
RL78 Smart Configurator

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User's Guide: IAREW

Introduction

This application note describes the basic usage of the RL78 Smart Configurator (hereafter called the Smart Configurator), and the procedure for importing its output files to IAR Embedded Workbench.

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

- IAR Embedded Workbench for Renesas RL78 V4.20.1

Target device and support compiler

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

<https://www.renesas.com/smart-configurator>

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1. Overview

1.1 Purpose

This application note describes the basic usage of the RL78 Smart Configurator (hereafter called the Smart Configurator), and the procedure for importing its output files to IAR Embedded Workbench.

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

1.2 Features

The Smart Configurator is a utility for combining software to meet your needs. It handles the following three functions to support the embedding of drivers from Renesas in your 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 RL78 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) Graphical Configurator (SMS, ELCL)
The Graphical Configurator module makes it easy to set up complex configurations by providing a graphical GUI compared to other drivers. It provides software components for SNOOZE mode sequencer (SMS) and logic and event link controller (ELCL).
- (3) RL78 Software Integration System (CAPACITIVE SENSING UNIT (CTSU2L), etc.)
The RL78 Software Integration System module is a software component of drivers, middleware SW that provides a simple GUI for generating code.

2. Before Using the Smart Configurator

2.1 Creating a New IAR C Project File

- (1) Select [Create New Project...] from the [Project] menu of IAR Embedded Workbench, to create a C project.

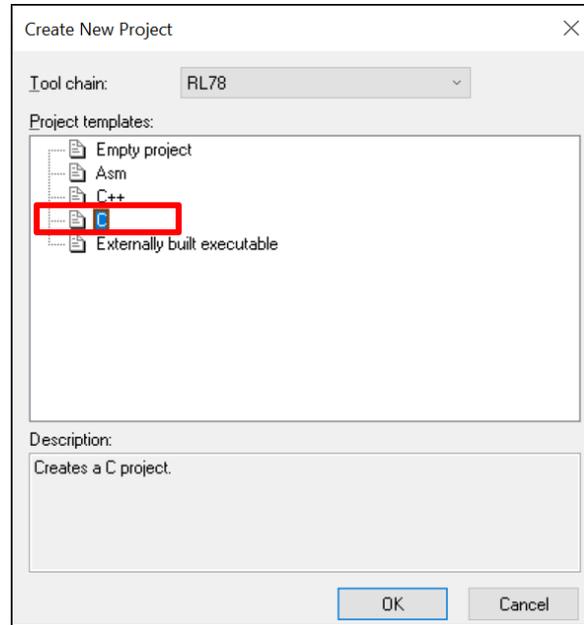


Figure 2-1. Create an IAR C Project

- (2) Please input project name and specify the path location for saving project files.

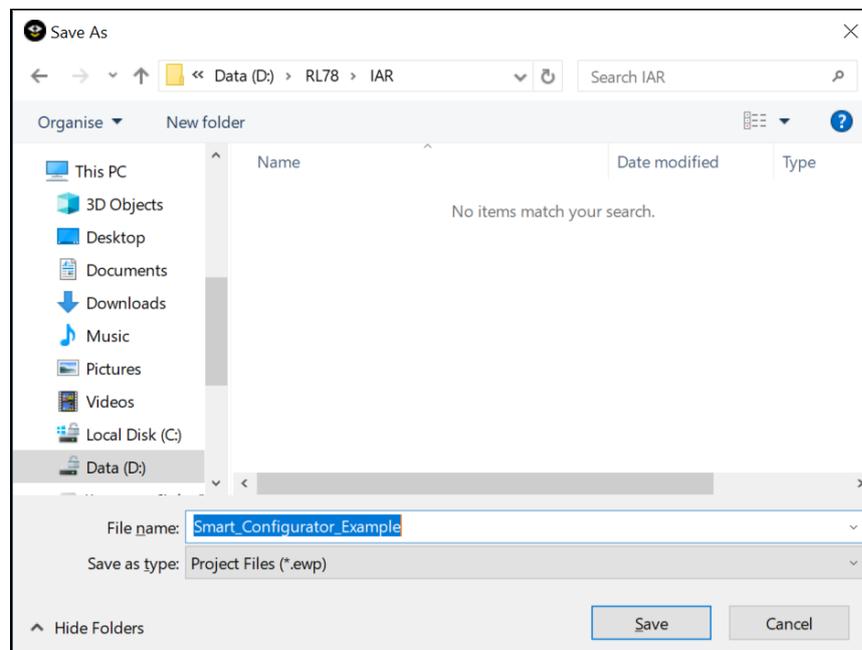


Figure 2-2. Specify *.ewp File

- (3) After step (2), a new C project workspace is created successfully in IAR IDE.

2.2 Installing the Smart Configurator

Download the Smart Configurator from the URL below.

<https://www.renesas.com/smart-configurator>

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

2.3 Uninstalling the Smart Configurator

If you wish to uninstall the Smart Configurator, select "Smart Configurator for RL78" 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 a source file using Smart Configurator and loading it into IAR Embedded Workbench. For the operation of IAR Embedded Workbench, refer to relevant document of IAR.

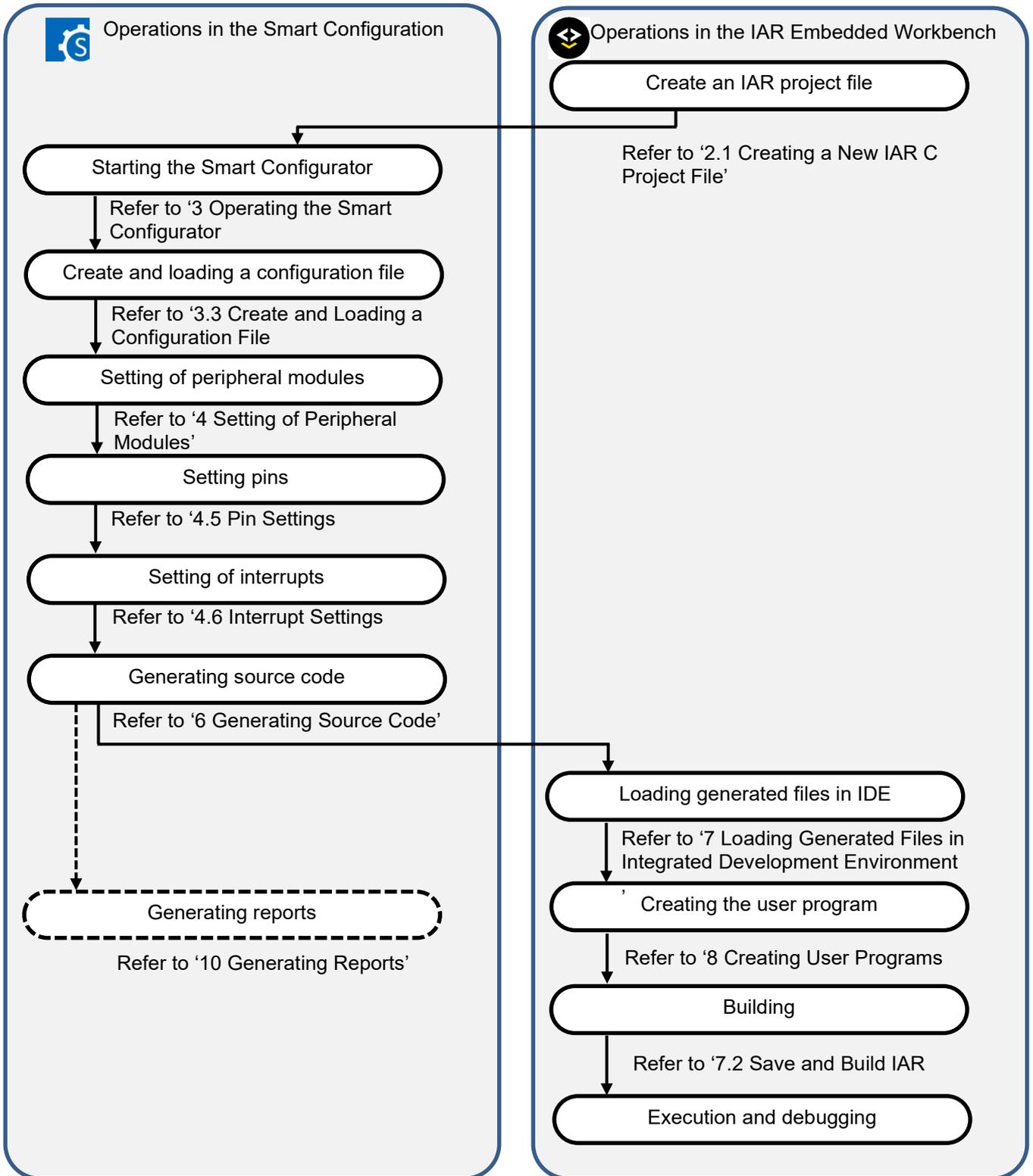


Figure 3-1. Operating Procedure

3.2 Starting the Smart Configurator

Select [Smart Configurator for RL78 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 your version.

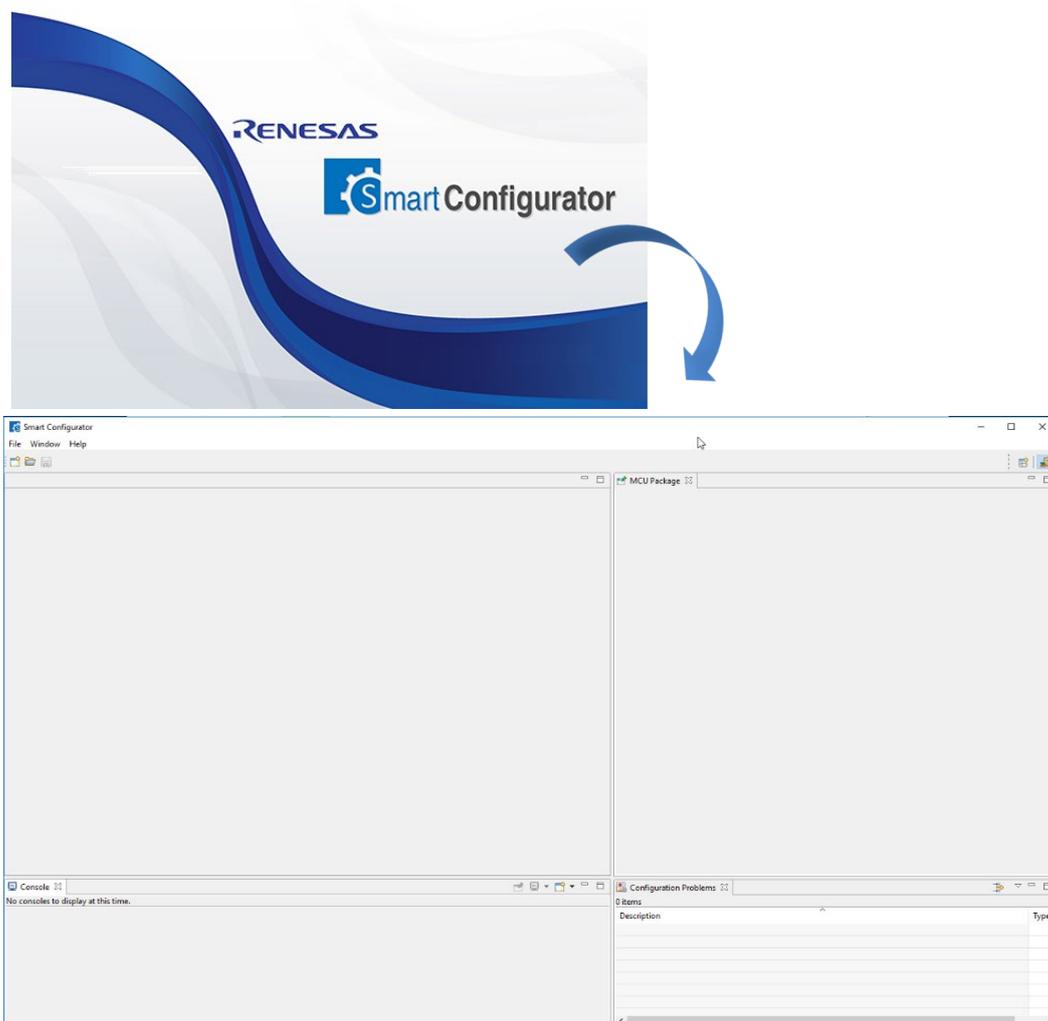


Figure 3-2. Starting of Smart Configurator

3.3 Create 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.
- (2) In [Toolchain:], select [IAR RL78 Toolchain].
- (3) In [File name:], enter the file name.
- (4) Confirm [Location:]. Please make sure the destination path is the same as IAR C project file path (refer to Figure 2-2 Specify *.ewp File).
- (5) Click [Finish] to create the configuration file.

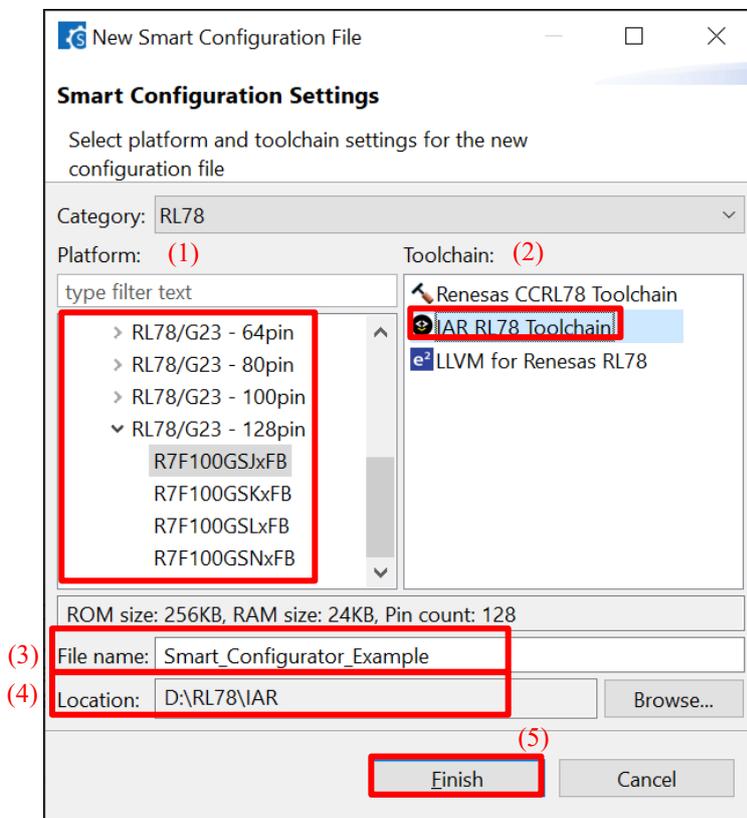


Figure 3-3. Create a Configuration File

- (6) Add any driver component, make random setting, generate code, and save the project as *.scfg file in the same path as IAR project which was created in IAR IDE.

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].

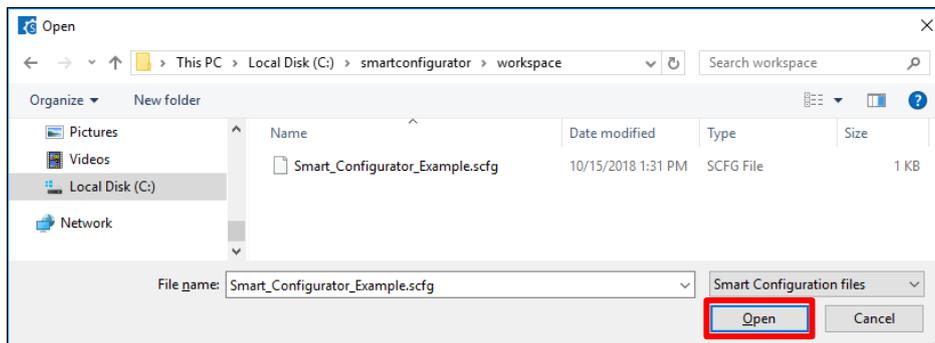


Figure 3-4. Opening an Existing Configuration File

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.

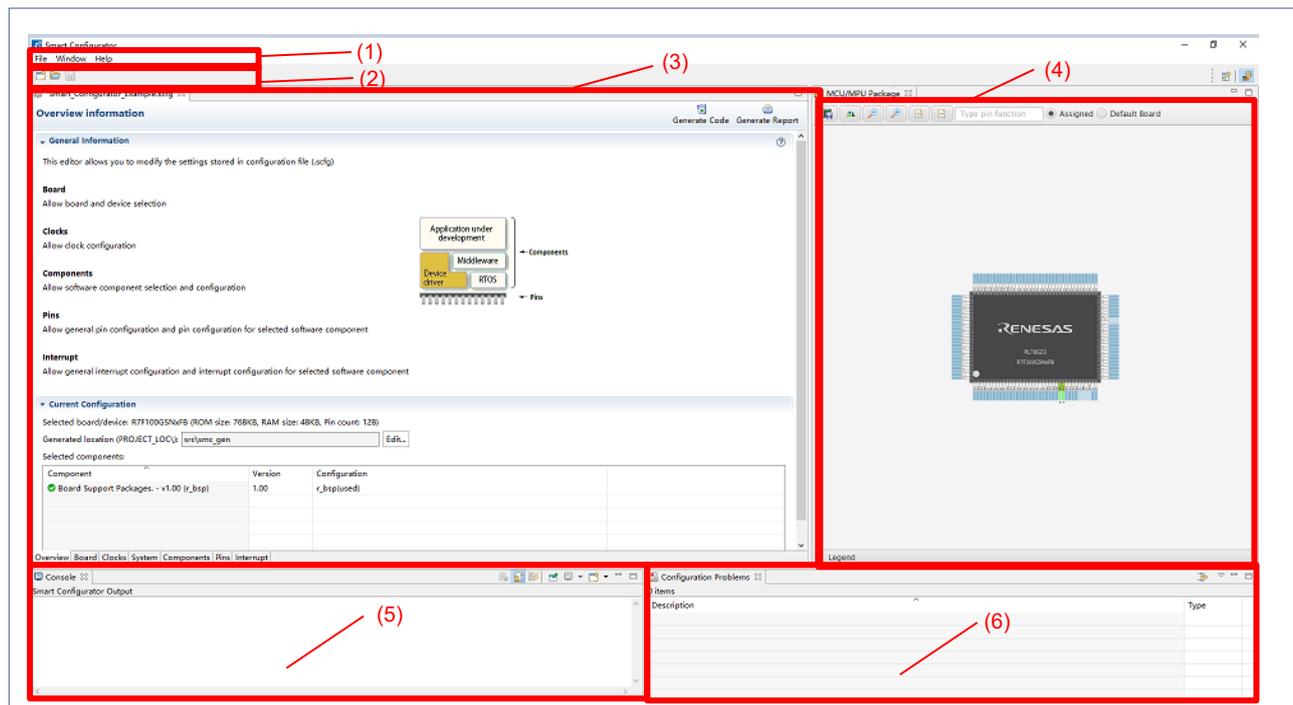


Figure 3-5. Main Window

- (1) Menu bar
- (2) Main toolbar
- (3) Smart Configurator view
- (4) MCU Package view
- (5) Console view
- (6) Configuration Problems view

3.4.1 Main Menu

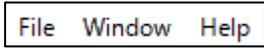


Table 3-1, Main Menu Items, lists the items of the main menu.

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	The home page is opened.
	Release Notes	The release note is opened.
	Tool News	The tool news is opened.
	API Manual	The API manual is opened.
	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.

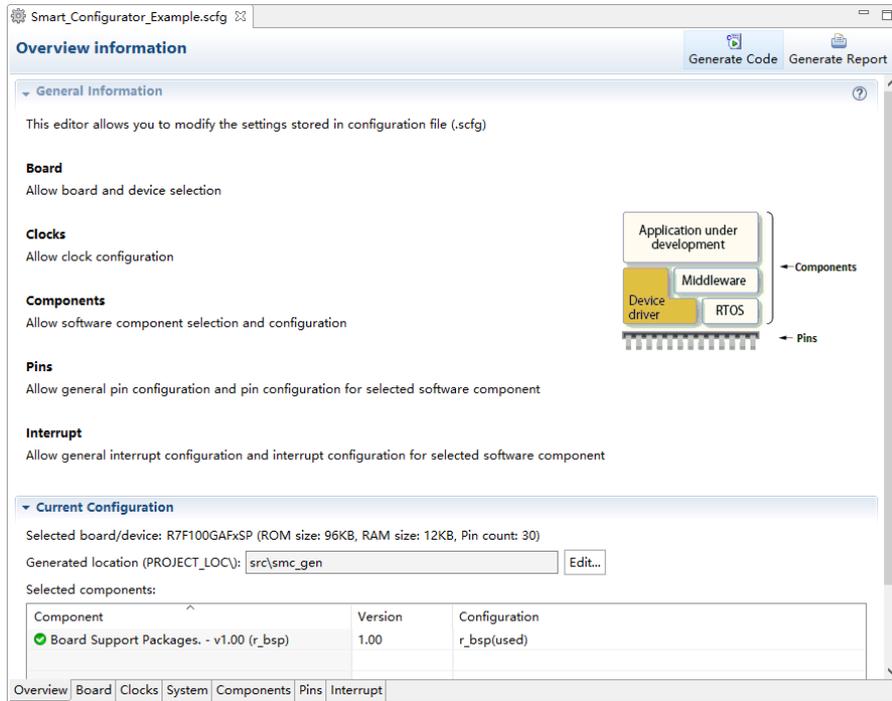


Figure 3-5. Smart Configurator View

3.4.4 MCU Package View

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

Two types of package view can be switched between [Assigned] and [Default Board]. [Assigned] displays the assignment status of the pin setting, and [Default Board] 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 "4.1.2 Selecting the Board").

