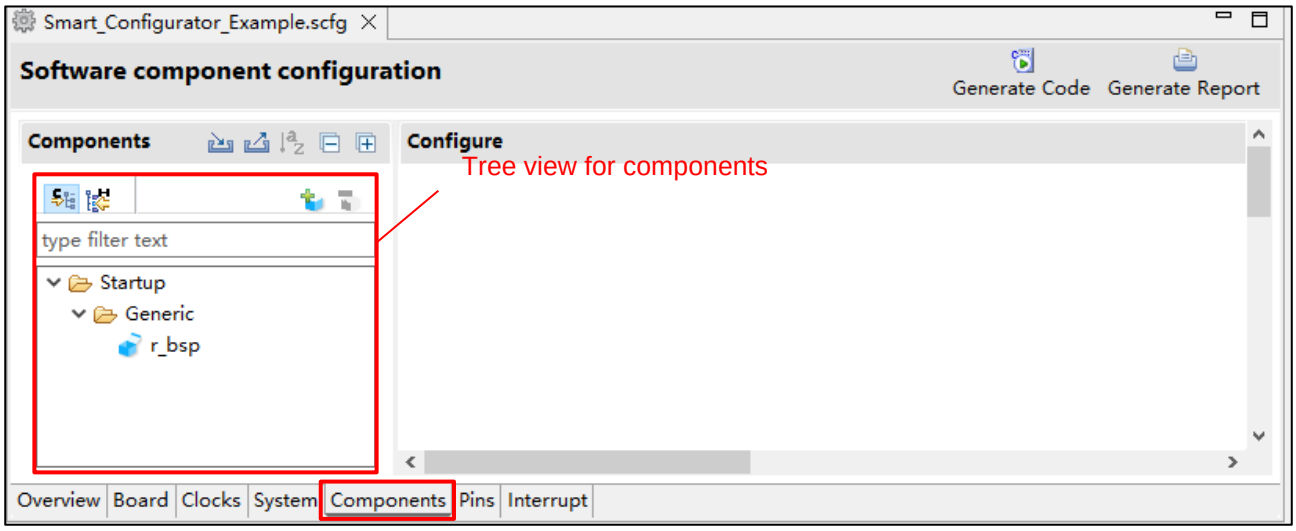


Figure 4-9 [Components] Page

4.4.1 Switching Between the Component View and Hardware View

The Smart Configurator provides two tree view: Component View and Hardware View. Please switch two views by clicking the following icons:

(1) Click on the [(Component View)] icon. The tree view will display the components by component category.

(2) Click on the [(Hardware View)] icon. The tree view will display the components in a hardware resource hierarchy.

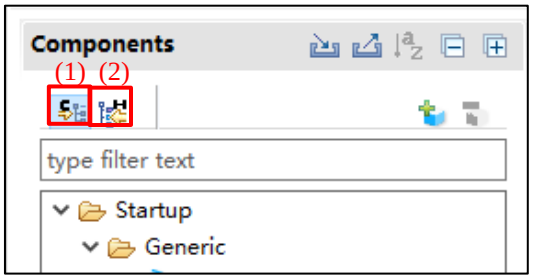


Figure 4-10 Switching to the Hardware View

4.4.2 Adding a Software Component

The Smart Configurator provides two methods for adding a new component:

a. Click on the [(Add component)] icon.

b. On Hardware Tree, double-click on a hardware resource node.

The following describes the procedure for adding a component by clicking on the [(Add component)] icon.

a-1. Click on the [(Add component)] icon.

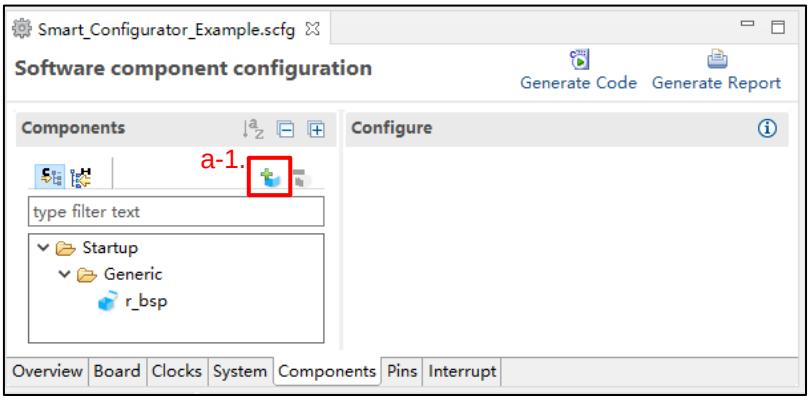


Figure 4-11 Adding a Component

a-2. Select a component from the list in the [Software Component Selection] page of the [New Component] dialog box (e.g. A/D Converter).

a-3. Check that [Type] for the selected component is [Code Generator].

a-4. Click on [Next].

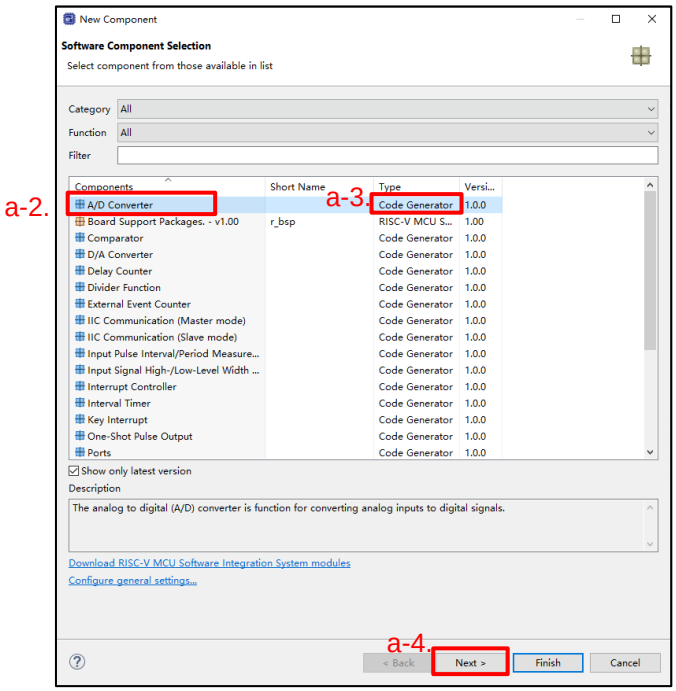


Figure 4-12 Adding a Code Generator Component

a-5. Specify an appropriate configuration name in the [Add new configuration for selected component] page of the [New Component] dialog box or use the default name (for e.g., Config_ADC).

a-6. Select a hardware resource or use the default resource (for e.g., ADC).

a-7. Click on [Finish].

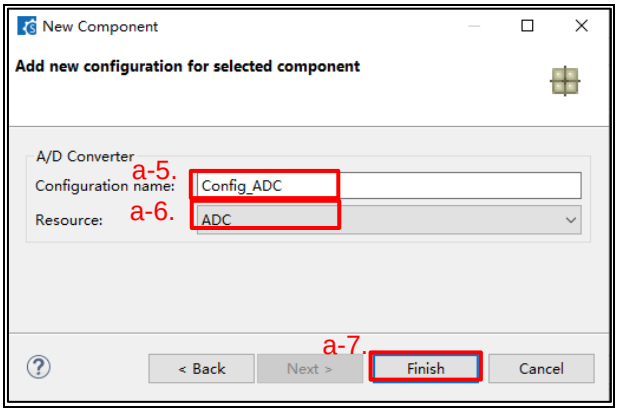


Figure 4-13 Adding a Component

To add a component on Hardware Tree directly, please use the following procedure:

b-1. Click on the [(Hardware View Menu)] icon. The tree will display in a hardware resource hierarchy.

b-2. Double-click on a hardware resource node (for e.g., A/D Converter) to open the [New Component] dialog box.

b-3. Select a component from the list (for e.g., A/D Converter) to add a new configuration.

b-4. Follow the same procedure as above "adding a component by clicking adding icon" step a-3 to a-7.

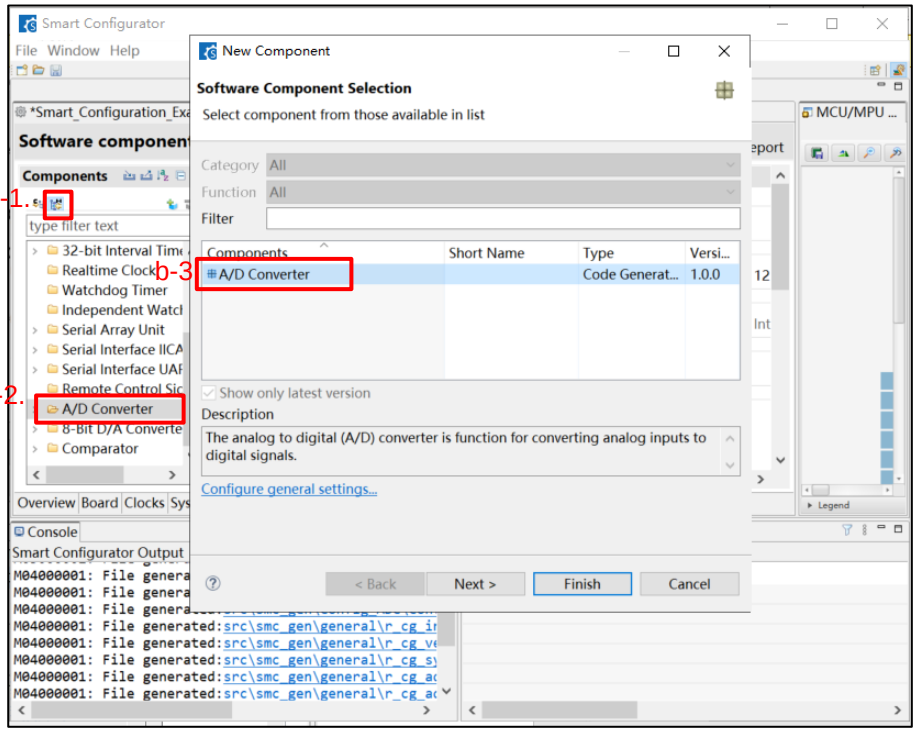


Figure 4-14 Adding a Code Generator Component to the Hardware View

Removing Software Component
Follow the procedure below to remove a software component or multiple components from a project.

(1) Select a software component or multiple components (press and hold CTRL key while selecting the next component) on the Components tree.

(2) Click on the [(Remove component)] icon.

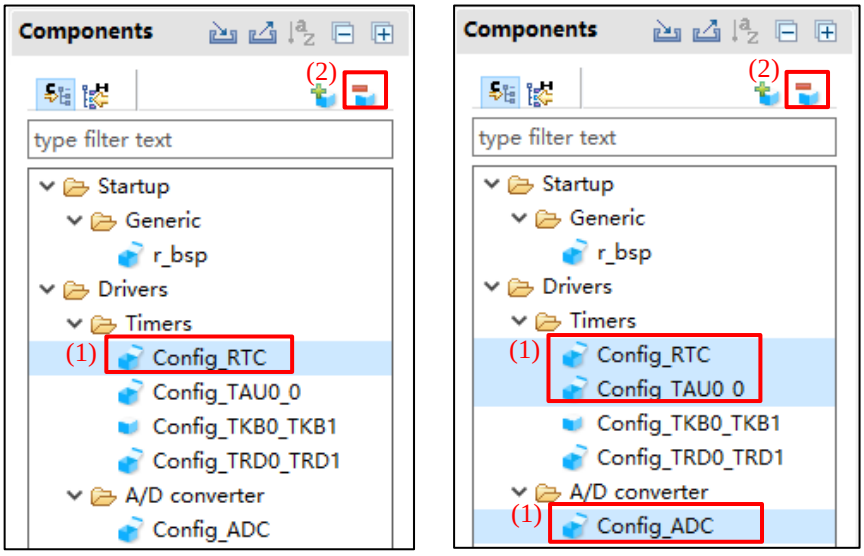


Figure 4-15 Removing a Software Component or Multiple Components

The selected software components will be removed from the Components tree.
To delete the source files previously generated for the removed components from the IAR Embedded Workbench project tree, click [(Generate Code)] icon.

4.4.3 Setting a Code Generator Component

Follow the procedure below to set up a Code Generator configuration.

(1) Select a Code Generator configuration from the Components tree (for e.g., A/D Converter).

(2) Configure the driver in the [Configure] panel to the right of the Components tree. The following steps and figures show an example.

a. Select [10 bits] under [Resolution setting].

b. Select [Software trigger no wait mode] under [Trigger mode setting].

c. Select [ANI0] for [A/D channel selection].

d. Select [2112/PCLKB] for [Conversion time].

e. Ensure ADC_ENDI has been configured a vector in [Interrupt] page, detailed usage please refer to 4.6 Interrupt Settings.

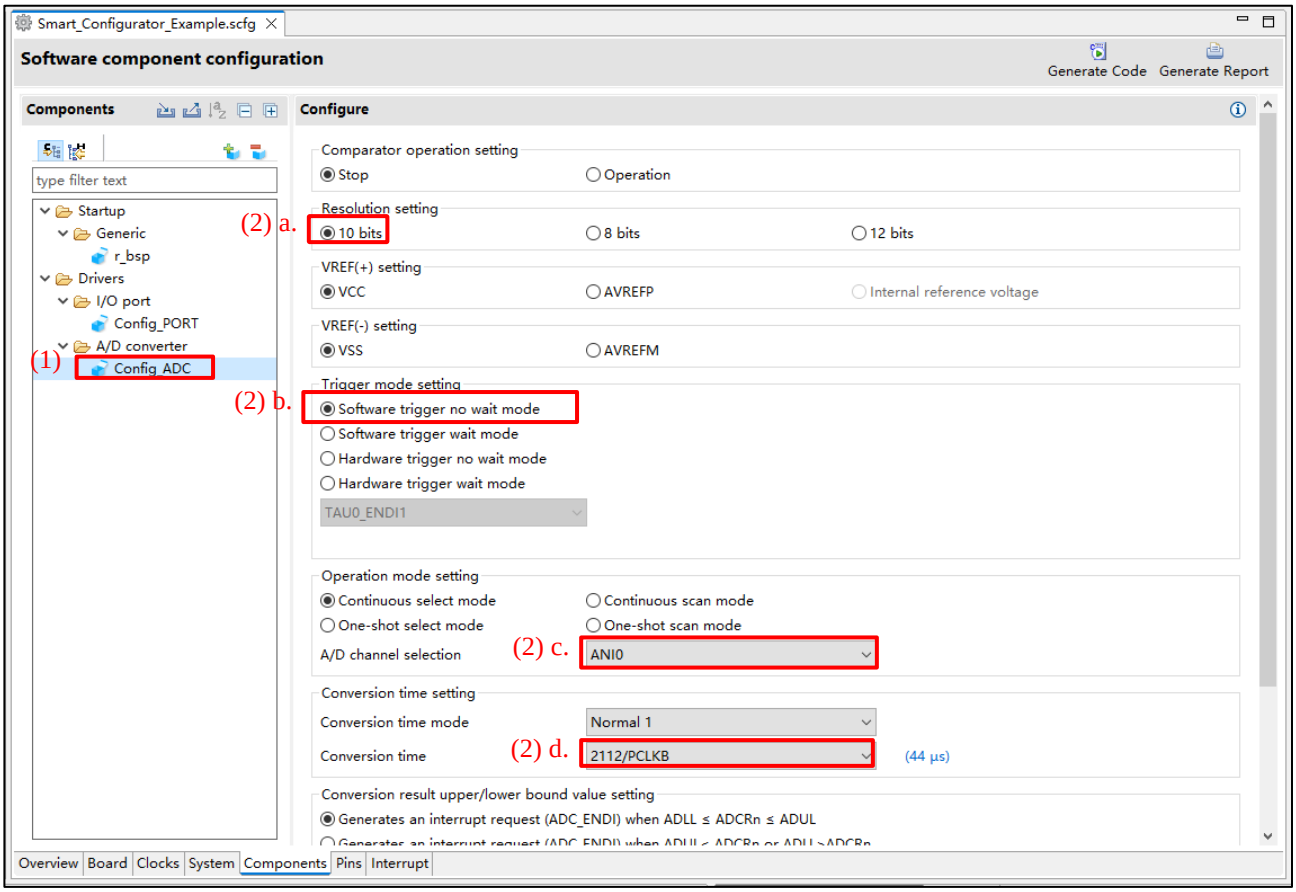


Figure 4-16 Setting of a Code Generator Driver

Generation of a code in accordance with each Code Generator configuration is enabled by default.

Right-clicking on a Code Generator configuration and then selecting the [✓ Generate code] icon changes the icon to [Generate code] and disables code generation for the Code Generator configuration.

To enable code generation again, click on the [Generate code] icon and change it to [✓ Generate code].

4.4.4 Changing the Resource for a Code Generator Configuration

The Smart Configurator enables user to change the resource for a Code Generator configuration (for e.g., from TAU0_1 to TAU0_3). Compatible settings can be ported from the current resource to the new resource selected.

Follow the procedure below to change the resource for an existing software component.

(1) Right-click on a Code Generator configuration (for e.g., Config_TAU0_1).

(2) Select [Change resource] from the context menu.

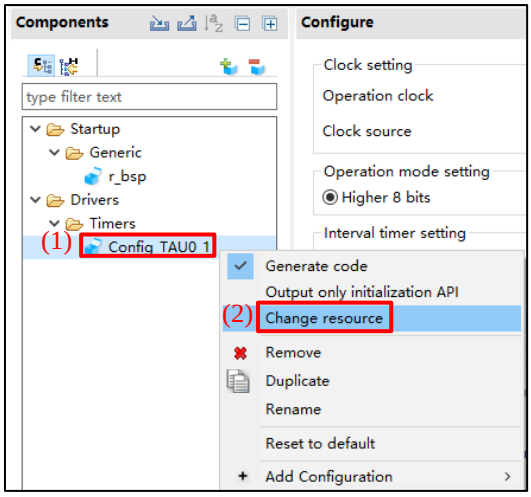


Figure 4-17 Changing the Resource

(3) Select a new resource (for e.g., TAU0_3) in the [Resource Selection] dialog box.

(4) The [Next] button will be active, click on it.

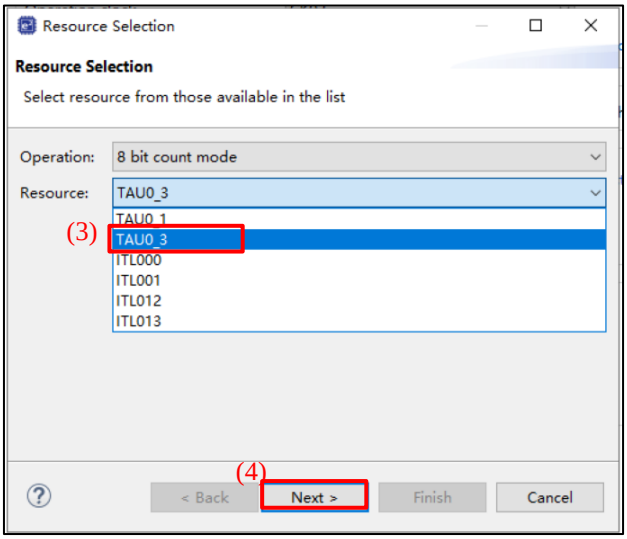


Figure 4-18 Components Page – Selecting a New Resource

(5) Configuration settings will be listed in the [Configuration setting selection] dialog box.

(6) Check the portability of the settings.

(7) Select whether to use the listed below or default settings.

(8) Click on [Finish].

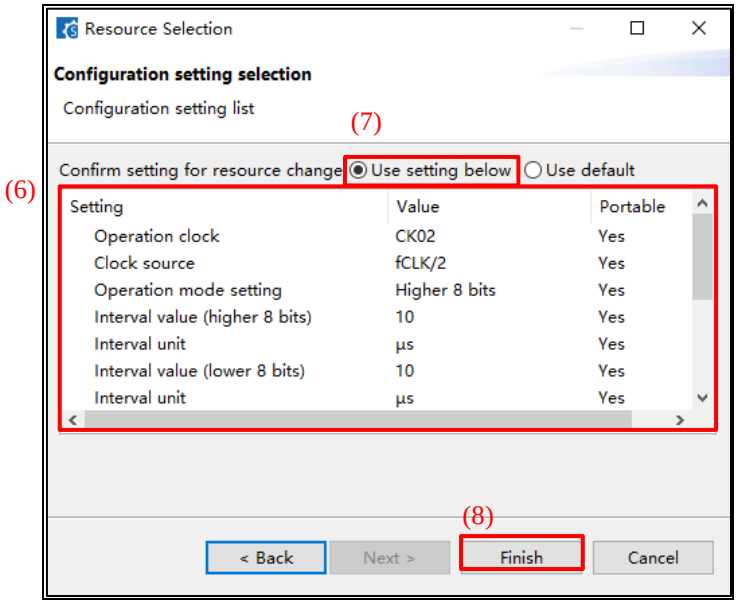


Figure 4-19 Checking the Settings of the New Resource

The resource is automatically changed (for e.g., changed from TAU0_END1 to TAU0_END3).

