APPLICATION NOTE

Smart Configurator

Guide on Sample Projects for RH850/F1KM Devices

R01AN4422EJ0130
Rev.1.3.0
20 Jul, 2023

Introduction

This document describes, with the use of sample projects, how to build files output from the Smart Configurator for RH850 devices in the various integrated development environments.

Target Devices

RH850/F1KM-S1, RH850/F1KM-S2, RH850/F1KM-S4

Contents

1. Overview 3
1.1 Purpose 3
1.2 Operating Environment 3

2. Outline of the Sample Projects 4
2.1 List of Sample Projects 4
2.2 Notes on the Sample Projects 5

3. Basic Procedures for Operating the Smart Configurator 6
3.1 CS+ Environment 6
3.2 MULTI Environment 7
3.3 IAREW Environment 8

4. Description of the Sample Project for CS+ and CCRH 9
4.1 Configuration of the Sample Project for CS+ and CCRH 9
4.2 Basic Operating Procedure 10
4.3 Procedure for Changing the Device 13
4.4 Settings in the Sample Project for CS+ and CCRH 16

5. Description of the Sample Project for CS+ and GHS CCRH850 17
5.1 Configuration of the Sample Project for CS+ and GHS CCRH850 17
5.2 Basic Operating Procedure 18
5.3 Procedure for Changing the Device 22
5.4 Settings in the Sample Project for CS+ and GHS CCRH850 26

6. Description of the Sample Project for CS+, CCRH, and RI850V4 27
6.1 Configuration of the Sample Project for CS+, CCRH, and RI850V4 27
6.2 Basic Operating Procedure 28

6.3 Procedure for Changing the Device 32
6.4 Settings in the Sample Project for CS+, CCRH, and RI850V4 35

7. Description of the Sample Project for MULTI and GHS CCRH850 37
7.1 Configuration of the Sample Project for MULTI and GHS CCRH850 37
7.2 Basic Operating Procedure 38
7.3 Procedure for Changing the Device 41
7.4 Settings in the Sample Project for MULTI and GHS CCRH850 45

8. Description of the Sample Project for IAREW and IAR ICC 46
8.1 Configuration of the Sample Project for IAREW and IAR ICC 46
8.2 Basic Operating Procedure 47
8.3 Procedure for Changing the Device 50
8.4 Settings in the Sample Project for IAREW and IAR ICC 54

9. Operations in the Smart Configurator 55
9.1 Set the Peripheral Modules (Software Components) 55
..... 58
9.2 Generate Drivers 58
9.3 Add the Application Code to the User Code Area 59
9.4 Add the Application Code to main() 60

1. Overview

1.1 Purpose

This document describes, with the use of sample projects, how to build files output from the Smart Configurator for RH850/F1KM devices in the various integrated development environments.

When applying this application note to a microcontroller, change the contents in accord with the specifications of the microcontroller you are using and validate the correct operation of the sample projects.

1.2 Operating Environment

Install the Smart Configurator and tools to be used in order to create or build programs in each integrated development environment based on the source files generated by the Smart Configurator with the use of the sample projects.

For details on how to use your integrated development environment, refer to the user's manual for the integrated development environment you are using.

Table 1-1 Operating Environment

Type	Name	Abbreviation in This Manual
IDE	CS+ for CC V8.10.00 or later	CS+
Toolchain	C Compiler Package for RH850 Family	CCRH
Toolchain	Real-time OS for RH850 Family [RI850V4] V3	RI850V4
IDE	MULTI v8.1.4 or later	MULTI
Toolchain	Green Hills Compiler	GHS CCRH850
IDE	IAR Embedded Workbench for RH850 V3.10.1 or later	IAREW
Toolchain	IAR C/C++ Compiler	IAR ICC

Green Hills is a registered trademark of Green Hills Software, Inc. in the United States and other countries.

IAR Embedded Workbench is a registered trademark of IAR Systems.

2. Outline of the Sample Projects

The Smart Configurator for RH850/F1KM devices outputs a main function and source files that initialize peripheral modules that are set by components of the Smart Configurator. After the microcontroller has been reset, the initialization processing that is to be performed before execution of the main function and the startup routine that starts the main function and handles other processing are not output.

Therefore, we have prepared sample projects that include startup of the sample projects so that code for peripheral modules according to the settings in the Smart Configurator and user applications employing this code can be built immediately.

2.1 List of Sample Projects

The Smart Configurator for RH850/F1KM devices provides the following sample projects.

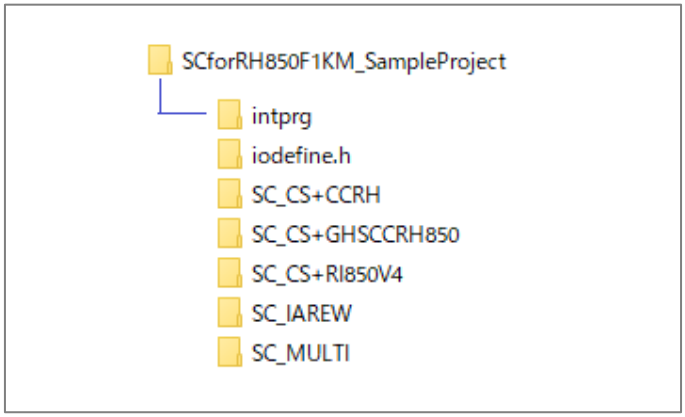


Figure 2.1 Sample project folders

For details on the sample projects, see the descriptions in the relevant sections.

Table 2-1 Sample Projects

Explanatory Section	Folder Name	Target Device	Description
Section 2	intprg	—	File defining the EI maskable interrupt vector table for RH850/F1KM-S1, RH850/F1KM-S2 and RH850/F1KM-S4 devices
Section 2	iodefine.h	—	Renesas CCRH header file defining the registers for RH850/F1KM-S1, RH850/F1KM-S2 and RH850/F1KM-S4 devices
Section 4	SC_CS+CCRH	R7F701651 (RH850/F1KM-S4)	Project for CS+ for CC and CCRH compiler
Section 5	SC_CS+GHSCCRH850	R7F701649 (RH850/F1KM-S4)	Project for CS+ for CC and GHS CCRH850 compiler
Section 6	SC_CS+RI850V4	R7F701649 (RH850/F1KM-S4)	Project for CS+ for CC, CCRH compiler, and RI850V4
Section 7	SC_MULTI	R7F701645 (RH850/F1KM-S4)	Project for MULTI and GHS CCRH850 compiler
Section 8	SC_IAREW	R7F701645 (RH850/F1KM-S4)	Project (workspace) for IAREW and IAR ICC compiler

2.2 Notes on the Sample Projects

1. When using this sample project, please copy and use it in a directory that does not restrict the access.
   If you use it in a directory that restricts access, the generated codes and other files will not be saved and some errors may occur.
   In general, the following directories require administrator permission:
   - Program files folder (e.g. "C:\Program Files", "C:\Program Files (x86)")
   - System root folder (e.g. "C:\Windows")
   For your environment, please contact your system administrator (IT department).

2. The Smart Configurator outputs the register descriptors according to iodefine.h for the Renesas CCRH compiler. Though header files of register definitions are also prepared in the GHS CCRH850 and IAR ICC compilers, include iodefine.h for the Renesas CCRH compiler when building files generated by the Smart Configurator.

3. The Smart Configurator uses interrupts with the table lookup method as the method for selecting the interrupt handler addresses. The address where the table starts is set as 0x00000200 in the sample projects.

4. The definition of the interrupt vector table of peripheral modules that was set in the Smart Configurator is reflected in smc/general/r_cg_intvector.c, which is output by the Smart Configurator. The file sc_intprg-S1.c, sc_intprg-S2.c or sc_intprg-S4.c in the intprg folder defines the vector table of EI maskable interrupt sources, which is not set by the Smart Configurator.

5. Settings of files and sections provided with the sample projects are examples. They should be changed or created newly by yourself to match the specifications of the microcontroller in use and the customer's system.

3. Basic Procedures for Operating the Smart Configurator

This section describes the basic operating procedures when building a user application with the files output from the Smart Configurator for RH850/F1KM devices.

The basic operating procedures in each integrated development environment without the use of the sample projects are described here. For the operating procedure when using a sample project, see the relevant section among sections 4 to 8, in accordance with the sample project you will be using.

3.1 CS+ Environment

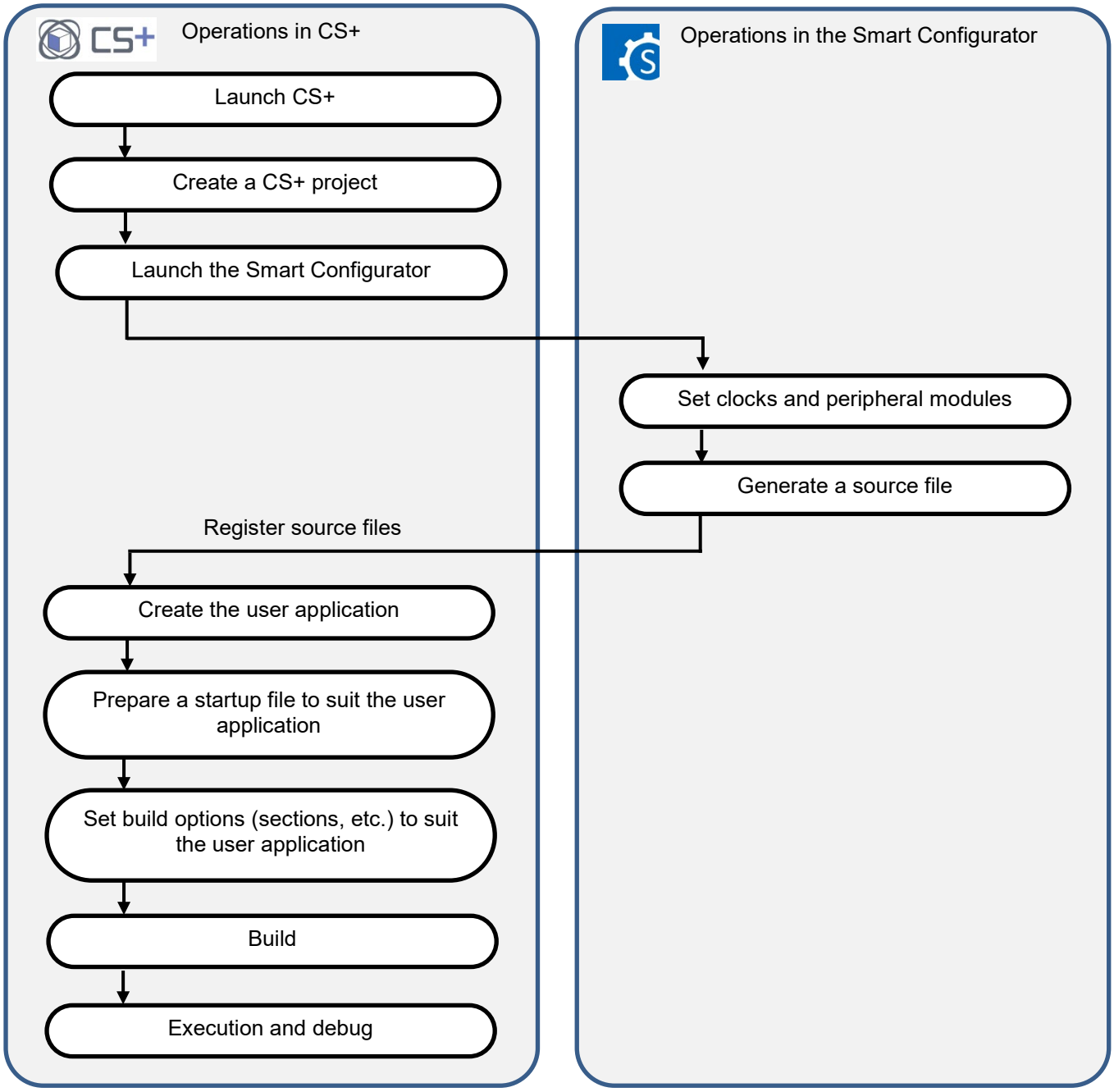


Figure 3.1 Basic Operating Procedure in the CS+ Environment

3.2 MULTI Environment

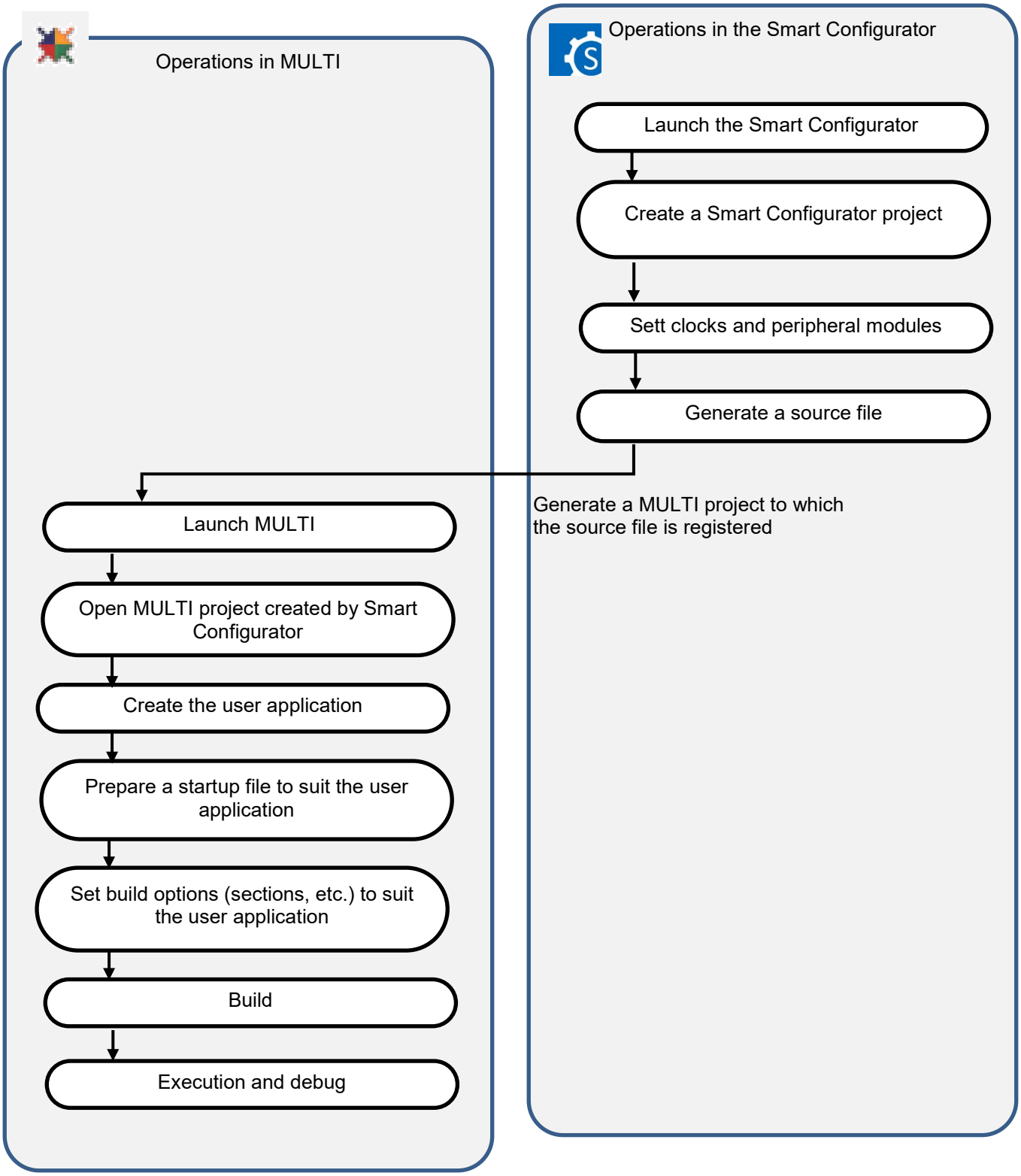


Figure 3.2 Basic Operating Procedure in the MULTI Environment

3.3 IAREW Environment

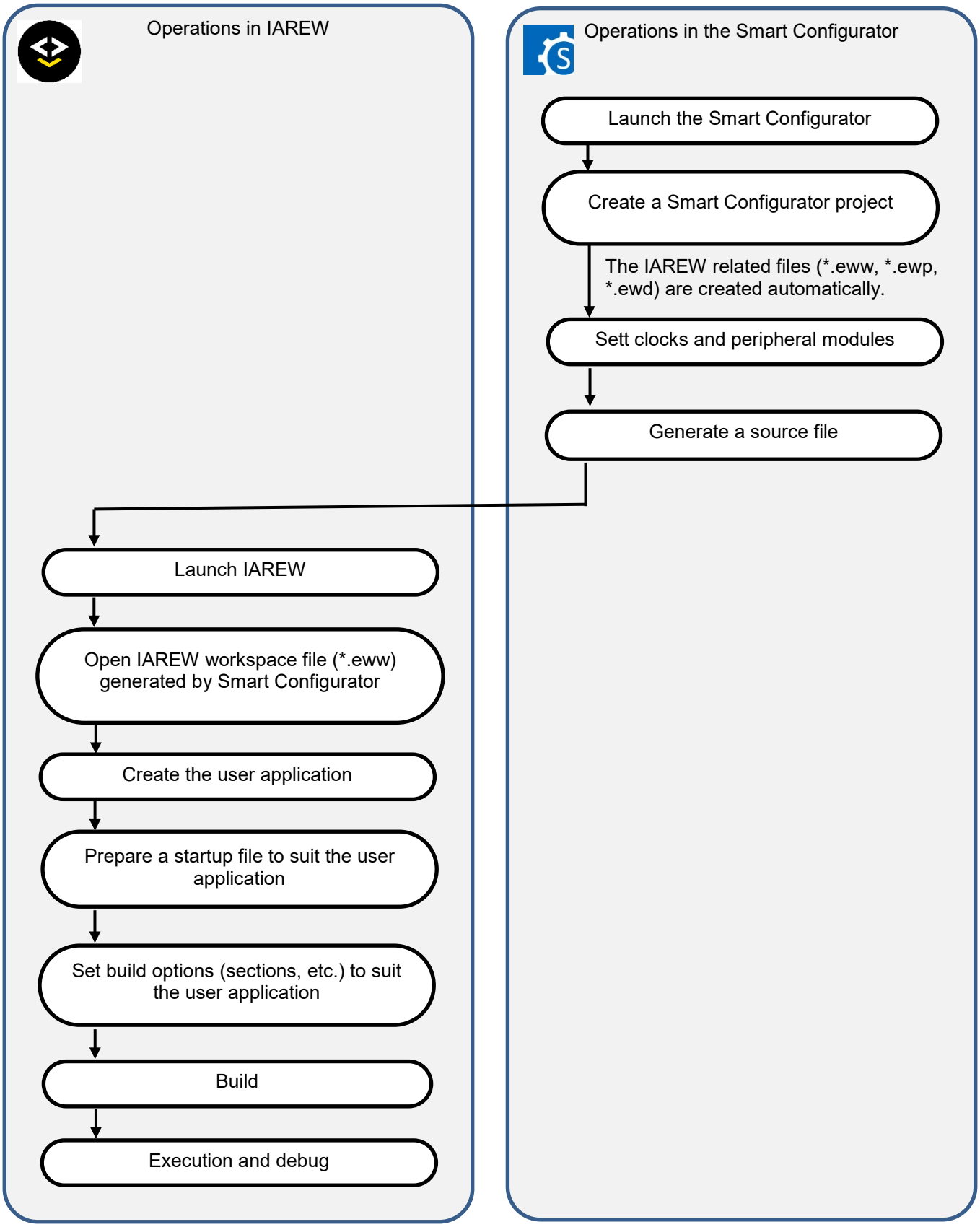


Figure 3.3 Basic Operating Procedure in the IAREW Environment

4. Description of the Sample Project for CS+ and CCRH

4.1 Configuration of the Sample Project for CS+ and CCRH

The following shows the configuration of the sample project.

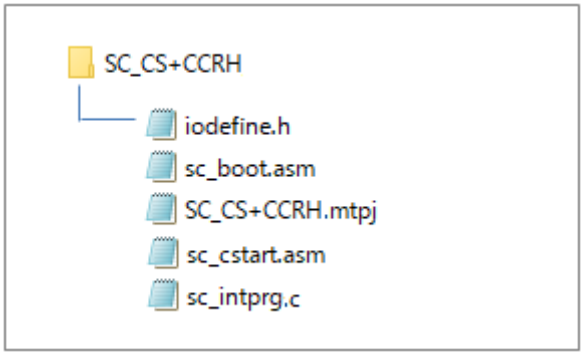


Figure 4.1 Sample project for CS+ and CCRH files

Table 4-1 File Configuration of the Sample Project for CS+ and CCRH

File Name	Outline of File
SC_CS+CCRH.mtpj	Project file for CS+
sc_boot.asm	Definition of the processing from a reset up to branching to the startup routine and definition of the interrupt vector table
sc_cstart.asm	Definition of the startup routine to be executed until branching to the main function
sc_intprg.c	Definition of the EI-level maskable interrupt vector table
iodefine.h	Definitions of registers

The Smart Configurator does not output the above files.

4.2 Basic Operating Procedure

Figure 4-2 shows the operating procedure when using the Smart Configurator based on a sample project.

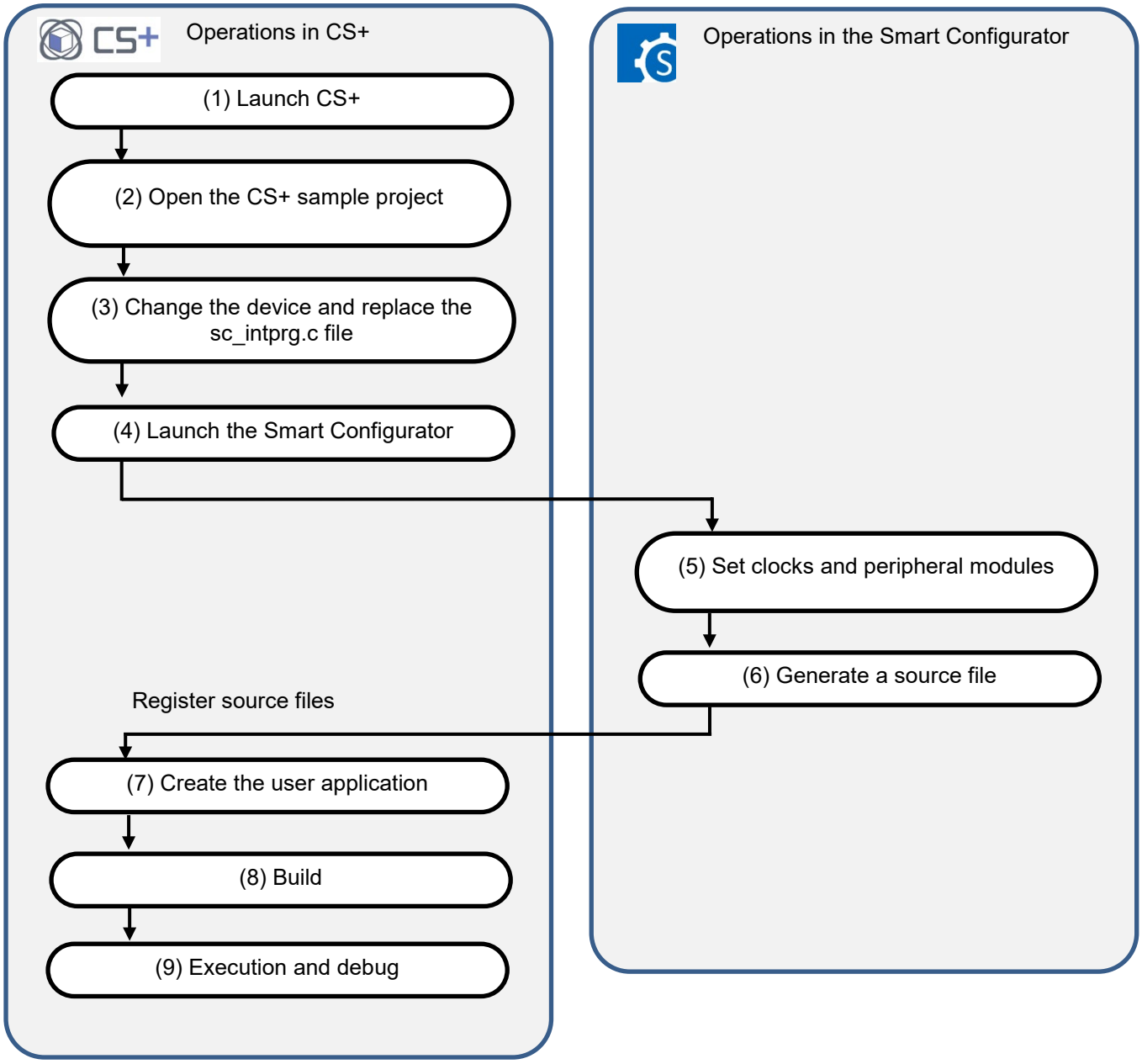


Figure 4.2 Operating Procedure for the Sample Project for CS+ and CCRH

(1) Launch CS+

In the [Start] menu of Windows, select [Renesas Electronics CS+] → [CS+ for CC(RL78,RX,RH850)].