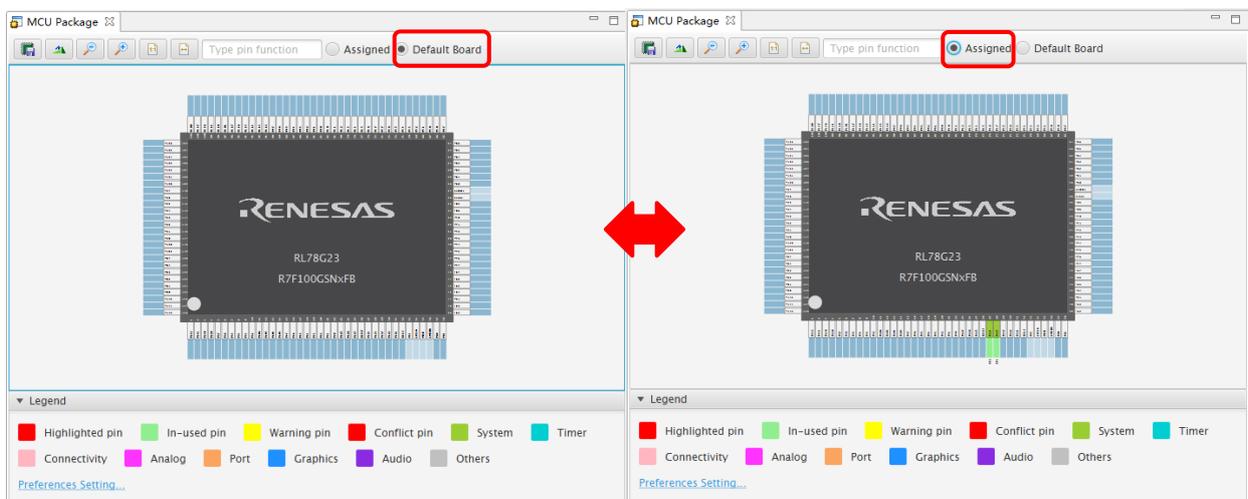


Figure 3-7. MCU Package View

3.4.5 Console View

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

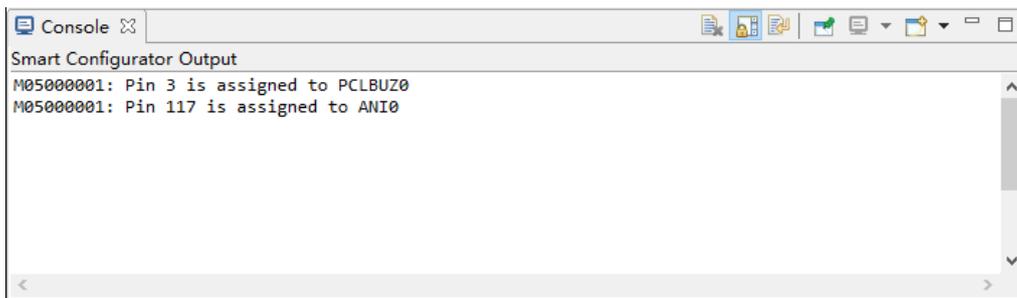


Figure 3-6. Console View

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.

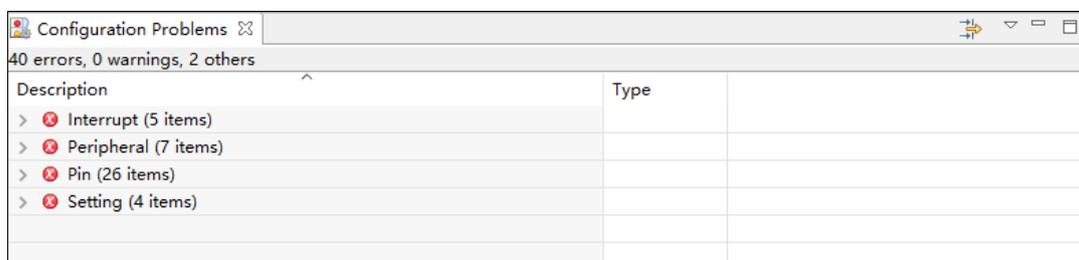


Figure 3-7. Configuration Problems View

4. Setting of Peripheral Modules

You can select peripheral modules from the Smart Configurator view.

4.1 Board Setting

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

4.1.1 Selecting the Device

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

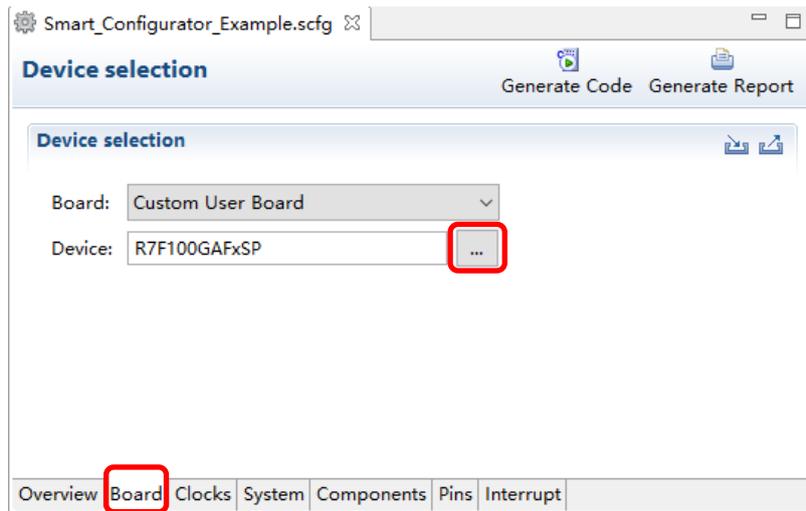


Figure 4-1. Selecting the Device

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

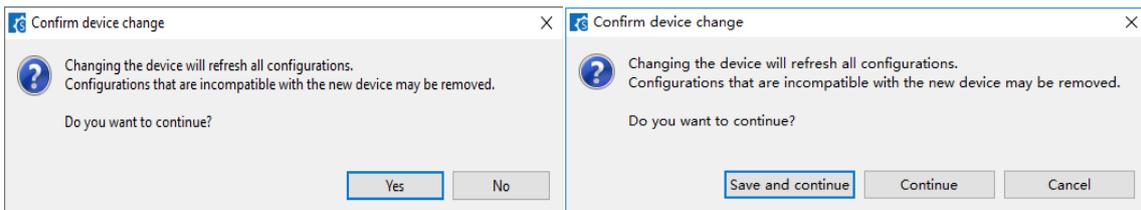


Figure 4-2. Confirm Device Change

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**

By selecting a board, the following settings can be changed at one time.

- Pin assignment (Initial pin setting)
- Frequency of the main clock
- Frequency of the subsystem clock
- Target device

The board setting information is defined in the Board Description File (.bdf).

The .bdf file of Renesas made board (e.g. Renesas Starter Kit) can be downloaded from website and imported.

In addition, by downloading the .bdf file provided by the alliance partner from website and importing it, it is possible to select alliance part boards.

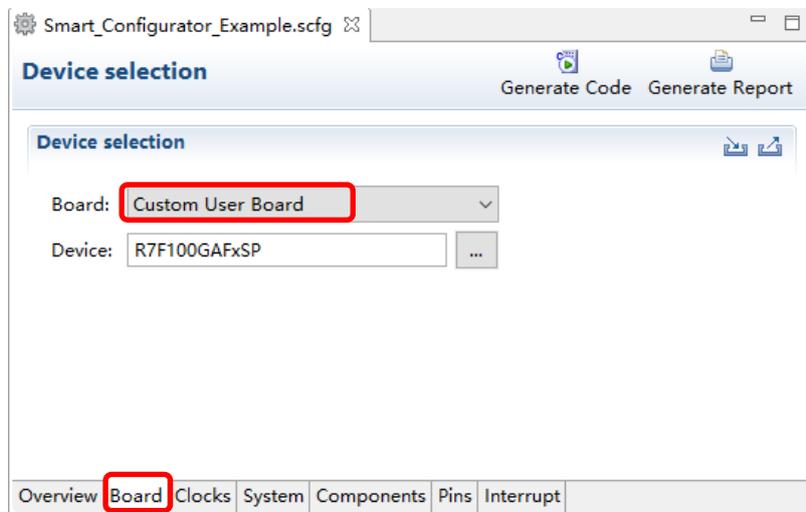


Figure 4-3. Selecting the Board

If you 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".

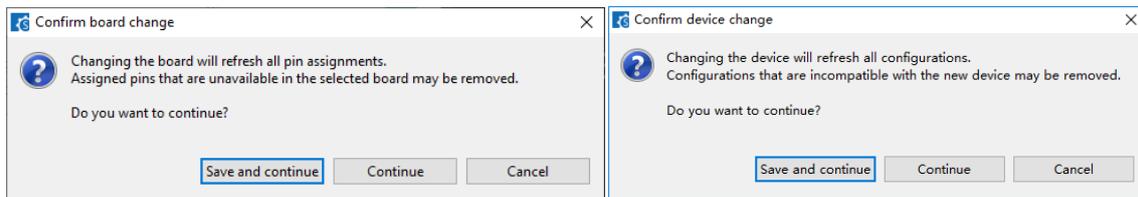


Figure 4-4. Confirm Board Change

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.

4.1.3 Exporting Board Settings

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.

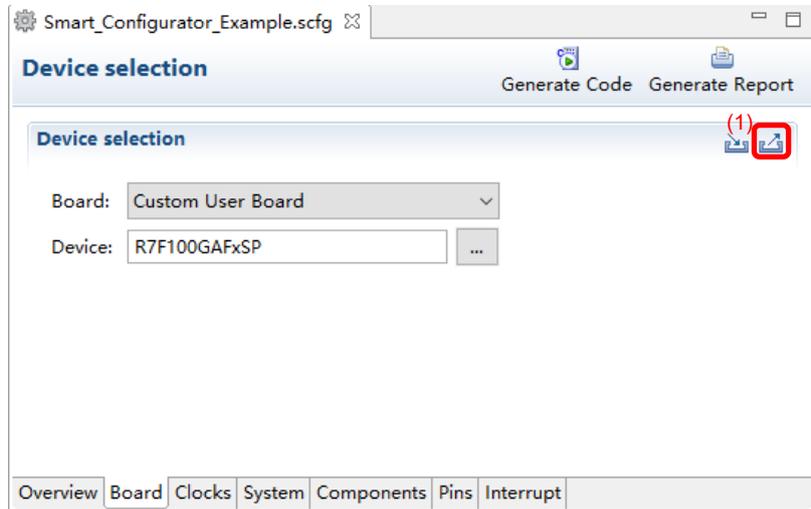


Figure 4-5. Exporting Board Settings (bdf Format)

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.

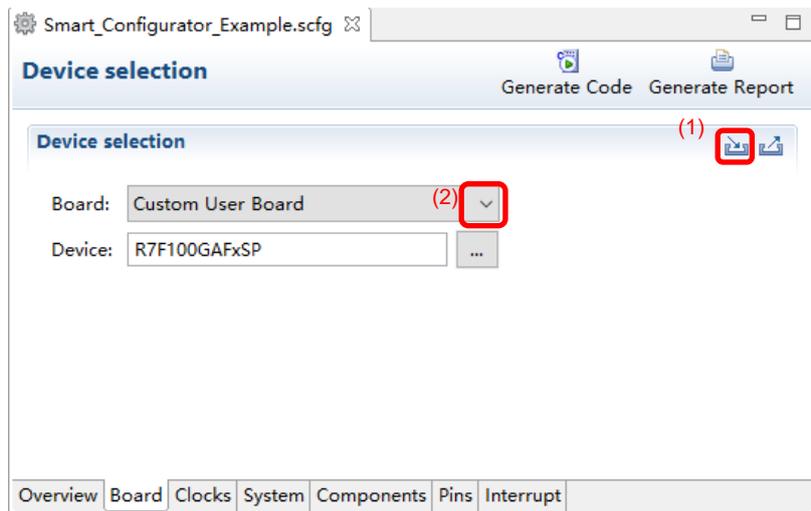


Figure 4-6. Importing Board Settings (bdf Format)

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

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

Follow the procedure below to modify the clock settings.

- (1) Specify the operation mode and EVDD 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.

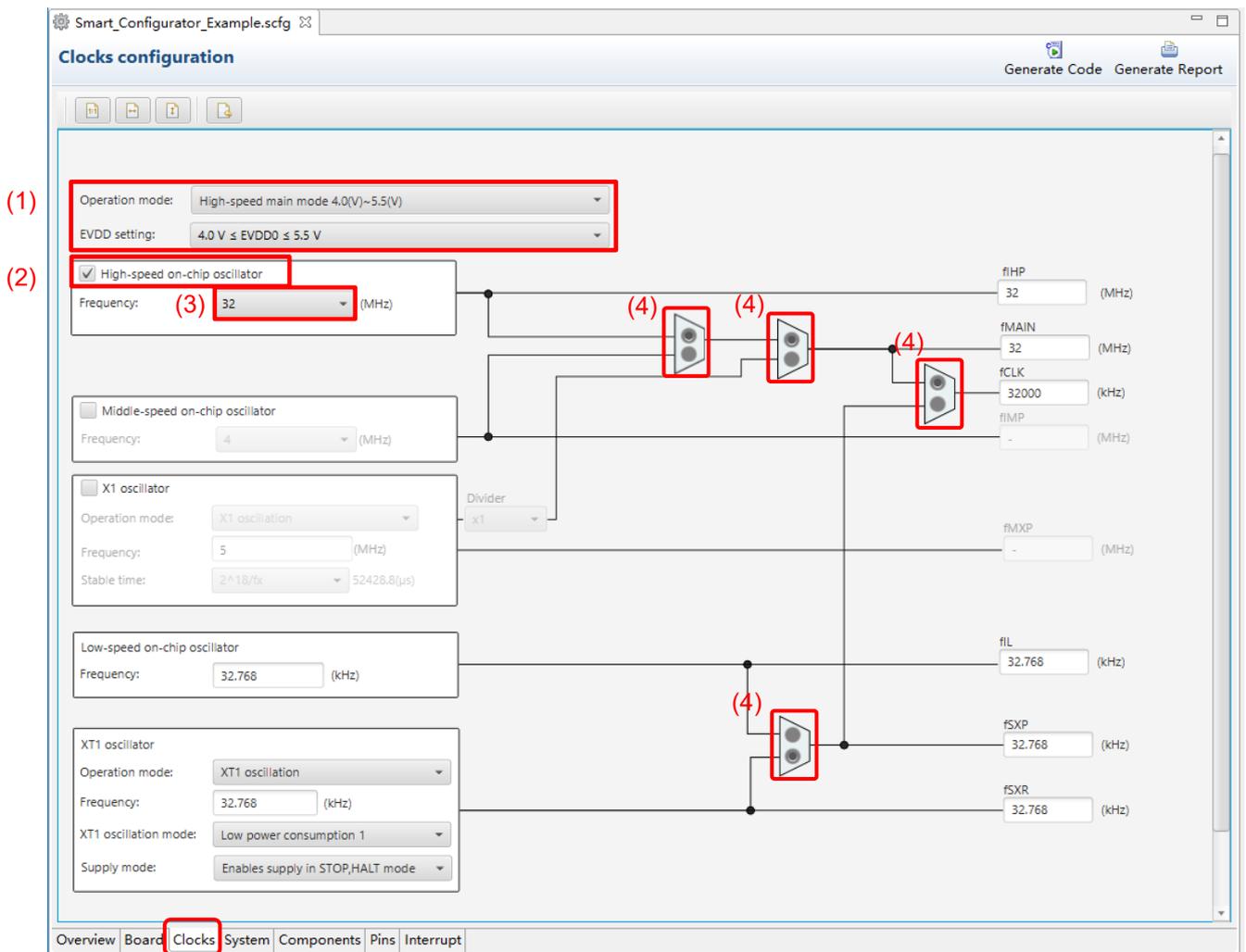


Figure 4-7. [Clocks] Page

4.3 System Settings

You can set the on-chip debug setting on the [System] page. This setting is reflected in into r_bsp file.

For example, make desired setting as in below figure for illustration, after that click on [Generate Code Generate Code] button as in step (4).

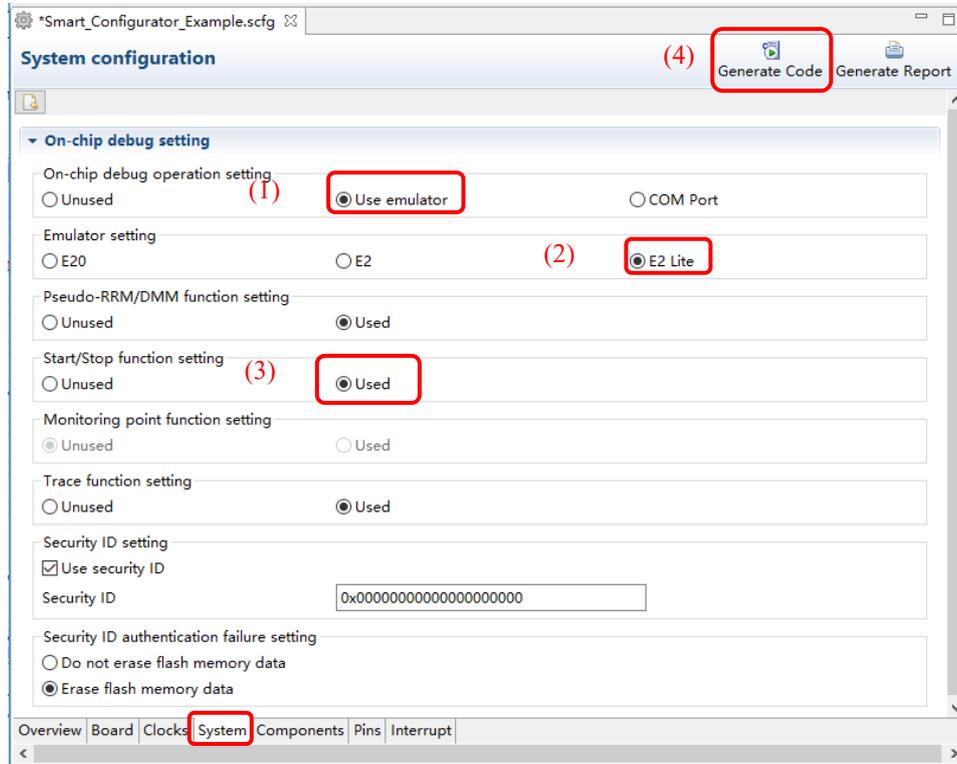


Figure 4-8. Smart Configurator [System] Page Setting

The on-chip debug setting is reflected into r_bsp file in:

\<ProjectDir>\src\smc_gen\r_bsp\r_config\r_bsp_config.h file. If you want to change the on-chip debug setting code value, change your desired setting and generate code again.

```

84  #if defined(__ICCRL78__)
85  /* Option byte setting(When using IAR) */
86  #define OPTBYTE0_VALUE (0xFFU)
87  #define OPTBYTE1_VALUE (0xFFU)
88  #define OPTBYTE2_VALUE (0xE0U)
89  #define OPTBYTE3_VALUE (0x04U)
    
```

Figure 4-9. On-Chip Debug Setting Code Generation

Note: Depending on the MCU type selection or chip part numbers, these setting values varies. Please refer to the latest device HUM for the detail setting configuration.

4.4 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.

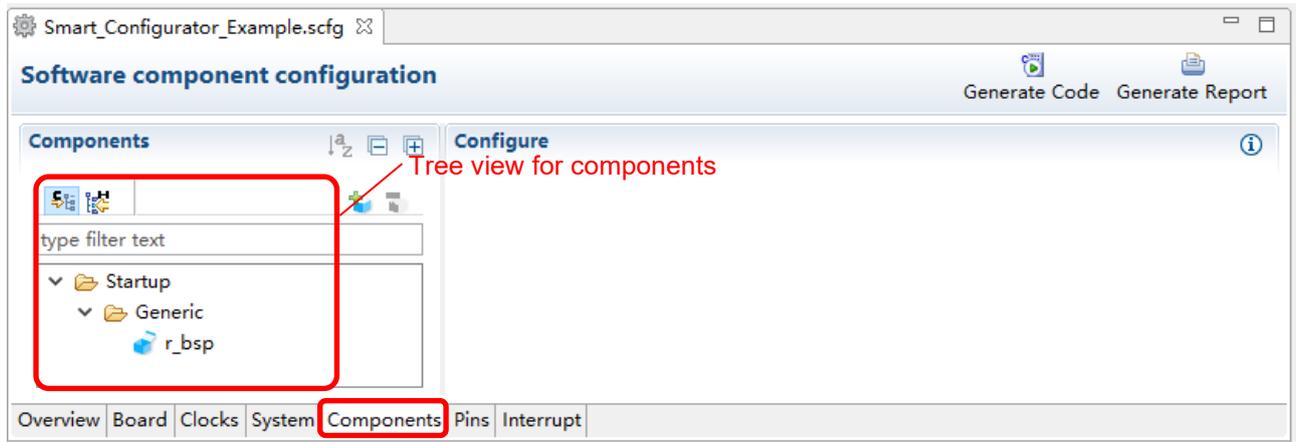


Figure 4-10. [Components] Page

4.4.1 Switching Between the Component View and Hardware View

The Smart Configurator provides two tree view: Component View and Hardware View. You can Switch two view 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 4-11. 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.