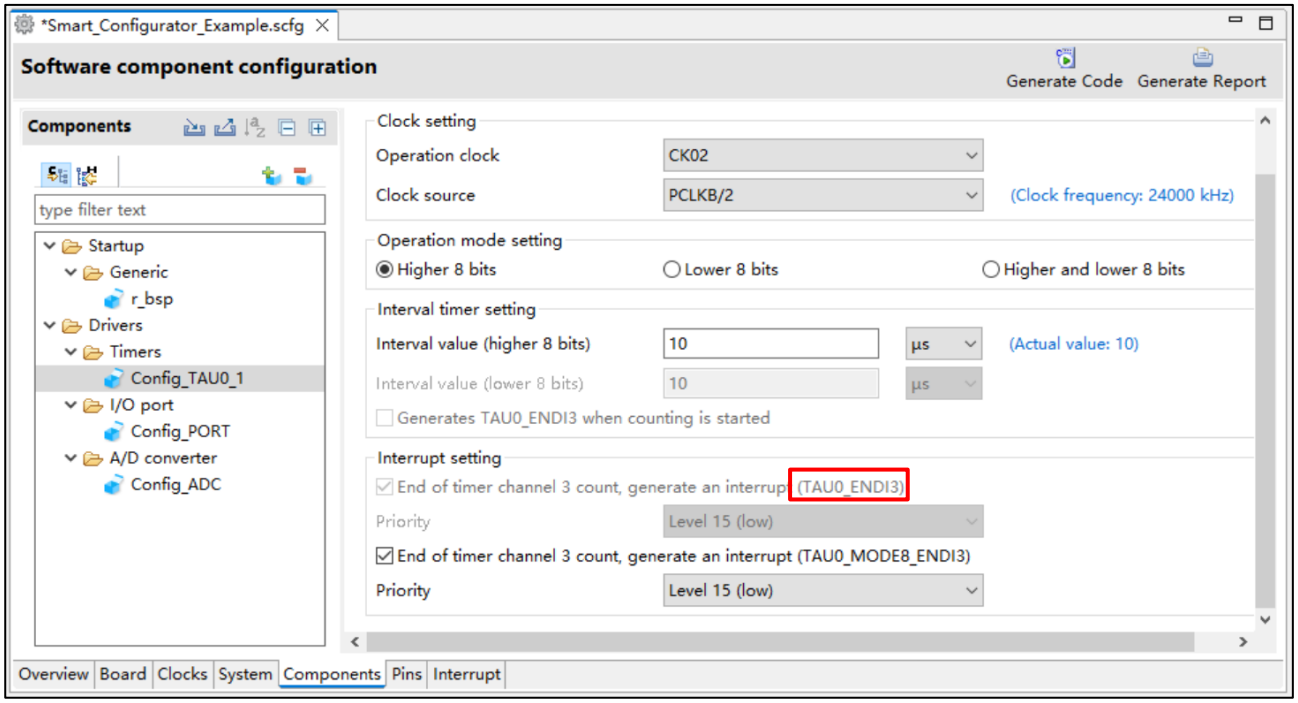


Figure 4-20 Resource Changed Automatically

To change the configuration name, follow the procedure below.

(9) Right-click on the Code Generator configuration.

(10) Select [Rename] to rename the configuration (for e.g., change Config_TAU0_1 to Config_TAU0_3).

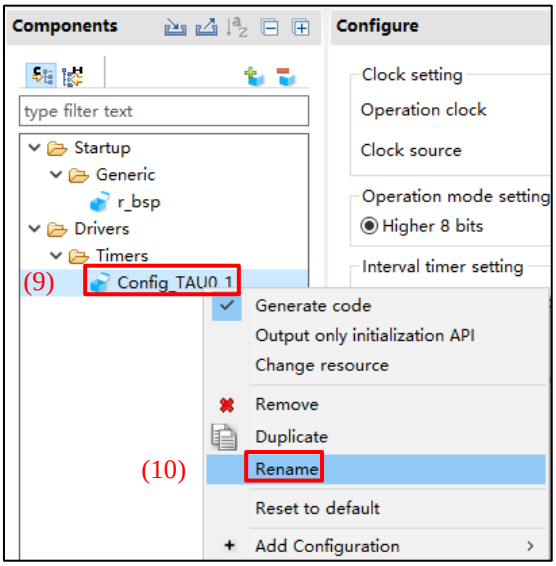


Figure 4-21 Renaming the Configuration

4.4.5 Adding a RISC-V MCU Software Integration System Module

The following describes the procedure for adding a RISC-V MCU Software Integration System Module.

(1) Click on the [(Add component)] icon.

(2) Select components which [Type] is [RISC-V MCU Software Integration System] from the list in the [Software Component Selection] page of the [New Component] dialog box. Two or more components can be selected by clicking with the Ctrl key pressed.

(3) Click on [Finish].

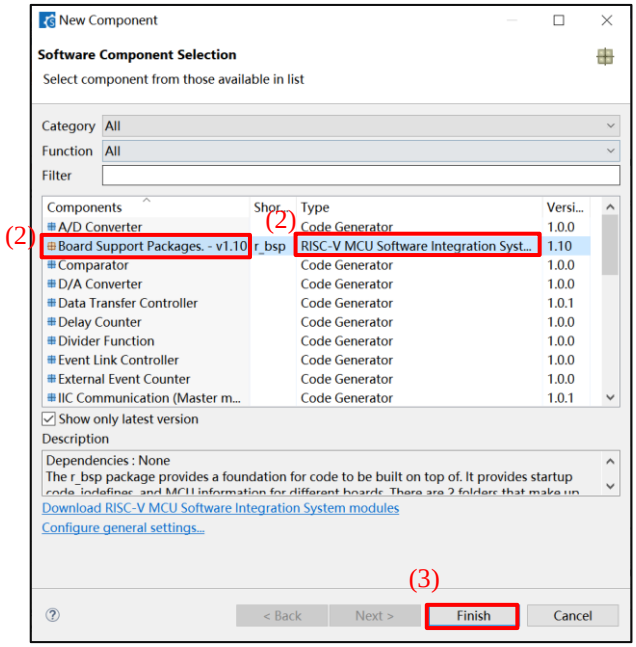


Figure 4-22 Adding RISC-V MCU Software Integration System Module

4.4.6 Changing Version of BSP Configuration

The following describes the procedure for version change of BSP configuration.

(1) From the component tree, right-click the r_bsp component whose version user wants to change.

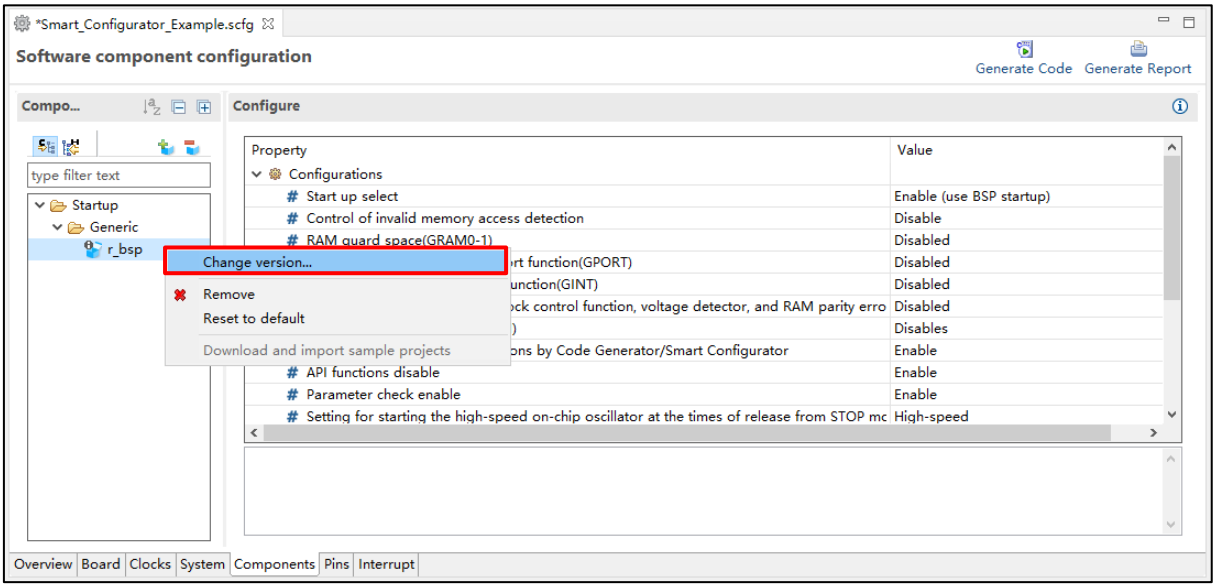


Figure 4-23 Version Change of BSP Configuration

(2) Select [Change Version ...] from the context menu.

(3) In the [Change Version] dialog box, select the version you want to change. If user selects a version that the device does not support, [Selected version doesn't support current device or toolchain] will be displayed.

(4) Click [Next].

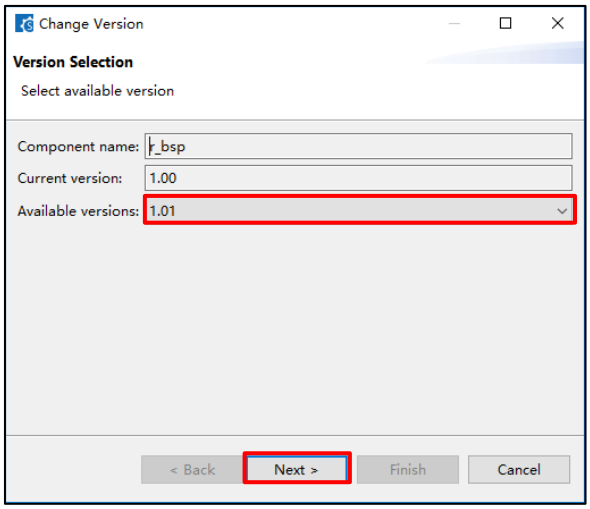


Figure 4-24 Select Version of BSP Component

(5) By version change, a list of setting items to be changed is displayed. Confirm that there is no problem and click the [Finish].

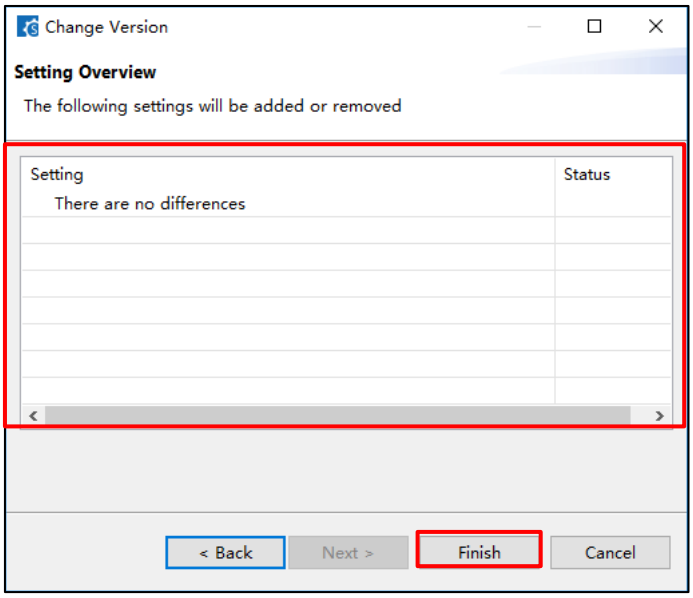


Figure 4-25 Confirm Setting Change Item

(6) As [Confirm to change version and proceed to generate code] is displayed, if user do not have any problem, click [Yes].

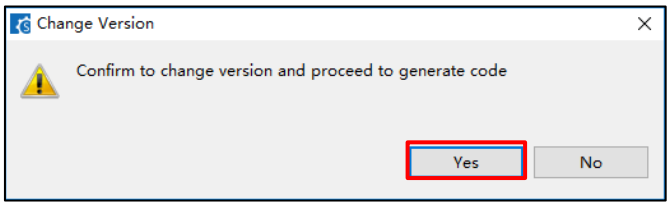


Figure 4-26 Confirm Version Change

(7) The BSP component version is changed, and code generation is executed automatically.

4.4.7 Export Component Configuration

The current configuration can be exported as *.xml file by clicking on the [(Export Configuration)] button on the [Components] tabbed page.

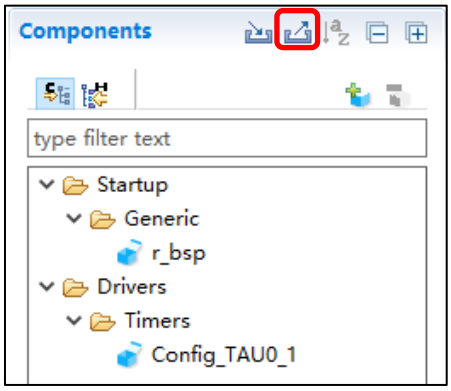


Figure 4-27 Export Configuration (xml format)

4.4.8 Import Component Configuration

Click on the [(Import Configuration)] button and select an exported xml file will import component configuration.

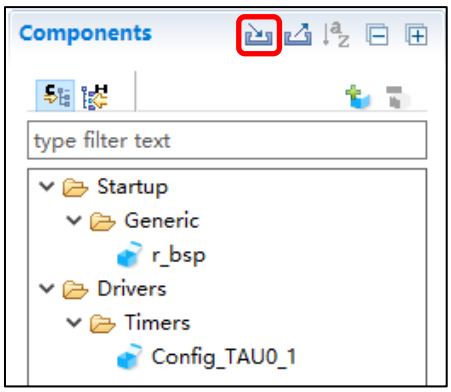


Figure 4-28 Import Configuration (xml format)

4.4.9 Configure General Setting of the Component

The general setting of the component, such as code generation component settings, dependency settings and location settings, can be configured inside the [Preferences] dialog.

If you want to change the settings, please click the [Configure general settings...] link on the [Software Component Selection] page displayed in the [New Component] dialog (Figure 4-12) and display the [Preferences] dialog. Or click "Preferences" of "Window" in Main Menu.

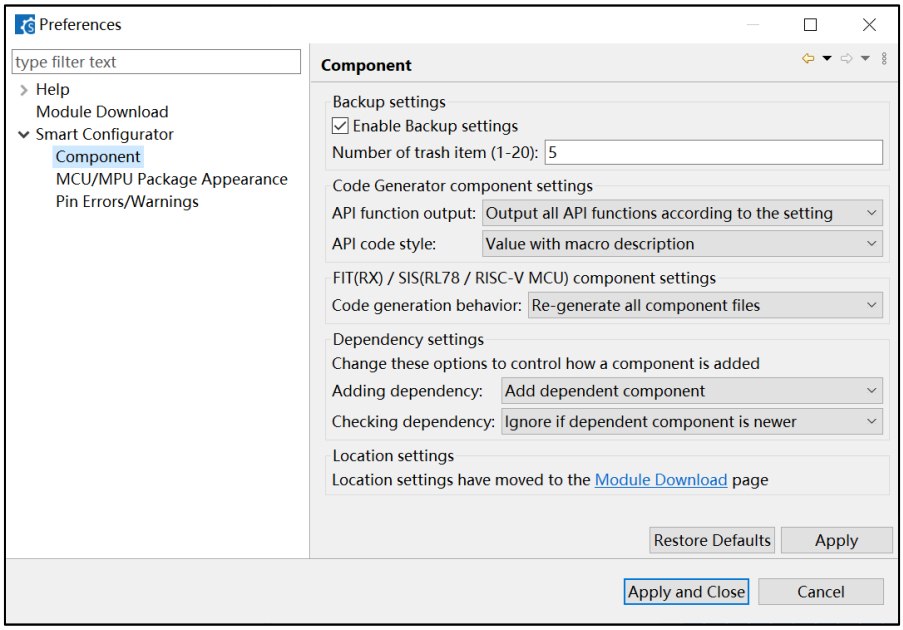


Figure 4-29 Configure General Setting of Component

Notes:

1. User can limit the number of folders created in the trash folder for backup purposes by setting the [Number of trash item (1-20)] option in the figure below. Once exceeding the limit, a folder with the newer timestamp will replace the oldest folder.

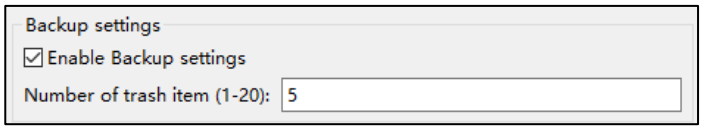


Figure 4-30 Trash number setting

2. The code generation behavior has two options: [Update configuration files] and [Re-generate all component files]. [Update configuration files] is the default selection. If "Update configuration files" is being selected and generate code, Smart Configurator will check whether the files are existing inside the user project. If the file exists, the file will not be overwritten. However, configuration files (e.g., xxx_config.h) will still be refreshed when code is generated. If "Re-generate all component files" being selected and generate code, Smart Configurator does not check the existence of the file and the file will always be overwritten.

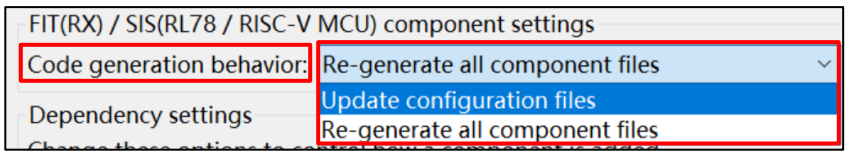


Figure 4-31 [Code generation behavior] Change

3. To only generate initialization API function, please change to [Output only initialization API function] option in below figure. So that only void R_{ConfigurationName}_Create (void), void R_{ConfigurationName}_Create_UserInit (void) in *.h *, *c * are generated. If user change back to default option setting: [Output all API functions according to the setting], then all API functions will be generated again.

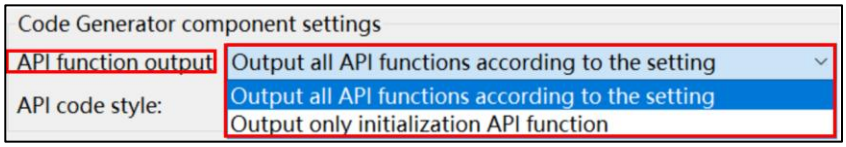


Figure 4-32 [RISC-V MCU API function output] Change

Please right-click the selected component and select the "Output only initialization API" from the context menu.

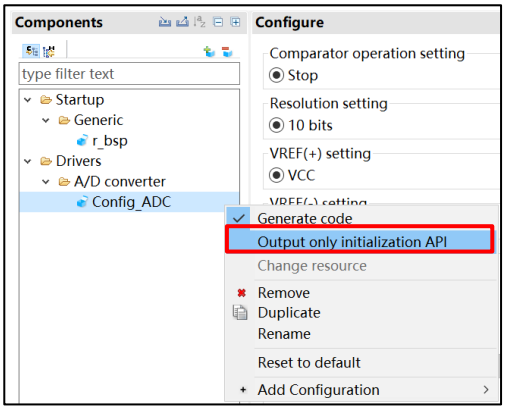


Figure 4-33 Context Menu "Output only initialization API" for Each Configuration

4. To generate code with HEX value, please change to [Value without macro description (raw HEX)] option in below figure. If user change back to default option setting: [Value with macro description], then all API with macro description will be generated again.

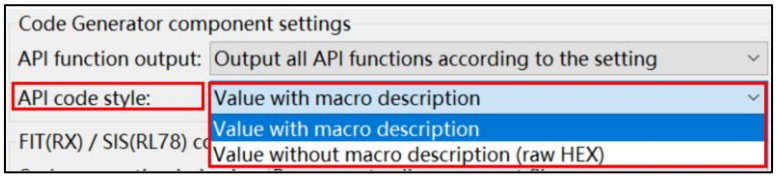


Figure 4-34 [API code style] Change

5. If the version of the module and its dependency do not match, a warning message W04020011 is displayed. If user check the revision history of the module and its dependencies and do not need to change the module used, please ignore this warning. To clear this warning, please select [Do not check for dependent component] in the [Checking dependency] list box in component preferences, then click [OK].

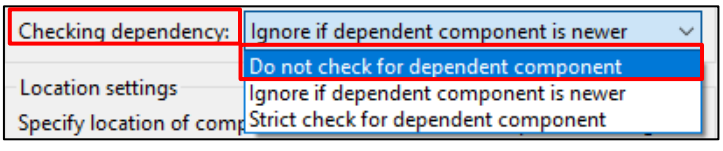


Figure 4-35 [Checking dependency] Change

4.5 Pin Settings

The [Pins] page is used for assigning pin functions. User can switch the view by clicking on the [Pin Function] and [Pin Number] pages. The [Pin Function] list shows the pin functions for each of the peripheral functions, and the [Pin Number] list shows all pins in order of pin number.

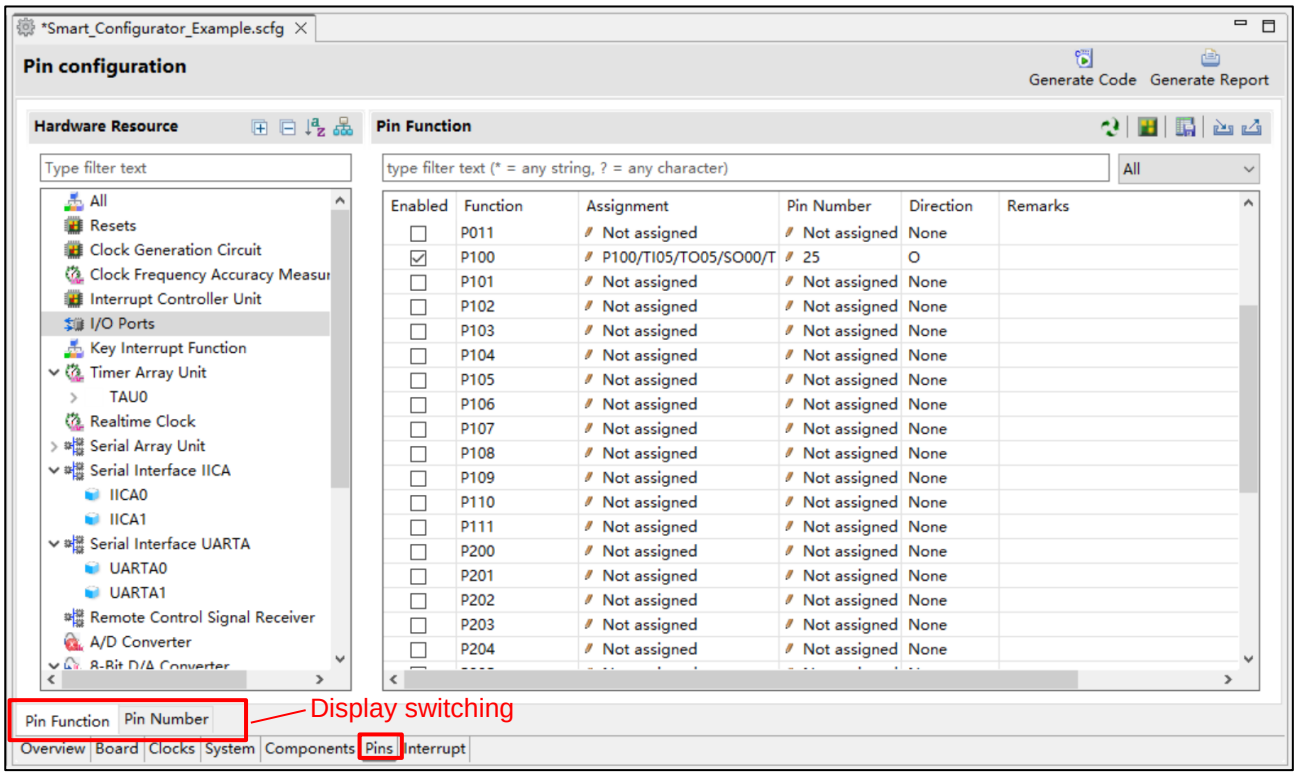


Figure 4-36 [Pins] Page ([Pin Function])

When you select a board on the [Board] page, the initial pin setting information of the board is displayed in [Board Function]. In addition, the [ ] icon displayed in the [Function] selection list indicates the initial pin function of the board.

