RA Family, RX Family, RL78 Family

RRH46410 Sample Software Manual

Introduction

This Application Note describes sample software for RRH46410 gas sensor that operates on RA Family, RX Family and RL78 Family.

Target Device

RA2E1 Group

RA0E1 Group

RX140 Group

RL78/G23 Group

Target Sensor Board

Digital Gas Sensor Module for Indoor Air Quality Applications (QCIOT-RRH46410POCZ)

The setting example described in this application note is an example when using the sensor board mentioned above.

Therefore, you will need to review the following settings according to the target circuit.

- Interrupt Signal Circuit: Refer to “6.5 Notes for Interrupt Signal Circuits”.
- RESET Signal Circuit: Refer to “6.6 Notes for RESET Signal Circuits”.

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Contents

Trademarks

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1. Overview

This sample software acquires data from the RRH46410 gas sensor and calculates the result values. In combination with the I2C driver of the FSP/FIT or the Code Generator, the sample software controls the RRH46410 through the I2C in the MCU to measure gas environment, acquires Measurement data, converts and calculates the acquired results.

1.1 Terms/Abbreviations

The terms and their abbreviations are listed below.

Table 1-1 List of Terms/Abbreviations

Terms	Abbreviation
RRH46410 Sensor Control Module	Sensor Control Module When MCU is RA Family, “rm_rrh46410” When MCU is RX Family, “r_rrh46410_rx” When MCU is RL78 Family, “r_rrh46410”
I2C Communication Middleware	COMMS_I2C When MCU is RA Family, “rm_comms_i2c” When MCU is RX Family, “r_comms_i2c_rx” When MCU is RL78 Family, “r_comms_i2c”
I2C Driver	When MCU is RA Family, “r_iic_master”, “r_sci_i2c”, “r_iica_master” When MCU is RX Family, “r_riic_rx”, “r_sci_iic_rx” When MCU is RL78 Family, “r_iica_master”
IRQ Driver	When MCU is RA Family, “r_icu” When MCU is RX Family, “r_irq_rx” When MCU is RL78 Family, “Interrupt Controller”
Serial Communications Interface	When MCU is RA Family, “SCI”, “SCI I/F” When MCU is RX Family, “SCI”, “SCI I/F”
Serial Array Unit	When MCU is RA Family, “SAU”, “SAU I/F” When MCU is RL78 Family, “SAU”, “SAU I/F”
I2C Bus Interface	When MCU is RA Family, “IIC”, “IIC I/F” When MCU is RX Family, “RIIC”, “RIIC I/F”
I2C Bus Interface (IICA)	When MCU is RA Family, “IICA”, “IICA I/F”
Serial Interface IICA	When MCU is RL78 Family, “IICA”, “IICA I/F”
General Term for I2C Bus Interface, I2C Bus Interface (IICA), Serial Interface (IICA)	“I2C I/F”
General Term for Interrupt Controller	“ICU I/F” (Interrupt Controller Unit)
General purpose I/O Port	“GPIO”, “GPIO I/F”
Pin No.1 (#1) of Renesas Pmod Type 6A Sensor Board	“IRQ#” (L output when an interrupt occurs)

2. Environment for Confirming Operation

2.1 Environment for Confirming Operation on RA Family MCU

The operation of this software has been confirmed on RA family MCU in the following environment.

(1) Evaluation Kit for RA2E1 (EK-RA2E1)

Table 2-1 Confirming Operating Environment for EK-RA2E1

Item	Description
Demonstration board	RTK7EKA2E1S00001BE (EK-RA2E1)
Microcontroller	RA2E1 (R7FA2E1A92DFM:64pin)
Operating frequency	48MHz
Operating voltage	5V
Integrated development environment	Renesas Electronics e^2 studio 2024-07
C compiler	GNU ARM Embedded 13.2.1.arm-13-7
Configuration options	Add the following settings to the compiler default settings: ISO C99 (-std=c99), Optimization Level: Default settings (-O2)
FSP	v5.4.0
RTOS	FreeRTOS v10.6.1
Emulator	On board (J-LINK)
Interposer	Interposer Board for Pmod Type2/3 to 6A (US082-INTERPEVZ)
Sensor board	Digital Gas Sensor Module for Indoor Air Quality Applications (QCIOT-RRH4N10POCZ)

Table 2-2 Memory Size Used in RA2E1 (When an Operation Mode with Maximum ROM Size Is Set)

Operation Mode	Area	Size (Non-OS) [Bytes]	Size (Free RTOS) [Bytes]
IAQ 2nd Gen	ROM	2,372	4,240 (Note 1)
	RAM	288	500

Note Memory size is calculated for sample code, RRH46410 sensor control module, and COMMS_I2C. In RTOS, memory size does not include memory size of the thread.

Note 1 This includes an increase of 1,554 bytes due to the Relax function.

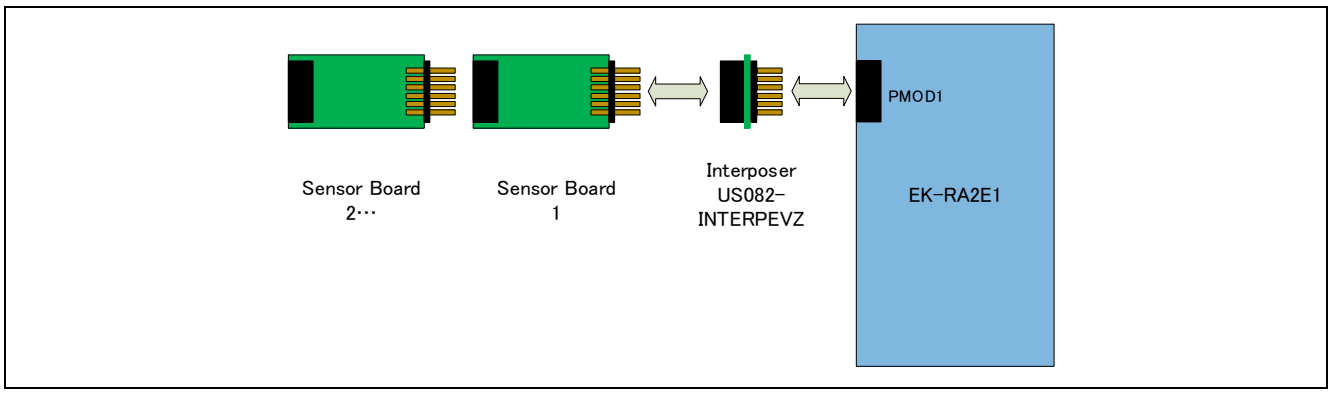


Figure 2-1 Hardware Connections for EK-RA2E1

(2) RA0E1 Fast Prototyping Board (FPB-RA0E1)

Table 2-3 Confirming Operating Environment for FPB-RA0E1

Item	Description
Demonstration board	RTK7FPA0E1S00001BJ (FPB-RA0E1)
Microcontroller	RA0E1 (R7FA0E1073CFJ:32pin)
Operating frequency	32MHz
Operating voltage	5V
Integrated development environment	Renesas Electronics e^2 studio 2024-07
C compiler	GNU ARM Embedded 13.2.1.arm-13-7
Configuration options	Add the following settings to the compiler default settings: ISO C99 (-std=c99), Optimization Level: Default settings (-Oz)
FSP	v5.4.0
Emulator	On board (J-LINK)
Interposer	Interposer Board for Pmod Type2/3 to 6A (US082-INTERPEVZ)
Sensor board	Digital Gas Sensor Module for Indoor Air Quality Applications (QCIOT-RRH46410POCZ)

Table 2-4 Memory Size Used in RA0E1 (When an Operation Mode with Maximum ROM Size Is Set)

Operation Mode	Area	Size (Non-OS) [Bytes]
IAQ 2nd Gen	ROM	2,066
	RAM	276

Note Memory size is calculated for sample code, RRH46410 sensor control module, and COMMS_I2C.

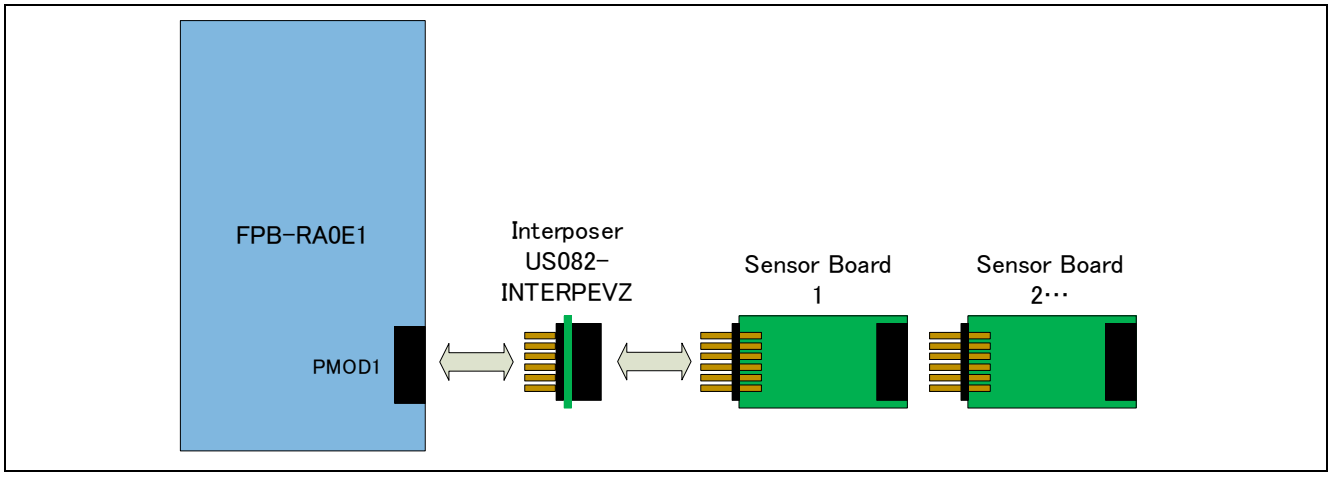


Figure 2-2 Hardware Connections for FPB-RA0E1

(3) Use of Interposer Board

The Interposer Board is an I/F conversion board for connecting Pmod Type 6A sensors by switching the Pmod Type 2A/Type 3A connector of the SCI I/F to the Simple IIC function.

Therefore, it cannot be used with the Pmod Type 2A/Type 3A connector of the SAU I/F. However, it may be usable by switching to the IICA I/F. Refer to the MCU hardware manual.

Table 2-5 Operational Feasibility Depending on Pmod I/F, Serial I/F, and Presence or Absence of Interposer Board

Pmod I/F	Destination MCU Serial I/F	Operational Feasibility
Type 2A, Type 3A	SCI I/F, IICA I/F (Note 1)	It works when using an Interposer Board. (Note 2)
	SAU I/F	It does not work regardless of whether the Interposer Board is present or not.
Type 6, Type 6A	SCI I/F, IIC I/F, SAU I/F, IICA I/F	It works without an Interposer Board. (Note 2)

Note 1: These pins are provided for SAU I/F but can be used when it is switchable to IICA pins by multi-function pins assignment. The signal connections when switchable are shown below.

Pmod Pin	Type 2A /Type 3A	Destination SAU I/F ICU I/F GPIO I/F	**Switching to Multi-Function IICA I/F**	Interposer Board	**Renesas Pmod Type 6A Sensor Board**
#1	CS/CTS	**GPIO**		↔	**IRQ# (Note 3)**
#2	MOSI/TXD	SAU TXD	**SDAA**	↔	**RESET#**
#3	MISO/RXD	SAU RXD	**SCLA**	↔	**IIC_SCL**
#4	SCK/RTS	**GPIO**		↔	**IIC_SDA**
#7	INT	**IRQ#**		↔	**BUSY#**
#8	RESET	**GPIO**		↔	**ENABLE**
#9	CS2/GPIO	**GPIO**		↔	**POWER_ON**
#10	CS3/GPIO	**GPIO**		↔	**GPIO**

Note 2: If an IRQ signal is used, make sure that the IRQ signal on MCU is connected to Pmod #1.
Note 3: For an interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

Application example: FPB-RA0E1 Pmod1 is applicable.

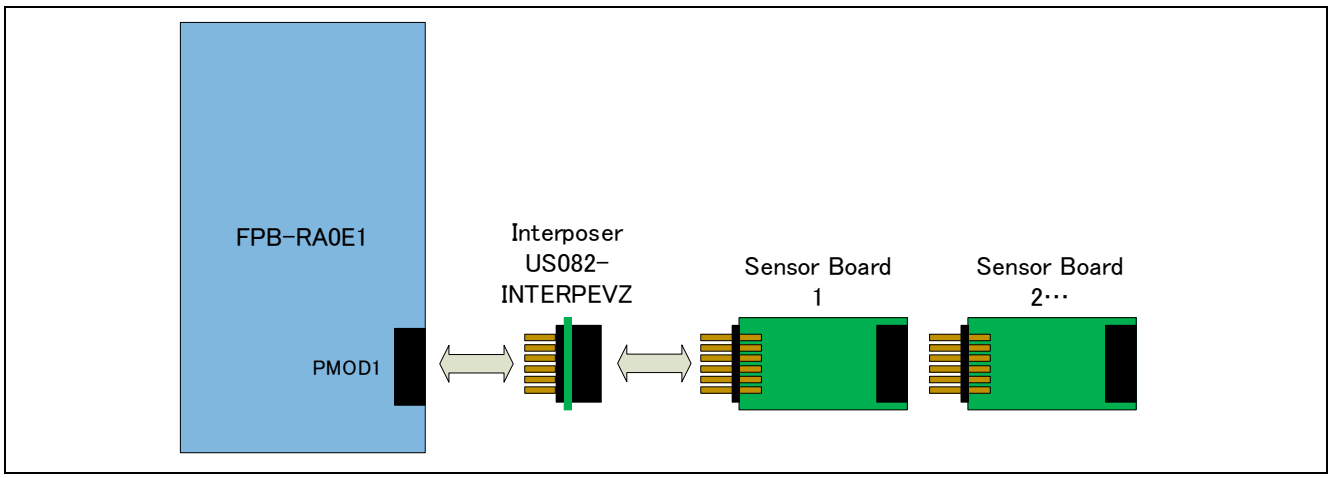


Figure 2-3 Hardware Connections for using IICA at Pmod Type 2A, Type 3A on FPB-RA0E1

2.2 Environment for Confirming Operation on RX Family MCU

The operation of this software has been confirmed on RX family MCU in the following environment.

(1) RX140 Fast Prototyping Board (FPB-RX140)

Table 2-6 Confirming Operating Environment for FPB-RX140

Item	Description
Demonstration board	RTK5FP1400S00001BE (FPB-RX140)
Microcontroller	RX140 (R5F51406BGFN: 80pin)
Operating frequency	48MHz
Operating voltage	5V
Integrated development environment	Renesas Electronics e^2 studio 2024-10
C compiler	Renesas Electronics CC-RX V.3.06.00 GCC for Renesas RX 8.3.0.202405
Configuration options	Add the following settings to the compiler default settings: CC-RX: C99 (-lang = c99), Optimization Level: Default settings (Level 2) GCC: ISO C99 (-std = c99), Optimization Level: Default settings (-Og)
FIT (RX Driver Package v1.45)	Board Support Packages (r_bsp) v7.51 GPIO Driver (r_gpio_rx) v5.10 RRH46410 Sensor Control Module (r_rrh46410_rx) v1.00 IIC Communication Middleware (r_comms_i2c_rx) v1.22 RIIC Multi Master I2C Driver (r_riic_rx) v3.00 Simple IIC Driver (r_sci_iic_rx) v2.80 IRQ Driver (r_irq_rx) v4.50 CMT Driver (r_cmt_rx) v5.70
RTOS	FreeRTOS Kernal 10.4.3-rx-1.0.9、FreeRTOS Object 10.4.3-rx-1.0.9
Emulator	On board (E2OB)
Interposer	Interposer Board for Pmod Type2/3 to 6A (US082-INTERPEVZ)
Sensor board	Digital Gas Sensor Module for Indoor Air Quality Applications (QCIOT-RRH46410POCZ)

Table 2-7 Memory Size Used in RX140 (When an Operation Mode with Maximum ROM Size Is Set)

Operation Mode	Area	Size (Non-OS) [Bytes] (CC-RX)	Size (Free RTOS) [Bytes] (CC-RX)
IAQ 2nd Gen	ROM	2,855	3,012
	RAM	313	305

Note Memory size is calculated for sample code, RRH46410 sensor control module, and COMMS_I2C. In RTOS, memory size does not include memory size of the thread.

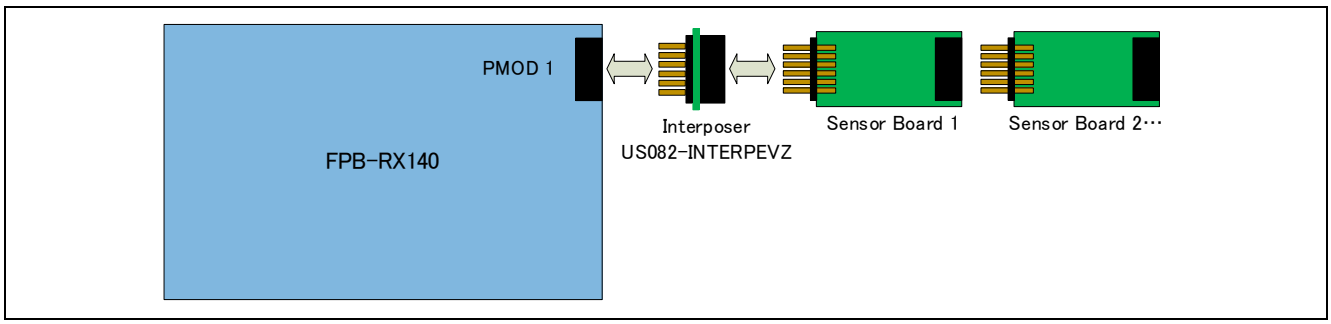


Figure 2-4 Hardware Connections for FPB-RX140

(2) Use of Interposer Board

If you add an Interposer Board to the Pmod Type 2A/Type 3A connector to which the SCI I/F is connected, you can use the Pmod Type 6A Sensor Pmod Board.

2.3 Environment for Confirming Operation on RL78/G23 Group MCU

The operation of this software has been confirmed on RL78/G23 group MCU in the following environment.

(1) RL78/G23-128p Fast Prototyping Board (RL78/G23-128p FPB)

Table 2-8 Confirming Operating Environment for RL78/G23-128p FPB

Item	Description
Demonstration board	RTK7RLG230CSN000BJ (RL78/G23-128p FPB)
Microcontroller	RL78/G23 (R7F100GSN2DFB :128pin)
Operating frequency	32MHz
Operating voltage	3.3V
Integrated development environment	Renesas Electronics e2 studio 2024-07
C compiler	Renesas Electronics CC-RL V1.14.00 LLVM for RL78 17.0.1.202409
Configuration options	Add the following settings to the compiler default settings. CC-RL: C99 (-lang = c99), Optimization Level: Default settings (-Odefault) LLVM: GNU ISO C99 (-std = gnu99), Optimization Level: Default settings (-Og)
SIS / CG	Board Support Packages (r_bsp) v1.70 Ports v1.5.0 RRH46410 Sensor Middleware (r_rrh46410) v1.00 IIC Communication Driver Interface Middleware (r_comms_i2c) v1.11 IIC Communication (Master mode) v1.6.0 Interrupt Controller v1.5.0 Interval Timer v1.5.0
Emulator	On board (COM Port)
Sensor board	Digital Gas Sensor Module for Indoor Air Quality Applications (QCIOT-RRH46410POCZ)

Table 2-9 Memory Size Used in RL78/G23 (When an Operation Mode with Maximum ROM Size Is Set)

Operation Mode	Area	Size (Non-OS) [Bytes] (CC-RL)
IAQ 2nd Gen	ROM	2,986
	RAM	240

Note Memory size is calculated for sample code, RRH46410 sensor control module, and COMMS_I2C.

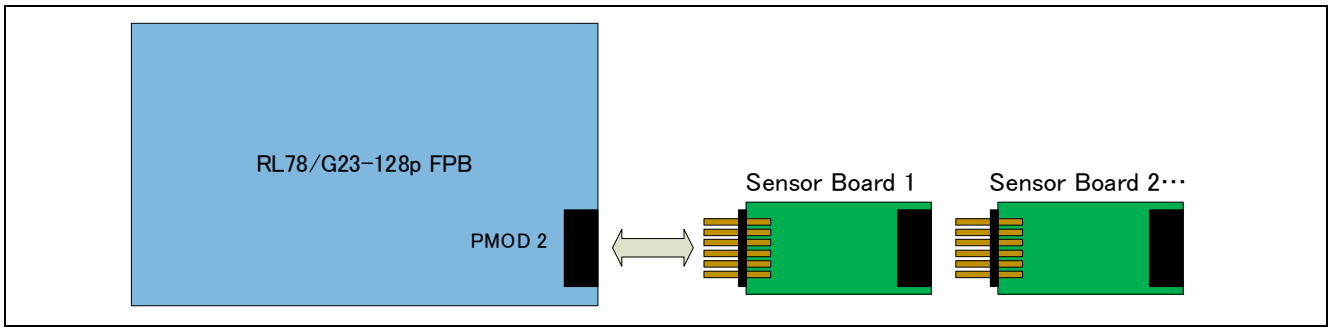


Figure 2-5 Hardware Connections for RL78/G23-128 FPB

(2) Use of Interposer Board

The Interposer Board is an I/F conversion board for connecting a Pmod Type 6A sensor by switching the Pmod Type 2A/Type 3A connector of an SCI I/F for RA/RX to the Simple IIC function.

Therefore, even if the Interposer Board is added to a Pmod Type 2A/Type 3A connector to which an SAU I/F is connected, the Pmod Type 6A Sensor Pmod Board cannot be used.

3. RRH46410 Sensor Specifications

3.1 Sensor Specifications Overview

The RRH46410 Gas Sensor Module is designed to detect typical TVOC contaminations based on studies and international standards for indoor air quality. Please refer to the RRH46410 datasheet for more information about the sensor module, including parameters that describe the module's characteristics.

3.2 Sensor Function and Methods

The RRH46410 architecture leverages different “Methods of Operation” which use time, temperature, and signatures from gases that enable unique signals from a highly trained machine learning system and makes use of embedded artificial intelligence (AI) technology. This section discusses the different operation modes of the RRH46410. At present, the following operation modes are released.

Family of IAQ software releases:

Operation Mode 1:	IAQ 2nd Generation	; IAQ, Relative IAQ, TVOC and eCO_2
Operation Mode 2:	IAQ 2nd Generation ULP	; IAQ, Relative IAQ, TVOC and eCO_2
Operation Mode 3:	PBAQ	; TVOC measurement to meet PBAQ standards

By default, the IAQ 2nd Generation (Mode 1) operation is recommended for new designs.

Additional technical information on sensitivity, selectivity, and stability for all operation modes is available in Renesas’ ZMOD4410 Application Note – TVOC Sensing. For more information, including application notes, white papers, blog, and manuals, visit the RRH46410 webpage.

3.2.1 Conversion of Output Data – Firmware / API / Algorithms

To operate the RRH46410, a firmware provided by Renesas containing an API and an example should be used. For implementing the sensor module in a customer-specific application, detailed information on the programming is available. For downloading these documents, please visit the RRH46410 webpage.

4. Specification of Sample Software

This sample software package contains a total of 8 projects:

- RA2E1 group: Non-OS project and OS (FreeRTOS) project
- RA0E1 group: Non-OS project
- RX140 group: Non-OS (CC-RX / GCC) projects and OS (FreeRTOS) project
- RL78/G23 group: Non-OS (CC-RL / LLVM) projects.

For the FreeRTOS settings for RX family, refer to the FAQ.

4.1 Sample Software Structure

The following shows the layer diagram of the sample software.

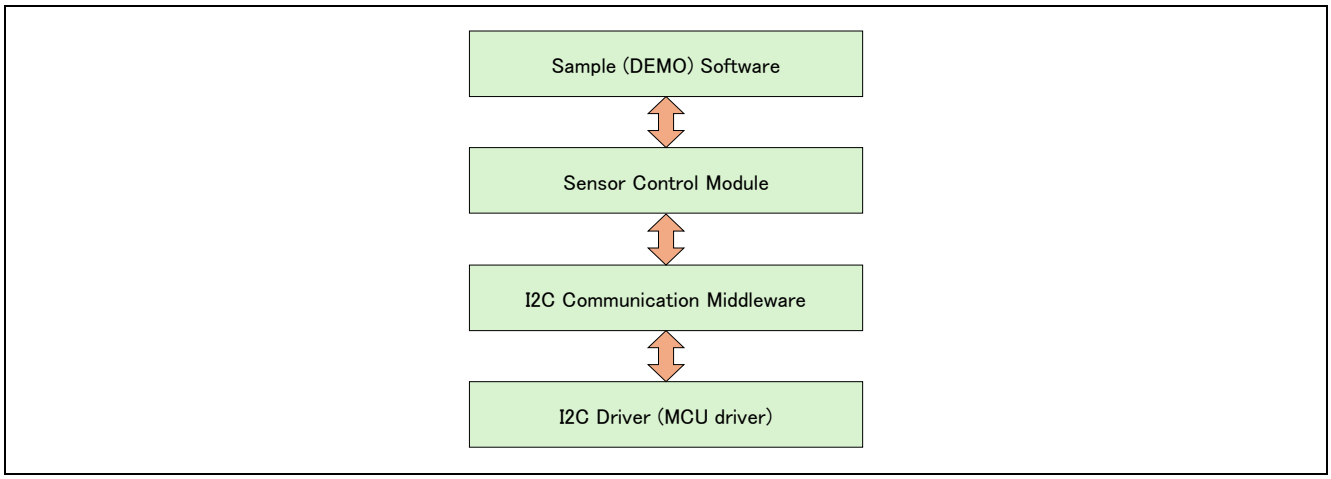


Figure 4-1 Layer diagram of Sample Software

4.2 Specification of Sensor Control Module API Functions

4.2.1 List of Sensor Control Module API Functions

The Sensor Control Module API includes the following functions.

For details on the Function API, see below.

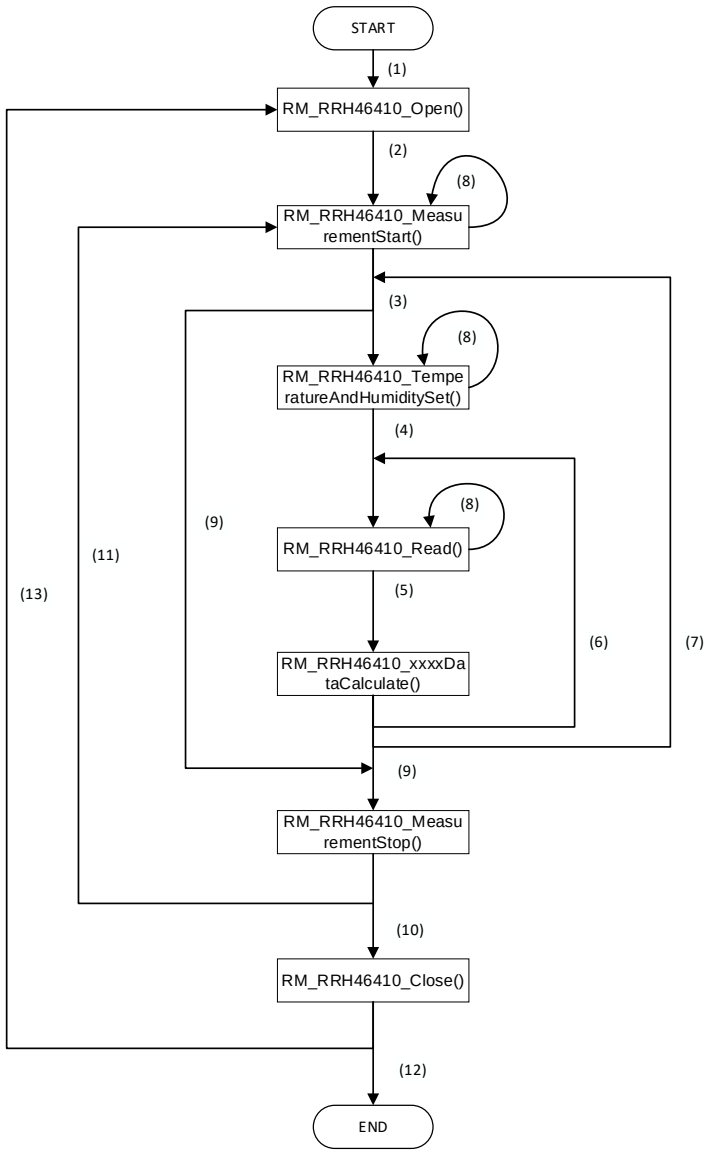
RA Flexible Software Package Documentation
Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)
Renesas Sensor Control Modules Software Integration System (R01AN6192)

Table 4-1 List of Sensor Control Module API Functions

Function	Feature
RM_RRH46410_Open()	Opens a sensor.
RM_RRH46410_Close()	Closes a sensor.
RM_RRH46410_MeasurementStart()	Starts measurement.
RM_RRH46410_MeasurementStop()	Stops measurement.
RM_RRH46410_Read()	Reads measurement data.
RM_RRH46410_TemperatureAndHumiditySet()	Sets humidity. Temperature is not supported. (IAQ_2nd_Gen operation and IAQ_2nd_Gen_ULP operation)
RM_RRH46410_Iaq2ndGenDataCalculate()	Calculates IAQ 2nd Gen. values from measurement data.
RM_RRH46410_PbaqDataCalculate()	Calculates PBAQ values from measurement data.

4.2.2 API Usage Guide

Figure 4-2 Transition of API Functions shows the transition diagram of functions calling order as the usage condition of API functions.