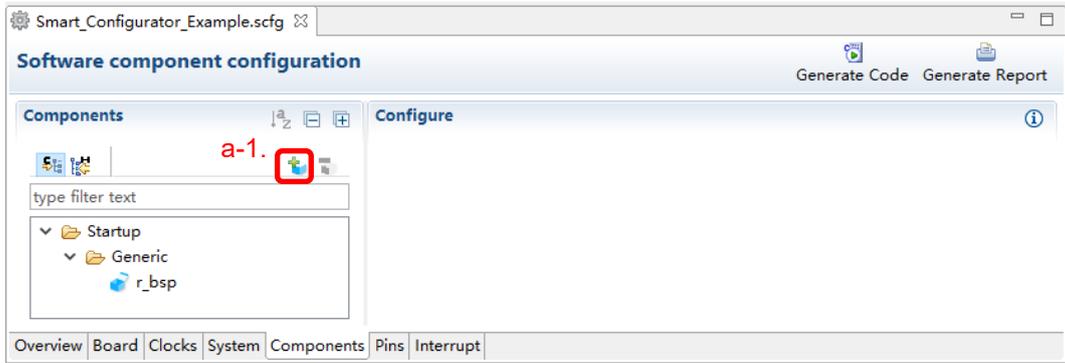


Figure 4-12. Adding a Component

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].

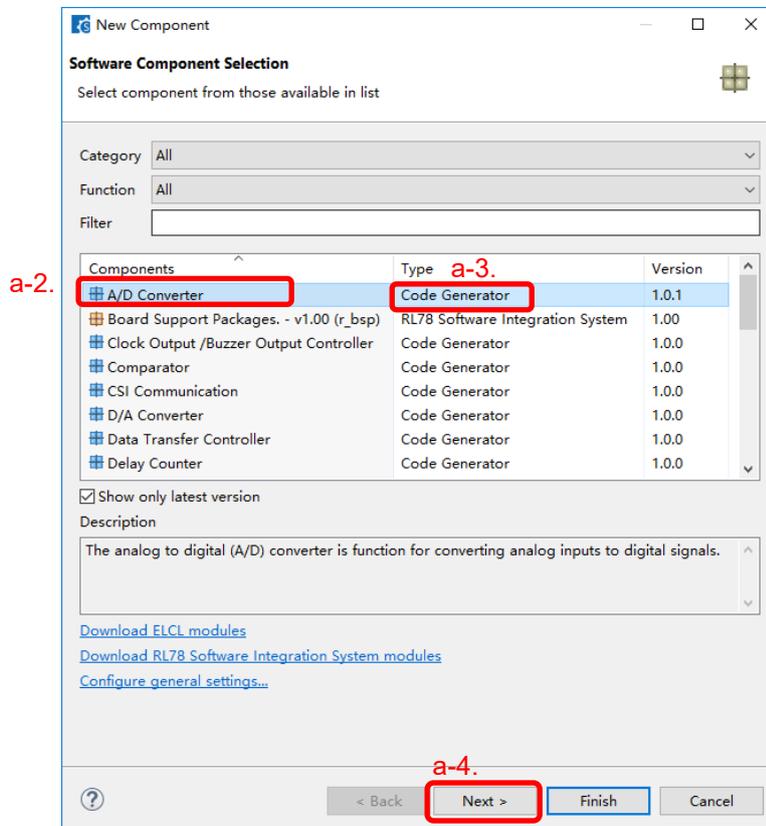


Figure 4-13. Adding a Code Generator Component

- 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 (e.g. Config_ADC).
- a-6. Select a hardware resource or use the default resource (e.g. ADC).
- a-7. Click on [Finish].

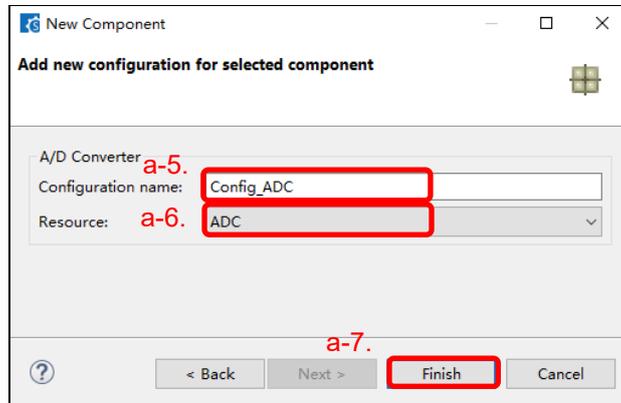


Figure 4-14. Adding a Component

To add a component on Hardware Tree directly, you can 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 (e.g. A/D Converter) to open the [New Component] dialog box.
- b-3. Select a component from the list (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.

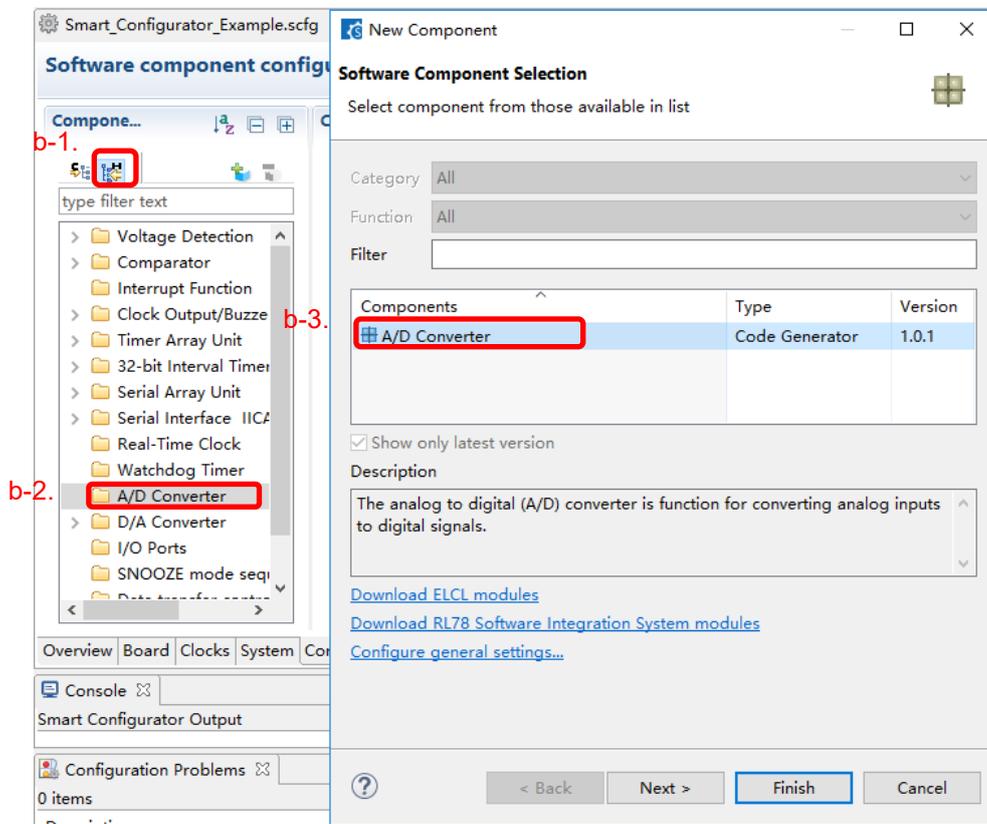


Figure 4-15. Adding a Code Generator Component to the Hardware View

4.4.3 Removing a Software Component

Follow the procedure below to remove a software component from a project.

- (1) Select a software component from the Components tree.
- (2) Click on the  (Remove component)] icon.

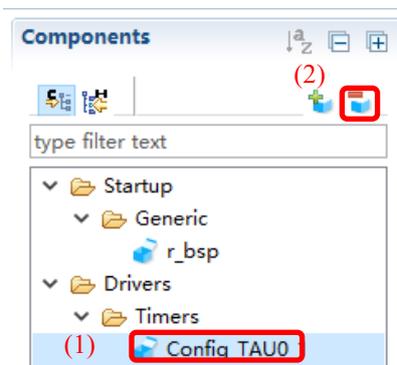


Figure 4-16. Removing a Software Component

The selected software component will be removed from the Components tree.

4.4.4 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 (e.g. A/D Converter).
- (2) Configure the driver in the [Configure] panel to the right of the Components tree. The following steps and figure 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 [2048/fCLK] for [Conversion time].

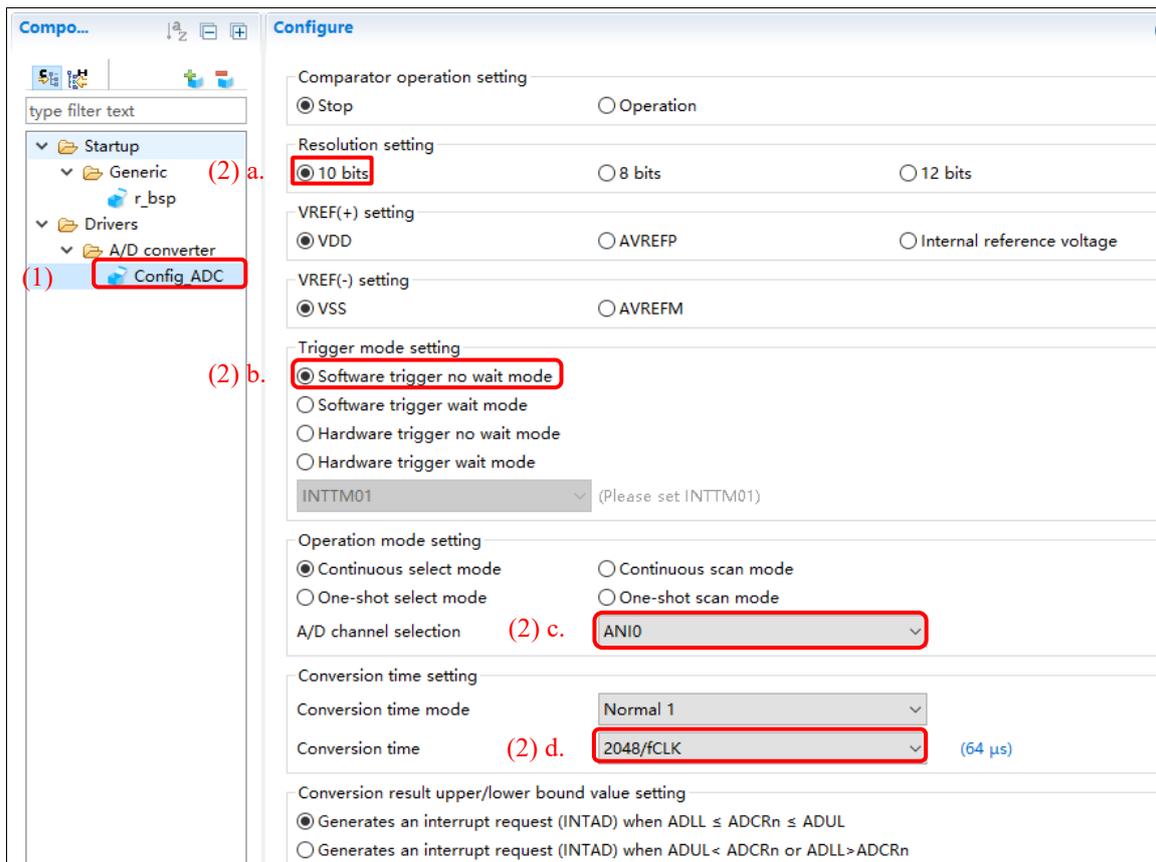


Figure 4-17. Setting of a Code Generator Driver

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].

4.4.5 Changing the Resource for a Code Generator Component

The Smart Configurator enables you to change the resource for a Code Generator component (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 (e.g. Config_TAU0_1).
- (2) Select [Change resource] from the context menu.

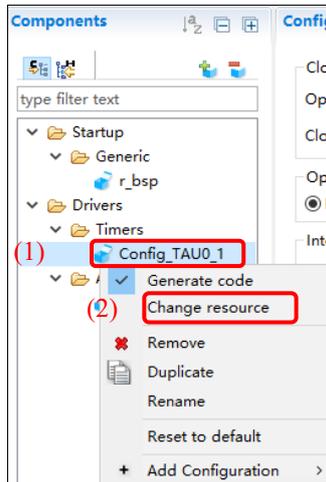


Figure 4-18. Changing the Resource

- (3) Select a new resource (e.g. TAU0_3) in the [Resource Selection] dialog box.
- (4) The [Next] button will be active, click on it.

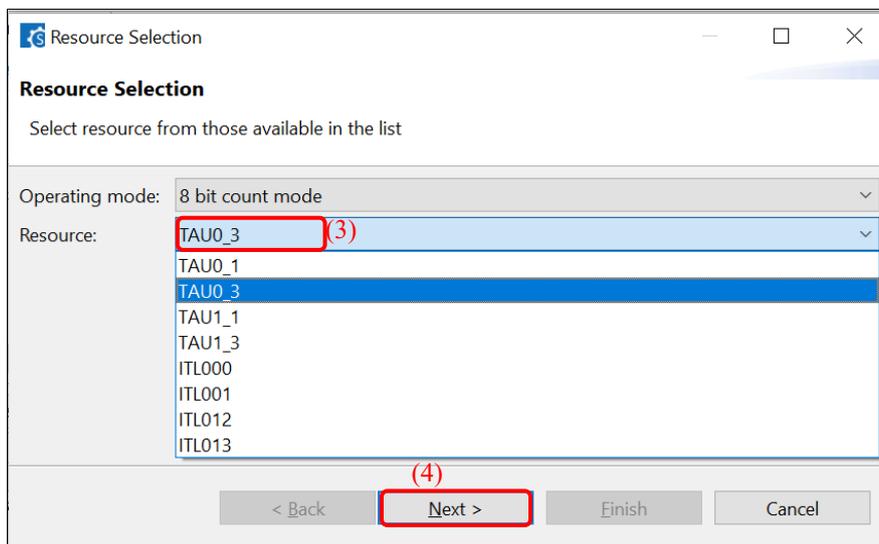


Figure 4-19. Components Page – Selecting a New Resource

- (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].

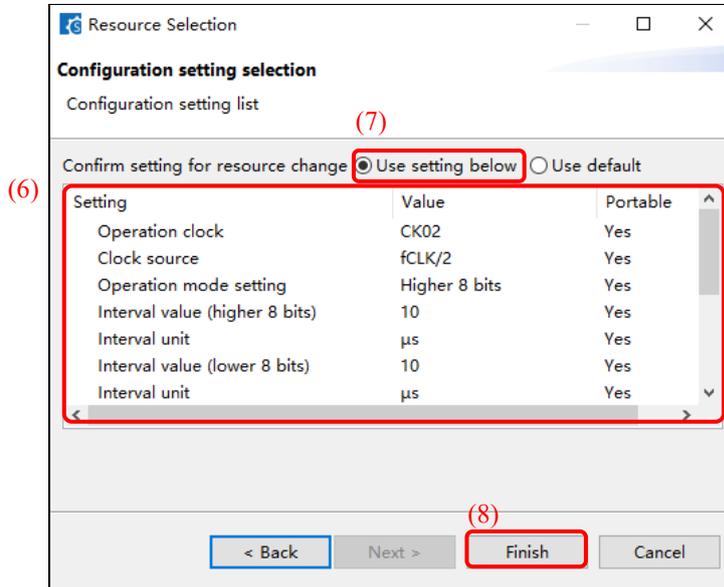


Figure 4-20. Checking the Settings of the New Resource

The resource is automatically changed (e.g. changed from INTTM01 to INTTM03).

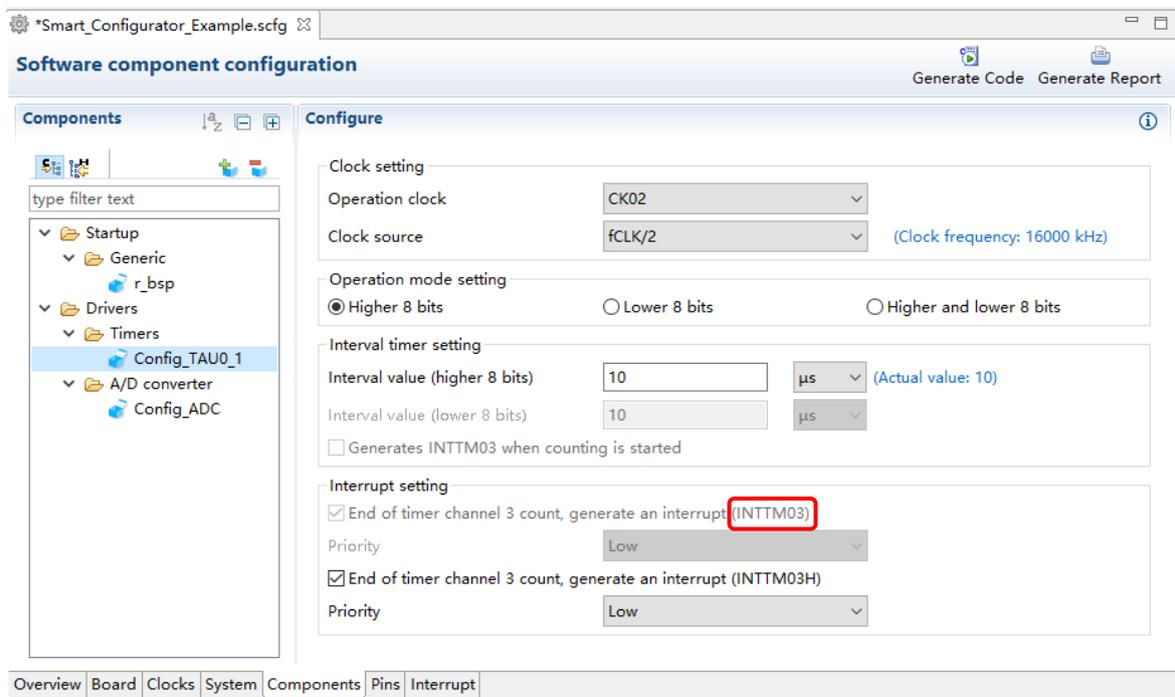


Figure 4-21. Resource Changed Automatically

To change the configuration name, follow the procedure below.

- (9) Right-click on the Code Generator configuration.
- (10) Select [Rename] to rename the configuration (e.g. change Config_TAU0_1 to Config_TAU0_3).

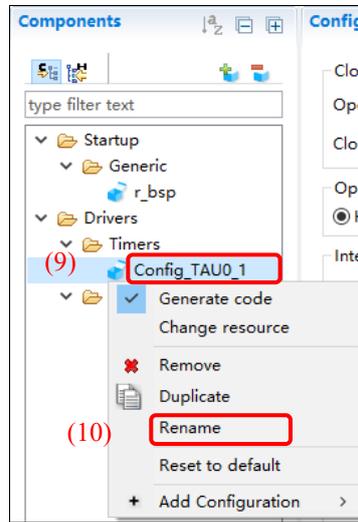


Figure 4-22. Renaming the Configuration

4.4.6 Setting SNOOZE Mode Sequencer (SMS) Component

SNOOZE Mode Sequencer (SMS) component is a new component type as “Graphical Configurator”, it is list and can be selected to use directly in default component list.

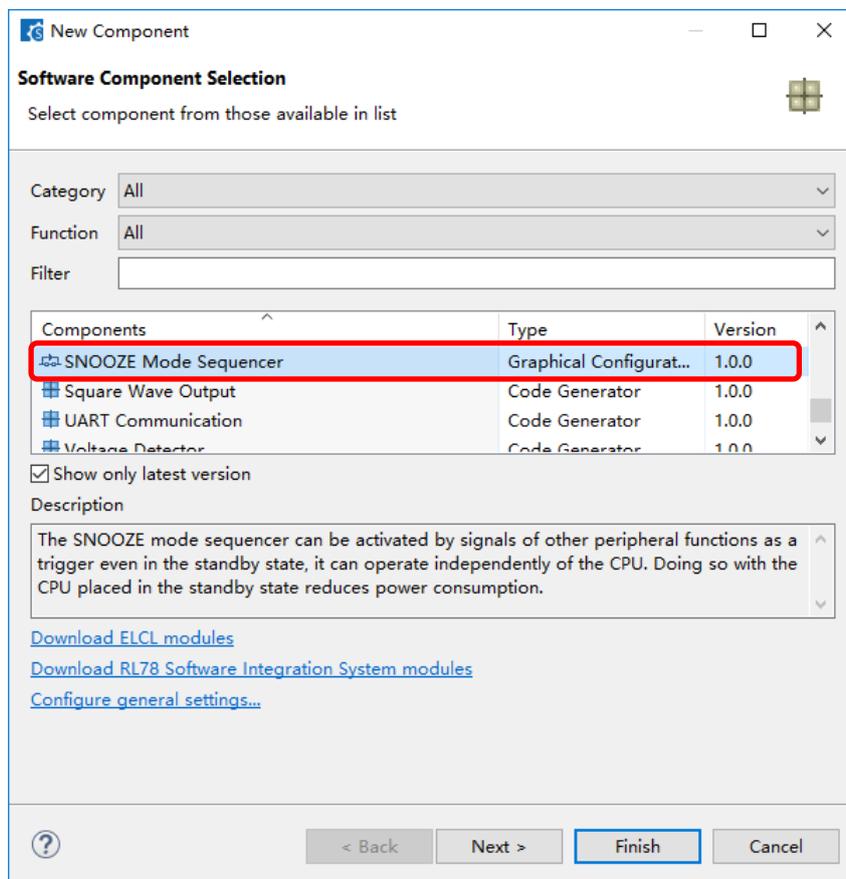


Figure 4-23. Add SNOOZE Mode Sequencer

A GUI of Graphical Configurator is displayed in below SMS figure, it is more graphically compared with Code Generator. You can Drag and Drop and configure the block which you want to use.