(2) Open the CS+ sample project

From the [Open...] item of the [File] menu or [Open Existing Project] of CS+, select "SC_CS+CCRH.mtpj".

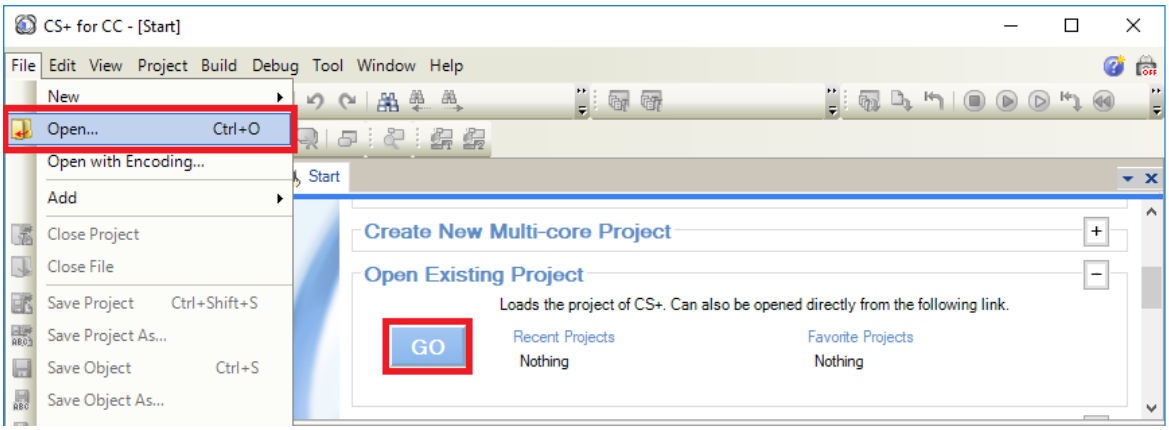


Figure 4.3 Open Sample project for CS+ and CCRH

NOTE: Sample project must be copied to a directory that does not restrict access before using. Please refer 2.2-1 for the detail.

(3) Change the device

The R7F701651 (RH850/F1KM-S4) is selected as the target device in the sample project. If you are using another device, change the target device and file to be used with reference to section 4.3, "Procedure for Changing the Device". If the device does not require changing, proceed to step (4).

(4) Launch the Smart Configurator

(4)-1. Confirm the setting of the path for the Smart Configurator for RH850. In the Project Tree panel, select [Smart Configurator (Design Tool)] and open the [Property] panel. Confirm that the path in which the Smart Configurator for RH850 was installed is set in [Smart Configurator for RH850 executable file path].

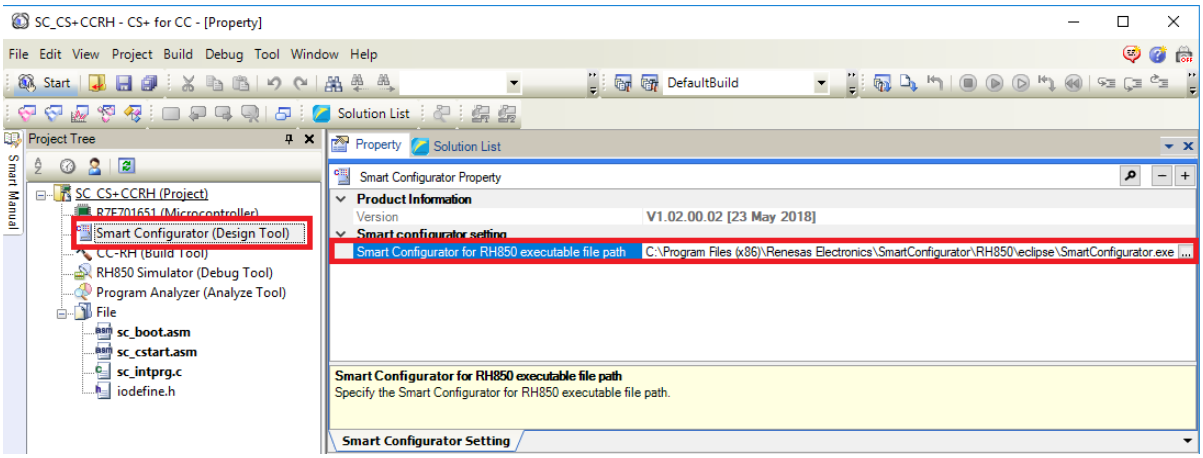


Figure 4.4 Configure executable file path for the Smart Configurator

(4)-2. Start the Smart Configurator for RH850 by double-clicking on [Smart Configurator (Design Tool)] in the Project Tree panel.

For steps (5) to (7), the procedure for setting clocks and components and generating a driver in the Smart Configurator, see section 9, "Operations in the Smart Configurator".

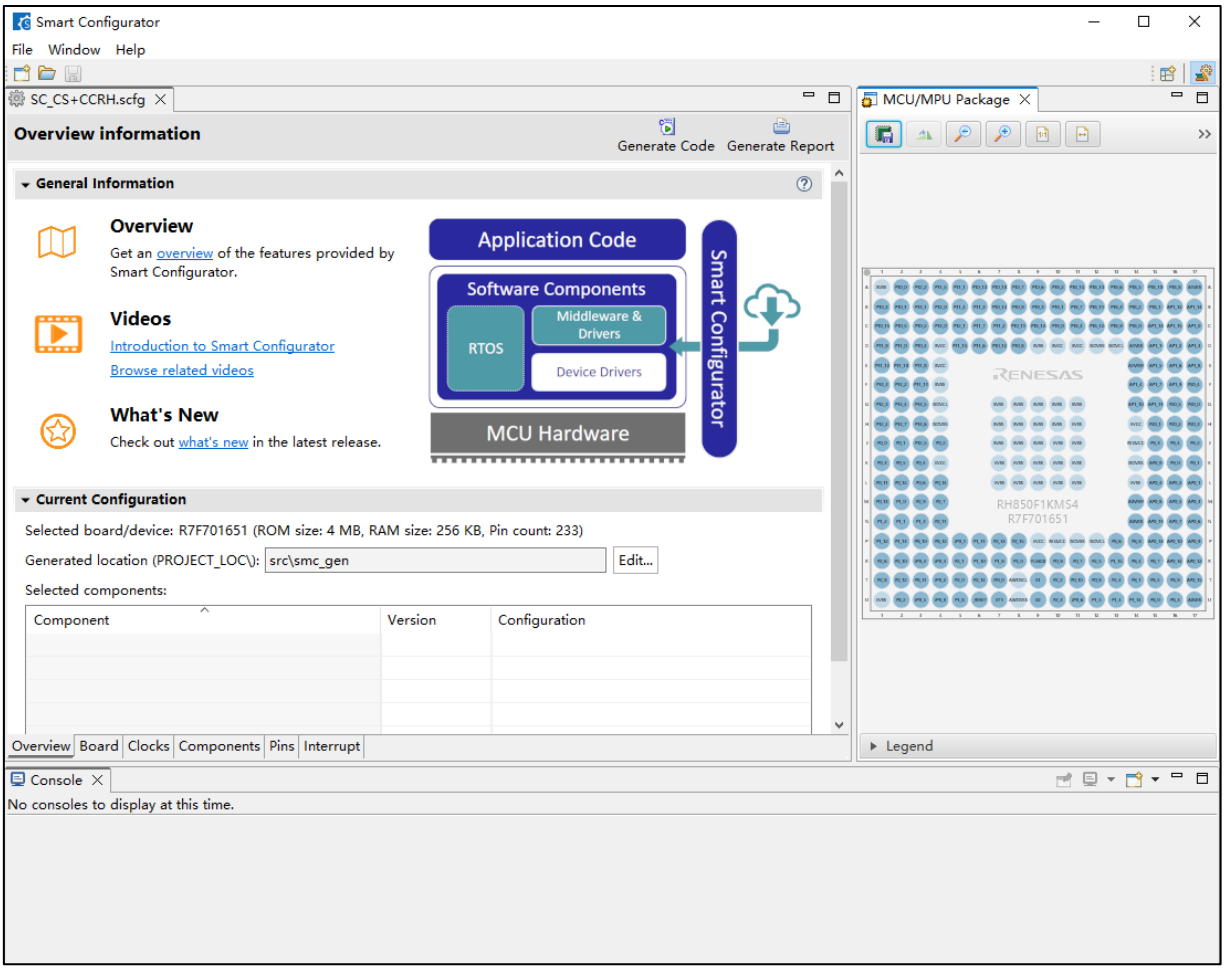


Figure 4.5 Launch Smart Configurator

(8) Build

Build the driver and application code. Select [Build Project] from the [Build] menu or click on the [Builds the project. (F7)] button in the toolbar of CS+.

(9) Execution and debug

For program execution and debugging in the emulator, refer to CS+ V8.09.00 Integrated Development Environment User's Manual: RH850 Debug Tool (R20UT5202).

4.3 Procedure for Changing the Device

If the target device of the sample project in Table 2-1, "Sample Projects" is different from the device that is intended to be used, the target device and some files must be changed according to the following procedure.

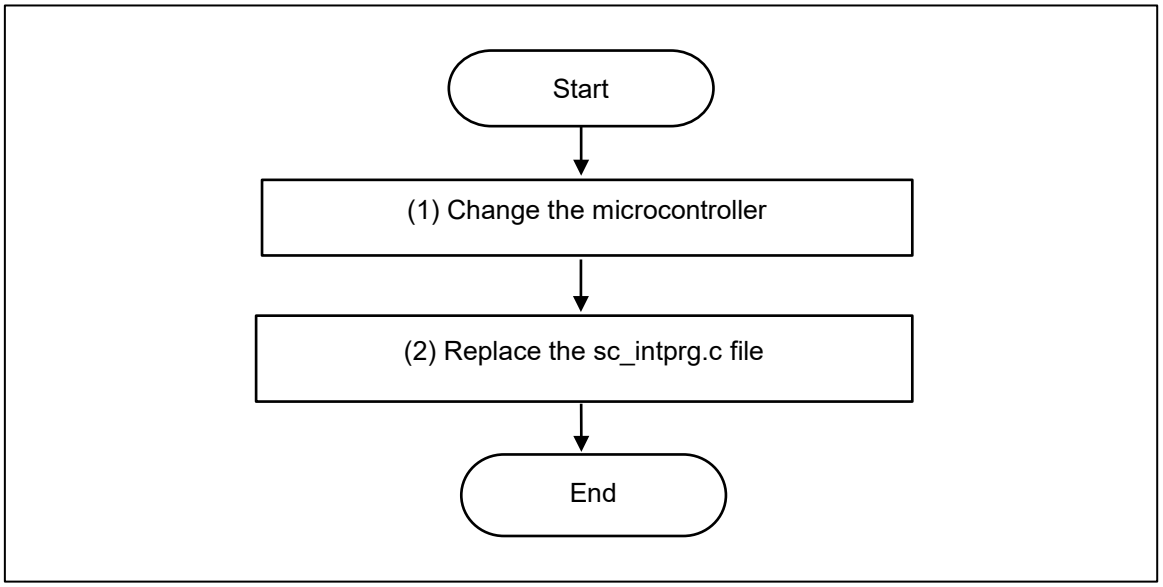


Figure 4.6 Change the Target Device of the Sample Project (CS+ Project)

(1) Change the microcontroller

(1)-1. Select "R7F701651 (Microcontroller)" and then select [Change Microcontroller...] from the context menu. Click on the [OK] button in the [Question] dialog box that appears.

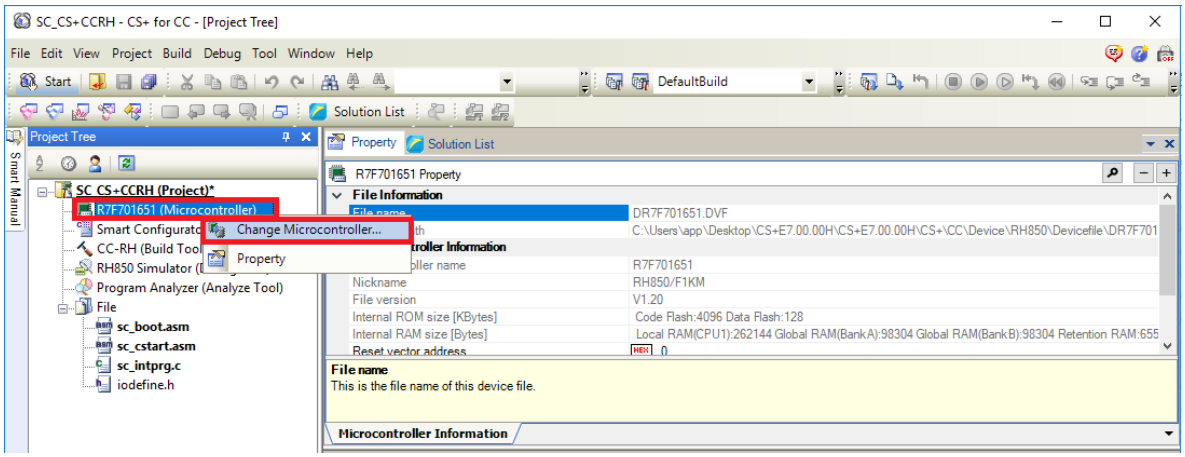


Figure 4.7 Change microcontroller in CS+

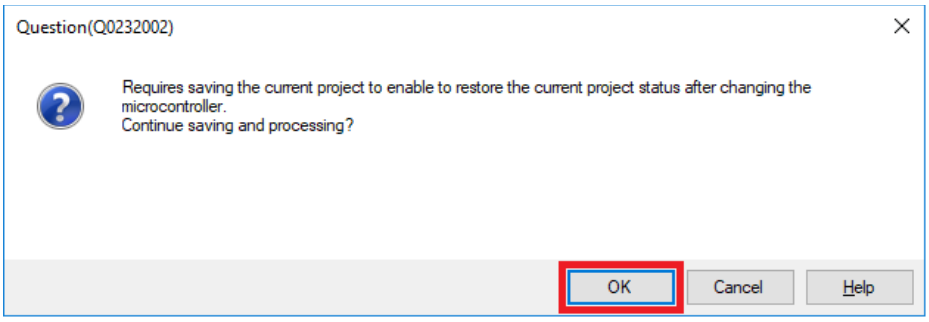


Figure 4.8 Confirm information of changing microcontroller

(1)-2. In the [Change Microcontroller] dialog box, select the RH850/F1KM-S1, RH850/F1KM-S2 or RH850/F1KM-S4 device to be used.

Example: Change from R7F701651 (RH850/F1KM-S4) to R7F701684 (RH850/F1KM-S1)

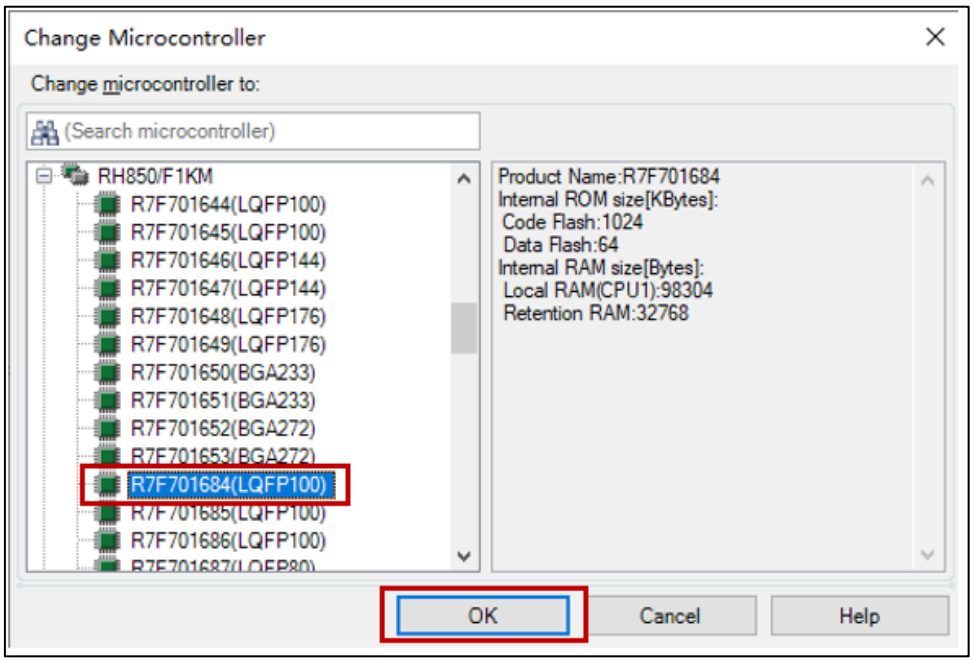


Figure 4.9 Select devices for changing microcontroller

(1)-3. Confirm that the microcontroller displayed on the Project Tree panel is changed to the intended device.

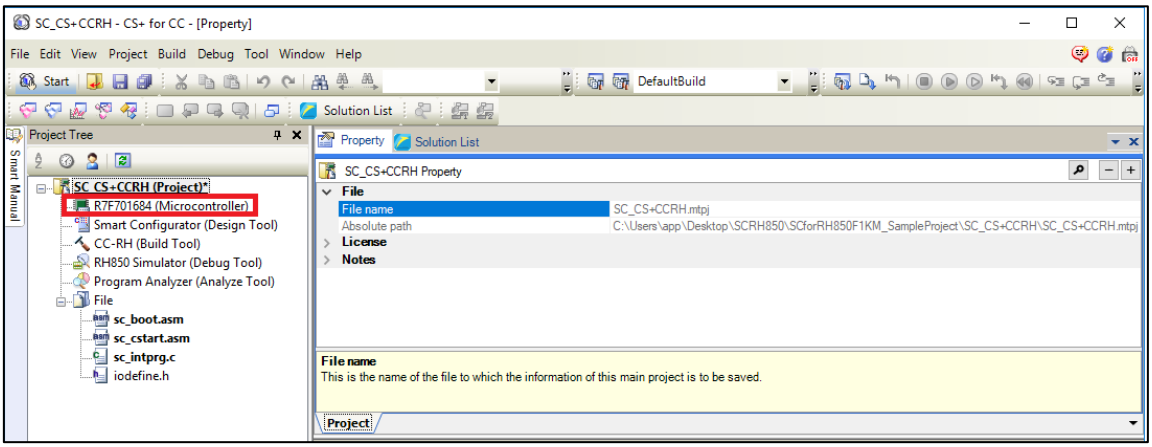


Figure 4.10 Confirm device information after changing microcontroller

(1)-4. Save the project by selecting [Save Project] from the [File] menu.

(2) Replace the sc_intprg.c file

This step is only necessary when a device of the RH850/F1KM-S4 Group was changed to a device of the RH850/F1KM-S2 or RH850/F1KM-S1 Group in step (1).

(2)-1. Since the sc_intprg.c file included in the sample project is for RH850/F1KM-S4 devices, it should be replaced with a file for RH850/F1KM-S2 or RH850/F1KM-S1 devices. In Windows Explorer, rename sc_intprg-S2.c or sc_intprg-S1.c in the intprg folder "sc_intprg.c" and replace sc_intprg.c of the sample project with this file.

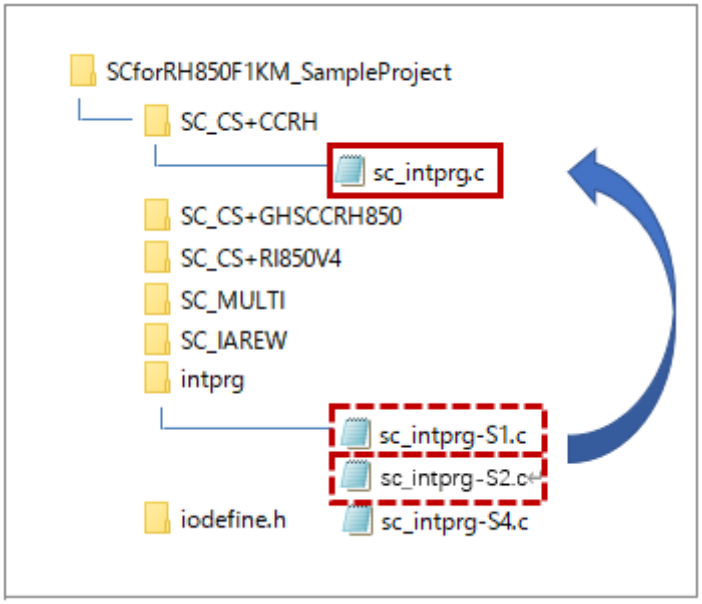


Figure 4.11 Replace the sc_intprg.c file after rename

(Files that are not described in this section are omitted from this figure.)

4.4 Settings in the Sample Project for CS+ and CCRH

The sample project is created in CS+ as an [Empty Application(CC-RH)] project. The include path is added and settings of the following options are changed.