Flow No.	Function	Transition Case
(1)	Start RRH46410	not open RRH46410
(2)	Start Measurement	open success
(3)	set Humidity	user set data (IAQ 2nd Gen operation and IAQ 2nd Gen ULP operation)
(4)	Measurement data Read	acquire measurement data
(5)	calculate	Measurement data Read success (callback state success)
(6)	Retry Read	Measurement not finished
(7)	next measurement start	DataCalculate return success and next Measurement data Get
(8)	Retry Process	Waiting for response (callback none)
(9)	Stop measurement	user stop measurement
(10)	Close RRH46410	Stop measurement success
(11)	Restart measurement	Stop measurement success and user restart
(12)	Stop RRH46410	Close success
(13)	Restart RRH46410	Close success and user restart

Figure 4-2 Transition of API Functions

The calling conditions for each function are as follows:

- RM_RRH46410_Open(): (1) When starting RRH46410
  (13) When re-stating after RM_RRH46410_Close()
- RM_RRH46410_Close(): (10) After RM_RRH46410_MeasurementStop()
- RM_RRH46410_MeasurementStart(): (2) When starting measurement after RM_ RRH46410_Open()
  (11) When re-stating measurement after RM_RRH46410_MeasurementStop()
  (8) When retrying by waiting for measurement start response
- RM_RRH46410_MeasurementStop(): (9) When stopping measurement
- RM_RRH46410_Read(): (4) When acquiring measurement data
  (6) When retrying due to measurement not finished
  (8) When retrying due to waiting for data acquisition response
- RM_RRH46410_TemperatureAndHumiditySet(): (3) When setting humidity (IAQ 2nd Gen and IAQ 2nd Gen ULP, Improved calculation accuracy)
  (8) When retrying due to waiting for humidity set response
- RM_RRH46410_xxxxDataCalculate(): (5) When calculating data after RM_RRH46410_Read()
  “xxxx” is the name of each sensor function (Iaq2ndGen, Pbaq).

Note:

Since RM_RRH46410_Open() checks the state of the I2C driver, the I2C driver must be opened before the RM_RRH46410_Open() processing.

Regarding how to open the I2C driver of RA family and RX family, refer to the g_comms_i2c_bus0_quick_setup() function in the sample software. For RL78 family, this is not necessary because the I2C driver will be opened in the startup processing.

When using this API functions in an RTOS system, bus controlling by using semaphore by user is required if controlling the sensors at the same time in multiple threads/tasks.

4.3 Flowchart of Main Processing in Non-OS Version of Sample Software

This sample software first starts the driver and then repeats the processing for acquiring data from the sensor and calculating values from the results of measurement.

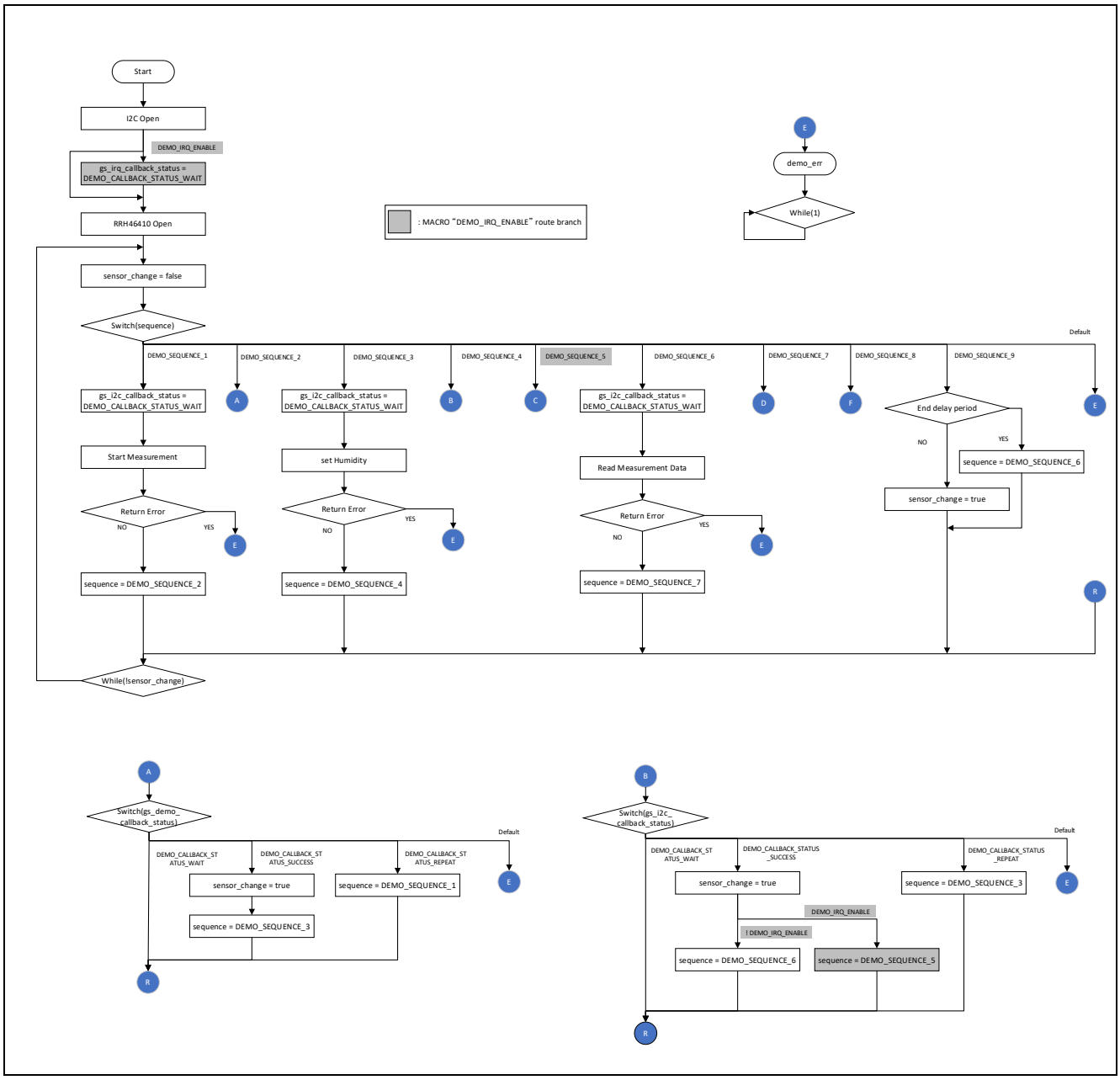


Figure 4-3 Flowchart of Main Processing in Non-OS Version of RRH46410 Sample Software (1)

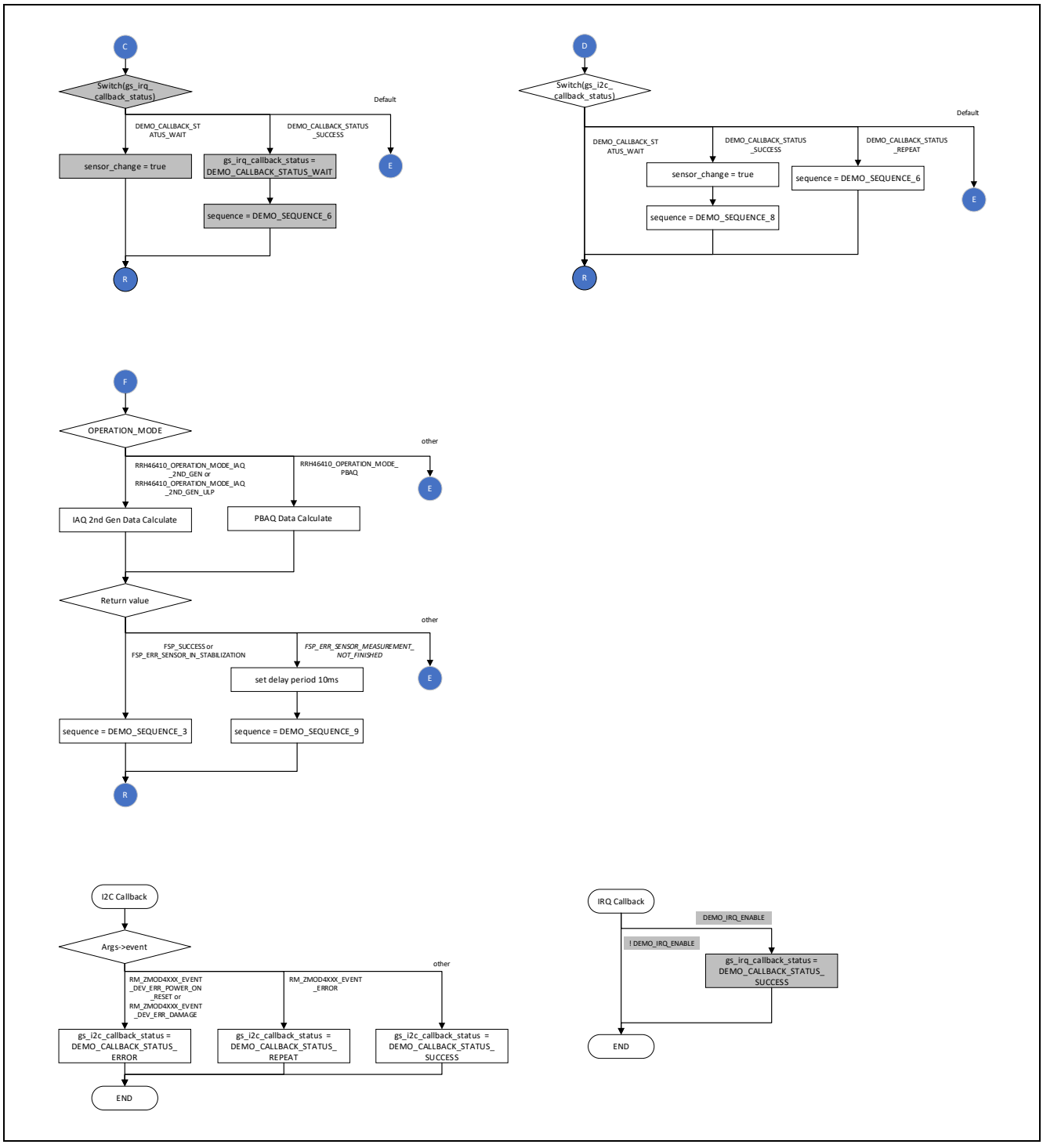


Figure 4-4 Flowchart of Main Processing in Non-OS Version of RRH46410 Sample Software (2)

4.4 Flowchart of OS Version of Sample Software

The OS version uses a semaphore in control of the sensor and operates a thread for controlling the sensor.

The sensor control in thread first starts the driver and then repeats the processing for acquiring data from the sensor and calculating values from the results of measurement.

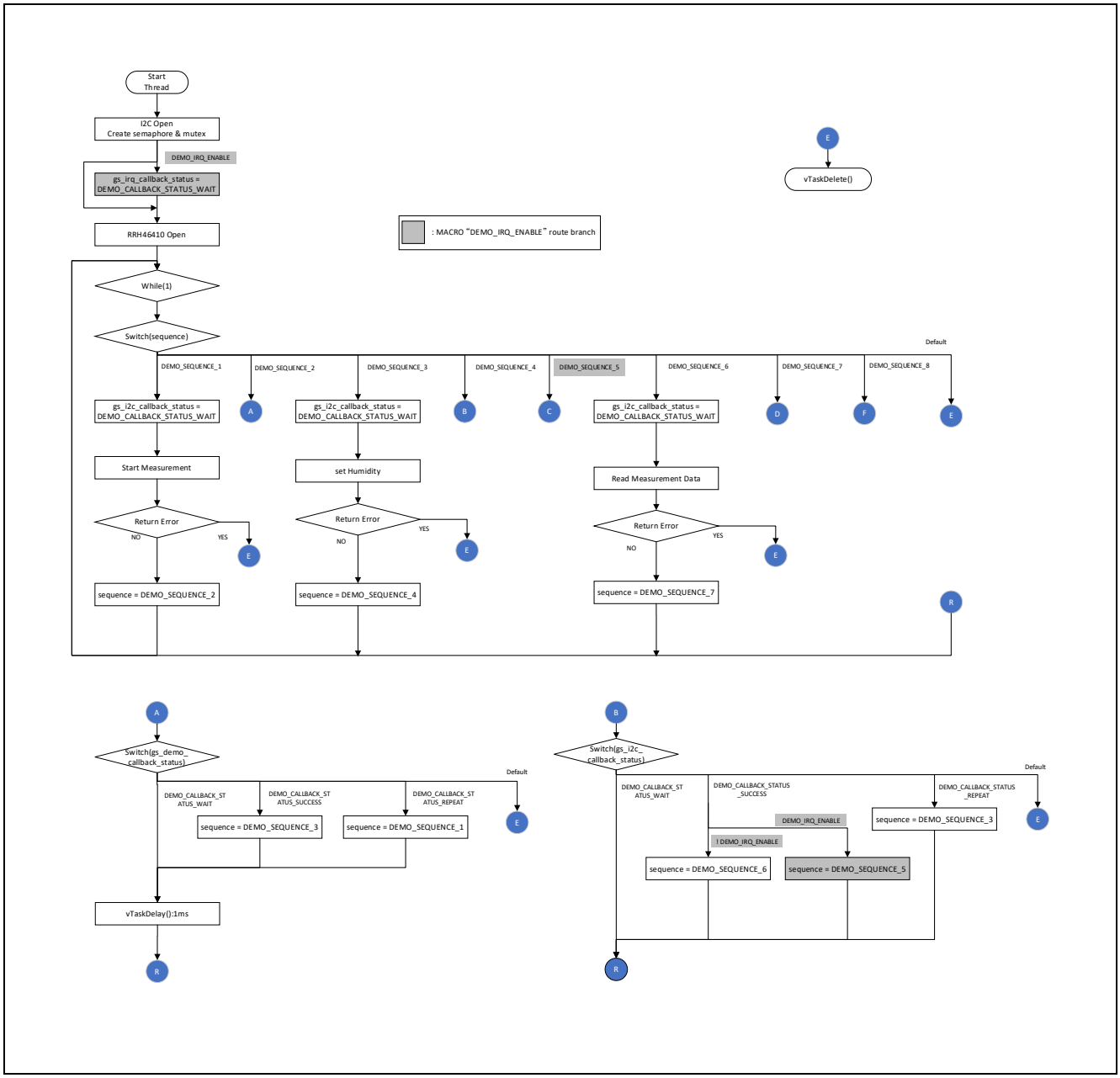


Figure 4-5 Flowchart of Main Processing in OS Version of RRH46410 Sample Software (1)

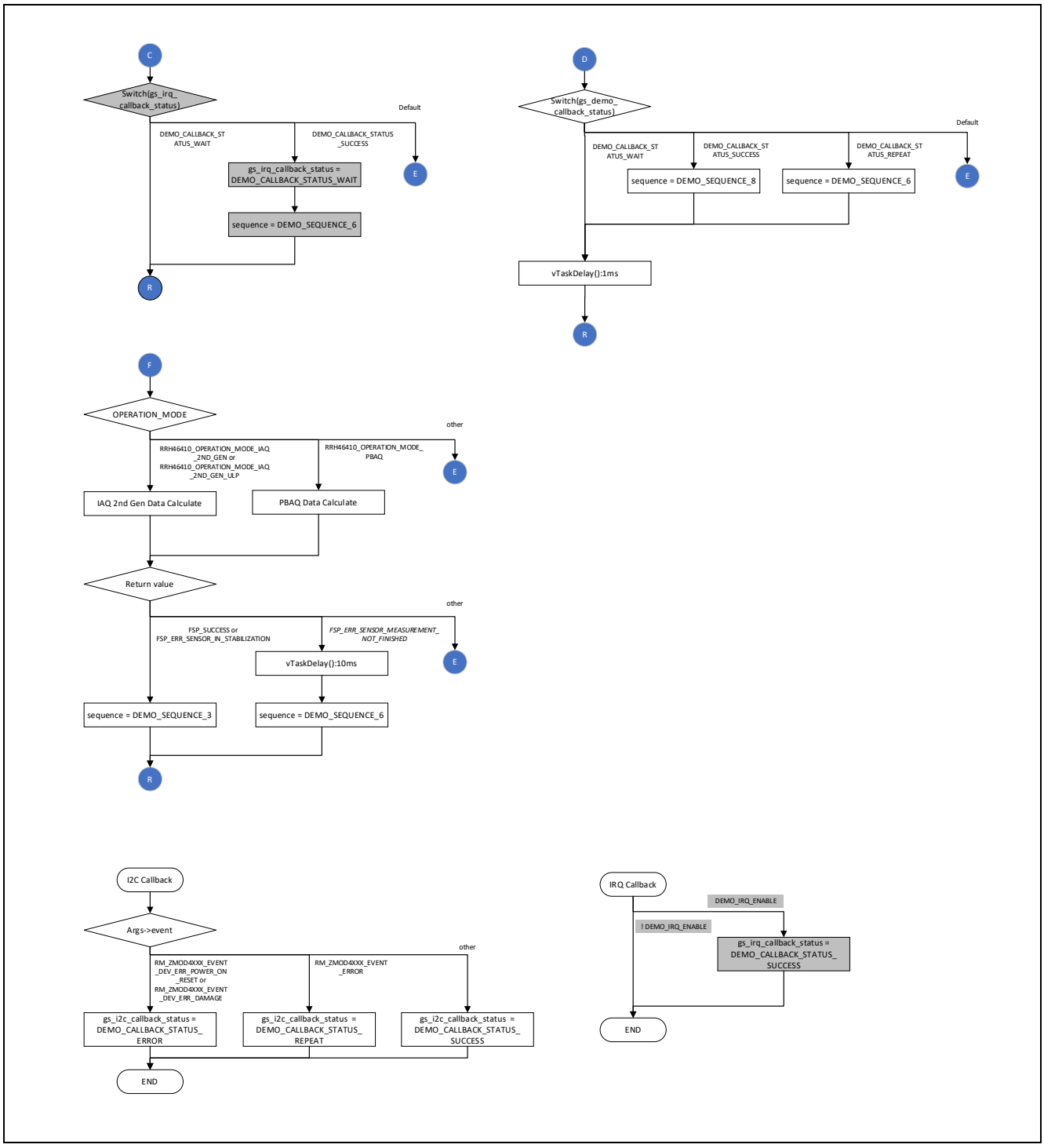


Figure 4-6 Flowchart of Main Processing in OS Version of RRH46410 Sample Software (2)

5. Configuration Settings

The following items and values can be specified.

Green setting value is an item selected by default, and Orange setting value is an item that cannot be changed.

For module names and callback function names, specify names that conform to the C language standard.

When using the different module version, the settings items and values shown below may differ.

5.1 RRH46410 Sensor Control Module Settings

5.1.1 RA Family

Select the **“rm_rrh46410”** stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

Table 5-1 RRH46410 Settings for RA Family

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP)	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
	Enabled	
	Disabled	
Operation Mode	IAQ 2nd Gen and Rel IAQ	Specify RRH46410 sensor operation mode.
	IAQ 2nd Gen ULP and Rel IAQ ULP	
	Public Building AQ Standard (PBAQ)	
Module g_rrh46410_sensor0 RRH46410 Gas Sensor Module (rm_rrh46410)		
Name	g_rrh46410_sensor0	Specify the name of the module.
Comms I2C Callback	rrh46410_comms_i2c_callback	Specify the name of the user callback function. When "NULL" is specified, no callback function is used.
IRQ Callback	rrh46410_irq_callback	Specify the IRQ user callback function name. When "NULL" is specified, no callback function is used.

5.1.2 RX Family

Select the **"r_rrh46410_rx"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items will be shown in the "Configure" panel.

Table 5-2 RRH46410 Settings for RX Family

Configurable Item	Value	Description
Configurations		
Parameter Checking	System Default Enabled Disabled	Specify the include parameter check processing in code. When "Disabled" is specified, excluding in the code. When "Enabled" is specified, including in the code.
Number of RRH46410 Sensors	1	Specify the number of RRH46410 sensor.
Operation mode of RRH46410 Sensor{x} (x = 0)	Not selected IAQ 2nd Gen. IAQ 2nd Gen. Ultra-Low Power PBAQ	Specify RRH46410 sensor operation mode.
I2C Communication device No. for RRH46410 sensor device{x} (x = 0)	I2C Communication Device{x} (x = 0 - 15)	Specify the communications device number to be used by the sensor.
I2C callback function for RRH46410 sensor device{x} (x = 0)	rrh4640_user_i2c_callback0	Specify the name of I2C callback function.
Enable IRQ from RRH46410 sensor device{x} (x = 0)	Disable Enable	Specify IRQ enable or disable.
IRQ Callback function for RRH46410 sensor device{x} (x = 0)	rrh46410_user_irq_callback0	Specify the name of IRQ callback function.
IRQ number for RRH46410 sensor device{x} (x = 0)	IRQ{x} (x = 0 - 15)	Specify valid IRQ number.
IRQ trigger for RRH46410 sensor device {x} (x = 0)	Low Level Falling Rising Both Edges	Specify IRQ trigger. When using RRH46410 Sensor Pmod Board, specify Falling. (Note 1)
IRQ interrupt priority for RRH46410 sensor device{x} (x = 0)	Priority{x} (x = 0 - 15)	Specify IRQ interrupt priority.

Note 1: The interrupt trigger setting depends on the interrupt signal circuit. For information of the interrupt circuit configuration, refer to "6.5 Notes for Interrupt Signal Circuits".
If the circuit configuration connects the RRH46410 INT signal directly to the MCU interrupt terminal, set it to "Rising".

5.1.3 RL78 Family

Select the **"r_rrh46410"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items will be shown in the "Configure" panel.

Table 5-3 RRH46410 Settings for RL78 Family

Configurable Item	Value	Description
Configurations		
Parameter Checking	System Default Enabled Disabled	Specify the include parameter check processing in code. When "Disabled" is specified, excluding in the code. When "Enabled" is specified, including in the code.
Number of RRH46410 Sensors	1	Specify the number of RRH46410 sensor.
Operation mode of RRH46410 Sensor{x} (x = 0)	Not selected IAQ 2nd Gen. IAQ 2nd Gen. Ultra-Low Power PBAQ	Specify RRH46410 sensor operation mode.
I2C Communication device No. for RRH46410 sensor device{x} (x = 0)	g_comms_i2c_device{x} (x = 0 - 4)	Specify the communications device number to be used by the sensor.
I2C callback function for RRH46410 sensor device{x} (x = 0)	rrh46410_user_i2c_callback0	Specify the name of I2C callback function.
Enable INTC from RRH46410 sensor device{x} (x = 0)	Disable Enable	Specify INTC enable or disable.
INTC Callback function for RRH46410 sensor device{x} (x = 0)	rrh46410_user_irq_callback0	Specify the name of INTC callback function.
INTC number for RRH46410 sensor device{x} (x = 0)	INTP{x} (x = 0 - 15)	Specify the number of INTC

5.2 I2C Communication Middleware (COMMS_I2C) Settings

5.2.1 RA Family

Select the **“rm_comms_i2c”** stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

Table 5-4 COMMS_I2C Settings for RA Family

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
Module g_comms_i2c_device0 I2C Communication Device (rm_comms_i2c)		
Name	g_comms_i2c_device0	Specify the name of the module.
Semaphore Timeout	0xFFFFFFFF	For an RTOS project, specify the time of semaphore timeout.
Slave Address	0x38	Specify the slave address. No setting is required as this will be overwritten by the Sensor Control module.
Address Mode	7-Bit	Specify the number of slave address bits. No setting is required as this will be overwritten by the Sensor Control module.
Callback	rm_rrh46410_comms_i2c_callback	Specify the name of the user callback function. No setting is required as this will be overwritten by the Sensor Control module.
Module g_comms_i2c_bus0 I2C Shared Bus (rm_comms_i2c)		
Name	g_comms_i2c_bus0	Specify the name of the I2C module.
Bus Timeout	0xFFFFFFFF	Specify the time of I2C bus timeout.
Semaphore for blocking	Unuse Use	For an RTOS project, enable or disable the blocking processing.
Recursive Mutex for Bus	Unuse Use	For an RTOS project, enable or disable the recursive operation when blocking processing is enabled.
Channel	0	Specify the channel number to be used. This setting is valid only when the I2C driver is “r_iic_master”. When using other I2C drivers, this setting is invalid.
Rate	Standard Fast-mode Fast-mode plus	Specify the bit rate. When using RRH46410, Standard or Fast-mode can be set. If other devices are connected on the same bus, set the transfer rate taking into consideration the transfer rate that can be set for those devices. When using “r_iica_master”, specify “Standard”due to the electrical characteristics of IICAx. When using “r_sci_i2c”, this setting is invalid.

5.2.2 RX Family

Select the **"r_comms_i2c_rx"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items are shown in the "Configure" panel.

Table 5-5 COMMS_I2C Settings for RX Family

Configurable Item	Value	Description
Configurations		
Parameter Checking	System Default Enabled Disabled	Specify the include parameter check processing in code. When "Disabled" is specified, excluding in the code. When "Enabled" is specified, including in the code.
Number of I2C Shared Buses	Unused 1 2 - 16	Specify the number of communications bus lines that can be connected.
Number of I2C Communication Devices	Unused 1 2 - 16	Specify the number of I2C device that can be connected.
Blocking operation supporting with RTOS	Disabled Enabled	For an RTOS project, enable or disable the blocking operation.
Bus lock operation supporting with RTOS	Disabled Enabled	For an RTOS project, enable or disable the bus lock operation.
I2C Driver Type for I2C Shared bus{x} (x = 0 - 15)	RIIC SCI IIC Not selected	Specify the I2C bus type to be used for the communication bus. When using the "RIIC", r_riic_rx is necessary. When using the "SCI IIC", "r_sci_iic_rx is necessary. If an unused FIT module is deleted, a warning message will appear, but this does not affect the operation.
Channel No. for I2C Shared bus{x} (x = 0 - 15)	0	Specify the I2C channel number to be used for the communication bus.
Timeout for the bus lock of I2C Shared Bus{x} (x = 0 - 15)	0xFFFFFFFF	Specify the time of I2C bus lock timeout.
I2C Shared Bus No. for I2C Communication Device{x} (x = 0 - 15)	I2C Shared Bus{x} (x = 0 - 15)	Specify the configuration of used communication bus.
Slave address for I2C Communication device{x} (x = 0 - 15)	0x00	Specify the slave address of the device to be connected to the communications bus. When using RRH46410, specify 0x38.
Address mode for I2C Communication device{x} (x = 0 - 15)	7 bit address mode	Specify the slave address mode. When using RRH46410, specify the 7-bit address mode.
Callback function for I2C Communication device{x} (x = 0 - 15)	comms_i2c_user_callback{x} (x = 0 - 15)	Specify the name of the user callback function. When using r_ rrh46410_rx, specify rm_ rrh46410_callback{y} (y = 0).
Timeout for the blocking bus of I2C Communication device{x} (x = 0 - 15)	0xFFFFFFFF	Specify the time of I2C bus blocking timeout.

5.2.3 RL78 Family

Select the **"r_comms_i2c"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items will be shown in the "Configure" panel.

Table 5-6 COMMS_I2C Settings for RL78 Family

Configurable Item	Value	Description
Configurations		
Parameter Checking	System Default Enabled Disabled	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
Number of I2C Shared Buses	Unused 1 2 - 5	Specify the number of communication bus lines that can be connected.
Number of I2C communication Devices	Unused 1 2 - 5	Specify the number of I2C devices can be connected.
I2C Driver Type for I2C Shared bus{x} (x = 0 - 4)	IICA SAU IIC Not selected	Specify the I2C type to be used for the communication bus. When using RRH46410, specify “IICA”.
Component name for the I2C bus{x} (x = 0 - 4)	Config_IIC00	Specify the I2C bus component name to be used for the communication bus.
I2C Shared Bus No. for I2C Communication Device{x} (x = 0 - 4)	I2C bus0 I2C bus1 I2C bus2 I2C bus3 I2C bus4	Specify the I2C bus configuration to be used for the communication bus.
Slave address for I2C Communication device{x} (x = 0 - 4)	0x00	Specify the slave address of the device to be connected to the communications bus. When using RRH46410, specify 0x38.
Callback function for I2C Communication device{x} (x = 0 - 4)	comms_i2c_user_callback{x} (x = 0 - 4)	Specify the name of the user callback function. When using r_rrh46410, specify rm_rrh46410_callback{y} (y = 0).

5.3 I2C Driver Settings

5.3.1 RA Family

Select the **“r_iic_master”**, **“r_sci_i2c”** or **“r_iica_master”** stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

Simplified I2C using Serial Array Unit (SAU) cannot be used because the clock stretch function is not supported.

(1) r_iic_master

Table 5-7 r_iic_master Settings for RA Family

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
DTC on Transmission and Reception	Enabled Disabled	Specify whether to use the DTC for transmission and reception.
10-bit slave addressing	Enabled Disabled	Specify whether to support 10-bit addressing for the slave address. No setting is required as this will be overwritten by COMMS_I2C.
Module g_i2c_master0 I2C Master (r_iic_master)		
Name	g_i2c_master0	Specify the name of the module.
Channel	0	Specify the channel number to be used. No setting is required as this will be overwritten by COMMS_I2C.
Rate	Standard Fast-mode Fast-mode plus	Specify the bit rate. No setting is required as this will be overwritten by COMMS_I2C.
Custom Rate (bps)	0	Specify the custom bit rate. This setting is valid when the value is other than 0. Use this setting when you want to set the low bitrate within the “Rate” setting range.
Rise Time (ns)	120	Specify the SCL rise time according to the specifications of the target board to be used.
Fall Time (ns)	120	Specify the SCL fall time according to the specifications of the target board to be used.
Duty Cycle (%)	50	Specify the SCL duty cycle.
Slave Address	0x00	Specify the slave address for the device to be connected. No setting is required as this will be overwritten by COMMS_I2C.
Address Mode	7-Bit 10-Bit	Specify the salve address mode for the device to be connected. No setting is required as this will be overwritten by COMMS_I2C.
Timeout Mode	Short Mode Long Mode	Specify the time of I2C bus timeout.
Timeout during SCL low	Enabled Disabled	Specify whether to timeout can occur when SCL is held low for a duration longer than what is set in the timeout mode.
Callback	rm_comms_i2c_callback	Set the user callback function name. No setting is required as this will be overwritten by COMMS_I2C.
Interrupt Priority Level	Priority 0 (highest) Priority 1 Priority 2 Priority 3	Specify the interrupt priority level of the I2C bus driver.
Pins		
SDA	Pxxx	The pin numbers to be used by the driver are displayed. Use the "Pins" tabbed page to modify the pin configuration.
SCL	Pxxx	

(2) r_sci_i2c

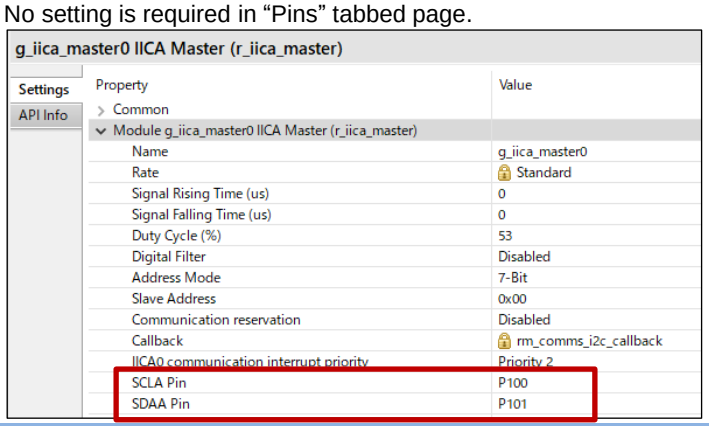
Table 5-8 r_sci_i2c Settings for RA Family

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP)	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
	Enabled	
	Disabled	
DTC on Transmission and Reception	Enabled	Specify whether to use the DTC for transmission and reception.
	Disabled	
10-bit slave addressing	Enabled	Specify whether to support 10-bit addressing for the slave address. No setting is required as this will be overwritten by COMMS_I2C.
	Disabled	
Module g_i2c0 I2C Master (r_sci_i2c)		
Name	g_i2c0	Specify the name of the module.
Channel	0	Specify the channel number to be used.
Slave Address	0x00	Specify the slave address for the device to be connected. No setting is required as this will be overwritten by COMMS_I2C.
Address Mode	7-Bit	Specify the salve address mode for the device to be connected. No setting is required as this will be overwritten by COMMS_I2C.
	10-bit	
Rate	Standard	Specify the bit rate. When using RRH46410, Standard or Fast-mode can be set. If other devices are connected on the same bus, set the transfer rate taking into consideration the transfer rate that can be set for those devices.
	Fast-mode	
Custom Rate (bps)	0	Specify the custom bit rate. This setting is valid when the value is other than 0. Use this setting when you want to set the low bitrate within the “Rate” setting range.
SDA Output Delay (nano seconds)	300	Specify the SDA output delay time.
Noise filter setting	Use clock signal divided by 1 with noise filter	Specify the noise filter to be used for input signals.
	Use clock signal divided by 2 with noise filter	
	Use clock signal divided by 4 with noise filter	
	Use clock signal divided by 8 with noise filter	
Bit Rate Modulation	Enable	Enable or disable the bit rate modulation function.
	Disable	
Callback	rm_comms_i2c_callback	Set the user callback function name. No setting is required as this will be overwritten by COMMS_I2C.
Interrupt Priority Level	Priority 0 (highest)	Specify the interrupt priority level of the I2C bus driver.
	Priority 1	
	Priority 2	
	Priority 3	
RX Interrupt Priority Level [Only used when DTC is enabled]	Priority 0 (highest)	When using DTC, specify the priority level of the reception interrupt.
	Priority 1	
	Priority 2	
	Priority 3	
	Disabled	
Pins		
SDA	Pxxx	The pin numbers to be used by the driver are displayed. Use the "Pins" tabbed page to modify the pin configuration.
SCL	Pxxx	

(3) r_iica_master

When configuring IICA using FSP v5.4.0 or higher, set “SCLA Pin” and “SDAA Pin” in “Stacks” tabbed page to Pin numbers only.