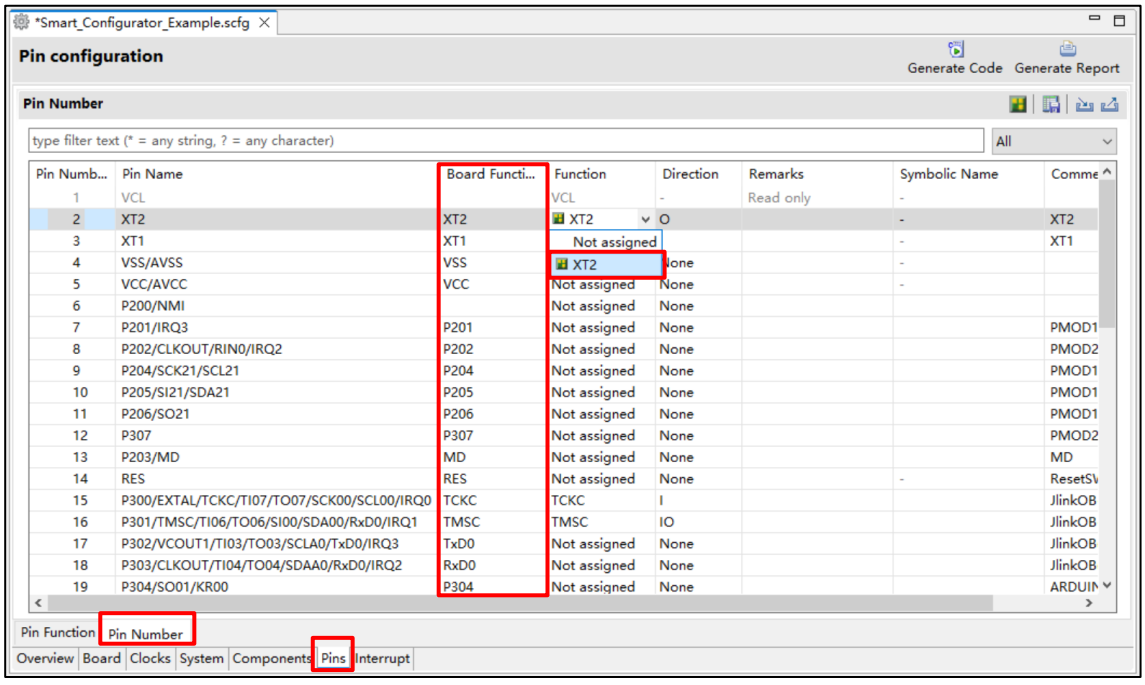


Figure 4-37 [Pins] Page ([Pin Number])

4.5.1 Changing the Pin Assignment of a Software Component

The Smart Configurator assigns pins to the software components added to the project. Assignment of the pins can be changed on the [Pins] page.

This page provides two lists: Pin Function and Pin Number.

Follow the procedure below to change the assignment of pins to a software component in the Pin Function list.

(1) Click on [(Show by Hardware Resource or Software Components)] to switch to the component view.

(2) Select the target software component (for e.g., Config_ICU).

(3) Click the [Enabled] header to sort by pins used.

(4) In the [Assignment] column or [Pin Number] column on the [Pin Function] list, change the pin assignment (for e.g., change from P201 to P302).

(5) In addition, assignment of a pin can be changed by clicking on the [(Next group of pins for the selected resource)] button. Pin that has peripheral function is displayed each time the button is clicked.

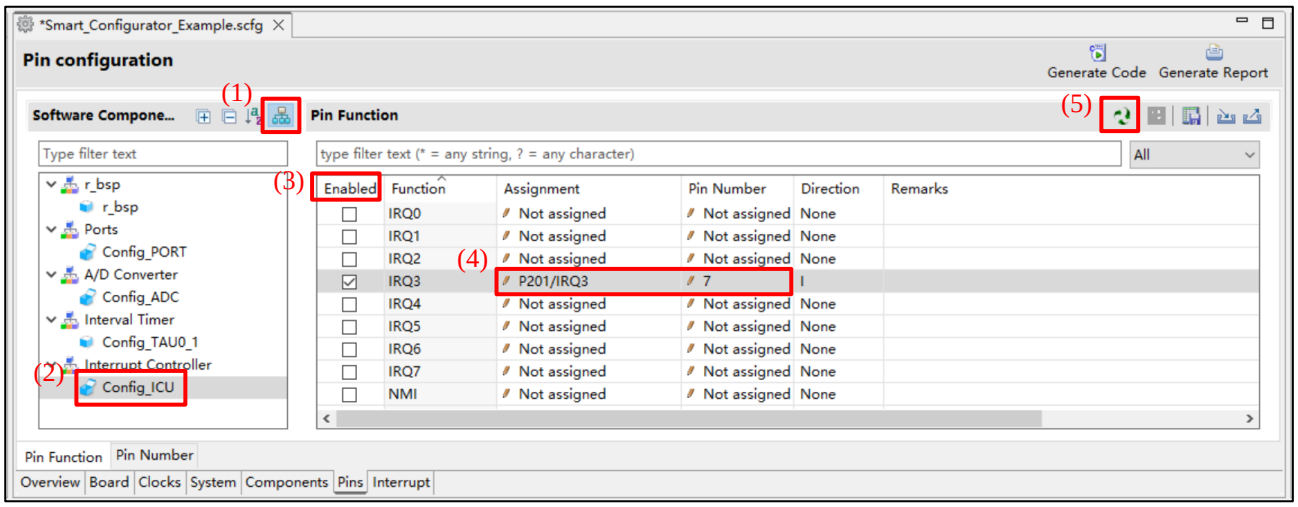


Figure 4-38 Pin Settings – Assigning Pins on the [Pin Function] List

The Smart Configurator allows user to enable pin functions on the [Pins] page without linking the current software component to another. To distinguish these pins from other pins that are used by another software component, there will be a remark "There is no software initializing this pin" on the list.

4.5.2 Assigning Pins Using the MCU/MPU Package View

The Smart Configurator visualizes the pin assignment in the MCU/MPU Package view. User can save the MCU/MPU Package view as an image file, rotate it, and zoom in to and out from it.

Follow the procedure below to assign pins in the MCU/MPU Package view.

(1) Zoom in to the view by clicking the [(Zoom in)] button or scrolling the view with the mouse wheel.

(2) Right-click on the target pin.

(3) Select the signal to be assigned to the pin.

(4) The color of the pins can be customized through [Preference Setting...].

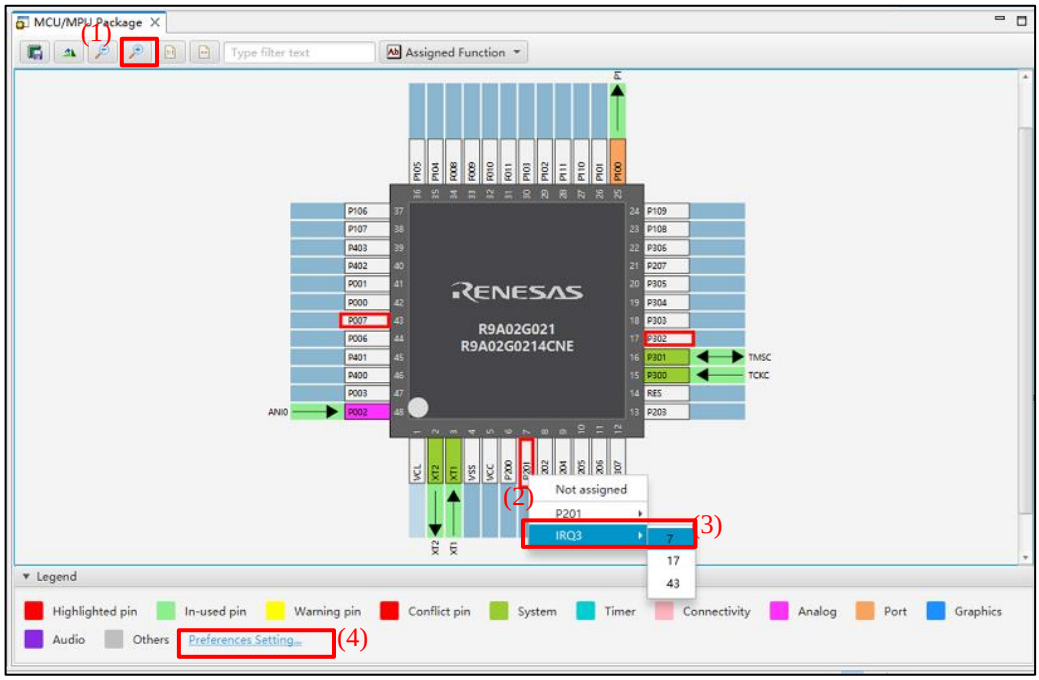


Figure 4-39 Assigning Pins Using the MCU/MPU Package View

4.5.3 Show Pin Number from Pin Functions

User can go to the pin number associated with a pin function.

Follow the procedure below to jump to pin number from a pin function.

(1) In the [Pin Function] tab, right click on a Pin Function to open the pop-up menu.

(2) Select "Jump to Pin Number".

(3) The [Pin Number] tab is opened with a Pin Number being selected. This is the pin number of the pin function.

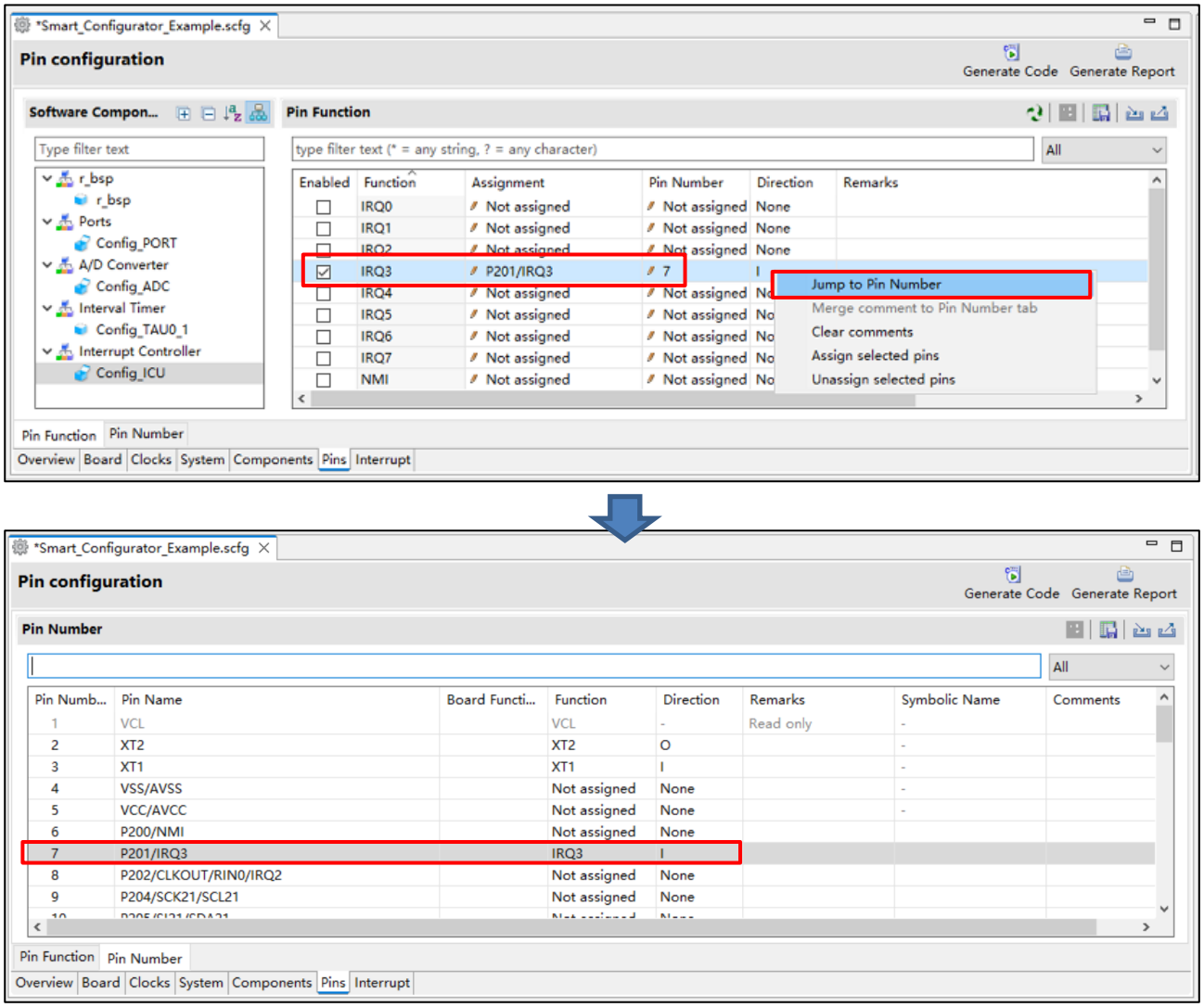


Figure 4-40 Jump to Pin Number

4.5.4 Exporting pin settings

The pin settings can be exported for later reference. Follow the procedure below to export the pin settings.

(1) Click on the [(Export pin assignments)] button on the [Pins] page.

(2) Select the output location and specify a name for the file to be exported.

The exported XML file can be imported to another project having the same device part number.

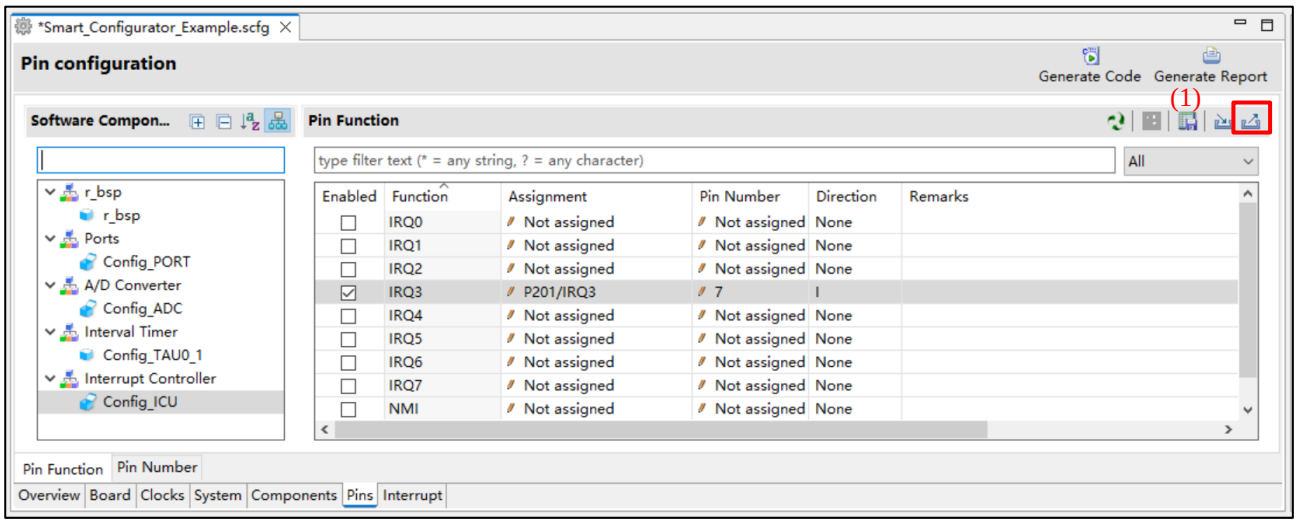


Figure 4-41 Exporting Pin Settings to an XML File

The Smart Configurator can also export the pin settings to a CSV file. Click on the [(Save the list to .csv file)] button on the [Pins] page.

4.5.5 Importing pin settings

To import pin settings into the current project, click on the [(Import pin assignments)] button and select the XML file that contains the desired pin settings. After the settings specified in this file are imported to the project, the settings will be reflected in the [Pin configuration] page.

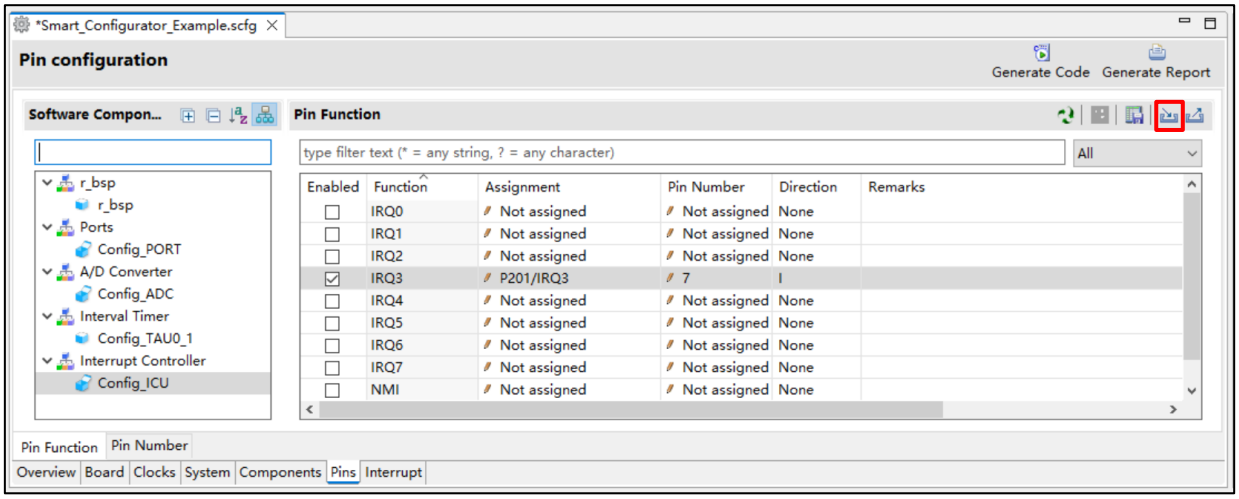


Figure 4-42 Importing Pin Settings from an XML File

Note: The pin setting is reflected, but it is not reflected in the component setting.

4.5.6 Pin setting using board pin configuration information

User can set the initial pin configuration according to the Renesas board that you selected to use. User can check the board that selected to use in [Board] tabbed page.

The following describes the procedure for collective setting of pins.

(1) Select a board setting information except [Custom User Board] in [Board] page. User can refer to 4.1.3 Exporting Board Settings

(2) Select [Board Function] in the MCU/MPU Package. (The initial pin configuration of the board can be referred.)

(3) Open the [Pin Configuration] page and click the [Assign default board pins] button.

(4) When [Assign default board pins] dialog opens, click [Select all].

(5) Click [OK].

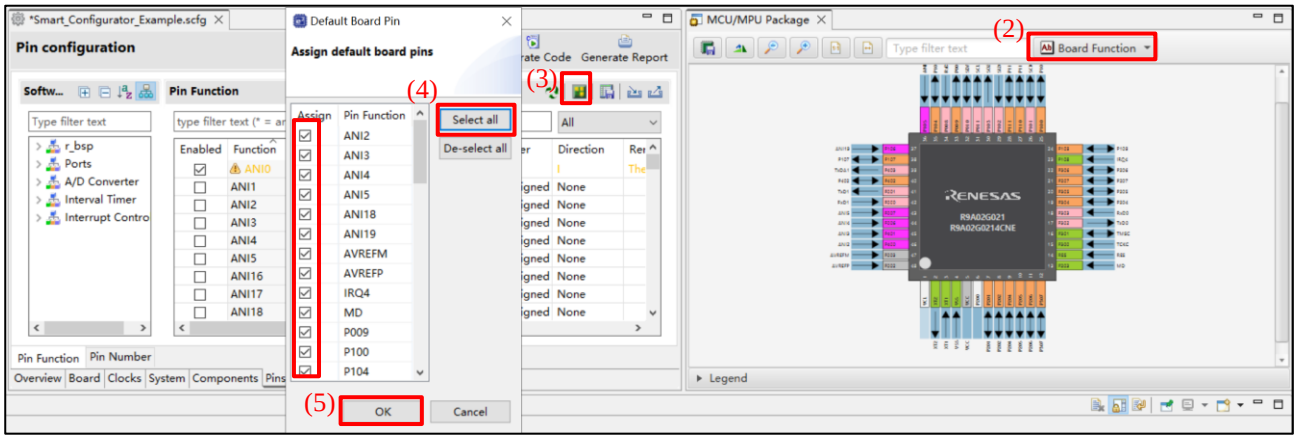


Figure 4-43 Setting for Initial Pin Configuration

If user does not set pin settings all at once, specify them individually in procedure (4).

4.5.7 Pin Filter Feature

By specifying the filter range on the [Pin Function] page and [Pin Number] page on the [Pins] page, user can refer to it more easily.