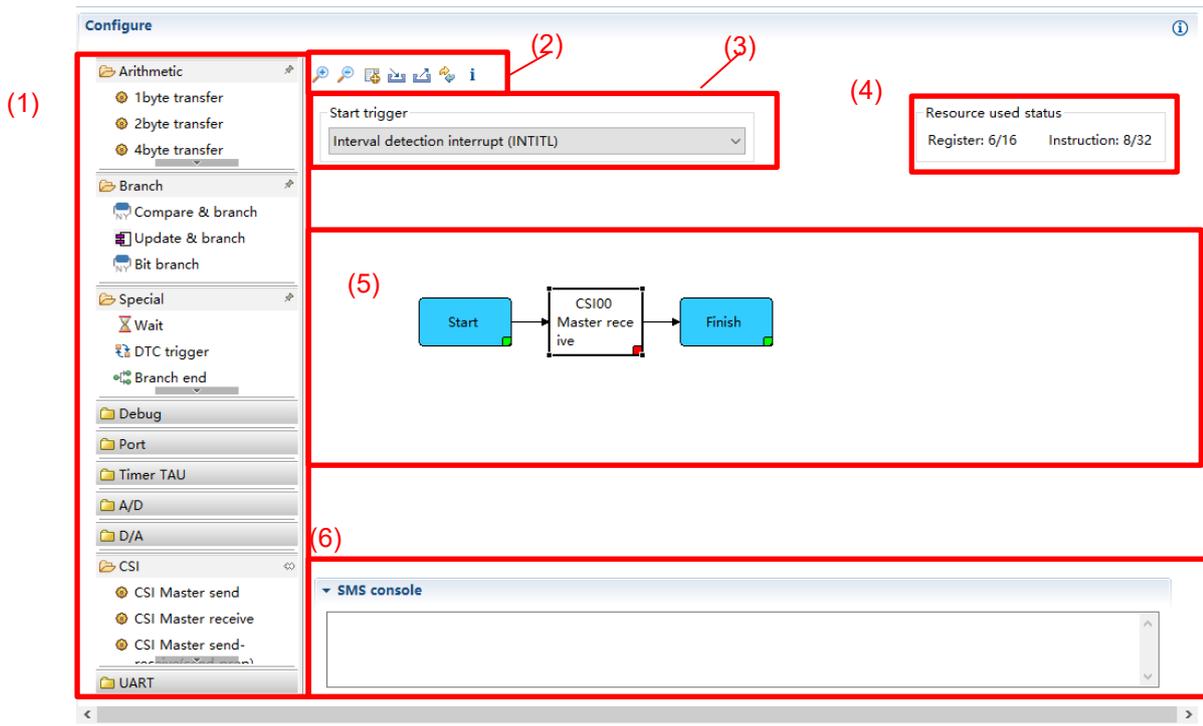


Figure 4-24. SNOOZE Mode Sequencer (SMS) GUI

Table 4-3. SMS GUI area description

Area	Description
(1) Block elements	View the available blocks for SMS. A block is a part for forming a sequence (function), and includes A/D voltage acquisition, comparison & branching and 1-byte transfer.
(2) Toolbar	Zoom in.
	Zoom out.
	Display the SMS data management dialog and manage the variables to be used.
	Import the SMS sequence. You can use some sample sequences by clicking this icon.
	Export the SMS sequence.
	Update the SMS data file.
	Displays the information of the SMS data file.
(3) Start trigger selection	Select a startup trigger.
(4) Resource status	It shows registers and the number of instructions used.
(5) Canvas area	Place the SMS block and create the sequence.
(6) SMS console	Displays message for unavailable configurations.

Follow the procedure below to set up SMS block:

- (1) Select a block from Block elements list (e.g. CSI Master receive).
- (2) Drag “CSI Master receive” block to SMS canvas between Start block and Finish block where the drop location doesn't show the indicator of .
- (3) You can configure the block by double click to pop the “CSI Master receive setting” property setting dialog.
- (4) You can specify the setting in the “CSI Master receive setting” property dialog.
- (5) Open “Data Management” setting, you can edit the receive data.
- (6) When you configure correctly the color of bottom right corner will change from red to green.
- (7) You can add some blocks, drag and drop to adjust the sequence.

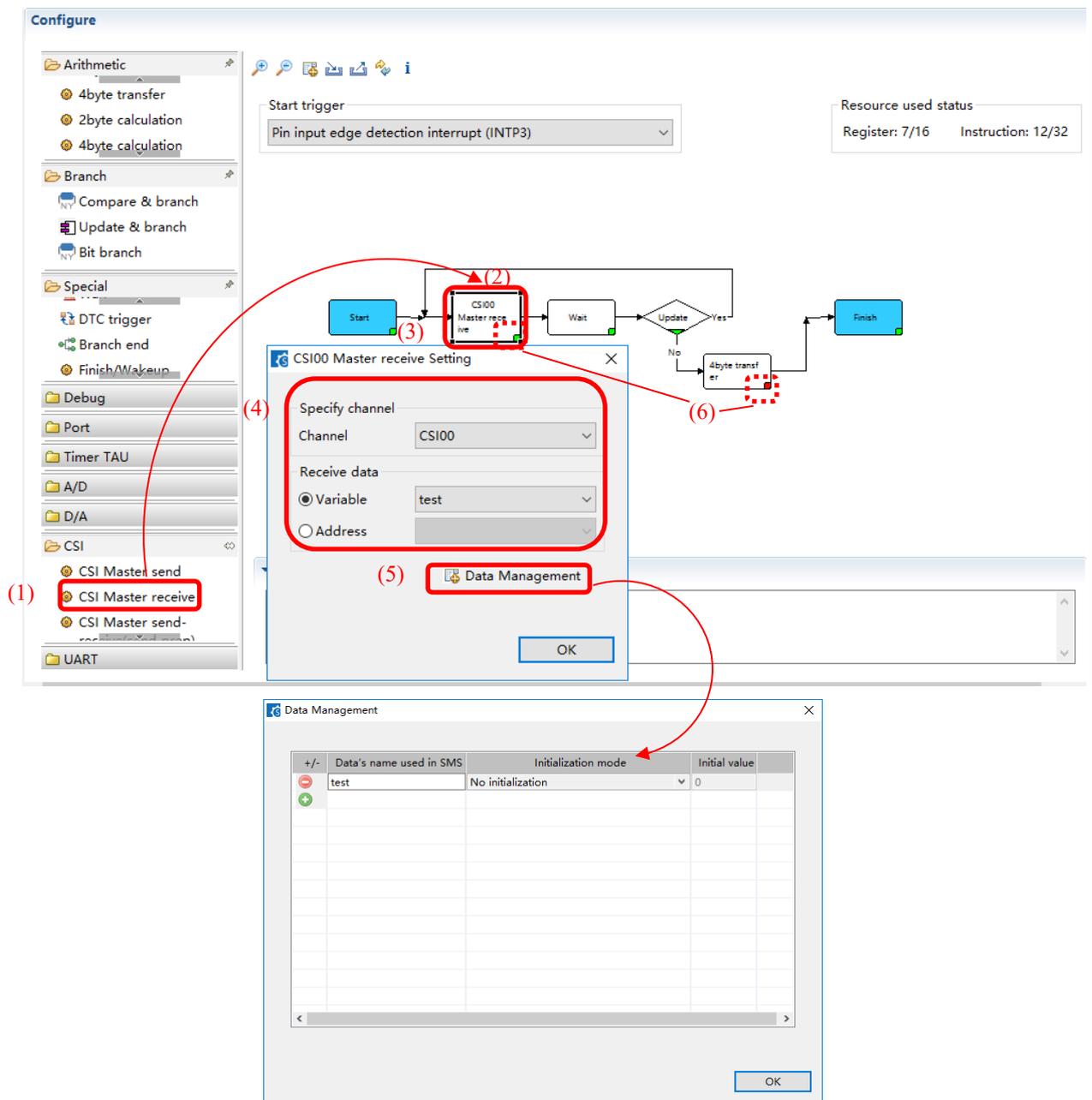


Figure 4-25. SMS Block Configure

4.4.7 Update SMS Data Files

Follow the procedure below to update SMS data file (Block, Sequence) to the latest version. You can use new blocks and sequences by updating.

- (1) Click on SMS GUI button [Update SMS data files] to check if SMS data file have the newer version and download automatically from the web.
- (2) Waiting for the operation finished.
- (3) Finished the latest version update.

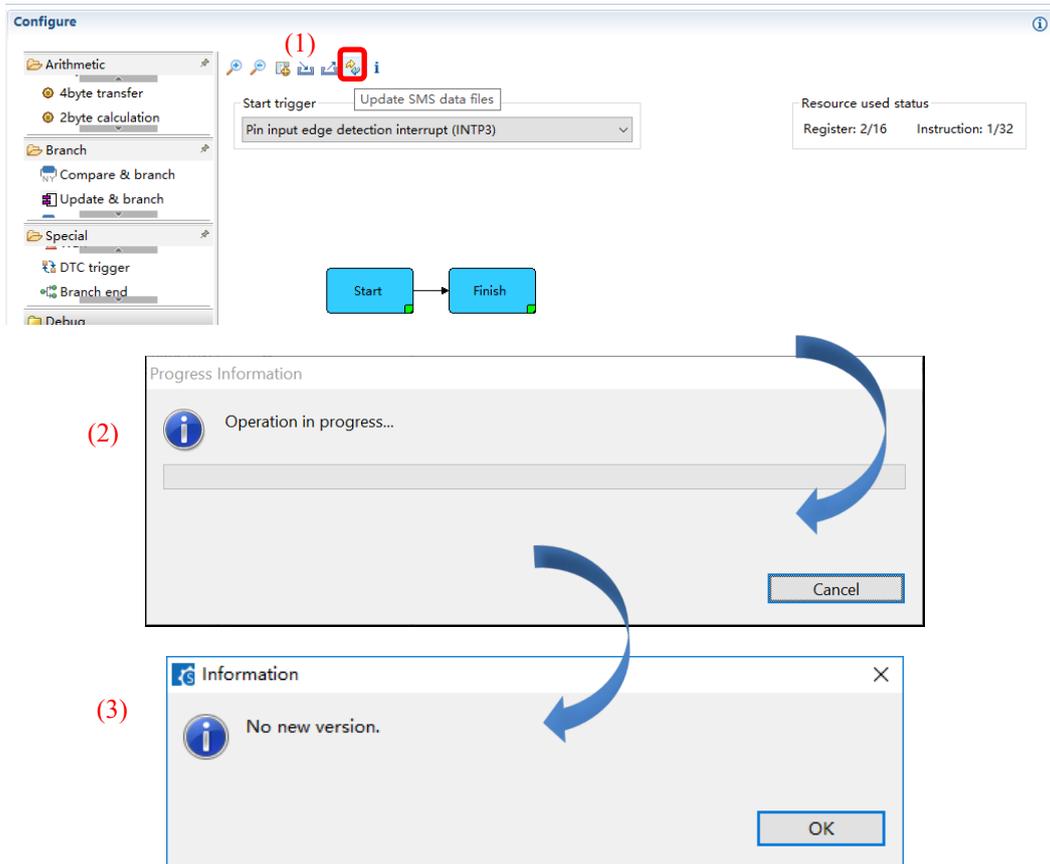


Figure 4-26. SMS Data File Download

4.4.8 Logic Event Link Controller (ELCL) Modules Download

The Software Component type for Logic Event Link Controller (ELCL) is Graphical Configurator. ELCL modules can be added from component list in New Component dialog. If you want to use other ELCL modules not included in Component list, you can click on [Download ELCL modules] link in New Component dialog to check and download more ELCL modules:

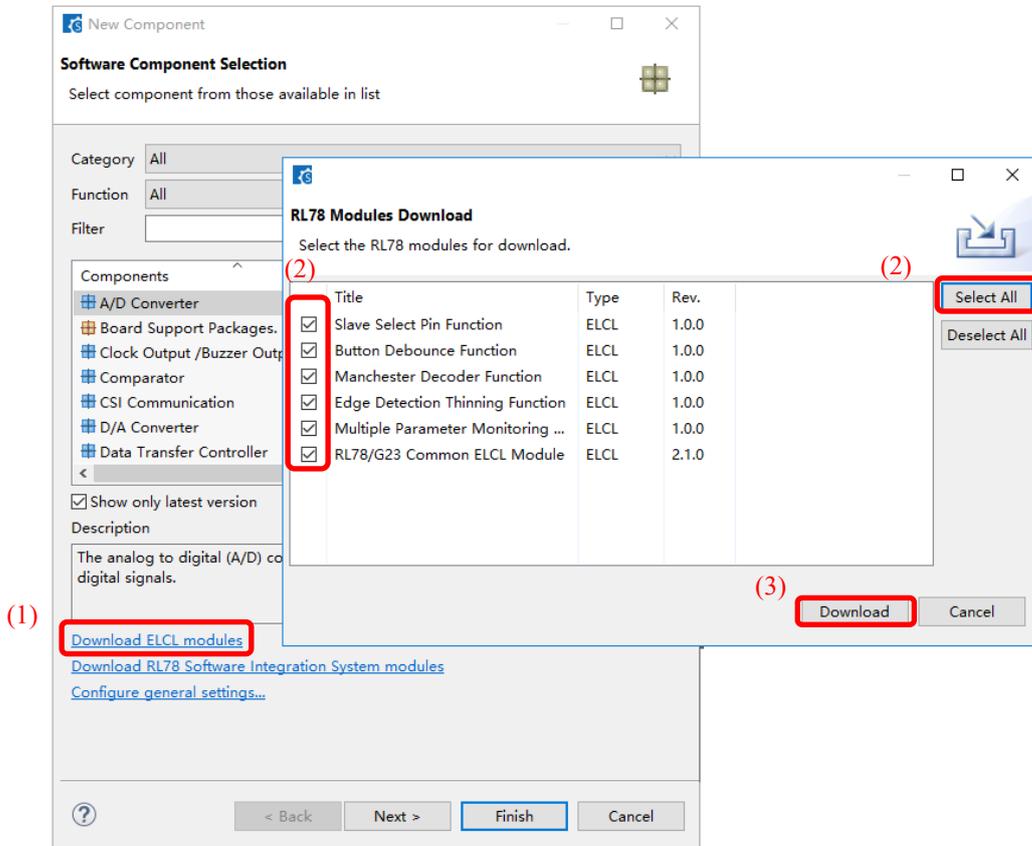


Figure 4-27. New ELCL Modules Download

After download, all ELCL modules are auto added to component list:

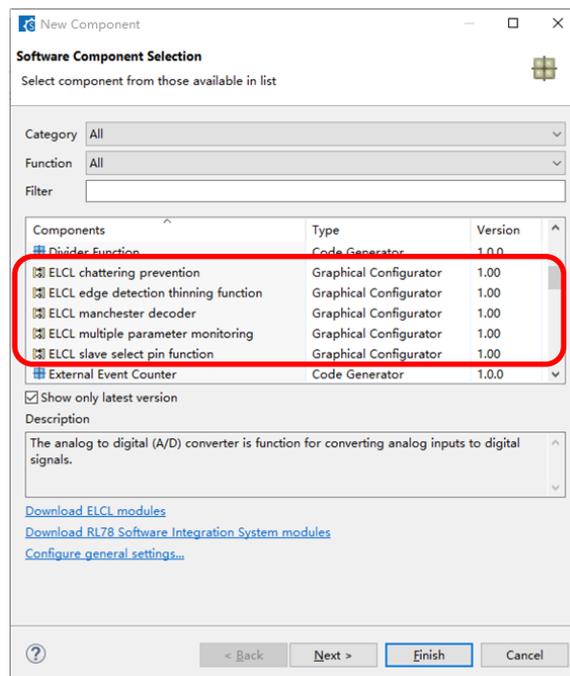


Figure 4-28. Add ELCL Module

4.4.9 Setting an ELCL Component

Follow the procedure below to set up an ELCL module.

- (1) Select an ELCL module from Software Component Selection list (e.g. ELCL slave select pin function).
- (2) Configure the driver in the [Configure] panel. The following steps and figure show an example.
 - a. Select the input signal under [Input signal selector] UI part.
 - b. Select the logic block under [Event controller (link processor)] UI part.
 - c. Select the output signal under [Output signal selector] UI part.
- (3) If you want for more details about current ELCL module usage, you can click the [ELCL_slave_select_pition.pdf] link to open the application notes for check.

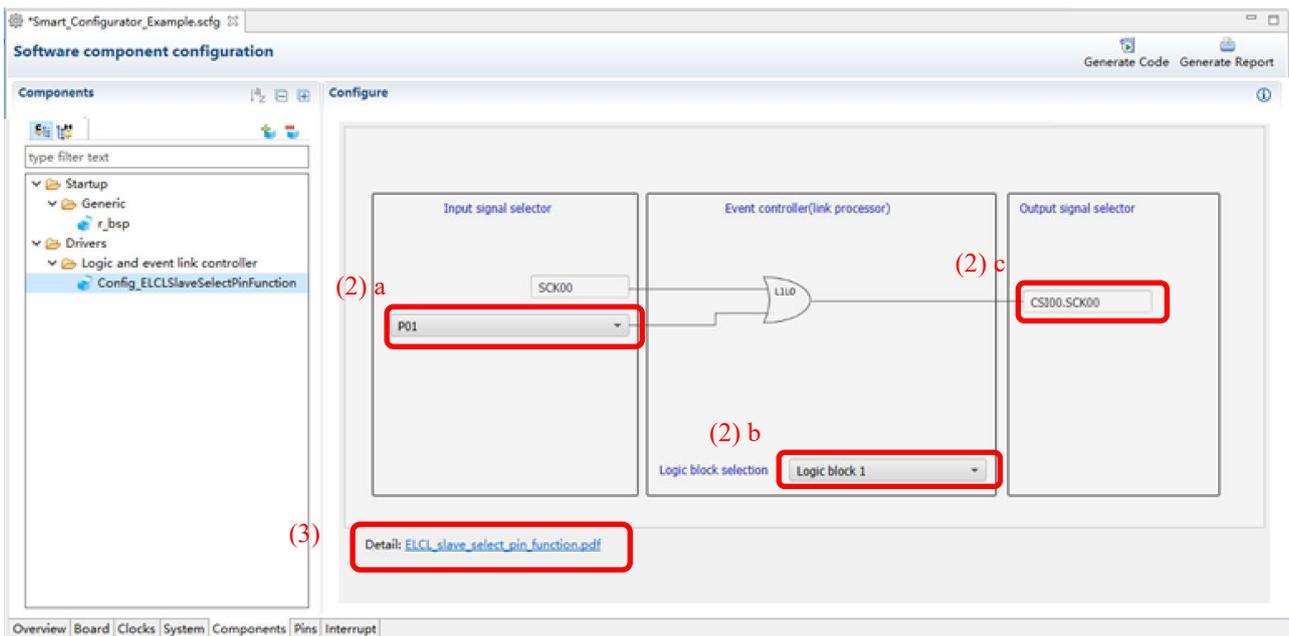


Figure 4-29. Configure an ELCL Module

4.4.10 Downloading RL78 Software Integration System Modules

RL78 Software Integration System modules are another software component type which can provide simple view for you to make driver/middle/application SW configuration and generate the code. The available RL78 Software Integration System modules can be downloaded from Renesas web. You first click on [Add component] as in Figure 4-12 to open an dialog, select the corresponding download entry link to start the download.

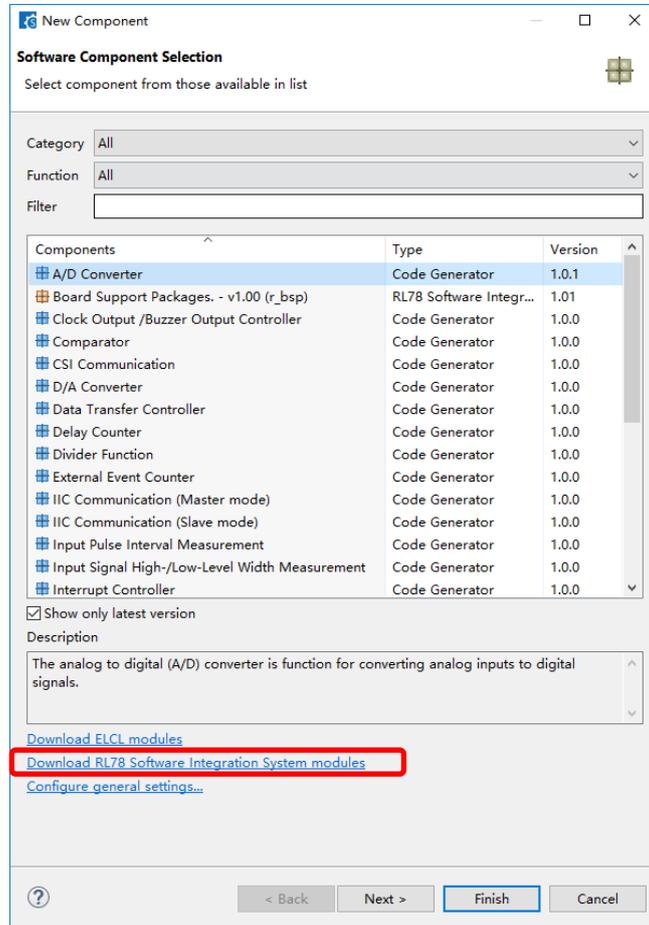


Figure 4-30. RL78 Software Integration System Download Link

The downloaded RL78 Software Integration System modules location was specified by Smart Configurator module download preference setting which can be checked and set by click main menu: [Window] → [Preference] → [Renesas] → [Module download] → [Location(RL78)].