Table 5-9 r_iica_master Settings for RA Family

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
10-bit slave addressing	Enabled Disabled	Specify whether to support 10-bit addressing for the slave address. No setting is required as this will be overwritten by COMMS_I2C.
Module g_iica_master0 IICA Master (r_iica_master)		
Name	g_iica_master0	Specify the name of the module.
Rate	Standard Fast-mode Fast-mode plus	Specify the bit rate. No setting is required as this will be overwritten by COMMS_I2C.
Custom Rate (bps)	0	Specify the custom bit rate. This setting is valid when the value is other than 0. Use this setting when you want to set the low bitrate within the “Rate” setting range.
Signal Rising Times (us)	0	Specify the SCL rise time according to the specifications of the target board to be used.
Signal Falling Times (us)	0	Specify the SCL fall time according to the specifications of the target board to be used.
Duty Cycle (%)	53	Specify the SCL duty cycle.
Digital Filter	Enabled Disabled	Specify whether to use the digital filter.
Address Mode	7-Bit 10-Bit	Specify the salve address mode for the device to be connected. No setting is required as this will be overwritten by COMMS_I2C.
Slave Address	0x00	Specify the slave address for the device to be connected. No setting is required as this will be overwritten by COMMS_I2C.
Communication reservation	Enabled Disabled	Specify whether to use the communication reservation.
Callback	rm_comms_i2c_callback	Set the user callback function name. No setting is required as this will be overwritten by COMMS_I2C.
IICA0 communication interrupt priority	Priority 0 (highest) Priority 1 Priority 2 Priority 3	Specify the interrupt priority level of the I2C bus driver.
SCLA Pin	Pxxx	Specify the pin numbers to be used. No setting is required in “Pins” tabbed page.
SDAA Pin	Pxxx	

5.3.2 RX Family

Select the **"r_riic_rx"** or **"r_sci_iic_rx"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items will be shown in the "Configure" panel.

(1) r_riic_rx

Table 5-10 r_riic_rx Settings for RX Family

Configurable Item	Value	Description
Configurations		
Set parameter checking enable	System Default	Specify the include parameter check processing in code. When "Not" is specified, excluding in the code. When "Include" is specified, including in the code.
	Not	
	Include	
MCU supported channels for CH{x} (x = 0 - 2)	Not supported	Specify whether to support the operation of the channel. When "Not supported" is specified, excluding in the code. When "Supported" is specified, including in the code.
	Supported	
CH{x} RIIC bps(kbps) (x = 0 - 2)	400	Specify the bit rate. When using RRH46410, set it to 400kbps or less. If other devices are connected on the same bus, set the transfer rate taking into consideration the transfer rate that can be set for those devices.
Digital filter for CH{x} (x = 0 - 2)	Not	Specify the digital filter for input signals. When "Not" is specified, disable the digital filter.
	One IIC phi	
	Two IIC phi	
	Three IIC phi	
	Four IIC phi	
Setting port setting processing	Not include port setting	Specify whether to include the pin function settings in the code to be generated. When "Not include port setting" is specified, excluding in the code. When "Include port setting" is specified, including in the code.
	Include port setting	
Master arbitration lost detection function for CH{x} (x = 0 - 2)	Unused	Specify whether to use the master arbitration lost detection function. If using it in a multi-master environment, set it to "Used". When "Unused" is specified, disable. When "Used" is specified, enable.
	Used	
Address {y} format for CH{x} (x = 0 - 2, y = 0 - 2)	Not	Specify whether to support 7-bit addressing or 10-bit addressing for the slave address. When using RRH46410, select "7 bit address format". Do not connect devices with different address formats on the same bus.
	7 bit address format	
	10 bit address format	
Slave Address {y} for CH{x} (x = 0 - 2, y = 0 - 2)	0x0025	Specify the slave address of the designated device. No setting is required as this will be overwritten by COMMS_I2C.
General call address for CH{x}	Unused	Specify whether to use the general call function. When "Unused" is specified, disable. When "Used" is specified, enable.
	Used	
CH{x} RXI INT Priority Level (x = 0 - 2)	Level 1	Specify the priority level of the reception interrupt.
	Level 2	
	…	
	Level 14	
	Level 15 (highest)	

CH{x} TXI INT Priority Level (x = 0 - 2)	Level 1 Level 2 … Level 14 Level 15 (highest)	Specify the priority level of the transmission interrupt.
CH{x} EEI INT Priority Level (x = 0 - 2)	Level 1 Level 2 … Level 14 Level 15 (highest)	Specify the priority level of the error interrupt.
CH{x} TEI INT Priority Level (x = 0 - 2)	Level 1 Level 2 … Level 14 Level 15 (highest)	Specify the priority level of the transmission end interrupt.
Timeout function for CH{x} (x = 0 - 2)	Unused Used	Specify whether to use the timeout function. When “Unused” is specified, disable. When “Used” is specified, enable.
Timeout detection time for CH{x} (x = 0 - 2)	Long mode Short mode	Specify the time for timeout detection. When “Long mode” is specified, select the long mode. When “Short mode” is specified, select the short mode.
Count up during low period of timeout detection for CH{x} (x = 0 - 2)	Unused Used	Specify whether to increment the counter for detecting a timeout while SCL is at the low level when the “Timeout function” for the specified channel is enabled. When “Unused” is specified, disable. When “Used” is specified, enable.
Count up during high period of timeout detection for CH{x} (x = 0 - 2)	Unused Used	Specify whether to increment the counter for detecting a timeout while SCL is at the high level when the “Timeout function” for the specified channel is enabled. When “Unused” is specified, disable. When “Used” is specified, enable.
Set Counter of checking bus busy	1000	Specify the counter value to be judged to represent the bus busy state.
Resources		
SCLx Pins	Checked Unchecked	Specify the pins to be used. Set the pin to “Checked”.
SDAx Pins	Checked Unchecked	

(2) r_sci_iic_rx

Table 5-11 r_sci_iic_rx Settings for RX Family

Configurable Item	Value	Description
Configurations		
Set parameter checking enable	System Default	Specify the include parameter check processing in code. When “Not” is specified, excluding in the code. When “Include” is specified, including in the code.
	Not	
	Include	
MCU supported channels for CH{x} (x = 0 - 12)	Not supported	Specify whether to support the operation of channel.
	Supported	
SCI IIC bitrate (bps) for CH{x} (x = 0 - 12)	384000	Specify the bit rate. When using RRH46410, set it to 38400bps or less. If other devices are connected on the same bus, set the transfer rate taking into consideration the transfer rate that can be set for those devices.
Interrupt Priority for CH{x} (x = 0 - 12)	Level 1	Specify the interrupt priority level.
	Level 2	
	…	
	Level 14	
	Level 15 (highest)	
Digital noise filter (NFEN bit) for CH{x} (x = 0 - 12)	Disable	Specify whether to use the digital noise filter.
	Enable	
Noise Filter Setting Register (NFCS bit) for CH{x} (x = 0 - 12)	The clock divided by 1	Specify the sample clock of the digital noise filter.
	The clock divided by 2	
	The clock divided by 4	
	The clock divided by 8	
I2C Mode Register 1 (IICDL bit) for CH{x} (x = 0 - 12)	18	Specify the number of SDA output delay cycles relative to the falling edge of SSCL pin output. Set in the range of 1 to 31.
Software bus busy check counter	1000	Specify the counter value to be judged to represent the bus busy state.
Port Setting Processing	Not include port setting	Specify whether to include the pin function settings in the code for using the ports as SSCL and SSDA pins. Not include port setting: Omitted from the code. Include port setting: Included in the code
	Include port setting	
Resources		
SSCLx Pins	Checked	Specify the pins to be used. Set the pin to “Checked”.
	Unchecked	
SSDAx Pins	Checked	
	Unchecked	

5.3.3 RL78 Family

Select **"IICAx"** as resource the IIC Communication (Master mode) component in the Smart Configurator, and the configurable items will be shown in the “Configure” panel.

Simplified I2C using Serial Array Unit (SAU) cannot be used because the clock stretch function is not supported.

(1) IICAx

Table 5-12 IICAx Settings for RL78 Family

Configurable Item	Value	Description
Configurations		
Clock mode setting	fCLK	Specify the clock to drive counting.
	fCLK/2	
Address	16	Specify the local address.
Operation mode setting	Standard	Specify the operating mode. When using RRH46410, Standard or Fast-mode can be set. If other devices are connected on the same bus, set the transfer rate taking into consideration the transfer rate that can be set for those devices.
	Fast mode	
	Fast mode plus	
Digital filter on	Checked	Specify whether to use the digital filtering.
	Unchecked	
Transfer clock (fSCL)	100000	Specify the bit rate. Due to the electrical characteristics of IICAx, specify 100000bps or less.
Set tR and tF manually	Checked	Manually set the SDAAn and SCLAn signal rising / falling times.
	Unchecked	
tR	0	Specify the SDAAn and SCLAn signal rising times.
tF	0	Specify the SDAAn and SCLAn signal falling times.
Communication end interrupt priority (INTIICAx)	Level0 (high)	Specify the priority level of the communication end interrupt.
	Level1	
	Level2	
	Level3 (low)	
Master transmission end	Checked	Specify whether to use the callback function when master transmission ends.
	Unchecked	
Master reception end	Checked	Specify whether to use the callback function when master reception ends.
	Unchecked	
Master error	Checked	Specify whether to use the callback function when a communication error occurs.
	Unchecked	
Generated stop condition in master transmission / reception end callback function	Checked	Specify whether to generate a stop condition in the callback function. Set to “Unchecked”.
	Unchecked	

5.4 IRQ Driver Settings

For information on matching the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

5.4.1 RA Family

Select the **“r_icu”** stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following is a configuration example for the RRH46410 Sensor Pmod Board.

Table 5-13 r_icu Settings for RA Family

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP)	Specify the include parameter check processing in code. When “Disabled” is specified, excluding in the code. When “Enabled” is specified, including in the code.
	Enabled	
	Disabled	
Module g_external_irq0 External IRQ (r_icu)		
Name	g_external_irq0	Specify the name of the module.
Channel	0	Specify the channel number to be used.
Trigger	Falling	Specify the trigger. When using RRH46410 Sensor Board, select "Falling". (Note 1)
	Rising	
	Both Edges	
	Low Level	
Digital Filtering	Enabled	Specify whether to use the digital filtering.
	Disabled	
Digital Filtering Sample Clock (Only valid when Digital Filtering is Enabled)	PCLK / 1	Specify the sample clock of digital filtering.
	PCLK / 8	
	PCLK / 32	
	PCLK / 64	
Callback	rm_rrh46410_irq_callback	Set the user callback function name. The name of the user callback function is automatically specified by r_icu.
Pin Interrupt Priority	Priority 0 (highest)	Specify the interrupt priority level of the IRQ driver.
	Priority 1	
	Priority 2	
	Priority 3	
Pins		
IRQ	Pxxx	The pin numbers to be used by the driver are displayed. Use the "Pins" tabbed page to modify the pin configuration.

Note 1: The interrupt trigger setting depends on the interrupt signal circuit. For information of the interrupt circuit configuration, refer to "6.5 Notes for Interrupt Signal Circuits".
If the circuit configuration connects the RRH46410 INT signal directly to the MCU interrupt terminal, set it to "Rising".

5.4.2 RX Family

Select the **"r_irq_rx"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items will be shown in the "Configure" panel.

The following is a configuration example for the RRH46410 Sensor Pmod Board.

Table 5-14 r_irq_rx Settings for RX Family

Configurable Item	Value	Description
Configurations		
Locking function for IRQ APIs	Enabled	Enable or disable the locking functions for the IRQ APIs.
	Disabled	
Set parameter checking enable	System Default	Specify the include parameter check processing in code. When "Disabled" is specified, excluding in the code. When "Enabled" is specified, including in the code.
	Not	
	Include	
Filter for IRQ{x} (x = 0 - 15)	Enabled	Specify whether to use the digital filtering.
	Disabled	
Filter clock divisor for IRQ{x} (x = 0 - 15)	Divisor 1	Specify the sample clock of digital filtering.
	Divisor 8	
	Divisor 32	
	Divisor 64	
IRQx Pins	Checked	Specify the pins to be used. Set the pin to "Checked".
	Unchecked	

5.4.3 RL78 Family

Select the **"Interrupt Controller"** component on the "Component" tabbed page of the Smart Configurator, and the configurable items will be shown in the "Configure" panel.

The following is a configuration example for the RRH46410 Sensor Pmod Board.

Table 5-15 Interrupt Controller Settings for RL78 Family

Configurable Item	Value	Description
Configurations		
INTP{x} (x = 0 - 11)	Checked	Enable or disable INTP{x}. (x = 0 - 11)
	Unchecked	
Valid edge	Falling edge	Specify the trigger. When using RRH46410 Sensor Board, select "Falling". (Note 1)
	Rising edge	
	Both edges	
Priority	Level 0 (high)	Specify the interrupt priority level of the INTP{x}. (x = 0 - 11)
	Level 1	
	Level 2	
	Level 3 (low)	

Note 1: The interrupt trigger setting depends on the interrupt signal circuit. For information of the interrupt circuit configuration, refer to "6.5 Notes for Interrupt Signal Circuits".
If the circuit configuration connects the RRH46410 INT signal directly to the MCU interrupt terminal, set it to "Rising".

6. Guide for Changing Target Device

Use the following procedures to change the target device to a new one and run a sample project on the new device.

Therefore, you will need to review the following settings according to the user target circuit.

— Interrupt Signal Circuit: Refer to “6.5 Notes for Interrupt Signal Circuits”.
— RESET Signal Circuit: Refer to “6.6 Notes for RESET Signal Circuits”.

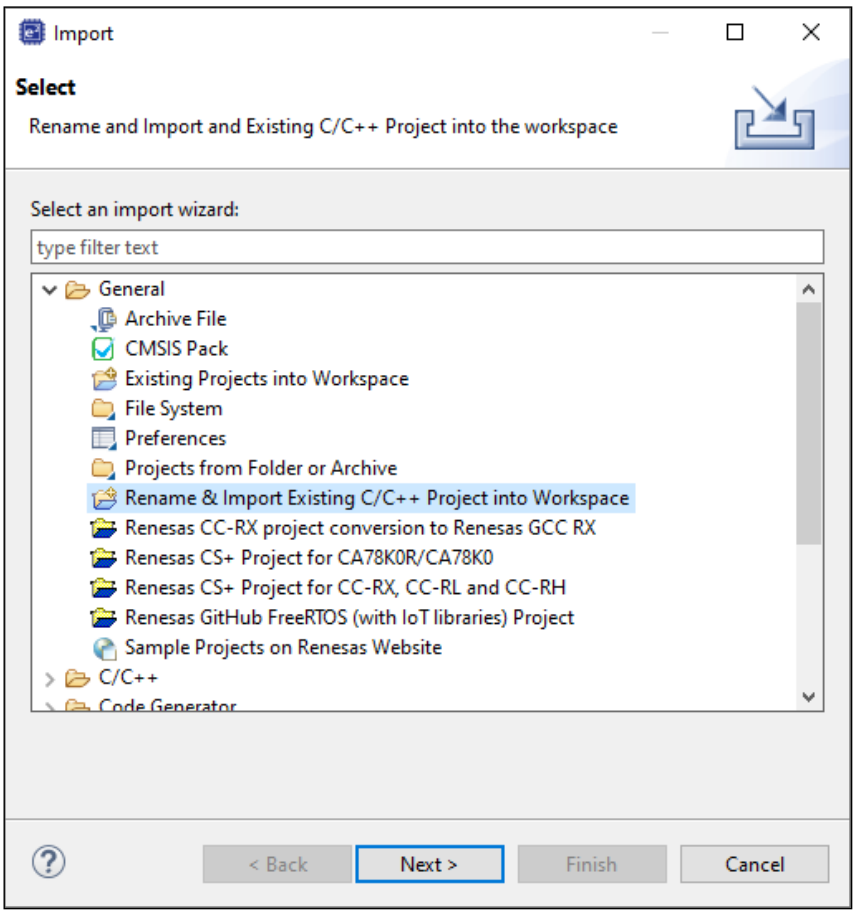
6.1 Importing Sample Project

To change a device in a sample project, need to import.

To import a sample project, follow the steps below.

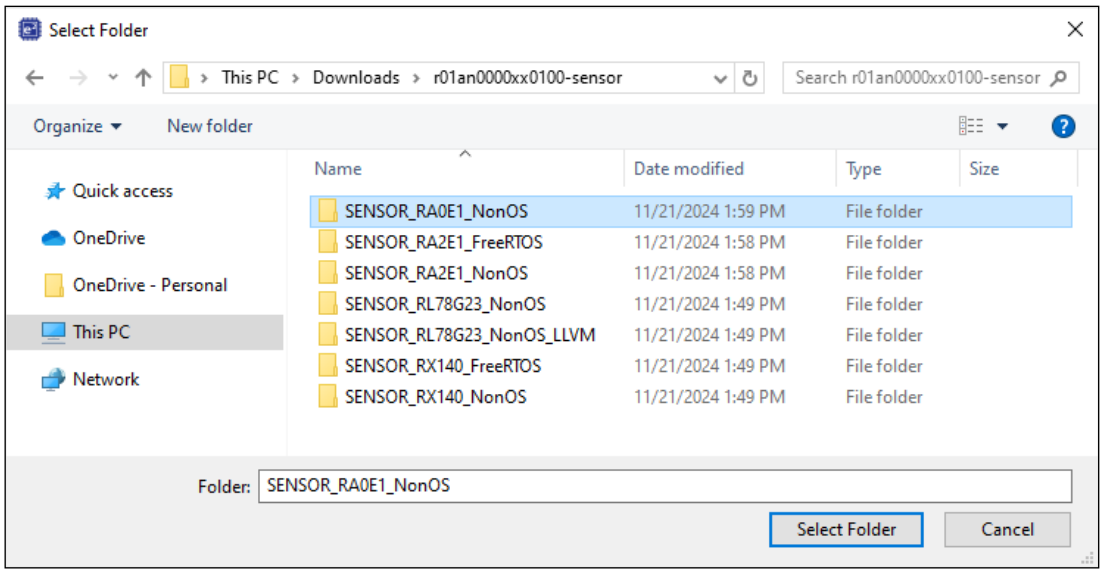
1. Select [Import] from the menu.

The "Import" window will appear. Select "Rename & Import Existing C/C++ Project into Workspace" in the window and press the [Next] button.

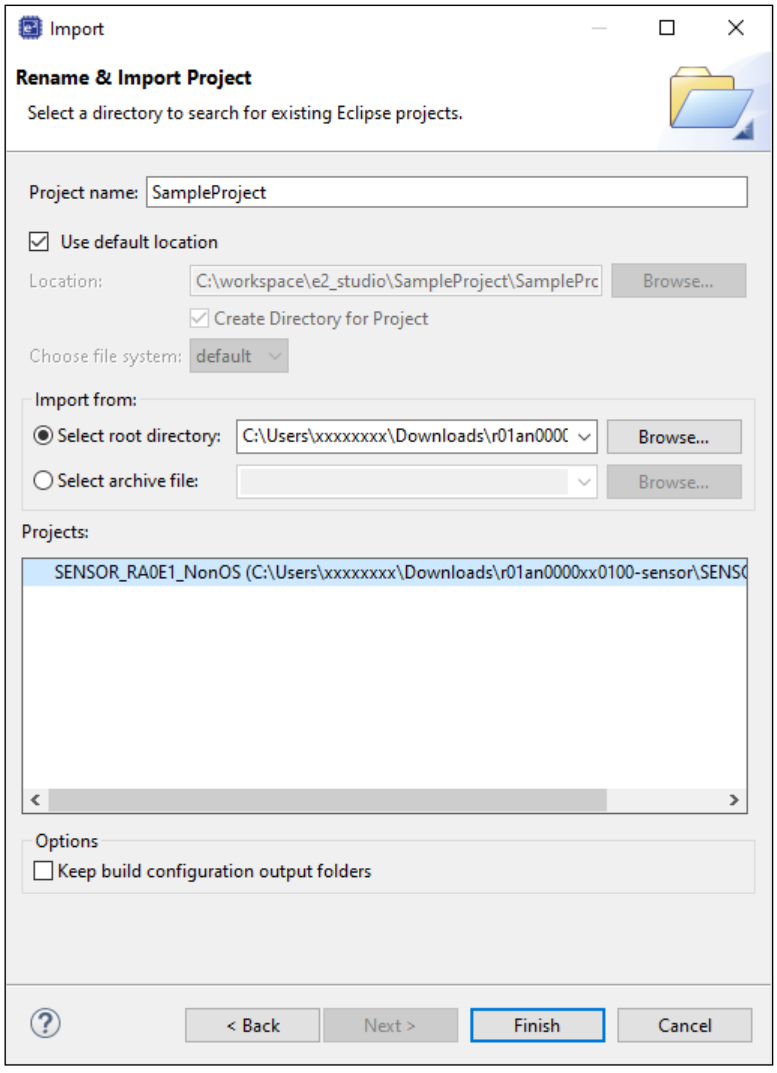


2. Press the [Browse] button to open the "Select Folder" window.

Select the folder of the original project for the current device from a list of imported sample projects and press the [Select Folder] button.



3. Enter the project name, select the original project for the current device, and press the [Finish] button.



6.2 RA Sample Project

After importing the sample projects, follow the steps below. Please refer to “6.1 Importing Sample Project” for importing instructions.

The following explains the change procedure for the following board change example. In addition, an Interposer Board is required when using a Pmod Type 2A/3A connector.

- Sample Project "RRH46410_RA2E1_NonOS":
  Pmod1 (Type 2A/3A: SCI0)
  → Pmod1 (Option Type 6A: IIC1) or Pmod2 (Type 2A: SCI0) of the EK-RA6M4 board

6.2.1 Modifying Settings of FSP Configurator

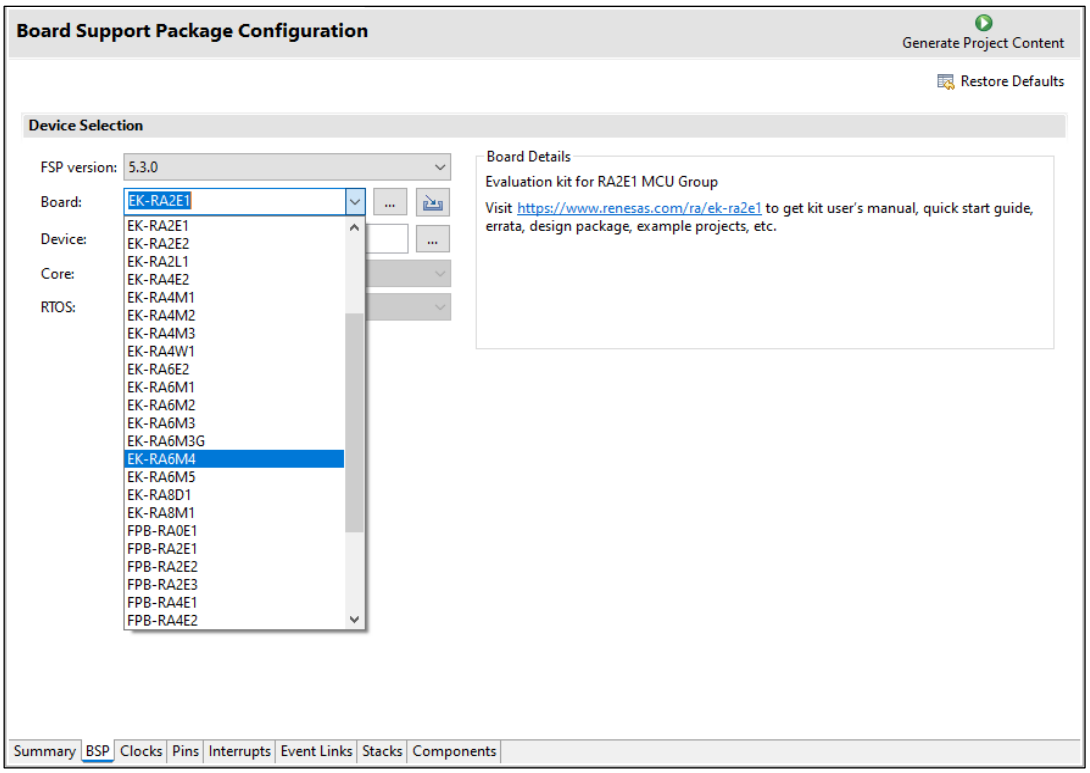
Double-click on "Configuration.xml" in the project tree to open the FSP Configurator.

(1) BSP

Change the settings of "Board" and "Device" in the "BSP" tabbed page.

When selecting a Renesas board, modify the "Board" setting only.

When selecting a board provided from other companies, change the "Board" setting to "Custom User Board (Any Device)" and then change the "Device" setting to the new device to be used.

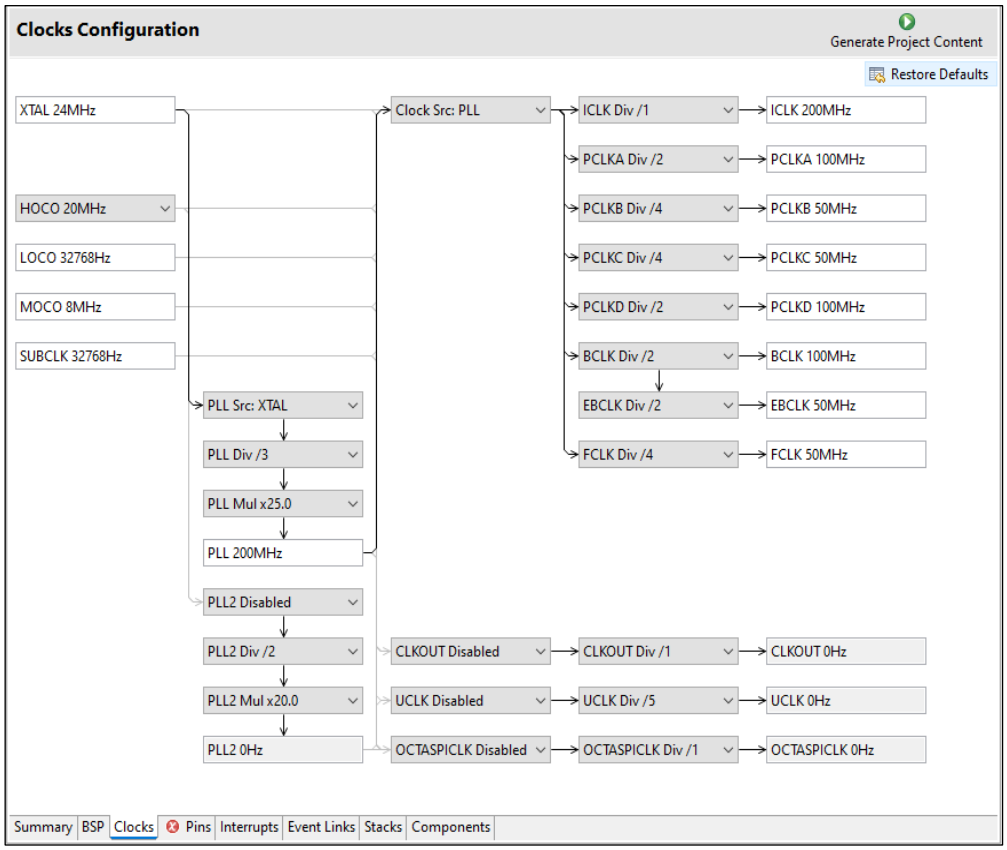


(2) Clocks

Set up the clocks in the "Clocks" tabbed page.

When "Custom User Board (Any Device)" is selected for "Board", set up the clocks according to the specifications of the target board to be used.

When a Renesas board is selected for "Board", the clocks are automatically set up.