(a) [Property] panel from [CC-RH (Build Tool)] → [Link Options] tab → [Section] → [Section start address]

[Settings in the sample project]

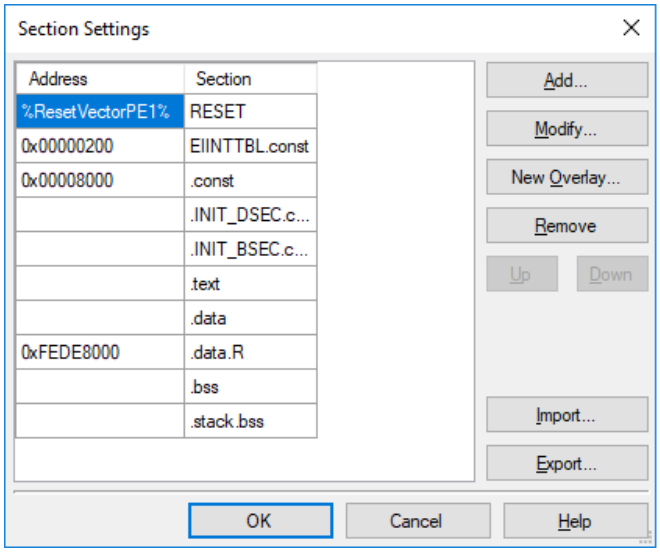


Figure 4.12 Configure section setting in SC+

(b) [Property] panel from [CC-RH (Build Tool)] → [I/O Header File Generation Options] tab → [I/O Header File] → [Update I/O header file on build]

[Settings in the sample project]

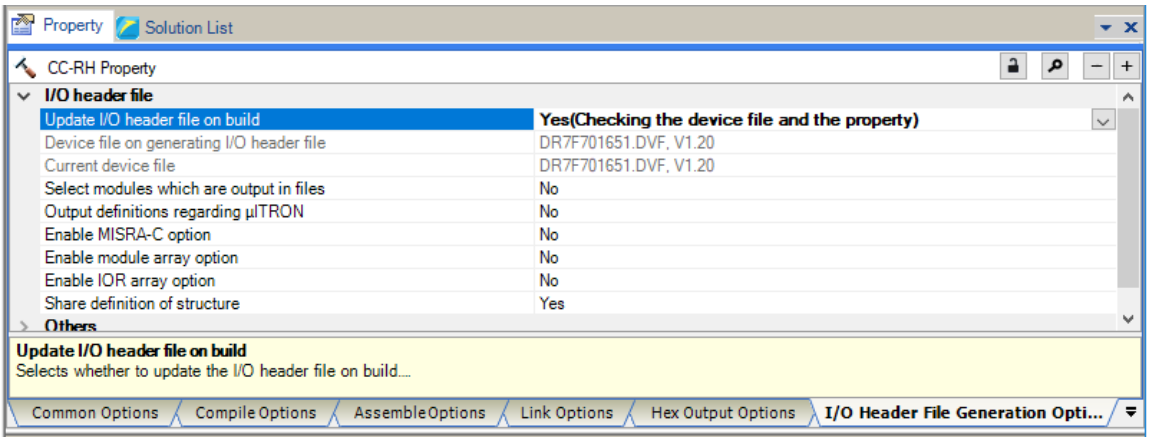


Figure 4.13 Configure I/O header file on build

5. Description of the Sample Project for CS+ and GHS CCRH850

5.1 Configuration of the Sample Project for CS+ and GHS CCRH850

The following shows the configuration of the sample project.

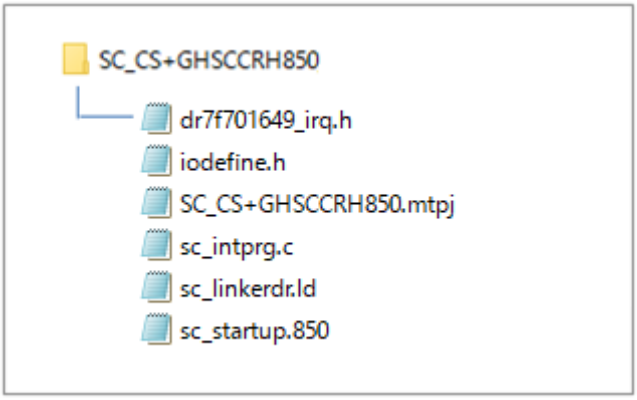


Figure 5.1 Sample project for CS+ and GHS CCRH850 files

Table 5-1 File Configuration of the Sample Project for CS+ and GHS CCRH850

File Name	Outline of File
SC_CS+GHSCCRH850.mtpj	Project file for CS+
sc_startup.850	Definition of the processing from a reset up to branching to the given application project, definition of the exception interrupt vector table, and definition of the startup routine up to branching to the main function
dr7f701649_irq.h	Definition of the exception interrupt vector table (macro definitions)
sc_linkerdr.ld	Linker directive file
sc_intprg.c	Definition of the EI-level maskable interrupt vector table
iodefine.h	Definitions of registers

The Smart Configurator does not output the above files.

5.2 Basic Operating Procedure

Figure 5.2 shows the operating procedure when using the Smart Configurator based on a sample project.

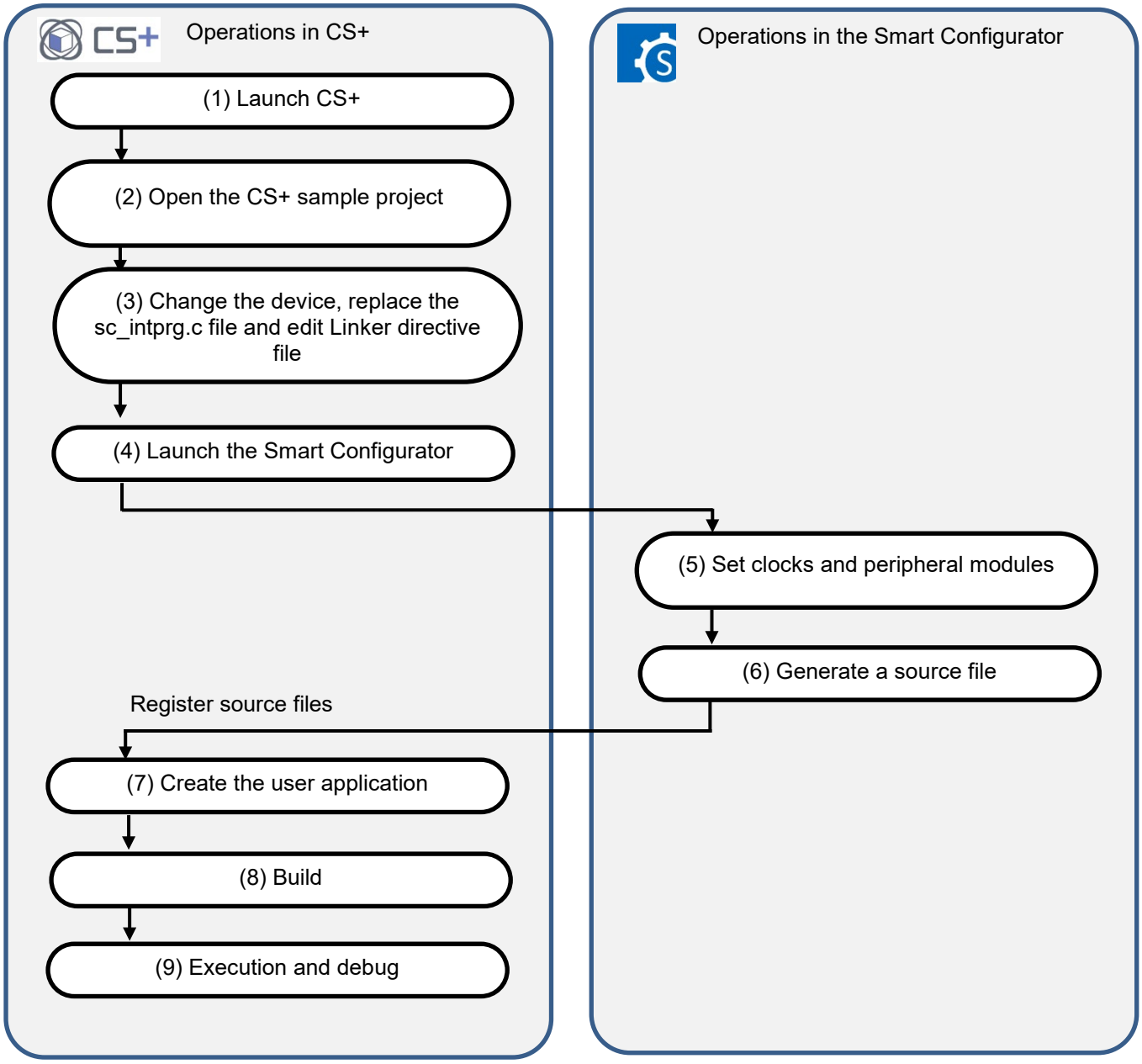


Figure 5.2 Operating Procedure for the Sample Project for CS+ and GHS CCRH850

(1) Launch CS+

In the [Start] menu of Windows, select [Renesas Electronics CS+] → [CS+ for CC(RL78,RX,RH850)].

(2) Open the CS+ sample project

From the [File] menu → [Open...] or [Open Existing Project] of CS+, select "SC_CS+GHSCCRH850.mtpj".

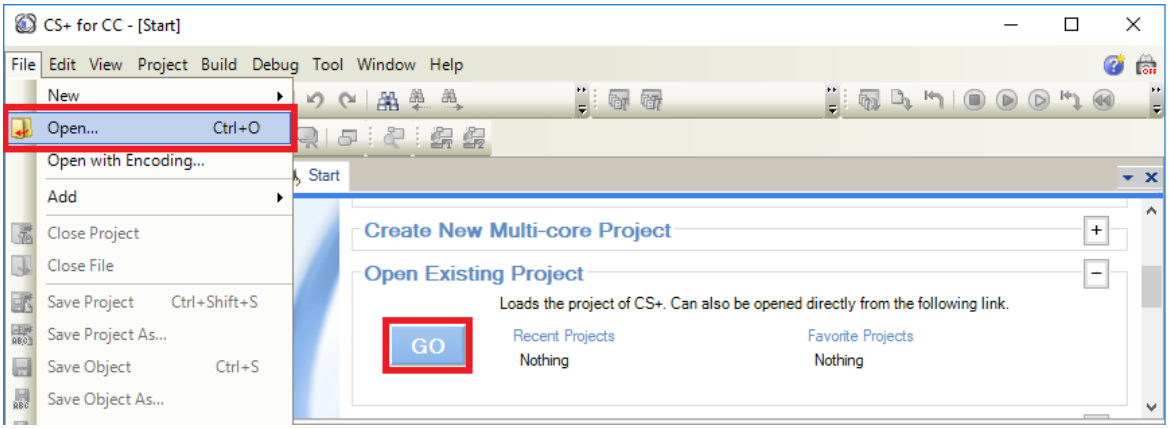


Figure 5.3 Open Sample project for SC+ and GHS CCRH850

NOTE: Sample project must be copied to a directory that does not restrict the access before using. Please refer 2.2-1 for the detail.

(3) Change the device

R7F701649 (RH850/F1KM-S4) is selected as the target device in the sample project. If you are using another device, change the target device and files to be used by referring to section 5.3, Procedure for Changing the Device. If does not require changes to the device, proceed to step (4).

(4) Launch the Smart Configurator

(4)-1. Confirm the setting of the path for the Smart Configurator for RH850. In the Project Tree panel, select [Smart Configurator (Design Tool)] and open the [Property] panel. Confirm that the path in which the Smart Configurator for RH850 was installed is set in [Smart Configurator for RH850 executable file path].

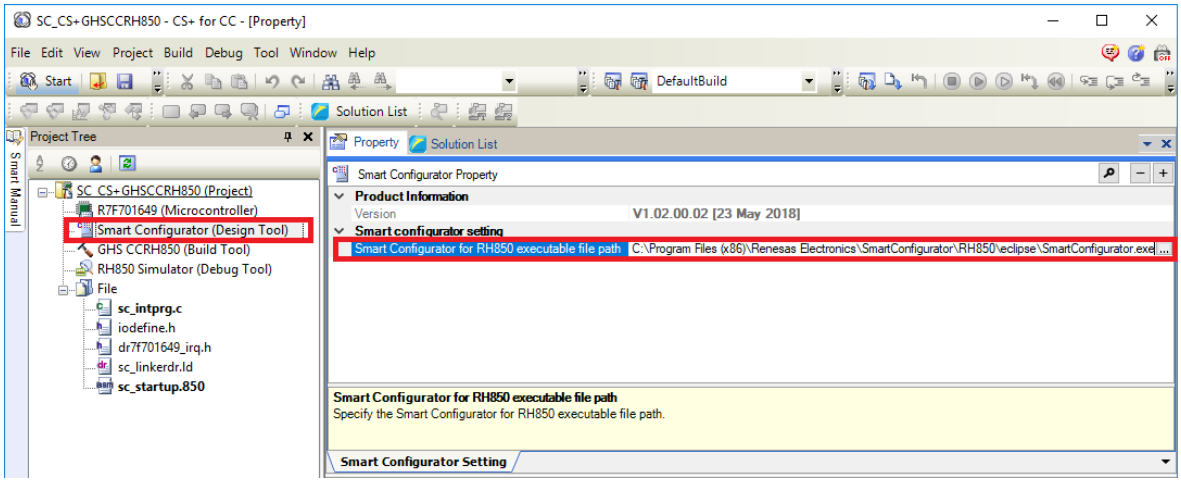


Figure 5.4 Configure executable file path for the Smart Configurator

(4)-2. Start the Smart Configurator for RH850 by double-clicking on [Smart Configurator (Design Tool)] in the Project Tree panel.

For steps (5) to (7), the procedure for setting clocks and components and generating a driver in the Smart Configurator, see section 9, "Operations in the Smart Configurator".

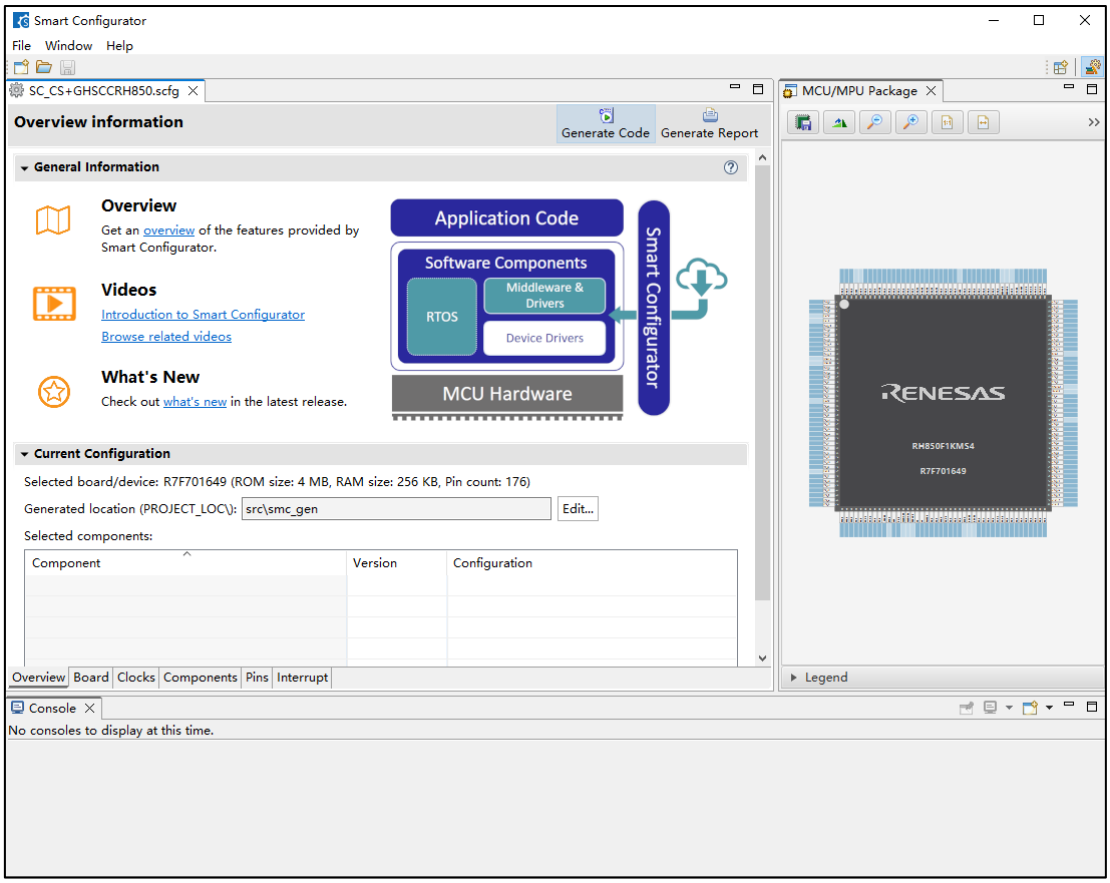


Figure 5.5 Open Smart Configurator

(8) Build

(8)-1. Set the path for the GHS CCRH850 compiler. In the Project Tree panel, select [GHS CCRH850 (Build Tool)] and open the [Property] panel. At [Common Options] tab, select [Compiler package folder], set the path to where the GHS CCRH850 compiler was installed.

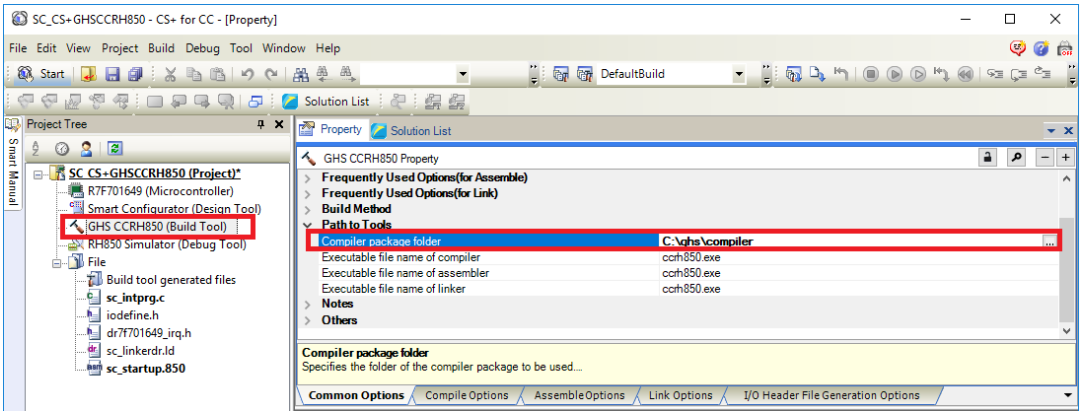
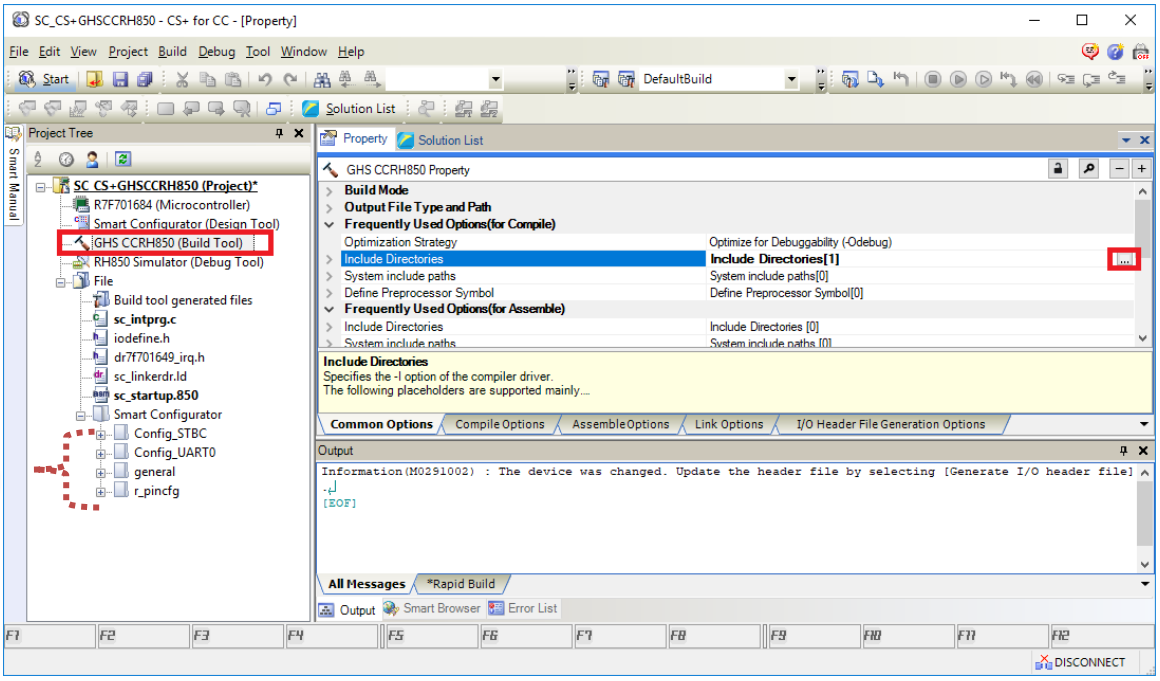


Figure 5.6 Set the path for the GHS CCRH850 compiler

(8)-2. Add the folder containing the files generated by the Smart Configurator for RH850 to the include path. In the Project Tree panel, select [GHS CCRH850 (Build Tool)] and open the [Property] panel. Click on the button in [Include Directories] on the [Common Options] tab.



Click on the [Browse...] button in the [Path Edit] dialog box and add iodefine.h and the folder containing the files generated by the Smart Configurator.

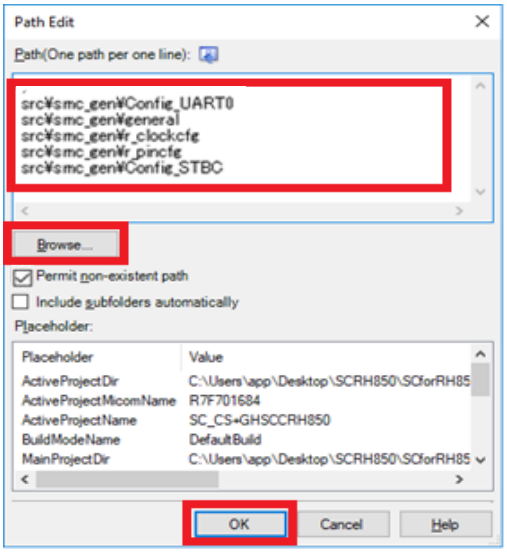


Figure 5.7 Add the folder containing the files

Remarks: Smart Configurator creates “src/smc_gen” folder under the folder where the sample project is located and generates files into “src/smc_gen” folder. Add “src/smc_gen” to the path in the [Path Edit] dialog box and select [Include subfolders automatically], related subfolders will be added automatically.

(8)-3. Build the driver and application code. Select [Build Project] from the [Build] menu or click on the [Builds the project. (F7)] button in the toolbar of CS+.

(9) Execution and debug

For program execution and debugging in the emulator, refer to *CS+ V8.09.00 Integrated Development Environment User’s Manual: RH850 Debug Tool* (R20UT5202).

5.3 Procedure for Changing the Device

If the target device of the sample project in Table 2-1, "Sample Projects" is different from the device that is intended to be used, the target device and some files must be changed according to the following procedure.