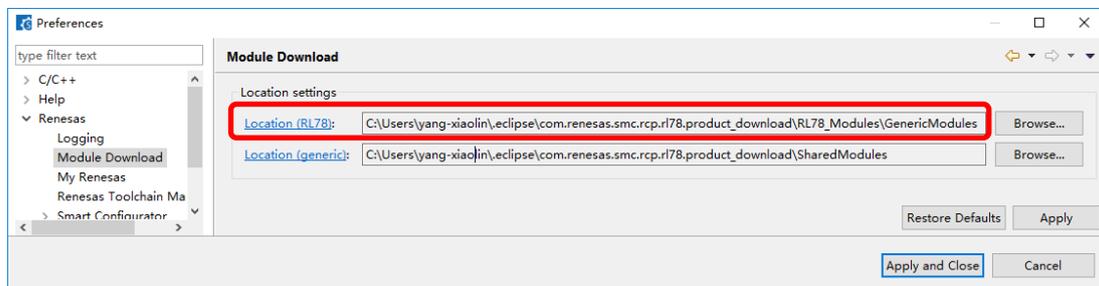


Figure 4-31. RL78 Software Integration System Modules Download Location

4.4.11 **Setting a RL78 Software Integration System Module**

After RL78 Software Integration System module is downloaded and added to New Component List, it can be selected in your project with providing the property view style configuration and code generation feature.

4.4.12 **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 you want to change.

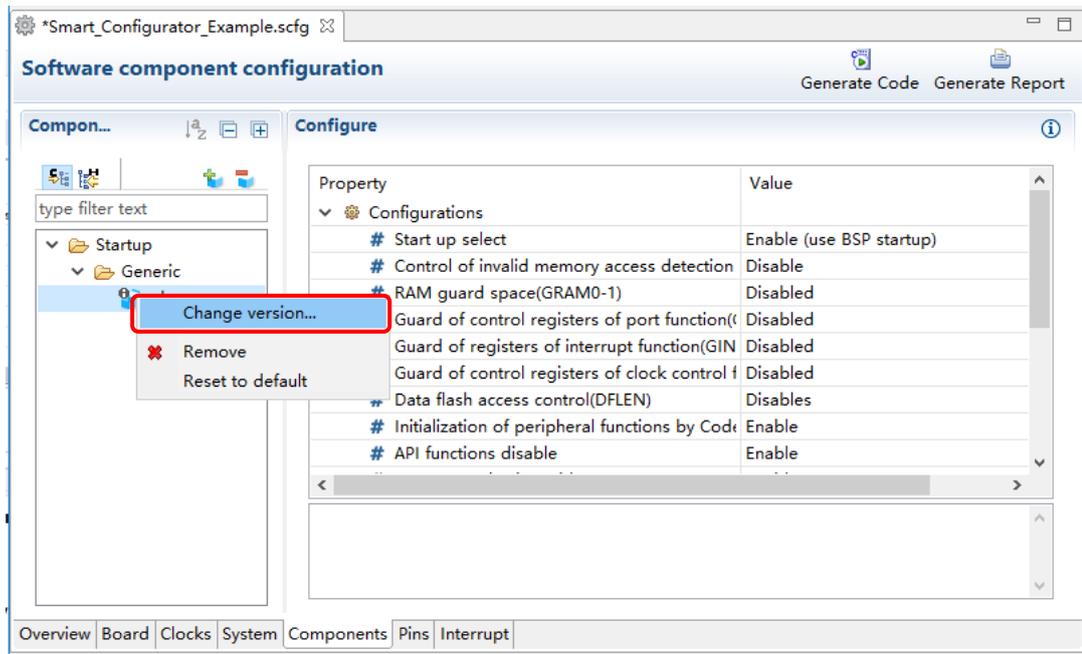


Figure 4-32. Version Change of BSP Configuration

- (2) Select [Change Version ...] from the context menu.
- (3) In the [Change Version] dialog box, select the version you want to change. If you select a version that the device does not support, [Selected version doesn't support current device or toolchain] will be displayed, so select the corresponding version.
- (4) Click [Next].

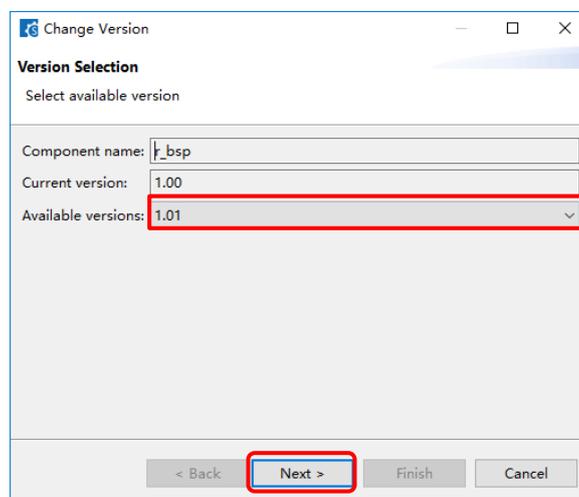


Figure 4-33. Select Version of BSP Component

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

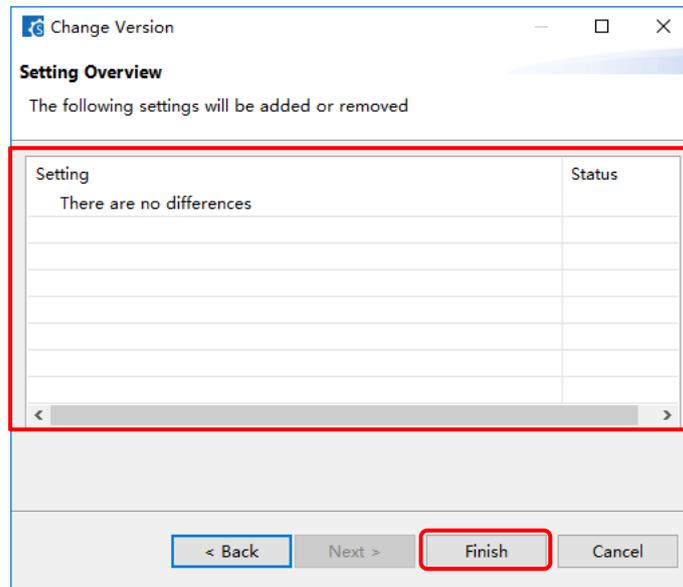


Figure 4-34. Confirm Setting Change Item

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

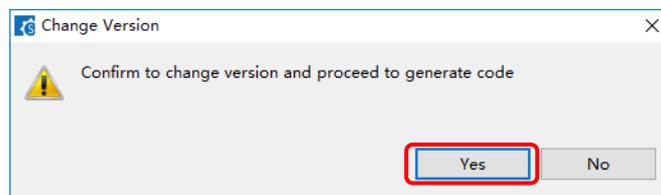


Figure 4-35. Confirm Version Change

- (7) The BSP component version is change and code generation is executed automatically.

Note: When you've generated BSP code by old version, after change BSP version, the code may not be replaced by new code. You can change the [Generating code] property in chapter 4.4.13 Configure General Setting of Component.

4.4.13 **Configure General Setting of Component**

You can change the general setting of the component such as location and dependency. If you want to change it, click the [Configure general settings...] link on the [Software Component Selection] page displayed in the [New Component] dialog (Figure 4-13), and display the [Preferences] dialog.

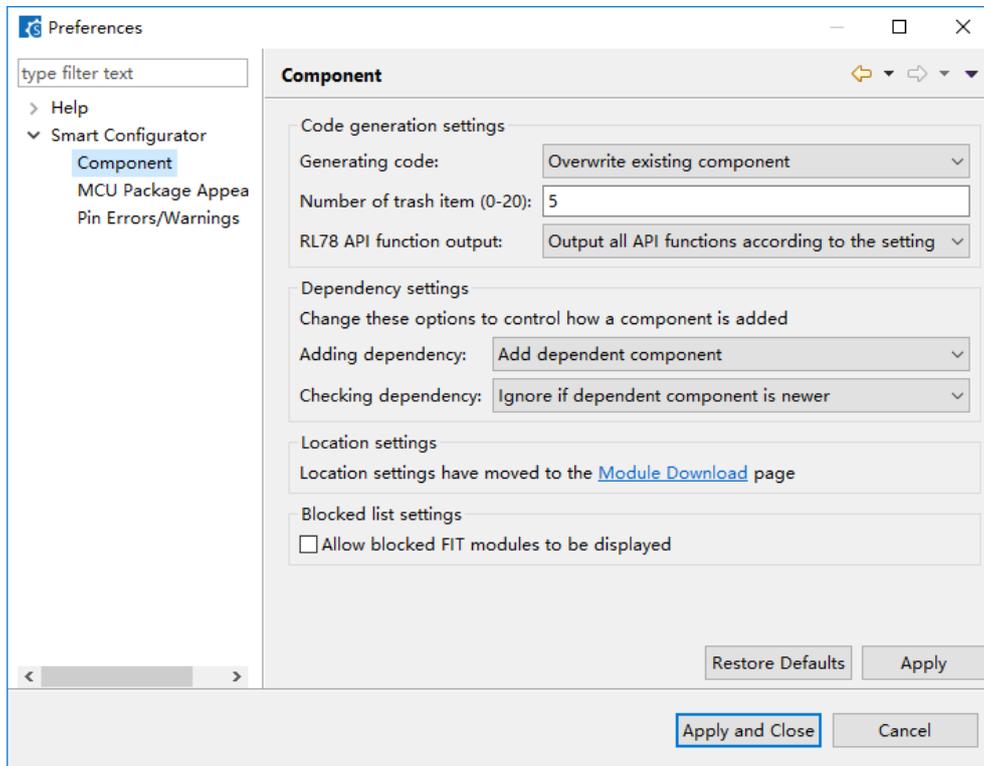


Figure 4-36. Configure General Setting of Component

Notes:

1. The code generation has two options: [Do nothing if component exists] and [Overwrite existing component]. [Do nothing if component exists] is the default selection, when select it, a code file, which has the same name as the new one, will not be replaced. After changing version, if you want to the code can be replaced, please select [Overwrite existing component].

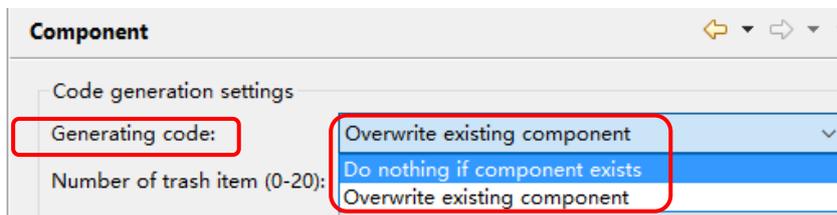


Figure 4-57. [Generation code] Change

Notes:

2. If you want to only generate initialization API function, you can 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 you change back to default option setting: [Output all API functions according to the setting], then all API functions will be generated again.

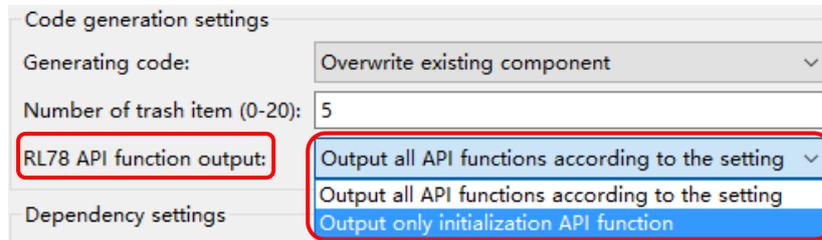


Figure 4-38. [RL78 API function output] Change

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

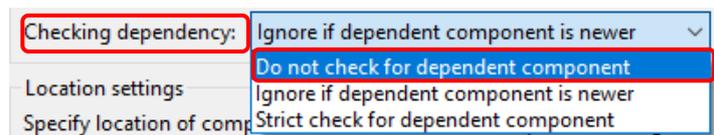


Figure 4-69. [Checking dependency] Change

4.5 Pin Settings

The [Pins] page is used for assigning pin functions. You 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.

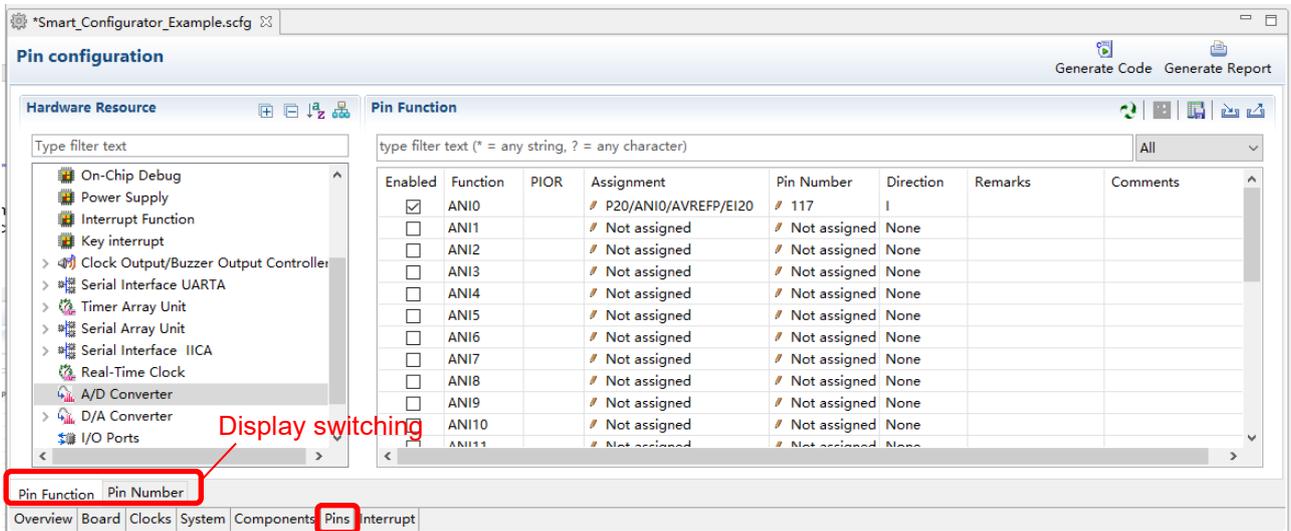


Figure 4-40. [Pins] Page ([Pin Function])

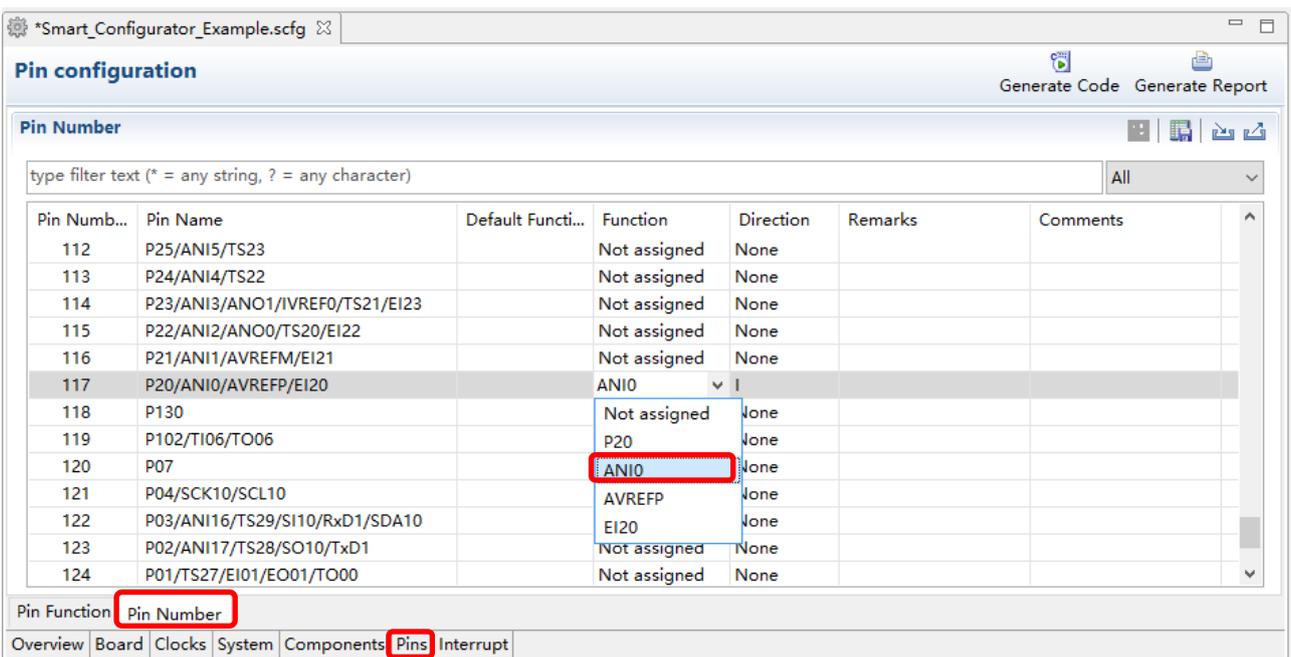


Figure 4-41. [Pins] Page ([Pin Number])

4.5.1 Changing the Pin Assignment by PIOR Function

PIOR “Filter Function” is a powerful feature to help you manage pin function settings, re-configure pin function settings or check pin function conflicts.

Follow the procedure below to change the assignment by PIOR function.

- (1) Type “pior1” in the tool text input box, all pin functions which related to PIOR1 will be listed out.
- (2) If you change one of pin assignment, all pin function assignments which related to PIOR1 will be re-assigned automatically.
- (3) The pin error messages may display in [Remark] column and [Configuration Problems view].
- (4) You need to re-configure pin assignment.

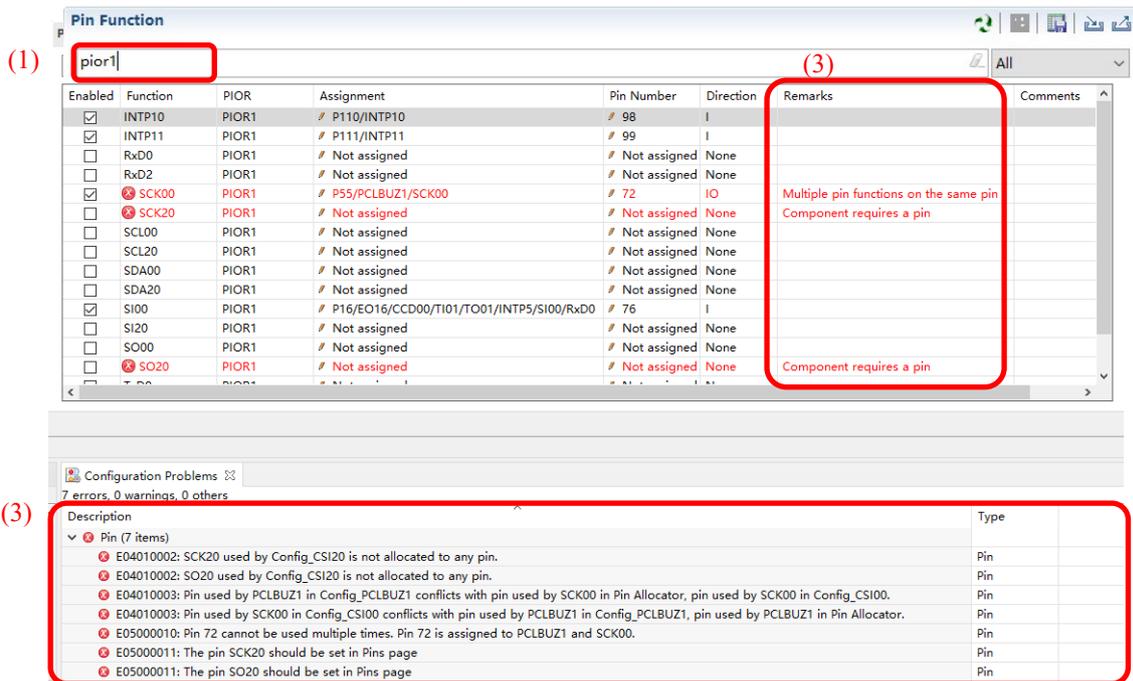


Figure 4-42. PIOR Filter Function

The PIOR setting can be reflected into r_bsp file in:

\\<ProjectDir>\src\smc_gen\r_bsp\r_config\r_bsp_config.h file. If you want to change the PIOR setting code value, change the assignment of related pin and generate code again.

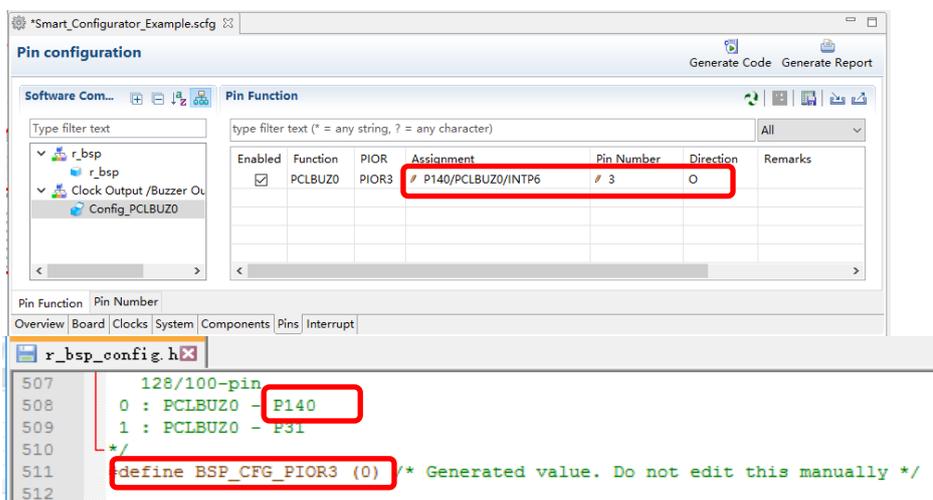


Figure 4-43. PIOR Code Generation

4.5.2 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 (e.g. Config_INTC).
- (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 (e.g. change from P12 to P16).
- (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.