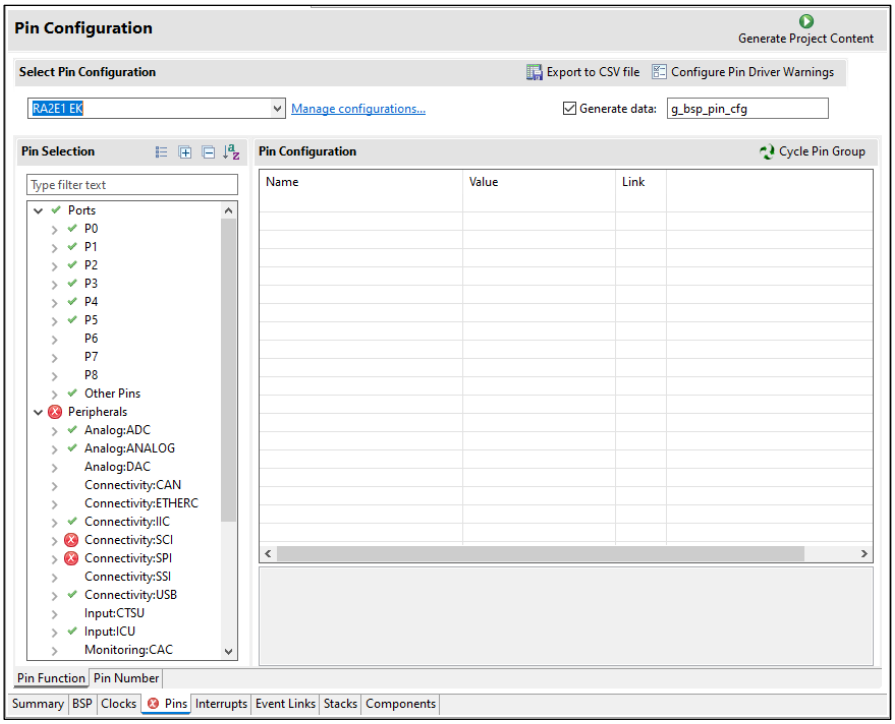


(3) Pins

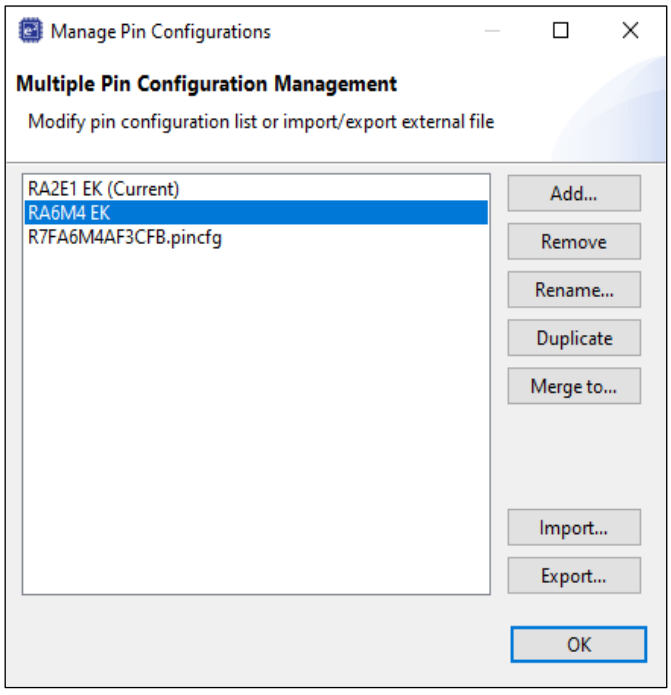
(a) Changing Board

In the “Pins” tabbed page, modify the pin configuration according to the specifications of the target board to be used.

When using a Renesas board, change the selection for "Select Pin Configuration" from ”RA2E1 EK” to the target board; appropriate pins are automatically assigned.



If the desired board is not displayed in the drop-down list for "Select Pin Configuration", click on [Manage Configuration] to open the "Manage Pin Configurations" window and select the desired board in the window.



(b) Changing I2C I/F Pins

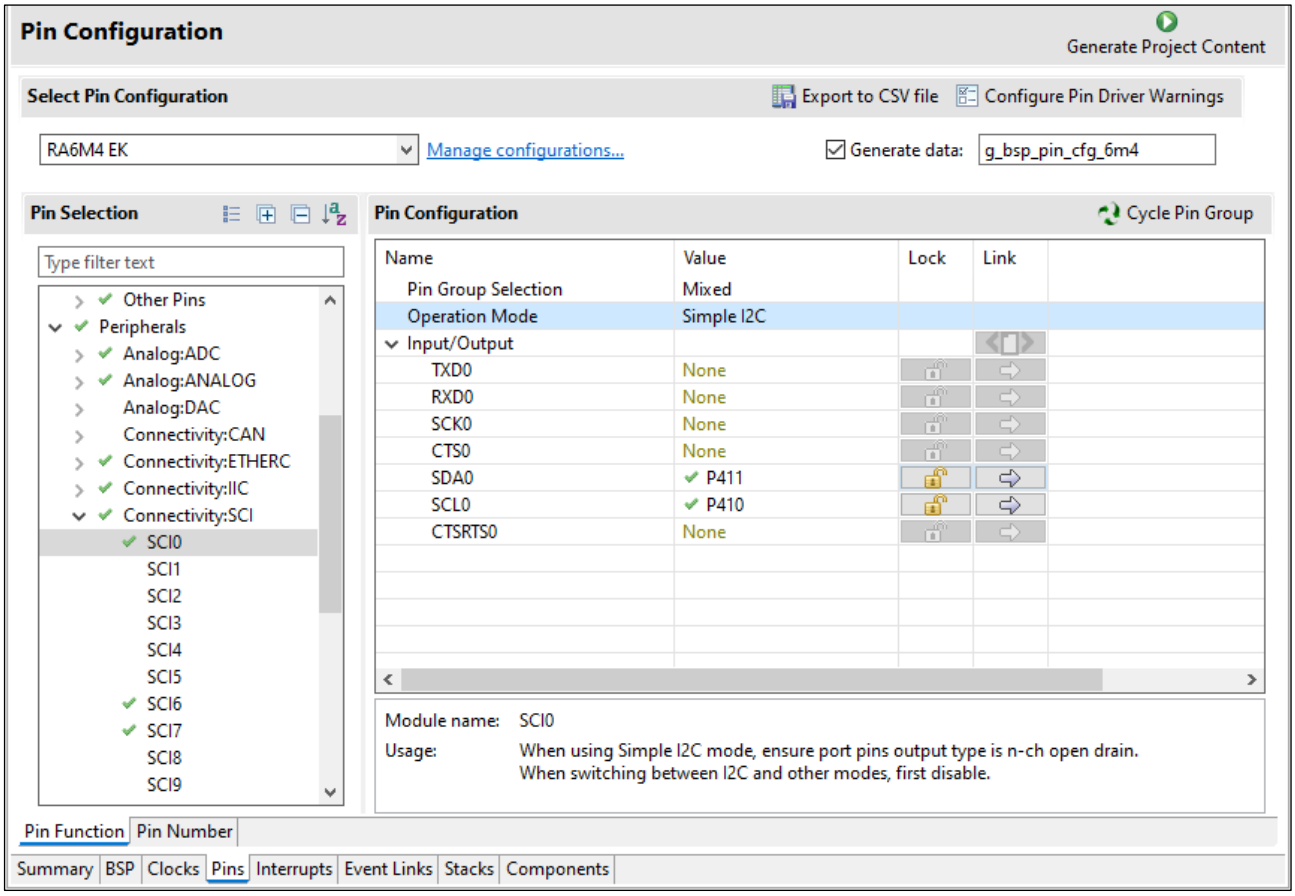
However, the assignment on the above “(a)Changing Board” will apply the SPI communication pin settings that support Pmod Type 2A on the EK-RA6M4 board.

This sample software uses Pmod Type 6A, therefore it is necessary to change the I2C communication pin settings that support Pmod Type 6A.

IIC1 (Pmod1 #3 P512 SCL1 and Pmod1 #4 P511 SDA1) is assigned to Pmod1 and SCI0 (Pmod2 #3 P410 SCL0 and Pmod2 #2 P411 SDA0) is assigned to Pmod2 on the EK-RA6M4 board.

Therefore, the pins used for I2C communication are as follows, so after automatic assignment of "Select Pin Configuration", reconfigure in "Pin Configuration":

- When using Pmod1 (Option Type 6A), set SCL1 to P512 and SDA1 to P511.
- When using Pmod2 (using the Interposer Board), set SCL0 to P410 and SDA0 to P411.



(c) Changing IRQ Pin

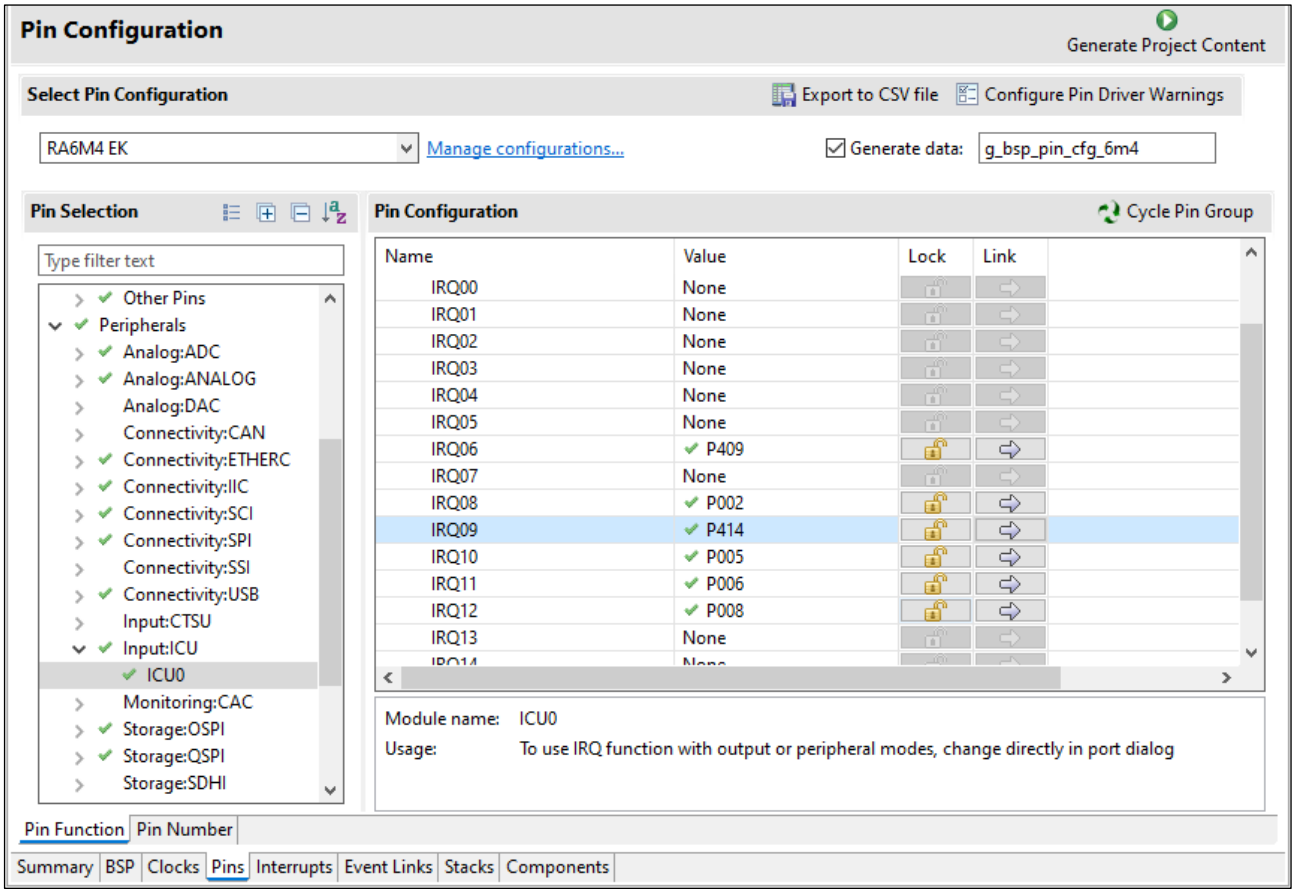
For information on configuring the pin of the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

Set the IRQ pin to match the interrupt signal pin of the sensor.

P301 IRQ06 is assigned to Pmod1 #1 and P414 IRQ09 is assigned to Pmod2 #7 on the EK-RA6M4 board.

Therefore, set the IRQ pin as follows:

- When using Pmod1 (Option Type 6A), set IRQ06 pin to P301.
- When using Pmod2 (using the Interposer Board), set IRQ09 pin to P414.



(d) Changing General Purpose I/O Port Pin: RESET

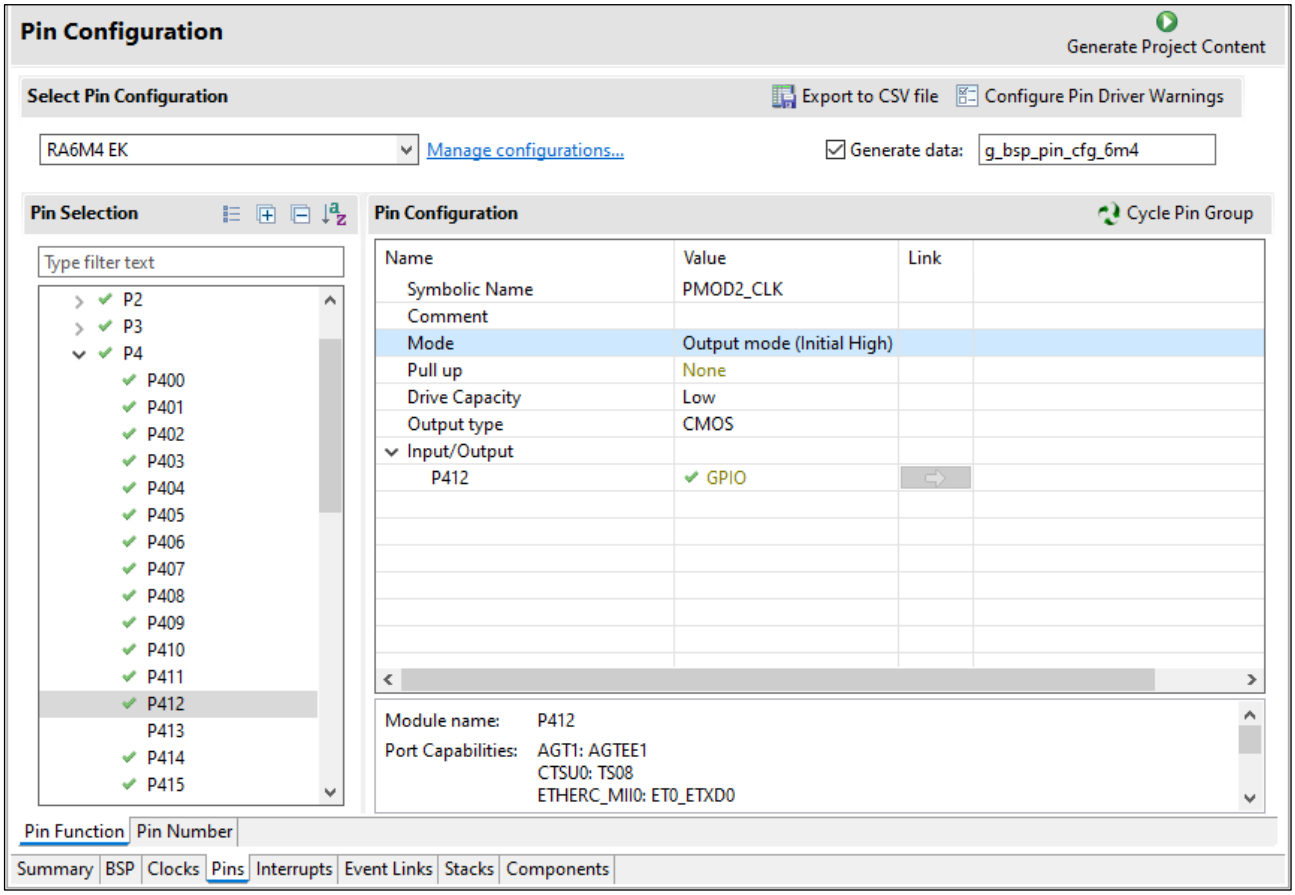
For information on configuring the pin of the RESET signal circuit, refer to “6.6 Notes for RESET Signal Circuits”.

Set the RESET pin to match the RESET signal pin of the sensor.

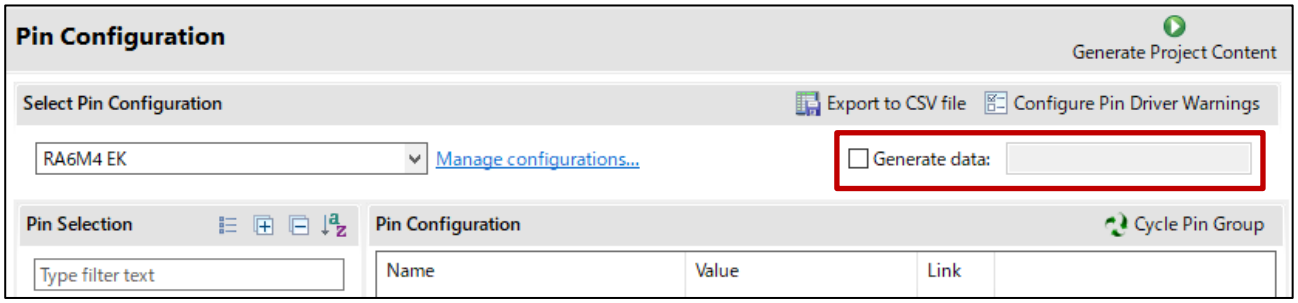
P203 Port is assigned to Pmod1 #2 and P412 Port is assigned to Pmod2 #4 on the EK-RA6M4 board.

Therefore, set the RESET pin as follows:

- When using Pmod1 (Option Type 6A), set P203 to GPIO Port Output pin.
- When using Pmod2 (using the Interposer Board), set P412 to GPIO Port Output pin.
  For both, select "Output mode (Initial High)" as “Mode”.



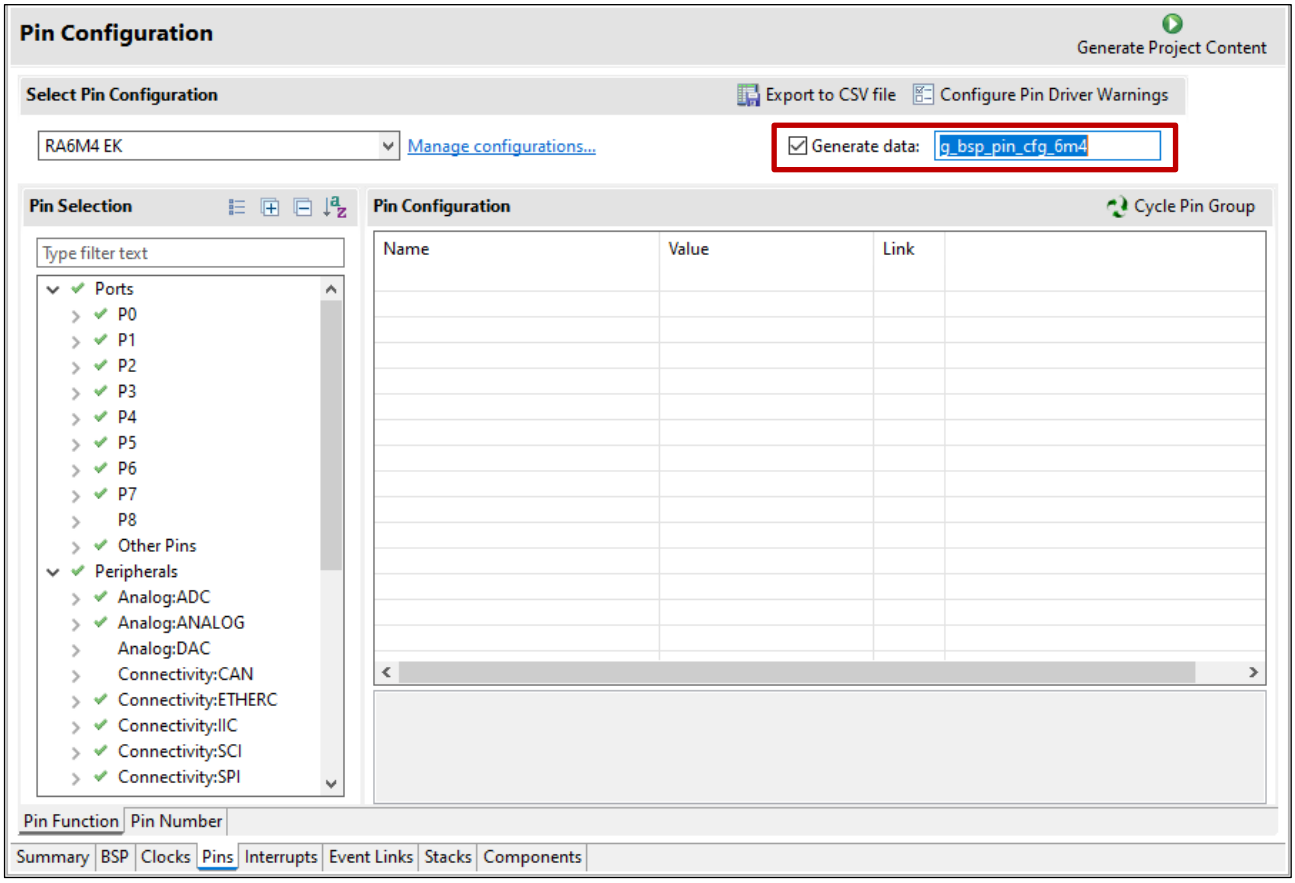
When you change the device, **"Generate data" will be disabled.** The next page explains how to enable it.



To enable generation of pin settings, check [Generate data] check-box and enter a desired name in the text field.

The entered name is linked to the pin configuration, therefore must use a unique name that does not duplicate with other pin configurations.

The following is an example named “g_bsp_pin_cfg_6m4”.



(4) Stacks

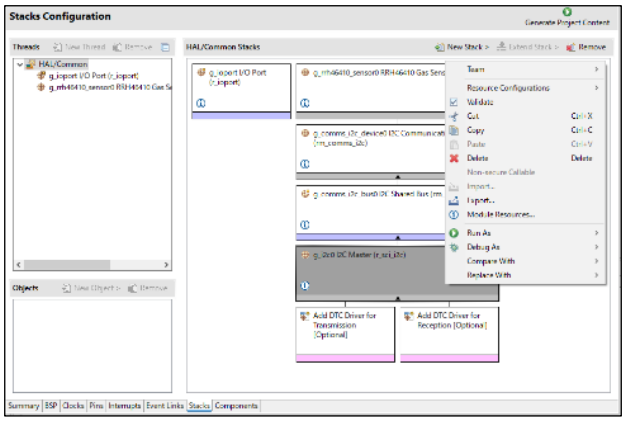
Modify the configuration of individual components in the "Stacks" tabbed page.

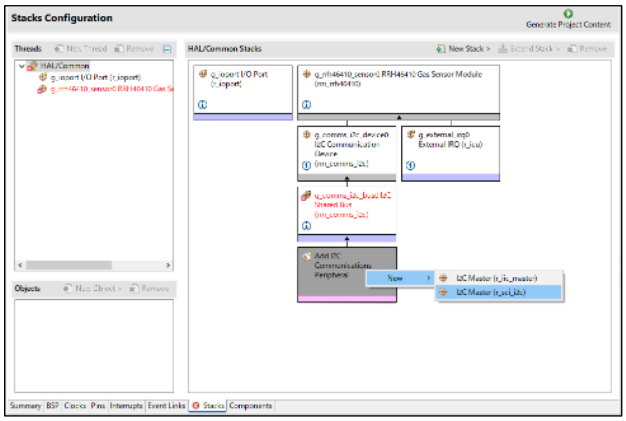
(a) Changing COMMS_I2C Settings and I2C Driver Settings

Modify the settings of COMMS_I2C and I2C driver according to the specifications of the target board. To use the pins of the I2C I/F, delete the unnecessary stack and add the new stack to use.

Table 6-1 Settings of I2C I/F and Channel for EK-RA6M4

EK-RA6M4	I2C I/F	g_comms_i2c_bus0 I2C Shared Bus (rm_comms_i2c)	g_i2c_master0 I2C Master
Pmod1 Option Type 6A	IIC1	Channel: 1	Check Pins
Pmod2 Type 2A	SCI0	Channel: 0	Check Pins





g_comms_i2c_bus0 I2C Shared Bus (rm_comms_i2c)

Settings | API Info

Property	Value
Common	
Parameter Checking	Default (BSP)
Module g_comms_i2c_bus0 I2C Shared Bus (rm_comms_i2c)	
Name	g_comms_i2c_bus0
Bus Timeout	0xFFFFFFFF
Semaphore for Blocking (RTOS only)	Use
Recursive Mutex for Bus (RTOS only)	Use
Channel	1
Rate	Standard

g_i2c_master0 I2C Master (r_iic_master)

Settings | API Info

Property	Value
Common	
Parameter Checking	Default (BSP)
DTC on Transmission and Reception	Disabled
10-bit slave addressing	Disabled
Module g_i2c_master0 I2C Master (r_iic_master)	
Name	g_i2c_master0
Channel	1
Rate	Standard
Custom Rate (bps)	0
Rise Time (ns)	120
Fall Time (ns)	120
Duty Cycle (%)	50
Slave Address	0x00
Address Mode	7-Bit
Timeout Mode	Short Mode
Timeout during SCL Low	Enabled
Callback	rm_comms_i2c_callback
Interrupt Priority Level	Priority 12
Pins	
SDA1	P511
SCL1	P512

g_i2c0 I2C Master (r_sci_i2c)

Settings | API Info

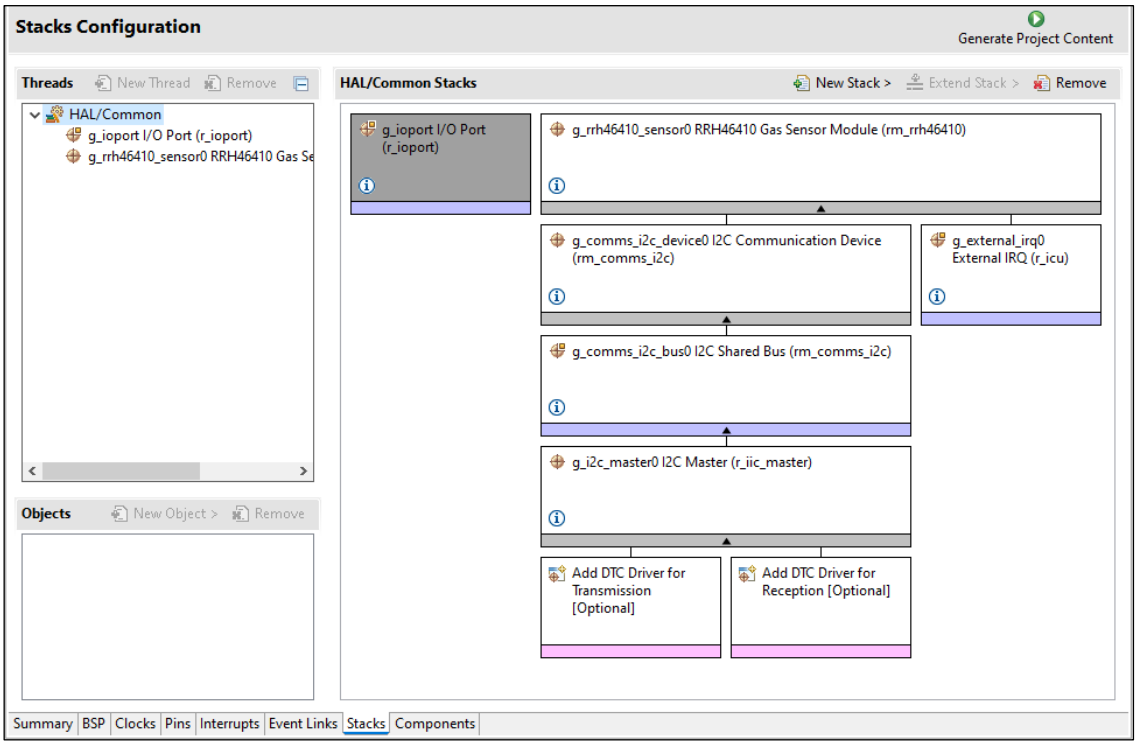
Property	Value
Common	
Parameter Checking	Default (BSP)
DTC on Transmission and Rec	Disabled
10-bit slave addressing	Disabled
Module g_i2c0 I2C Master (r_sci_	
Name	g_i2c0
Channel	0
Slave Address	0x00
Address Mode	7-Bit
Rate	Standard
Custom Rate (bps)	0
SDA Output Delay (nano sec	300
Noise filter setting	Use clock signal divided by 1 with noise filter
Bit Rate Modulation	Enable
Callback	rm_comms_i2c_callback
Interrupt Priority Level	Priority 2
RX Interrupt Priority Level [O	Disabled
Pins	
SDA0	P411
SCL0	P410

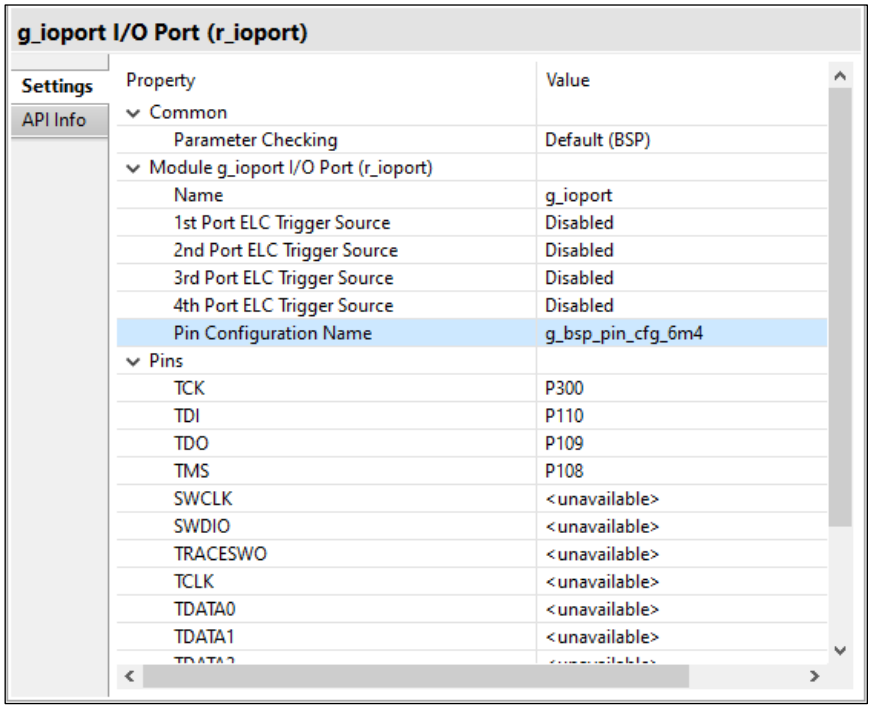
(b) Changing General Purpose I/O Port Driver Settings: RESET

For information on how to modify the source of the RESET signal control, refer to “6.2.2(1) RESET Signal Control”.