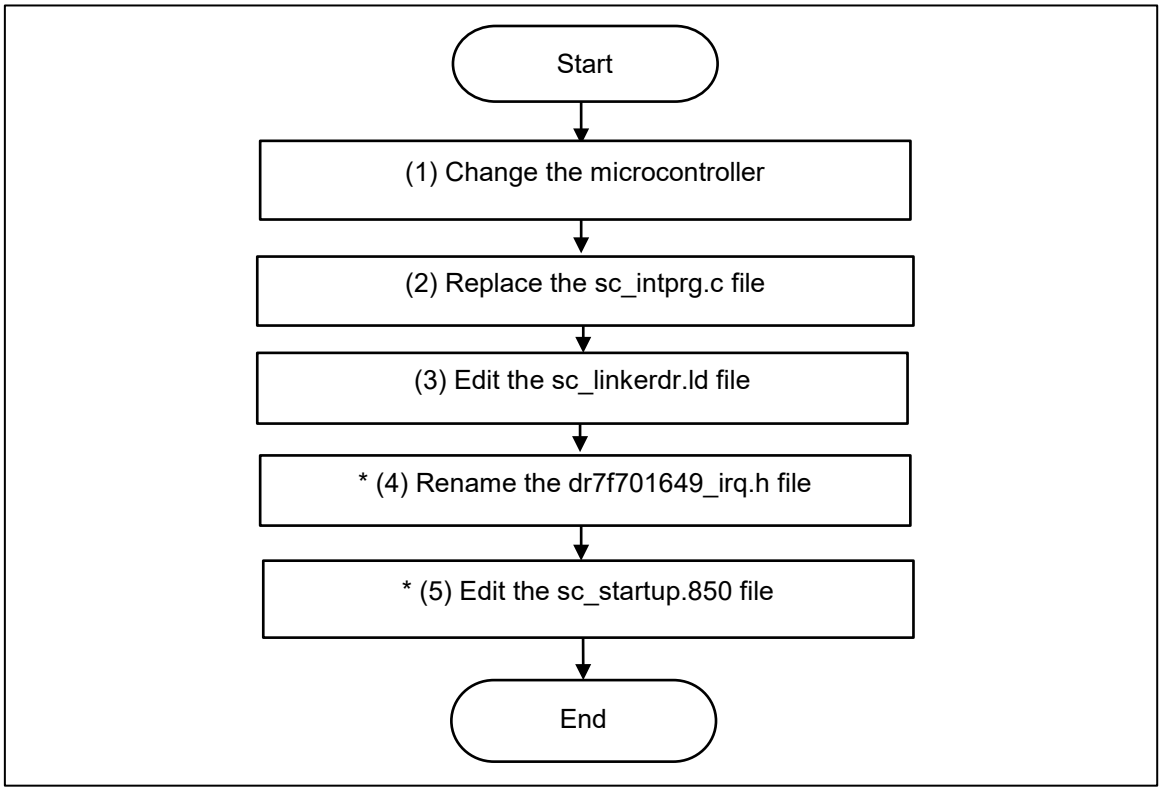


Figure 5.8 Change the Target Device of the Sample Project (CS+ Project)

*: Steps (4) and (5) are optional.

(1) Change the microcontroller

(1)-1. Select "R7F701649 (Microcontroller)" and then select [Change Microcontroller...] from the context menu. Click on the [OK] button in the [Question] dialog box that appears.

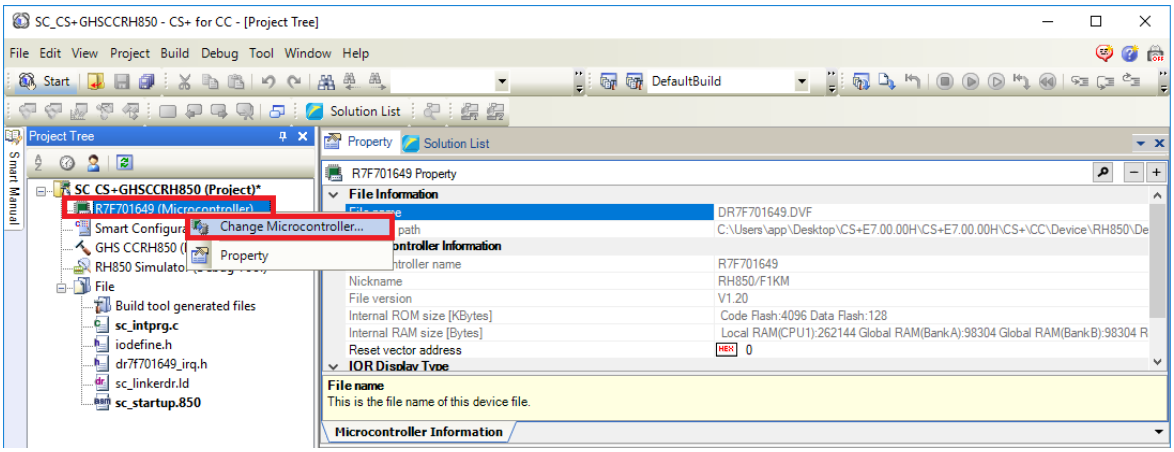


Figure 5.9 Change microcontrollers in CS+

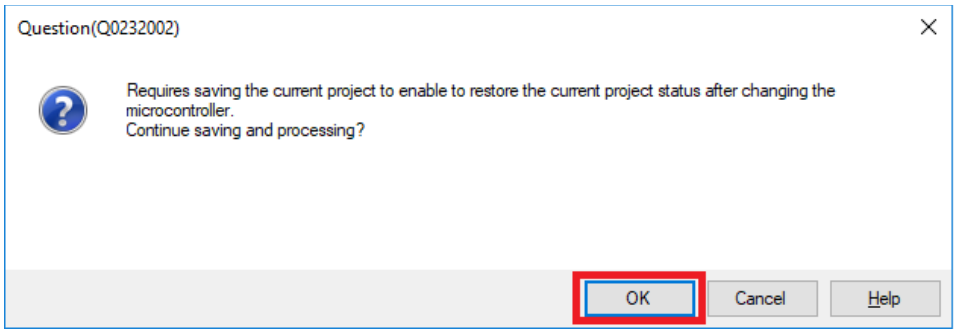


Figure 5.10 Save project before changing microcontroller

(1)-2. In the [Change Microcontroller] dialog box, select the RH850/F1KM-S1, RH850/F1KM-S2 or RH850/F1KM-S4 device to be used.

Example: Changing from R7F701649 (RH850/F1KM-S4) to R7F701684 (RH850/F1KM-S1)

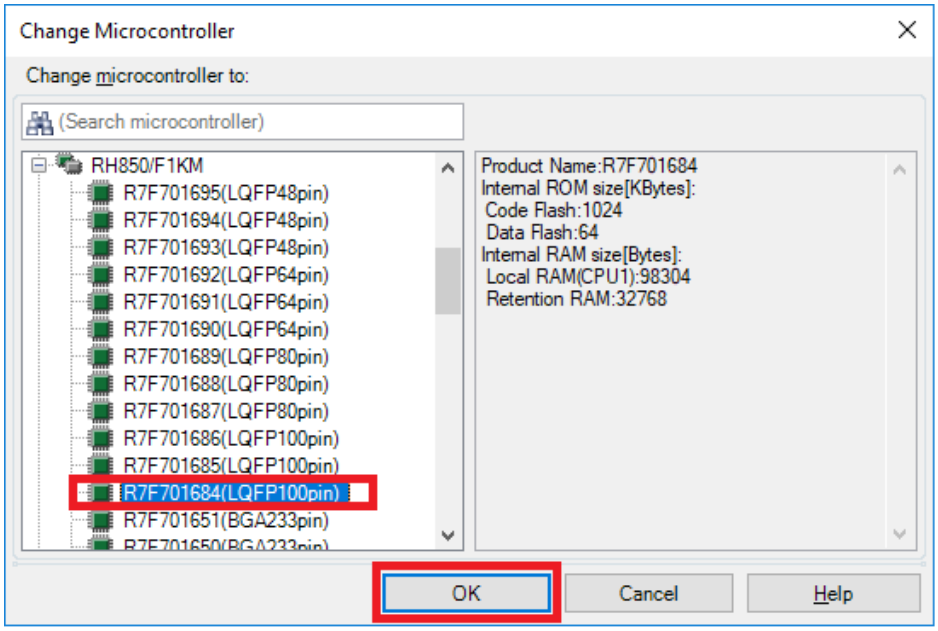


Figure 5.11 Select devices for changing microcontroller

(1)-3. Confirm that the microcontroller displayed on the Project Tree panel is changed to the intended device.

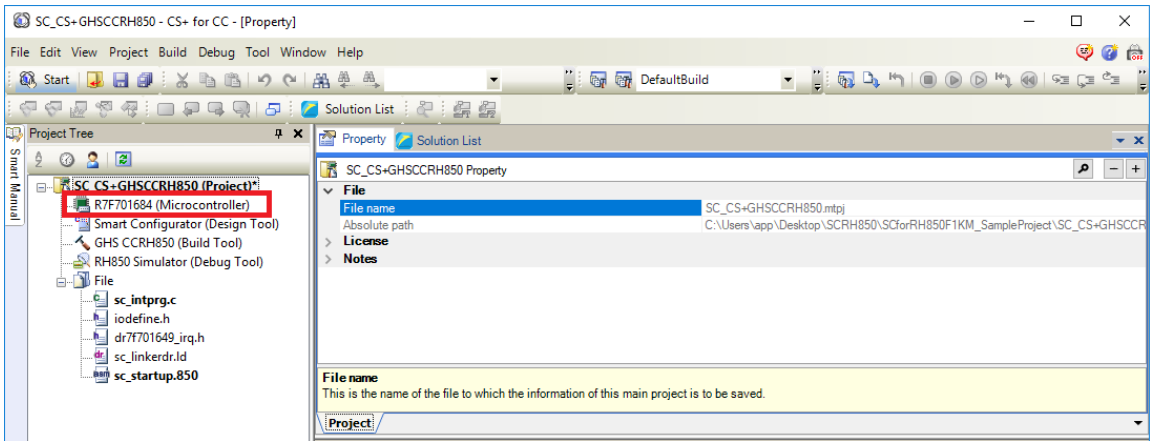


Figure 5.12 Confirm device information after changing microcontroller

(1)-4. Save the project by selecting [Save Project] from the [File] menu.

(2) Replace the sc_intprg.c file

This step is only necessary when a device of the RH850/F1KM-S4 Group was changed to a device of the RH850/F1KM-S2 or RH850/F1KM-S1 Group in step (1).

(2)-1. Since the sc_intprg.c file included in the sample project is for RH850/F1KM-S4 devices, it should be replaced with a file for RH850/F1KM-S2 or RH850/F1KM-S1 devices. In Windows Explorer, rename the sc_intprg-S2.c or sc_intprg-S1.c file in the intprg folder to "sc_intprg.c" and replace the sc_intprg.c file in the sample project with this file.

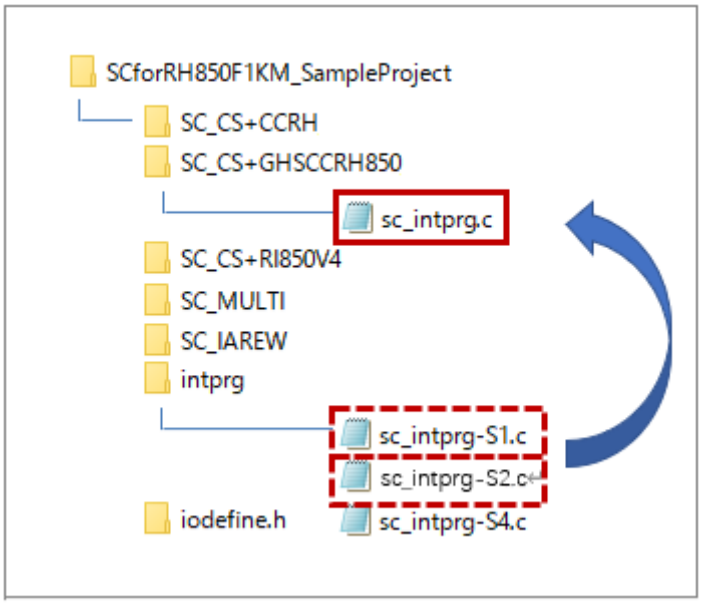


Figure 5.13 Replace the sc_intprg.c file after rename

(Files that are not described in this section are omitted from this figure.)

(3) Edit the sc_linkerdr.ld file

(3)-1. Open the “sc_linkerdr.ld” in any editor to edit it.

(3)-2. Change the start address and size of the memory to match the specifications of the microcontroller in use. (Renaming microcontroller name in the file header is optional.)

```
44 /*
45 /*==============================================================
46 /* Environment:
47 /*              Device:          R7F701649
48 /*              IDE:             GHS Multi for V800  V6.xx or late
49 /*==============================================================
50
51 CONSTANTS
52 {
53   zero_start = 0xffff8000
54 }
55
56 MEMORY
57  {
58   iROM_0          : ORIGIN = 0x00000000,  LENGTH = 4096k
59   iROM_1          : ORIGIN = 0x01000000,  LENGTH = 32k
60   iRAM_0          : ORIGIN = 0xFEBC0000,  LENGTH = 256k
61   iRAM_R          : ORIGIN = 0xFEF00000,  LENGTH = 64k
62  }
```

Figure 5.14 Changing the start address and size of the memory

(3)-3. Change the “EIINTTBL_end” that is the end address of EIINTTBL section to match the specifications of the microcontroller in use.

```
64 SECTIONS
65  {
66
67 /* Start of internal ROM area (iROM_0) */
68
69 /* original */
70 /*  .intvect                          :>iROM_0 /* start of inter
71 /*  .intvect_end  0x07E4              :>.      /* end   of inter
72 /* */
73
74 /* Changed for sample project */
75   .intvect                          :>iROM_0 /* start of interru
76   .intvect_end  0x01FF              :>.      /* end   of interru
77   EIINTTBL_align_(4)                :>iROM_0 /* start of EI mask
78   EIINTTBL_end  0x07E4              :>.      /* end   of EI mask
79 /* */
```

Figure 5.15 Change the “EIINTTBL_end” value

(The line number may differ according to which file you are using.)

Reference value:

RH850/F1KM-S1: 0x0798

RH850/F1KM-S2: 0x07E4

RH850/F1KM-S4: 0x07E4

The following steps (4) and (5) are optional. Building sample project is possible without steps (4) and (5).

(4) Rename the dr7f701649_irq.h file

(4)-1. In Windows Explorer, rename from “dr7f01649_irq.h" to “dr7f0xxxx_irq.h” to match the microcontroller name in use.

(5) Edit the sc_startup.850 file

(5)-1. Open the “sc_startup.850” in any editor to edit it.

(5)-2. Change the include file name to the file name changed in step (4) and save the sc_startup.850 file. (Renaming microcontroller name in the file header is optional.)

```
45 ------------------------------------------------
46 -- Environment:
47 --              Device:          R7F701649
48 --              IDE:             GHS Multi for
49 ------------------------------------------------
50
51 ------------------------------------------------
52 -------------  Selection of external interrup
53 -------------  User modifiable section
54 -------------  Please uncomment the required
55 ------------------------------------------------
56 #include "dr7f701649_IRQ.h"
57
```

Figure 5.16 Change the include file name

5.4 Settings in the Sample Project for CS+ and GHS CCRH850

The sample project is created in CS+ as an [Empty Application(GHS CCRH850)] project. The include path is added and settings of the following options are changed.

(a) [Property] panel from [GHS CCRH850 (Build Tool)] → [I/O Header File Generation Options] tab → [I/O Header File] → [Update I/O header file on build]

[Settings in the sample project]

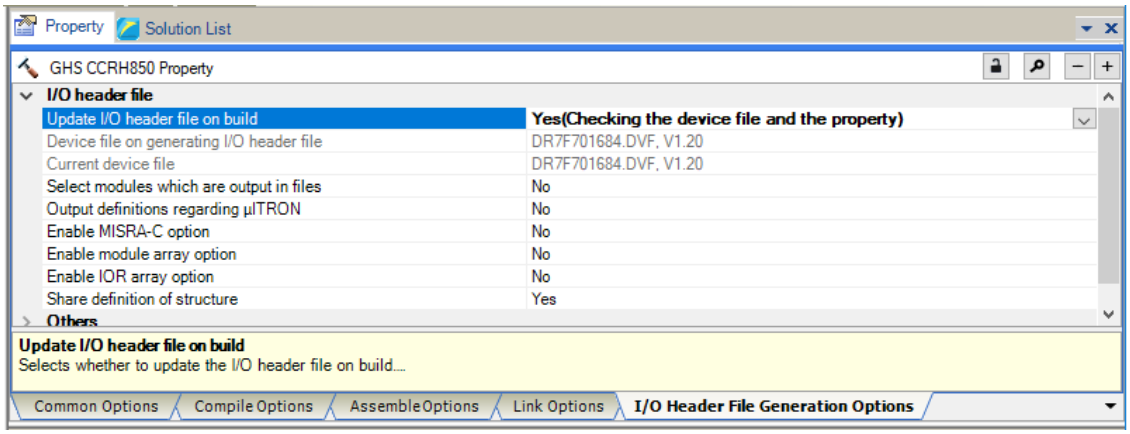


Figure 5.17 Configure I/O header file on build

6. Description of the Sample Project for CS+, CCRH, and RI850V4

6.1 Configuration of the Sample Project for CS+, CCRH, and RI850V4

The following shows the configuration of the sample project.

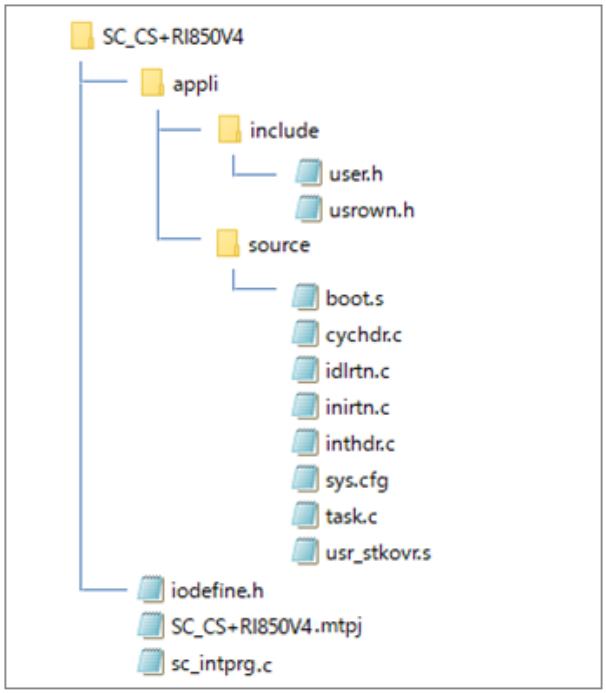


Figure 6.1 Sample project for SC+, CCRH and RI850V4 files

Table 6-1 File Configuration of the Sample Project for CS+, CCRH, and RI850V4

File Name	Outline of File
SC_CS+RI850V4.mtpj	Project file for CS+
user.h	System-dependent information (for the user-coded part)
userown.h	System-dependent information (for the user-coded part)
boot.s	Boot processing
cychdr.c	Cyclic handler
idlrtn.c	Idle routine
inirtn.c	Initialization routine
inthdr.c	Interrupt handler
task.c	Task
usr_stkovr.s	Overflow post-processing
sys.cfg	System configuration file
iodefine.h	Definitions of registers
sc_intprg.c	Definition of the EI-level maskable interrupt vector table

The Smart Configurator does not output the above files.

For details on the RI850V4 related files, refer to *RI850V4 V2 Real-Time Operating System User's Manual: Coding* (R20UT2889).

6.2 Basic Operating Procedure

Figure 6.2 shows the operating procedure when using the Smart Configurator based on a sample project.

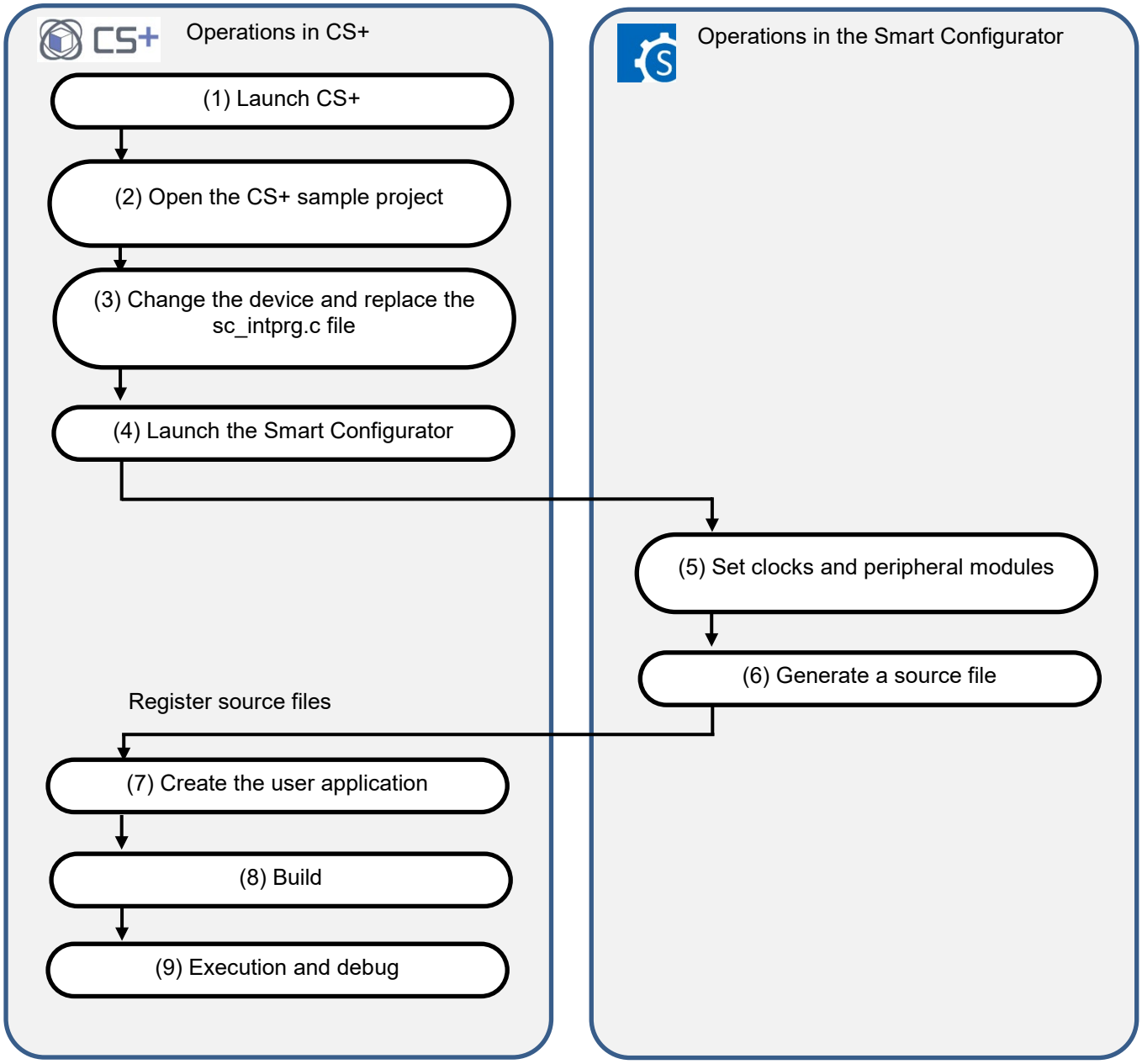


Figure 6.2 Operating Procedure for the Sample Project for CS+, CCRH, and RI850V4

(1) Launch CS+

In the [Start] menu of Windows, select [Renesas Electronics CS+] → [CS+ for CC(RL78,RX,RH850)].

(2) Open the CS+ sample project

From the [Open...] item of the [File] menu or [Open Existing Project] of CS+, select "SC_CS+RI850V4.mtpj".

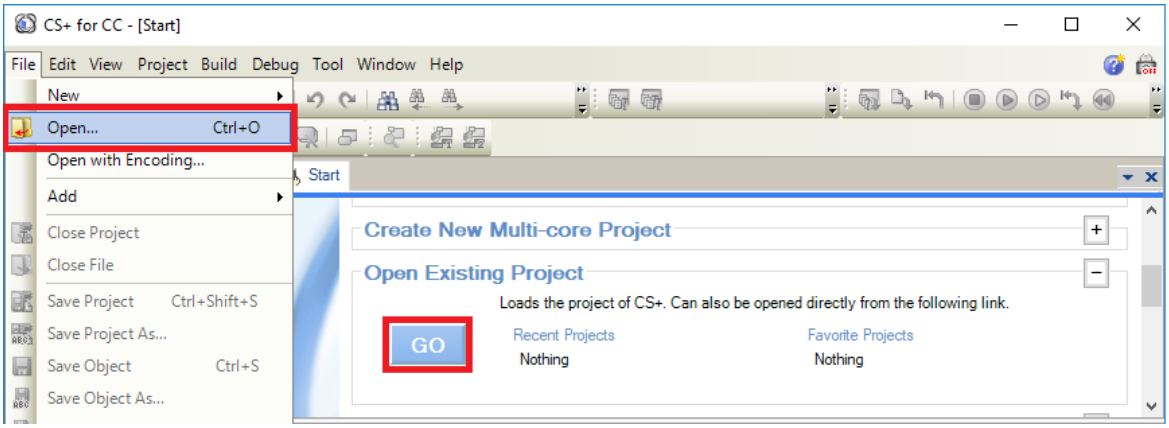


Figure 6.3 Open Sample project for SC+, CCRH and RI850V4

NOTE: Sample project must be copied to a directory that does not restrict access before using . Please refer 2.2-1 for the detail.