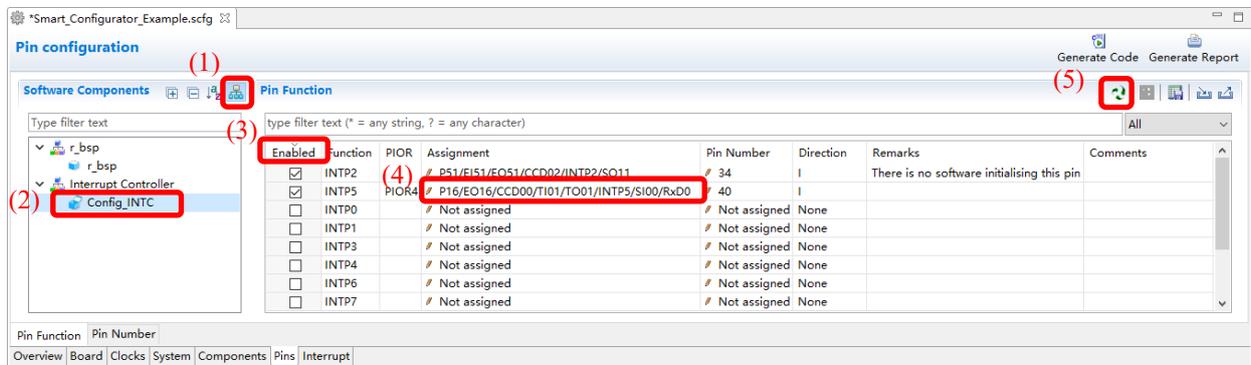


Figure 4-44 Pin Settings – Assigning Pins on the [Pin Function] List

The Smart Configurator allows you 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. In this case, no initialization code will be generated, so add the component.

4.5.3 Assigning Pins Using the MCU Package View

The Smart Configurator visualizes the pin assignment in the MCU Package view. You can save the MCU 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 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...].

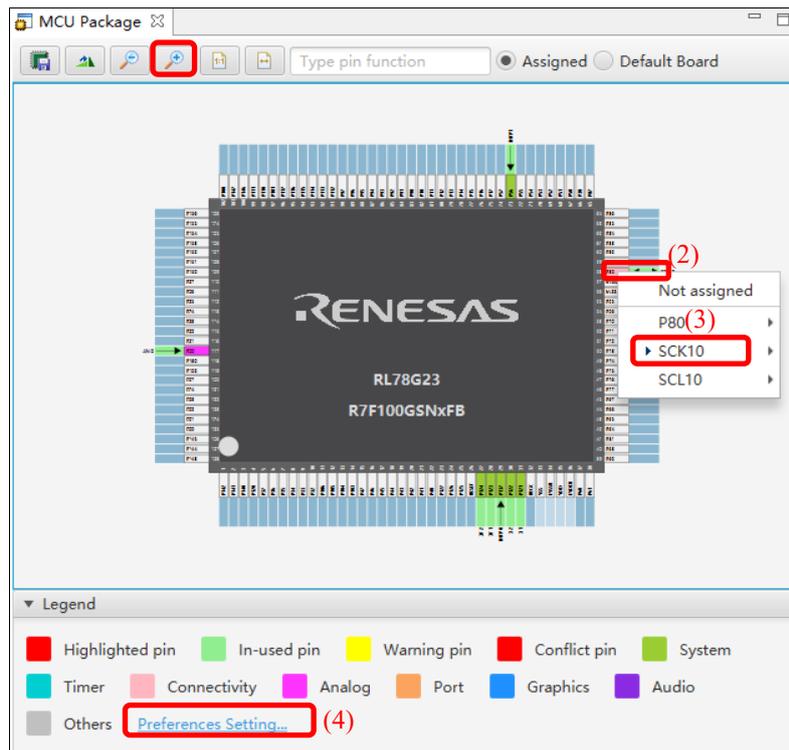


Figure 4-45. Assigning Pins Using the MCU Package View

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 board setting) 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.

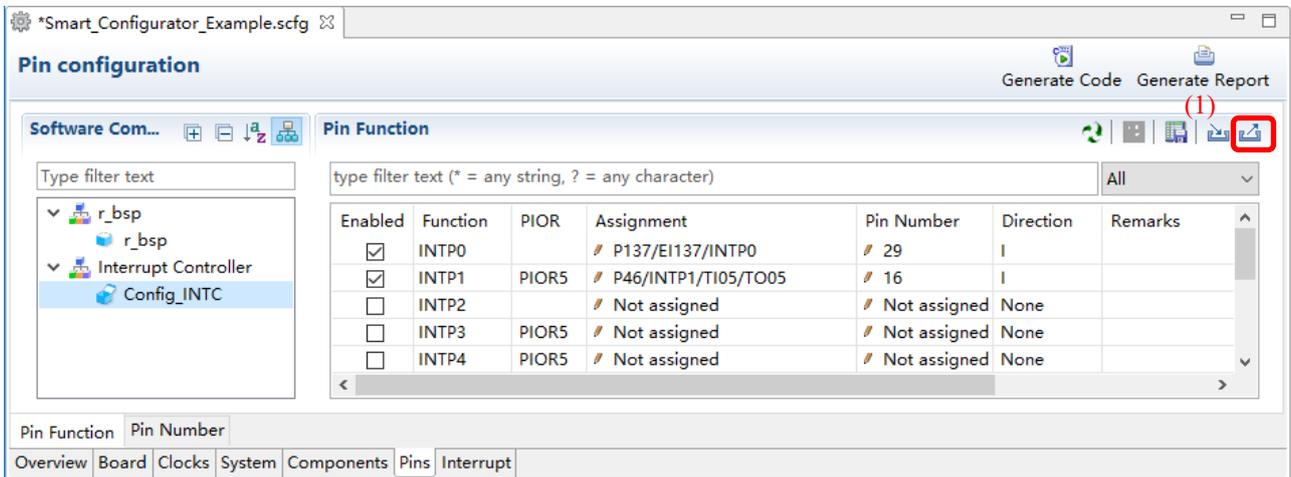


Figure 4-46. Exporting Pin Settings to an XML File

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 board setting) 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.

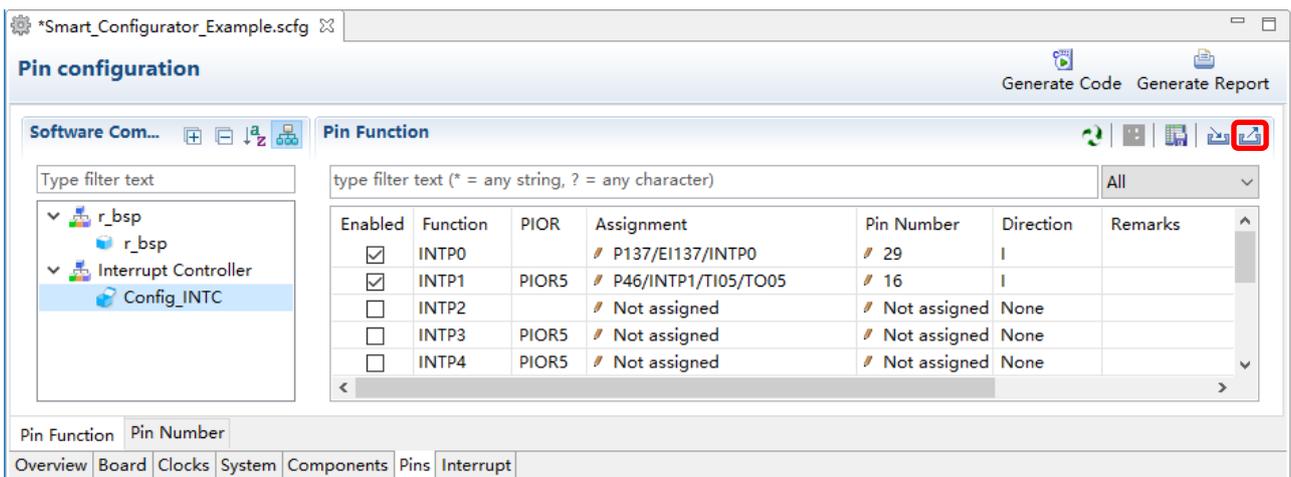


Figure 4-47. Importing Pin Settings from an XML File

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

You can set the initial pin configuration of the board at once. The following describes the procedure for collective setting of pins.

- (1) Select a board setting information except [Custom User Board] in [Board] page. You can refer to 4.1.2 Selecting the Board.
- (2) Select [Default Board] in the MCU 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].

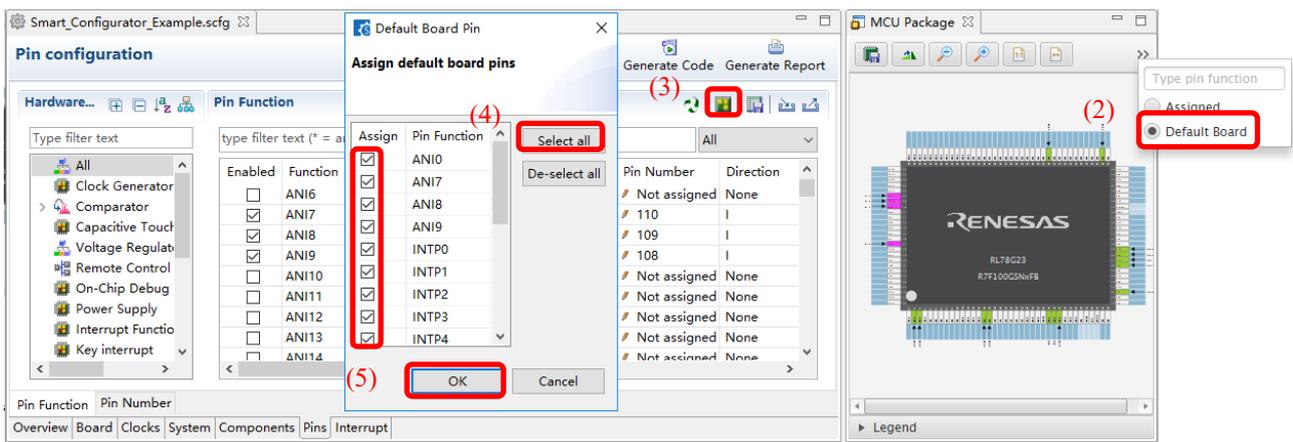


Figure 4-48. Setting for Initial Pin Configuration

If you do not set pin settings all at once, specify them individually in procedure (3).

4.5.7 Pin Filter Feature

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

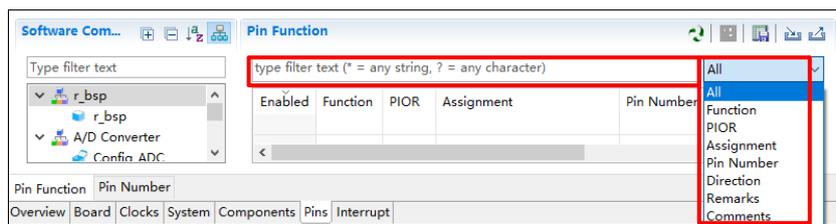


Figure 4-49. Filter for [Pin Function] Page

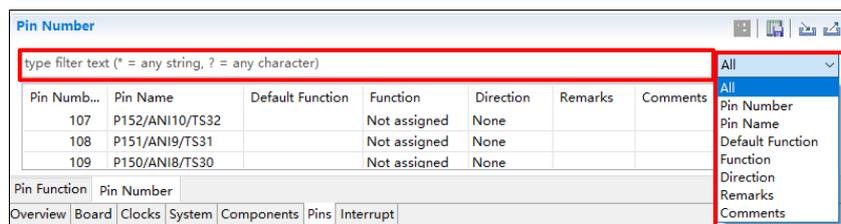


Figure 4-50. Filter for [Pin Number] Page

4.6 Interrupt Settings

The [Interrupt] page displays all interrupt by each of the vector numbers. You 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".

- (1) To display the used interrupts only, click on the  (Show used interrupts)] button.
- (2) Group interrupts are collapsed in the interrupt table. Click on the  (Open)] button to expand the view and see the interrupts in the group interrupt list.

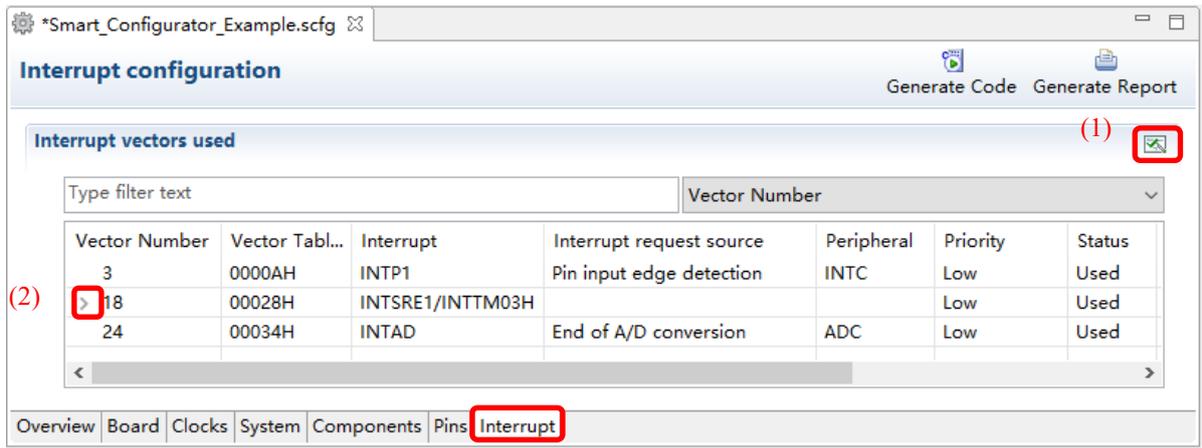


Figure 4-51. [Interrupts] Page

4.6.1 Changing Interrupt Priority Setting

You can change the interrupt priority level on the [Interrupts] page using the following procedure:

- (1) Find the interrupt which you want to change priority setting on this page.
- (2) Click the priority cell and select an interrupt priority level from the drop-down list.

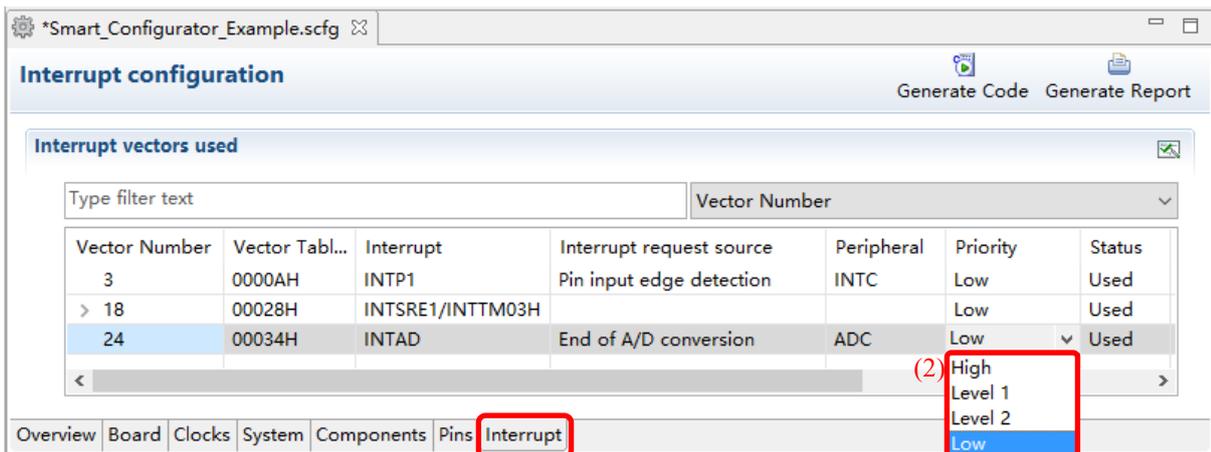


Figure 4-52. Interrupt Settings

4.6.2 Changing Interrupt Bank Setting

You can change the interrupt bank level on the [Interrupts] page using the following procedure:

- (1) Find the interrupt which you want to change bank setting on this page.
- (2) Click the [Bank specify] cell and select a bank setting from the drop-down list (There are four levels [None / 1 / 2 / 3])
- (3) If same bank levels are selected for different interrupt, warning mark will display and warning message is displayed in [Remarks]. You should check and re-set the bank setting.

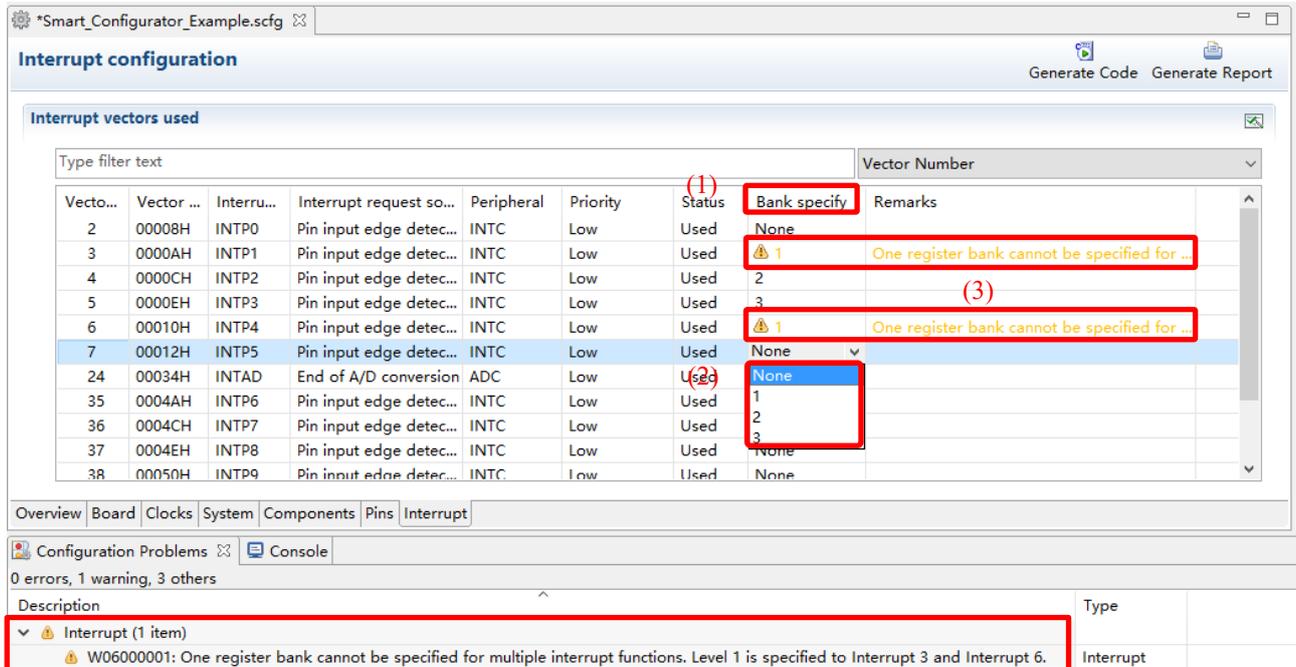


Figure 4-53. Change Interrupt Bank Setting Example

The interrupt bank setting can be reflected into generated code in component's {ConfigurationName}_user.c file.

```
#pragma vector = INTP1_vect
#pragma bank = 1
__interrupt static void r_Config_INTC_intp1_interrupt(void)
{
    /* Start user code for r_Config_INTC_intp1_interrupt. Do not edit comment generated here */
    /* End user code. Do not edit comment generated here */
}
```

Figure 4-54. Interrupt Bank Setting Example (IAR Project)

The concrete generated code specification is different for different compilers. You can get more information in corresponding IDE user guide.

5. Managing Conflicts

When you 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. You can refer to the displayed information to fix the conflict issues. You can generate code even if there are conflicts.

5.1 Resource Conflicts

When two software components are configured to use the same resource (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 the you in which software configurations peripheral conflicts have been detected.