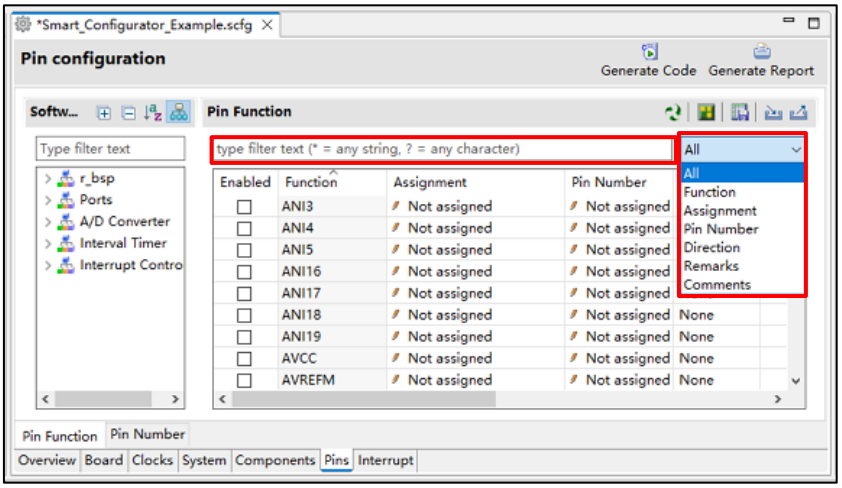


Figure 4-44 Filter for [Pin Function] Page

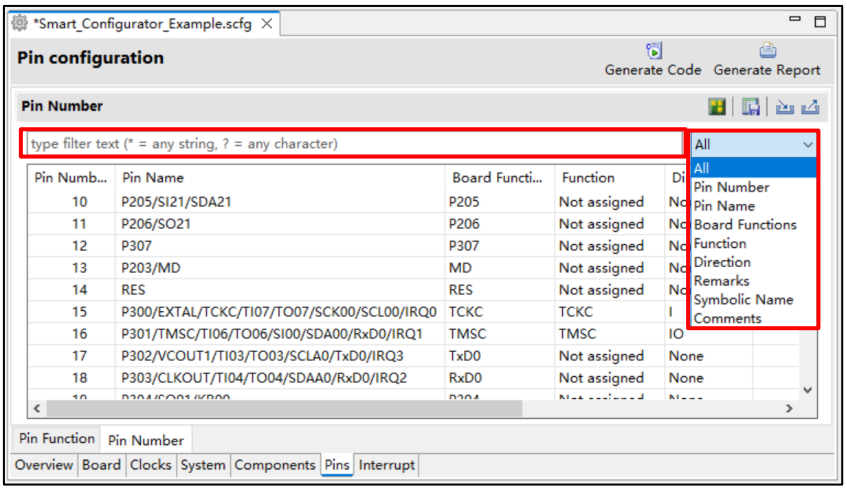


Figure 4-45 Filter for [Pin Number] Page

4.5.8 Pin Errors/Warnings setting

User can control how pin problem is displayed on Configuration Problems view by using the Pin Errors/Warnings setting. If you want to control it, on the [New Component] dialog, click the [Configure general settings...] link to display the [Preferences] dialog. Then select [Smart Configurator] > [Pin Errors/Warnings] and use the combo boxes to change the errors/warning setting.

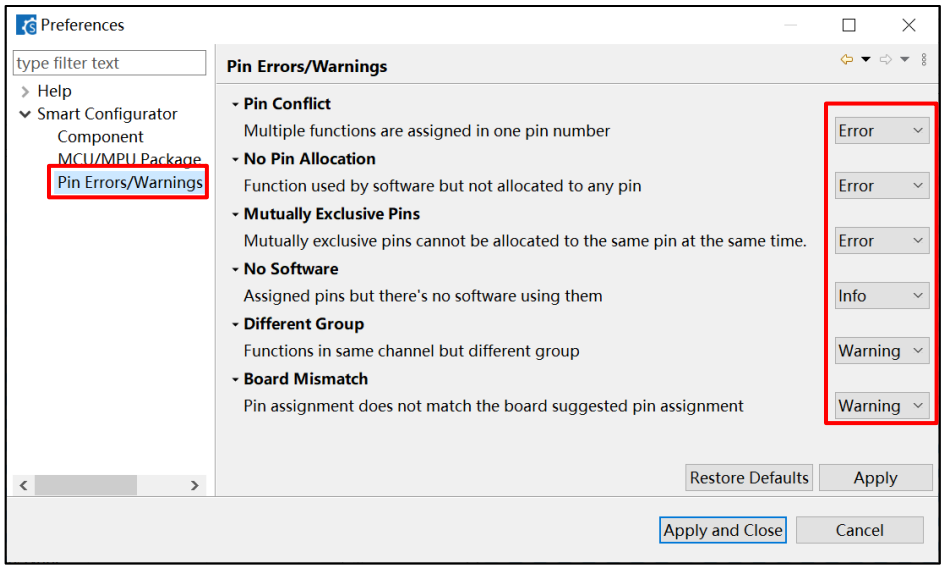


Figure 4-46 Pin Errors/Warnings Settings at Preferences

Example: Change "No Software" setting from "Info" to "Error"

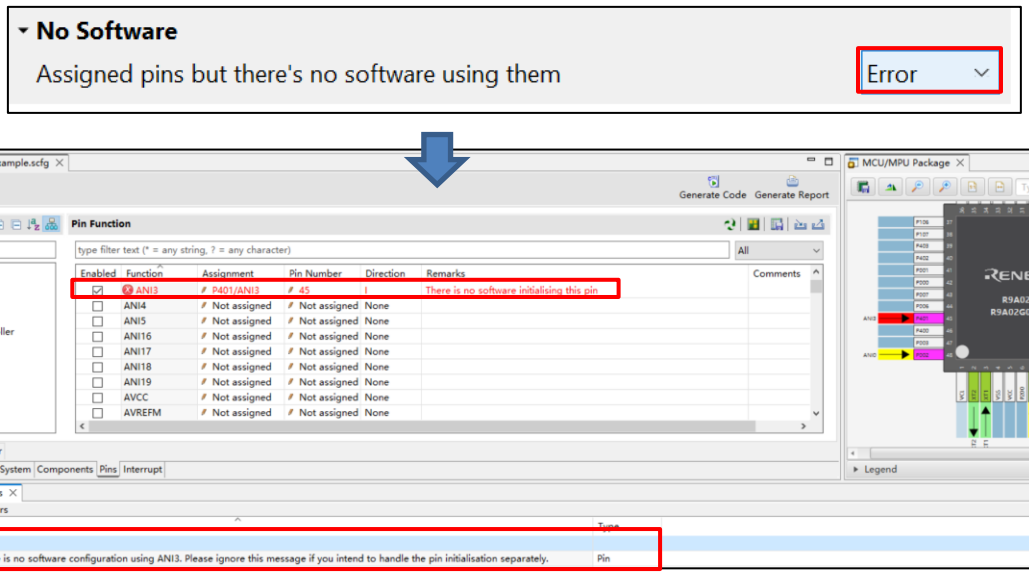


Figure 4-47 Change "No Software" Setting from "Info" to "Error"

4.6 Interrupt Settings

The [Interrupt] page displays all interrupts by each of the vector numbers. User can check and set the interrupts of the peripheral modules that have been selected on the [Components] page. When an interrupt is used in a Code Generator configuration on the [Components] page, the status of the interrupt will be changed to "Used".

To display the used interrupts only, click on the [(Show used interrupts)] button.

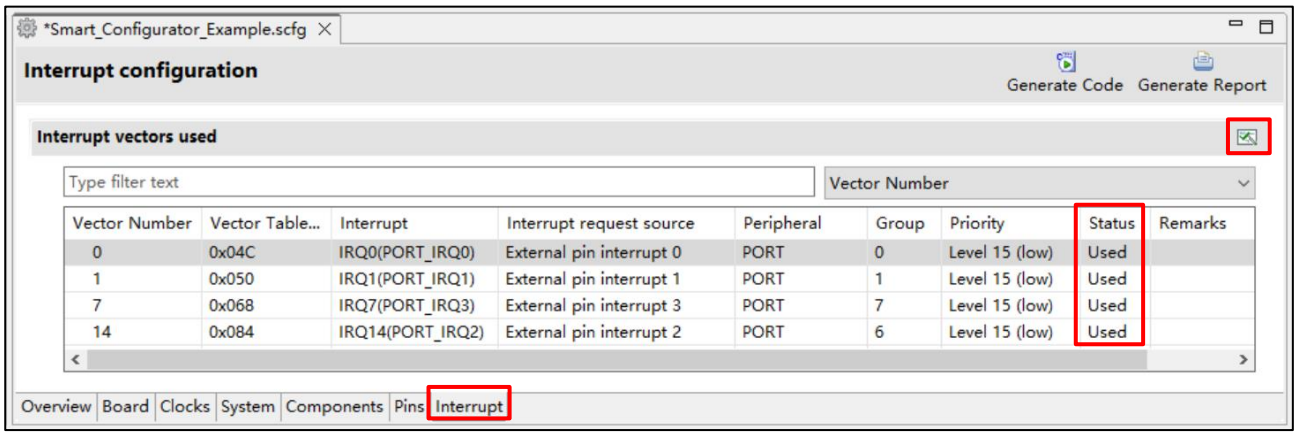


Figure 4-48 Show used interrupts

4.6.1 Changing Interrupt Priority Setting

User can change the interrupt priority level on the [Interrupt] page using the following procedure:

(1) Find the interrupt which user wants to change priority setting on this page.

(2) Click the priority cell and select an interrupt priority level from the drop-down list.

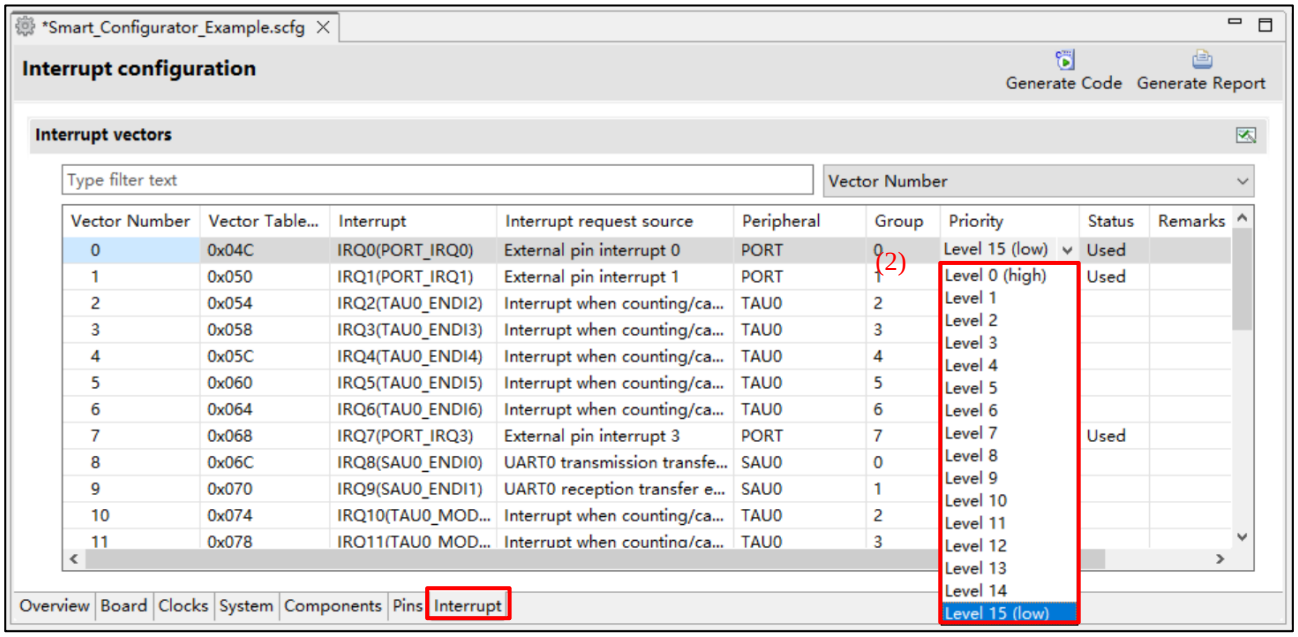


Figure 4-49 Change the interrupt priority level

4.6.2 Interrupt Filter Feature

By specifying the filter range on the [Interrupts] page, user can find interrupt more easily.

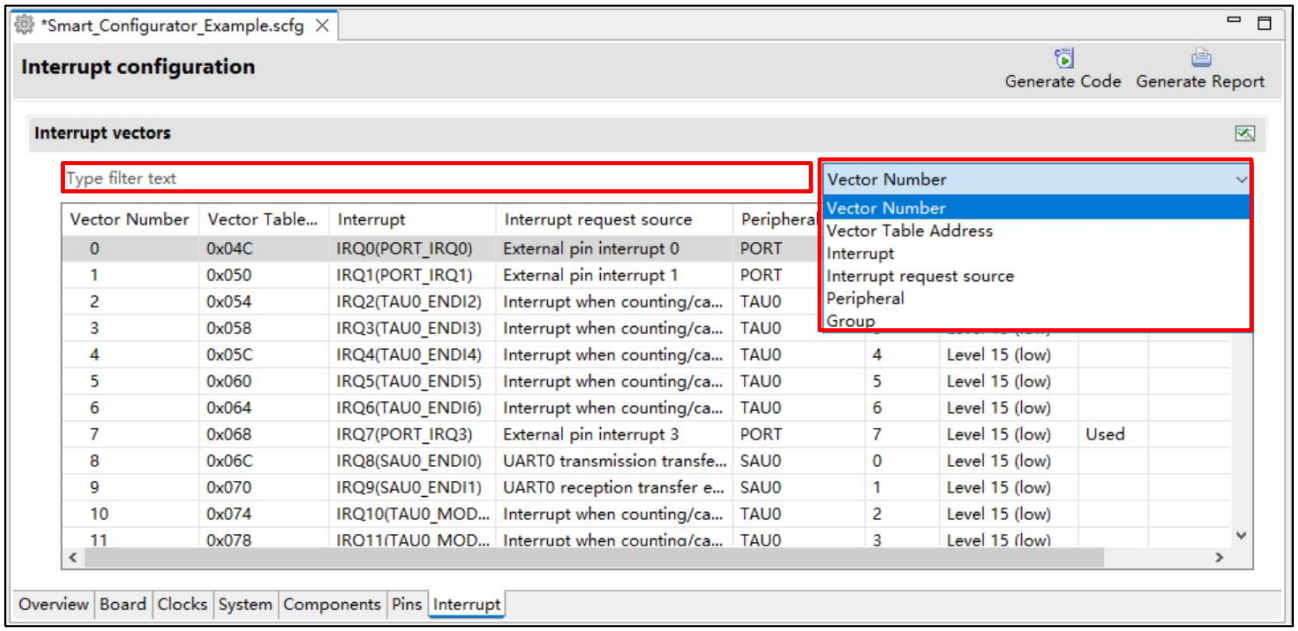


Figure 4-50 Filter for [Interrupts] Page

4.6.3 Changing Interrupt Vector or Group Setting

User can change the interrupt Vector or Group setting on the [Interrupts] page using the following procedure:

(1) Find the interrupt which you want to change Vector Number or Group setting on this page.

If the interrupt has been used, please start from step a.

If the interrupt hasn't been used, please start from step b.

a. Please release interrupt by right-clicking on a Code Generator configuration and then selecting the [Generate code] icon changes the icon to [Generate code] and disables code generation for the Code Generator configuration.

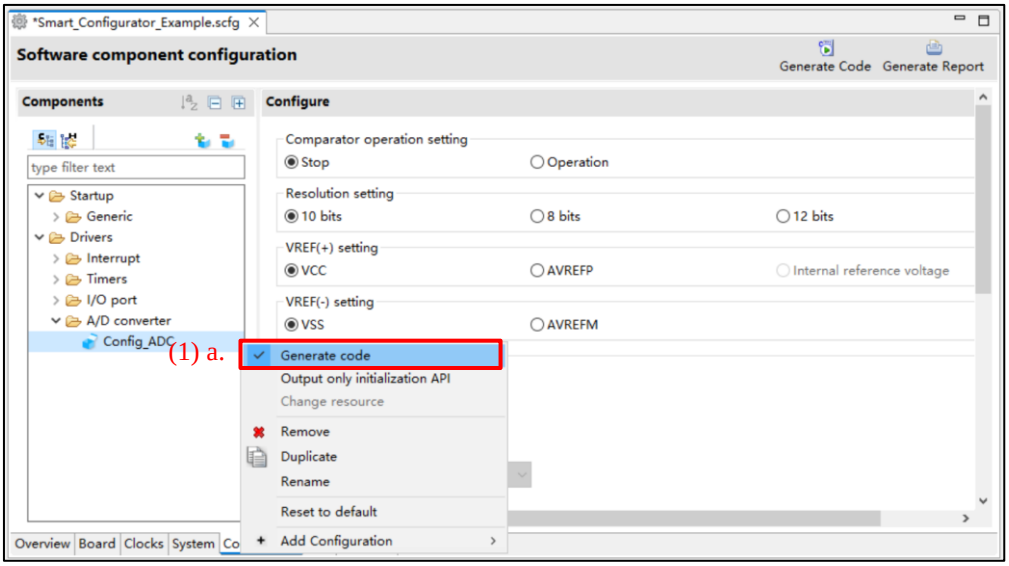


Figure 4-51 Release used interrupt

b. Change the filter to [interrupt].

c. Input filter text (for e.g., ADC_ENDI).

(2) Find the Vector Number or Group you want to change.

Note: You cannot select the item which status is Used.

(3) Click the [Interrupt] cell and select an Interrupt setting from the drop-down list.

(4) When you use related components or enable code generation by clicking on the [Generate code] icon and change it to [Generate code], the interrupts with specified vector or group will be used.

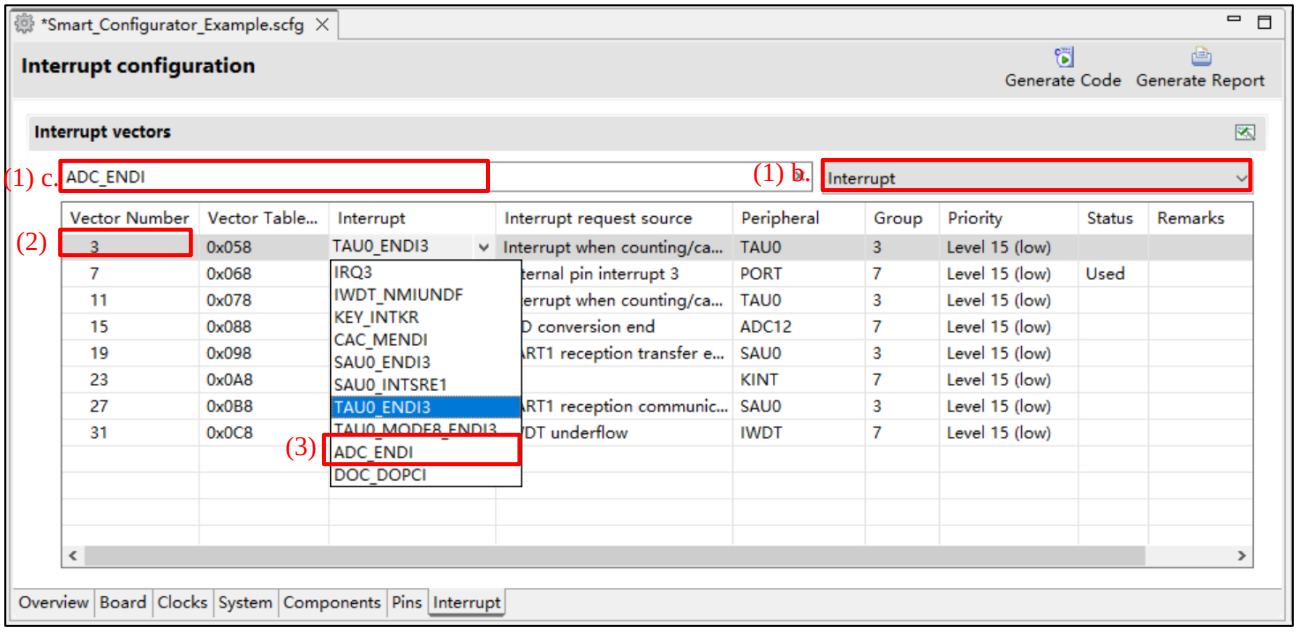


Figure 4-52 Change Interrupt Vector Setting Example

4.6.4 Resolving Interrupt error

Use IRQ5 as example, when IRQ5 is used in interrupt component, but an interrupt error is shown in "Configuration Problems" view. It means all interrupt vectors which can been used as IRQ5 have been occupied.

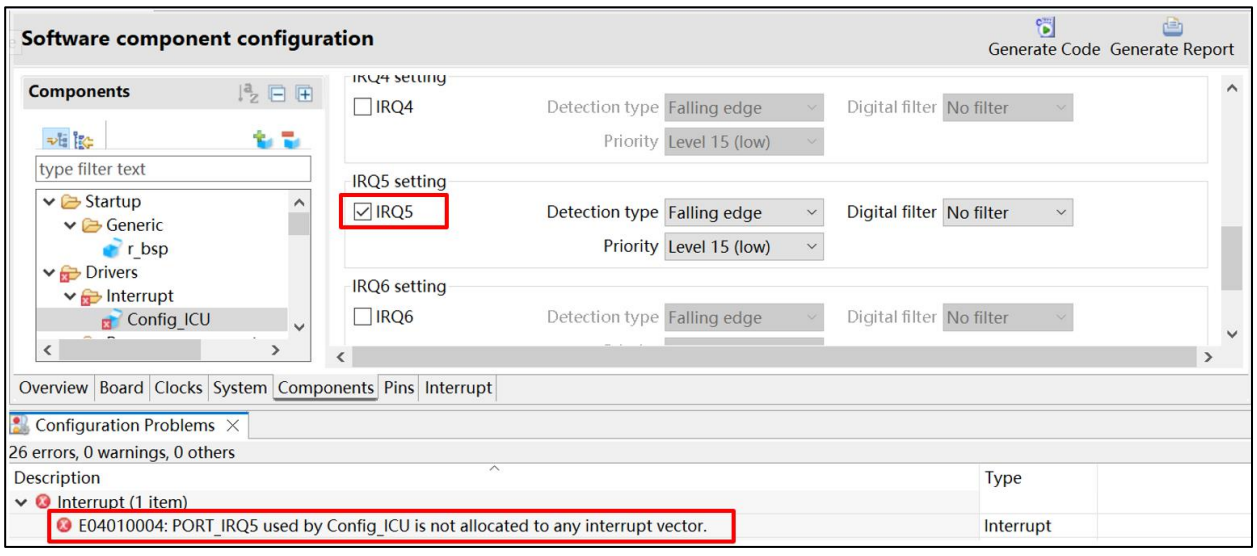


Figure 4-53 An interrupt is not allocated to any interrupt vector number

To solve this error, please release an occupied vector by other components and select a vector number for IRQ5 in [Interrupt] page using the following procedure:

(1) Change the filter to [interrupt].