(3) Change the device

The R7F701649 (RH850/F1KM-S4) is selected as the target device in the sample project. If you are using another device, change the target device and file to be used with reference to section 6.3, "Procedure for Changing the Device". If the device does not require changing, proceed to step (4).

(4) Launch the Smart Configurator

(4)-1. Confirm the setting of the path for the Smart Configurator for RH850. In the Project Tree panel, select [Smart Configurator (Design Tool)] and open the [Property] panel. Confirm that the path in which the Smart Configurator for RH850 was installed is set in [Smart Configurator for RH850 executable file path].

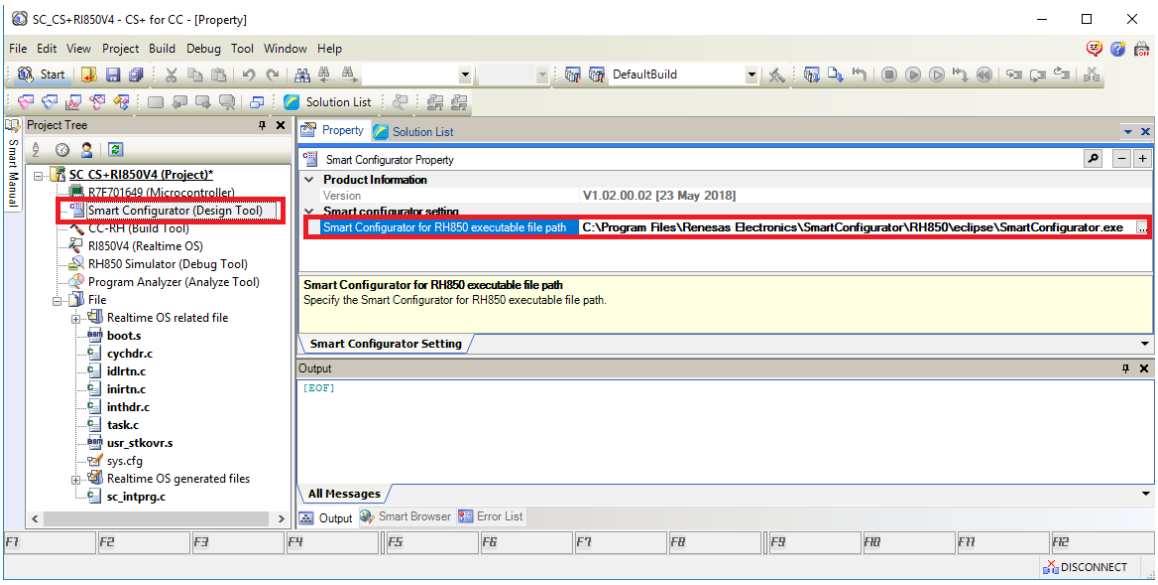


Figure 6.4 Configure executable file path for the Smart Configurator

(4)-2. Start the Smart Configurator for RH850 by double-clicking on [Smart Configurator (Design Tool)] in the Project Tree panel.

For steps (5) to (7), the procedure for setting clocks and components and generating a driver in the Smart Configurator, see section 9, "Operations in the Smart Configurator".

Note: Do not use the OS timer (OSTM) in the component settings of the Smart Configurator. This is because the file "appli/source/inirtn.c" of the sample project contains the code for setting the OS timer.

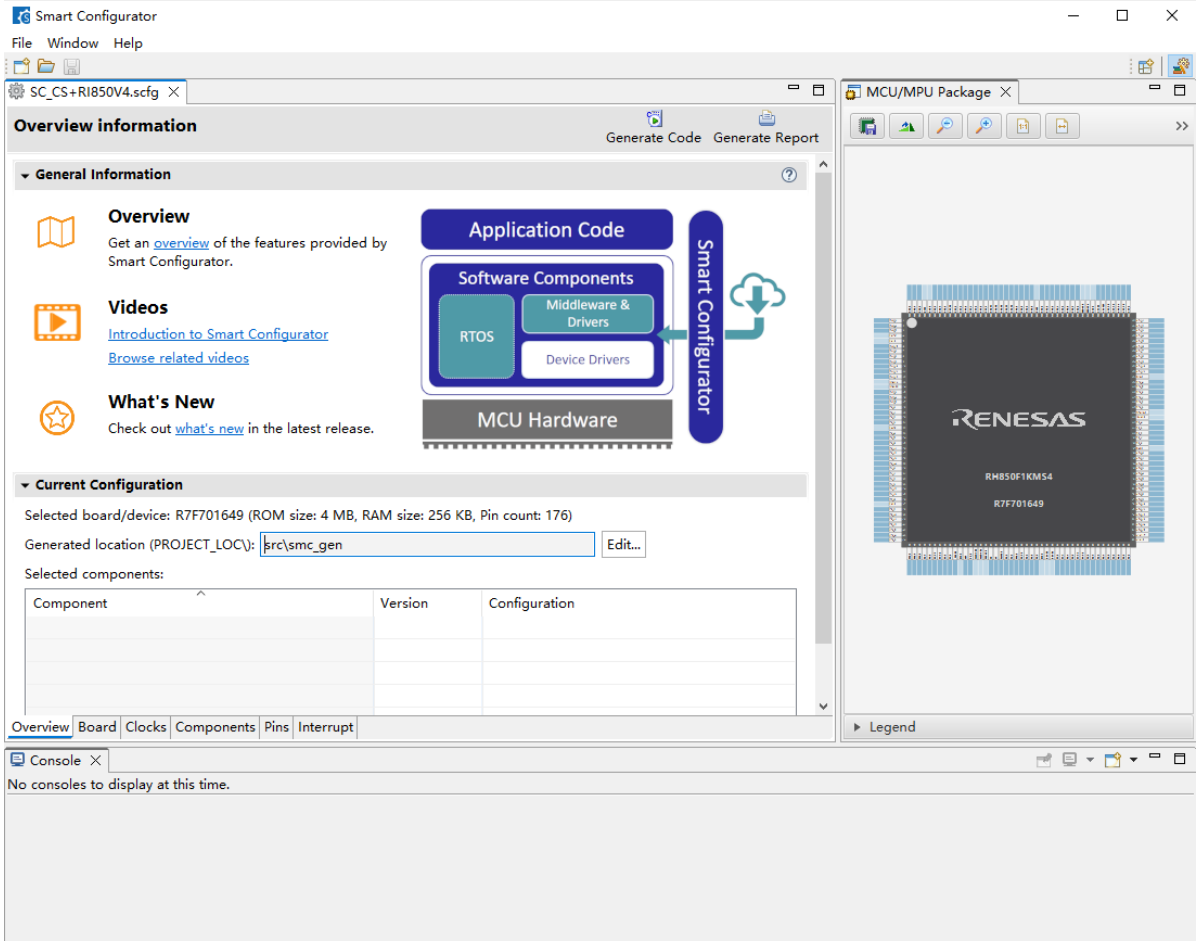


Figure 6.5 Open Smart Configurator

(8) Build

Build the driver and application code. Select [Build Project] from the [Build] menu or click on the [Builds the project. (F7)] button in the toolbar of CS+.

(9) Execution and debug

For program execution and debugging in the emulator, refer to *CS+ V8.09.00 Integrated Development Environment User's Manual: RH850 Debug Tool* (R20UT5202).

6.3 Procedure for Changing the Device

If the target device of the sample project in Table 2-1, "Sample Projects" is different from the device that is intended to be used, the target device and some files must be changed according to the following procedure.

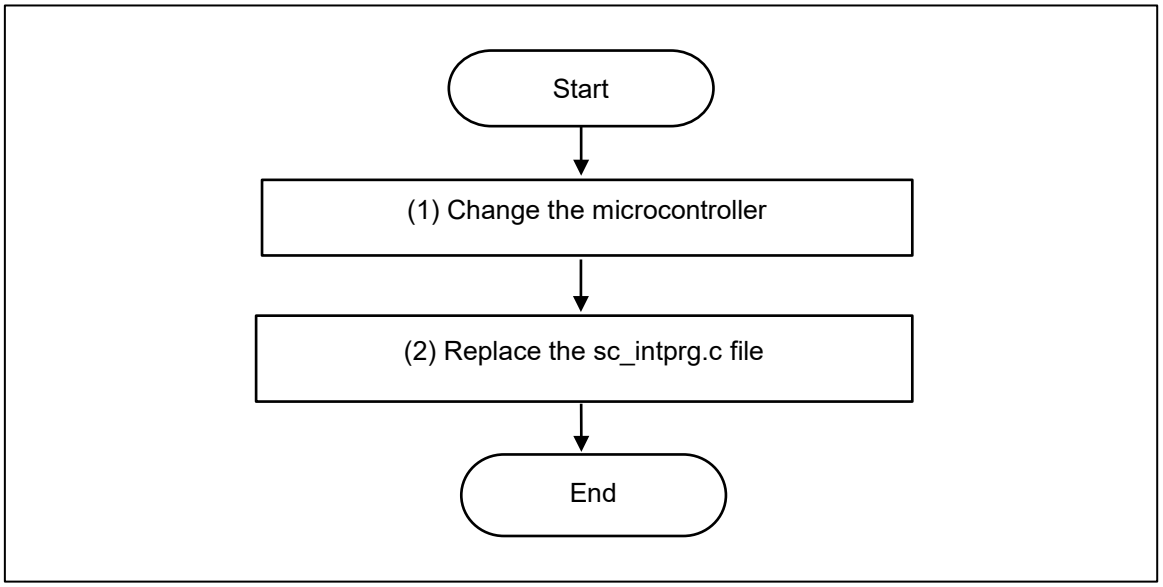


Figure 6.6 Change the Target Device of the Sample Project (CS+ Project)

(1) Change the microcontroller

(1)-1. Select "R7F701649 (Microcontroller)" and then select [Change Microcontroller...] from the context menu. Click on the [OK] button in the [Question] dialog box that appears.

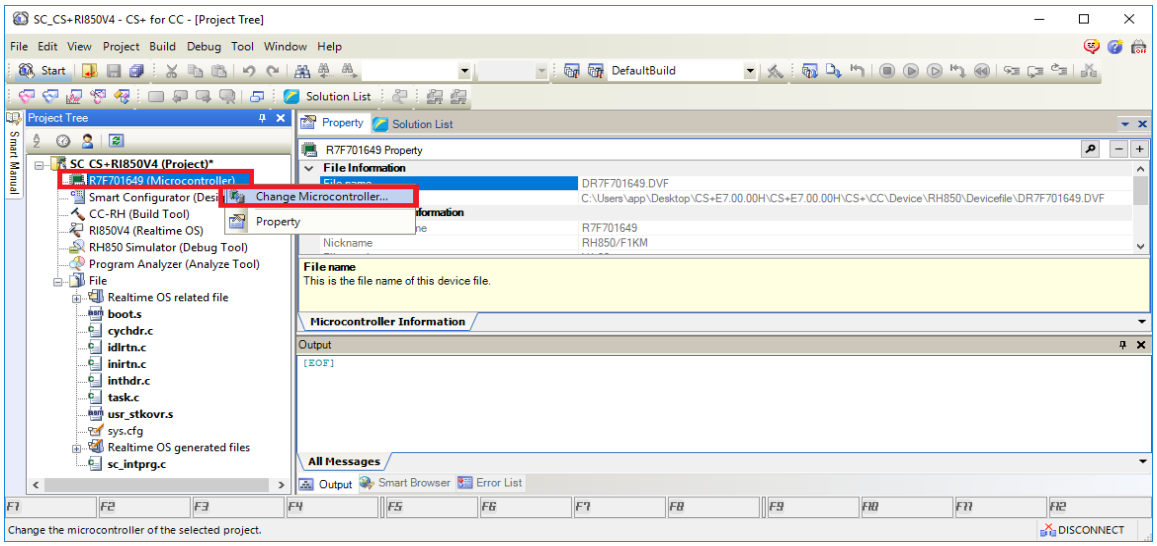


Figure 6.7 Change microcontrollers in CS+

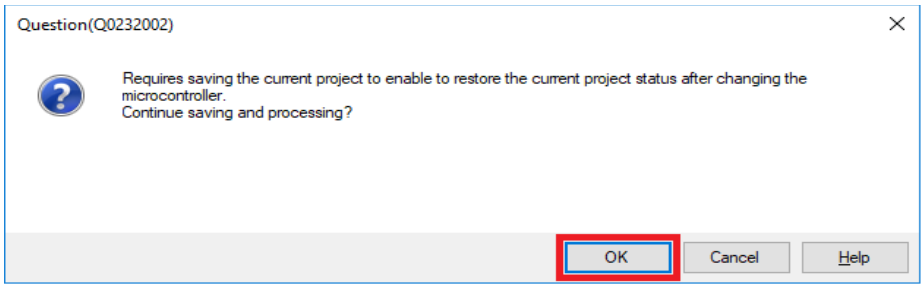


Figure 6.8 Save project before changing microcontroller

(1)-2. In the [Change Microcontroller] dialog box, select the RH850/F1KM-S1, RH850/F1KM-S2 or RH850/F1KM-S4 device to be used.

Example: Changing from R7F701649 (RH850/F1KM-S4) to R7F701684 (RH850/F1KM-S1)

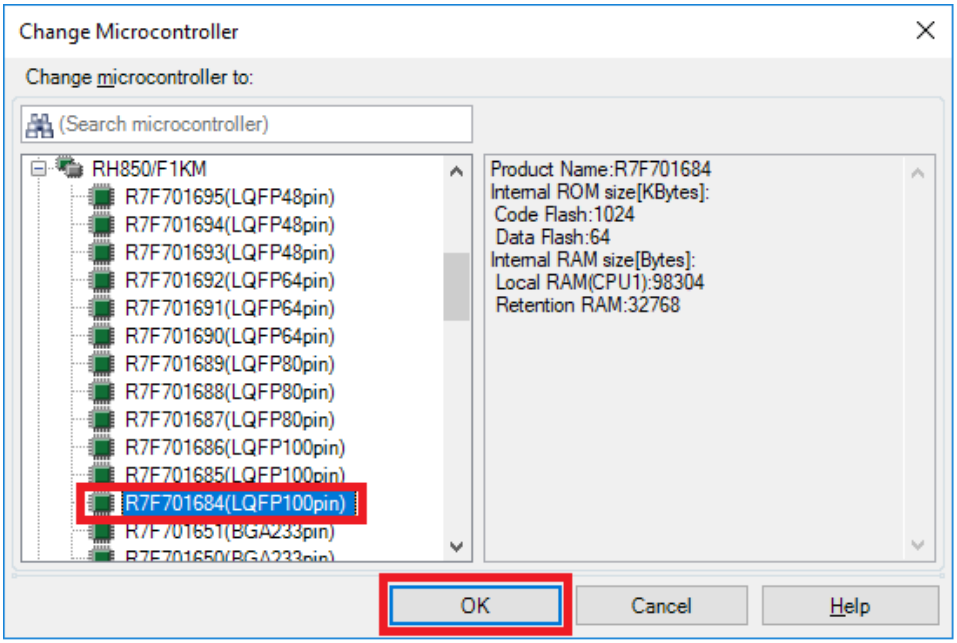


Figure 6.9 Select devices for changing microcontroller

(1)-3. Confirm that the microcontroller displayed on the Project Tree panel is changed to the intended device.

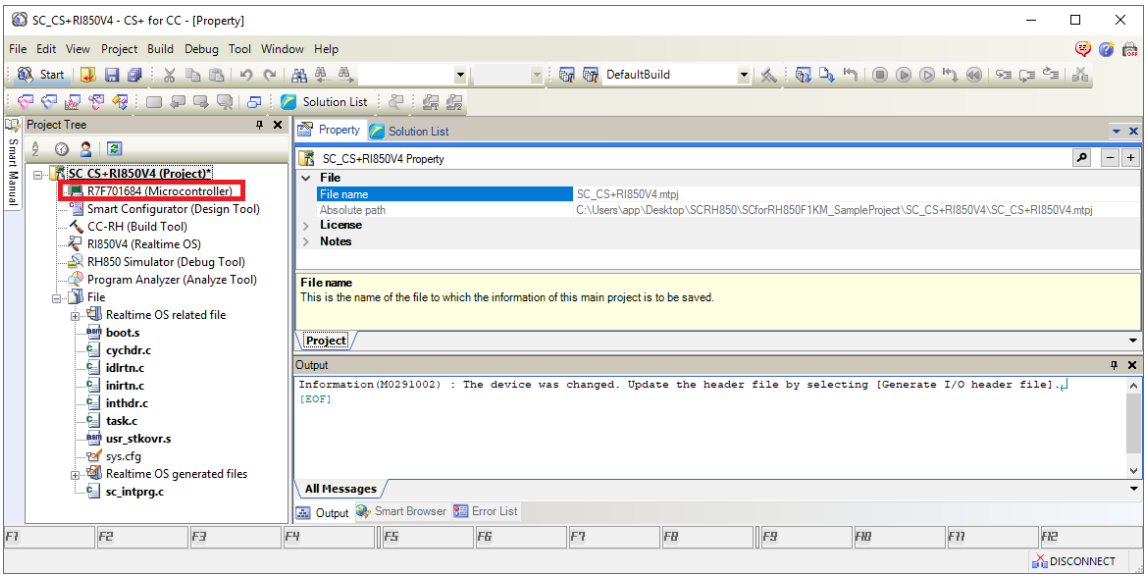


Figure 6.10 Confirm device information after changing microcontroller

(1)-4. Save the project by selecting [Save Project] from the [File] menu.

(2) Replace the sc_intprg.c file

This step is only necessary when a device of the RH850/F1KM-S4 Group was changed to a device of the RH850/F1KM-S2 or H850/F1KM-S1 Group in step (1).

(2)-1. Since the sc_intprg.c file included in the sample project is for RH850/F1KM-S4 devices, it should be replaced with a file for RH850/F1KM-S2 or RH850/F1KM-S1 devices. In Windows Explorer, rename sc_intprg-S2.c or sc_intprg-S1.c in the intprg folder "sc_intprg.c" and replace sc_intprg.c of the sample project with this file.

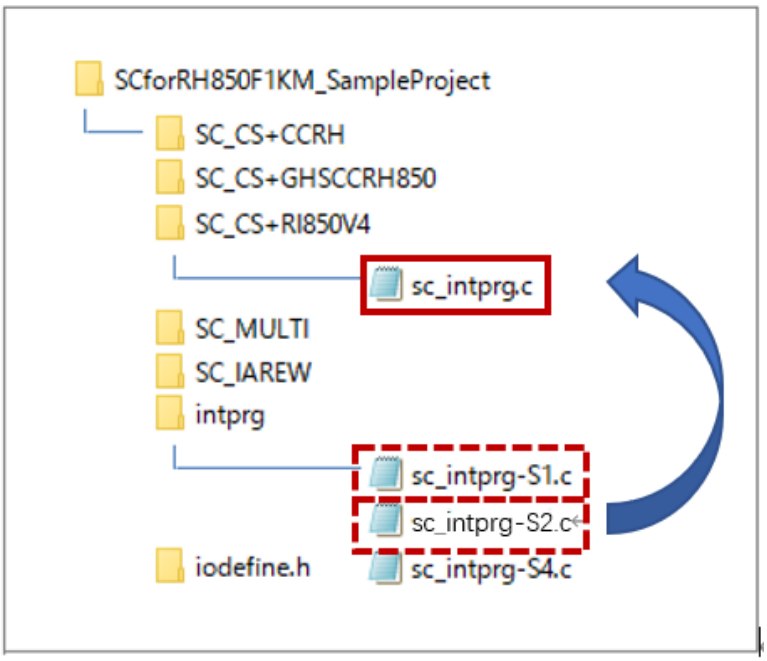


Figure 6.11 Replace the sc_intprg.c file after rename

(Files that are not described in this section are omitted from this figure.)

6.4 Settings in the Sample Project for CS+, CCRH, and RI850V4

The sample project is created in CS+ as an [Application(RI850V4,CC-RH)] project. The include path is added and settings of the following options are changed.