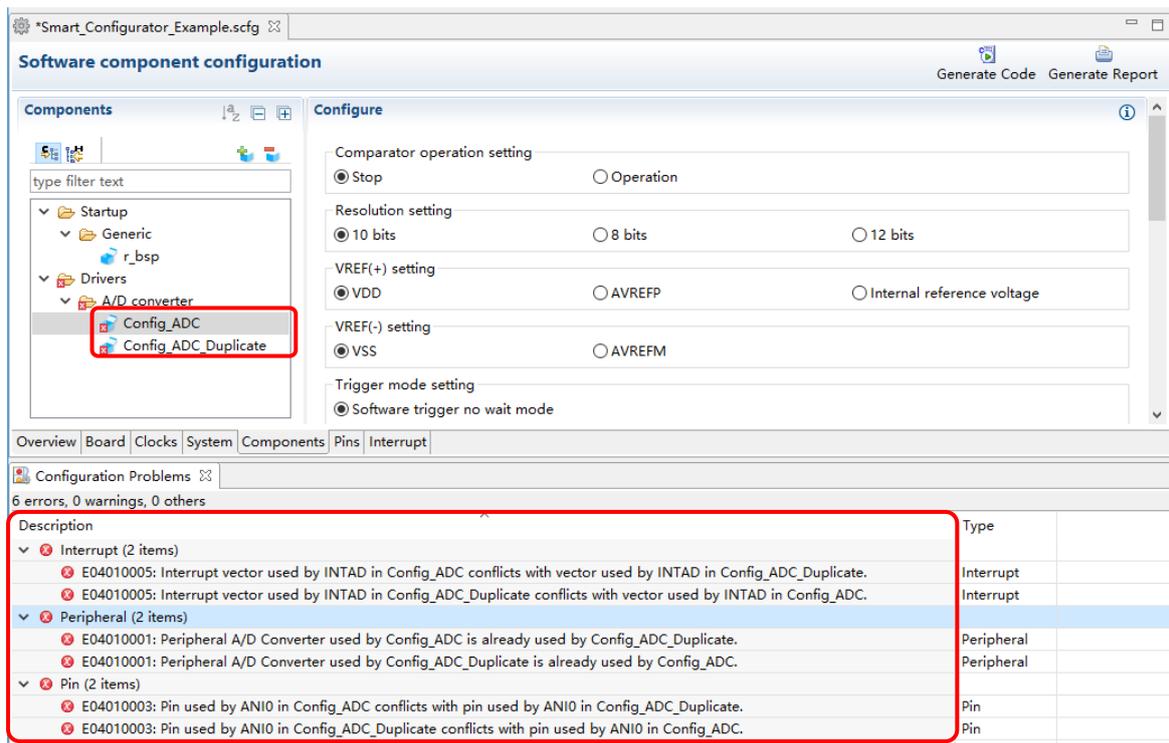


Figure 5-1. Resource Conflicts

5.2 Resolving Pin Conflicts

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

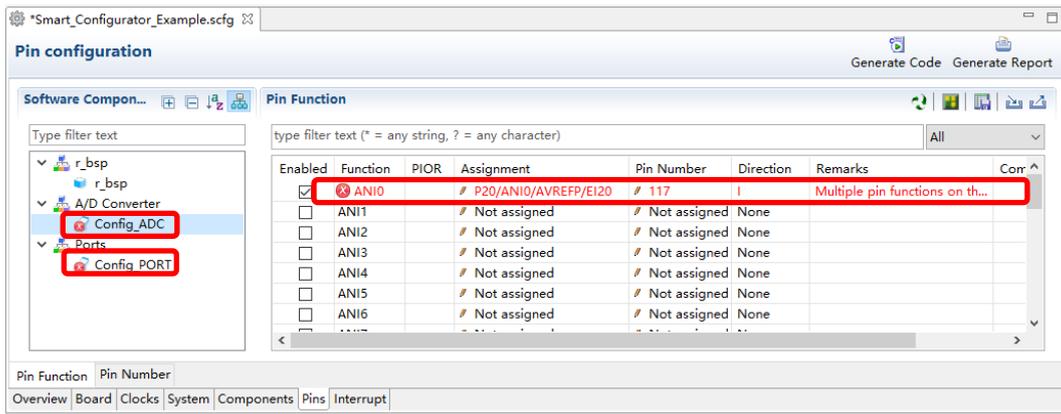


Figure 5-2. Pin Conflicts

The 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].

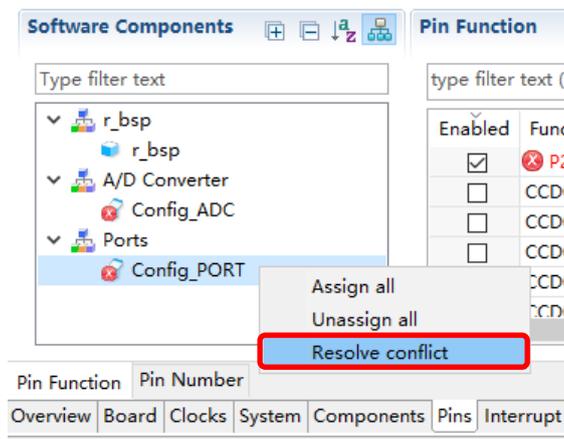


Figure 5-4. Resolving Pin Conflicts

The pins of the selected node 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)] button in the Smart Configurator view.

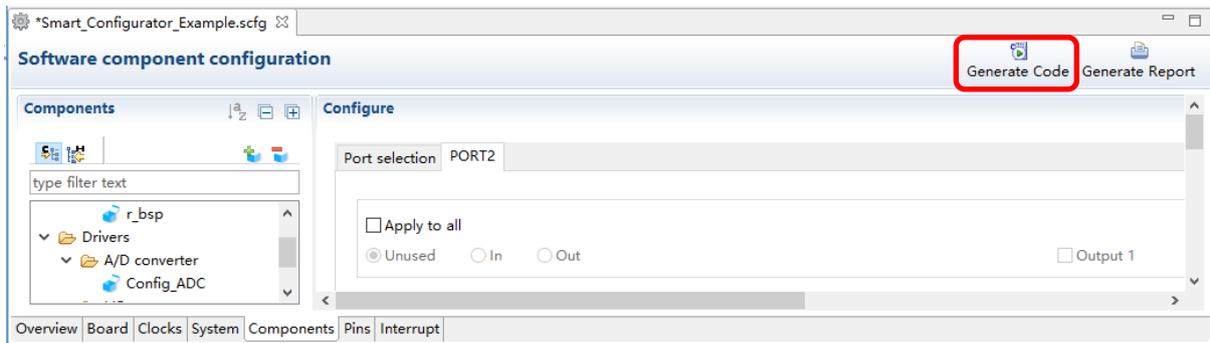


Figure 6-1. Generating a Source File

The Smart Configurator generates a source file in <ProjectDir>\src\smc_gen. If your 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 {Project name}.c, which is generated when the project is created by the IAREW.

“ConfigName” indicates the name of the configuration formed by the component settings, and “Project name” indicates a project name set in the IAREW.

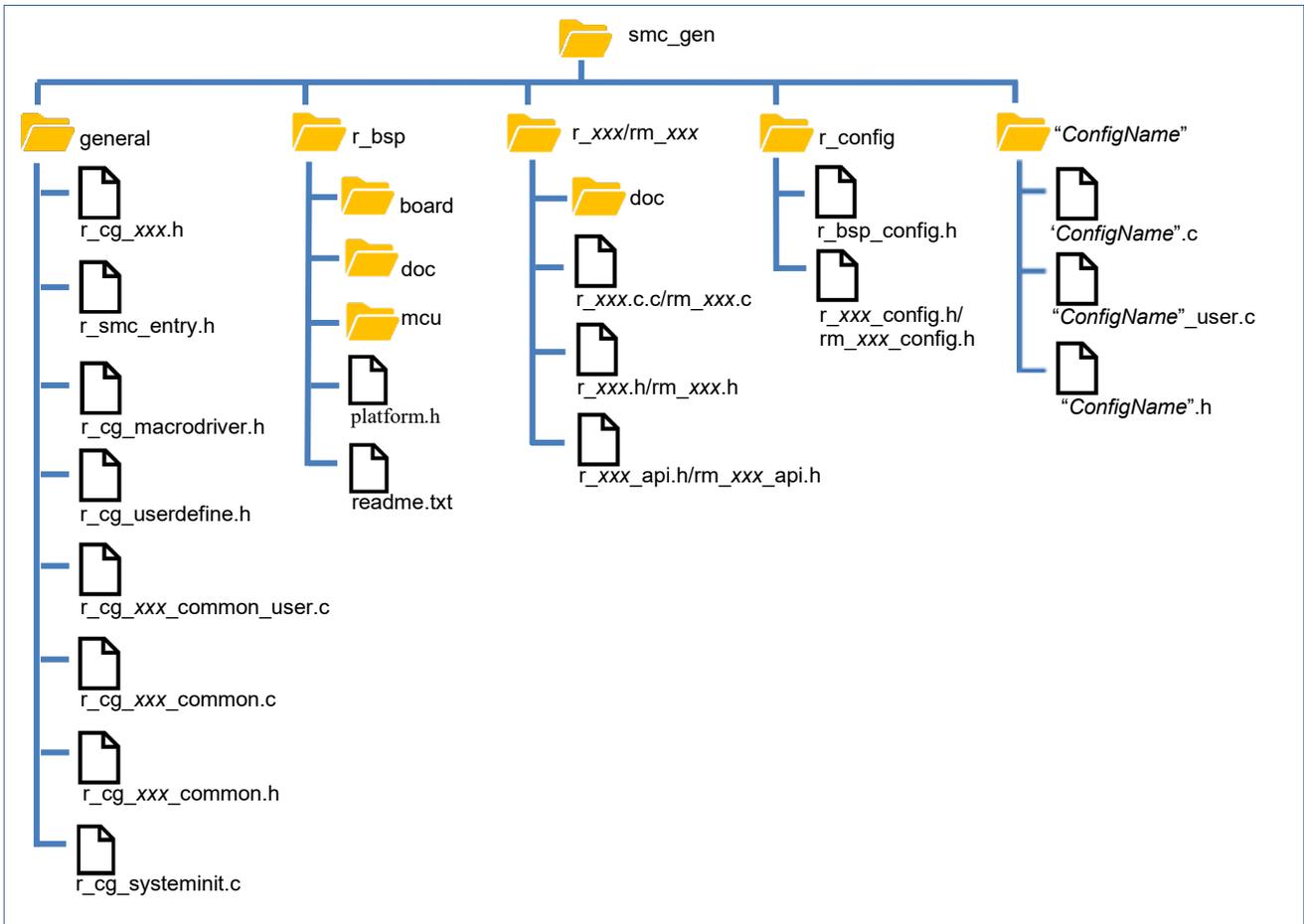


Figure 6-2. Configuration of Generated Files and File Names

Folder	File	Description
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, *2)	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_bsp		This folder is always generated. It consists of multiple subfolders (board, doc, mcu) with: <ul style="list-style-type: none"> - Initialization codes to start up the MCU before entering main () (e.g. setup stack, initialize memory) - Definitions of all SFR registers in iodef.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_XXX/ rm_XXX ^(Note*1)		This folder is generated for the RL78 Software Integration System module that is added to the project. It consists of: <ul style="list-style-type: none"> - doc folder: Application note of this RL78 Software Integration System module - r_XXX.c/rm_XXX.c^(Note*1): RL78 Software Integration System module source file - r_XXX.c/rm_XXX.h^(Note*1): RL78 Software Integration System header file - r_XXX_api.h/rm_XXX_api.h^(Note*1): List of all API calls and interface definitions of this RL78 Software Integration System module
r_config		This folder is always generated. It contains configuration header files for the MCU package, clocks, interrupts, and RL78 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_XXX_config.h/rm_XXX_config.h ^(Note*1)	These are configuration header files for all RL78 Software Integration drivers/middleware that are added to the project.

{ <i>ConfigName</i> }		This folder is generated for the Code Generator drivers that are added to the project. API functions in this folder are named after the <i>ConfigName</i> (configuration name).
	{ <i>ConfigName</i> }.c	This file contains functions to initialize driver (R_ <i>ConfigName</i> _Create) and perform operations that are driver-specific, e.g. start (R_ <i>ConfigName</i> _Start) and stop (R_ <i>ConfigName</i> _Stop).
	{ <i>ConfigName</i> }_user.c	This file contains interrupt service routines and functions for user to add code after the driver initialization (R_ <i>ConfigName</i> _Create). User can add codes and functions in the dedicated user code areas.
	{ <i>ConfigName</i> }.h	This is header file for { <i>ConfigName</i> }.c and { <i>ConfigName</i> }_user.c.

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

Note *2: It can be replaced by port, pclbuz, kr, wdt, intc, sms.

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 (e.g. package, stack size).

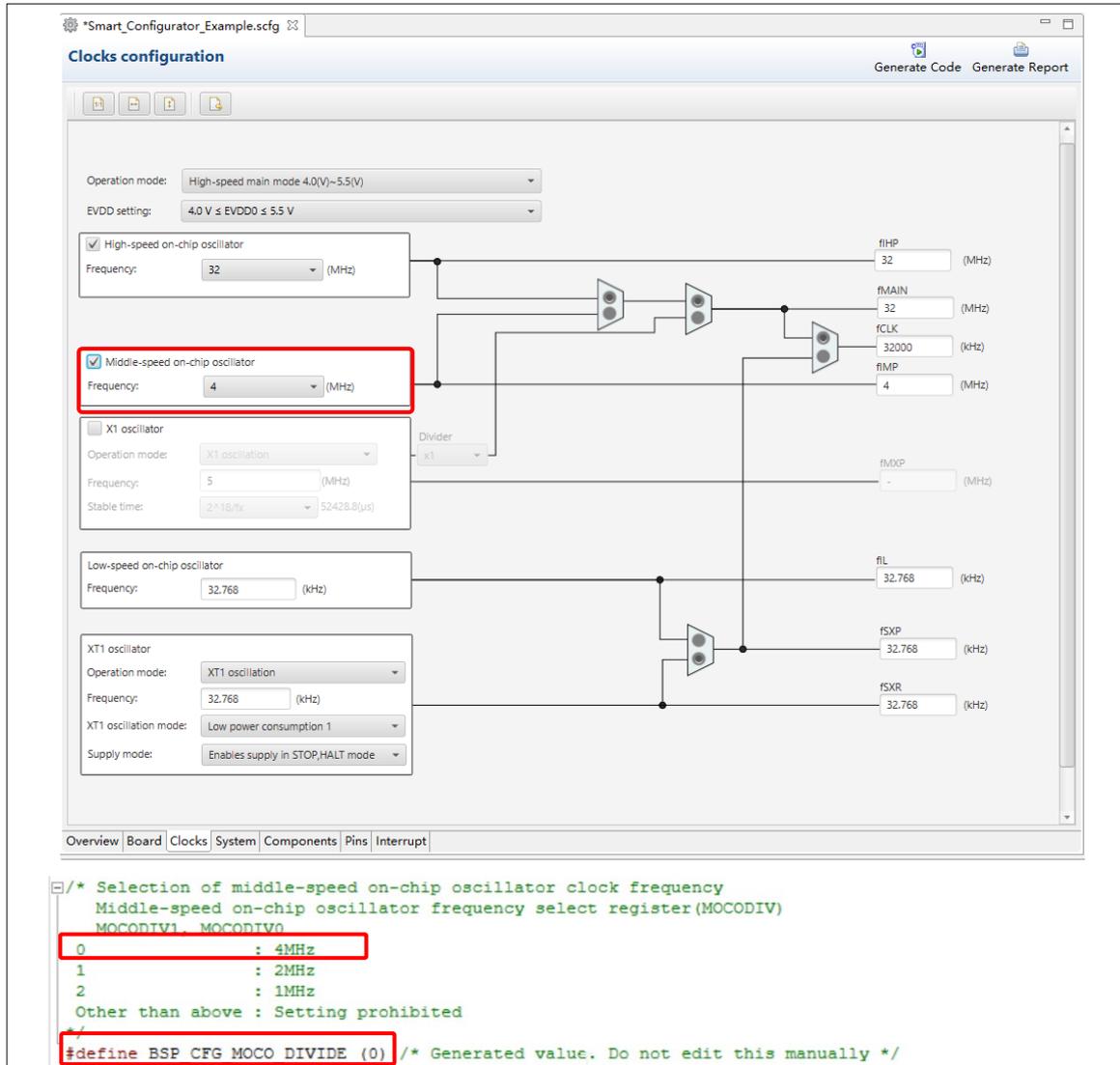


Figure 6-2. Clocks Configuration and Generated Code in `r_bsp_config.h`

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. <code>r_bsp</code> will handle the clock initialization before entering <code>main ()</code> .
		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 <code>r_bsp</code> folder: <code>\src\smc_gen\r_bsp\doc</code>

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 ().

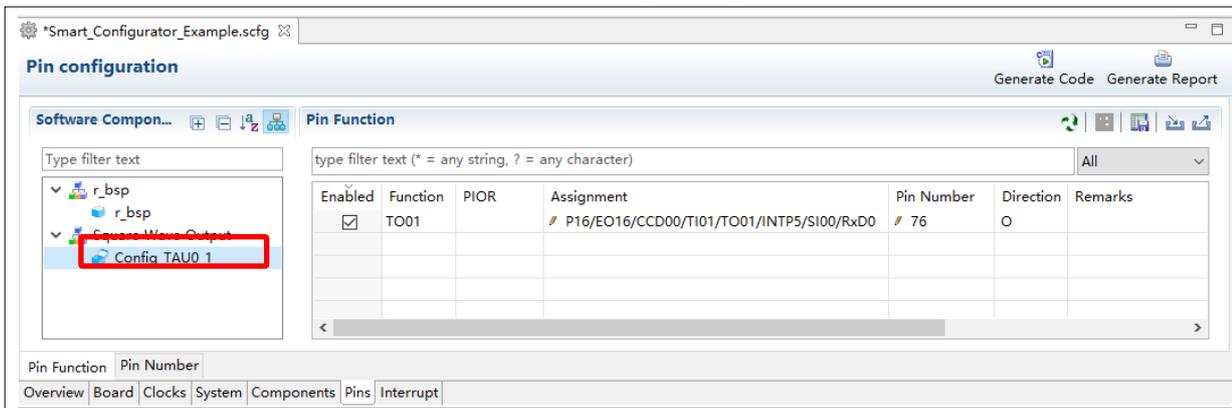


Figure 6-3. Config_TAU0_1 in Software Components View

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) Pin initialization for RL78 Software Integration System component

Pin functions are initialized in R_{PeripheralName}_PinSetInit of the file \src\smc_gen\r_pincfg\{ConfigName}_pinset.c.

User will call the pin initialization codes in main ().

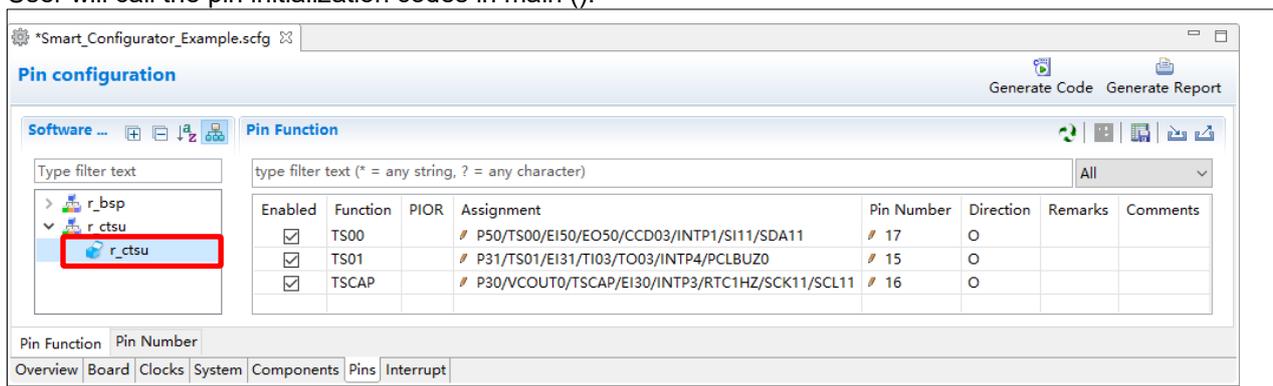


Figure 6-6. r_ctsu in Software Components View

Folder	File	Function	Component type	Description
r_pincfg	{ConfigName}_pinset.c	R_{PeripheralName}_PinSetInit	RL78 Software Integration System	This API function initializes the pins used by this driver. User need call this function in main () function.

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*.

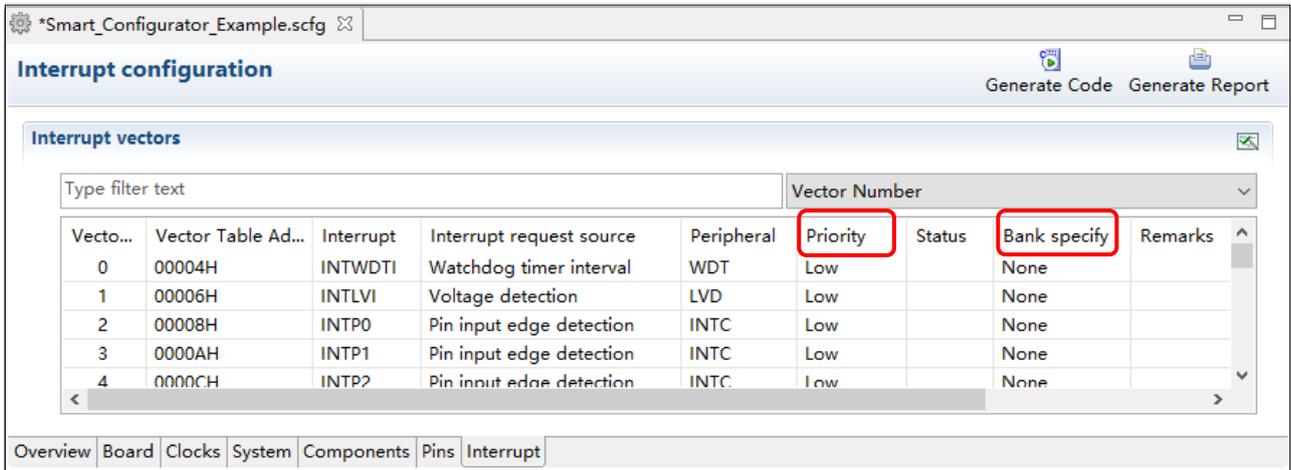


Figure 6-7. Interrupts Configuration in Interrupts View

Item	Folder	File	Component type	Description
Priority	{ConfigName}	{ConfigName}.c	Code Generator	It is initialized in <i>R_ConfigName_Create</i> of this file. <i>r_cg_systeminit</i> will call this function before entering <i>main ()</i> function.
Bank	{ConfigName}	{ConfigName}_user.c	Code Generator	Declaration of interrupt as: #pragma vector = "InterruptVectorName"_vect #pragma bank = "bankNumber" please see example in Figure 4-54

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 also outputs the project connection file (.ipcf) together with the source file. The project connection file contains source file registration information. It is not necessary for the user to add or delete source files after configuration change in the Smart Configurator.