(2) Input filter text (for e.g., IRQ5).

(3) Find the Peripheral you want to release.

(4) Right-clicking on ELC and then selecting the [Generate code] icon changes the icon to [Generate code] and disables code generation for the Code Generator configuration.

(5) The interrupt of ELC has been released.

(6) Click the [Interrupt] cell and select PORT_IRQ5 from the drop-down list.

(7) Generate Code again.

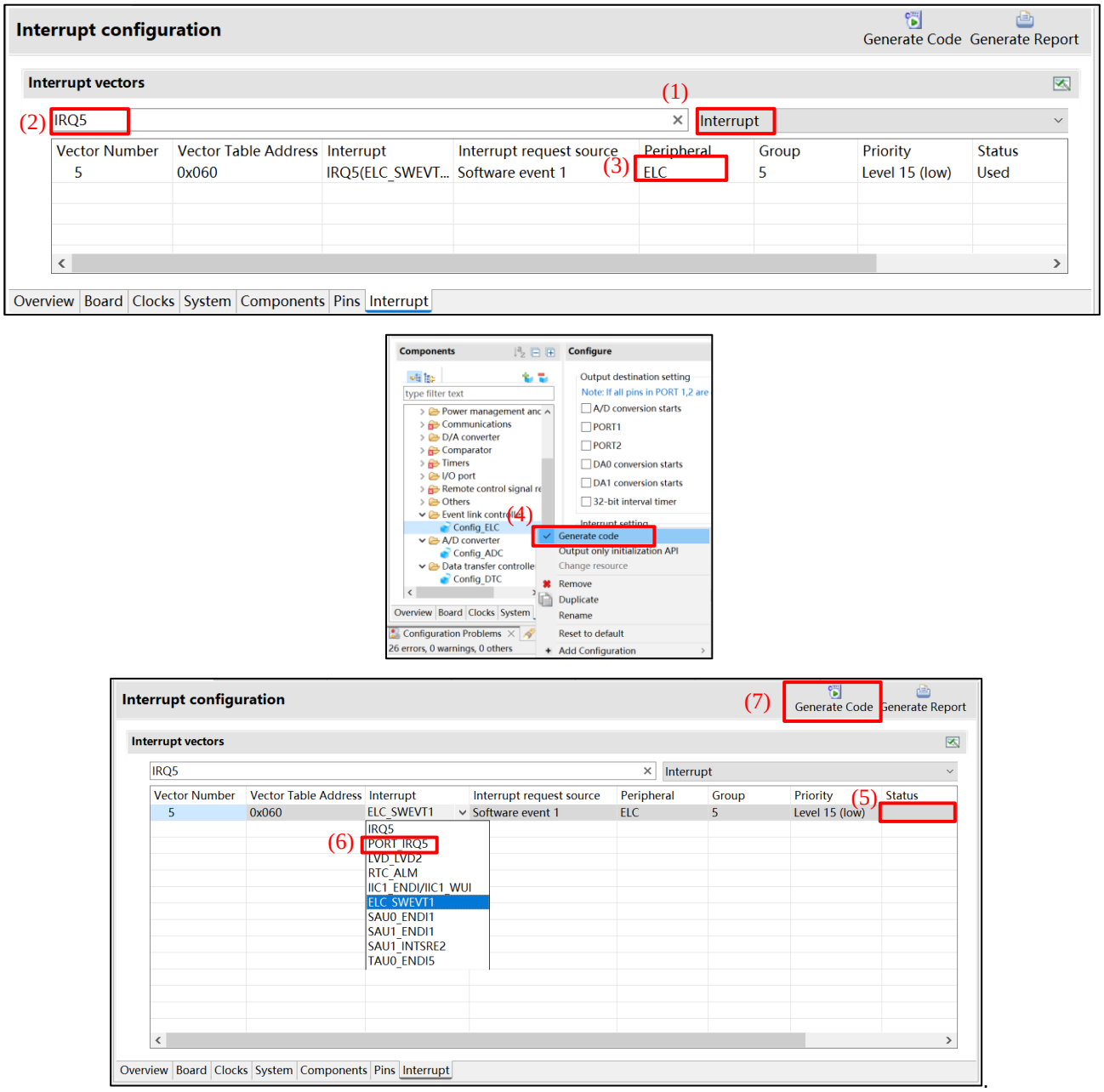


Figure 4-54 Release an occupied Interrupt

Note: If want to use ELC interrupt again, please start from step (1).

5. Managing Conflicts

When user add a component or configuring a pin or interrupt may cause problems in terms of resource conflict and missing dependency modules. This information will be displayed in the Configuration Problems view. User can refer to the displayed information to fix the conflict issues and generate code even if there are conflicts.

5.1 Resource Conflicts

When two software components are configured to use the same resource (for e.g., ADC), an error mark ( ) will be displayed in the Components tree.

The Configuration Problems view will display messages on peripheral conflicts to inform user in which software configurations peripheral conflicts have been detected.

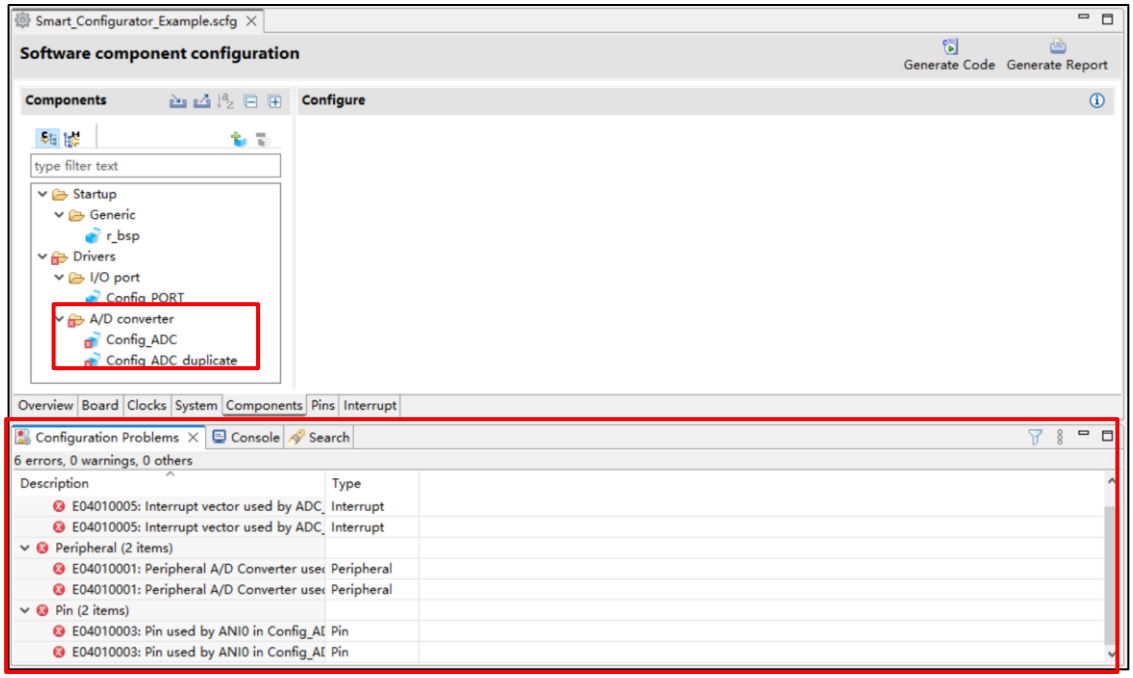


Figure 5-1 Resource Conflicts

5.2 Resolving Pin Conflicts

If there is a pin conflict, an error mark will appear on the tree and [Pin Function] list.

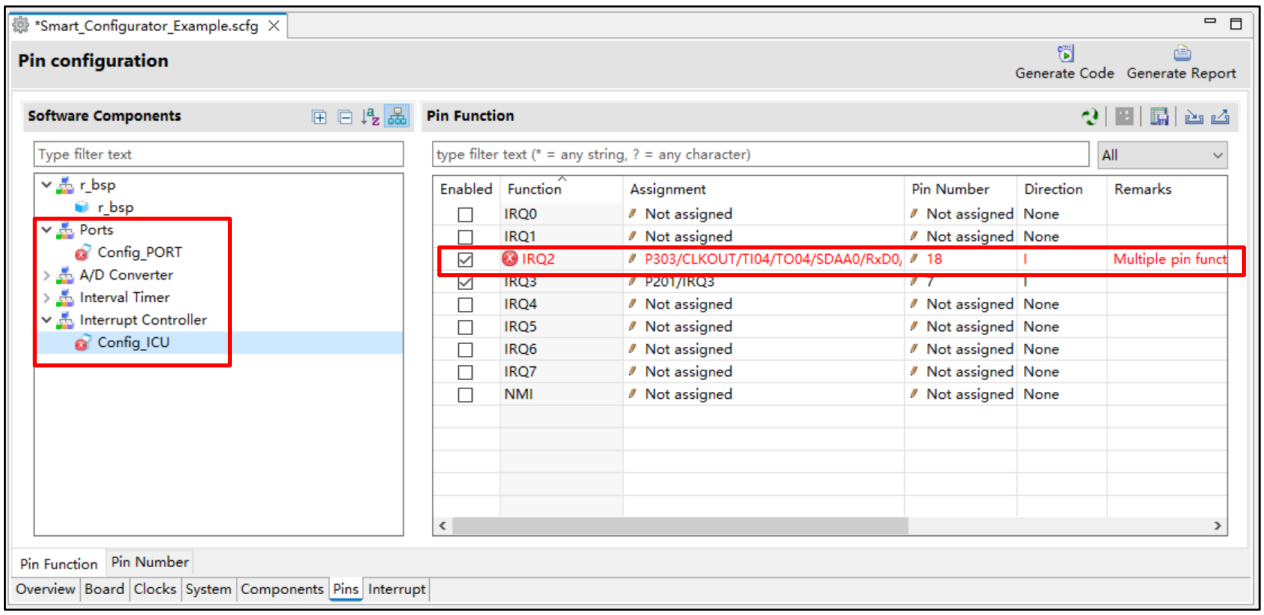


Figure 5-2 Pin Conflicts

Detailed information regarding conflicts is displayed in the Configuration Problems view.

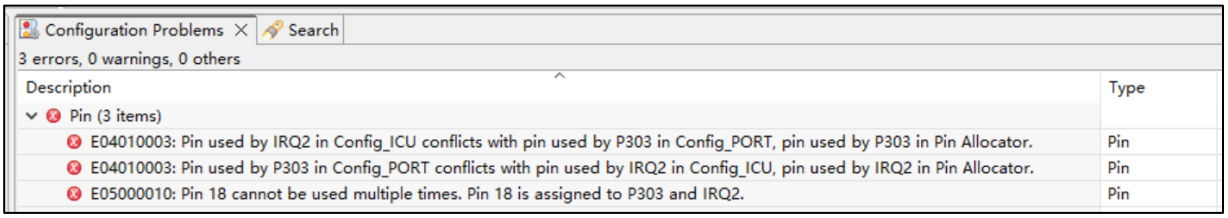


Figure 5-3 Pin Conflict Messages

To resolve a conflict, right-click on the node with an error mark on the tree and select [Resolve conflict].

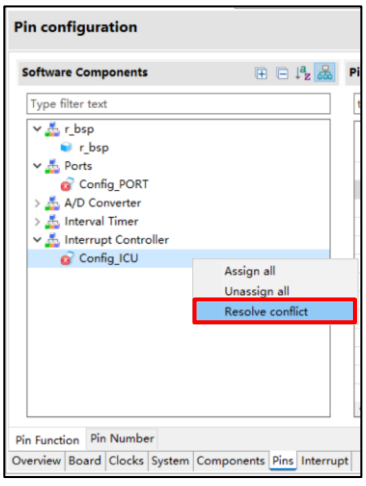


Figure 5-4 Resolving Pin Conflicts

The pin function of the selected nodes will be re-assigned to other pins.

6. Generating Source Code

Source generation can be generated even if there is a conflict in the Configuration Problems view.

6.1 Generating Source Code File

Output a source file for the configured details by clicking on the [Generate Code (Generate Code)] button in the Smart Configurator view.

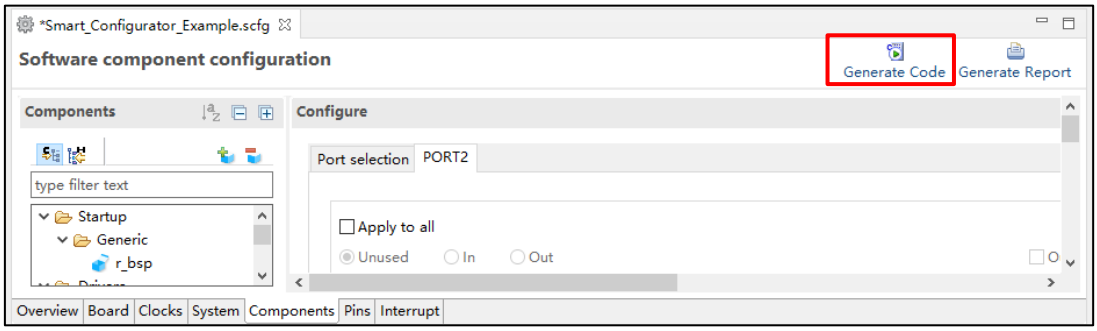


Figure 6-1 Generating a Source File

The Smart Configurator generates the source files in <ProjectDir>\src\smc_gen and IAR / SEGGER Embedded Studio related files in save location (refer to 3.3.1 Creating a New Smart Configurator Configuration File). If user's Smart Configurator has already generated a file, a backup copy of that file is also generated (refer to the chapter 9 Backing up Generated Source Code).

6.2 Configuration of Generated Files and File Names

Figure 6-2 Configuration of Generated Files and File Names, shows the folders and files output by the Smart Configurator. Function main () is included in main.c which is generated when clicking "Generated Code" in the Smart Configurator.

r_xxx indicates the names of Software Integration System Modules, "*ConfigName*" indicates the name of the configuration formed by the component settings and "*ProjectName*" indicates a project name set in the Smart Configurator.

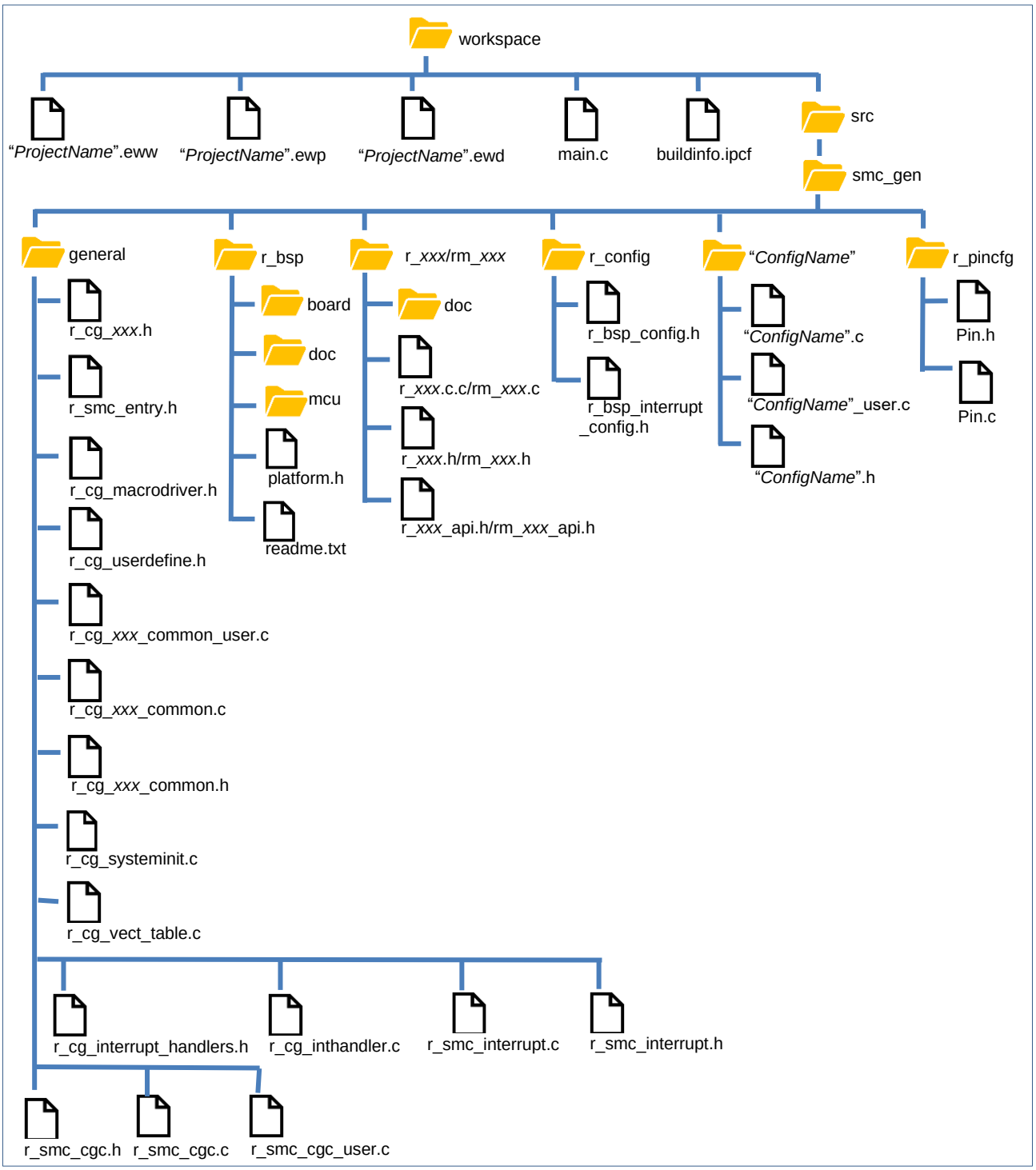


Figure 6-2 Configuration of Generated Files and File Names (IAREW)

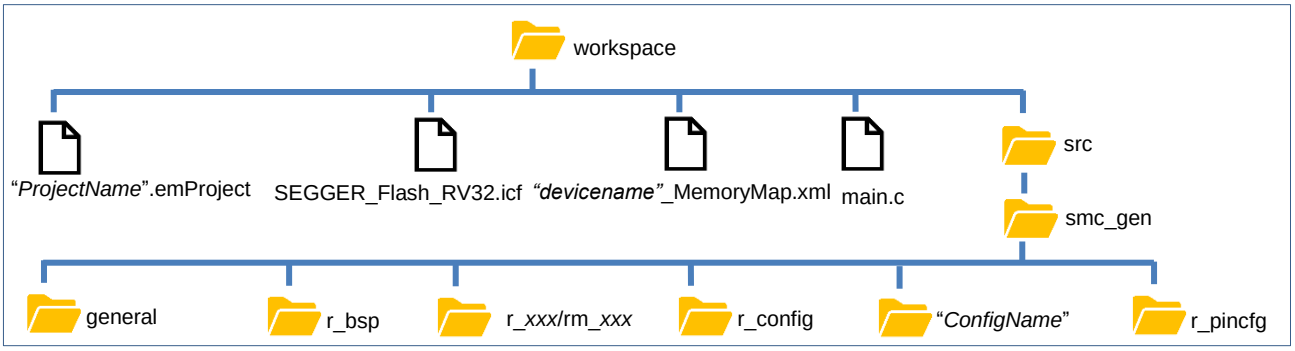


Figure 6-3 Configuration of Generated Files and File Names (SEGGER Embedded Studio)

Note: The generated files and file name under smc_gen folder is same for IAREW and SEGGER Embedded Studio.

Folder	File	Description
Workspace	-	This folder is not generated by Smart Configurator, but is the location that user selects to create Smart Configurator project. All folders and files generated by Smart Configurator will be generated into this folder.
	{*ProjectName*}.eww	This file generates once only in the first code generation. {*ProjectName*}.ewp file path is specified in this file. It is the workspace file for IAREW.
	{*ProjectName*}.ewp	This file generates once only in the first code generation. It appends the "buildinfo.ipcf" and "main.c" files at the end of this file. It is the project file for IAREW.
	{*ProjectName*}.ewd	This file generates once only in the first code generation. It is totally same as the default *.ewd file generated by IAREW. It is the debug file for IAREW.
	main.c	This file generates once only in the first code generation. It contains function main ().
	buildinfo.ipcf	This file is generated when clicking button "Generate Code" in Smart Configurator each time. It is the connection file for IAREW. It includes the path for all files generated for each component by Smart Configurator
	{ProjectName}.emProject	This file is generated when clicking button "Generate Code" in Smart Configurator each time. It is the project file for SEGGER Embedded Studio.
	SEGGER_Flash_RV32.icf	This file generates once only in the first code generation. It is the linker script file for SEGGER Embedded Studio section placement file.
	*"devicename"*_MemoryMap.xml	This file generates once only in the first code generation. It is the memory map file for SEGGER Embedded Studio.
general	-	This folder is always generated. It contains header files and source files commonly used by Code Generator drivers of the same peripheral function.
	r_cg_*xxx*.h(Note*1)	The files contain macro definitions for setting SFR registers.
	r_smc_entry.h	This file is always generated. This file includes the header files of Code Generator drivers that are added to the project. When using functions of Code Generator drivers in source files added by user, including this file is necessary.
	r_cg_macrodriver.h	This file is always generated. This header file contains common macro definitions used in drivers.
	r_cg_userdefine.h	This file is always generated. User can add macro definitions in the dedicated user code areas.
	r_cg_systeminit.c	This file is always generated. This file contains all component's Create () function. it is used for peripheral modules initialization.
	r_cg_*xxx*_common_user.c(Note*1)	The files contain common interrupt API of used peripherals.
	r_cg_*xxx*_common.c(Note*1)	This file is generated when related peripherals are used.
	r_cg_*xxx*_common.h(Note*1)	This file is generated when related peripherals are used.

	r_cg_interrupt_handlers.h	This file includes all interrupt routine declaration. If no configuration created, all interrupt routine is default routine; if specific configuration is created, corresponding interrupt routine declaration of this configuration will replace the default routine declaration.
	r_cg_inthandler.c	This file includes all default interrupt routine definition.
	r_cg_vect_table.c	This file includes an interrupt vector table which includes all interrupt routine entry address. if no configuration created, all interrupt routine entry address is default; if specific configuration is created, corresponding interrupt routine entry address of this configuration will replace the default routine entry address.
	r_smc_cgc.c	This file is always generated. It contains the initialization of clock sources other than the clock source selected in the [Clocks] page.
	r_smc_cgc.h	This file is always generated. This header file contains macro definitions to initialize clocks other than the selected clock source.