(a) [Property] panel from [CC-RH (Build Tool)] → [Common Options] tab → [Frequently Used Options(for Compile)] → [Macro definition]

[Settings in the sample project]

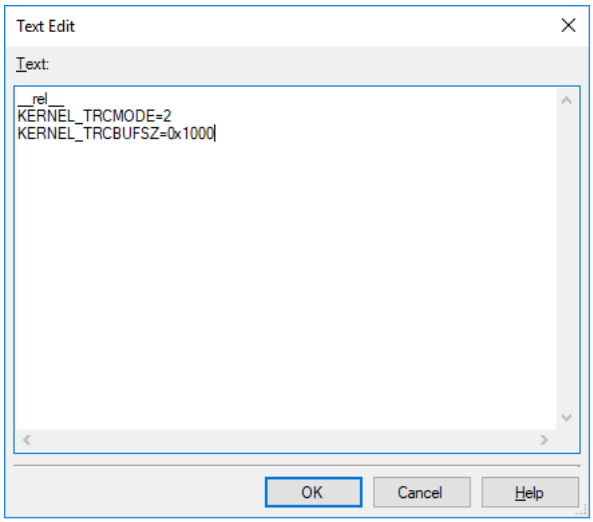


Figure 6.12 Set macro definition for compile

(b) [Property] panel from [CC-RH (Build Tool)] → [Link Options] tab → [Section] → [Section start address]

[Settings in the sample project]

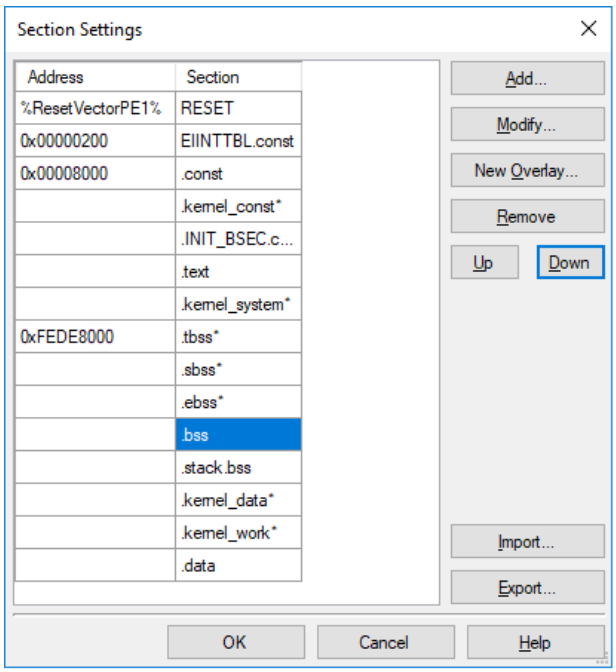


Figure 6.13 Set section start address

(c) [Property] panel from [CC-RH (Build Tool)] → [Link Options] tab → [Section] → [ROM to RAM mapped section]

[Settings in the sample project]

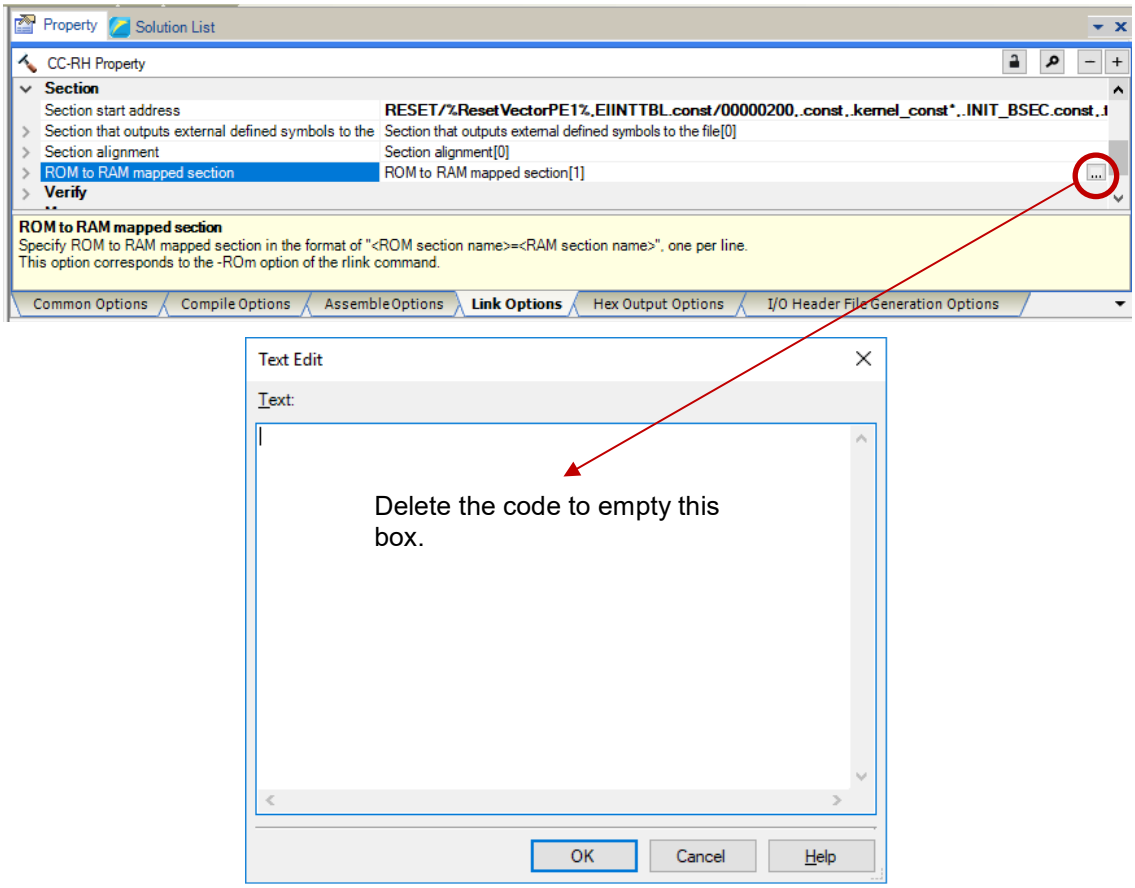


Figure 6.14 Set ROM to RAM mapped section

(d) [Property] panel from [CC-RH (Build Tool)] → [I/O Header File Generation Options] tab → [I/O Header File] → [Update I/O header file on build]

[Settings in the sample project]

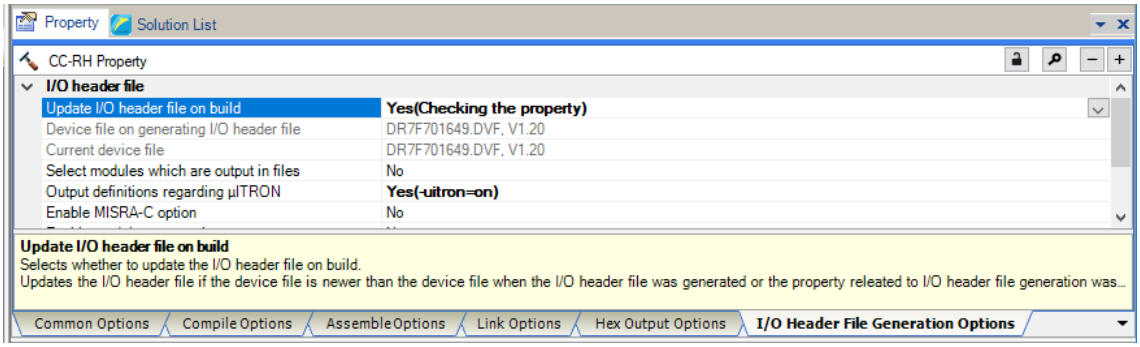


Figure 6.15 Configure I/O header file on build

7. Description of the Sample Project for MULTI and GHS CCRH850

7.1 Configuration of the Sample Project for MULTI and GHS CCRH850

The following shows the configuration of the sample project.

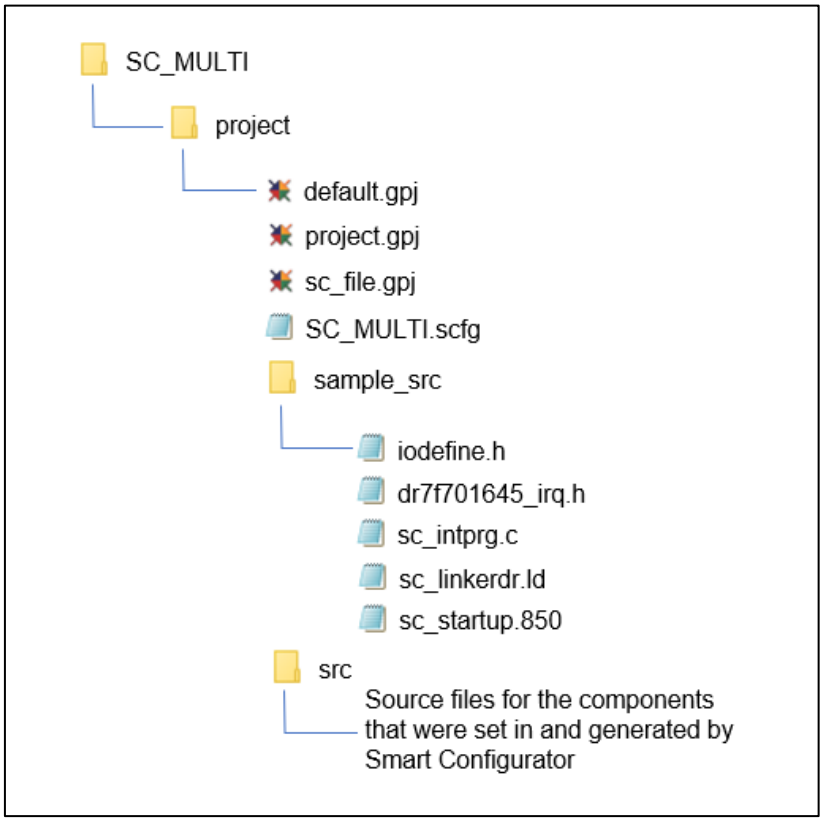


Figure 7.1 Sample project for MULTI and GHS CCRH850 files

Table 7-1 File Configuration of the Sample Project for MULTI and GHS CCRH850

File Name	Outline of File
default.gpj	Top project file for MULTI
project.gpj	Project file for MULTI
sc_file.gpj	Smart Configurator config file for MULTI
SC_MULTI.scfg	Project file for the Smart Configurator
iodefine.h*	Definitions of registers
dr7f701645_irq.h*	Definition of the exception interrupt vector table (macro definitions)
sc_intprg.c*	Definition of the EI-level maskable interrupt vector table
sc_linkerdr.ld*	Linker directive file
sc_startup.850*	Definition of the process from reset to main function of the application project, definition of the exception interrupt vector table, and definition of the startup routine up to branching to the main function

*: The Smart Configurator does not output these files.

7.2 Basic Operating Procedure

Figure 7.2 shows the operating procedure when using the Smart Configurator based on a sample project.

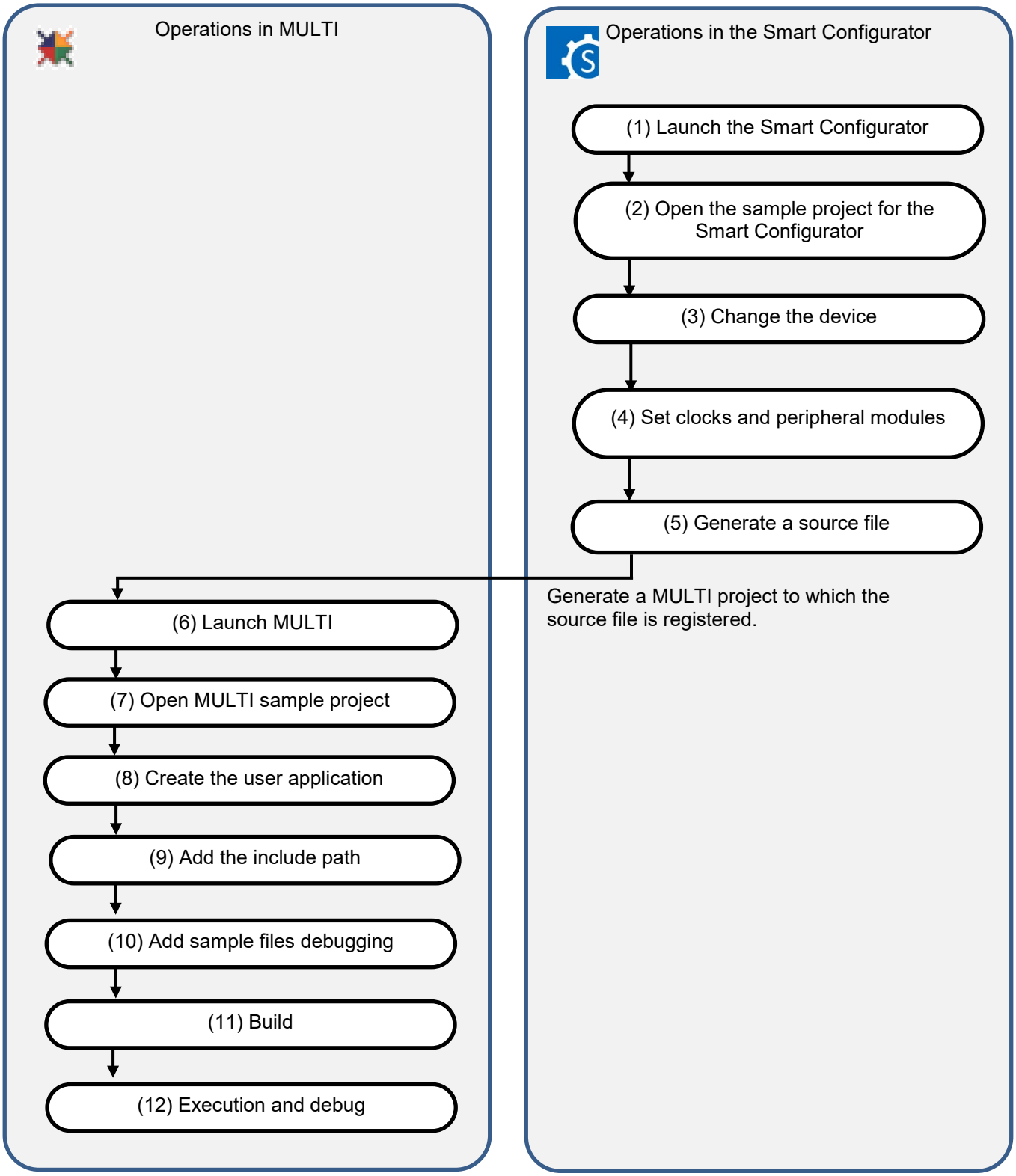


Figure 7.2 Operating Procedure for the Sample Project for MULTI and GHS CCRH850

(1) Launch the Smart Configurator

In the [Start] menu of Windows, select [Renesas Electronics Smart Configurator] → [Smart Configurator for RH850].

(2) Open the sample project for the Smart Configurator

From the [File] menu → [Open...] or click the [Open Existing Configuration File] toolbar button , select "SC_MULTI.scfg".

NOTE: Sample project must be copied to a directory that does not restrict the access before using. Please refer 2.2-1 for the detail.

(3) Change the device

R7F701645 (RH850/F1KM-S4) is selected as the target device in the sample project. If you are using another device, change the target device in the Smart Configurator and files to be used by referring to section 7.3, "Procedure for Changing the Device". If does not require changes to the device, proceed to step (4).

Change the device in [Device] on the [Board] page in Smart Configurator.

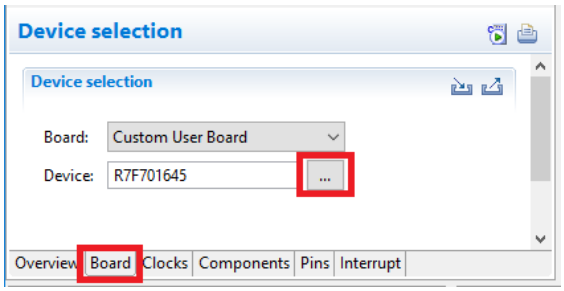


Figure 7.3 Change the target device in the Smart Configurator

(4) Set clocks and peripheral modules

(5) Generate a source file

The procedure for step (4) and step (5), see section 9, "Operations in the Smart Configurator".

(6) Launch MULTI

In the [Start] menu of Windows, select [Green Hills Software] → [MULTI].

(7) Open MULTI sample project

Select the [Open Project Manager...] item of the [Components] menu of MULTI. Then select "default.gpj" in the [Select a project to open] dialog box.

(8) Create the user application

For the procedure for creating the user application, see section 9, "Operations in the Smart Configurator".

(9) Add the include path

Add an include path to refer iodefine.h.

(9)-1. Right click on the “project.gpj” in MULTI and select the [Set Build options…].

(9)-2. In the [Basic Options] tab of the [Build Options for project.gpj] dialog box, double click the [Project]-[Include Directories].

(9)-3. In the [Edit List Option] dialog box, add the path of iodefine.h.

(10) Add sample files

Add the sample startup file and the others as the build target.

(10)-1. Right click on the “project.gpj” in MULTI and select the [Add File into project.gpj…]

(10)-2. In the [Choose file(s) to add:] dialog box, add all files under “sample_src” folder.

(11) Build

Select [Build] → [Build Program Project] of MULTI.

(12) Execution and debug

For program execution and debugging in the emulator, refer to the user’s manual for MULTI.

7.3 Procedure for Changing the Device

If the target device of the sample project in Table 2-1, "Sample Projects" is different from the device that is intended to be used, the target device and some files to be used must be changed according to the following procedure.

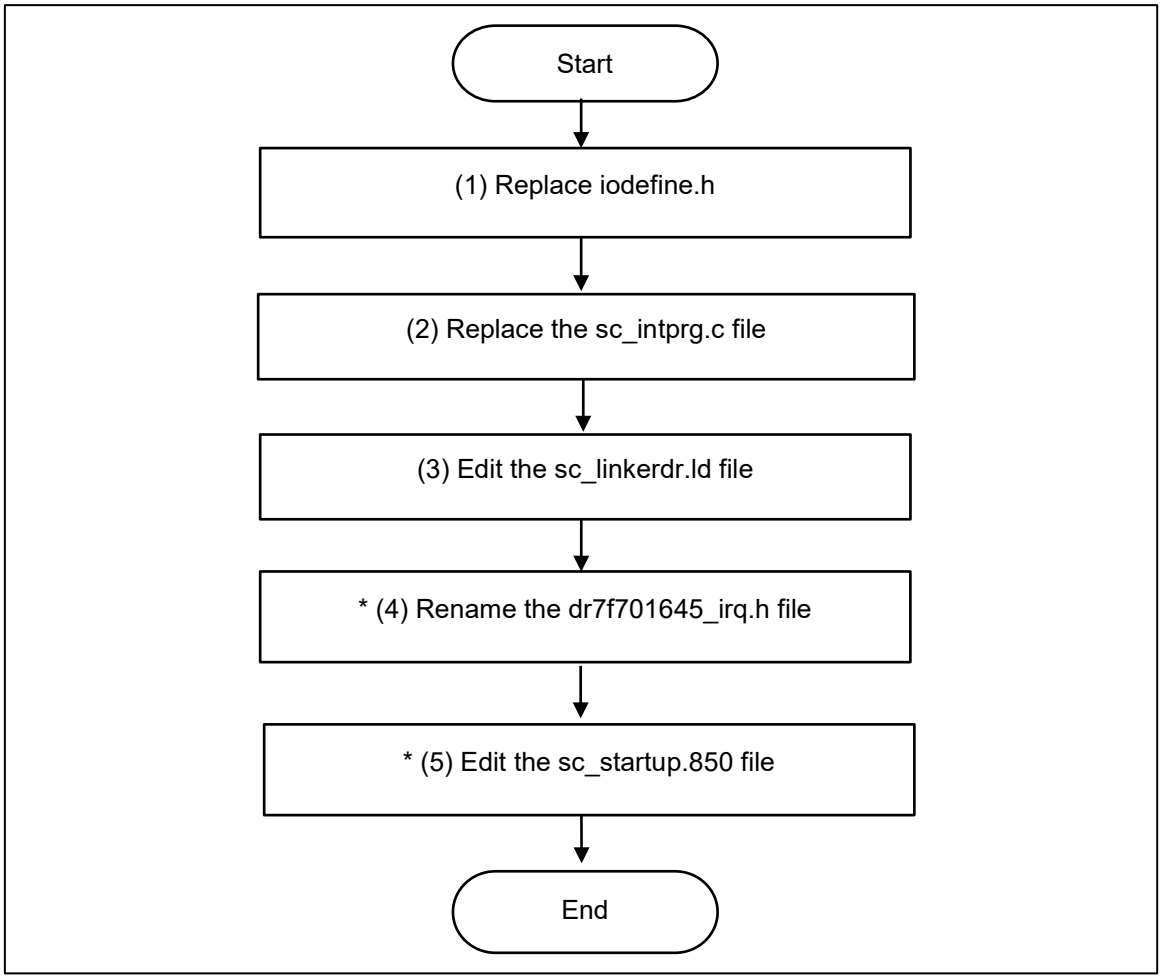


Figure 7.4 Change the Target Device of the Sample Project (MULTI Project)

*: Steps (4) and (5) are optional.

The procedure as described hereafter is based on the sample project "SC_MULTI".

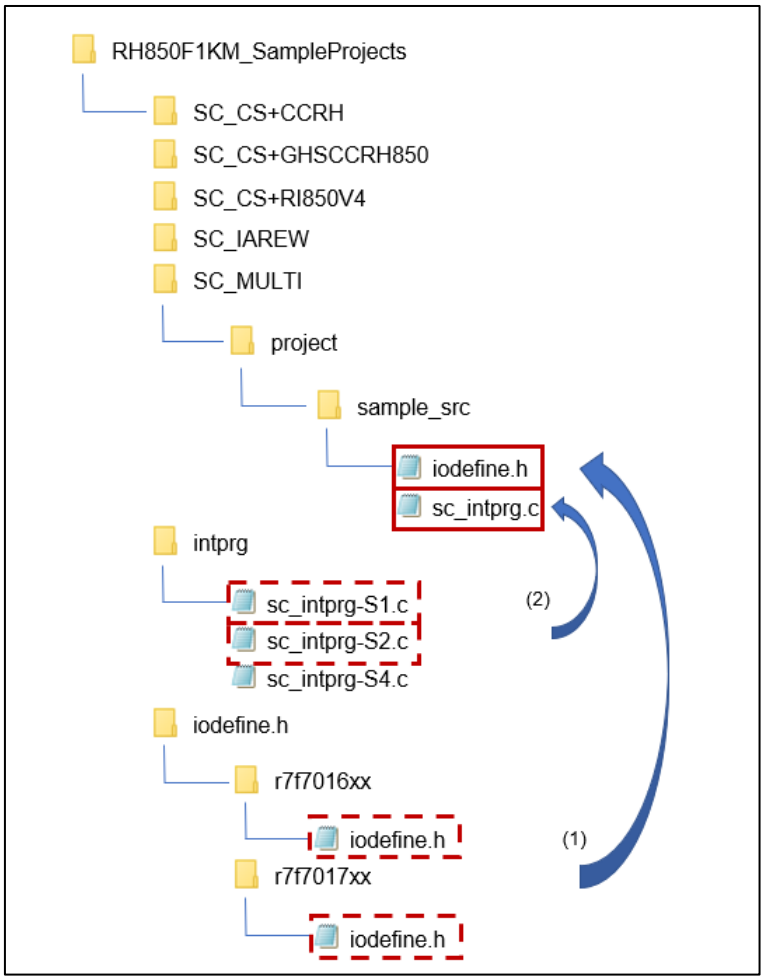


Figure 7.5 Replace the iodefine.h and sc_intprg.c files

(Files that are not described in this section are omitted from this figure.)

(1) Replace iodefine.h

In Windows Explorer, replace the iodefine.h file in the sample project with the file of the intended device from iodefine.h folder.

(2) Replace the sc_intprg.c file

This step is only necessary when a device of the RH850/F1KM-S4 Group was changed to a device of the RH850/F1KM-S2 or H850/F1KM-S1 Group.

(2)-1. Since the sc_intprg.c file included in the sample project is for RH850/F1KM-S4 devices, it should be replaced with a file for RH850/F1KM-S2 or RH850/F1KM-S1 devices. In Windows Explorer, copy sc_intprg-S2.c or sc_intprg-S1.c from the intprg folder to the sample project.

(2)-2. Delete "sc_intprg.c" in the sample project.

(2)-3. Rename "sc_intprg-S2.c" or "sc_intprg-S1.c" in the sample project to "sc_intprg.c".

(3) Edit the sc_linkerdr.ld file

(3)-1. Open the “sc_linkerdr.ld” in any editor to edit it.

(3)-2. Change the start address and size of the memory to match the specifications of the microcontroller in use. (Renaming microcontroller name in the file header is optional.)

```
44 /*
45 /*==================================================================
46 /* Environment:
47 /*              Device:          R7F701645
48 /*              IDE:             GHS Multi for V800  V6.xx or later
49 /*==================================================================
50
51 CONSTANTS
52 {
53   zero_start = 0xffff8000
54 }
55
56 MEMORY
57  {
58   iROM_0          : ORIGIN = 0x00000000,  LENGTH = 4096k
59   iROM_1          : ORIGIN = 0x01000000,  LENGTH = 32k
60   iRAM_0          : ORIGIN = 0xFEBC0000,  LENGTH = 256k
61   iRAM_R          : ORIGIN = 0xFEF00000,  LENGTH = 64k
62  }
63
```

Figure 7.6 Change the start address and size of the memory

(3)-3. Change the “EIINTTBL_end” that is the end address of EIINTTBL section to match the specifications of the microcontroller in use.

```
64 SECTIONS
65  {
66
67 /* Start of internal ROM area (iROM_0) */
68
69 /* original */
70 /*  .intvect                                  :>iROM_0 /* start of inter
71 /*  .intvect_end  0x07E4                      :>.      /* end   of inter
72 /* */
73
74 /* Changed for sample project */
75   .intvect                                  :>iROM_0 /* start of interru
76   .intvect_end  0x01FF                      :>.      /* end   of interru
77   EIINTTBL align (4)                        :>iROM_0 /* start of EI mask
78   EIINTTBL_end  0x07E4                      :>.      /* end   of EI mask
79 /* */
```

Figure 7.7 Change the “EIINTTBL_end” value

Reference value:

RH850/F1KM-S1: 0x0798

RH850/F1KM-S2: 0x07E4

RH850/F1KM-S4: 0x07E4

The following steps (4) and (5) are optional. Building sample project is possible without steps (4) and (5).