Enter the pin configuration name to use in "Pin Configuration Name" of "g_ioport I/O Port".

The following is an example named “g_bsp_pin_cfg_6m4”.





(c) Changing IRQ Driver Settings

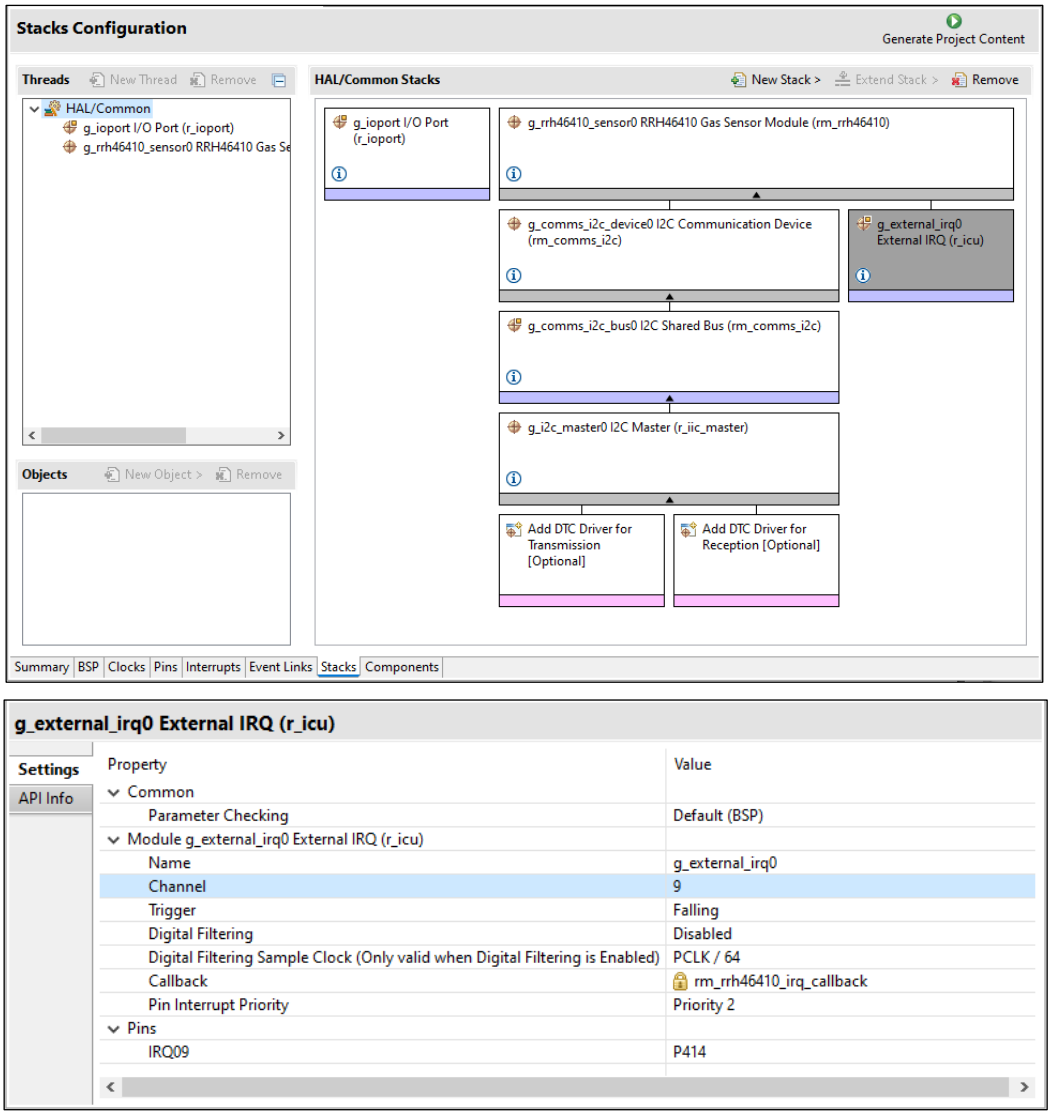
For information on matching the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

Modify the settings of r_icu according to the specifications of the target board.

P301 IRQ6 is assigned to Pmod1 #1 and P414 IRQ9 is assigned to Pmod2 #7 on the EK-RA6M4 board.

Therefore, set IRQ channel as follows:

- When using Pmod1 (Option Type 6A), set “Channel” to 6.
- When using Pmod2 (using the Interposer Board), set “Channel” to 9.



If an error is displayed in other stacks, modify the specified item according to the displayed error.

(5) Code Generation and Build

After modifications are finished, press [Generate Project Content] to generate files.

Build the project after implementing “6.2.2 Changing Sample Code”

Select [Debug Configurations] from the menu and modify the debugger settings according to the specifications of the emulator to be connected to the target board.

6.2.2 Changing Sample Code

(1) RESET Signal Control

For pin configuration, refer to “6.2.1(3)(d) Changing General Purpose I/O Port Pin: RESET”

Open "hal_entry.c" (Non-OS) or "rrh46410_sensor_thread_entry.c" (FreeRTOS) and change the reset operation when resetting the sensor. Also, change the reset control logic to an appropriate one.

Modify RESET pin designation according to the specifications of the target board.

With the above settings, the EK-RA6M4 board is configured as follows:

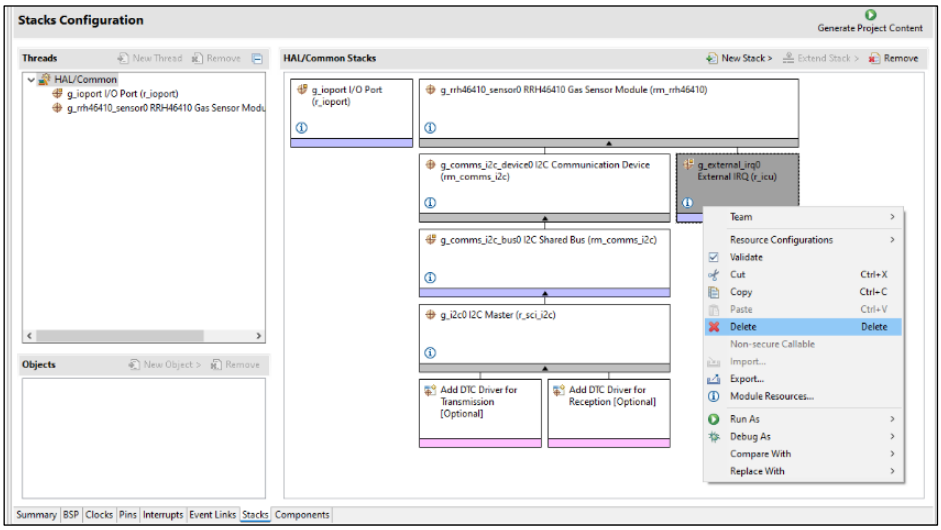
- When using Pmod1 (Option Type 6A), RESET pin is assigned to P203.
- When using Pmod2 (using the Interposer Board), RESET pin is assigned to P412.

```
  /* Reset RRH46410 sensor (active low). Please change to the IO port connected to
the RES_N pin of the RRH46410 sensor on the customer board. */
  R_IOPORT_PinWrite(&g_ioport_ctrl, BSP_IO_PORT_04_PIN_12, BSP_IO_LEVEL_HIGH);
  R_BSP_SoftwareDelay(10, BSP_DELAY_UNITS_MILLISECONDS);
  R_IOPORT_PinWrite(&g_ioport_ctrl, BSP_IO_PORT_04_PIN_12, BSP_IO_LEVEL_LOW);
  R_BSP_SoftwareDelay(10, BSP_DELAY_UNITS_MILLISECONDS);
  R_IOPORT_PinWrite(&g_ioport_ctrl, BSP_IO_PORT_04_PIN_12, BSP_IO_LEVEL_HIGH);
  R_BSP_SoftwareDelay(10, BSP_DELAY_UNITS_MILLISECONDS);
```

6.2.3 Changing when not using IRQ

If IRQ is not used, delete stack, and change the values of constants defined.

In the "Stacks" tabbed page, delete “g_external_irq0 External IRQ”.



Open "RA_RRH46410.c" (Non-OS) or "rrh46410_sensor_thread_entry.c" (FreeRTOS) and change the value of “G_RRH46410_SENSOR0_IRQ_ENABLE” to “0”.

```
  /* TODO: Enable if you want to open RRH46410 */
  #define G_RRH46410_SENSOR0_IRQ_ENABLE    (0)
```

6.2.4 Changing Toolchain Setting

If you want to use a toolchain other than the GCC ARM Embedded toolchain, copy RA_RRH46410.c (Non-OS) or rrh46410_sensor_thread_entry.c, sensor_thread_common.c and sensor_thread_common.h (FreeRTOS) from this project to create a new project.

6.3 RX Sample Project

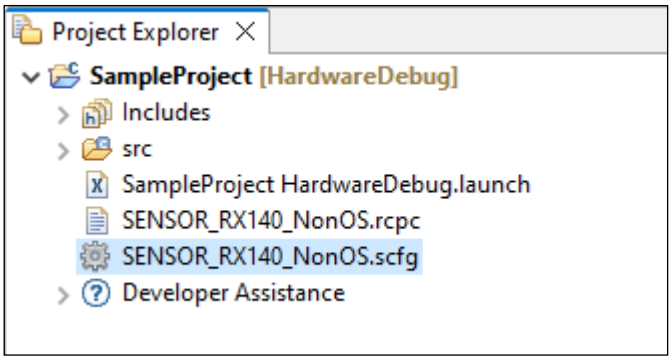
After importing the sample projects, follow the steps below. Please refer to “6.1 Importing Sample Project” for importing instructions.

The following explains the change procedure for the following board change example. In addition, an Interposer Board is required when using a Pmod Type 2A/3A connector.

- Sample project "RRH46410_RX140_NonOS":
  Pmod1 (Type2A: SCI5)
  → Pmod1 (Option Type 6A: RIIC0) or Pmod2 (Option Type6A: SCI11) of the EK-RX671 board

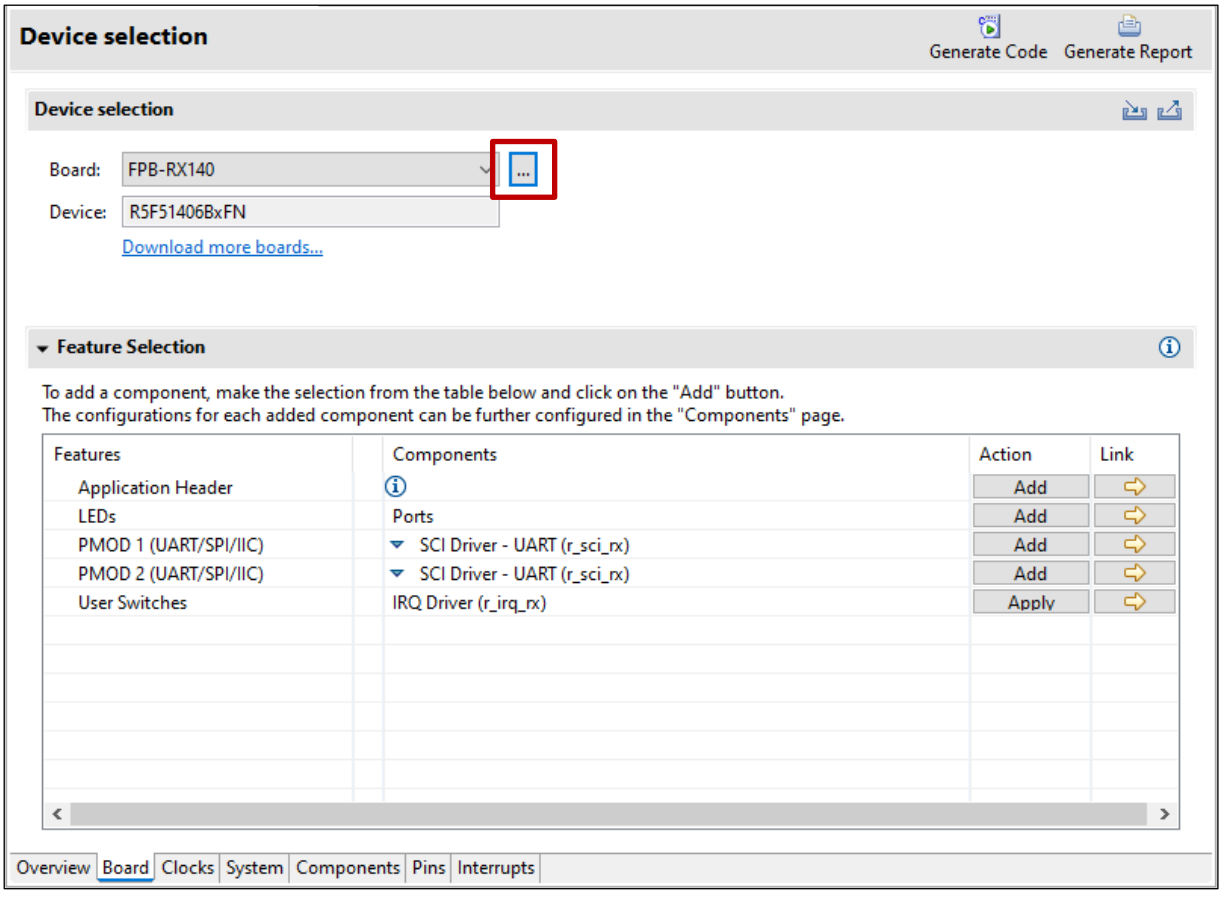
6.3.1 Modifying Settings of Smart Configurator

On the project tree, double-click on the .scfg file of the imported project in the Smart Configurator window will open.

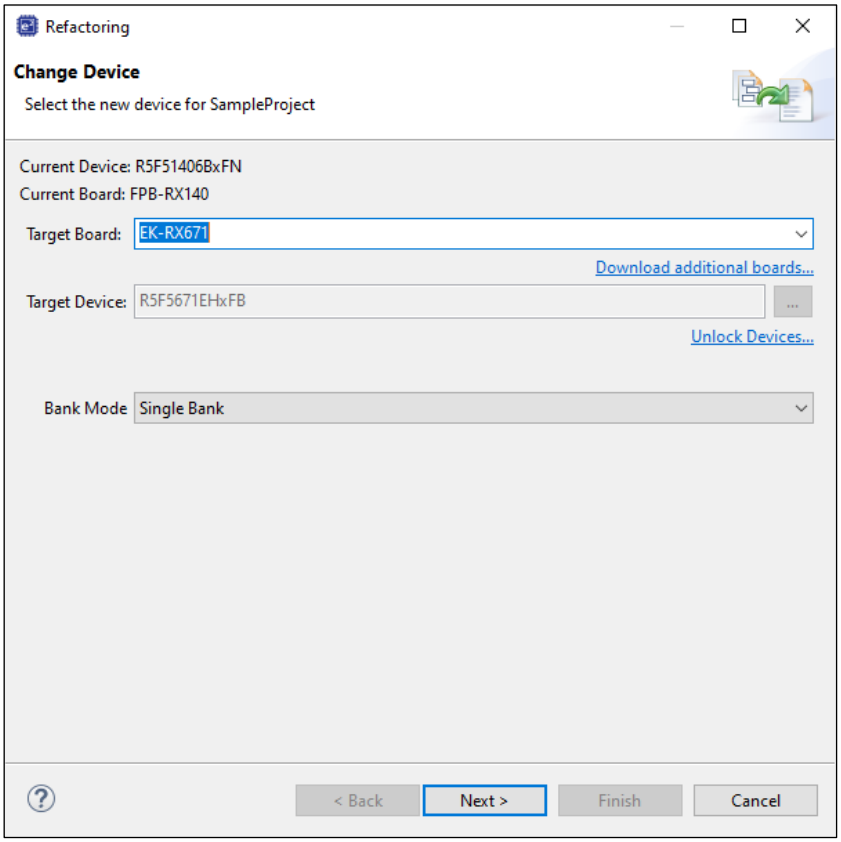


(1) Board

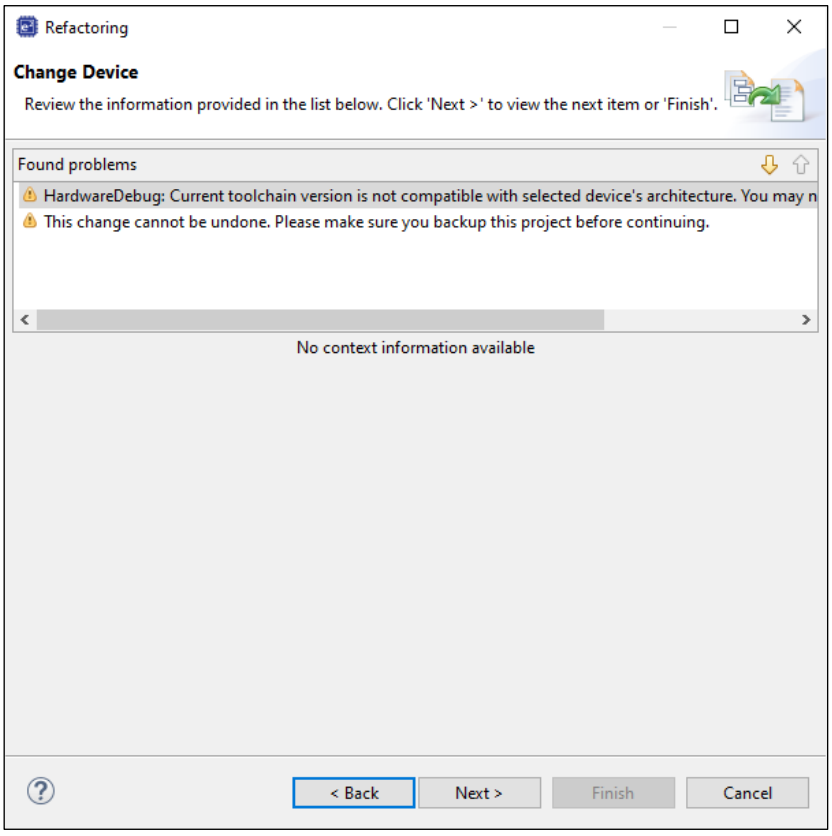
1. On the Board tab, click the [...] button.



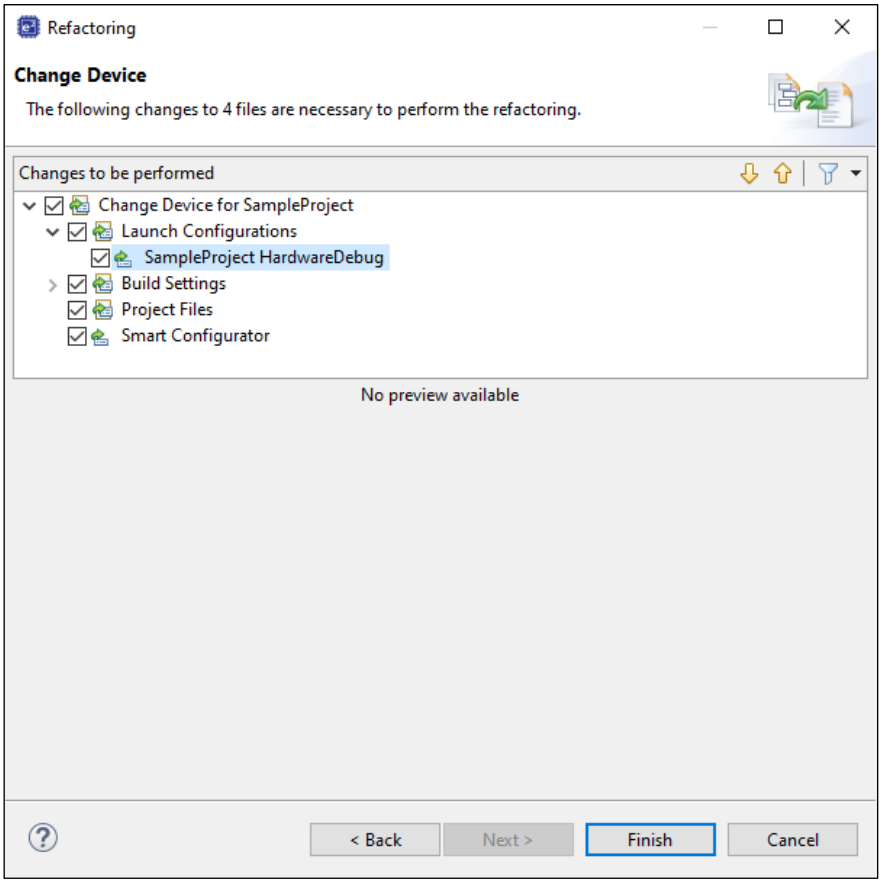
2. Select a desired board or device in the "Change Device" window and press the [Next] button.



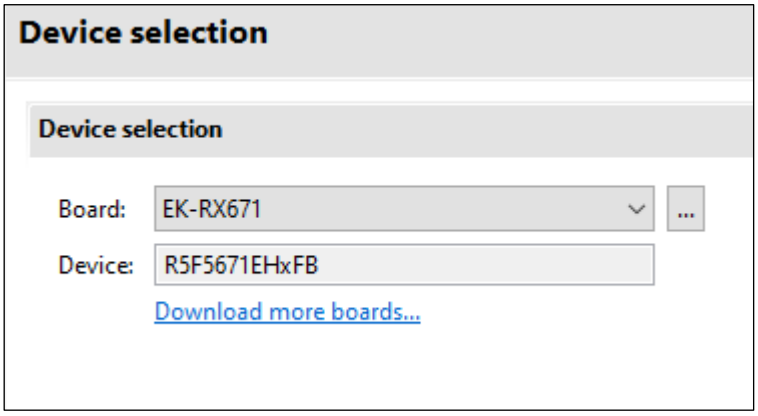
3. If a warning message appears, read it and check if there is a problem in proceeding with the procedure. Press [Next] to move to the next step.



4. The changes you have made in the settings will be displayed. Press the [Finish] button to apply the changes to the project.



5. Select the "Board" tabbed page to check that the board and device have been changed correctly.

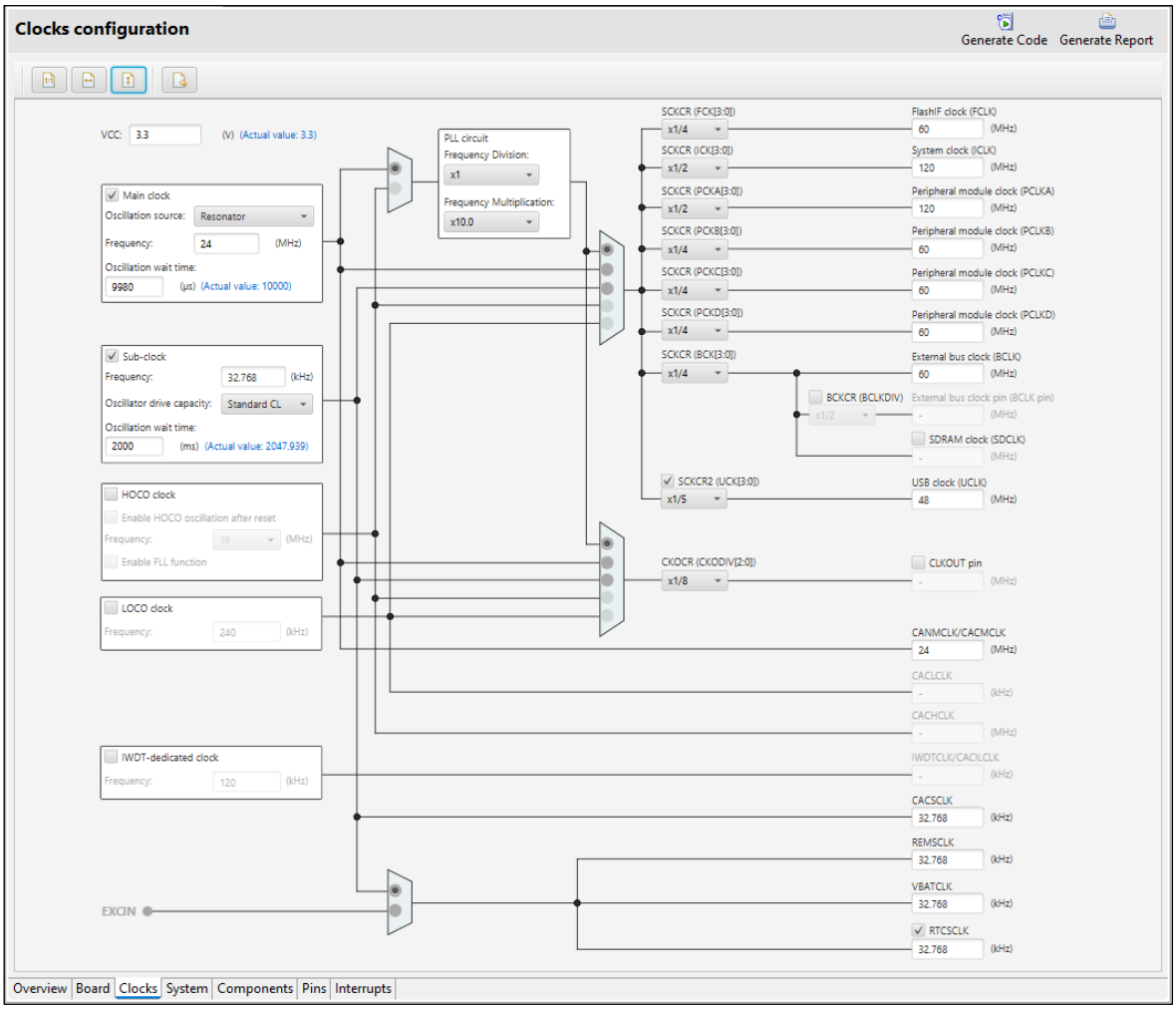


(2) Clocks

Set up the clocks in the "Clocks" tabbed page.

When "Custom User Board (Any Device)" is selected for "Board", set up the clocks according to the specifications of the target board to be used.

When a Renesas board is selected for "Board", the clocks are automatically set up.



(3) Components

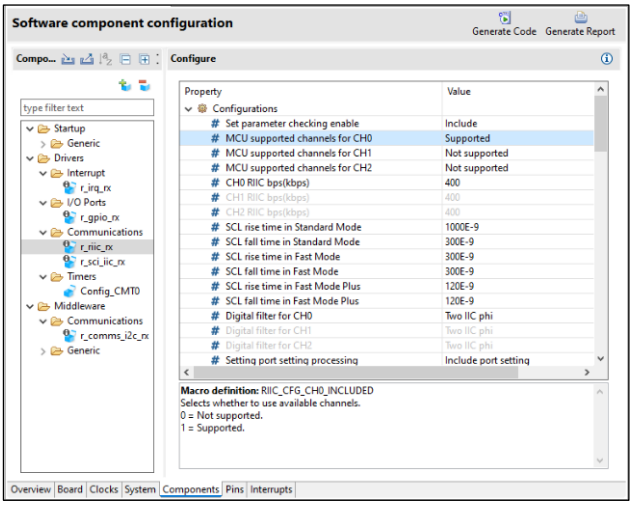
Modify the settings of individual components in the "Components" tabbed page according to the specifications of the target board.

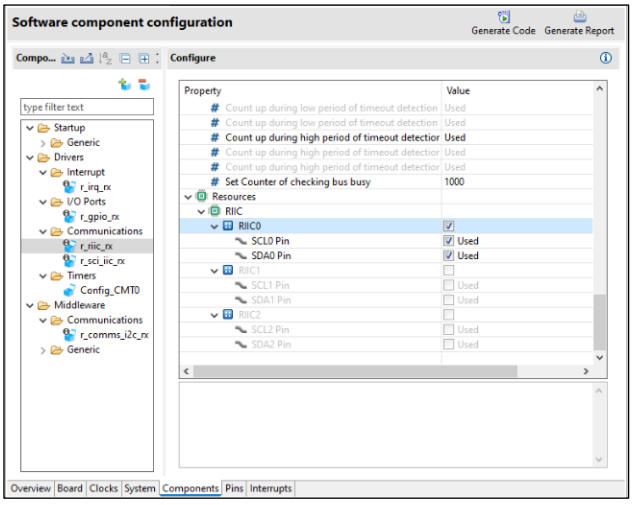
(a) Changing I2C Driver Settings

RIIC0 is assigned to Pmod1 and SCI11 to Pmod2 on the EK-RX671 board.

When using Pmod1 (Option Type 6A), set it as follows:

- For r_riic_rx, set "MCU supported channels for CH0" to "Supported".
- For r_riic_rx, add the check settings of “RIIC0”, "SCL0 Pin" and "SDA0 Pin" under "Resources".

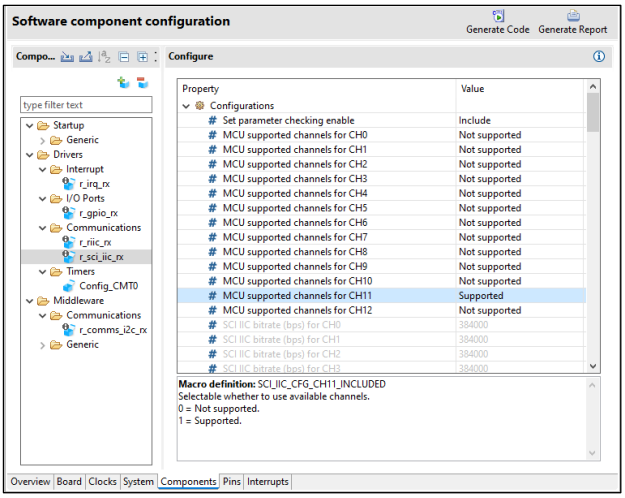


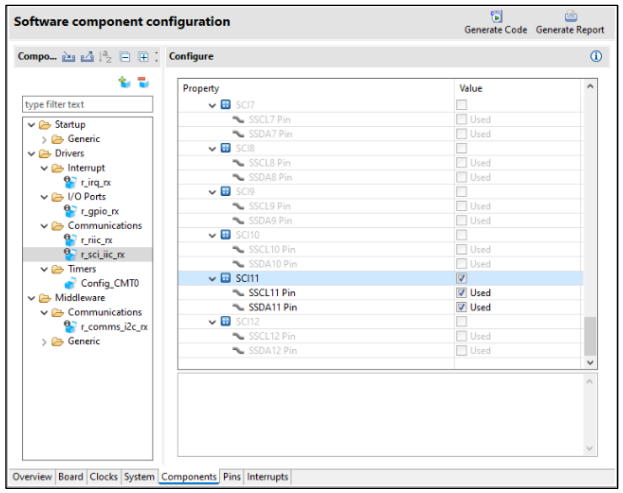


When using Pmod2 (Option Type 6A), set it as follows:

- For r_sci_iic_rx, set "MCU supported channels for CH5" to "Not supported",

  and set "MCU supported channels for CH11" to "Supported".
- For r_sci_iic_rx, add the check settings of “SCI11”, "SSCL11 Pin" and "SSDA11 Pin" under "Resources".