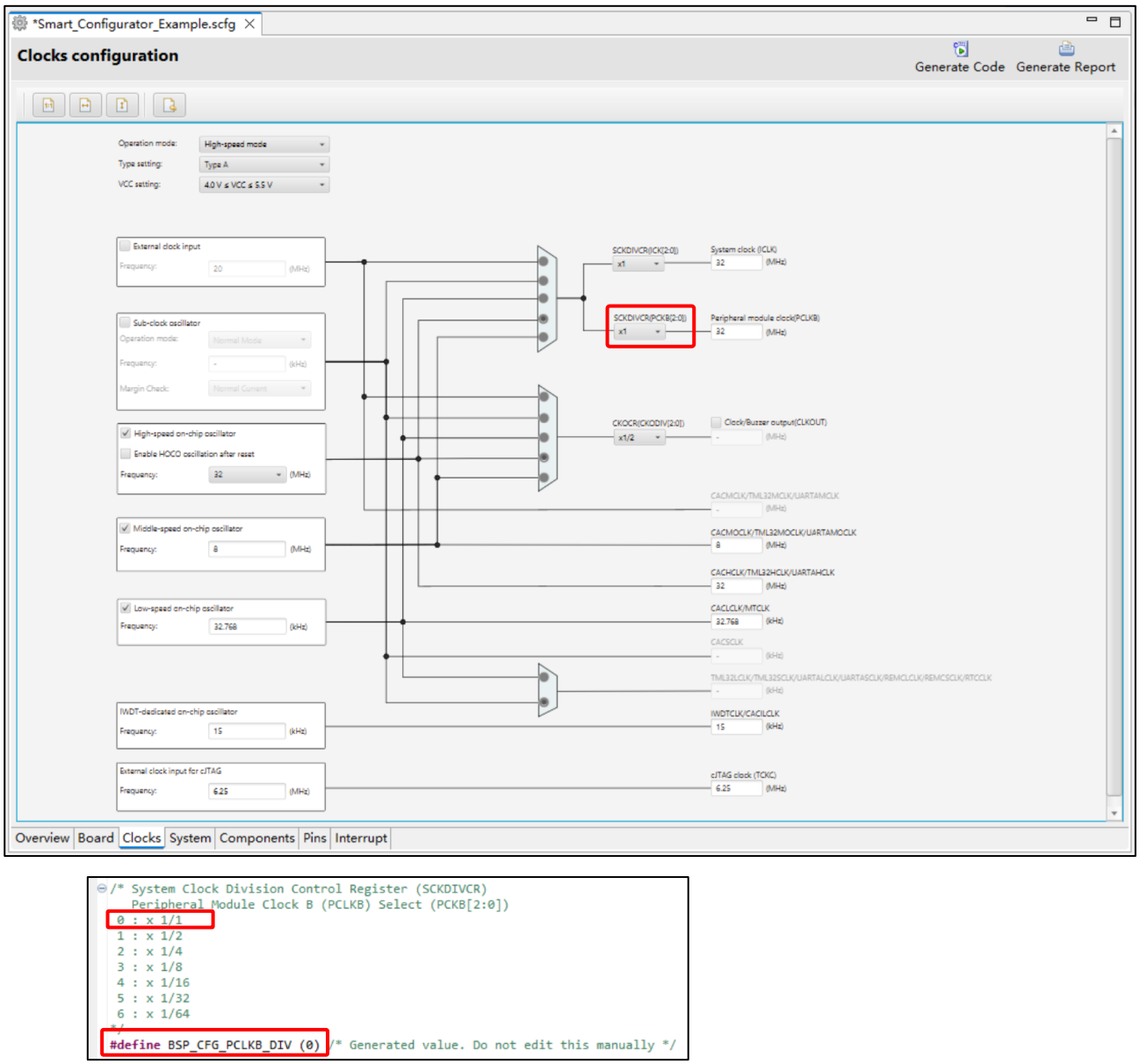
Folder	File	Description
general	r_smc_cgc_user.c	This file contains functions to be added to R_CGC_Create. User can add codes and functions in the dedicated user code areas.
	r_smc_interrupt.c	This file is always generated. It contains interrupt initialization (depending on hardware specification).
	r_smc_interrupt.h	This file is always generated. It contains the priority level of all interrupts that are configured in the [Interrupts] tabbed page. User can use these macro definitions in application codes.
r_bsp		This folder is always generated. It consists of multiple subfolders (board, doc, mcu) with: - Initialization codes to start up the MCU before entering main () (e.g. setup stack, initialize memory) - Definitions of all SFR registers in iodefine.h (mcu folder) - Application note of r_bsp (doc folder) It also contains platform.h that will include r_bsp.h of the device used in the project.
r_config		This folder is always generated. It contains configuration header files for the MCU package, clocks, interrupts, and RISC-V MCU Software Integration System drivers/middleware.
	r_bsp_config.h	This file is always generated. It contains configurations of r_bsp for clock initialization and other MCU related settings. Some MCU related settings are generated by Smart Configurator (e.g. package type) and other settings (e.g. stack size) are configured by user manually.
	r_bsp_interrupt_config.h	This file is always generated. It contains mapping of the software configurable interrupts (depending on hardware specification).
r_pincfg	Pin.h	This file is always generated. It is generated for supporting pin symbol and included in smc_entry.h.
	Pin.c	This file is always generated. It is a reference of pin function initialization for all peripherals configured in the [Pins] tabbed page (except I/O Ports).
{*ConfigName*}		This folder is generated for the Code Generator drivers that are added to the project. API functions in this folder are named after the *ConfigName* (configuration name).
	{*ConfigName*}.c	This file contains functions to initialize driver (R_*ConfigName*_Create) and perform operations that are driver-specific, e.g. start (R_*ConfigName*_Start) and stop (R_*ConfigName*_Stop).
	{*ConfigName*}_user.c	This file contains interrupt service routines and functions for user to add code after the driver initialization (R_*ConfigName*_Create). User can add codes and functions in the dedicated user code areas.
	{*ConfigName*}.h	This is header file for {*ConfigName*}.c and {*ConfigName*}_user.c.

Note *1: *xxx* is the name of a peripheral function.

6.3 Initializing Clocks

Configurations of the clock source selected in the [Clocks] page are generated to the macros in the r_bsp_config.h file located in \src\smc_gen\r_config folder. Clock initialization codes will be handled by r_bsp before entering main ().

The r_bsp_config.h file also contains other MCU related settings (for e.g., package, stack size).




```
/* System Clock Division Control Register (SCKDIVCR)
   Peripheral Module Clock B (PCLKB) Select (PCKB[2:0])
 0 : x 1/1
 1 : x 1/2
 2 : x 1/4
 3 : x 1/8
 4 : x 1/16
 5 : x 1/32
 6 : x 1/64
*/
#define BSP_CFG_PCLKB_DIV (0) /* Generated value. Do not edit this manually */
```

Figure 6-3 Clocks Configuration and Generated Code in r_bsp_config.h

Folder	File	Macros/Functions	Description
r_config	*r_bsp_config.h*	Macros related to clocks	These settings are generated by Smart Configurator based on user's selection in the [Clocks] page for the clock source. *r_bsp* will handle the clock initialization before entering *main ()*.
		Macros related to MCU settings	Some MCU related settings are generated by Smart Configurator (e.g. package type) macros. For the detail macro information, user can refer to the application note in *r_bsp* folder: *\src\smc_gen\r_bsp\doc*

Note: r_bsp_config.h will be backed up to trash folder before each code generation (refer to chapter 9 Backing up Generated Source Code).

6.4 Initializing Pins

Configurations in the [Pins] page are generated in some source files depending on driver's requirements and hardware specifications.

(1) Pin initialization for drivers with {*ConfigName*}

Pin functions are initialized in R_*ConfigName*_Create of the file \src\smc_gen\{*ConfigName*}\{*ConfigName*}.c.

Pin initialization codes will be handled before entering main ().

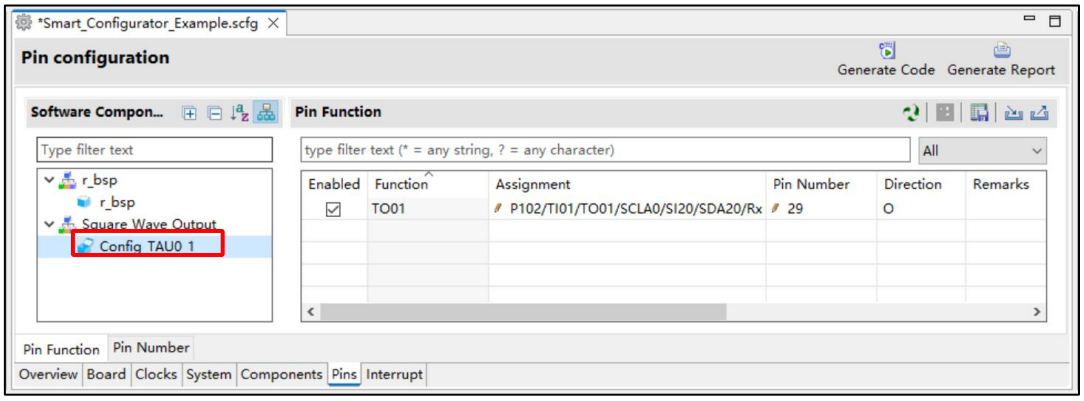


Figure 6-4 *Config_TAU0_1* in Software Components View

Folder	File	Function	Component type	Description
{*ConfigName*}	{*ConfigName*}.c	R_*ConfigName*_ Create	Code Generator	This API function initializes the pins used by this driver. r_cg_systeminit will call this function before entering main () function.

(2) Reference to pin initialization codes

Refer to *Pin.c* in \src\smc_gen\r_pincfg folder for all peripheral pin functions used in the project (except I/O ports).

Folder	File	Function	Driver	Description
r_pincfg	*Pin.c*	*R_Pins_Create*	-	This file contains the initialization codes of all pin functions configured in the [Pins] page except I/O ports.

6.5 Initializing Interrupts

Configurations in the [Interrupts] page are generated in some source files.
Interrupt functions are initialized in R_*ConfigName*_Create of the file \src\smc_gen\{*ConfigName*}\{*ConfigName*}.c.

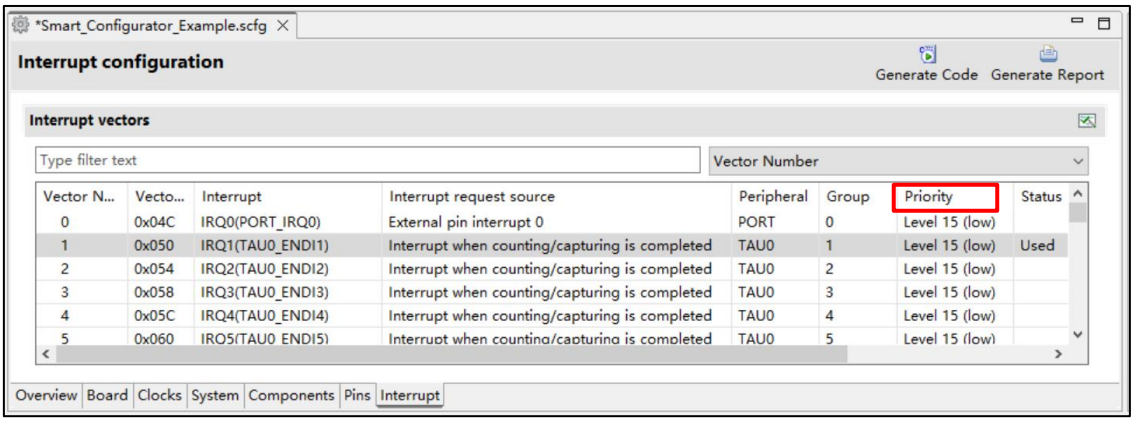


Figure 6-5 Interrupts Configuration in Interrupts View

Item	Folder	File	Component type	Description
Priority	{*ConfigName*}	{*ConfigName*}.c	Code Generator	It is initialized in R_*ConfigName*_Create of this file. *R_systeminit* in *r_cg_systeminit.c* will call this function before entering *main ()* function.

7. Loading Generated Files in Integrated Development Environment

Load source code outputted by Smart Configurator on Integrated Development Environment Platform.

7.1 Loading in IAR Embedded Workbench

When IAR environment is selected for the compiler to be used, Smart Configurator outputs the related files (.eww/.ewp/.ewd/main.c) together with the source file. It is not necessary for the user to create project files in IAR Embedded Workbench.

The usage procedure is as follows.

(1) Select [Open Workspace…] from the [File] menu of IAR Embedded Workbench.

(2) In the [Open Workspace] dialog box, browse to the folder where the project file is saved, select the project file (.eww), and click the [Open] button.

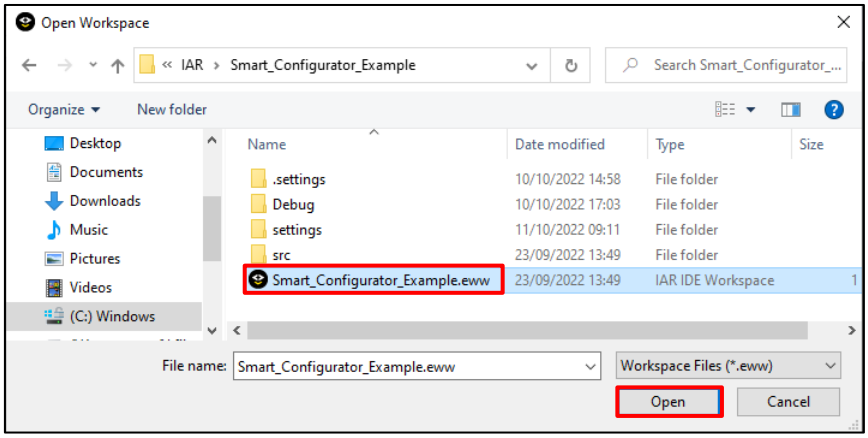


Figure 7-1 Load a *.eww File

(3) The source file output by the Smart Configurator is added to the IAR C project workspace.

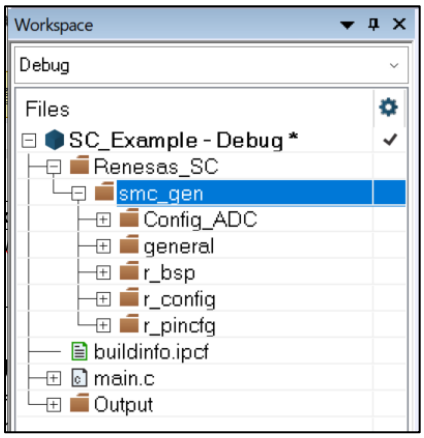


Figure 7-2 New Files Added to IAR Workspace

(4) Select [Options…] from the [Project] menu of IAR Embedded Workbench.

(5) In the [Options for node "*ProjectName*"] dialog box, change the target device to match with the target device selected when creating Smart Configurator's configuration file.

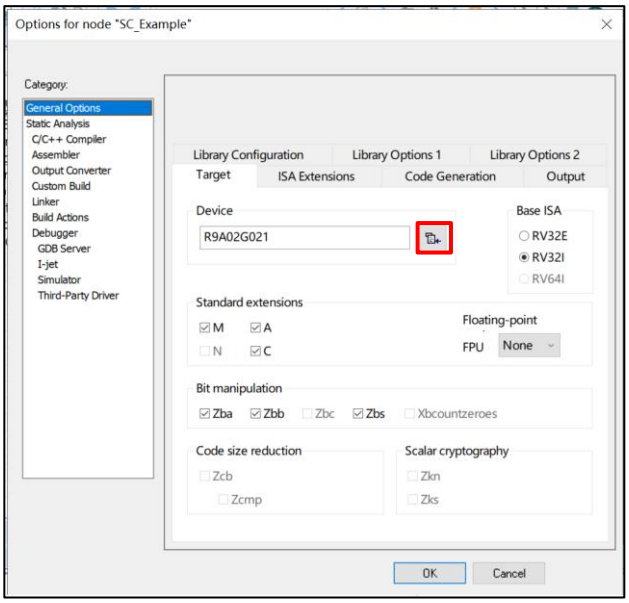


Figure 7-3 Change Target Device

7.2 Loading in SEGGER Embedded Studio

When SEGGER environment is selected for the compiler to be used, Smart Configurator outputs the related files (.emProject/Linker script file/Memory map file/main.c) together with the source file. It is not necessary for the user to create project files in SEGGER Embedded Studio.

The usage procedure is as follows.

(1) Select [Open Solution…] from the [File] menu of SEGGER Embedded Studio.

(2) In the [Open Solution] dialog box, browse to the folder where the project file is saved, select the project file (.emProject), and click the [Open] button.

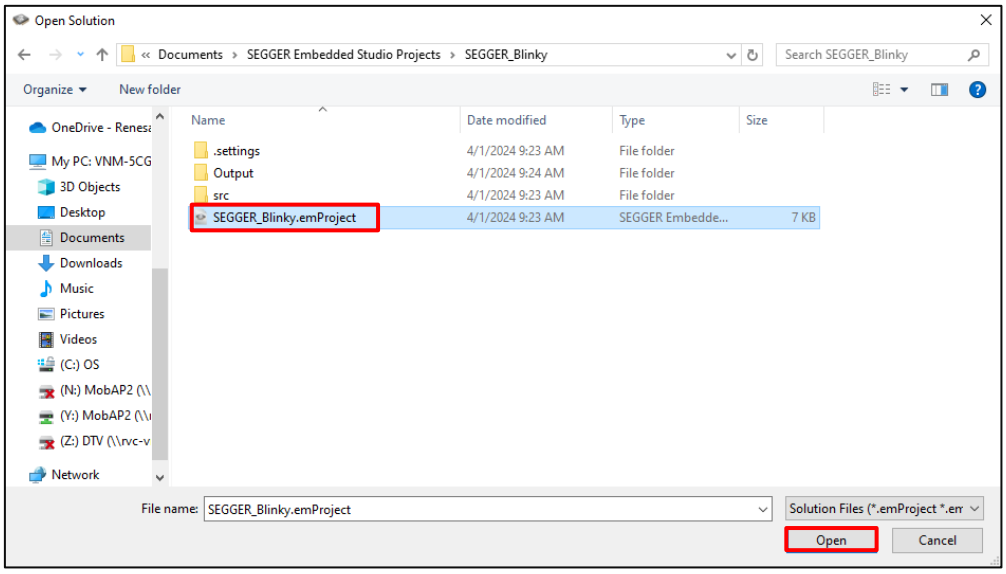


Figure 7-1 Load a *.emProject File

(3) The source file output by the Smart Configurator is added to the SEGGER Embedded Studio project workspace.

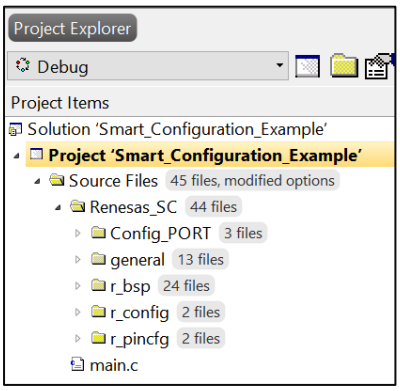


Figure 7-2 New Files Added to SEGGER Embedded Studio Workspace

7.3 Build IAR Project File

After loading Smart Configurator project file to IAR Embedded Workbench successfully, user can right-click on project name, select [Rebuild All] from context manual, then build operation will be executed successfully.

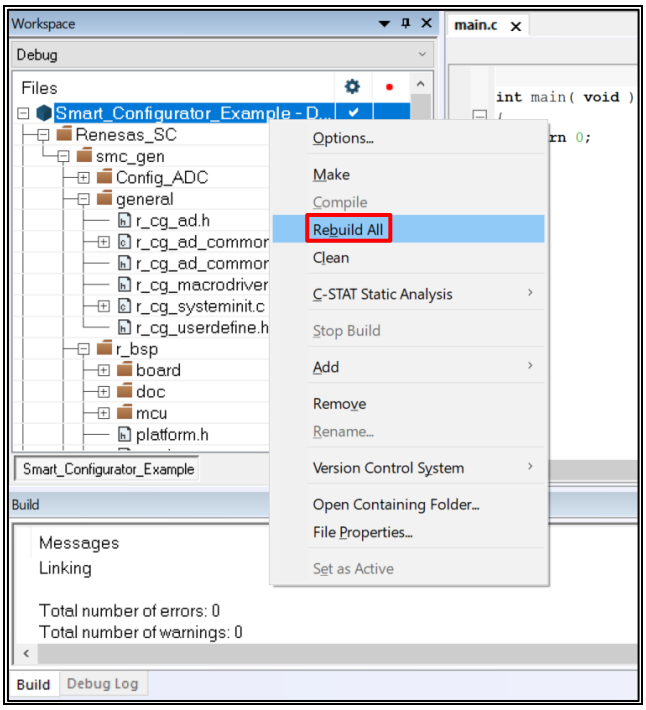


Figure 7-4 Build C Project File in IAR

7.4 Build SEGGER Embedded Studio Project File

After loading Smart Configurator project file to SEGGER Embedded Studio successfully, user can right-click on project name, select [Build] from context manual, then build operation will be executed successfully.