(4) Rename the dr7f701645_irq.h file

(4)-1. In Windows Explorer, rename from “dr7f01645_irq.h” to “dr7f0xxxx_irq.h” to match the microcontroller name in use.

(5) Edit the sc_startup.850 file

(5)-1. Open the “sc_startup.850” in any editor to edit it.

(5)-2. Change the include file name to the filename changed in step (4) and save the sc_startup.850 file. (Renaming microcontroller name in the file header is optional.)

```
45 ------------------------------------------------
46 -- Environment:
47 --              Device:          R7F701645
48 --              IDE:             GHS Multi for
49 ------------------------------------------------
50
51 ------------------------------------------------
52 -------------  Selection of external interrupt
53 -------------  User modifiable section
54 -------------  Please uncomment the required
55 ------------------------------------------------
56 #include "dr7f701645_IRQ.h"
57
```

Figure 7.8 Change the include file name

7.4 Settings in the Sample Project for MULTI and GHS CCRH850

The sample project has an added build target setting for sample files and an added include path for “iodefine.h” to the MULTI project.

Remarks: A build target setting for sample files and an added include path for “iodefine.h” are removed by step (5) in section 7.2.

8. Description of the Sample Project for IAREW and IAR ICC

8.1 Configuration of the Sample Project for IAREW and IAR ICC

The following shows the configuration of the sample project.

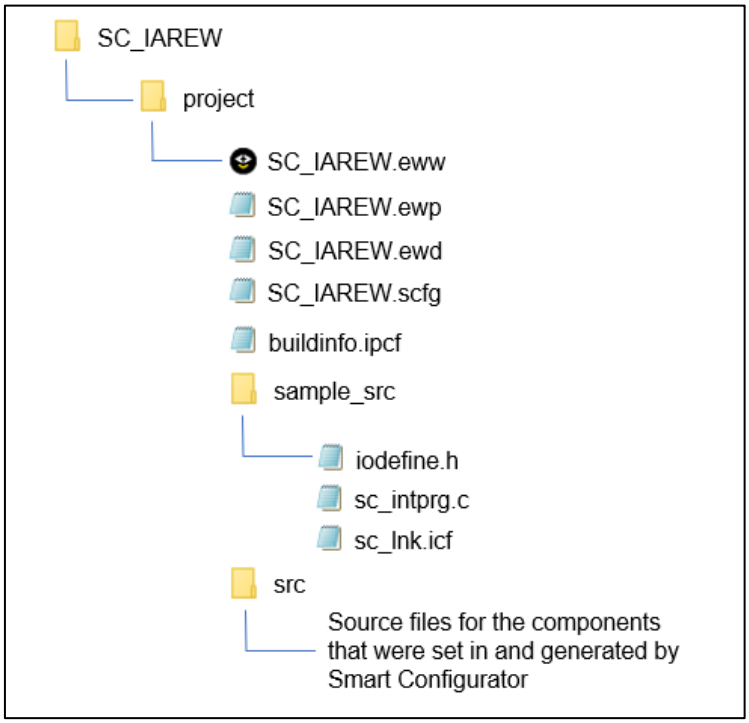


Figure 8.1 Sample project for IAREW and IAR ICC files

Table 8-1 File Configuration of the Sample Project for IAREW and IAR ICC

File Name	Outline of File
SC_IAREW.eww	Workspace file for IAREW
SC_IAREW.ewp	Project file for IAREW
SC_IAREW.ewd	Debug file for IAREW
SC_IAREW.scfg	Project file for the Smart Configurator
buildinfo.ipcf	Connection file for the IAREW project
iodefine.h*	Definitions of registers
sc_intprg.c*	Definition of the EI-level maskable interrupt vector table
sc_lnk.icf*	Linker configuration file

*: The Smart Configurator does not output these files.

8.2 Basic Operating Procedure

Figure 8.2 shows the operating procedure when using the Smart Configurator based on a sample project.

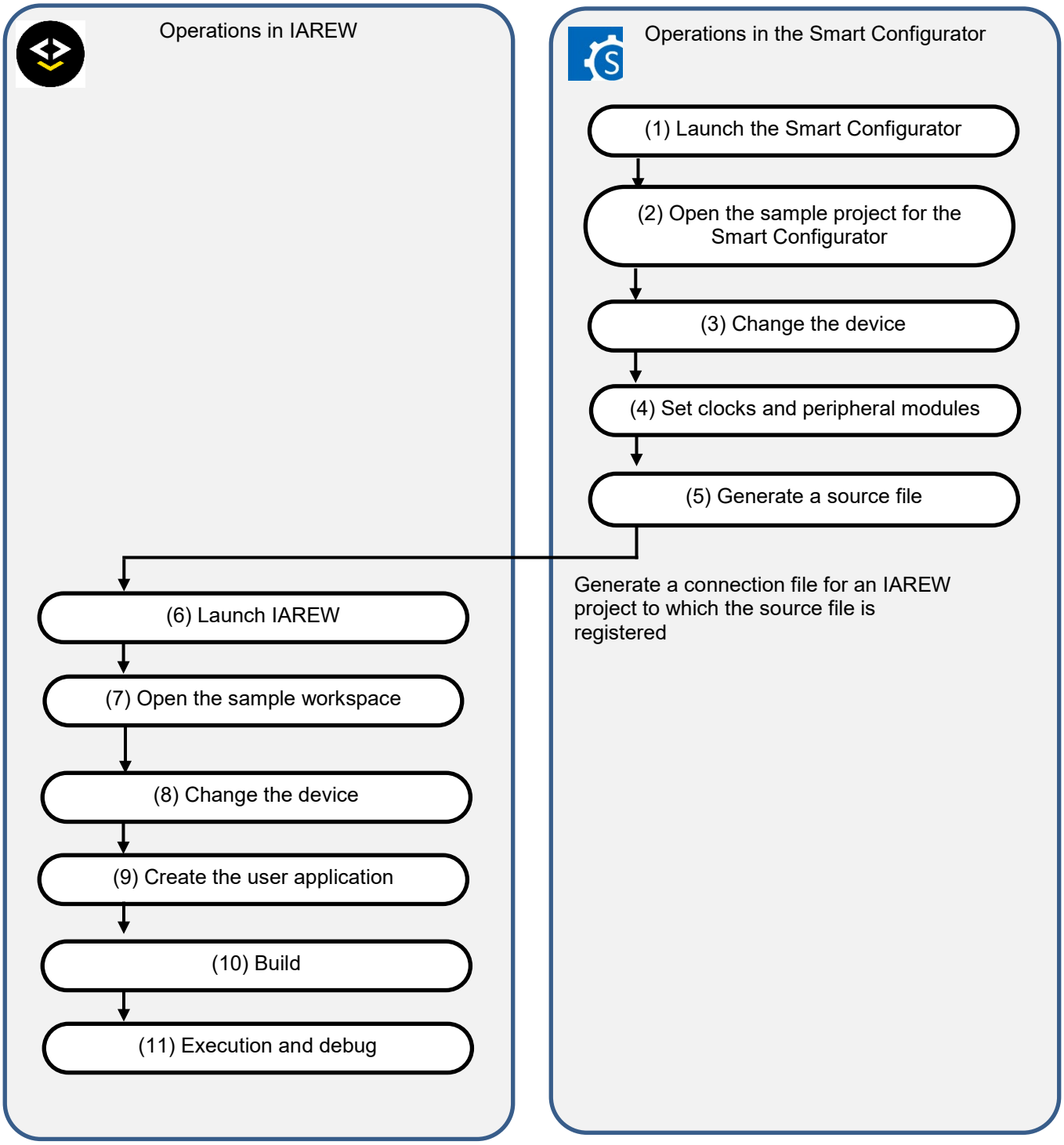


Figure 8.2 Operating Procedure for the Sample Project for IAREW and IAR ICC

(1) Launch the Smart Configurator

In the [Start] menu of Windows, select [Renesas Electronics Smart Configurator] → [Smart Configurator for RH850].

(2) Open the sample project for the Smart Configurator

From the [Open...] item of the [File] menu or with the [Open Existing Configuration File] toolbar butt of the Smart Configurator, select "SC_IAREW.scfg".

NOTE: Sample project must be copied to a directory that does not restrict access before using . Please refer 2.2-1 for the detail.

(3) Change the device

The R7F701645 (RH850/F1KM-S4) is selected as the target device in the sample project. If you are using another device, change the target device in the Smart Configurator. If the device does not require changing, proceed to step (4).

Changing the target device in the Smart Configurator

Change the device in [Device selection] on the [Board] page.

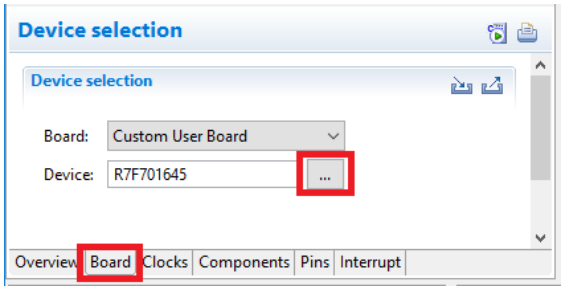


Figure 8.3 Change the target device in the Smart Configurator

For steps (4) and (5), the procedure for setting clocks and components and generating a driver in the Smart Configurator, see section 9, "Operations in the Smart Configurator".

(6) Launch IAREW

In the [Start] menu of Windows, select [IAR Systems] → [IAR Embedded Workbench].

(7) Open the sample workspace

Select [File] → [Open] → [Workspace..] in IAREW. Then select "SC_IAREW.eww" in the [Open Workspace] dialog box.

(8) Change the device

The R7F701645 (RH850/F1KM-S4) is selected as the target device in the sample project. If you are using another device, change the file to be used with reference to section 8.3, "Procedure for Changing the Device". If the device does not need to be changed, proceed to step (9).

(9) Create the user application

For the procedure for creating the user application, see section 9, "Operations in the Smart Configurator".

(10) Build

Select [Project] → [Rebuild All] in IAREW.

(11) Execution and debug

For program execution and debugging in the emulator, refer to the user's manual for IAREW.

Also, set the value of the INTBP register to 0x00000200 before executing the main function.

8.3 Procedure for Changing the Device

If the target device of the sample project in Table 2-1, "Sample Projects" is different from the device that is intended to be used, the target device and some files must be changed according to the following procedure.

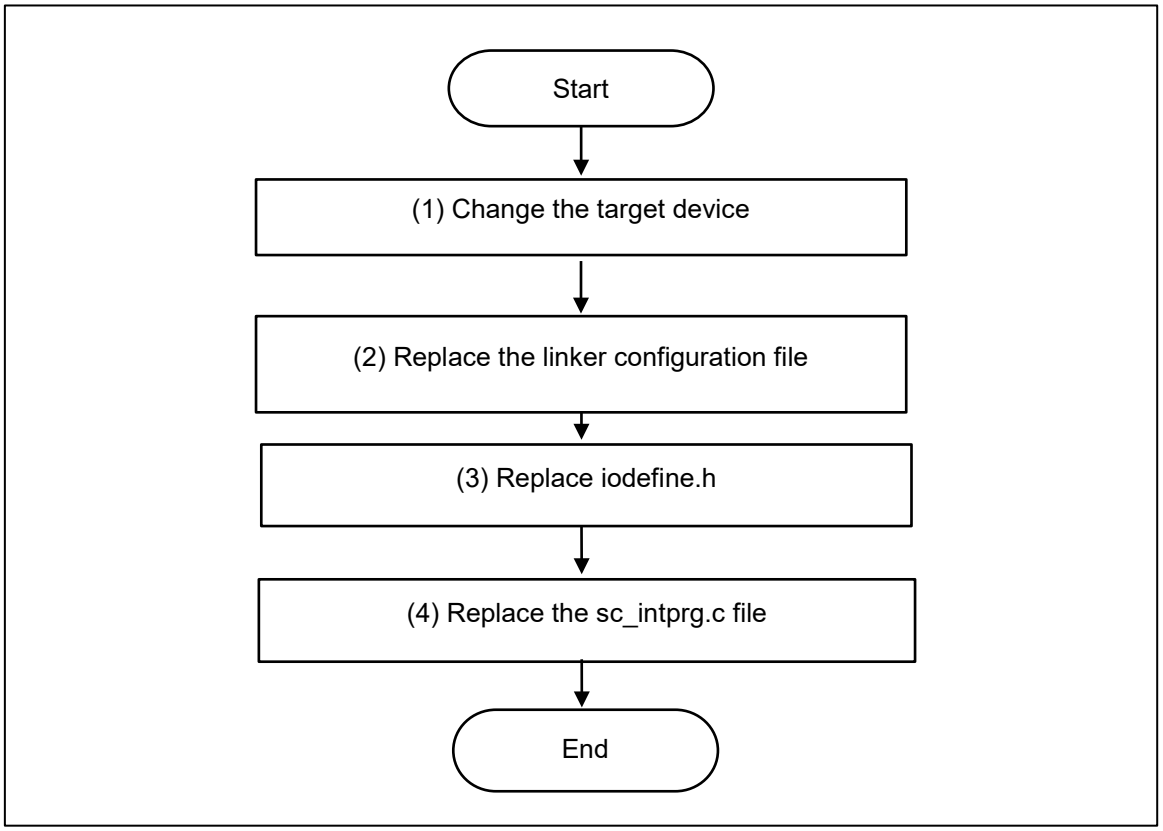


Figure 8.4 Change the Target Device of the Sample Project (IAREW Project)

The procedure as described hereafter is based on the sample project "SC_IAREW".

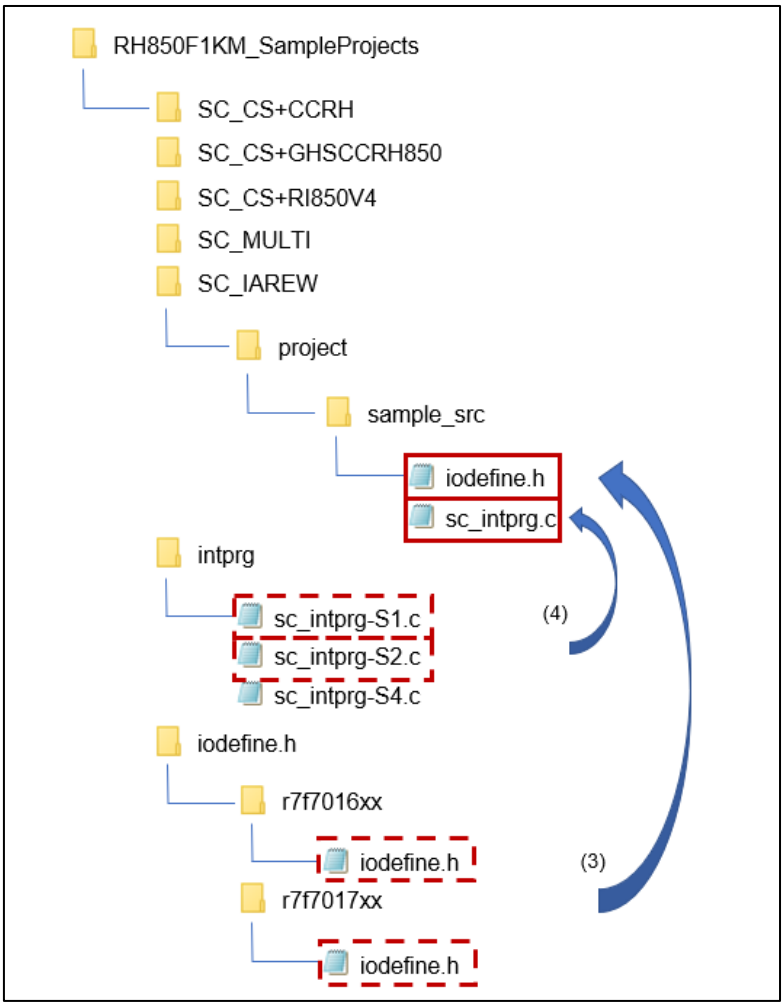


Figure 8.5 Replace the sc_intprg.c and iodefine.h file

(Files that are not described in this section are omitted from this figure.)

(1) Change the target device

(1)-1. Select [Options...] menu in [Project] of IAREW.

(1)-2. Select [General Options] → [Target] in the [Options for node “SC_IAREW”] dialog box. Select the device to be used from the drop-down list under [Device].

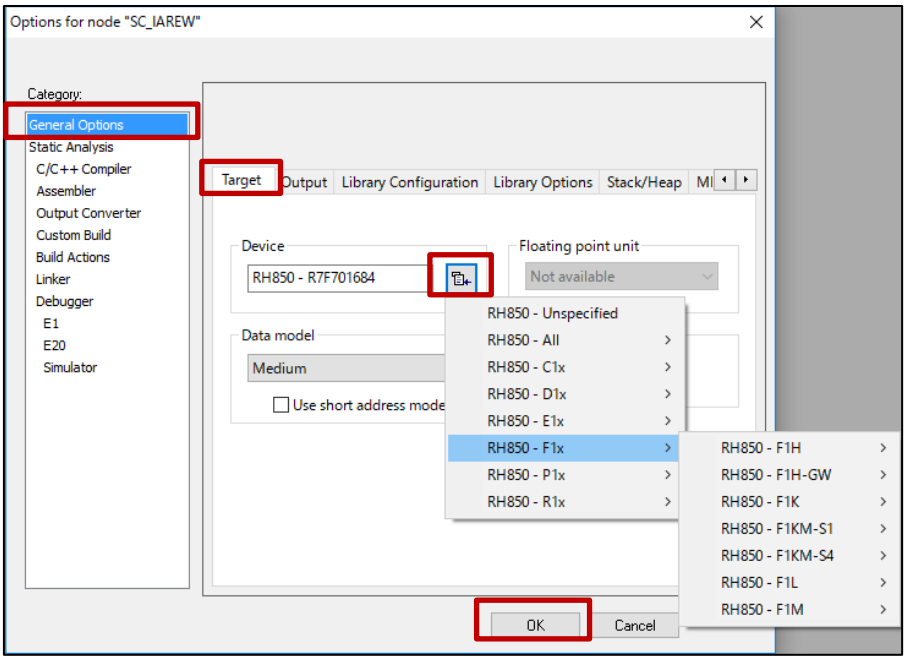


Figure 8.6 Select devices for changing microcontroller

(2) Replace the linker configuration file

(2)-1. In Windows Explorer, copy the "lnkr7f70xxxx.icf" file for the device you will be using from the installation folder for IAREW (C:\Program Files (x86) \IAR Systems\Embedded Workbench x.x\rh850\config) to the sample project.

(2)-2. Edit the copied "lnkr7f70xxxx.icf" file. Open it in any editor.

(2)-3. Add a section to be used in the sample project. Change the code as shown below so that the EIINTTBL section is located from address 0x200 and then save the file.

[Before the change]

```
69 //Uncomment and adapt the following section if you want to place the interrupt tal
70 // define block .interrupt_core1 with alignment = 8 {
71 //   ro section .table.interrupt_core_1 };
72 //
73 // "INTERRUPT":place at address mem:0x200
74 // {
75 //   block .interrupt_core1
76 // };
77
78 include "layout.icf";
79
80 //-----------------------------------------------------------------------
81 //      End of file
82 //-----------------------------------------------------------------------
   [EOF]
```

Figure 8.7 Add a section for sample project (before the change)

[After the change]

```
69 //Uncomment and adapt the following section if you want to place the interrupt t
70  define block .interrupt_core1 with alignment = 8 {
71    ro section .table.interrupt_core_1 };
72 //
73 // "INTERRUPT":place at address mem:0x200
74 // {
75 //   block .interrupt_core1
76 // };
77
78  "EIINTTBL":place at address mem:0x200
79  {
80    block .interrupt_core1,
81    section EIINTTBL
82  };
83
84
85 include "layout.icf";
86
87 //-----------------------------------------------------------------------
88 //      End of file
89 //-----------------------------------------------------------------------
   [EOF]
```

Figure 8.8 Add a section for sample project (after the change)

(The line number may differ according to which file you are using.)

(3) Replace iodefine.h

In Windows Explorer, replace the iodefine.h file in the sample project with the file of the intended device from iodefine.h folder.

(4) Replace the sc_intprg.c file

This step is only necessary when a device of the RH850/F1KM-S4 Group was changed to a device of the RH850/F1KM-S2 or RH850/F1KM-S1 Group.

(4)-1. Since the sc_intprg.c file included in the sample project is for RH850/F1KM-S4 devices, it should be replaced with a file for RH850/F1KM-S2 or RH850/F1KM-S1 devices. In Windows Explorer, copy sc_intprg-S2.c or sc_intprg-S1.c from the intprg folder to the sample project.

(4)-2. Delete "sc_intprg.c" in the sample project.

(4)-3. Rename "sc_intprg-S2.c" or "sc_intprg-S1.c" in the sample project to "sc_intprg.c".

8.4 Settings in the Sample Project for IAREW and IAR ICC

The sample project is created in IAREW. An include path is added and settings of the following options are changed.

(a) [Project] of IAREW → [Options...] menu → [Options for node “SC_IAREW”] dialog box → [Linker] → [Linker configuration file]

[Settings in the sample project]

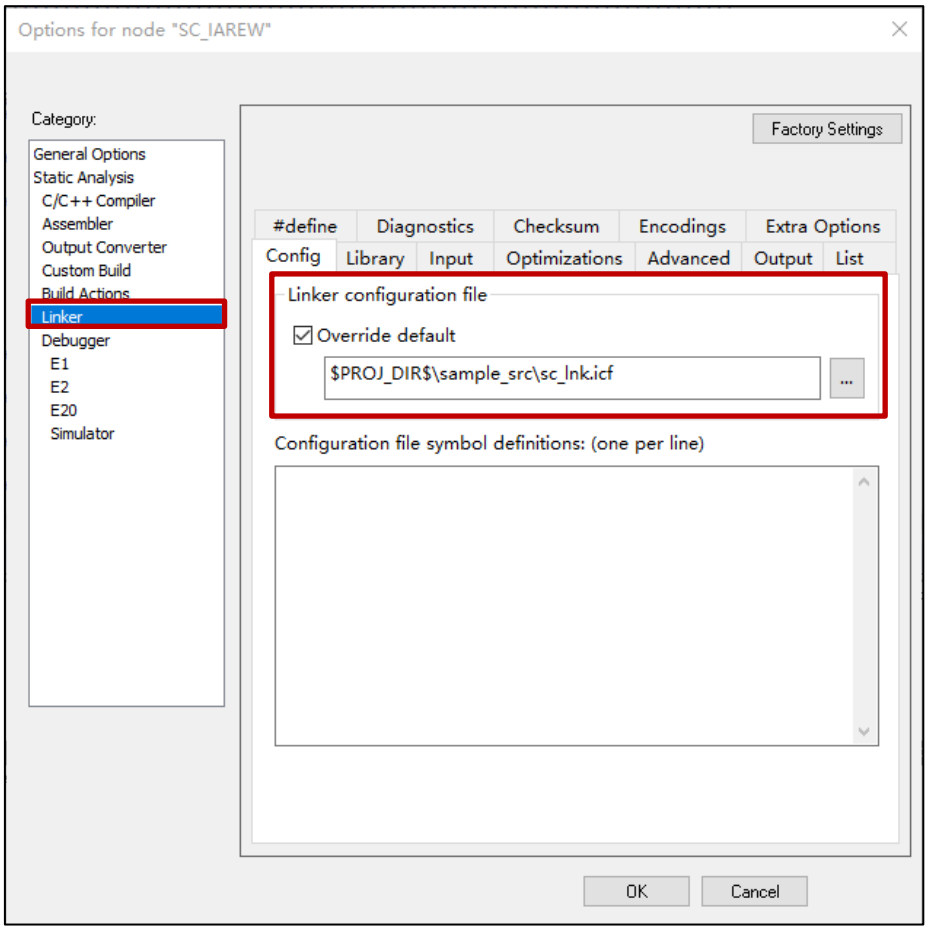


Figure 8.9 Set the linker configuration file

9. Operations in the Smart Configurator

This section gives an overview of setting the drivers of peripheral modules of the device and handling of the Smart Configurator for the generation of code.