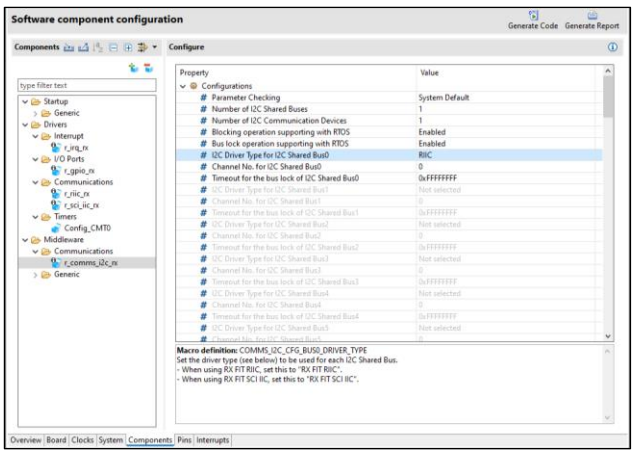


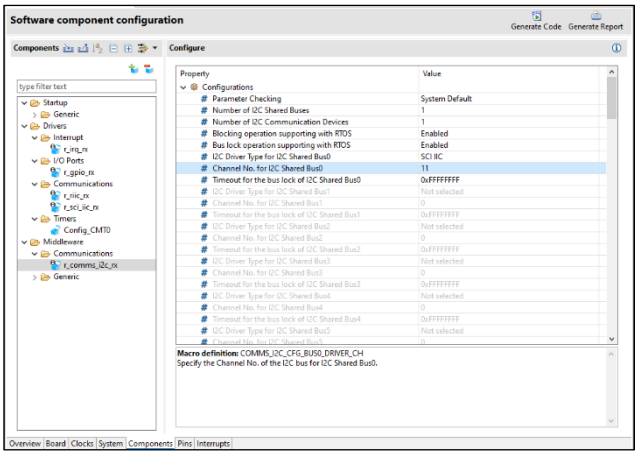
(b) Changing COMMS_I2C Settings

If you have changed the I2C driver or channel, you will need to change these settings.

Set “I2C Driver Type for I2C Shared BusX” (X: Bus No.) and “Channel No. for I2C Shared BusX” (X: Bus No.) in **r_comms_i2c_rx** as follows:

- When using Pmod1 (Option Type 6A),
  set “I2C Driver Type for I2C Shared Bus0” to “RIIC”,
  set “Channel No. for I2C Shared Bus0” to “0”.
- When using Pmod2 (Option Type 6A),
  set “I2C Driver Type for I2C Shared Bus0” to “SCI_IIC”,
  set “Channel No. for I2C Shared Bus0” to “11”.





(c) Changing IRQ Driver Settings

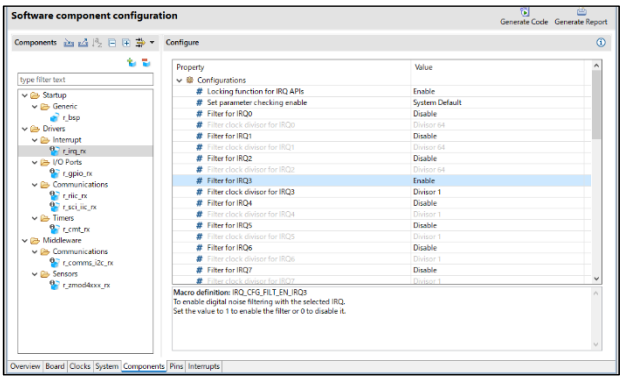
For information on matching the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

For interrupt settings, the following explains the example of modifying the ZMOD4XXX FIT module (r_zmod4xxx_rx), since the sensor control module uses a common IRQ driver. In the following, treat ZMOD4XXX as RRH46410.

P83 IRQ3 is assigned to Pmod1 #1 and P74 IRQ12 to Pmod2 #1 on the EK-RX671 board.

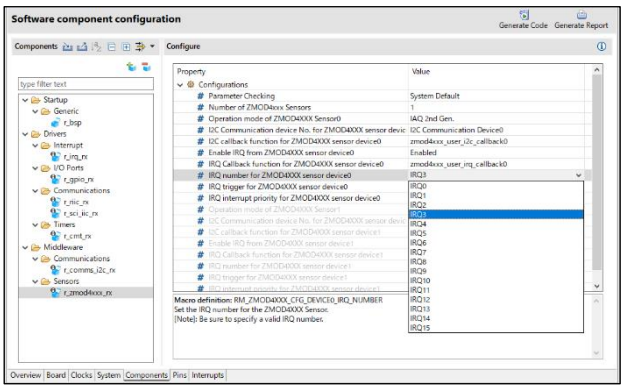
Therefore, set IRQ channel in “r_irq_rx” as follows and disable any unnecessary settings, also:

- When using Pmod1 (Option Type 6A),
  set “Filter of IRQ4” to “Disable”,
  set “Filter of IRQ3” to “Enable”,
  remove the check setting of “IRQ4 pin” under “Resources”,
  add the check setting of “IRQ3 pin” under “Resources”.
- When using Pmod2 (Option Type 6A),
  set “Filter of IRQ4” to “Disable”,
  set “Filter of IRQ12” to “Enable”,
  remove the check setting of “IRQ4 pin” under “Resources”,
  add the check setting of “IRQ3 pin” under “Resources”.



Change the settings of “IRQ number for ZMOD4XXX sensor device0” to “IRQ3” or “IRQ12” in r_zmod4xxx_rx.

For RRH46410, there is also “IRQ number for RRH46410 sensor device0”. Change it in the same way.



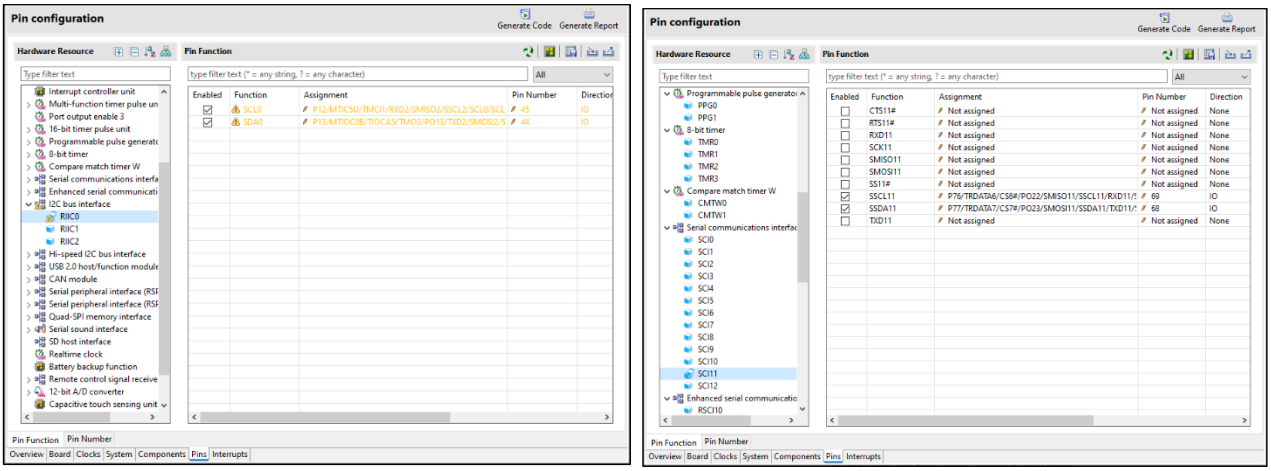
(4) Pins

(a) Changing I2C I/F Pins

RIIC0 is assigned to Pmod1 and SCI11 to Pmod2 on the EK-RX671 board.

Therefore, set the pins used for I2C communication in “Pin Function” on “Pins” tabbed page as follows:

- When using Pmod1 (Option Type 6A): Enable RIIC0, P12 SCL0 and P13 SDA0.
- When using Pmod2 (Option Type 6A): Enable SCI11, P76 SSCL11 and PB7 SSDA11.



As the use of Pmod1 at “High-Speed I2C Bus Interface (RIICHS)” is specified in the EK-RX671 board information, a warning message will appear when RIIC is used, but this does not produce any problems.

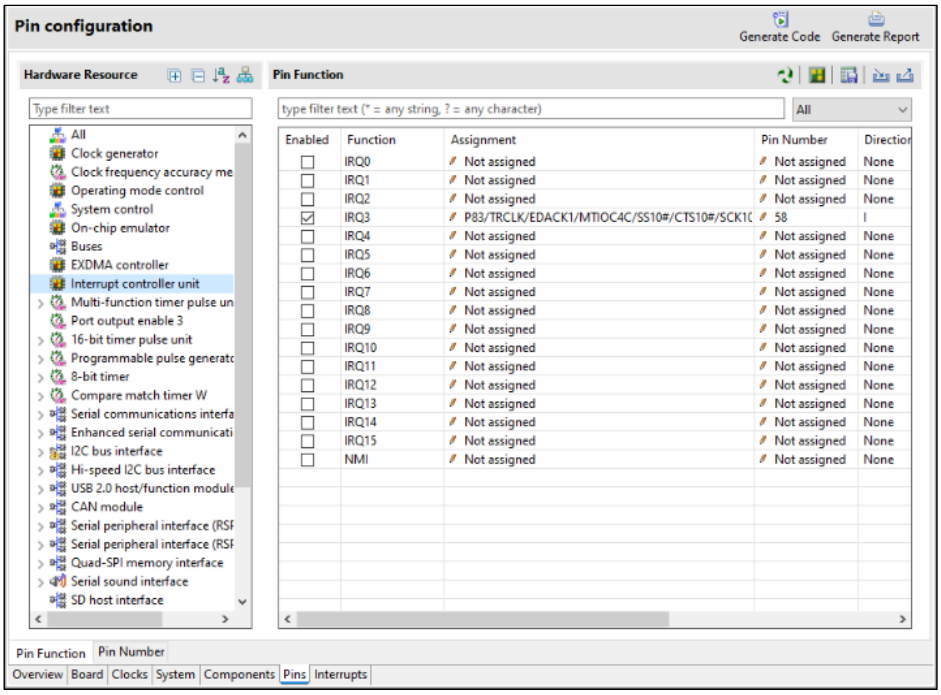
(b) Changing IRQ Pin

For information on configuring the pin of the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

P83 IRQ3 is assigned to Pmod1 #1 and P74 IRQ12 to Pmod2 #1 on the EK-RX671 board.

Therefore, select “Interrupt controller unit” in “Pin Function” on “Pins” tabbed page and set pins as follows:

- When using Pmod1 (Option Type 6A): Enable IRQ3 and set the IRQ3 pin to P83.
- When using Pmod2 (Option Type 6A): Enable IRQ12 and set the IRQ12 pin to P74.



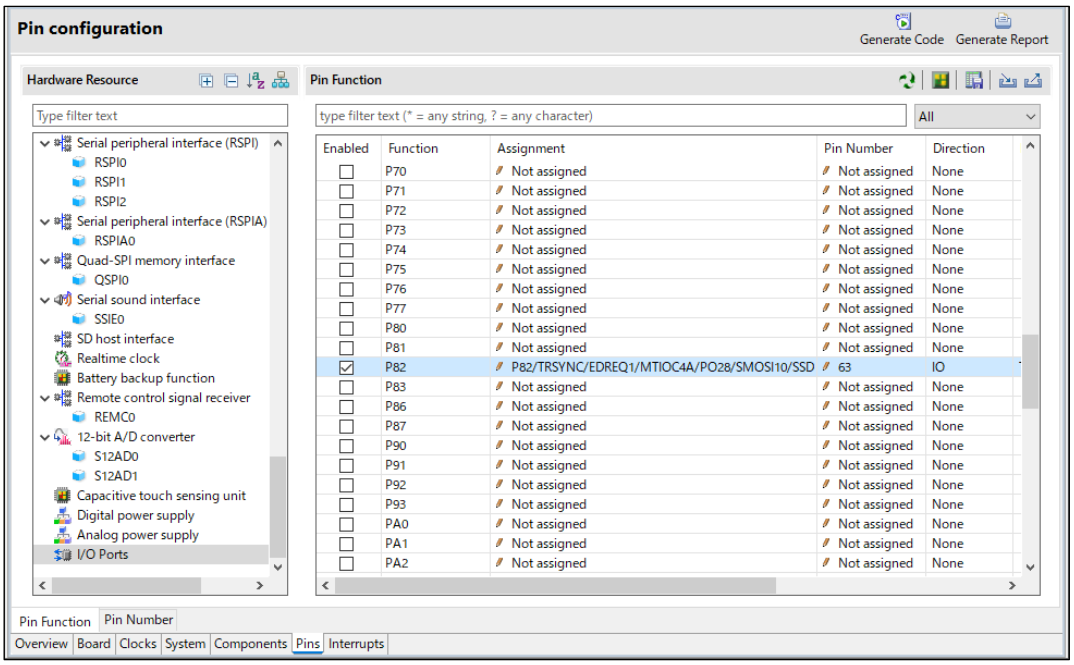
(c) Changing General Purpose I/O Port Pin: RESET

For information on configuring the pin of the RESET signal circuit, refer to “6.6 Notes for RESET Signal Circuits”.

The RESET pin is assigned to P82 Port for Pmod1 #2 and P77 Port for Pmod2 #2 on the EK-RX671 board.

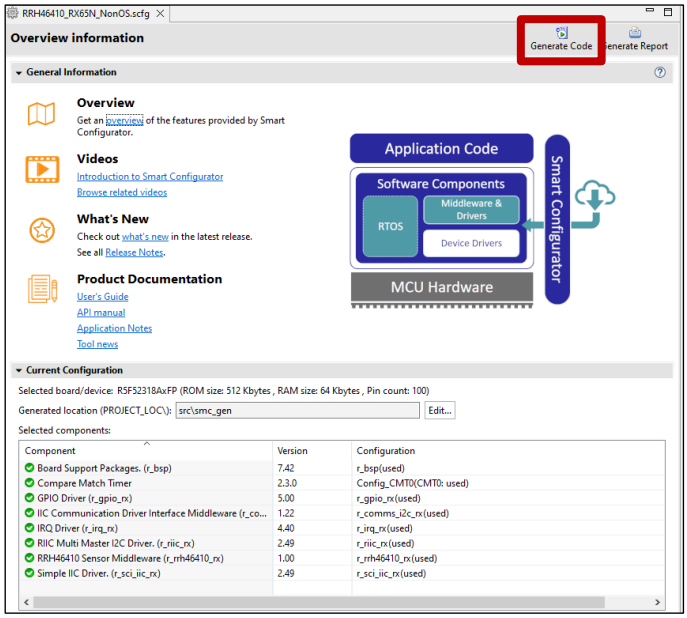
Therefore, select “I/O Ports” in “Pin Function” on “Pins” tabbed page and set pins as follows:

- When using Pmod1 (Option Type 6A): Enable P82.
- When using Pmod2 (Option Type 6A): Enable P77.



(5) Code Generation and Build

Press the [Generate Code] icon to generate code.



Build the project after implementing “6.3.2 Changing Sample Code”.

Select [Debug Configurations] from the menu and modify the debugger settings according to the specifications of the emulator to be connected to the target board.

6.3.2 Changing Sample Code

(1) RESET Signal Control

For pin configuration, refer to “6.3.1(4)(c) Changing General Purpose I/O Port Pin: RESET”.

Open main.c and change the reset operation when resetting the sensor. Also, change the reset control logic to an appropriate one.

Modify RESET pin designation according to the specifications of the target board.

With the above settings, the EK-RX671 board is configured as follows:

- When using Pmod1 (Option Type 6A), RESET pin is assigned to P82.
- When using Pmod2 (Option Type 6A), RESET pin is assigned to P77.

```
    /* Reset RRH46410 sensor (active low). Please change to the IO port
connected to the RES_N pin of the RRH46410 sensor on the customer board. */
    R_GPIO_PinWrite(GPIO_PORT_8_PIN_2, GPIO_LEVEL_HIGH);
    R_GPIO_PinDirectionSet(GPIO_PORT_8_PIN_2, GPIO_DIRECTION_OUTPUT);
    R_BSP_SoftwareDelay(10, BSP_DELAY_MILLISECS);
    R_GPIO_PinWrite(GPIO_PORT_8_PIN_2, GPIO_LEVEL_LOW);
    R_BSP_SoftwareDelay(10, BSP_DELAY_MILLISECS);
    R_GPIO_PinWrite(GPIO_PORT_8_PIN_2, GPIO_LEVEL_HIGH);
    R_BSP_SoftwareDelay(10, BSP_DELAY_MILLISECS);
```

6.3.3 Changing Toolchain Setting

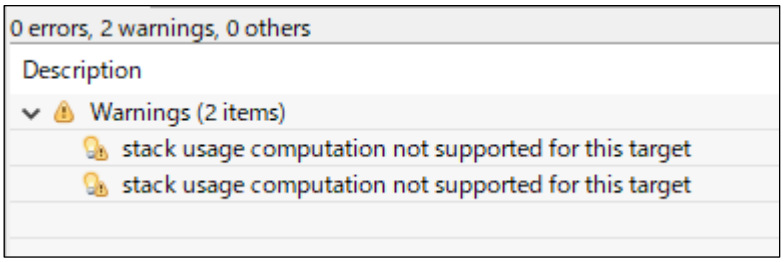
If you want to use a toolchain other than the CC-RX toolchain, copy main.c and RX_RRH46410.c (Non-OS), or main.c and rrh46410_sensor_thread_entry.c (FreeRTOS) from this project to create a new project.

6.3.4 Notes for Build on GCC

The following Warning occurs when building an GCC project.

These Warnings are occurring because specifying a stack size limit in the compiler options, and the target portion (the inline assembler processing portion) is not included in the calculation of stack usage.

Therefore, there is no problem in operation even if warnings occur.



6.3.5 When using IAR Integrated Development Environment "IAR Embedded Workbench"

You can use the RX Smart Configurator to import source files into IAR Embedded Workbench.

For instructions, see below.

RX Smart Configurator User's Guide: IAREW

6.4 RL78 Sample Project

After importing the sample projects, follow the steps below. Please refer to “6.1 Importing Sample Project” for importing instructions.

The following explains the change procedure for the following board change example.

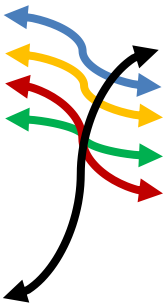
- Sample project "RRH46410_RL78G23_NonOS":
  Pmod2 (Type 6A: IICA1)
  → Grove (IICA0) of RL78/G22 Fast Prototyping Board
  With interrupt control
  → Without interrupt control
  RESET control pin
  → Change to any Port pin

Set J17 to 2-3 to change Grove's VDD to 3.3V.

Also, connect with jumper wires as shown below.

RL78/G22 Fast Prototyping Board (Grove)		
Pin	**Function**	**IICA I/F, Power Supply**
#1	SCL	**SCLA0**
#2	SDA	**SDAA0**
#3	VCC	**3.3V**
#4	GND	**GND**

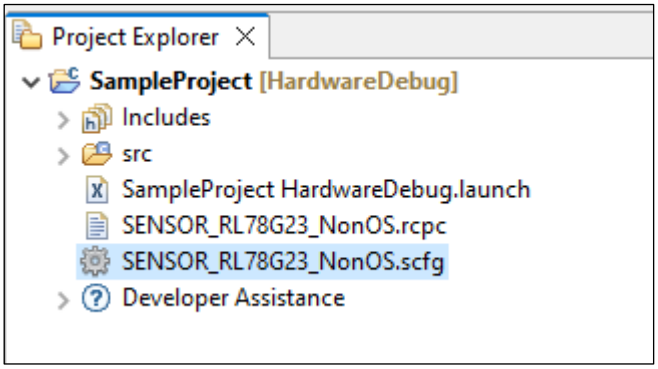
RL78/G22 Fast Prototyping Board		
Pin	**Function**	
Any	RESET	Port



Renesas Pmod Type 6A Sensor Board	
Pin	**Function**
#1	IRQ
#2	RESET
#3	**IIC_SCL**
#4	**IIC_SDA**
#5	**GND**
#6	**VCC**
#7	BUSY#
#8	ENABLE
#9	POWER_ON
#10	GPIO

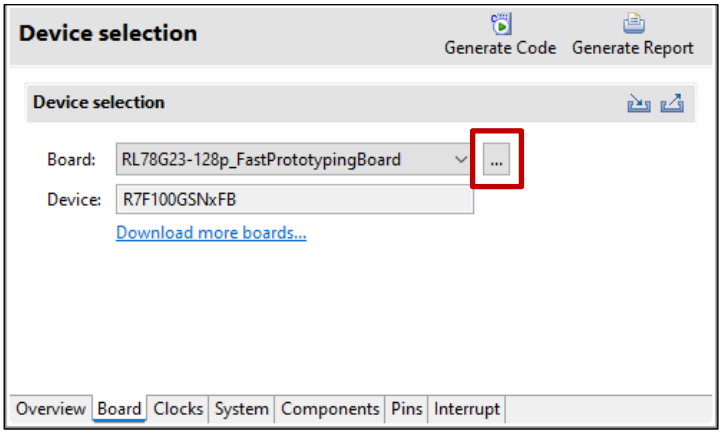
6.4.1 Modifying Settings of Smart Configurator

On the project tree, double-click on the .scfg file of the imported project in the Smart Configurator window will open.

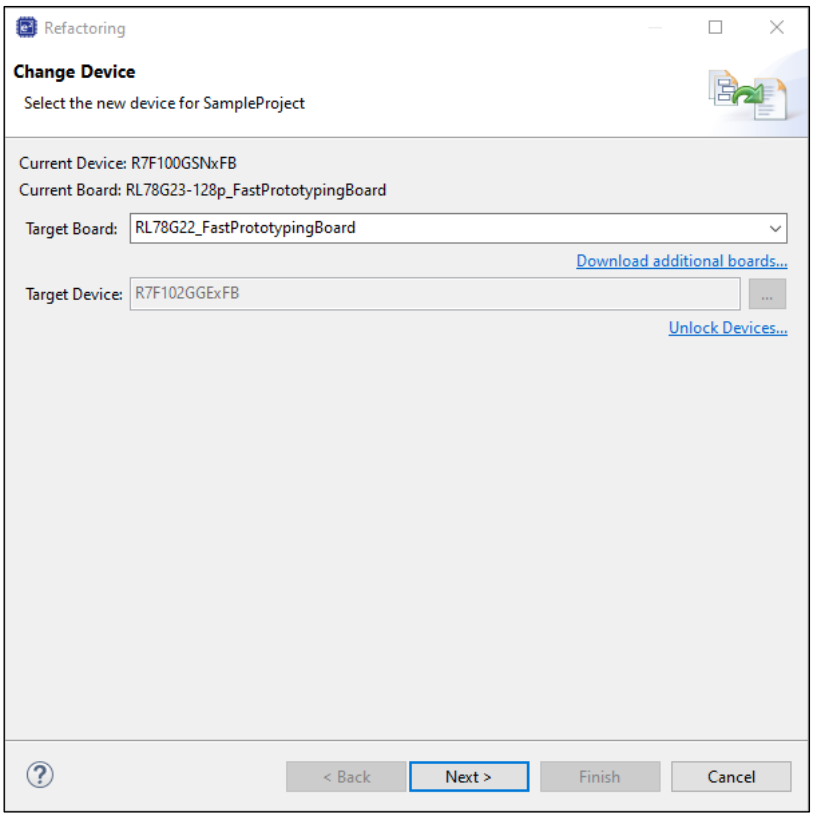


(1) Board

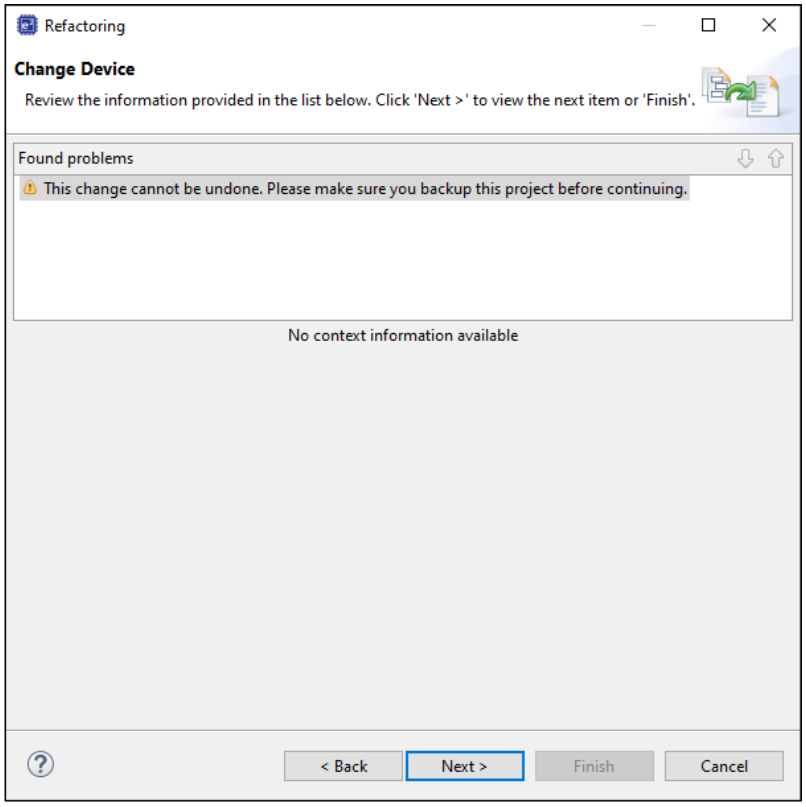
1. On the Board tab, click the [...] button.



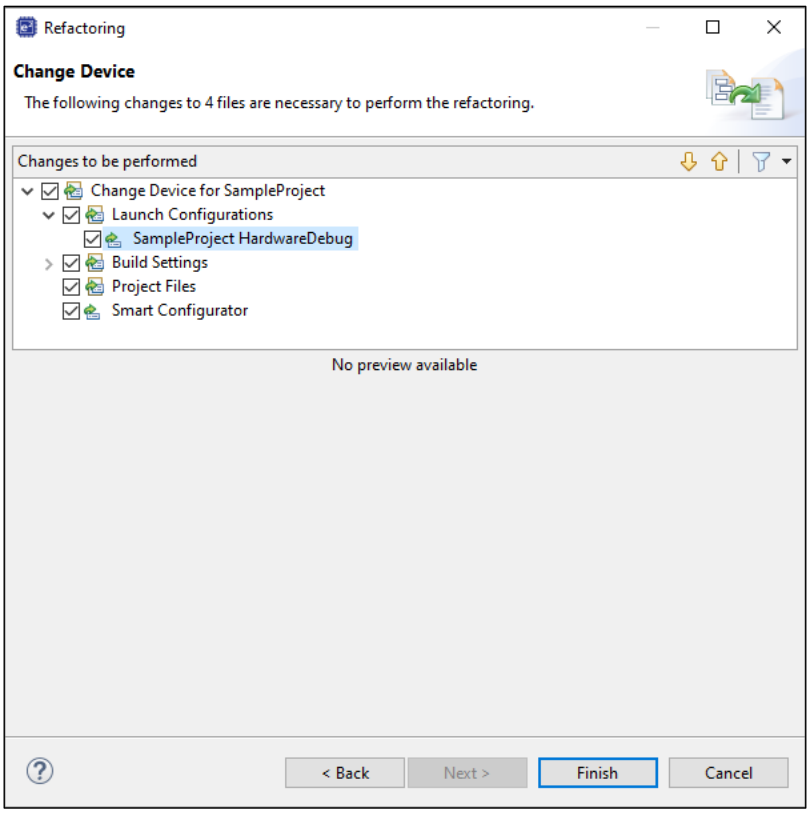
2. Select a desired board or device in the "Change Device" window and press the [Next] button.



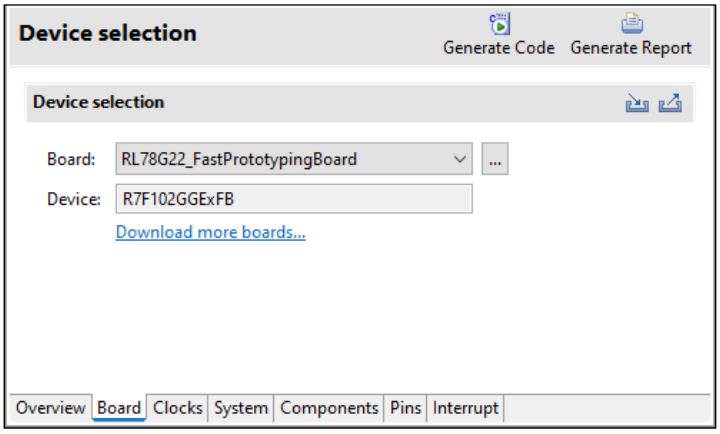
3. If a warning message appears, read it and check if there is a problem in proceeding with the procedure. Press [Next] to move to the next step.



4. The changes you have made in the settings will be displayed. Press the [Finish] button to apply the changes to the project.