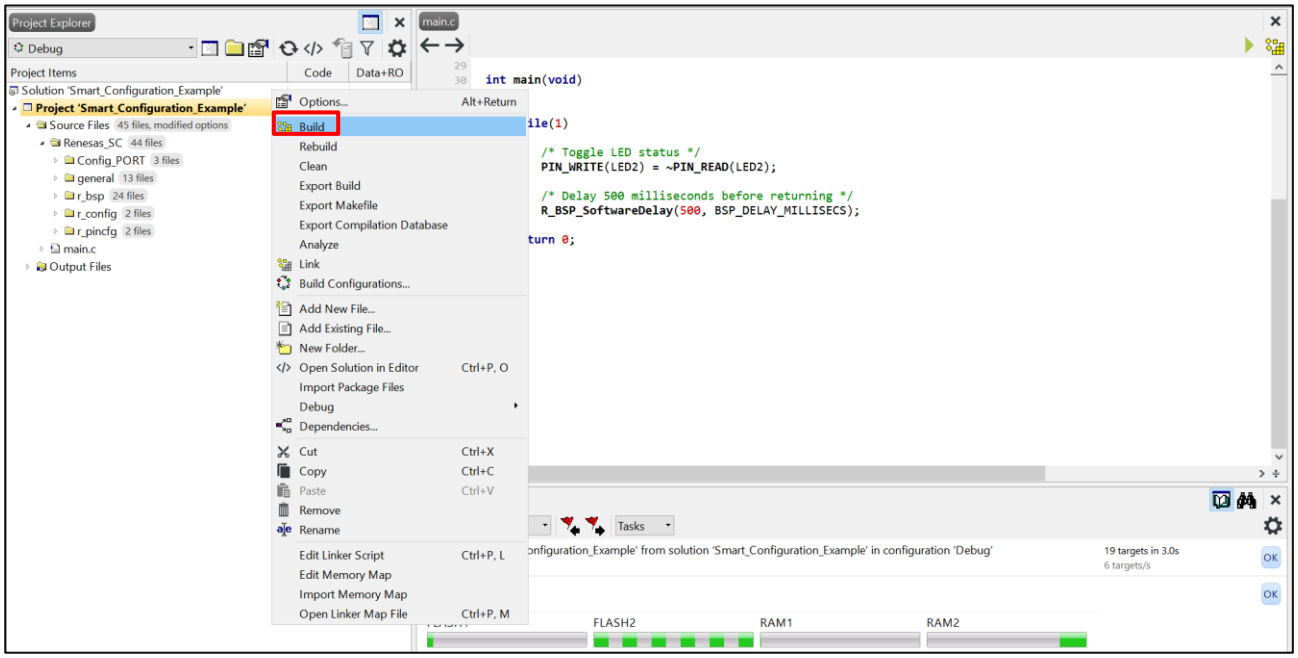


Figure 7-4 Build Project File in SEGGER Embedded Studio

8. Creating User Programs

The Smart Configurator can add custom code to the output source files. This chapter describes how to add custom code to the source file generated by the Smart Configurator. Please follow the procedure in ， to create an IAR project file first and make configuration setup, build and run the project.

8.1 Adding Custom Code

When [Code Generator] or [Graphical Configurator] is selected as the component type, if files which have the same name already exist, new code will be merged only with the existing code that is between the comments below.

```
/* Start user code for xxxx. Do not edit comment generated here */

/* End user code. Do not edit comment generated here */
```

In the case of [Code Generator], three files are generated for each of the specified peripheral functions. The file names are "Config_xxx.h", "Config_xxx.c", and "Config_xxx_user.c" as the default, with "xxx" representing the name of the peripheral module. For example, "xxx" will be "ADC" for the A/D Converter (resource ADC). The comments to indicate where to add custom code are at the start and end of *.c files, and at the end of *.h file. Comments to indicate where to add user code are also added to the interrupt function for the peripheral module corresponding to Config.xxx_user.c. The following example is for ADC (Config_ADC_user.c).

```
/***********************************************************************************************
***********************************
Pragma directive
***********************************************************************************************
***********************************/
/* Start user code for pragma. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */

/***********************************************************************************************
***********************************
Includes
***********************************************************************************************
***********************************/
#include "r_cg_macrodriver.h"
#include "Config_ADC.h"
/* Start user code for include. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */
#include "r_cg_userdefine.h"

/***********************************************************************************************
***********************************
Global variables and functions
***********************************************************************************************
***********************************/
/* Start user code for global. Do not edit comment generated here */
/* End user code. Do not edit comment generated here */

/***********************************************************************************************
***********************************
* Function Name: R_Config_ADC_Create_UserInit
* Description  : This function adds user code after initializing the AD converter.
* Arguments    : None
* Return Value : None
***********************************************************************************************
***********************************/
void R_Config_ADC_Create_UserInit(void)
{
    /* Start user code for user init. Do not edit comment generated here */
    /* End user code. Do not edit comment generated here */
}
/***********************************************************************************************
***********************************

* Function Name: r_Config_ADC_interrupt

* Description  : This function is ADC_ENDI interrupt service routine.

* Arguments    : None

* Return Value : None

***********************************************************************************************
***********************************/

void r_Config_ADC_interrupt(void)

{

    /* Start user code for r_Config_ADC_interrupt. Do not edit comment generated here
*/

    /* End user code. Do not edit comment generated here */

    R_ICU->IELSR15 &= 0xFFFEFFFFU;    /* clear ADC_ENDI interrupt flag */

}


/* Start user code for adding. Do not edit comment generated here */

/* End user code. Do not edit comment generated here */
```

8.2 Using Generated Code in User Application

To use the generated code of RISC-V MCU Software Integration System Modules and Code Generator, follow the below steps:

Driver initialization functions (R_ConfigName_Create) including initialization of pins have been called in *R_Systeminit* function of *r_cg_systeminit.c* by default. User just need to add application codes to perform operations that are driver-specific, for e.g., start (*R_ConfigName_Start*) and stop (*R_ConfigName_Stop*).

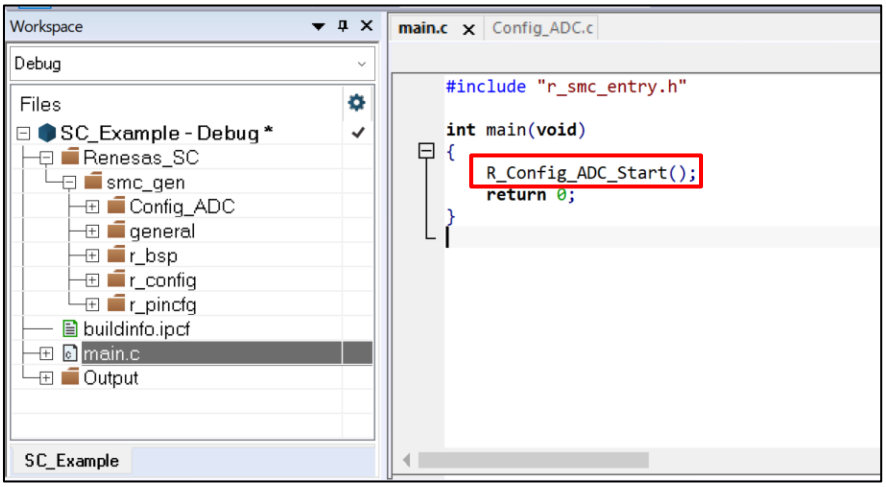


Figure 8-1 Call Code Generator Functions

9. Backing up Generated Source Code

The Smart Configurator has a function for backing up the source code at:

<ProjectDir>\trash\<Date-and-Time>

The Smart Configurator generates a backup folder for the previously generated source code when new code is generated by clicking on the [Generate Code (Generate Code)] button. <Date-and-Time> indicates the date and time when the backup folder is created after code generation.

10. How to make debug connections via J-Link OB on the FPB Board

Connecting the PC and the target Board by using a J-Link OB.

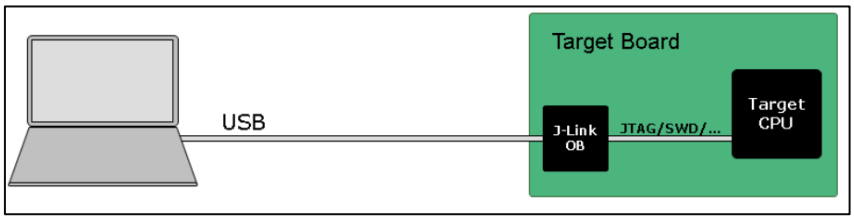


Figure 10-1 Connecting the PC and the target Board by using a J-Link OB

Use IAREW GDB server debugger as an example:

1. Create a Blinky project of IAR toolchain. Select the GDB server debugger in project's Options:

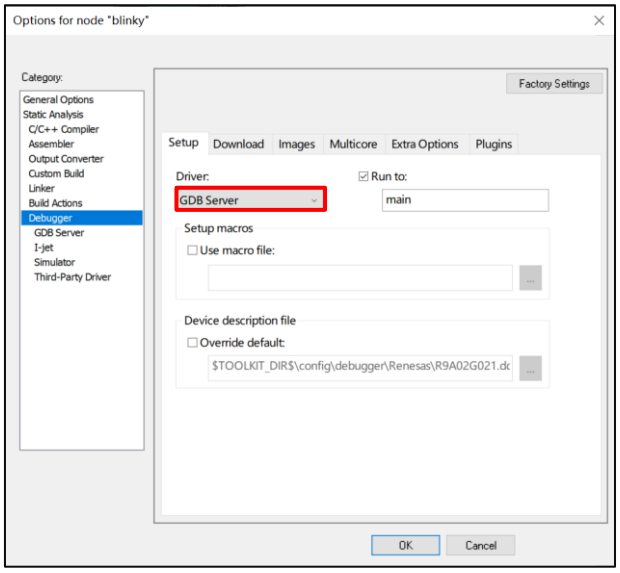


Figure 10-2 Using GDB server debugger

2. Ensure that project is configured to use the IAREW flash loader.

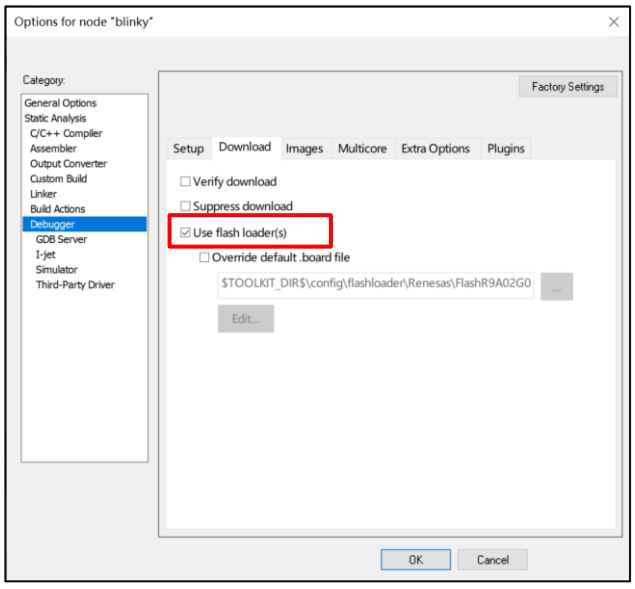


Figure 10-3 Using IAR flash loader

3. Using "localhost,2331" for TCP/IP address or hostname of GDB server.

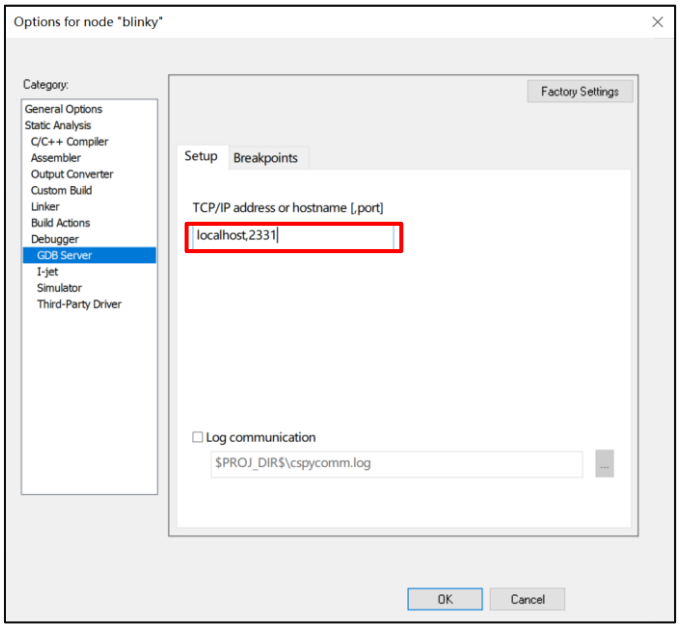


Figure 10-4 Set TCP/IP address or hostname

4. Open Command Prompt, input JLinkGDBServerCL.exe file location, device, and port information:
"C:\Program Files\SEGGER\JLink_V794\JLinkGDBServerCL.exe" -device risc-v -if cjtag -port 2331.

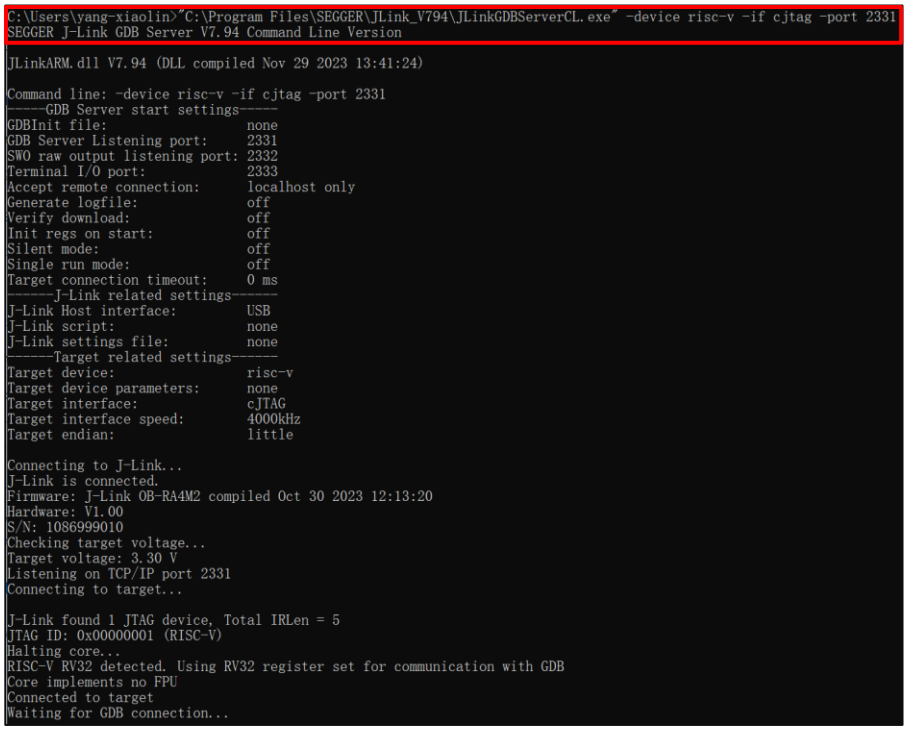


Figure 10-5 Set .exe file location/device/port information in Command Prompt

Note: J-Link version V7.94 or later.

5. Click on [Download and Debug] in IAREW:

Figure 10-6 Click on [Download and Debug] in IAREW

6. The code can be downloaded successfully and start from main() function :

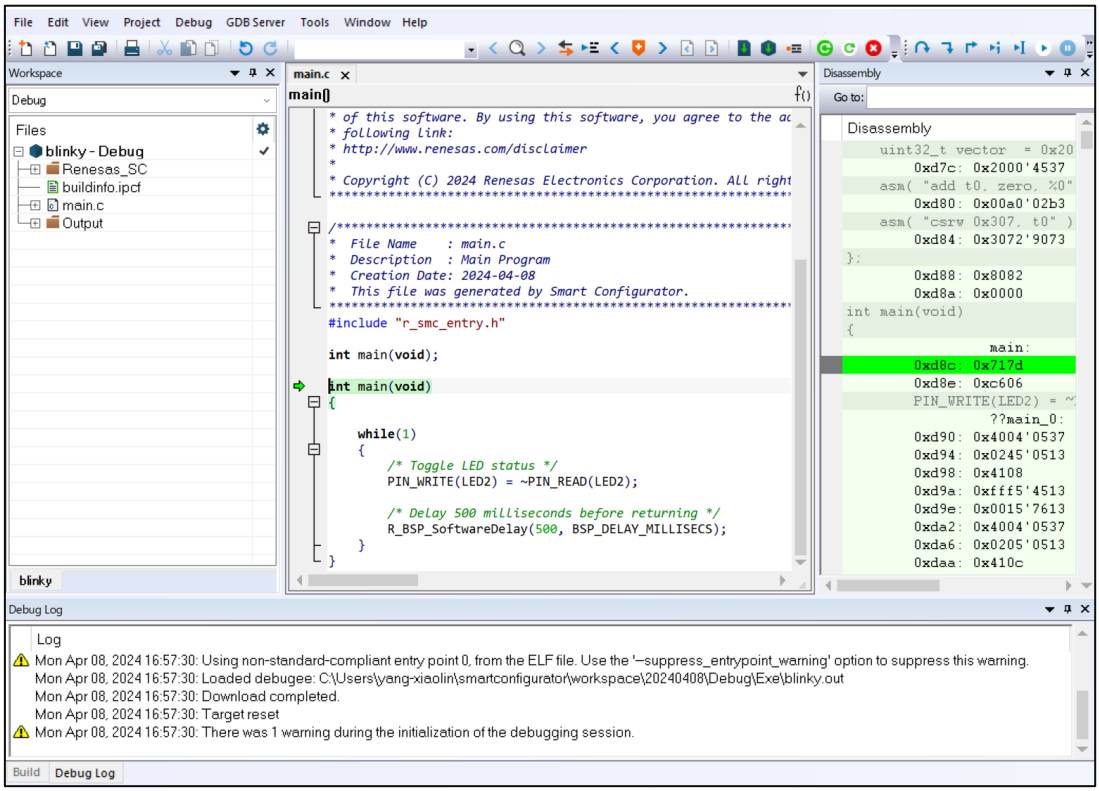


Figure 10-7 The code can be downloaded successfully

11. Generating Reports

The Smart Configurator can output the configuration information of the project to the report. Follow the procedure below to generate a report.

11.1 Report on All Configurations (PDF or Text File)

A report is output in response to clicking on the [Generate Report (Generate Report)] button in the Smart Configurator view.

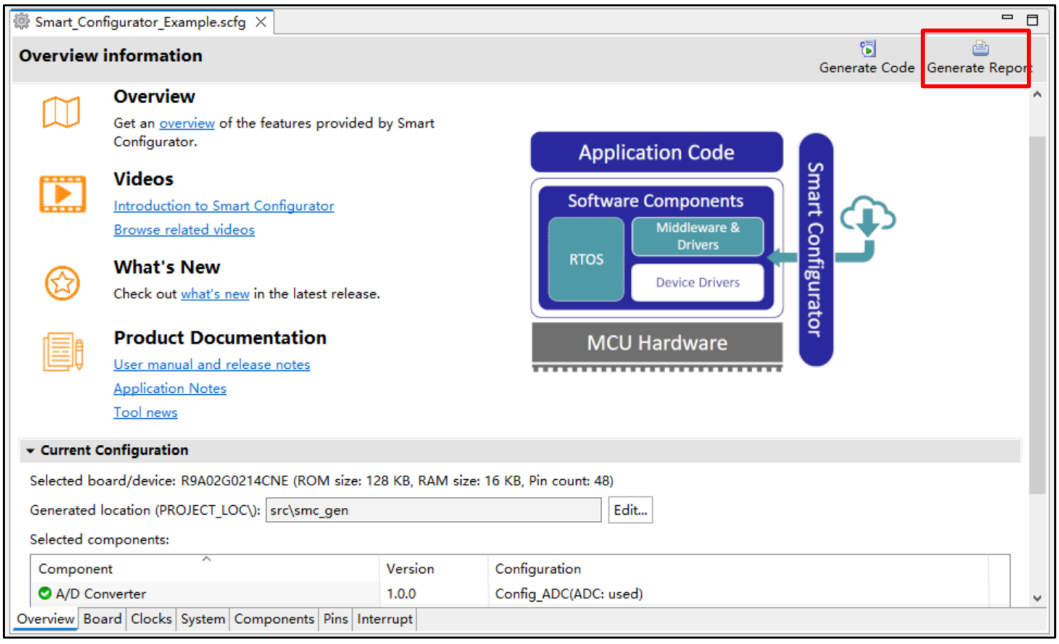


Figure 11-1 Output of a Report on the Configuration (as a PDF/Text File)

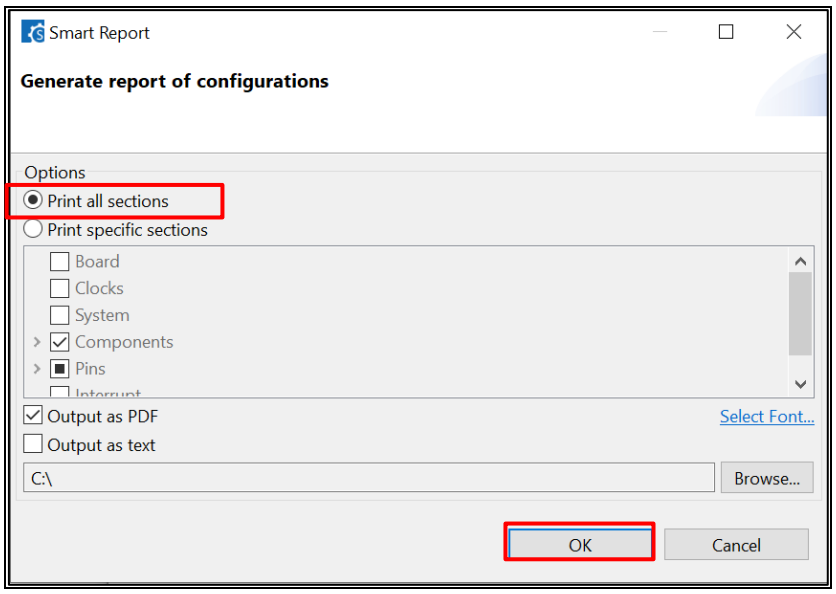


Figure 11-2 Dialog Box for Output of a Report (Example is selecting "Output as PDF")

11.2 Configuration of Pin Function List and Pin Number List (in csv Format)

A list of the configuration of pin functions and pin numbers (whichever is selected at the time) is output in response to clicking on the [(Save the list to .csv file)] button on the [Pins] page of the Smart Configurator view.