For details, refer to RH850 Smart Configurator User's Guide: CS+ (R20AN0516).

9.1 Set the Peripheral Modules (Software Components)

(1) Configure the clocks of the device on the [Clocks] tabbed page.

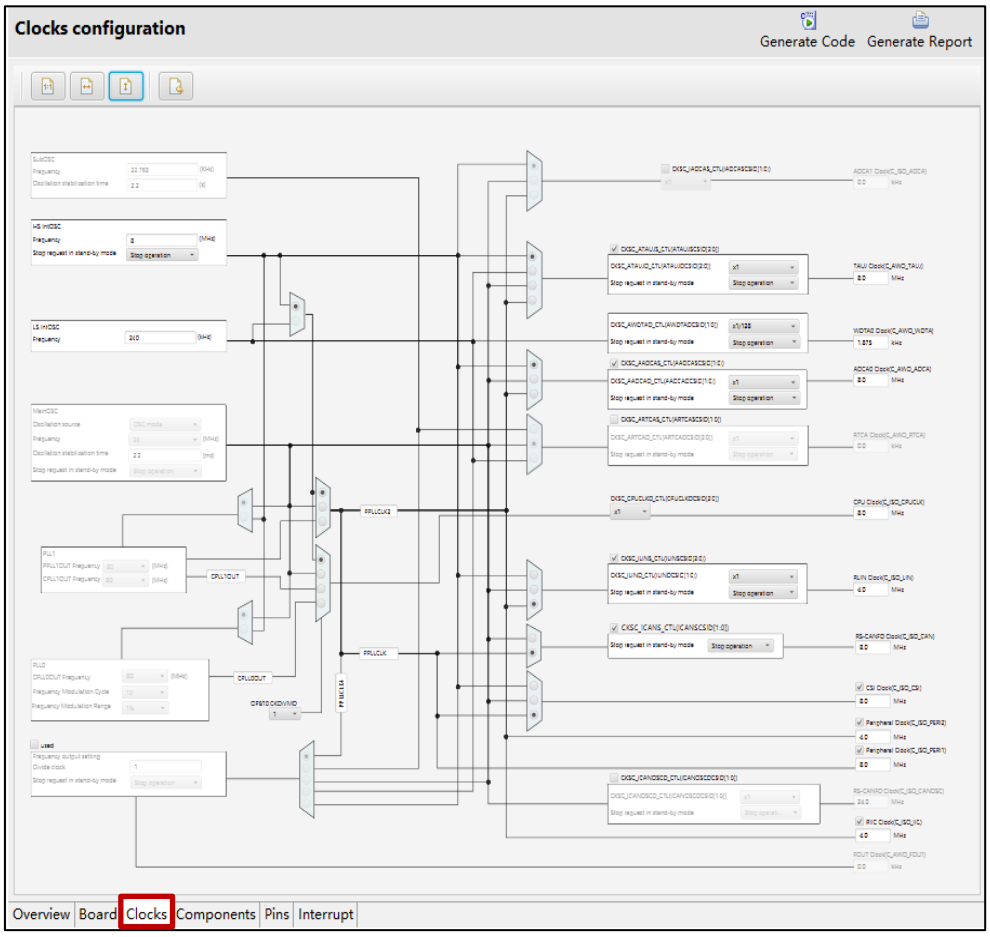


Figure 9.1 Configure the clocks of the device

(2) Add or set the peripheral modules of the device on the [Components] tabbed page. The peripheral modules are set as software components. Click on the [Adding components] icon .

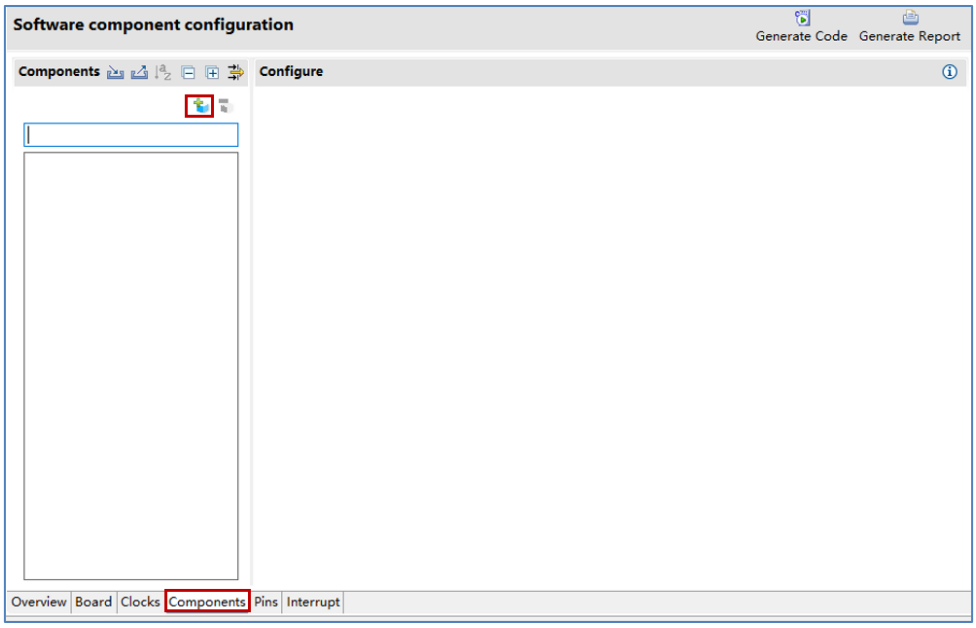


Figure 9.2 Add or set the peripheral modules

Remarks: Importing middleware in the form of FIT (Firmware Integration Technology) modules is not supported for the RH850 Family.

(3) Select components on the [Software Component Selection] page of the [New Component] dialog box. Select each component to be used from the list and click on the [Next] button.

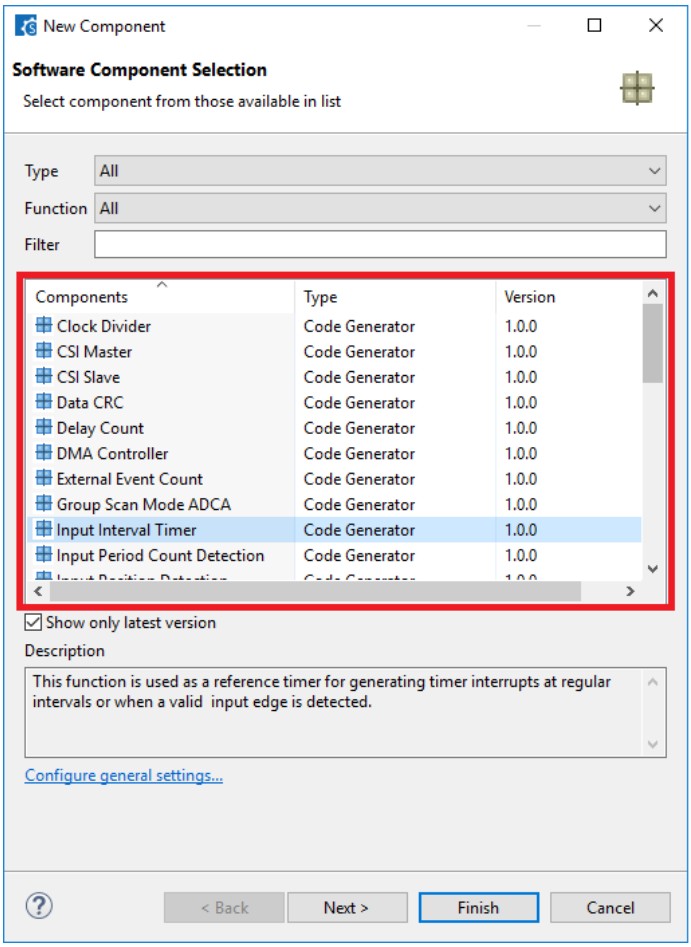


Figure 9.3 Select components

(4) Select the configuration name and resource of the selected component. On the [Add new configuration for selected component] page of the [New Component] dialog box, enter an appropriate configuration name or use the default name. Select the resource or use the default resource. After you have made the selections, click on the [Finish] button.

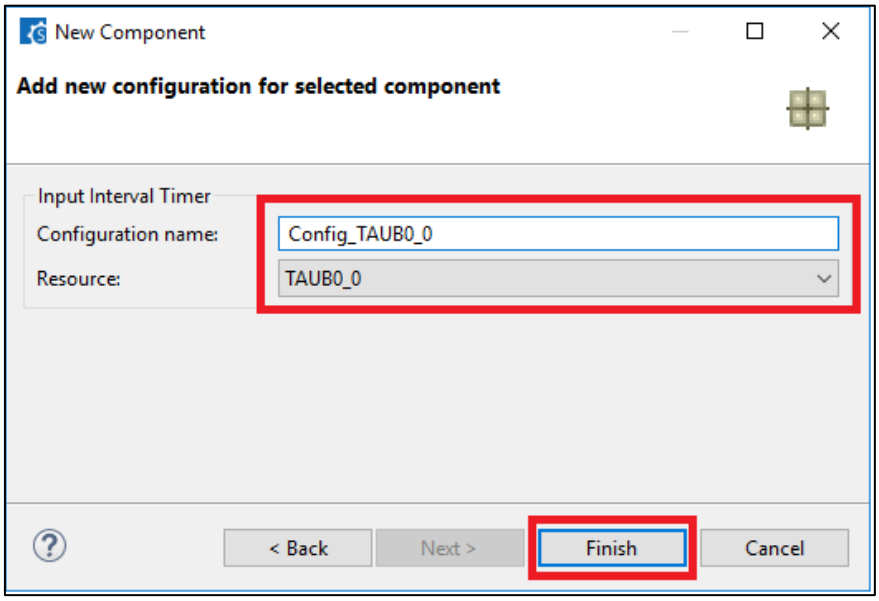


Figure 9.4 Select the configuration name and resource

(5) Set the configuration of the component. Click on the configuration icon in the Component Tree panel and make detailed settings in the right-hand panel.

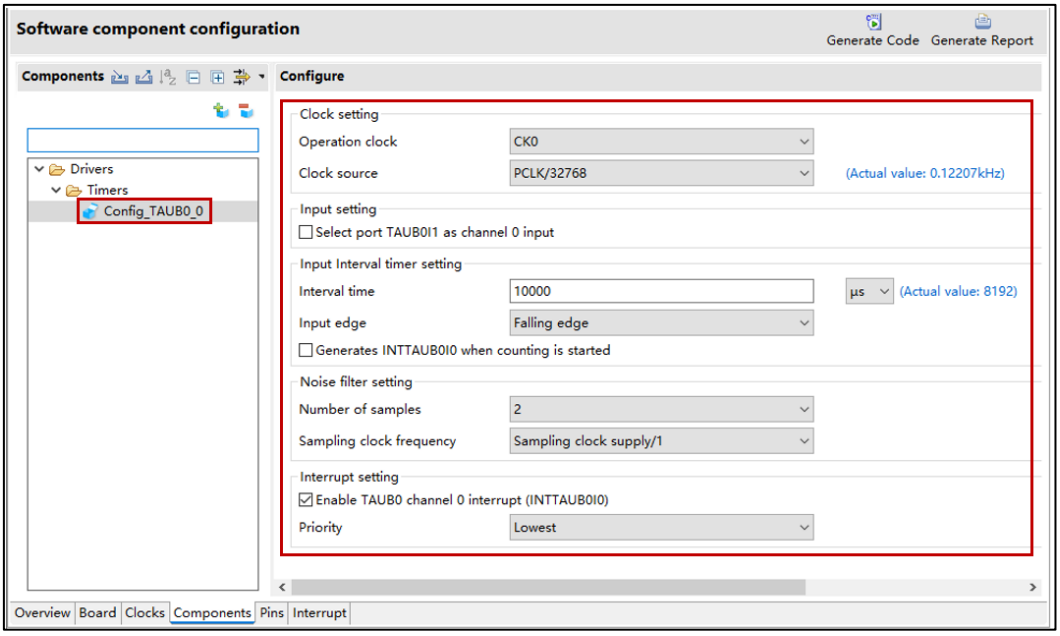


Figure 9.5 Set the configuration of the component

(6) Repeat steps (2) to (5) for each component you intend to use.

9.2 Generate Drivers

(1) Click on the [Code Generator] button . The source files generated by the Smart Configurator are stored in the <ProjectDir>¥src¥smc_gen folder.

<ProjectDir> is the folder containing the project files (scfg) for the Smart Configurator.

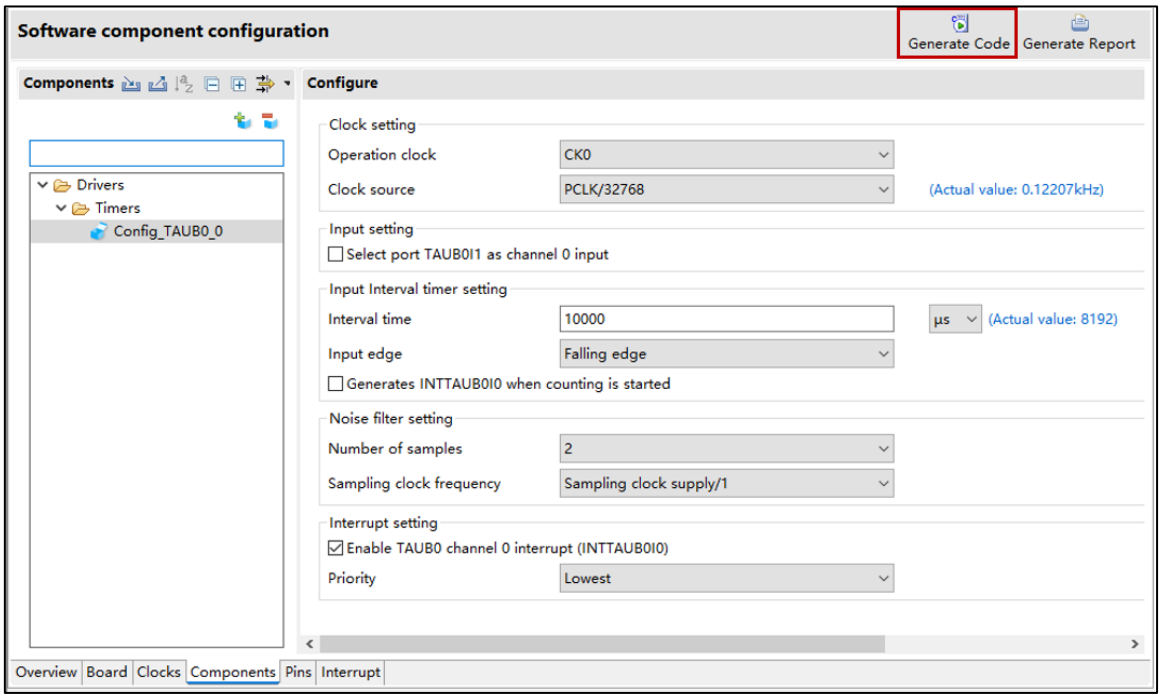


Figure 9.6 Generate code in Smart Configurator

9.3 Add the Application Code to the User Code Area

Some generated source files have a user code area for the writing of user code. Open such files in an editor from the integrated development environment you are using and add the application code (e.g. code for interrupt processing) to the user code areas as necessary.

Example: File generated for the interval timer component in the CS+ environment

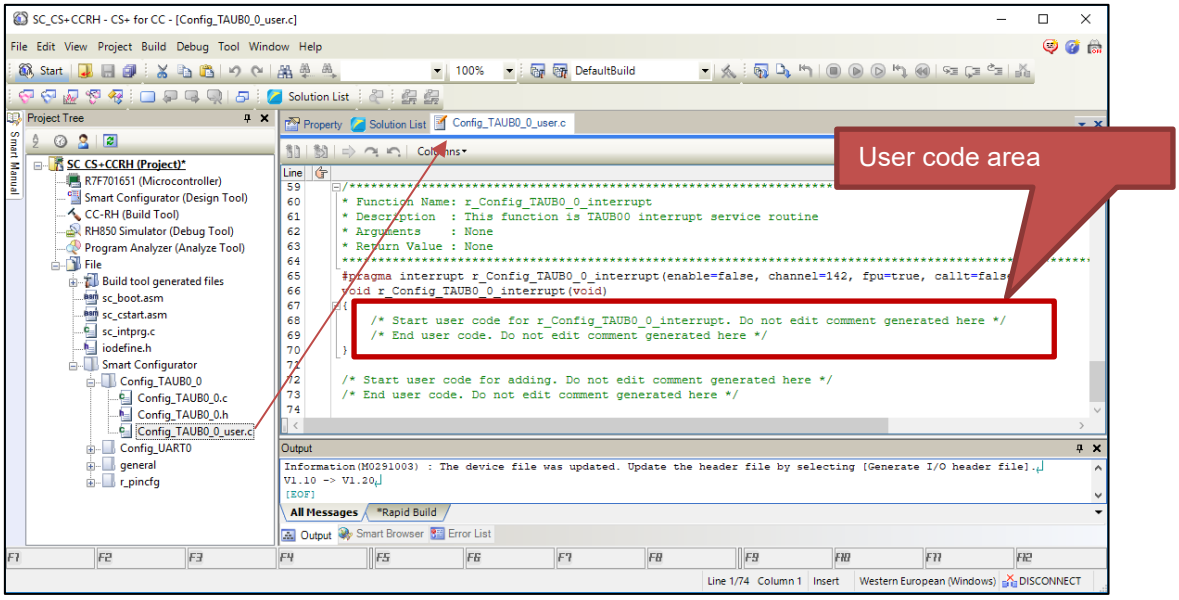


Figure 9.7 Add the Application code to the user code area

9.4 Add the Application Code to main()

The main function is in "<ProjectDir>¥src¥smc_gen ¥general¥r_cg_main.c". Open the file in an editor from the integrated development environment you are using and add the application code to the user code area.

Example: CS+ environment

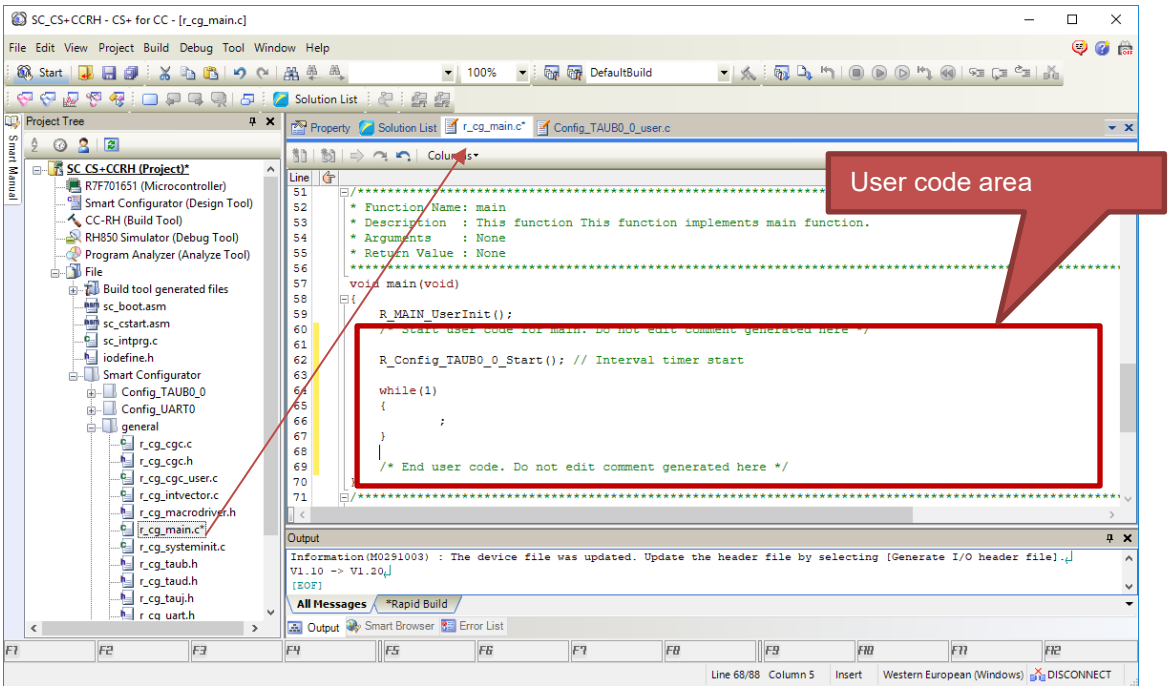


Figure 9.8 Modify r_cg_main.c in CS+ environment

Revision History

Rev.	Section	Description
1.10	All	New release
1.20	5. Description of the Sample Project for CS+ and GHS CCRH850	Figure 9.9 Operating Procedure for the Sample Project for CS+ and GHS CCRH850: Changed the content of step (3)
		Figure 5.7 Adding the folder containing the files: Added Remark message
		Figure 5.8 Changing the Target Device of the Sample Project (CS+ Project): Changed steps (3) to (5)
		5.3 Procedure for Changing the Device: Changed the content of steps (3) to (5)
	7. Description of the Sample Project for MULTI and GHS CCRH850	Figure 7.2 Operating Procedure for the Sample Project for MULTI and GHS CCRH850: Added steps (9) and (10)
		7.2 Basic Operating Procedure: Added steps (9) and (10)
		Figure 7.4 Changing the Target Device of the Sample Project (MULTI Project): Changing the content of steps (3) to (5)
		7.3 Procedure for Changing the Device: Changing the content of steps (3) to (5)
		7.4 Settings in the Sample Project for MULTI and GHS CCRH850: Changed the content of this section
1.30	Front page	Target Devices: Add RH850/F1KM-S2 information
	1. Overview	Table 1-1 Operating Environment: Update Operating Environment tools version
	2. Outline of the Sample Projects	Table 2-1 Sample Projects: Add RH850/F1KM-S2 information
		2.2 Notes on the Sample Projects: Add Note 1 message
	4. Description of the Sample Project for CS+ and CCRH	4.3 Procedure for Changing the Device: Add RH850/F1KM-S2 information
	5. Description of the Sample Project for CS+ and GHS CCRH850	5.3 Procedure for Changing the Device: Add RH850/F1KM-S2 information
	6. Description of the Sample Project for CS+, CCRH, and RI850V4	6.3 Procedure for Changing the Device: Add RH850/F1KM-S2 information
	7. Description of the Sample Project for MULTI and GHS CCRH850	7.3 Procedure for Changing the Device: Add RH850/F1KM-S2 information
		Figure 7.5 Replace the sc_intprg.c and iodefine.h file: Add RH850/F1KM-S2 information to this figure.
	8. Description of the Sample Project for IAREW and IAR ICC	8.3 Procedure for Changing the Device: Add RH850/F1KM-S2 information
		Figure 8.1 Sample project for IAREW and IAR ICC files: Update this figure according to new sample project.
		Table 8-1 File Configuration of the Sample Project for IAREW and IAR ICC: Update this table according to new sample project.
		Figure 8.5 Replace the sc_intprg.c and iodefine.h file: Add RH850/F1KM-S2 information to this figure.

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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas

   Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.

6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,

Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks

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

© 2023 Renesas Electronics Corporation. All rights reserved.