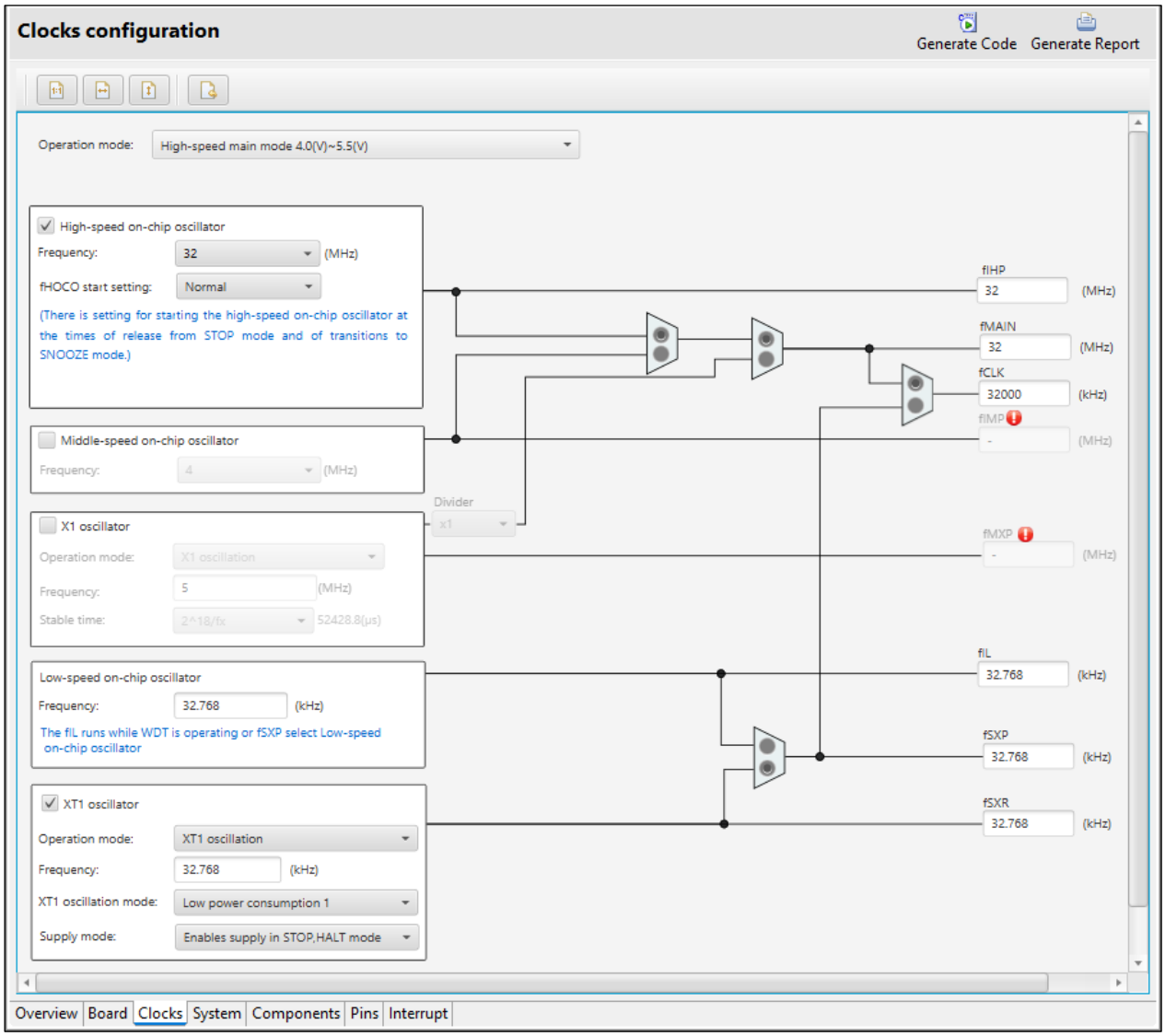
5. Select the "Board" tabbed page to check that the “Board” and “Device” have been changed correctly.



(2) Clocks

When "Custom User Board (Any Device)" is selected for "Board", set up the clocks according to the specifications of the target board to be used.

When a Renesas board is selected for "Board", the clocks are automatically set up.



(3) Components

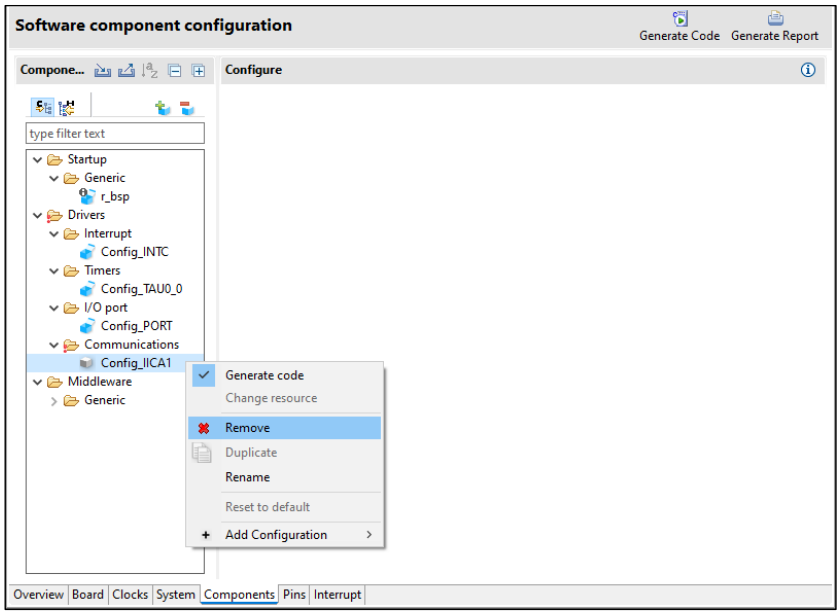
Modify the settings of individual components in the "Components" tabbed page according to the specifications of the target board.

(a) Changing I2C Driver Settings

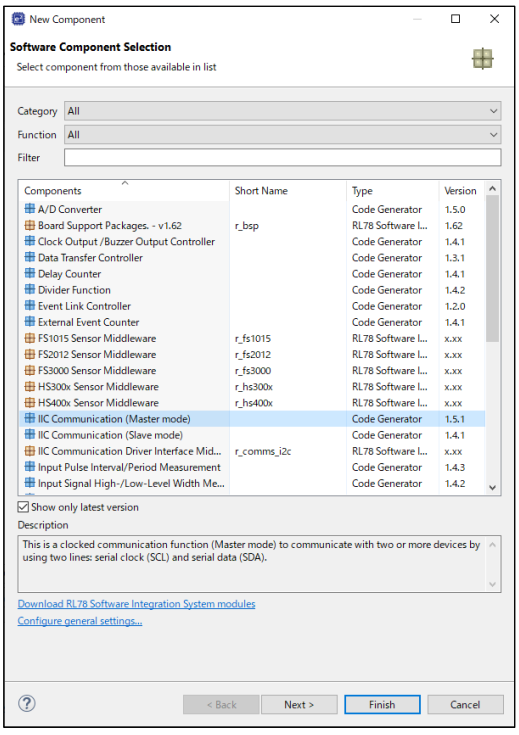
The SAU cannot be used because it does not support the clock stretching function required by RRH46410 sensor.

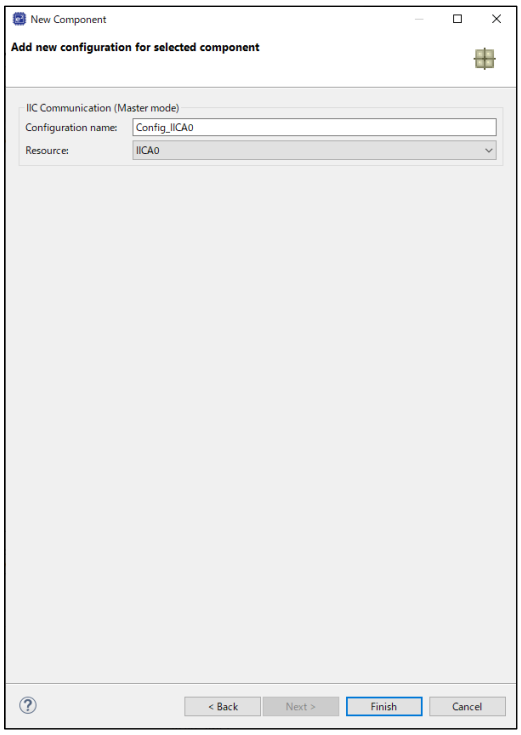
To change I2C driver setting, follow the steps below.

1. In RL78/G22, the only resource that can be used as IICA is IICA0, so delete Config_IICA1.

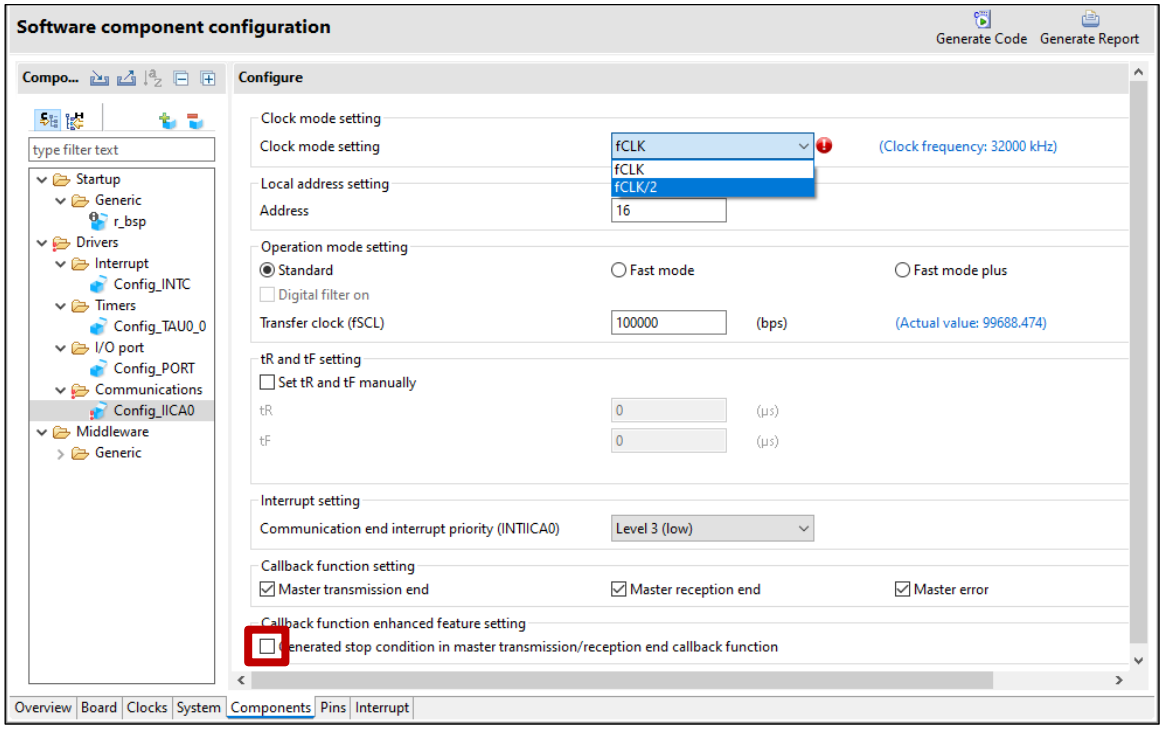


2. In "Software Component Selection", select "IIC Communication (Master Mode)" and specify "IICA0" as the resource.





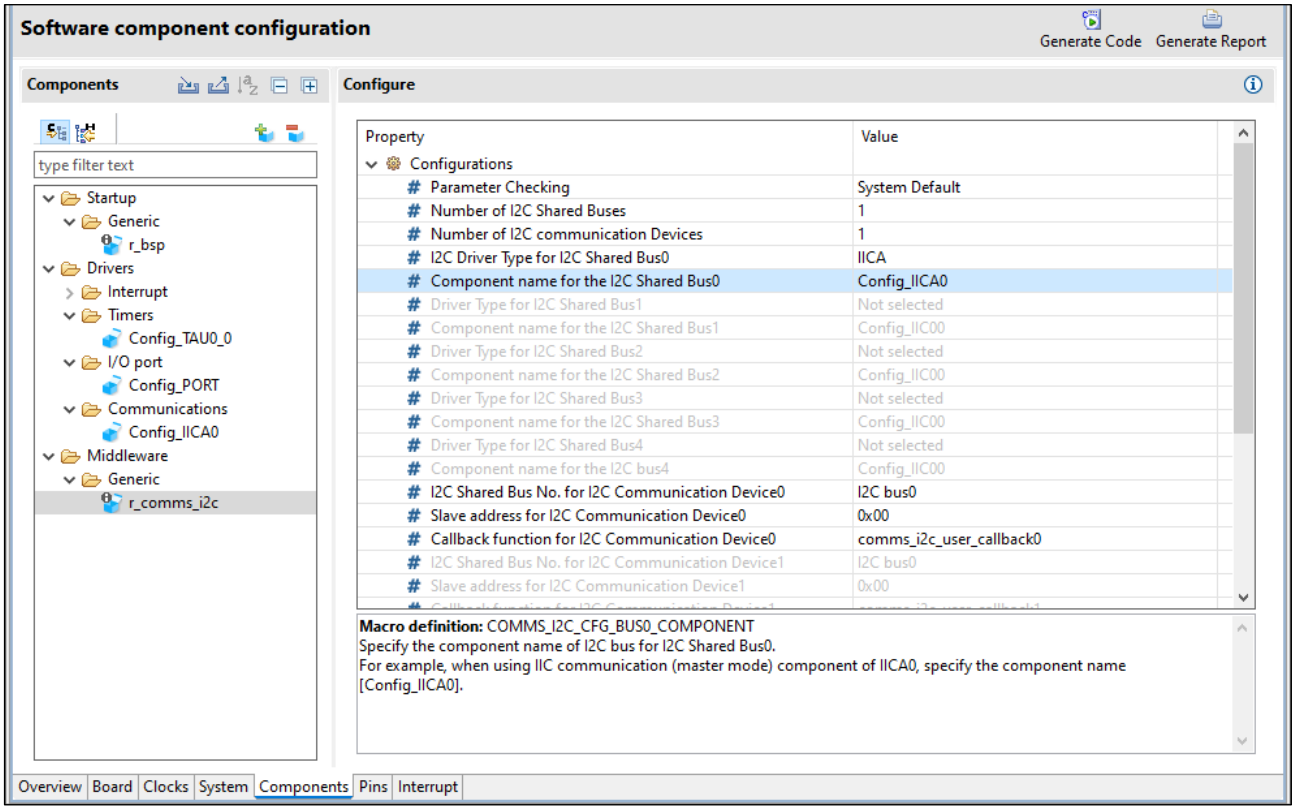
3. Change the setting of "Clock mode setting" to "fCLK/2" and uncheck "Generated stop condition in master transmission/reception end callback function".



(b) Changing COMMS_I2C Settings

Review the settings to make sure they are appropriate. If you have changed the I2C driver, you will need to review them.

Change the setting of ”Component name for the I2C Shared Bus0” to "Config_IICA0" in r_comms_i2c.



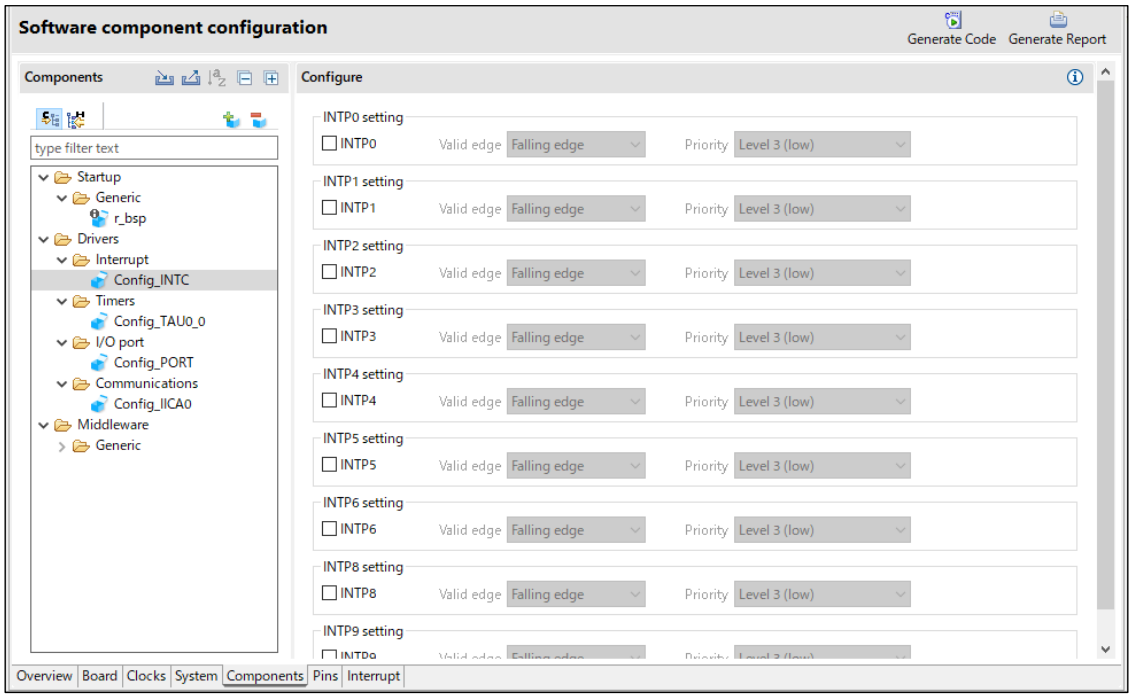
(c) Changing INTC Driver Settings

For information on matching the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

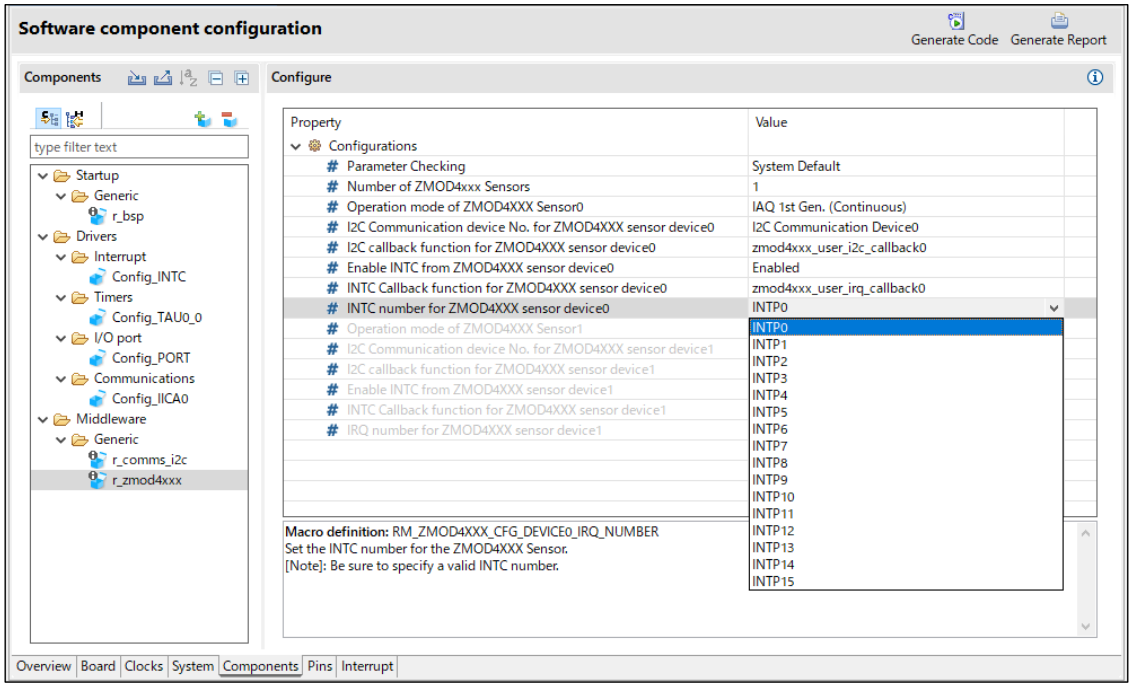
There is no interrupt pin assigned to Grove on the RL78/G22 Fast Prototyping Board. Please use another pin if necessary.

For interrupt settings, the following explains the example of modifying the ZMOD4XXX SIS module (r_zmod4xxx_rl), since the sensor control module uses a common INTC driver.

1. Set INTP pin in Config_INTC according to the specifications of the target board.



2. Change “INTC number for ZMOD4XXX sensor device0” in r_zmod4xxx_rl to the INTP pin set above.



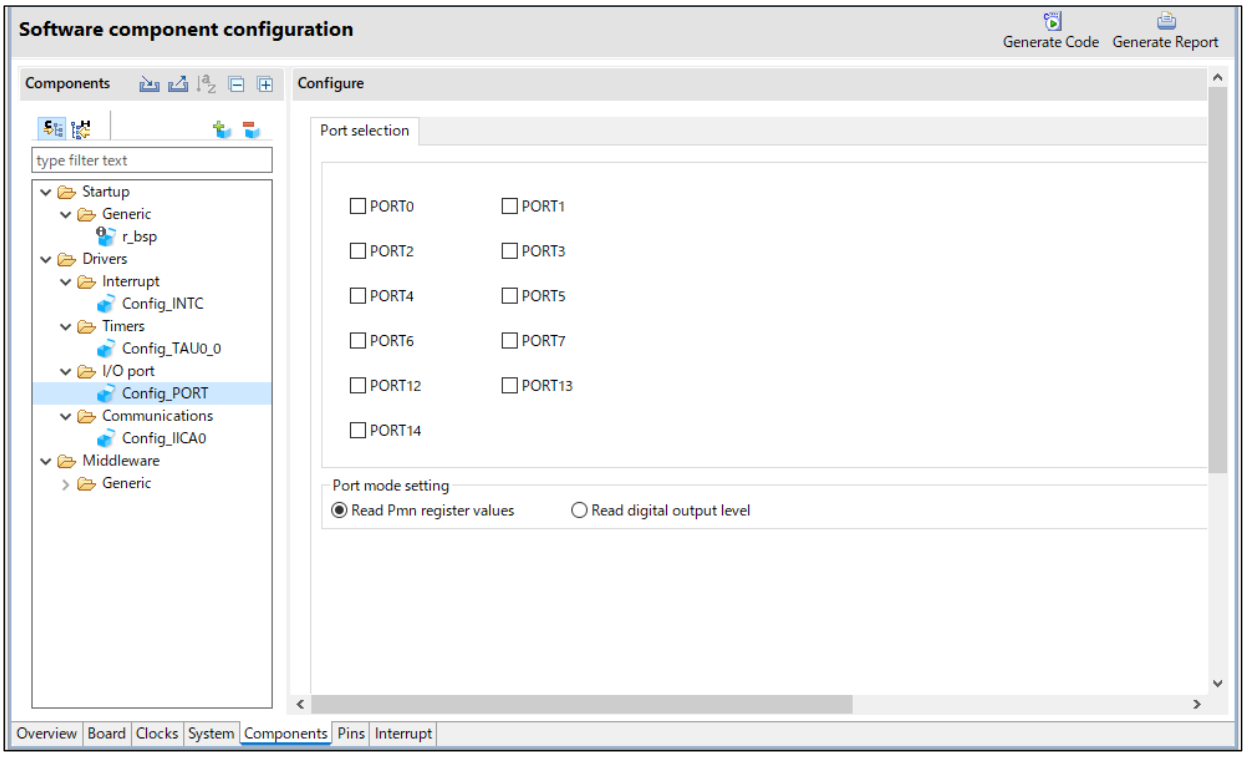
(d) Changing General Purpose I/O Port Driver Settings: RESET

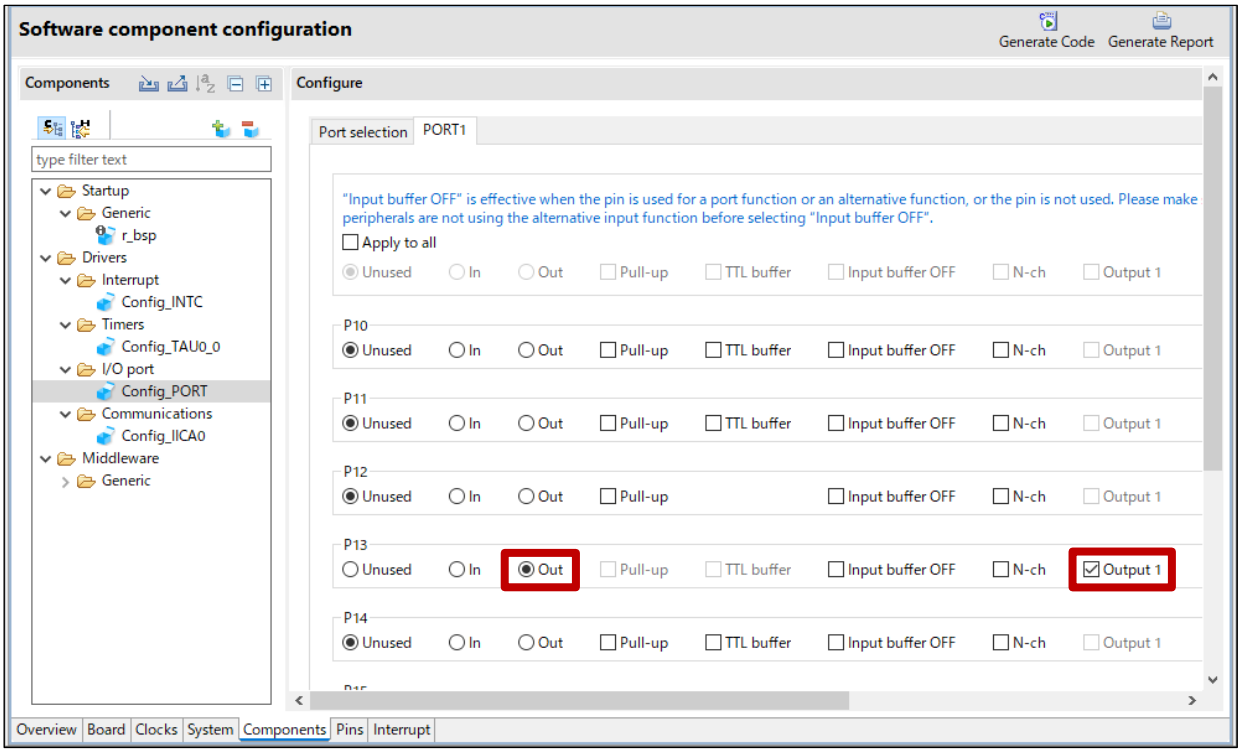
For information on how to modify the source of the RESET signal control, refer to “6.4.3(1) RESET Signal Control”.

There is no RESET pin assigned to Grove on the RL78/G22 Fast Prototyping Board. Therefore, assign any port.

Set RESET pin on Pmod in Config_PORT according to the specifications of the target board.

Set “Out” and enable “Output 1” in the “Port selection” tabbed page and the “PORT(x)” tabbed page.





(4) Pins

(a) Changing I2C I/F Pins

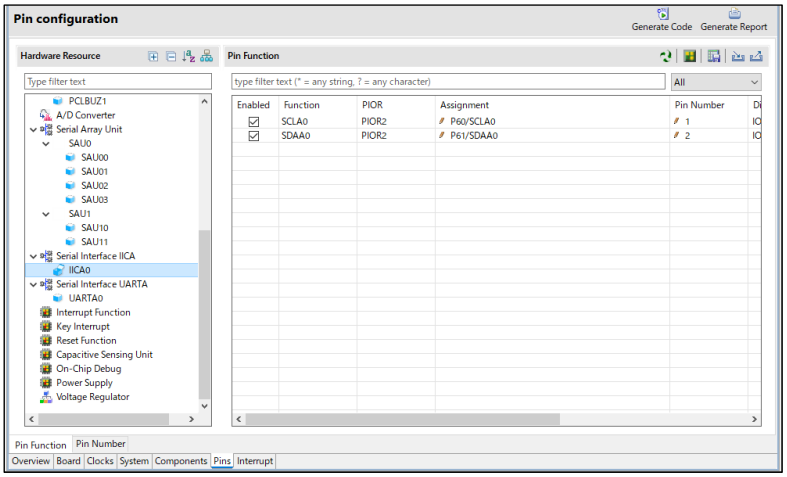
(b) Changing INTP Pins

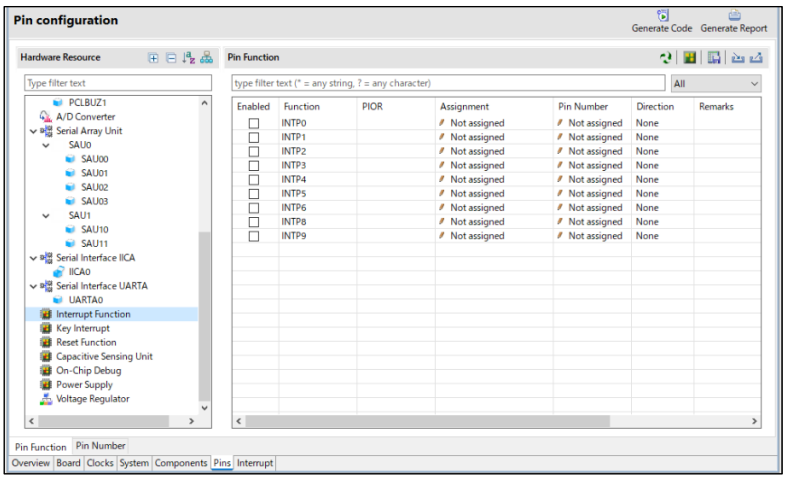
(c) Changing General Purpose I/O Port Pin: RESET

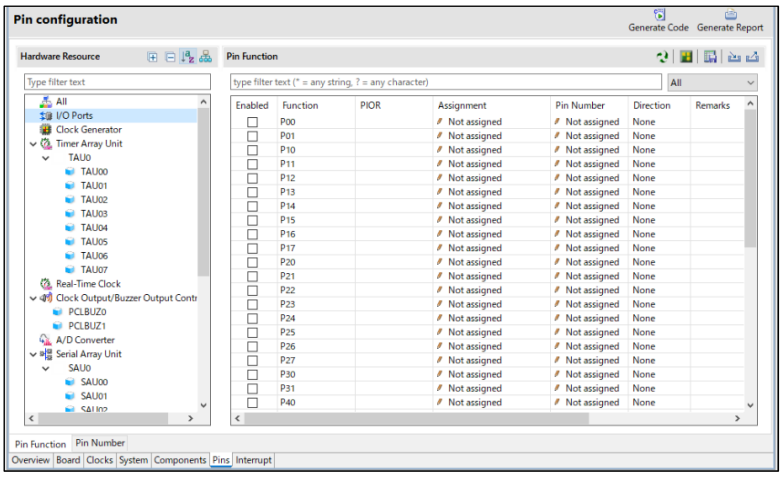
For information on configuring the pin of the interrupt signal circuit, refer to “6.5 Notes for Interrupt Signal Circuits”.

For information on configuring the pin of the RESET signal circuit, refer to “6.6 Notes for RESET Signal Circuits”.

Select “IICA0”, “Interrupt Function” and “I/O Ports” in "Pins" tabbed page and check that functions are assigned to the IICA pins, INTP pin, and RESET pin in the "Pin Function" panel.