The usage procedure is as follows.

- (1) Make sure the file generated by Smart Configurator is put in the same folder with IAR project (*.ewp file). (refer to Figure 2-2 Specify *.ewp File)
- (2) Select [Add Project Connection...] from the [Project] menu of IAR Embedded Workbench.
- (3) The [Add Project Connection] dialog is displayed. Select [IAR Project Connection] and click [OK].
- (4) In the [Select IAR Project Connection File] dialog box, browse to the folder where the Smart Configurator configuration file is saved, select the project connection file (.ipcf), and click the [Open] button.

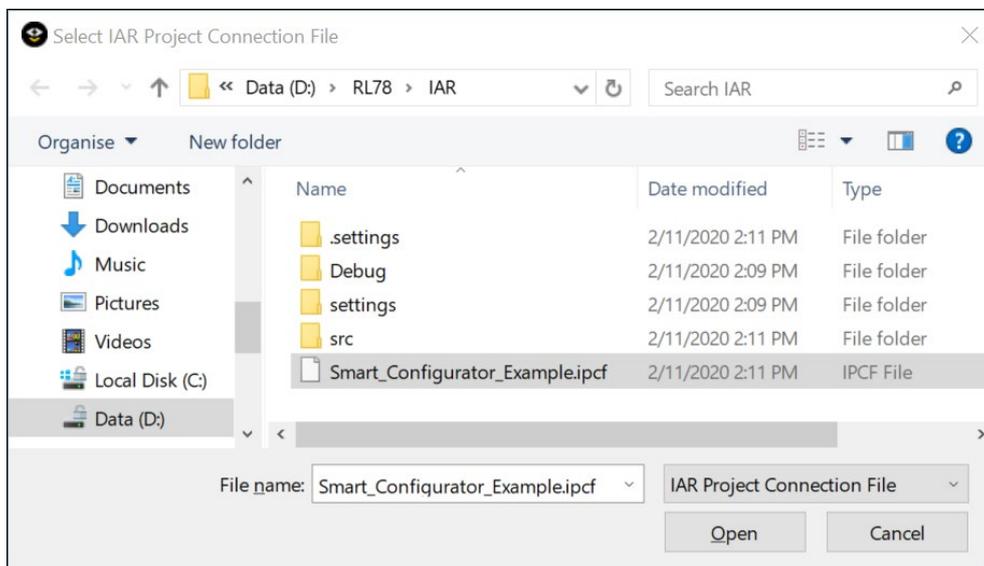


Figure 7-1. Load a *.ipcf File

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

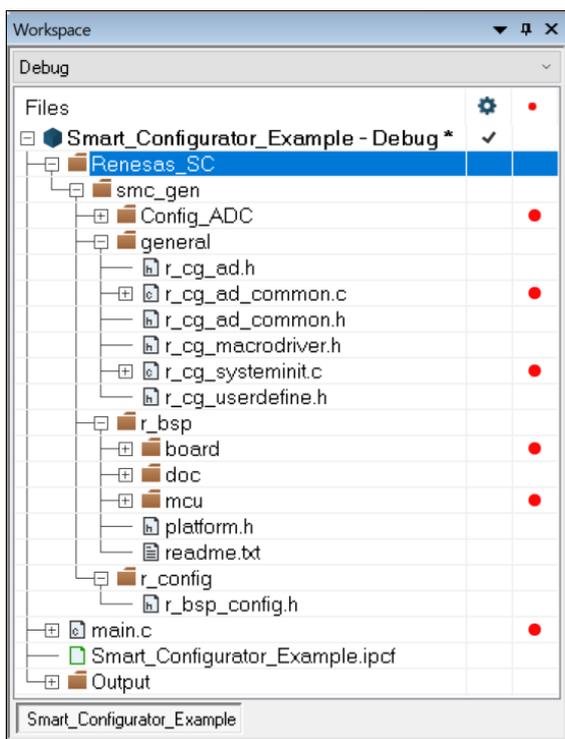


Figure 7-2. New Files added to IAR Workspace

7.2 Save and Build IAR Project File

After loading Smart Configurator project connection file (.ipcf) to IAR C project workspace successfully, user can right-click on project name, select [Rebuild All] from context menu, please first specify the name and location for saved workspace file, then build operation will be executed successfully.

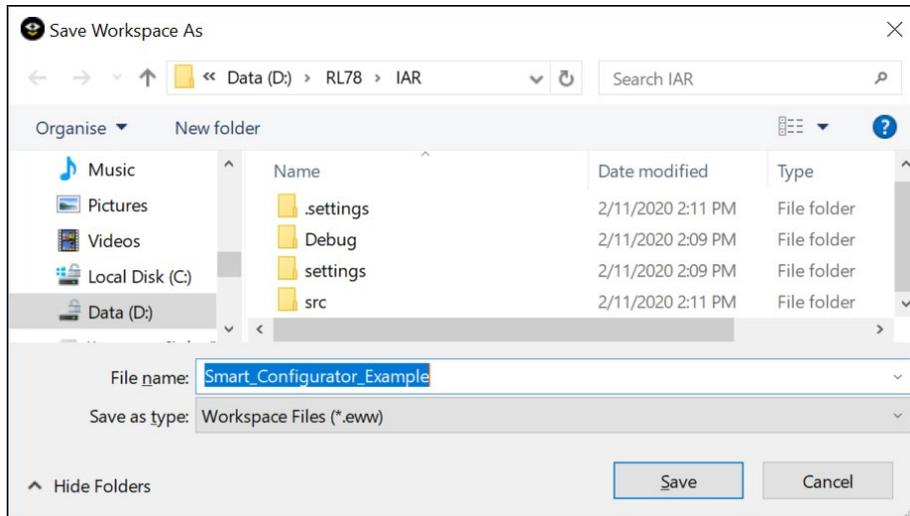


Figure 7-1. Specify *.eww File

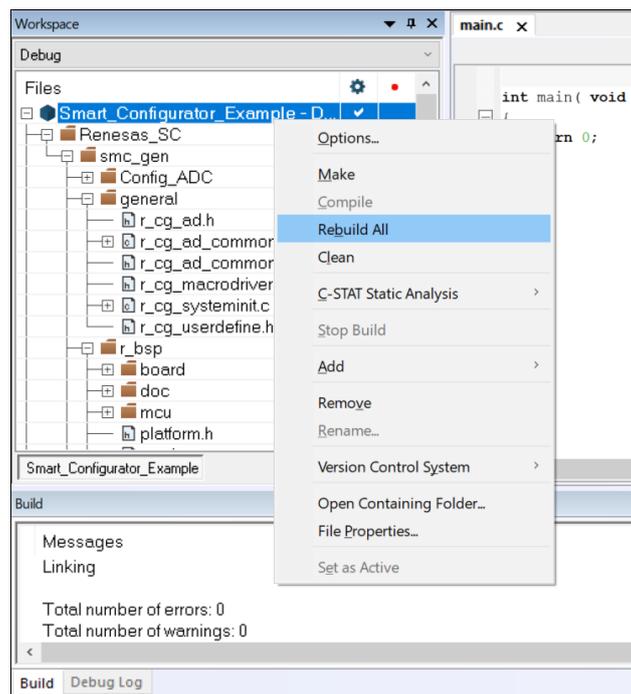


Figure 7-4. Build C Project File in IAR

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 Figure 3-1 Operating Procedure, 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).

```

/*****
Includes
*****/
#include "r_cg_macrodriver.h"
#include "r_cg_userdefine.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 */

/*****
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 INTAD interrupt service routine.
* Arguments: None
* Return Value: None
*****/
#pragma vector = INTAD_vect
__interrupt static 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 */
}

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

```

9. Backing up Generated Source Code

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

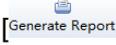
<ProjectDir>\trash\<Date-and-Time>

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. Generating Reports

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

10.1 Report on All Configurations (PDF or Text File)

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

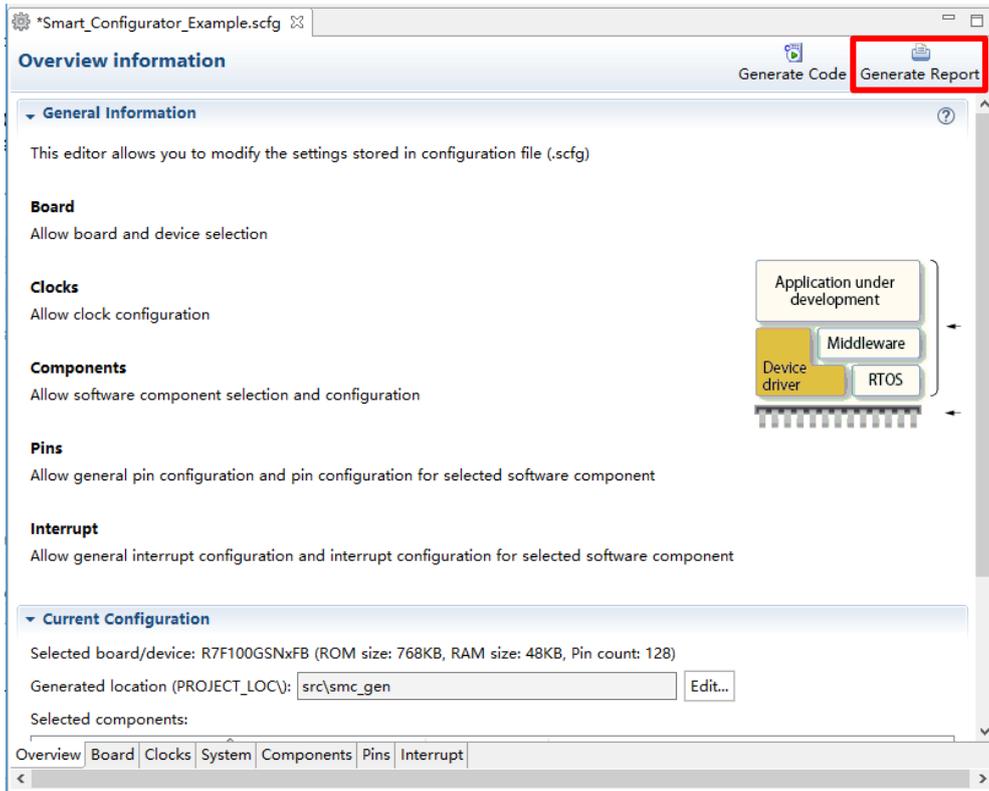


Figure 10-1. Output of a Report on the Configuration (as a PDF/Text File)

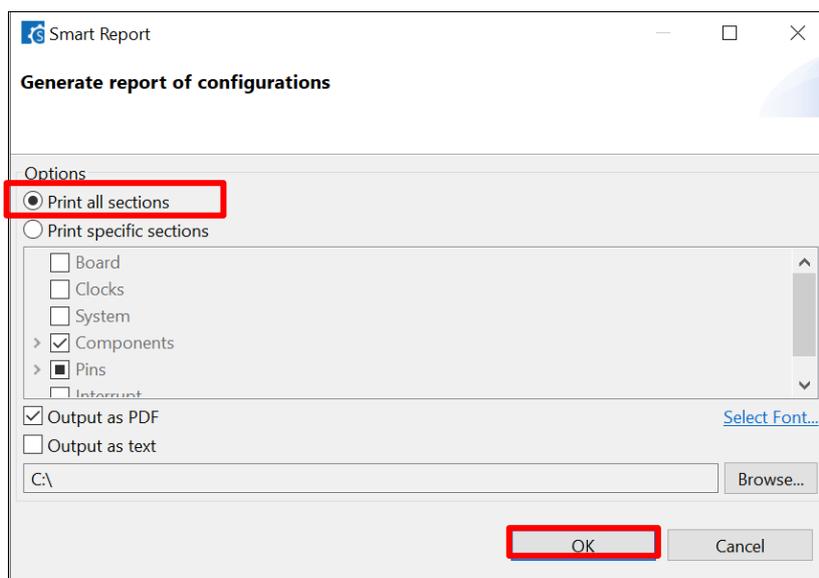


Figure 10-2. Dialog Box for Output of a Report

10.2 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.

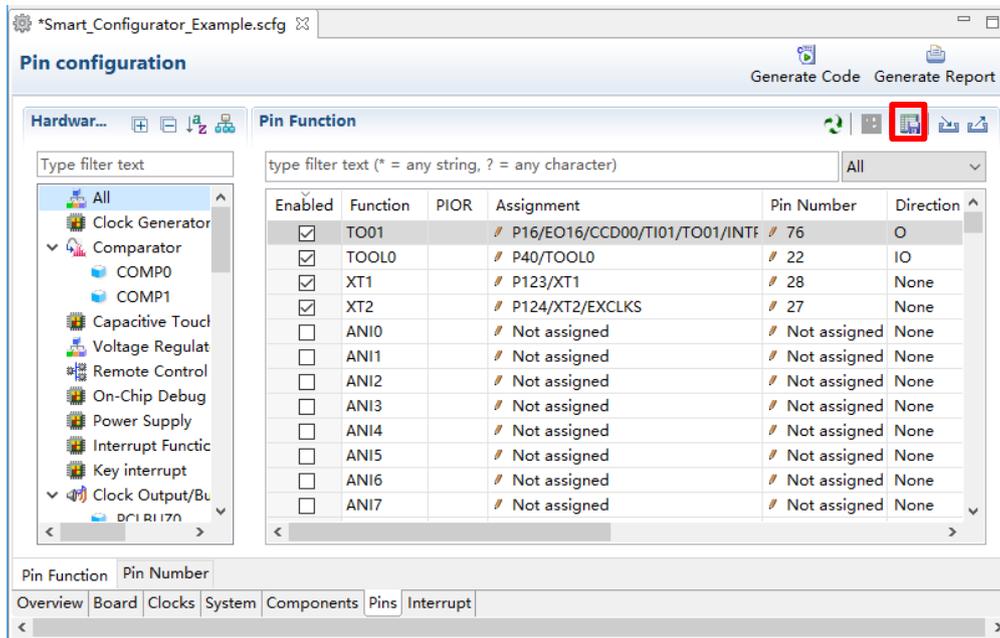


Figure 10-3. Output of a List of Pin Functions or Numbers (in csv Format)

10.3 Image of MCU Package (in png Format)

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

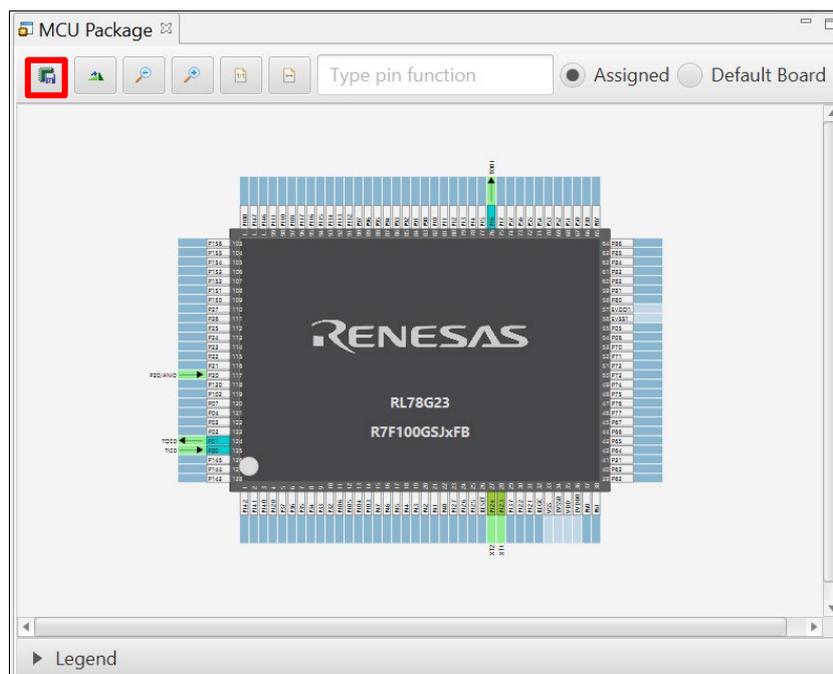


Figure 10-4. Outputting a Figure of MCU Package (in png Format)

11. Help

Refer to the help system for detailed information on the Smart Configurator. If selected from Help user menu, it will prompt out the Help dialog window, it is specially pointed to Smart Configurator portion in Help content.

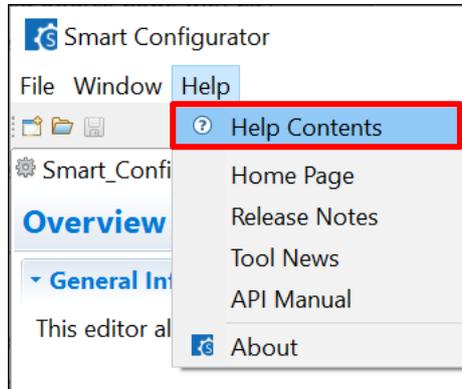


Figure 11-1. Help Menu

The help system can also be activated from the [Overview information] page. If selected from this page, it will open a Help panel in the current GUI view, it shows all Smart Configurator related topics. In whichever way to check Help information, the whole Help contents is the same.

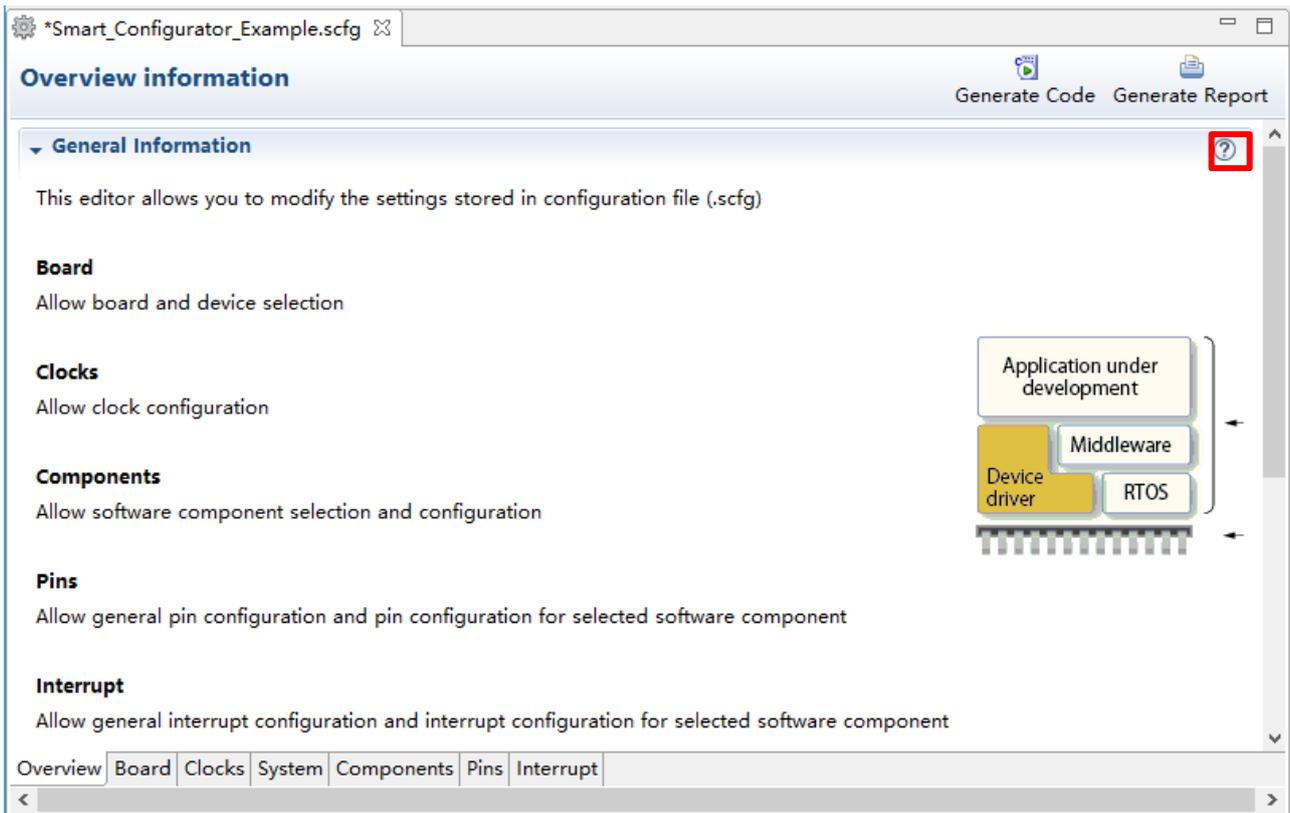


Figure 11-2. Quick Start

12. 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: RL78 API Reference (R20UT4852)

Obtain the latest version of IAR Embedded Workbench for Renesas RL78 manual from the website of IAR.

Application Notes:

SMS LED Blinking Dimming Control (R01AN5611)

SMS Fire Detection Operation (R01AN5617)

SMS Button Long Press/Short Press Judgment (RN01AN5609)

SMS Moving Average Calculation (R01AN5610)

SMS Power Supply Monitoring (R01AN5605)

ELCL Slave Select Pin Function (4-wire SPI) (R01AN5614)

ELCL Chattering Prevention Function (R01AN5612)

ELCL Manchester Decoder Function (A01AN5616)

ELCL Edge Detection Thinning Function (A01AN5613)

ELCL Multiple Parameter Monitoring Function (A01AN5615)

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr 01, 2021	-	First edition issued

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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