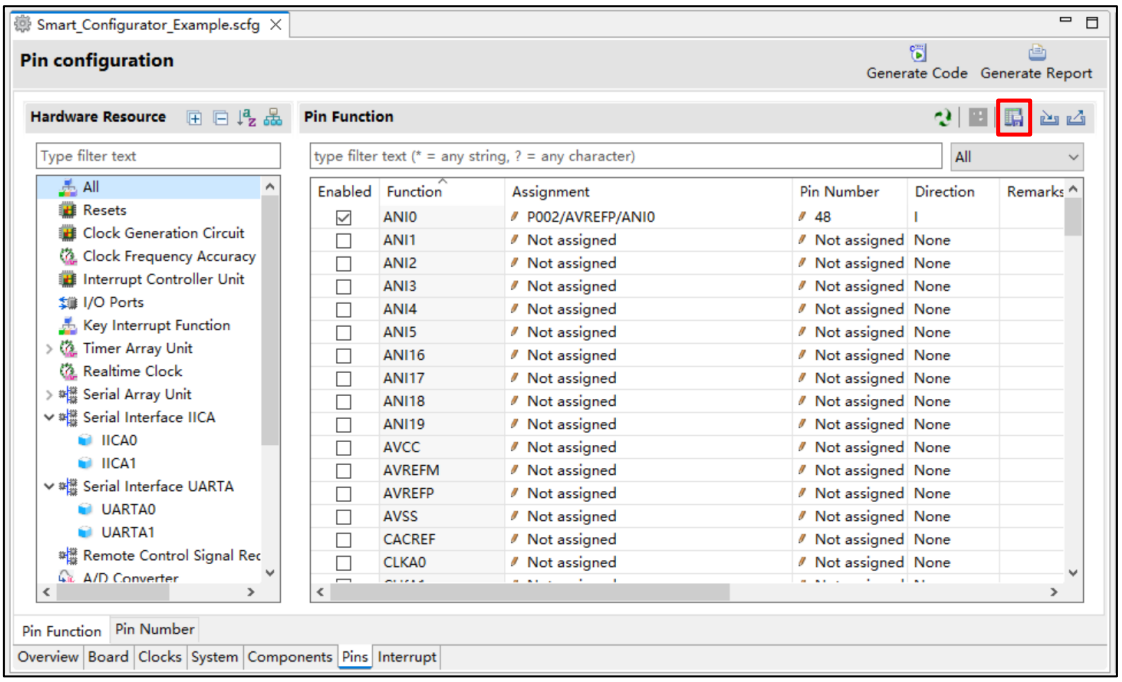


Figure 11-3 Output of a List of Pin Functions or Numbers (in csv Format)

11.3 Image of MCU/MPU Package (in png Format)

An image of the MCU/MPU package is output in response to clicking on the [(Save Package View to external image file)] button of the [MCU/MPU Package] view.

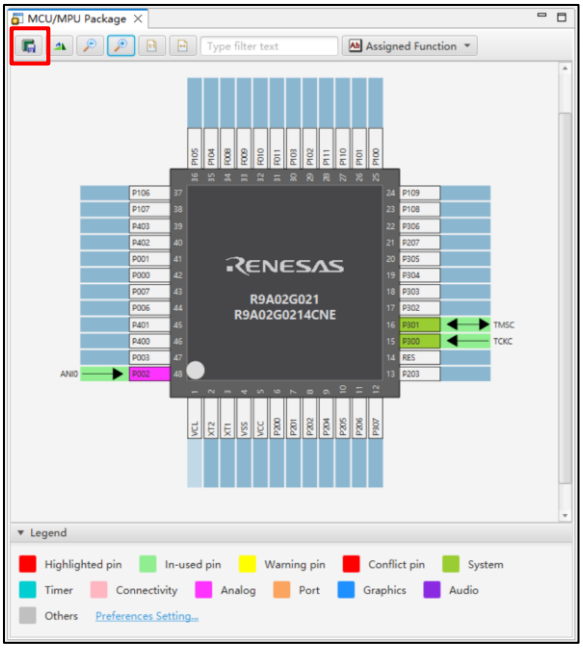


Figure 11-4 Outputting a Figure of MCU/MPU Package (in png Format)

12. User Code Protection Feature for Smart Configurator Code Generation Component

This feature empowers users to insert codes to any location in the generated codes by utilizing the specific tags, as shown in Figure 12-1. After the next code generation, the inserted user codes will be protected and automatically merged into the generated files.

The user code protection feature will be supported on the files that are generated by the "Code Generation" component and "Clock" tool.

12.1 Specific Tags for the User Code Protection Feature

When using the user code protection feature, please insert /* Start user code */ and /* End user code */ as shown in Figure 12-1 and add the user codes between these tags. If the specific tags do not match exactly, the inserted user code will not be protected after the code generation.

```
/* Start user code */

User code can be added between the specific tags

/* End user code */
```

Figure 12-1 Specific Tags for User Code Protection Feature

12.2 Examples of Using User Code Protection Feature to Add New User Code

Figure 12-2 shows an example of adding new user code into the Create API of A/D Converter module by using the specific tags shown in Figure 12-1. After updating the configuration in the A/D Converter GUI and re-generating the codes, the inserted user codes will be automatically merged into the newly generated file.

Figure 12-2 User Code Protection with Auto Merge

12.3 What to Do When Merge Conflict Occurs

12.3.1 What is Merge Conflict

When the lines of generated codes before and after the inserted user codes are updated due to changes in GUI configuration or the version update of Smart Configurator, merge conflict codes will be generated out.

If the merge conflict occurs, conflict message will be displayed in the Smart Configurator console, as shown in Figure 12-3 The Merge Conflict Message Outputted in the Smart Configurator Console.

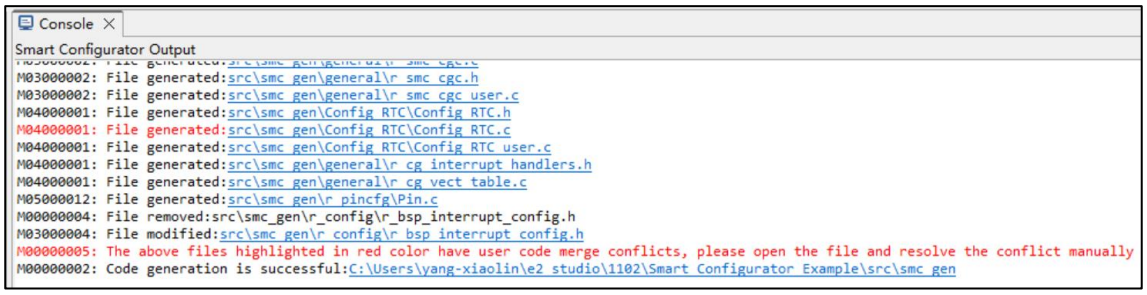


Figure 12-3 The Merge Conflict Message Outputted in the Smart Configurator Console

User can click the conflicted file in the console message to open the File Compare view and then can resolve the conflict as next chapter 12.3.2 Steps for Resolving the Merge Conflict described.

12.3.2 Steps for Resolving the Merge Conflict

User can follow the steps below to solve the merge conflicts.

(1) Click on the conflicting file in the console to open the "File Compare" view (Figure 12-4 Code before Resolving Conflict).

(2) Click on "Copy Current Change from Left to Right" (Figure 12-4 Code before Resolving Conflict).

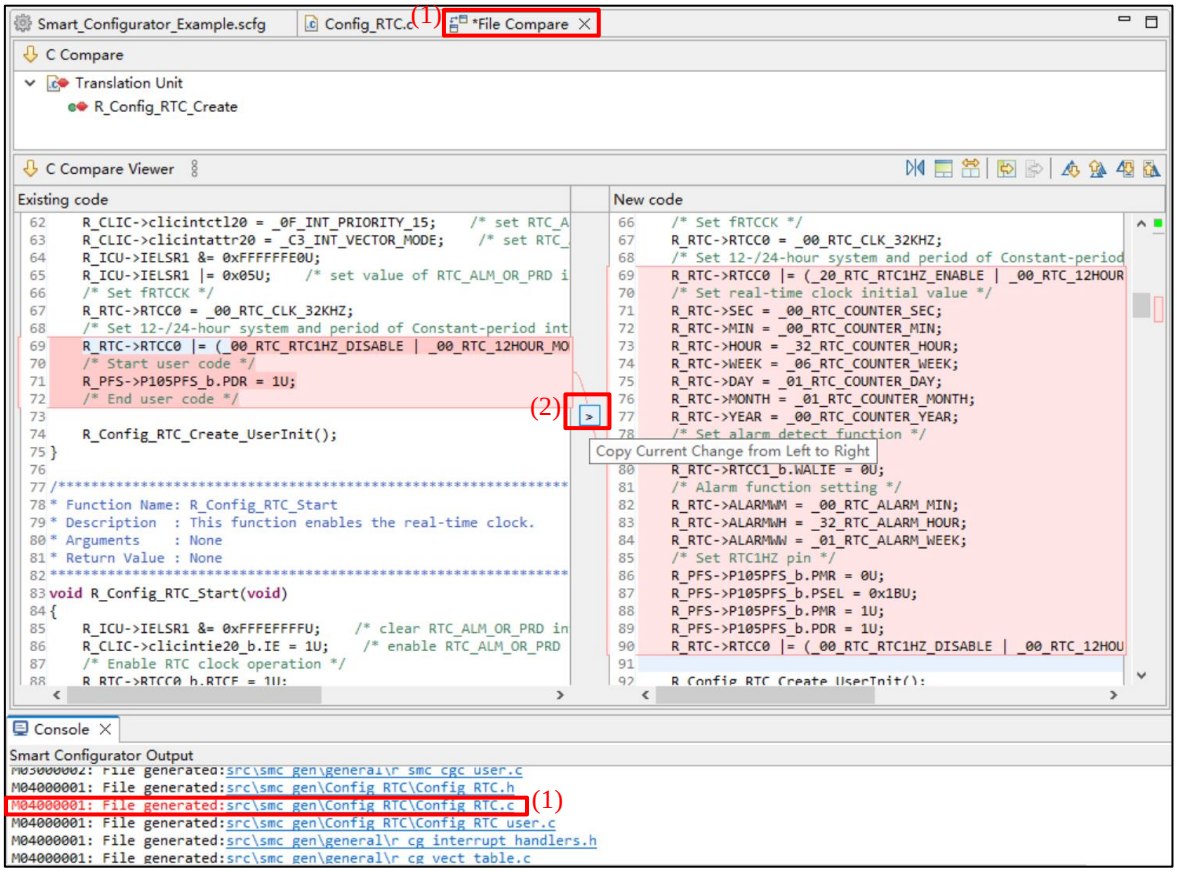


Figure 12-4 Code before Resolving Conflict

(3) Move user codes to the place you want to use (Figure 12-5 Code after Applying "Copy Current Change from Left to Right").

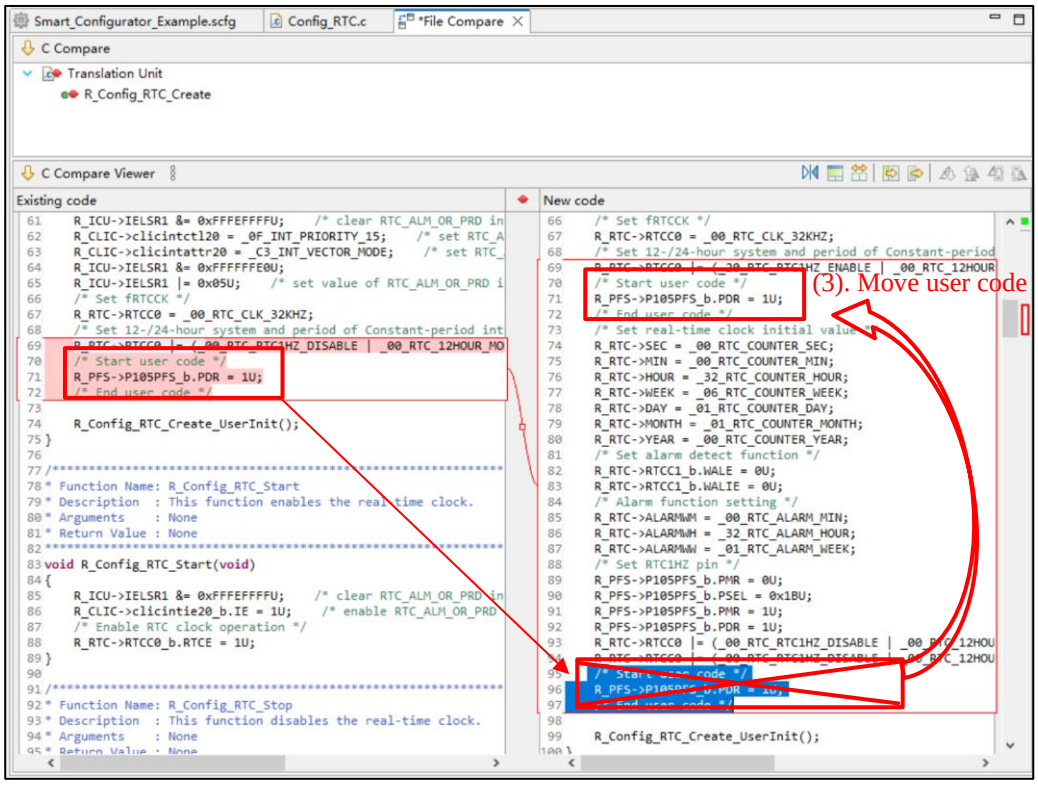


Figure 12-5 Code after Applying "Copy Current Change from Left to Right"

(4) Save the modified code (Figure 12-6 Code after Moving and Saving).

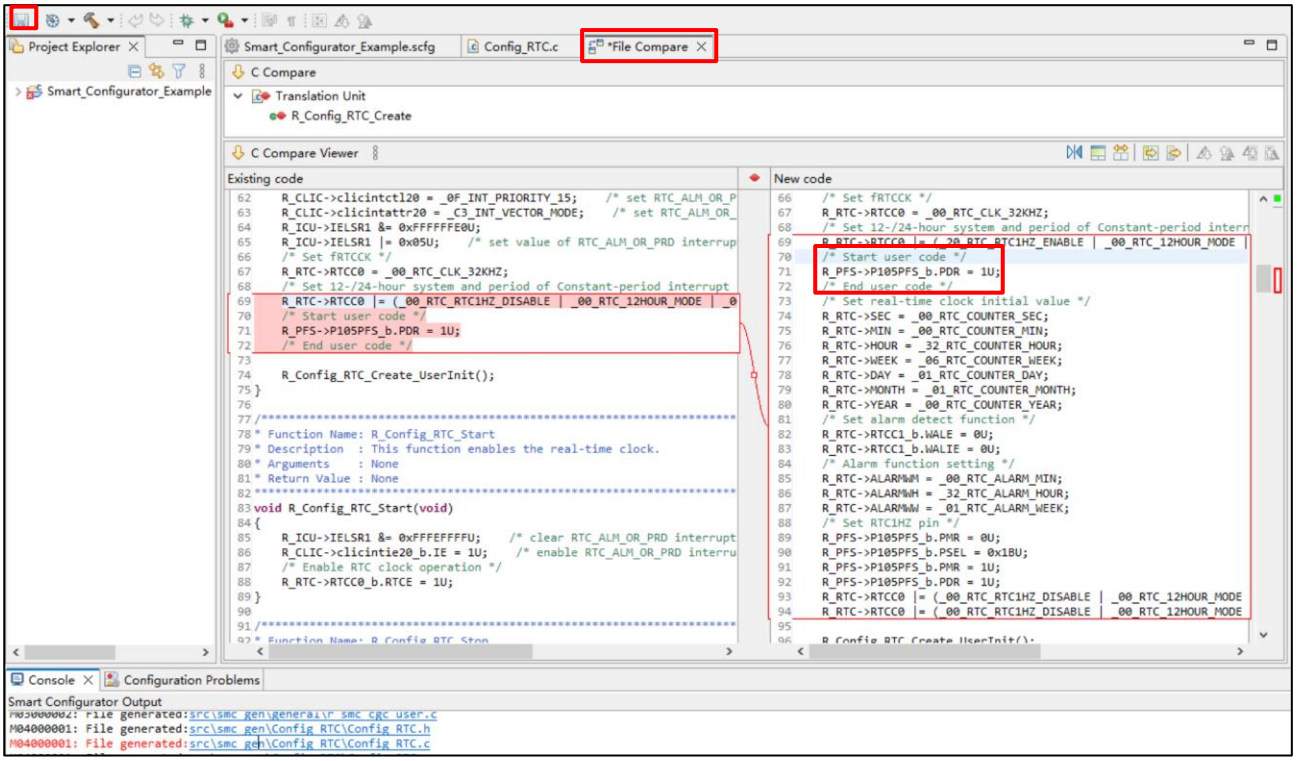


Figure 12-6 Code after Moving and Saving

User can also resolve the conflict by editing the code in the right panel directly.

Note: After conflict resolved, if click the confliction message, it still can open [File Compare] view.

13. Help

Refer to the help system for detailed information on the Smart Configurator by clicking the [Help Contents] menu..

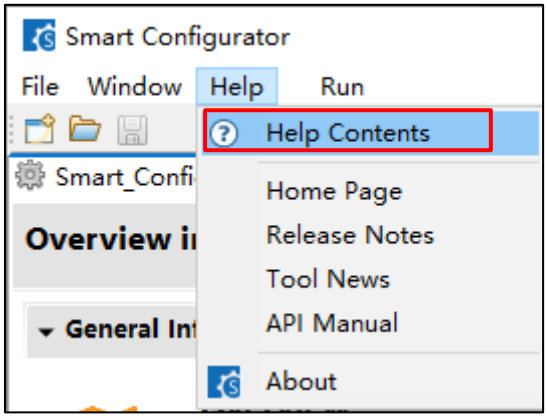


Figure 13-1 Help Menu

The help system can also be activated from the [Overview information] page by clicking button.

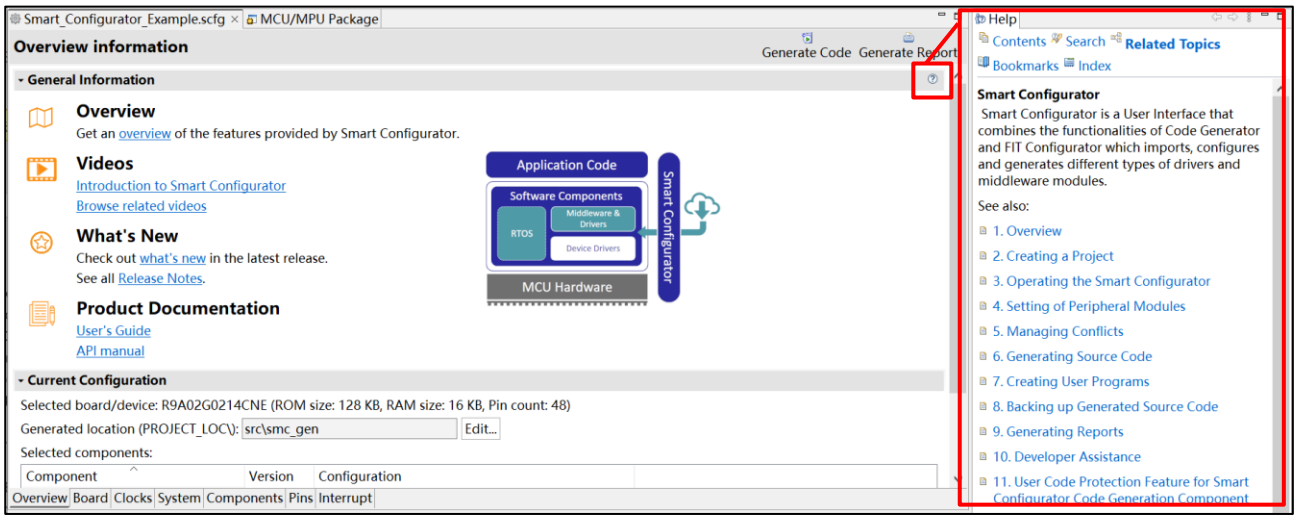


Figure 13-2 Quick Start

In both ways to check Help information, the whole Help contents is the same.

14. Documents for Reference

User's Manual: Hardware

Obtain the latest version of the manual from the website of Renesas Electronics.

Technical Update/Technical News

Obtain the latest information from the website of Renesas Electronics.

User's Manual: Development Environment

Smart Configurator User's Manual: RISC-V MCU API Reference (R20UT5385)

Obtain the latest version of IAR Embedded Workbench for Renesas RISC-V manual from the website of IAR.

Revision History

Rev.	Section	Description
1.00	-	First edition issued
1.01	Chapter Introduction	Add the SEGGER information and URL.
	Chapter 2.1	Add URL.
	Chapter 3.1	Add SEGGER information for operating procedure.
	Chapter 3.3.1	Add SEGGER information for creating a new Smart Configurator Configuration File
	Chapter 4.3	Update Figure 4-8.
	Chapter 6.2	Add Figure 6-3 for SEGGER. Update table for SEGGER.
	Chapter 7.2	Add SEGGER information for loading in SEGGER Embedded Studio
	Chapter 7.4	Add SEGGER information for build SEGGER Embedded Studio Project File
	Chapter 10	Add SEGGER information for how to make debug connections via J-Link OB on the FPB Board

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.

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