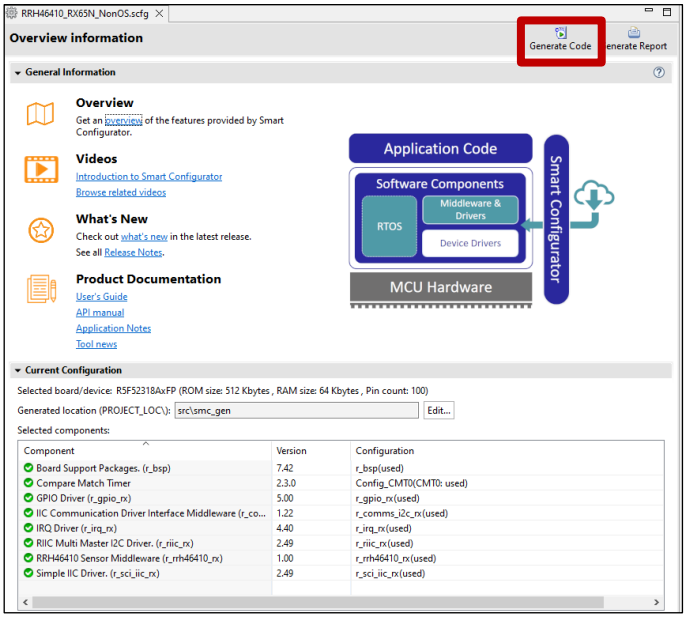






(5) Code Generation and Build

Press the [Generate Code] icon to generate code.



Build the project after implementing “6.4.2 Modifying Generated Code“ and “6.4.3 Changing Sample Code”

Select [Debug Configurations] from the menu and modify the debugger settings according to the specifications of the emulator to be connected to the target board.

6.4.2 Modifying Generated Code

Open Config_IICA0_user.c and add the following code.

Definition for including r_comms_i2c_if.h:

```
/***********************************************************************
Includes
***********************************************************************/
#include "r_cg_macrodriver.h"
#include "r_cg_userdefine.h"
#include "Config_IICA0.h"
/* Start user code for include. Do not edit comment generated here */
#include "r_comms_i2c_if.h"
/* End user code. Do not edit comment generated here */
```

Addition of the rm_comms_i2c_bus0_callback() function to the callback function:

Specify the "false" parameter for the transmission and reception end callback functions and the "true" parameter for the error callback function.

```
/***********************************************************************
* Function Name: r_Config_IICA0_callback_master_sendend
* Description  : This function is a callback function when IICA0 finishes master
transmission.
* Arguments    : None
* Return Value : None
***********************************************************************/
static void r_Config_IICA0_callback_master_sendend(void)
{
/* Start user code for r_Config_IICA0_callback_master_sendend. Do not edit comment
generated here */
  rm_comms_i2c_bus0_callback(false);
/* End user code. Do not edit comment generated here */
}

/***********************************************************************
* Function Name: r_Config_IICA0_callback_master_receiveend
* Description  : This function is a callback function when IICA0 finishes master
reception.
* Arguments    : None
* Return Value : None
***********************************************************************/
static void r_Config_IICA0_callback_master_receiveend(void)
{
/* Start user code for r_Config_IICA0_callback_master_receiveend. Do not edit comment
generated here */
  rm_comms_i2c_bus0_callback(false);
/* End user code. Do not edit comment generated here */
}

/***********************************************************************
* Function Name: r_Config_IICA0_callback_master_error
* Description  : This function is a callback function when IICA0 master error occurs.
* Arguments    : flag -
*                    status flag
* Return Value : None
***********************************************************************/
static void r_Config_IICA0_callback_master_error(MD_STATUS flag)
{
    /* Start user code for r_Config_IICA0_callback_master_error. Do not edit comment
generated here */
  rm_comms_i2c_bus0_callback(true);
    /* End user code. Do not edit comment generated here */
}
```

6.4.3 Changing Sample Code

(1) RESET Signal Control

For pin configuration, refer to “6.4.1(4)(c) Changing General Purpose I/O Port Pin: RESET”.

There is no RESET pin assigned to Grove on the RL78/G22 Fast Prototyping Board. Therefore, assign any port.

Open RRH46410_RL78G23_NonOS.c and change the reset operation when resetting the sensor.

Modify RESET pin designation according to the specifications of the target board. Also, change the reset control logic to an appropriate one.

The following is an example of using P13 as RESET pin.

```
    /* Reset RRH46410 sensor (active low). Please change to the IO port
connected to the RES_N pin of the RRH46410 sensor on the customer board. */
    P1 = _00_Pn7_OUTPUT_0 | _00_Pn6_OUTPUT_0 | _00_Pn5_OUTPUT_0 |
_00_Pn4_OUTPUT_0 | _08_Pn3_OUTPUT_1 |
         _00_Pn2_OUTPUT_0 | _00_Pn1_OUTPUT_0 | _00_Pn0_OUTPUT_0;
    R_BSP_SoftwareDelay(10, BSP_DELAY_MILLISECS);
    P1 = _00_Pn7_OUTPUT_0 | _00_Pn6_OUTPUT_0 | _00_Pn5_OUTPUT_0 |
_00_Pn4_OUTPUT_0 | _00_Pn3_OUTPUT_0 |
         _00_Pn2_OUTPUT_0 | _00_Pn1_OUTPUT_0 | _00_Pn0_OUTPUT_0;
    R_BSP_SoftwareDelay(10, BSP_DELAY_MILLISECS);
    P1 = _00_Pn7_OUTPUT_0 | _00_Pn6_OUTPUT_0 | _00_Pn5_OUTPUT_0 |
_00_Pn4_OUTPUT_0 | _08_Pn3_OUTPUT_1 |
         _00_Pn2_OUTPUT_0 | _00_Pn1_OUTPUT_0 | _00_Pn0_OUTPUT_0;
    R_BSP_SoftwareDelay(10, BSP_DELAY_MILLISECS);
```

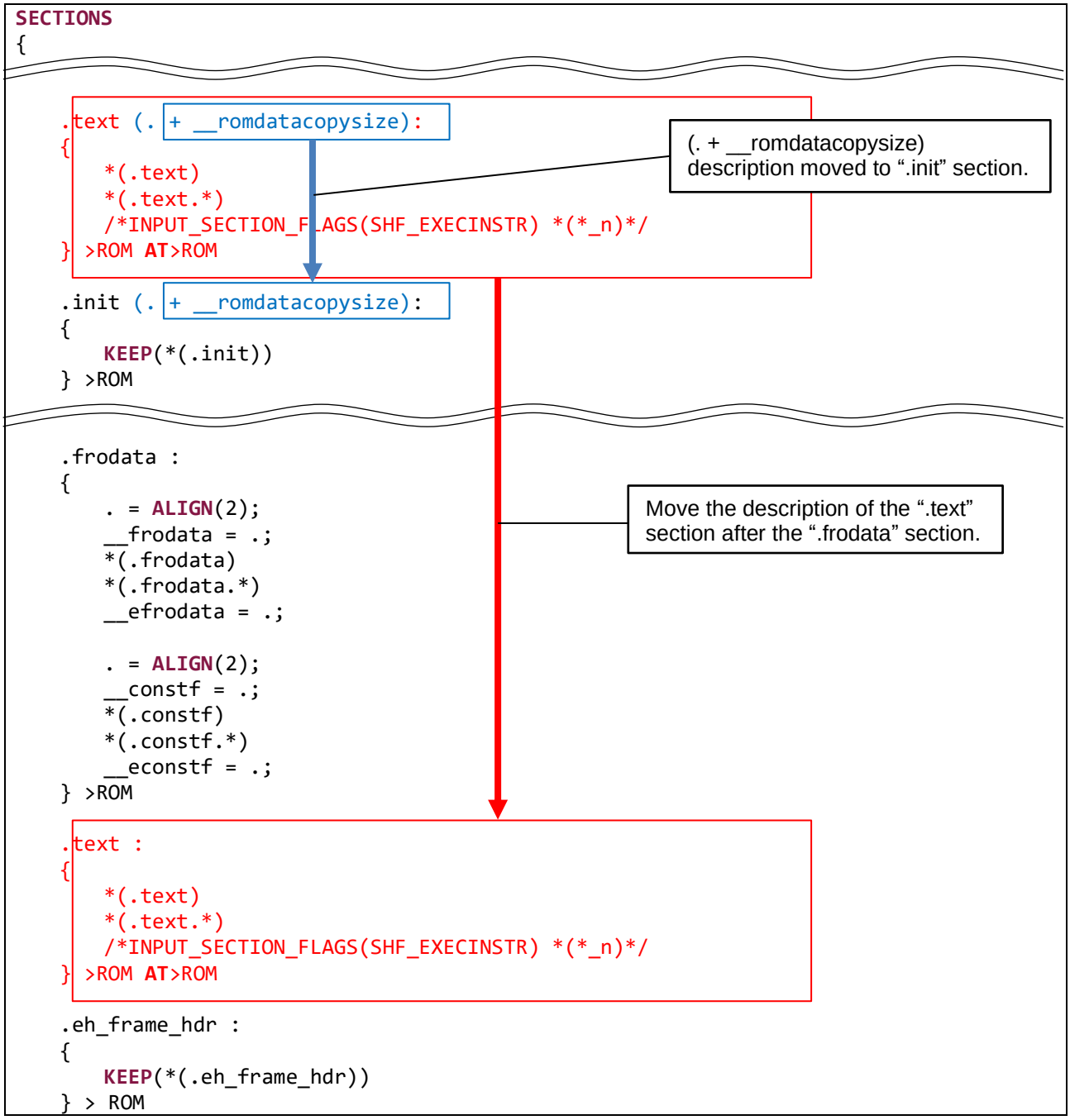
6.4.4 Changing Toolchain Setting

If you want to use a toolchain the LLVM toolchain, use ”RRH46410_RL78G23_NonOS_LLVM”.

If you want to use a toolchain other than the CC-RL toolchain or LLVM toolchain, copy RRH46410_RL78G23_NonOS.c and RL78_RRH46410.c from this project to create a new project.

Also, when using the LLVM toolchain, build errors may occur due to section placement. In this case, the linker script must be modified.
The following describes an example of modifying linker_script.ld in the sample project “RRH46410_RL78G23_NonOS_LLVM”.

1. Place the “.text” section after the “.frodata” section.



2. Fix the address of the ".rodata" section to the top address of the mirror area.

```
    .fini :
    {
        KEEP(*(.fini))
    } >ROM

    PROVIDE(__rodata_limit = CONSTANT(MIRRORAREASTART)+ 0x3000 + LENGTH(MIRROR));

    /* The rodata section is placed in MIRROR area in order to access as near
addressing. */
    .rodata MAX(., (CONSTANT(MIRRORAREASTART)+ 0x3000));
    .rodata 0x3000 : AT(0x3000)
    {
        . = ALIGN(2);
        __rodata = .;
        *(.rodata)
        *(.rodata.*)
        . = ALIGN(2);
```

Change the address of the ".rodata" section to 0x3000.

3. Change the ".data" section to the address after the ".ocd_traceram" section.

```
    .eh_frame :
    {
        KEEP(*(.eh_frame))
    } > ROM

    .ocd_traceram 0xf4300 (NOLOAD) : AT(0xf4300)
    {
        KEEP(*(.ocd_traceram))
    } >RAM

    .data 0xF4700 : AT(__mdata)
    {
        . = ALIGN(2);
        PROVIDE (__datastart = .);
```

Change the address of the ".data" section to 0xF4700.

```
    .bssf (NOLOAD):
    {
        PROVIDE(__bssfstart = .);
        . = ALIGN(2);
        *(.bssf)
        *(.bssf.*)
        /*INPUT_SECTION_FLAGS(!SHF_EXECINSTR, SHF_WRITE, SHF_ALLOC) *(*_f)*/
        . = ALIGN(128);
        __end = .;
    } >RAM AT>RAM
    PROVIDE(__bssfsize = SIZEOF(.bssf));

    PROVIDE(__stack_size = 0x100);
    .ocd_traceram 0xf4300 (NOLOAD) : AT(0xf4300)
    {
        KEEP(*(.ocd_traceram))
    } >RAM
    .stack 0xFFE20 (NOLOAD) : AT(0xFFE20)
    {
        PROVIDE(__stack = .);
```

Move the description in the ".ocd_traceram" section before the ".data" section.

Note: Changing the section address reduces the available ROM / RAM area.

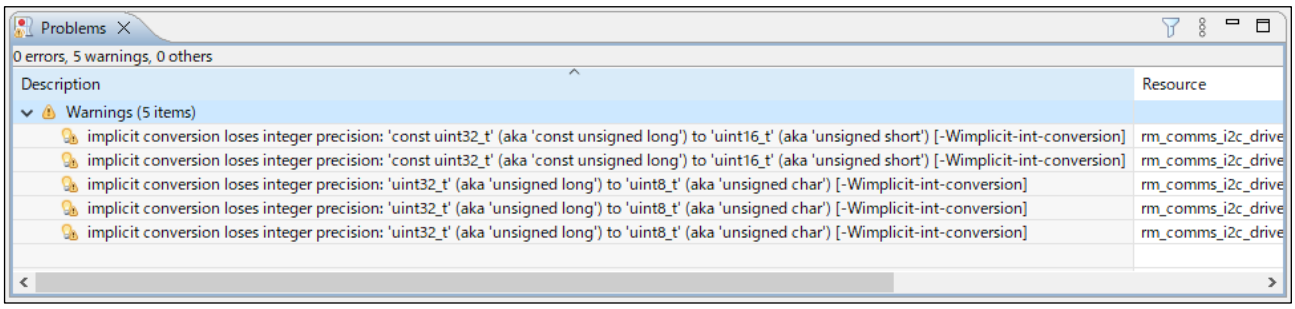
6.4.5 Notes for Build on LLVM

The following Warning occurs when building an LLVM project.

These Warnings are occurring because “slave_address” and “bytes” used in COMMS_I2C are handled as 32-bit type.

Since “slave_address” is 7-bit data and “bytes” is 16-bit data, no loss occurs due to conversion.

Therefore, warning messages will appear, but this does not affect the operation.



6.5 Notes for Interrupt Signal Circuits

It is necessary to configure settings according to the circuit to be embedded.

When using the sensor interrupt request signal (SensorINT), set the trigger level correctly.

(1) Circuit Configuration of RRH46410 Sensor Pmod Board

The circuit configuration of the interrupt signal of the RRH46410 Sensor Pmod Board is shown below. For details, please refer to the board datasheet.

Table 6-2 Circuit Configuration of Interrupt Signal on RRH46410 Sensor Pmod Board

Sensor Pmod Board	Circuit Configuration（Pull-up resistor can be set to on or off)
#1: IRQ# L Output: Data Available	Inverted output of SensorINT (Open-Drain output) and fixedly connected to IRQ#. (Output of the inverted SensorINT signal cannot be disabled.)
#7: BUSY#	- (No SensorINT signal output circuit)

(2) How to Control Interrupt Trigger Control when Multiple Sensor Pmod Boards are Daisy-chained

If the IRQ# of each board is an open-drain output, daisy chain connection is possible. (Note)

With this connection, if an interrupt request is asserted, it will be difficult to identify the I2C device that generated the interrupt request.

If multiple interrupt output signals are connected to IRQ# of Pmod #1 due to the circuit configuration, operate all I2C devices without interrupts. (Note)

Note: Do not connect I2C devices with outputs other than Open-Drain (Push-Pull output of CMOS or TTL). If connected, the I2C device and the peripheral circuit ICs connected to the interrupt signal may be damaged.

(3) How to Control Interrupt Triggers when using a Sensor Pmod Board that Allows Changing an Interrupt Request Output Destination

Some sensor Pmod boards can output an interrupt request signal to Pmod #7 (BUSY#) by changing the circuit on the board.

By daisy-chaining a board that switches this interrupt request signal to BUSY# output and a board with a standard IRQ# output, it becomes possible to trigger interrupts from two devices at the same time.

Note that an operating condition is that Pmod #1 and #7 on the MCU side have to input interrupt signals.

Table 6-3 Circuit Configuration of Interrupt Signal on Sensor Pmod Board (Board Dependent)

Sensor Pmod Board	Circuit Configuration（Pull-up resistor can be set to on or off)
#1: IRQ#	The Sensor Pmod Board allows the following circuit modifications (Board dependent): • SensorINT non-inverted or inverted output (open-drain output or push-pull output) is possible for either #1 or #7. (Note 1) • SensorINT Output is disabled and open for both #1 and #7.
#7: BUSY#	

Note 1: Non-inverted or inverted output, Open-Drain or Push-Pull output are board-dependent.

6.6 Notes for RESET Signal Circuits

It is necessary to configure settings according to the circuit to be embedded.

(1) Circuit Configuration of RRH46410 Sensor Pmod Board

The circuit configuration of the RESET signal of the RRH46410 Sensor Pmod Board is shown below. For details, please refer to the board datasheet.

Table 6-4 Circuit Configuration of RESET Signal on RRH46410 Sensor Pmod Board

Sensor Pmod Board	Circuit Configuration（Pull-up resistor can be set to on or off)
#2: RESET# L Input: Device Reset	Directly connected to the RESET signal of the sensor device

(2) When You Want to Daisy-chain Multiple I2C Devices and Operate them using Interrupt Triggers

A single RESET output signal from the MCU can control the reset of multiple I2C devices.

In that case, it is necessary to configure a RESET signal circuit that matches the reset control logic of the multiple I2C devices and to implement a reset sequence that meets the requirements of the multiple I2C devices.

In addition, when connecting multiple I2C devices, the pin load capacitance will be large, so be sure to generate a sufficient reset pulse period.

6.7 Pull-up Resister Circuit Configuration when Daisy Chain Connections of Renesas Sensor Pmod Boards

The recommended method for connecting the pull-up resistors in a daisy chain is shown below. Also, disable the pull-ups on other Renesas Sensor boards.

If the pull-up resistors of many Renesas Sensor boards are enabled at the same time, the sensor boards may not function properly.

Table 6-5 Target Board that Enable Pull-up Resistors when Daisy-chaining

Pmod Sensor Board Type 6A Singal Name	Recommended Circuit Configuration of Pull-up Resisters
#1: IRQ# (Note 1)	Enable only the board closest to the MCU board for boards with pull-up resistor circuits.
#2: RESET# (Note 1)	Enable only the board closest to the MCU board for boards with pull-up resistor circuits.
#3: SCL	Enable only the board closest to the MCU board for boards.
#4: SDA	Enable only the board closest to the MCU board for boards.
#7: BUSY# (Note 1, 2)	Enable only the board closest to the MCU board for boards with pull-up resistor circuits.

Note 1 There are the boards without the pull-up resisters.
Note 2 Configure when using as an Interrupt signal.

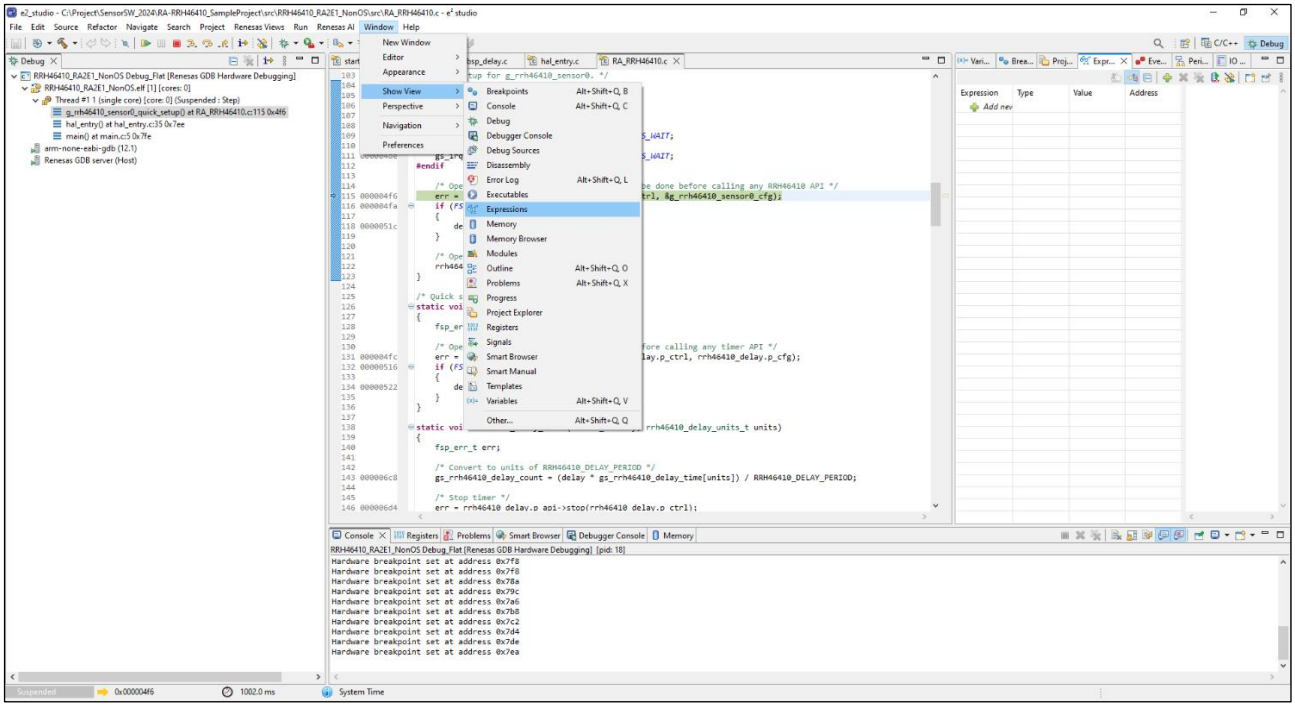
7. Viewing Gas Data

To check the real-time gas data, follow the steps below.

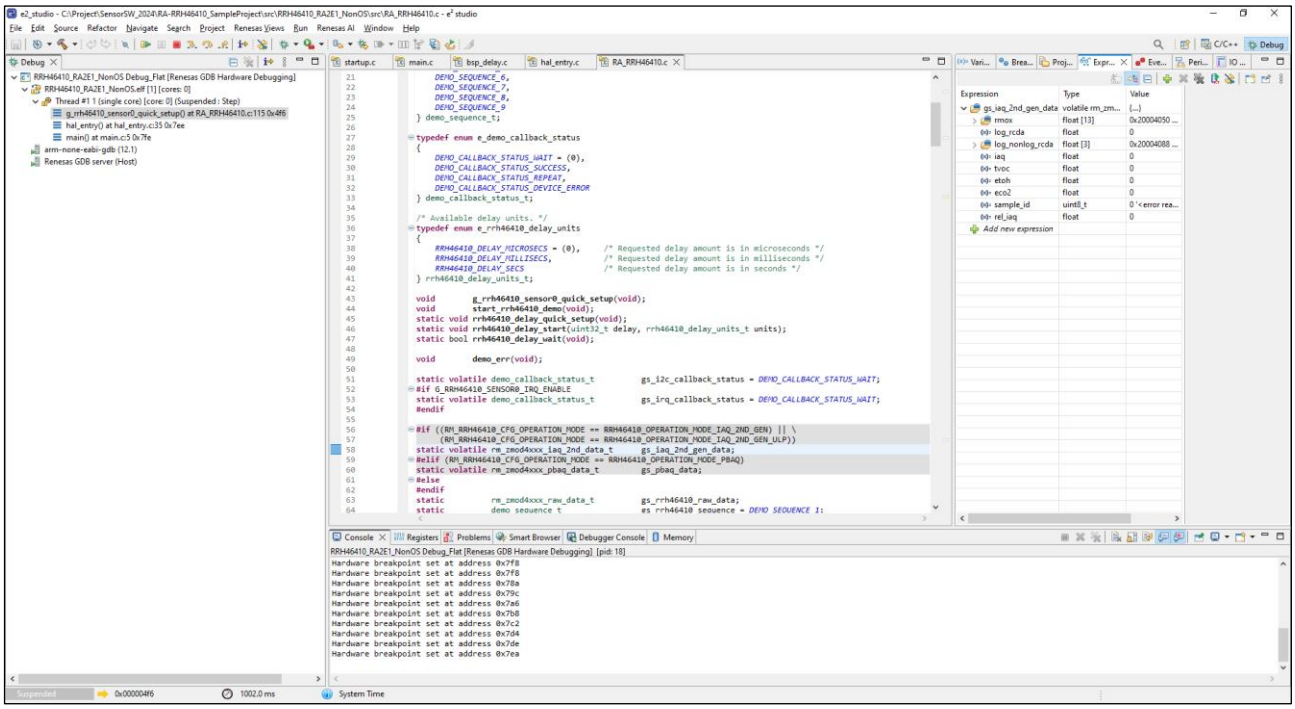
Take the “IAQ 2nd Generation” as an example.

1. After running the Debug, open the “Expressions” window.

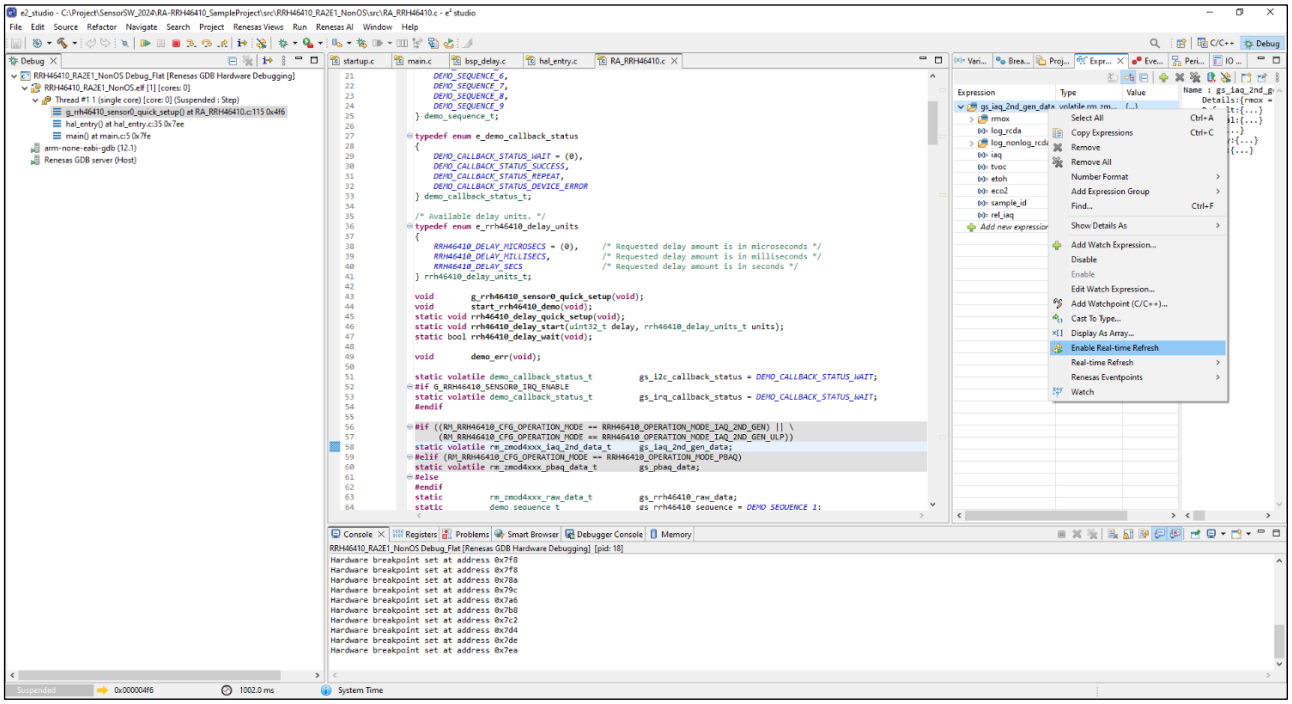
   “Expressions” window is available from [Window]→[Show View]→[Expressions].



2. Click “Add new expression” in the “Expressions” and add “gs_iaq_2nd_gen_data”.

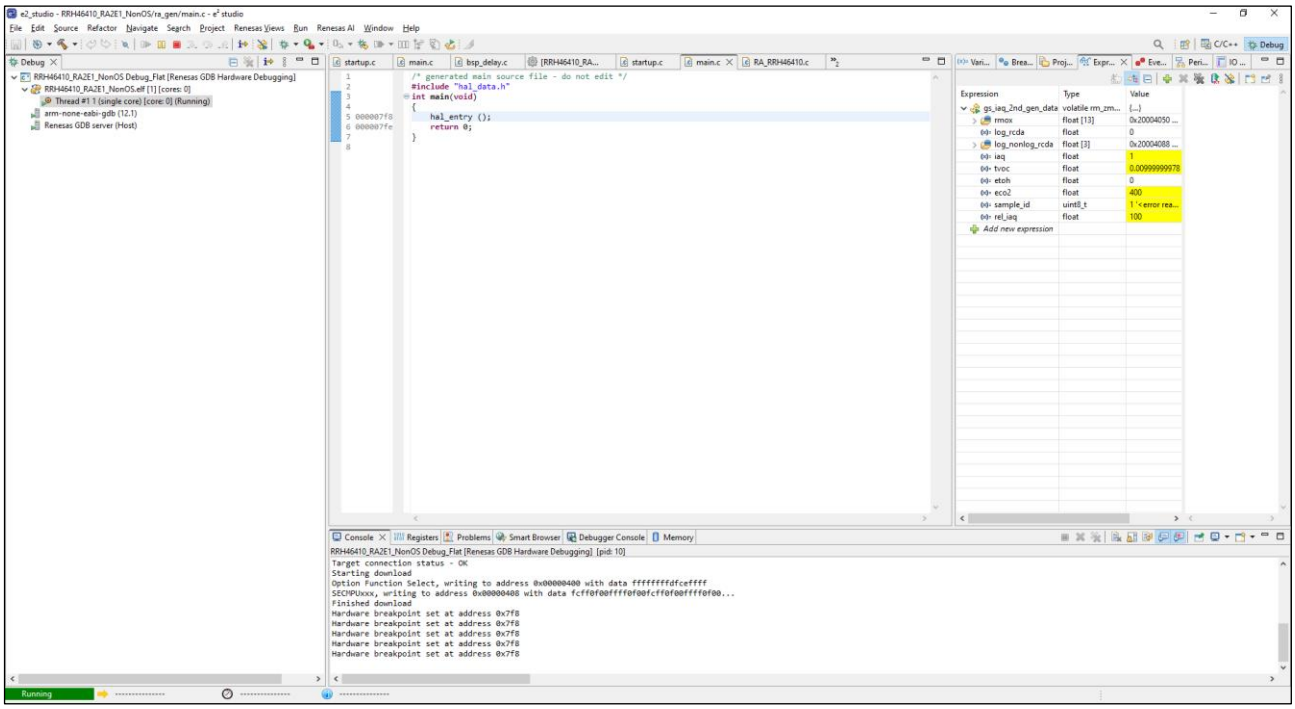


3. Right-click on the added variable and select the “Enable Real-time Refresh”.



4. Start the Debug.

It is possible to check the real-time values.



Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Dec.19.24	-	First Release

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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